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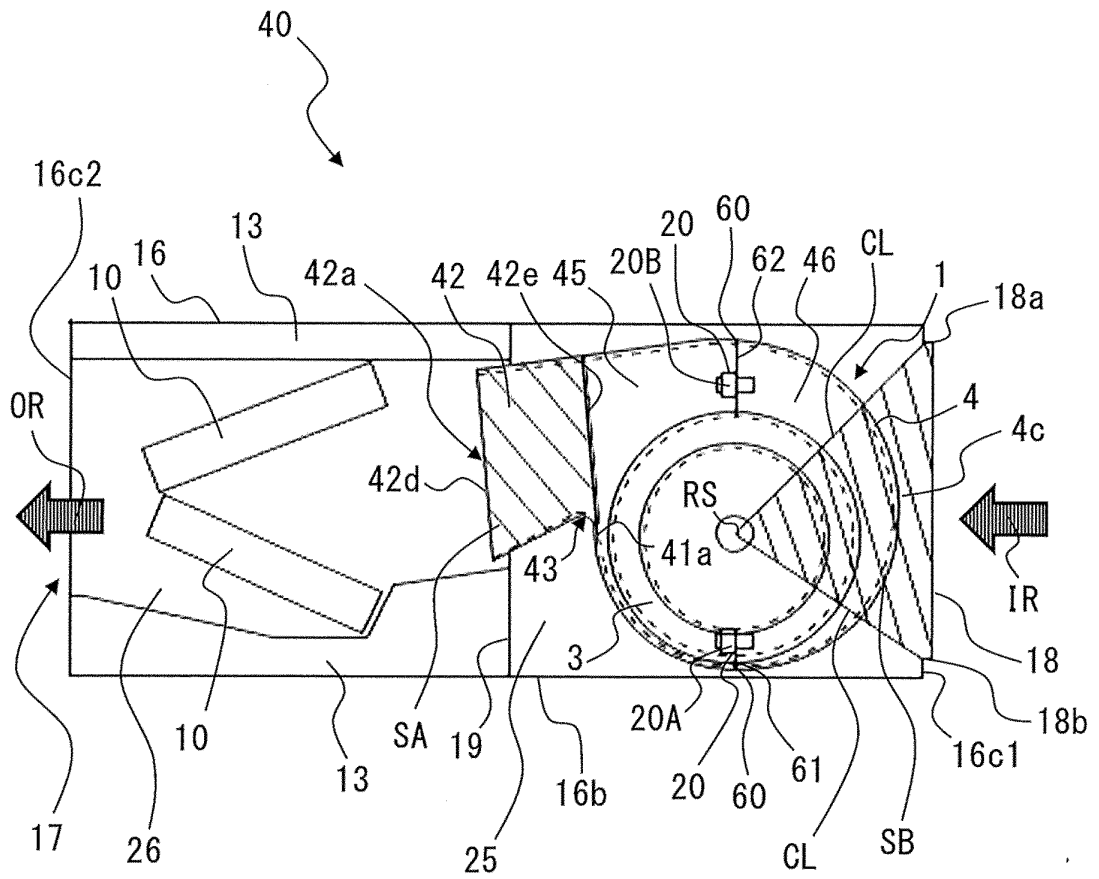
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(54) **AIR CONDITIONER**

(57) An air-conditioning apparatus includes a centrifugal air-sending device that has a fan driven to rotate and a scroll casing that houses the fan, the scroll casing having a circumferential wall and a side wall, the circumferential wall being formed in a volute shape, the side wall having a suction port of air; a driving power supply configured to supply driving power to the fan; a heat exchanger located to face a discharge port of air, the discharge port being formed in the scroll casing; and a housing that houses the centrifugal air-sending device, the driving power supply, and the heat exchanger, the housing having a partition plate that partitions an interior of the housing into an air-sending chamber in which the fan is located and a heat-exchanging chamber in which the heat exchanger is located, the housing having a housing inlet through which air that flows into the air-sending chamber passes and a housing outlet through which air that flows out of the heat-exchanging chamber passes. The scroll casing has a first casing part that has a dis-

charge part that forms the discharge port, the discharge part being fixed to the partition plate, a second casing part that has a portion of the circumferential wall that faces the housing inlet, the second casing part being fixed to the first casing part in such a manner that the second casing part is capable of being detached, and a fixing portion located in the side wall and at which the first casing part and the second casing part are fixed to each other. The first casing part and the second casing part are fixed to each other at a boundary. The boundary extends over the side wall and the circumferential wall. The boundary is located in a portion other than the discharge part. The fixing portion is located, when the fixing portion is viewed in an axial direction of a rotation axis of the fan, in an area other than an area defined by first virtual lines and a line that represents the housing inlet, the first virtual lines being virtual lines that connect opposite ends of the housing inlet and the rotation axis.

