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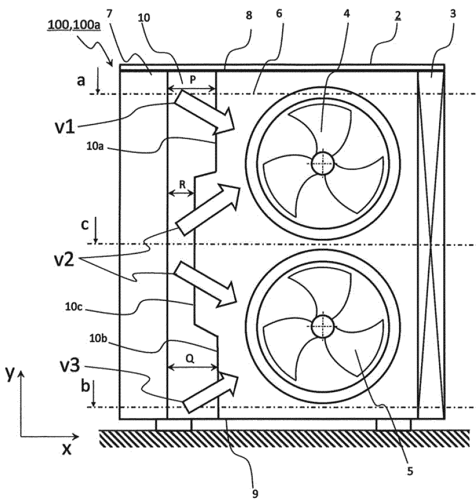
(54) OUTDOOR UNIT AND REFRIGERATION CYCLE DEVICE

(57) An outdoor unit including fans at two locations reduces noise caused by suction air. The outdoor unit includes: a housing; a bottom plate forming a lower surface of the housing, a top plate forming an upper surface of the housing, and a side wall provided between the bottom plate and the top plate to partition an internal space of the housing; a heat exchanger provided in the housing and on an inlet-port side; and fans provided in the housing and on an outlet port side. In the housing, an air flow passage is provided to extend from the heat exchanger to the fans. The fans are first and second fans that are respectively provided in upper and lower regions on the outlet port side in the housing. The air flow passage is defined by the bottom plate, the top plate, and the side wall located beside the fans. Cross sections of regions of the air flow passage that are located between central axes of the fans and the side wall have respective cross-sectional areas A, B, and C such that the cross-sectional area B < the cross-sectional area A < the cross-sectional area C is satisfied, where the cross-sectional area A is a cross-sectional area of a first cross section that is located between the central axis of the first fan and the top plate and is parallel to the bottom plate, the cross-sectional area B is a cross-sectional area of a second cross section that is located between the central axis of the second fan and the bottom plate and is parallel to the bottom plate, and the cross-sectional area C is a cross-sectional area of a third cross section that is located between the first cross section and the second cross section and is parallel to the bottom plate.

FIG. 1



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Description

Technical Field

[0001] The present disclosure relates to an outdoor unit and a refrigeration cycle apparatus, and more particularly to a configuration of an air flow passage in the outdoor unit in which a heat exchanger and a fan are provided.

Background Art

[0002] An outdoor unit of an existing refrigeration cycle apparatus includes a partition plate that serves as a partition between an air flow passage in which a heat exchanger and a fan are provided and a machine chamber in which a compressor and other components are provided. The air flow passage is defined by the partition plate, a top plate, and a bottom plate, and the fan is driven to cause outside air to flow into the air flow passage through an inlet port, to send the outside air to the heat exchanger, and to blow the outside air through an outlet port. The partition plate is shaped in such a manner as to protrude toward a machine chamber side, and the air flow passage is partially widened. Thus, because the space between the partition plate and outer circumference portions of blades of the fan, which is a propeller fan, is large, the level of rotational sound made due to a non-uniform wind velocity distribution is reduced, and the noise caused by the outdoor unit is reduced (for example, see Patent Literature 1).

Citation List

Patent Literature

[0003] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2010-127590

Summary of Invention

Technical Problem

[0004] However, in an outdoor unit of a refrigeration cycle apparatus disclosed in Patent Literature 1, only one fan is provided in an air flow passage, and if two fans are arranged side by side, and then even if a partition plate provided close to the fans is formed to have a recessed portion, the velocity of wind is non-uniform, and noise cannot be reduced.

[0005] The present disclosure is applied to solve the above problem, and relates to reduction of noise caused by suction air at an outdoor unit provided with two fans and at a refrigeration cycle apparatus.

Solution to Problem

[0006] An outdoor unit according to an embodiment of the present disclosure includes: a housing in which an inlet port and an outlet port are formed; a bottom plate that forms a lower surface of the housing, a top plate that forms an upper surface of the housing, and a side wall that is provided between the bottom plate and the top plate to partition an internal space of the housing; a heat exchanger provided in a region in the housing that adjoins the inlet port; and fans provided in a region in the housing that adjoins the outlet port. The fans are a first fan and a second fan that are respectively provided in an upper side and a lower side of the region in the housing that adjoins the outlet port. An air flow passage is provided to extend from the heat exchanger to the fans, and is defined by the bottom plate, the top plate, and the side wall, the side wall being located beside the fans. Cross sections of regions of the air flow passage that are located between central axes of the fans and the side wall have respective cross-sectional areas A, B, and C such that the cross-sectional area B < the cross-sectional area A < the cross-sectional area C is satisfied, where the cross-sectional area A is a cross-sectional area of a first cross section that is located between the central axis of the first fan and the top plate and is parallel to the bottom plate, the cross-sectional area B is a cross-sectional area of a second cross section that is located between the central axis of the second fan and the bottom plate and is parallel to the bottom plate, and the cross-sectional area C is a cross-sectional area of a third cross section that is located between the first cross section and the second cross section and is parallel to the bottom plate.

Advantageous Effects of Invention

[0007] According to the embodiment of the present disclosure, the cross sectional area of a region of the air flow passage that extends from the side wall toward center lines of the fans varies in a direction along the height of the outdoor unit, that is, cross sections of regions of the above region of the air flow passage that are located at different locations in the above height direction of the outdoor unit have different areas, whereby it is possible to eliminate non-uniformity of a wind velocity distribution in a region of the air flow passage that is close to the side wall and to thus reduce noise.

Brief Description of Drawings

[0008]

[Fig. 1] Fig. 1 is a schematic view illustrating an internal configuration of an outdoor unit according to Embodiment 1 as viewed from a back side.

[Fig. 2] Fig. 2 is a schematic view illustrating an internal configuration of the outdoor unit according to Embodiment 1 as viewed from an upper side.

[Fig. 3] Fig. 3 is a schematic view illustrating another internal configuration of the outdoor unit according to Embodiment 1 as viewed from the upper side.

[Fig. 4] Fig. 4 is a schematic view illustrating still another internal configuration of the outdoor unit according to Embodiment 1 as viewed from the upper side.

[Fig. 5] Fig. 5 is a schematic view illustrating an internal configuration of a modification of the outdoor unit according to Embodiment 1 as viewed from the upper side.

[Fig. 6] Fig. 6 is a schematic view illustrating an internal configuration of an outdoor unit of a comparative example that is to be compared with the outdoor unit according to Embodiment 1 as viewed from a back side.

[Fig. 7] Fig. 7 is a schematic view illustrating an internal configuration of the outdoor unit according to Embodiment 1 as viewed from a back side.

[Fig. 8] Fig. 8 is a schematic view illustrating an internal configuration of an outdoor unit according to Embodiment 2 as viewed from an upper side.

[Fig. 9] Fig. 9 is a schematic view illustrating an internal configuration of the outdoor unit according to Embodiment 2 as viewed from the upper side.

[Fig. 10] Fig. 10 is a schematic view illustrating an internal configuration of an outdoor unit according to Embodiment 3 as viewed from a back side.

[Fig. 11] Fig. 11 is a schematic view illustrating an internal configuration of the outdoor unit according to Embodiment 3 as viewed from an upper side.

Description of Embodiments

[0009] Embodiments of an outdoor unit will be described. It should be noted that the configurations as illustrated in the above figures are merely examples, and the configurations according to the embodiments are not limited to those as illustrated in the figures. In each of the figures, components that are the same as or equivalent to those in a previous figure or figures are denoted by the same references. The same is true of the entire text of the specification. Furthermore, in the figures, a relationship in size between components may be different from an actual one. The configurations of components are described by way of example in the entire text of the specification are merely examples, and are not limited to those described in the specification. In particular, in the case where components are combined, it is not limited to the case where components according to the same embodiment are combined. A component or components in an embodiment can be applied to another embodiment as appropriate.

Embodiment 1

[0010] Fig. 1 is a schematic view illustrating an internal configuration of an outdoor unit 100 according to Embodiment 1 as viewed from a back side of the outdoor unit 100. Fig. 1 illustrates the outdoor unit 100 as viewed from the back side, and a section taken in a direction perpendicular to rotational axes of fans 4 and 5 at a location between a heat exchanger 3 provided on the back side and the fans 4 and 5. In Fig. 1, an x direction is a width direction of the outdoor unit 100 that is a direction parallel to the width of the outdoor unit 100; a y direction is a height direction of the outdoor unit 100 that is a direction parallel to the height of the outdoor unit 100; and a z direction perpendicular to x-axis and y-axis is parallel to the rotational axes of the fans 4 and 5.

[0011] The outdoor unit 100 as illustrated in Fig. 1 is included in an air-conditioning apparatus or a refrigeration cycle apparatus such as a refrigerator. In the refrigeration cycle apparatus, for example, a compressor, a four-way valve, an outdoor heat exchanger, an expansion device, and an indoor heat exchanger are connected by refrigerant pipes to form a refrigerant circuit. The outdoor unit 100 includes a housing 2 having a top plate 8 that forms an upper surface of the housing 2 and a bottom plate 9 that forms a lower surface of the housing 2. The inside of the housing 2 is partitioned into an air-sending chamber 6 and a machine chamber 7 by a side wall 10. In the air-sending chamber 6, the heat exchanger 3 is provided on an inlet-port side, and the fan 4 is provided on an outlet-port side. In the machine chamber 7, a compressor, electric components, and other components are provided. The fans 4 and 5 send outside air to the heat exchanger 3, and heat exchange is performed between the outside air and refrigerant.

[0012] The outdoor unit 100 includes the air-sending chamber 6 in which the fans 4 and 5, that is, a first fan 4 and a second fan 5, are arranged side by side in the y direction. In the following description, the fan located closer to the top plate 8 is sometimes referred to as the first fan 4, and the fan located closer to the bottom plate 9 is sometimes referred to as the second fan 5. The fans 4 and 5 are provided such that the rotational axes of these fans coincide with each other in the x direction.

[0013] Fig. 2 is a schematic view illustrating an internal configuration of the outdoor unit 100 according to Embodiment 1 as viewed from an upper side of the outdoor unit 100. To be more specific, Fig. 2 illustrates the internal configuration of a cross section of part a-a of the outdoor unit 100 that is taken along line a-a in Fig. 1; however, in order to describe a positional relationship between the side wall 10 and the fans 4 and 5, Fig. 2 does not illustrate a sectional configuration of each of the fans 4 and 5, and simply illustrates an external appearance of each fan as viewed from above. The same is true of schematic views that illustrate the internal configuration as viewed from the upper side. The section of the part a-a indicated in Fig. 1 is a first section that is located closer to the top plate 8 than to at least the central axis of the fan 4 and that is located parallel to the bottom plate 9.

[0014] In the air-sending chamber 6, the heat exchanger 3 is located to adjoin an inlet port 20, and the fans 4 and 5 are located to adjoin an outlet port 21. The heat exchanger 3 is L-shaped as viewed from the upper side of the housing 2, and outside air that flows into the outdoor unit 100 from a back surface and a side of the outdoor unit 100 passes through the heat exchanger 3. Each of the fans 4 and 5 includes blades 40 arranged around the rotational axis. Each of the fans 4 and 5 further has a bell mouth 41 located outward of outer circumferential portions of the blades 40. Air in the air-sending chamber 6 is made to flow into the bell mouth 41 and then flow out through the outlet port 21 by the rotation of the blades 40 located inward of the bell mouth 41.

[0015] In the air-sending chamber 6, the side wall 10 is located close to the machine chamber 7. The side wall 10 is provided between the top plate 8 and the bottom plate 9 and serves as, in Embodiment 1, a partition plate between the air-sending chamber 6 and the machine chamber 7. In the side wall 10, a side-wall upper portion 10a in the section as illustrated in Fig. 2 is formed in such a manner as to narrow an air flow passage in a direction from the heat exchanger 3 toward the fans 4 and 5. In other words, in a cross section perpendicular to y-axis, a surface of the side-wall upper portion 10a is formed to narrow the air-sending chamber 6 in the x direction such that the distance by which the air-sending chamber 6 is narrowed increases in the z direction. The air flow passage is a passage in which air that has passed through the heat exchanger 3 passes through the air-sending chamber 6. The side-wall upper portion 10a has a guide surface 11a that is inclined toward the rotational axis of the fan 4 in a direction from the heat exchanger 3 toward the fan 4. That is, an upstream end portion 12a of the guide surface 11a is closer to the machine chamber 7 than a downstream end portion 13a of the guide surface 11a. The cross-sectional shape of the guide surface 11a is not limited to a linear shape, and may be, for example, a curved shape such that the guide surface 11a protrudes toward the air flow passage or protrudes in a direction away from the air flow passage. The same is true of guide surfaces 11b and 11c, which will be described below.

[0016] In the first cross section as illustrated in Fig. 2, a region Ha as illustrated in Fig. 2 is defined by a line parallel to a rotational axis 44 of each of the fans 4 and 5, a line parallel to an end face 42 of the bell mouth 41, a line that extends from the end face 42 of the bell mouth 41 and along the surface on the upstream side of the side-wall upper portion 10a, and a line parallel to a surface of the heat exchanger 3 that faces the fans 4 and 5. The region defined by a dotted line in Fig. 2 is a cross section of a region of the air flow passage that is located from the central axes of the fans 4 and 5 to the side-wall upper portion 10a. The area of the region Ha corresponds to a cross-sectional area A of the air flow passage between the central axis of each of the fans 4 and 5 and the side wall 10 in the first cross section as illustrated in Fig. 2.

[0017] As illustrated in Fig. 2, the side-wall upper portion 10a in the first cross section protrudes by a protrusion amount P in the x direction. As the outdoor unit 100 is viewed from the back side, the protrusion amount P is the distance between an imaginary line that extends, in the y direction, from an end portion 14 of the inlet port 20 that adjoins the machine chamber 7 and part of the side wall 10 that most greatly protrudes in the x direction. In other words, the protrusion amount P is the distance between the end portion 14 of the inlet port 20 that adjoins the machine chamber 7 and the part of the side wall 10 that most greatly protrudes toward the air flow passage side. The same is true of a protrusion distance Q and a protrusion distance R, which will be described below. The part of the side-wall upper portion 10a that protrudes toward the air flow passage side is located, in the z direction, between the heat exchanger 3 and the end face 42 of the bell mouth 41.

[0018] Figs. 3 and 4 are schematic views each illustrating an internal configuration of the outdoor unit 100 according to Embodiment 1 as viewed from the upper side of the outdoor unit 100. Fig. 3 illustrates a cross section of part b-b of the outdoor unit 100 that is taken along line b-b in Fig. 1, and Fig. 4 illustrates a cross section of part c-c of the outdoor unit 100 that is taken along line c-c in Fig. 1. As illustrated in Fig. 1, the protrusion amount of the side wall 10 toward the air flow passage side in the outdoor unit 100 varies between the cross section of the part a-a, the cross section of the part b-b, and the cross section of the part c-c. However, all the above cross sections of the side wall 10 are shaped such that the distance by which the air flow passage is narrowed increases from the heat exchanger 3 toward the fans 4 and 5.

[0019] As illustrated in Fig. 3, the cross section of the part b-b is a second cross section that is located closer to the bottom plate 9 than at least the central axis of the second fan 5, and that is parallel to the bottom plate 9. A side-wall lower portion 10b as illustrated in Fig. 3 has a guide surface 11b that is inclined toward the rotational axis of the fan 4 in a direction from the heat exchanger 3 toward the fan 4, and an upstream end portion 12b of the guide surface 11b is closer to the machine chamber 7 than a downstream end portion 13b of the guide surface 11b. In the second cross section as illustrated in Fig. 3, the area of a region Hb corresponds to a cross-sectional area B of the air flow passage between the central axis of the each of the fans 4 and 5 and the side wall 10.

[0020] In the second cross section, the side-wall lower portion 10b protrudes by a protrusion amount Q. The protrusion amount Q is larger than the protrusion amount P in the first cross section as illustrated in Fig. 2, and the cross-sectional area B of the air flow passage in the second cross section as illustrated in Fig. 3 is smaller than the cross-sectional area A of the air flow passage in the first cross section as illustrated in Fig. 2. In the second cross section, the downstream end portion 13b of the guide surface 11b is closer to the heat exchanger 3 than the downstream end portion 13a of the guide surface 11a of the first cross section.

[0021] As illustrated in Fig. 4, the cross section of the part c-c is a third cross section that is located in a middle region between the first fan 4 and the second fan 5. More specifically, the third cross section is located between the central axis of the first fan 4 and the central axis of the second fan 5. A side-wall middle portion 10c as illustrated in Fig. 4 is formed in such a manner as to narrow the air flow passage in the direction from the heat exchanger 3 toward the fans 4 and 5. The side-wall middle portion 10c has the guide surface 11c that is inclined toward the rotational axis of the fan 4 in the direction from the heat exchanger 3 toward the fan 4, and an upstream end portion 12c of the guide surface 11c is closer to the machine chamber 7 than a downstream end portion 13c. In the third cross section as illustrated in Fig. 4, the area of a region Hc corresponds to a cross-sectional area C of a region of the air flow passage that is located between the central axis of each of the fans 4 and 5 and the side wall 10.

[0022] In the third cross section, the side-wall middle portion 10c protrudes by a protrusion amount R. The protrusion amount R in the third cross section is smaller than the protrusion amount P in the first cross section as illustrated in Fig. 2. A cross-sectional area C of the air flow passage of the third cross section as illustrated in Fig. 4 is greater than a cross-sectional area A of the air flow passage in the first cross section as illustrated in Fig. 2. That is, a region Hc as indicated in Fig. 4 is larger than the region Ha as indicated in Fig. 2. In the third cross section, a downstream end portion 13c of a guide surface 11c is closer to the fans 4 and 5 than the downstream end portion 13c of the guide surface 11a of the first cross section.

[0023] As described above, the side wall 10 of the outdoor unit 100 has the side-wall upper portion 10a that is closer to the top plate side than the central axis of the first fan 4, the side-wall lower portion 10b that is closer to the bottom plate side than the central axis of the second fan 5, and the side-wall middle portion 10c that is located between the central axis of the first fan 4 and the central axis of the second fan 5. The cross-sectional area A that is the area of the region Ha of the air flow passage in the first cross section in which the side-wall upper portion 10a is located, the cross-sectional area B that is the area of the region Hb in the air flow passage in the second cross section in which the side-wall lower portion 10b is located, and the cross-sectional area C that is the area of the region Hc of the air flow passage in the third cross section in which the side-wall middle portion 10c is located satisfy the relationship "B < A < C".

[0024] The side-wall upper portion 10a, the side-wall lower portion 10b, and the side-wall middle portion 10c protrudes toward the air flow passage side by different protrusion amounts, and the protrusion amount P of the side-wall upper portion 10a, the protrusion amount Q of the side-wall lower portion 10b, and the protrusion amount R of the side-wall middle portion 10c satisfies the relationship "R < P < Q".

[0025] In Embodiment 1, in the side wall 10 having portions that have the first cross section, the second cross section, and the third cross section, regarding the length (creepage distance) of a line that extends, along the surface of the side wall 10, from a surface of the heat exchanger 3 that is closer to the fans 4 and 5 toward the end face 42 of the bell mouth 41 of each of the fans 4 and 5, the length of the above line in the second cross section is the greatest, and the length of the above line in the third cross section is the smallest. That is, a creepage distance La in the first cross section, a creepage distance Lb in the second cross section, and a creepage distance Lc in the third cross section satisfy the relationship "Lc < La < Lb". Such a relationship is established in the case where the side wall 10 in each of the first cross section, the second cross section, and the third cross section is shaped to protrude toward the air flow passage side, as described above with respect to the side wall 10 according to Embodiment 1. That is, the relationship "Lc < La <Lb" is established in the case where the side wall 10 between points 15 and 16 indicated in each of Figs. 2 to 4 is shaped to protrude toward the air-sending chamber 6.

[0026] The first cross section is a cross section that is located between at least the central axis of the first fan 4 and the top plate 8, and that is parallel to the bottom plate 9. The second cross section is a cross section that is located between at least the second fan 5 and the bottom plate 9, and that is parallel to the bottom plate 9. The third cross section is a cross section that is located between the first cross section and the second cross section, and that is parallel to the bottom plate 9.

[0027] Fig. 5 is a schematic view illustrating an internal configuration of an outdoor unit 100a that is a modification of the outdoor unit 100 according to Embodiment 1 as viewed from an upper side of the outdoor unit 100a. Fig. 5 illustrates a cross section of part c-c that is taken along line c-c in Fig. 1 as a representative, and side walls 110 that are taken line a-a and line b-b in Fig. 1 are indicated by dashed-dotted lines. In the outdoor unit 100a, part of the side wall 110 that is located between points 15 and 16 is shaped to be recessed in a direction away from the air flow passage. That is, each of guide surfaces 111a, 111 b, and 111c of the side wall 110 forms a curved surface that is located between the points 15 and 16 and that protrudes toward the machine chamber 7. In the side wall 110, regarding the length (creepage distance) of a line along a surface of the side wall 110 that extends from the surface of the heat exchanger 3, which is closer to the fans 4 and 5, to the end face 42 of the bell mouth 41 of each of the fans 4 and 5, the creepage distance Lc in the third cross section is the greatest and the creepage distance Lb in the second cross section is the smallest. That is, regarding the side wall 110, in the case where the upstream end portion 12 and the downstream end portion 13 of each of the guide surfaces 111a, 111b, and 111c are fixed, the creepage distance La in the first cross section, the creepage distance Lb in the second cross section, and the creepage distance Lc in the third cross section satisfy the relationship "Lb < La < Lc". In this case also, the cross-sectional area A of the air flow passage in the first cross section, the cross-sectional area B of the air flow passage in the second cross section, and the cross-sectional area C of the air flow passage in the third cross section satisfy the relationship "B < A < C".

(Advantages of Outdoor Unit 100)

[0028] Fig. 6 is a schematic view illustrating an internal configuration of an outdoor unit 1000 as a comparative example that is to be compared with the outdoor unit 100 according to Embodiment 1, as viewed from a back side of the outdoor unit 1000. The outdoor unit 1000 of the comparative example has the same configuration as the outdoor unit 100 according to Embodiment 1, except for only the side wall; that is, the side wall of the outdoor unit 1000 of the comparative example is different from the side wall 10 of the outdoor unit 100. To be more specific, a side wall 1010 of the outdoor unit 1000 of the comparative example has a uniform cross-sectional shape between the top plate 8 and the bottom plate 9. Thus, the cross-sectional area of the air flow passage does not vary in the height direction throughout the entire region of the outdoor unit 1000.

[0029] In the outdoor unit 100 of Embodiment 1 and the outdoor unit 1000 of the comparative example, in a region between the side wall 1010 and the fans 4 and 5 that are propeller fans, the velocity of suction air in a region corresponding to a region between the first fan 4 and the second fan 5 is high. At a suction surface of each of the propeller fans, a tip flow having a strength depending on the difference in pressure between a pressure surface and the suction surface is generated. In the case where two propeller fans are provided side by side as in the outdoor units 100 and 1000, as illustrated in Fig. 6, with respect to suction air at the outdoor unit 1000, the velocity of suction air v2 in a region that is located close to the side wall 1010 and corresponds to the region between the first fan 4 and the second fan 5 is the highest. Where suction air v1 is suction air in a region close to the side wall 1010 and the top plate 8, and suction air v3 is suction air in a region close to the side wall 1010 and the bottom plate 9, the velocity of the suction air v1 is higher than the velocity of the suction air v3. This is because under an installation environment of the outdoor units 100 and 1000, the region close to the bottom plate 9 is close to the ground, and a space surrounding the region close to the bottom plate 9 is thus smaller than a space surrounding the region close to the top plate 8. Therefore, in the outdoor unit 1000, the velocities of the suction air V1 to V3 satisfy the relationship "v3 < v1 < v2".

[0030] In general, air that has flowed into the air flow passage flows at a high velocity in a region in which the width of air flow passage is small and flows at a low velocity in a region in which the width of the air flow passage is great. In the outdoor unit 1000, the cross-sectional shape of the side wall 1010 is uniform between the top plate 8 and the bottom plate 9. Thus, the cross-sectional area of the air-sending chamber 6 is uniform in the y direction of the outdoor unit 1000, the width of the air flow passage is thus also uniform, and the velocities of suction air v1, v2, and v3 are non-uniform.

[0031] In contrast, in the outdoor unit 100 according to Embodiment 1, the side-wall upper portion 10a, the side-wall lower portion 10b, and the side-wall middle portion 10c have different shapes, and respective regions of the air flow passage that are associated with the side-wall upper portion 10a, the side-wall lower portion 10b, and the side-wall middle portion 10c have different widths. That is, in the outdoor unit 100, the cross-sectional area A in the air flow passage in the first cross section, the cross-sectional area B in the air flow passage in the second cross section, and the cross-sectional area C in the air flow passage in the third cross section satisfy the relationship "B < A < C". In the outdoor units 100 and 100a according to Embodiment 1, the third cross section, in which the air velocity is the highest in the outdoor unit 1000 of the comparative example, has the greatest cross-sectional area in the air flow passage, and the second cross section, in which the air velocity is the lowest in the outdoor unit 1000, has the smallest cross-sectional area in the air flow passage. By virtue of such a configuration, in the outdoor unit 100 according to Embodiment 1, it is possible to reduce non-uniformity of the velocities of the suction air v1, v2, and v3. Since the non-uniformity of the velocities of the suction air v1, v2, and v3 is reduced, the air flow in a region beside the side wall 10 is averaged, whereby the fluctuation of a flow field of air around the blades of the fans 4 and 5 is reduced, and the pressure fluctuation at the surfaces of the blades 40 of the fans 4 and 5 is also reduced. Thus, in the outdoor unit 100 according to Embodiment 1, the sound caused by rotation of the fans 4 and 5 is reduced and noise can thus be reduced.

Embodiment 2

[0032] An outdoor unit 200 according to Embodiment 2 has the same configuration of the outdoor unit 100 according to Embodiment 1, except for the shape of the side wall 10. The outdoor unit 200 according to Embodiment 2 will be described by referring mainly to the difference between Embodiments 1 and 2. Regarding the outdoor unit 200 according to Embodiment 2, components as illustrated in figures that have the same functions as those in Embodiment 1 will be denoted by the same reference signs.

[0033] Fig. 7 is a schematic view illustrating an internal configuration of the outdoor unit 200 according to Embodiment 2 as viewed from a back side of the outdoor unit 200. A side wall 210 of the outdoor unit 200 has a side-wall middle-upper portion 10d between the side-wall upper portion 10a and the side-wall middle portion 10c, and has a side-wall middle-lower portion 10e between the side-wall middle portion 10c and the side-wall lower portion 10b. Part d-d as indicated in Fig. 7 corresponds to a fourth cross section that is located between the first cross section that corresponds to part a-a as indicated in Fig. 7 and the second cross section that corresponds to part c-c as indicated in Fig. 7, and that is parallel to the bottom plate 9. Also, the fourth cross section is a cross section that passes through the side-wall middle-upper portion 10d. Part e-e as indicated in Fig. 7 is a fifth cross section that is located between the third cross section that corresponds to part c-c as indicated in Fig. 7 and the second cross section that corresponds to part b-b as indicated in Fig. 7, and the fifth cross section is parallel to the bottom plate 9. Also, the fifth cross section is a cross section including the side-wall middle-lower portion 10e.

[0034] Fig. 8 is a schematic view illustrating an internal configuration of the outdoor unit 200 according to Embodiment 2 as viewed from an upper side of the outdoor unit 200. Fig. 8 illustrates the internal configuration of part d-d and part e-e as indicated in Fig. 7 in the outdoor unit 100. A dashed-dotted line in Fig. 8 indicates the shape of the part e-e of the side wall 210 as indicated in Fig. 7. The side-wall middle-upper portion 10d has the same shape as the side-wall upper portion 10a in the first cross section, and also has a guide surface 11d having an upstream end portion 12d that is closer to the machine chamber 7 than a downstream end portion 13d. The side-wall middle-lower portion 10e also has the same shape as the side-wall upper portion 10a, and has a guide surface 11e having an upstream end portion 12e that is closer to the machine chamber 7 than a downstream end portion 13e.

[0035] The cross-sectional area D that is the area of the region Hd of the air flow passage in the fourth cross section in which the side-wall middle-upper portion 10d is located, the cross-sectional area E that is the area of the region He in the air flow passage in the fifth cross section in which the side-wall middle-lower portion 10e is located, the cross-sectional area A in the air flow passage in the first cross section, the cross-sectional area Bin the air flow passage in the second cross section, and the cross-sectional area C in the air flow passage in the third cross section satisfy "B < A < E < D < C".

[0036] Furthermore, the side-wall upper portion 10a, the side-wall lower portion 10b, the side-wall middle portion 10c, the side-wall middle-upper portion 10d, and the side-wall middle-lower portion 10e protrude toward the air flow passage side by different protrusion amounts, and the protrusion amount S of the side-wall middle-upper portion 10d, the protrusion amount T of the side-wall middle-lower portion 10e, the protrusion amount P, the protrusion amount Q, and the protrusion amount R satisfy "R < T < S < P < Q".

[0037] Furthermore, in Embodiment 2, in part of the side wall 10 that is located from the first cross section to the fifth cross section, regarding the length (creepage distance) of a line along a surface of part of the side wall 10 that extends from the surface of the heat exchanger 3 that is closer to the fans 4 and 5 to the end face 42 of the bell mouth 41 of each of the fans 4 and 5, the length of the line in the second cross section is the greatest, and the length of the line in the third cross section is the smallest. The creepage distance Ld in the fourth cross section corresponding to the part d-d indicated in Fig. 7, the creepage distance Le in the fifth cross section corresponding to the part e-e indicated in Fig. 7, the creepage distance La in the first cross section, the creepage distance Lb in the second cross section, and the creepage distance Lc in the third cross section satisfy the relationship "Lc < Le < Ld < La < Lb". As in the side wall 210 as illustrated in Figs. 2 to 4 and 7, the above relationship is established in the case where the side wall 210 in each of the first cross section, the second cross section, the third cross section, the fourth cross section, and the fifth cross section is formed in such a manner as to protrude toward the air flow passage side. That is, the relationship "Lc < Le < Ld < La < Lb" is established in the case where part of the side wall 10 that is located between points 15 and 16 as illustrated in Figs. 2 to 4 and 7 is formed to protrude toward the air-sending chamber 6.

[0038] In the case where the part of the side wall 210 that is located between points 15 and 16 is recessed in the direction away from the air flow passage as in the outdoor unit 100a according to Embodiment 1, the creepage distances of the first cross section to the fifth cross section satisfy "Lb < La < Ld < Le < Lc".

[0039] By virtue of such a configuration, in the outdoor unit 200 according to Embodiment 2, it is possible to reduce the velocity of suction air even in regions adjacent to the side-wall middle-upper portion 10d and the side-wall middle-lower portion 10e that are regions close to the fans 4 and 5 and in which the suction air tends to flow at a higher velocity, and also to further reduce non-uniformity of the velocities of suction air v1, v2, and v3 than in the outdoor units 100 and 100a according to Embodiment 1. Since the non-uniformity of the velocities of the suction air v1, v2, and v3 is reduced, the air flow in the vicinity of the side wall 210 is averaged, whereby the fluctuation of the flow field of air around the blades of the fans 4 and 5 is reduced, and the pressure fluctuation at surfaces of the blades 40 of the fans 4 and 5 is also reduced. Thus, in the outdoor unit 200 according to Embodiment 2, the magnitude of the sound caused by rotation of the fans 4 and 5 is reduced, and the noise can be reduced.

[0040] Fig. 9 is a schematic view illustrating an internal configuration of the outdoor unit 200 according to Embodiment 2 as viewed from the upper side of the outdoor unit 200. There can be a case in which the side wall 210 of the outdoor unit 200 is formed to partially protrude toward the air flow passage side. For example, as illustrated in Fig. 9, in a side wall 210a, a plate can be attached to part of a partition plate 90, which adjoins the inlet port 20, the partition plate 90 serving as a partition between the air-sending chamber 6 and the machine chamber 7. In such a case, each of the regions Ha to He in the air flow passage is determined by extending an imaginary line from a most protruding point of the side wall 210a, which most greatly protrudes in the x direction, in the y direction until the imaginary line intersects the end face 42 of the bell mouth 41. That is, in the case illustrated in Fig. 9, a region that is covered by the side wall 210a as viewed from an upstream side of the air flow passage is not included in the air flow passage.

Embodiment 3

[0041] An outdoor unit 300 according to Embodiment 3 has the same configuration as the outdoor unit 100 according to Embodiment 1 except for the setting of cross-sectional areas A, B, and C of the regions Ha, Hb, and Hc. The outdoor unit 300 according to Embodiment 3 will be described by referring mainly to the differences between Embodiments 1 and 3. Regarding the outdoor unit 300 according to Embodiment 3, components as illustrated in figures that have the same functions as those in Embodiment 1 will be denoted by the same reference signs.

[0042] Fig. 10 is a schematic view illustrating an internal configuration of the outdoor unit 300 according to Embodiment 3 as viewed from a back side of the outdoor unit 300. Fig. 11 is a schematic view illustrating an internal configuration of the outdoor unit 300 according to Embodiment 3 as viewed from an upper side of the outdoor unit 300. Fig. 11 illustrates the internal configuration of each of part a-a, part b-b, and part c-c as illustrated in Fig. 10 in the outdoor unit 300. A dashed-dotted line in Fig. 11 indicates the shape of a side-wall upper portion 310a in the part a-a as illustrated in Fig. 10. A chain-double dashed line in Fig. 11 indicates the shape of a side-wall lower portion 310b in the part b-b as illustrated in Fig. 10. A solid line in Fig. 11 illustrates the shape of a side-wall middle portion 310c in the part c-c as illustrated in Fig. 10. In a side wall 310 of the outdoor unit 300 according to Embodiment 3, the protrusion amount P of the side-wall upper portion 310a, the protrusion amount Q of the side-wall lower portion 310b, and the protrusion amount R of the side-wall middle portion 310c are set equal to each other, and cross-sectional areas A, B, and C in the air flow passage are different from each other since the upstream end portions 12a, 12b, and 12c of the guide surfaces 11a, 11b, and 11c are located at different positions.

[0043] Also, in the outdoor unit 300, the cross-sectional area A that is the area of the region Ha of the air flow passage in the first cross section in which the side-wall upper portion 310a is provided, the cross-sectional area B that is the area of the region Hb of the air flow passage in the second cross section in which the side-wall lower portion 310b is provided, and the cross-sectional area C that is the area of the region Hc of the flow passage in the third cross section in which the side-wall middle portion 310c is provided satisfy "B < A < C" as in Embodiment 1. Of the upstream end portions 12a, 12b, and 12c, the upstream end portion 12b of the side-wall lower portion 310b is the closest to the fans 4 and 5, the upstream end portion 12a of the side-wall upper portion 310a is second closest to the fans 4 and 5, and the upstream end portion 12c of the side-wall middle portion 310c is the furthest from the fans 4 and 5. That is, where Wa, Wb, and Wc are the distances between the upstream end portions 12a, 12b, and 12c and the center line of each of the fans, respectively, the relationship "Wb < Wa < Wc" is satisfied.

[0044] As described above, at each part of the side wall 310, since the positions of the upstream end portions 12a, 12b, and 12c of the guide surfaces 11a, 11b, and 11c are different from each other, the non-uniformity of the velocities v1, v2, and v3 of suction air can be reduced as in Embodiment 1. Also, in the outdoor unit 300 according to Embodiment 3, the amplitude of sound caused by rotation of the fans 4 and 5 is reduced, and noise can also be reduced.

[0045] As indicated by dotted lines in Fig. 11, in the outdoor unit 300 according to Embodiment 3, in the case where a side-wall middle-upper portion 310d is provided between the side-wall upper portion 310a and the side-wall middle portion 310c, and a side-wall middle-lower portion e is provided between the side-wall middle portion 310c and the side-wall lower portion 310b, where Wd and We are the distance between the center line of each of the fans and the upstream end portion 12d of the guide surface 11d in the side-wall middle-upper portion 310d and the distance between the center line of each fans and the upstream end portion 12e of the guide surface 11e in the side-wall middle-lower portion 310e, respectively, the relationship "Wb < Wa < We < Wd < Wc" is satisfied. By virtue of the above configuration, the outdoor unit 300 can obtain similar advantages to those of Embodiment 2.

Reference Signs List

[0046] 2 housing 3 heat exchanger 4 (first) fan 5 (second) fan 6 air-sending chamber 7 machine chamber 8 top plate 9 bottom plate 10 side wall 10a side-wall upper portion 10b side-wall lower portion 10c side-wall middle portion 10d side-wall middle-upper portion 10e side-wall middle-lower portion 11a guide surface 11b guide surface 11c guide surface 11d guide surface 11e guide surface 12 upstream end portion 12a upstream end portion 12b upstream end portion 12c upstream end portion 12d upstream end portion 12e upstream end portion 13 downstream end portion 13a downstream end portion 13b downstream end portion 13c downstream end portion 13d downstream end portion 13e downstream end portion 14 end portion 20 inlet port 21 outlet port 40 blade 41 bell mouth 42 end surface 44 rotational axis 90 partition plate 100 outdoor unit 100a outdoor unit 110 side wall 111a guide surface 111b guide surface 111c guide surface 200 outdoor unit 210 side wall 210a side wall 300 outdoor unit 310 side wall 310a side-wall upper portion 310b side-wall lower portion 310c side-wall middle portion 310d side-wall middle-upper portion 310e side-wall middle-lower portion 1000 outdoor unit 1010 side wall A cross-sectional area B cross-sectional area C cross-sectional area D cross-sectional area E cross-sectional area Ha region Hb region Hc region Hd region He region La creepage distance Lb creepage distance Lc creepage distance Ld creepage distance Le creepage distance P protrusion amount Q protrusion amount R protrusion amount S protrusion amount T protrusion amount v1 suction air v2 suction air v3 suction air Wa distance Wb distance Wc distance Wd distance We distance

Claims

1. An outdoor unit comprising:

a housing in which an inlet port and an outlet port are formed;
a bottom plate that forms a lower surface of the housing, a top plate that forms an upper surface of the housing, and a side wall that is provided between the bottom plate and the top plate and partitions an internal space of the housing;
a heat exchanger provided in a region in the housing that adjoins the inlet port; and
fans provided in a region in the housing that adjoins the outlet port,
wherein the fans are a first fan and a second fan that are respectively provided in an upper side and a lower side of the region in the housing that adjoins the outlet port,
wherein an air flow passage is provided to extend from the heat exchanger to the fans, and is defined by the bottom plate, the top plate, and the side wall, the side wall being located beside the fans, and
wherein cross sections of the air flow passage that are taken along a direction parallel to the bottom plate and located between central axes of the fans and the side wall have respective cross-sectional areas A, B, and C such that the cross-sectional area B < the cross-sectional area A < the cross-sectional area C is satisfied, where the cross-sectional area A is a cross-sectional area of a first cross section that is located between the central axis of the first fan and the top plate and is parallel to the bottom plate, the cross-sectional area B is a cross-sectional area of a second cross section that is located between the central axis of the second fan and the bottom plate and is parallel to the bottom plate, and the cross-sectional area C is a cross-sectional area of a third cross section that is located between the first cross section and the second cross section and is parallel to the bottom plate.

2. The outdoor unit of claim 1, wherein cross sections of the air flow passage that are taken along the direction parallel to the bottom plate and located between the central axes of the fans and the side wall have respective cross-sectional areas D and E such that the cross-sectional area B < the cross-sectional area A < the cross-sectional area E < the cross-sectional area D < the cross-sectional area C is satisfied, where the cross-sectional area D is a cross-sectional area of a fourth cross section that is located between the first cross section and the third cross section, and the cross-sectional area E is a cross-sectional area of a fifth cross section that is located between the second cross section and the third cross section.

3. The outdoor unit of claim 1 or claim 2,
wherein as viewed from the inlet port,
in the first cross section parallel to the bottom plate, the side wall protrudes by a protrusion amount P in a protrusion direction toward an associated one of the fans,
in the second cross section parallel to the bottom plate, the side wall protrudes by a protrusion amount Q in the protrusion direction, and
in the third cross section parallel to the bottom plate, the side wall protrudes by a protrusion amount R in the protrusion direction, and
the protrusion amount R < the protrusion amount P < the protrusion amount Q is satisfied,

4. The outdoor unit of claim 3,
wherein as viewed from inlet port,
in the fourth cross section located between the first cross section and the third cross section and parallel to the bottom plate, the side wall protrudes by a protrusion amount S in the protrusion direction, and
in the fifth cross section located between the second cross section and the third cross section and parallel to the bottom plate, the side wall protrudes by a protrusion amount T in the protrusion direction, and
the protrusion amount R < the protrusion amount S < the protrusion amount T < the protrusion amount P < the protrusion amount Q is satisfied.

5. The outdoor unit of any one of claims 1 to 4,
wherein the side wall is shaped in such a manner as to protrude in a direction toward the air flow passage, and
wherein a creepage distance Lc < a creepage distance La < a creepage distance Lb is satisfied,
where the creepage distance La is a creepage distance between a point of the side wall in the first cross section that mot greatly protrudes in the protrusion direction and a point of the side wall in the first cross section that adjoins the inlet port,
the creepage distance Lb is a creepage distance between a point of the side wall in the second cross section that most greatly protrudes in the protrusion direction and a point of the side wall in the second cross section that adjoins the inlet port, and
the creepage distance Lc is a creepage distance be-

tween a point of the side wall in the third cross section that most greatly protrudes in the protrusion direction and a point of the side wall in the third cross section that adjoins the inlet port.

6. The outdoor unit of claim 5,
wherein in the side wall,
the creepage distance Lb < the creepage distance La < a creepage distance Le < a creepage distance Ld < the creepage distance Lc is satisfied,
where the creepage distance Ld is a creepage distance between a point of the side wall in a fourth cross section at which a protrusion amount of the side wall in the protrusion direction toward an associated one of the fans is maximum and a point of the side wall in the fourth cross section that adjoins the inlet port, the fourth cross section being located between the first cross section and the third cross section, and
the creepage distance Le is a creepage distance between a point of the side wall in a fifth cross section at which a protrusion amount of the side wall in the protrusion direction is maximum and a point of the side wall in the fifth cross section that adjoins the inlet port, the fifth cross section being located between the second cross section and the third cross section.

7. The outdoor unit of any one of claims 1 to 4,
wherein the side wall is shaped in such a manner to be recessed in a direction away from the air flow passage, and
wherein a creepage distance Lb < a creepage distance La < a creepage distance Lc is satisfied,
where the creepage distance La is a creepage distance between a point of the side wall in the first cross section at which a protrusion amount of the side wall in a protrusion direction toward an associated one of the fans is maximum and a point of the side wall in the first cross section that adjoins the inlet port,
the creepage distance Lb is a creepage distance between a point of the side wall in the second cross section at which a protrusion amount of the side wall in the protrusion direction is maximum and a point of the side wall in the second cross section that adjoins the inlet port, and
the creepage distance Lc is a creepage distance between a point of the side wall in the third cross section at which a protrusion amount of the side wall in the protrusion direction is maximum and a point of the side wall in the third cross section that adjoins the inlet port.

8. The outdoor unit of claim 7,
wherein in the side wall,
the creepage distance Lc < a creepage distance Ld < a creepage distance Le < the creepage distance La < the creepage distance Lb is satisfied,
where the creepage distance Ld is a creepage distance between a point of the side wall in a fourth cross section at which a protrusion amount of the side wall in the protrusion direction is maximum and a point of the side wall in the fourth cross section that adjoins the inlet port, the fourth cross section being located between the first cross section and the third cross section, and
the creepage distance Le is a creepage distance between a point of the side wall in a fifth section at which a protrusion amount of the side wall in the protrusion direction is maximum and a point of the side wall in the fifth section that adjoins the inlet port, the fifth section being located between the second cross section and the third cross section.

9. The outdoor unit of claim 1 or claim 2,
wherein the side wall has a guide surface that is inclined outwards from a side of the side wall that is closer to the fans, and,
wherein cross sections of the air flow passage that are taken along the direction parallel to the bottom plate have respective distances Wa, Wb, and Wc each of which is a distance between a central axis of an associated one of the fans and an upstream end portion of the guide surface, such that a distance Wb < a distance Wa < a distance Wc is satisfied,
where the distance Wa is the distance in the first cross section, the distance Wb is the distance in the second cross section, and the distance Wc is the distance in the third cross section.

10. The outdoor unit of claim 9,
wherein cross sections of the air flow passage that are taken along the direction parallel to the bottom plate have respective distance Wd and We such that the distance Wb < the distance Wa < the distance We < the distance Wd < distance Wc is satisfied,
each of the distances corresponding to a protrusion amount by which the side wall protrudes in a protrusion direction toward an associated one of the fans as viewed from the inlet port, and
where the distance Wd is the distance in a fourth cross section located between the first cross section and the third cross section, and the distance We is the distance in a fifth cross section located between the second cross section and the third cross section.

11. The outdoor unit of any one of claims 1 to 10, wherein the side wall is a partition plate that serves as a partition between a machine chamber and an air-sending chamber in the housing.

12. A refrigeration cycle apparatus comprising:
the outdoor unit of any one of claims 1 to 11.

FIG. 1

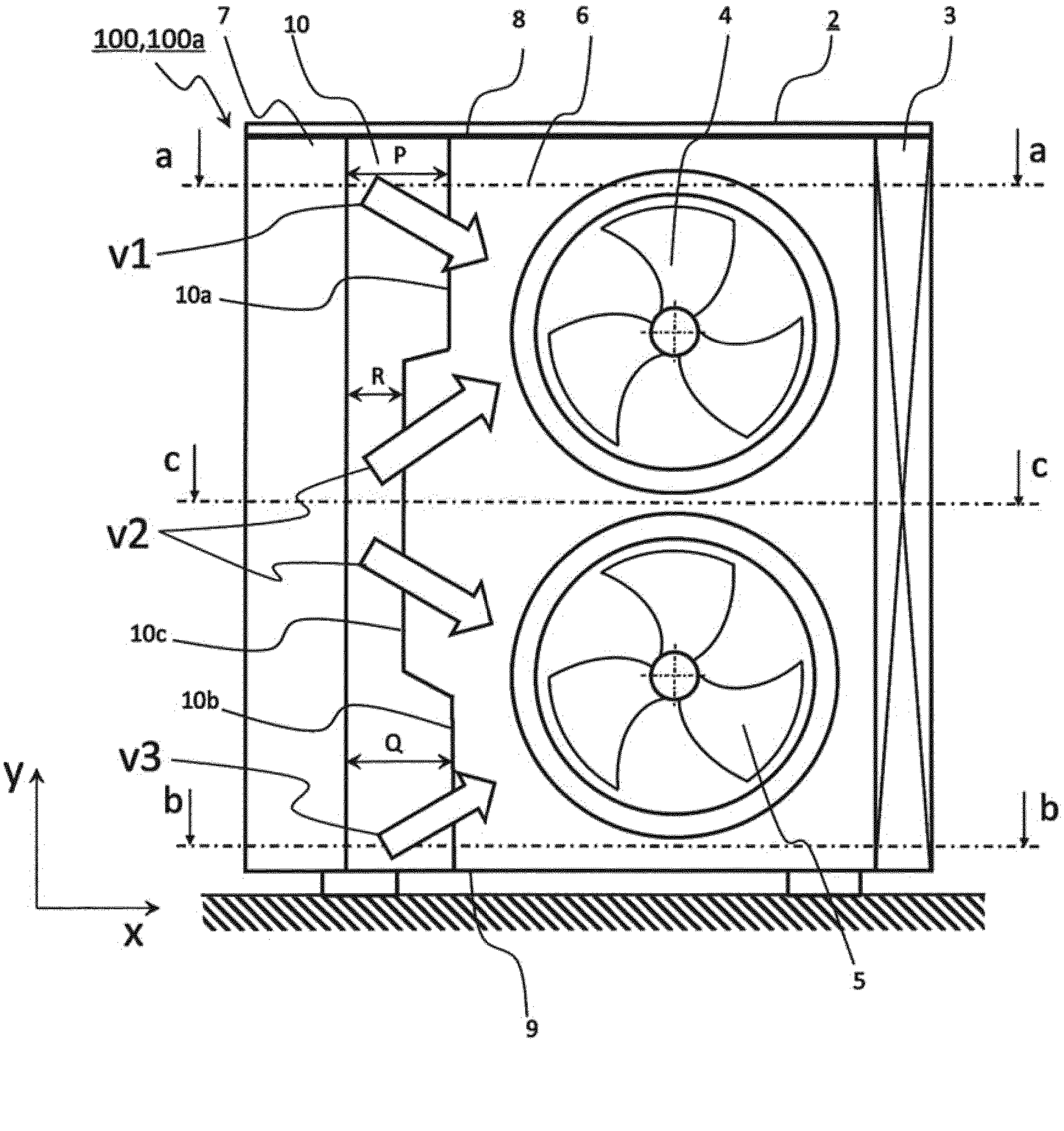

FIG. 2

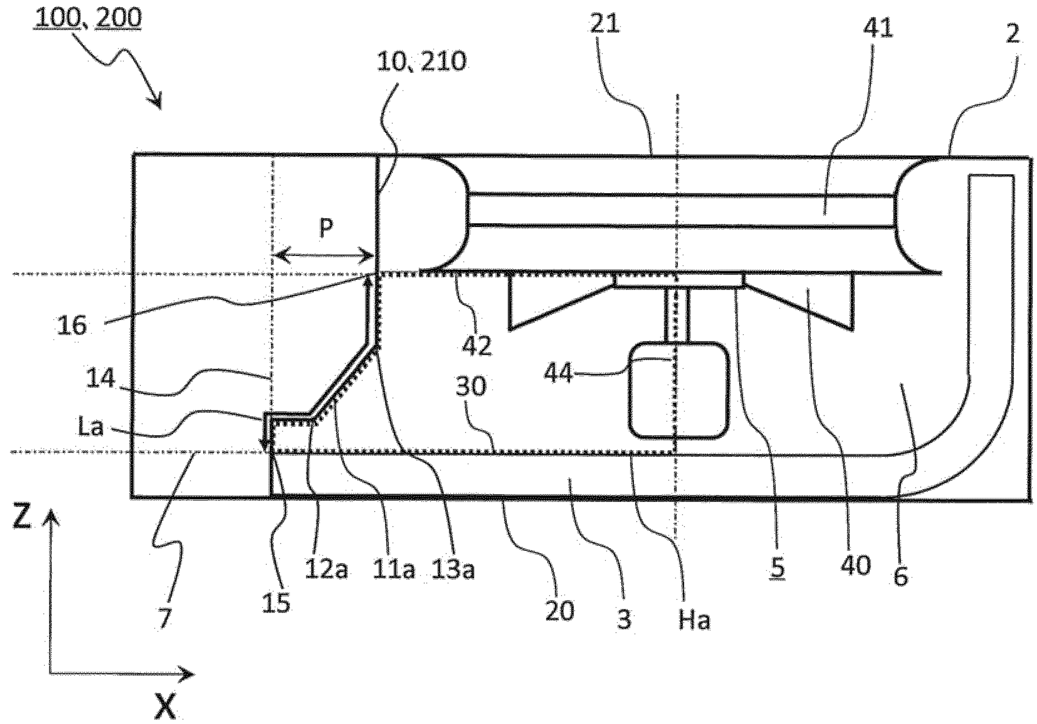
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FIG. 3

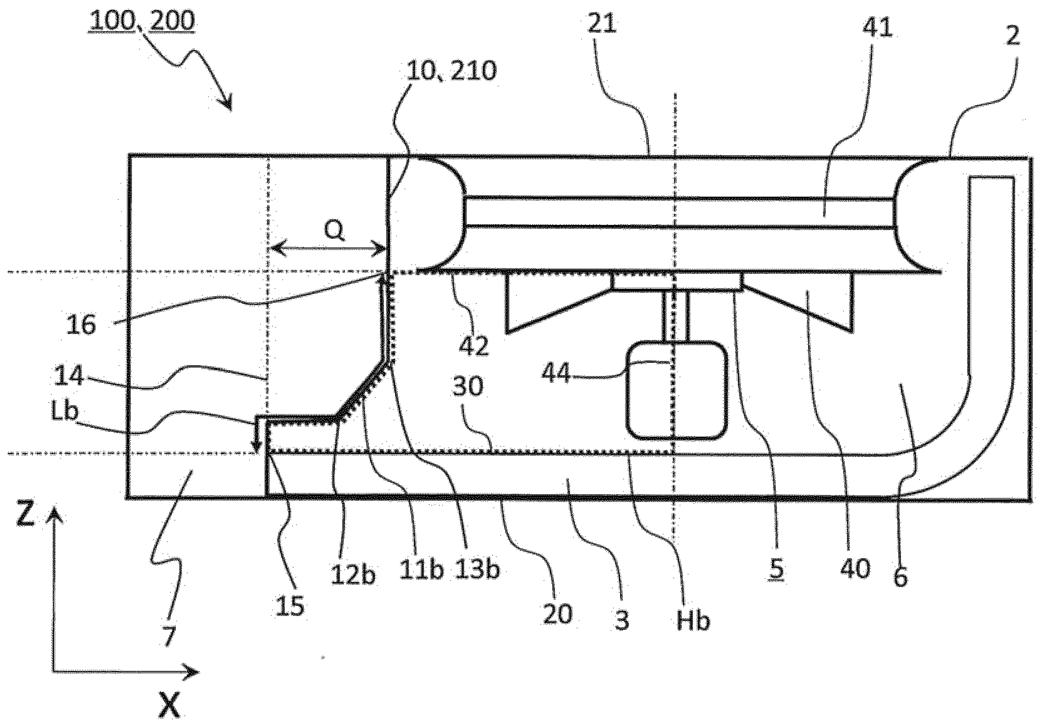
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FIG. 4

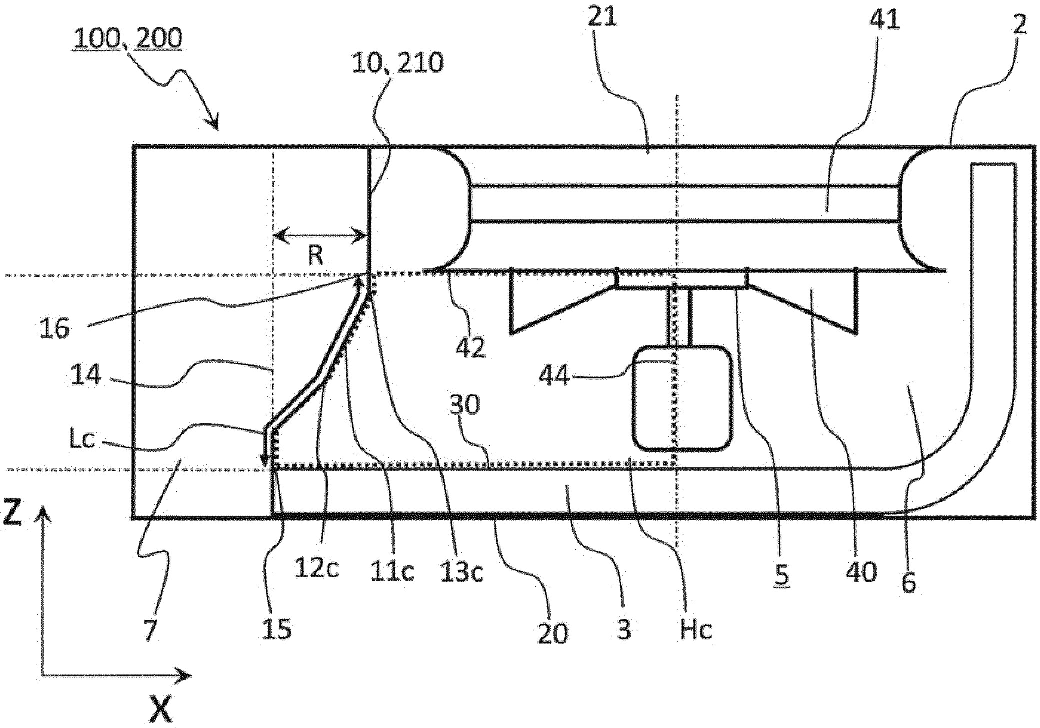
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FIG. 5

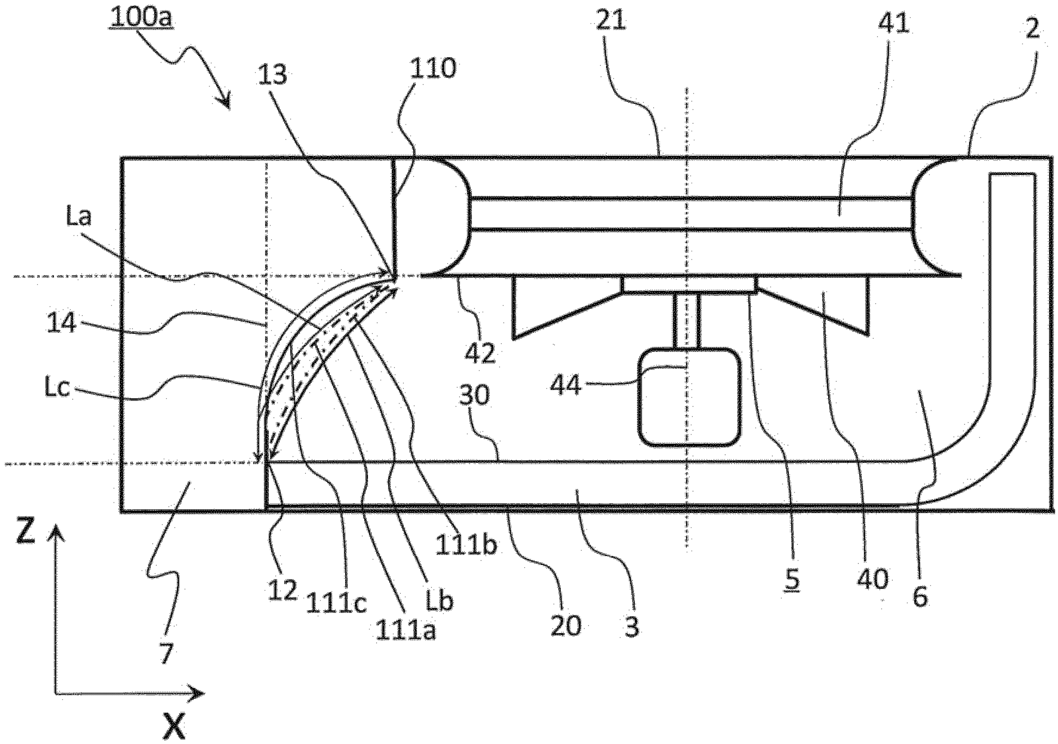
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FIG. 6

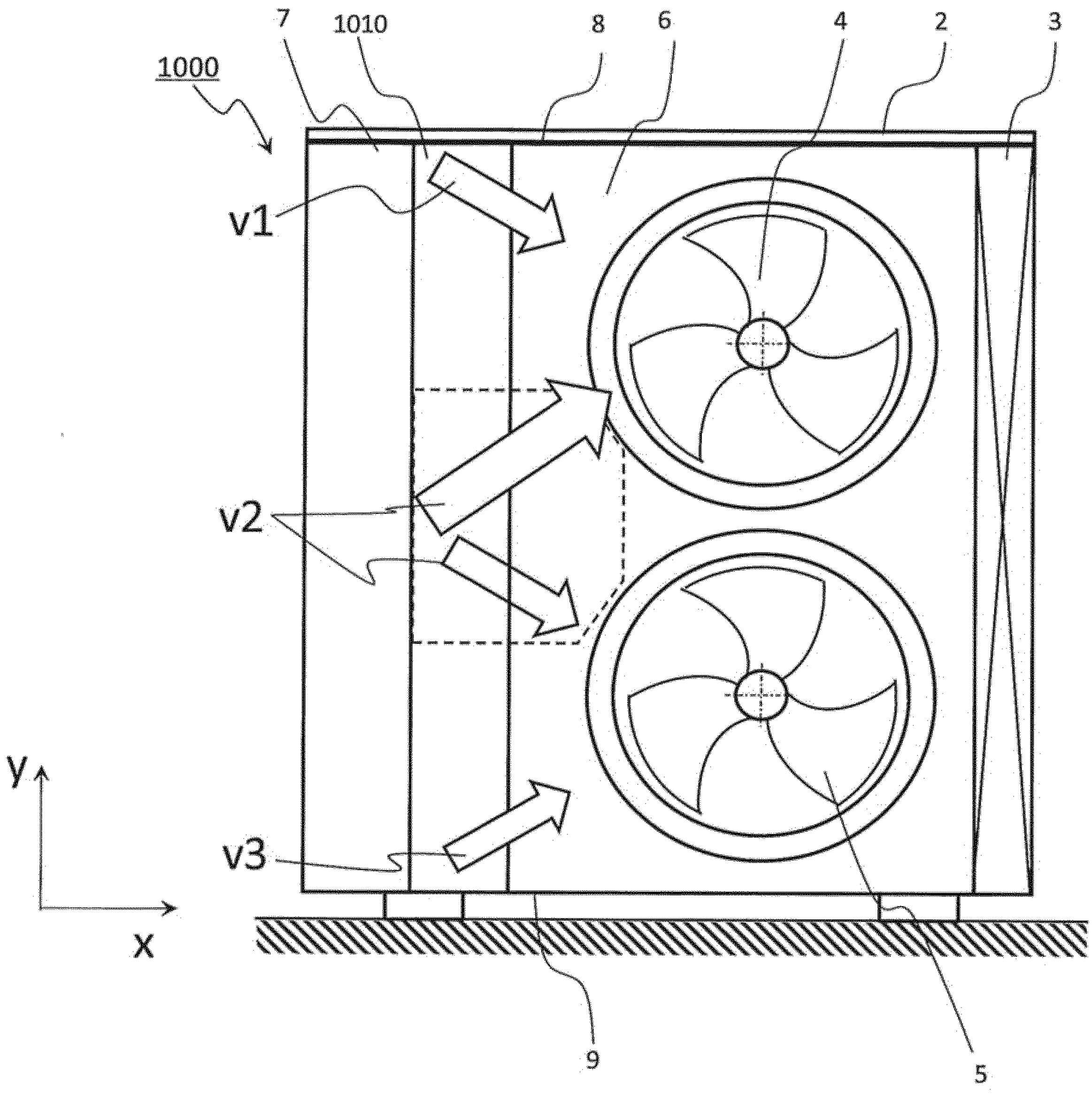

FIG. 7

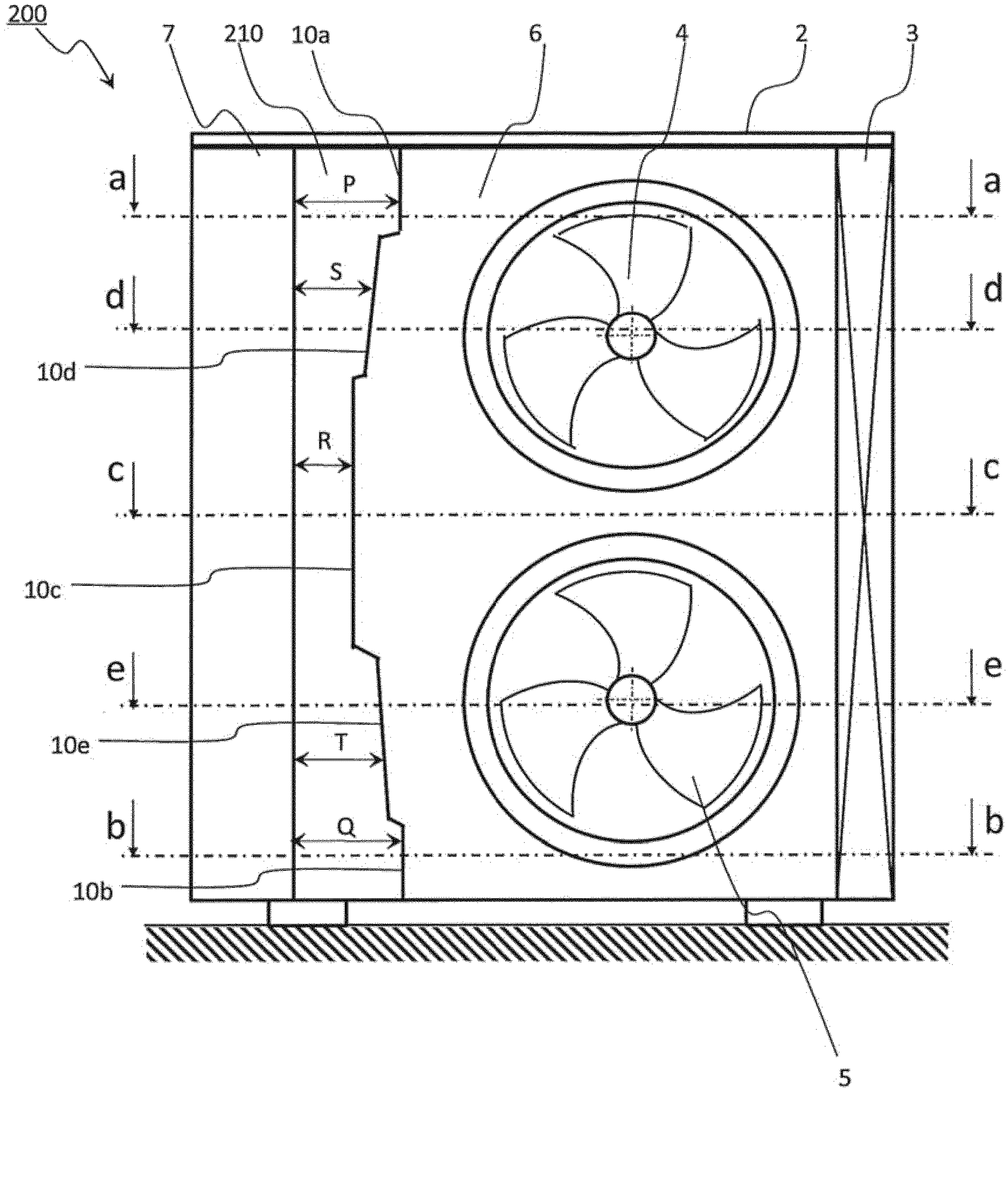

FIG. 8

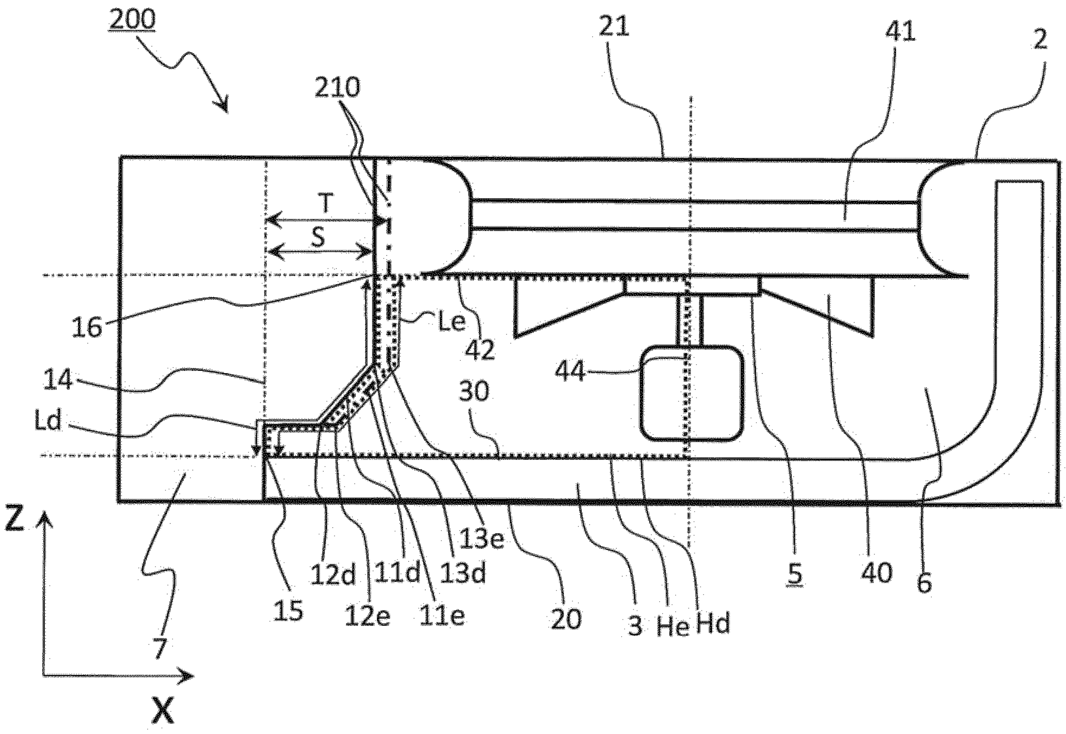
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FIG. 9

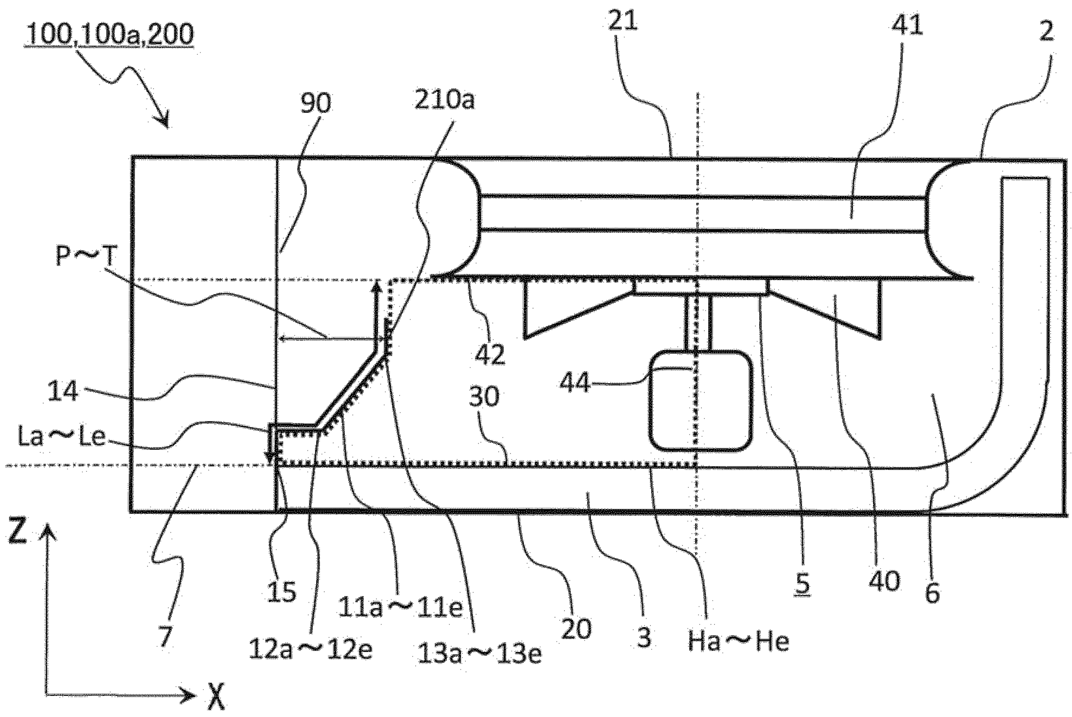
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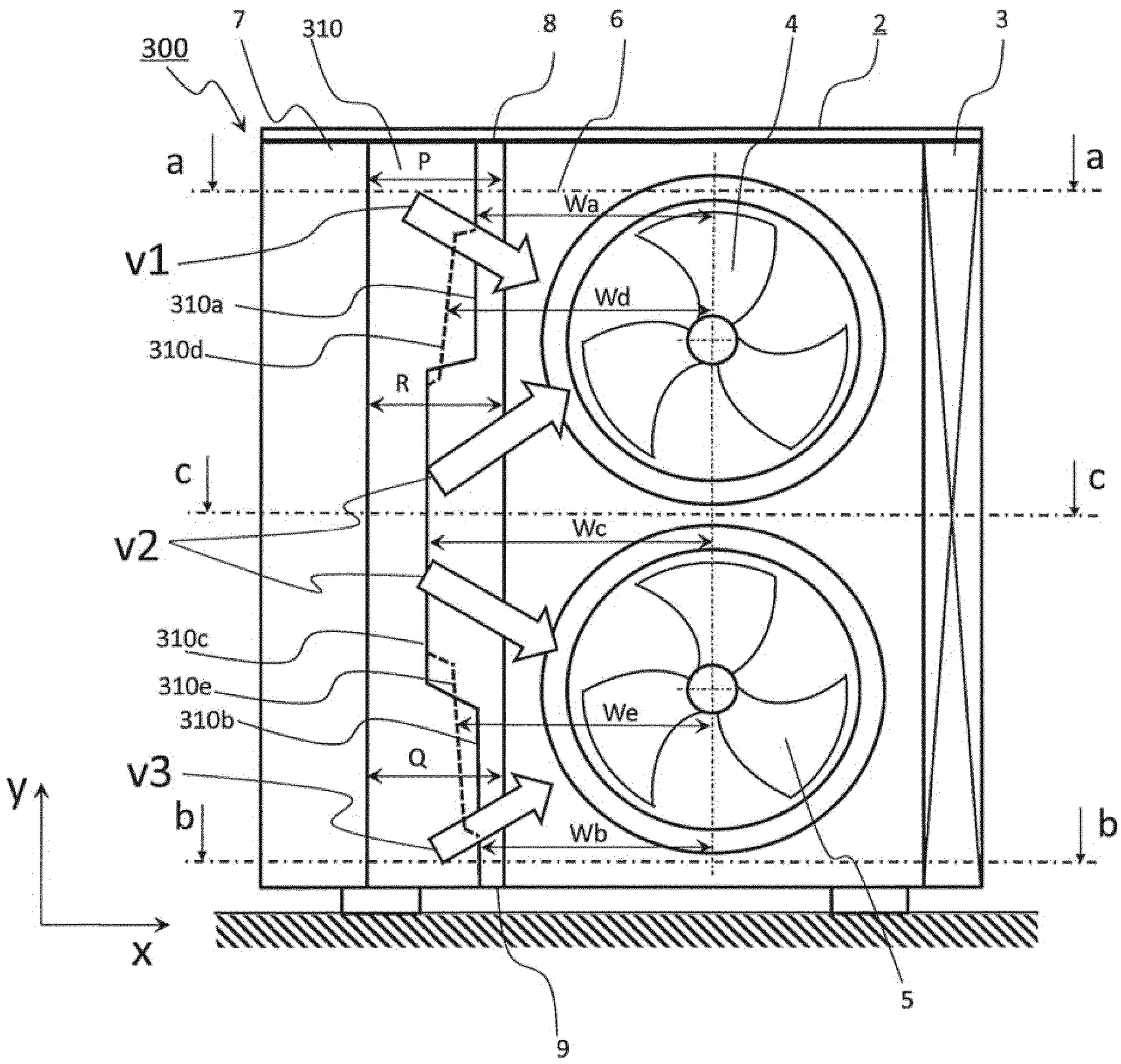
FIG. 10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Wb
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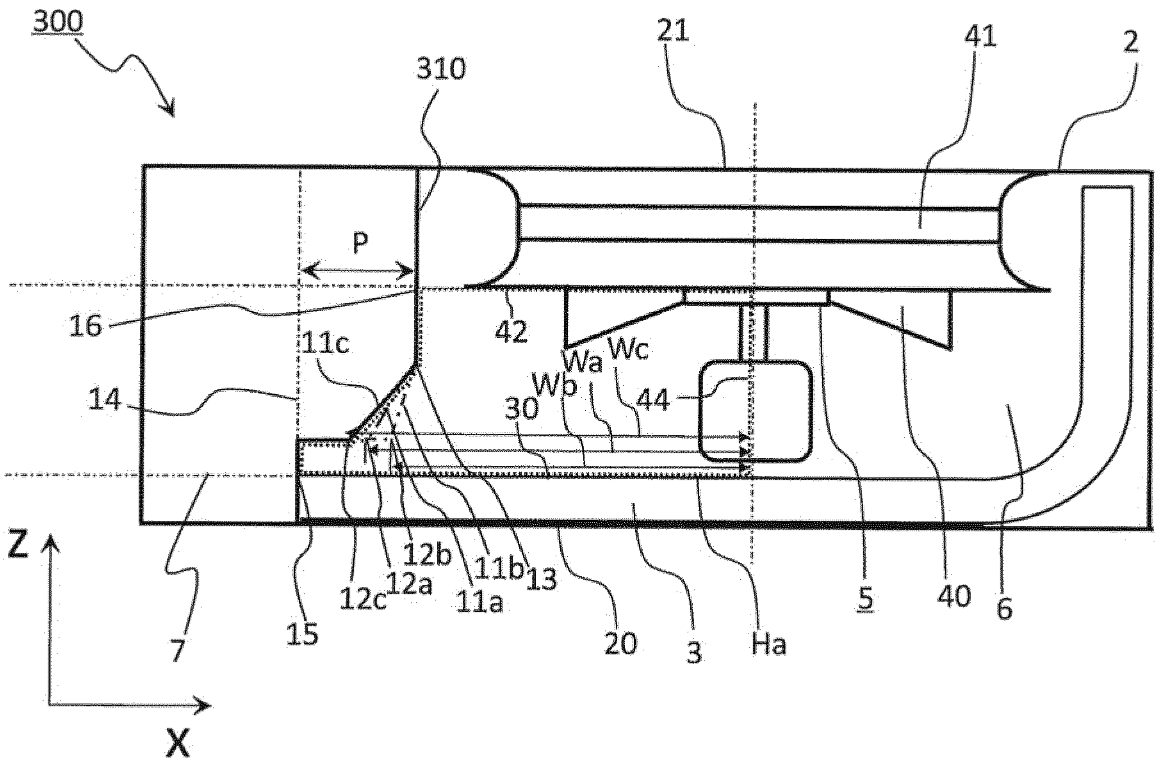
FIG. 11



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11b
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15
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3
Ha
5
40
6
7
Z
X

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/037027

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F24F1/54(2011.01)i, F24F1/40(2011.01)i, F24F1/56(2011.01)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)
Int.Cl. F24F1/54, F24F1/40, F24F1/56

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

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2018
Registered utility model specifications of Japan	1996-2018
Published registered utility model applications of Japan	1994-2018

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 A	WO 2013/094082 A1 (MITSUBISHI ELECTRIC CORP.) 27 June 2013, paragraphs [0001], [0010]-[0022], [0038]-[0040], fig. 5-6, 13 & US 2014/0299298 A1, paragraphs [0002], [0024]-[0038], [0055]-[0059], fig. 5-6, 13 & EP 2801763 A1 & CN 104024746 A	1-2, 5-6, 9-12 7-8 3-4
Y	JP 7-180862 A (DAIKIN INDUSTRIES, LTD.) 18 July 1995, fig. 1 (Family: none)	7-8

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

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"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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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	Date of mailing of the international search report
02 November 2018 (02.11.2018)	13 November 2018 (13.11.2018)

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/037027

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 6-257796 A (MATSUSHITA SEIKO CO., LTD.) 16 September 1994, entire text, all drawings (Family: none)	1-12
A	JP 5-99458 A (TOSHIBA CORP.) 20 April 1993, entire text, all drawings (Family: none)	1-12

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2010127590 A **[0003]**