FIG. 6



Description

Technical Field

[0001] The present disclosure relates to an air-conditioning apparatus including a centrifugal air-sending device.

Background Art

[0002] Some existing air-conditioning apparatus includes, between an air inlet and an air outlet, a heat exchanger and a centrifugal air-sending device that has a scroll casing. Rotation of a fan housed in a scroll casing of such an air-conditioning apparatus causes air sucked through an inlet of the air-conditioning apparatus to flow into the fan along a bell mouth formed at a suction port of the scroll casing. The pressure of airflow discharged from the fan is increased in the scroll casing. Subsequently, the airflow is discharged from the scroll casing, then passes through a heat exchanger, and is discharged into an air-conditioning target space through an outlet of the air-conditioning apparatus.

[0003] A scroll casing to be used in an air-conditioning apparatus is sometimes separated into two parts to contain a fan. In view of ease of production, the scroll casing separated into the two parts has a boundary that is located in a component forming a discharge port of the scroll casing and at which the two parts are fixed to each other and another boundary located opposite to the boundary across a suction port of the scroll casing (see, for example, Patent Literature 1). To fix the two separated parts to each other, the air-conditioning apparatus in Patent Literature 1 further has a fixing portion located at a position in a wall surface of the scroll casing in the vicinity of each boundary.

Citation List

Patent Literature

[0004] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2005-69177

Summary of Invention

Technical Problem

[0005] However, the velocity of air flowing into the suction port of the scroll casing increases at an inlet of the air-conditioning apparatus. Thus, interference between airflow and the fixing portion located at the inlet of the air-conditioning apparatus in Patent Literature 1 may cause separation of air flowing in a bell mouth and thus may reduce the amount of gas flowing into the scroll casing.

[0006] The present disclosure is made to solve such a problem, and an object of the present disclosure is to

obtain an air-conditioning apparatus that inhibits a reduction in the amount of gas flowing into a scroll casing of a centrifugal air-sending device. Solution to Problem

[0007] An air-conditioning apparatus according to an embodiment of the present disclosure includes a centrifugal air-sending device that has a fan driven to rotate and a scroll casing that houses the fan, the scroll casing having a circumferential wall and a side wall, the circumferential wall being formed in a volute shape, the side wall having a suction port of air; a driving power supply configured to supply driving power to the fan; a heat exchanger located to face a discharge port of air, the discharge port being formed in the scroll casing; and a housing that houses the centrifugal air-sending device, the driving power supply, and the heat exchanger, the housing having a partition plate that partitions an interior of the housing into an air-sending chamber in which the fan is located and a heat-exchanging chamber in which the heat exchanger is located, the housing having a housing inlet through which air that flows into the air-sending chamber passes and a housing outlet through which air that flows out of the heat-exchanging chamber passes. The scroll casing has a first casing part that has a discharge part that forms the discharge port, the discharge part being fixed to the partition plate, a second casing part that has a portion of the circumferential wall that faces the housing inlet, the second casing part being fixed to the first casing part in such a manner that the second casing part is capable of being detached, and a fixing portion located in the side wall and at which the first casing part and the second casing part are fixed to each other. The first casing part and the second casing part are fixed to each other at a boundary. The boundary extends over the side wall and the circumferential wall. The boundary is located in a portion other than the discharge part. The fixing portion is located, when the fixing portion is viewed in an axial direction of a rotation axis of the fan, in an area other than an area defined by first virtual lines and a line that represents the housing inlet, the first virtual lines being virtual lines that connect opposite ends of the housing inlet and the rotation axis.

Advantageous Effects of Invention

[0008] According to an embodiment of the present disclosure, the centrifugal air-sending device has the fixing portion at which the first casing part and the second casing part are fixed to each other. The fixing portion is located in the side wall. The fixing portion is located, when the fixing portion is viewed in the axial direction of the rotation axis of the fan, in an area other than the area defined by the first virtual lines and the line that represents the housing inlet, the first virtual lines being the virtual lines that connect the opposite ends of the housing inlet and the rotation axis. The fixing portion is located away from the housing inlet of the air-conditioning apparatus, and the air-conditioning apparatus is thus capable of inhibiting interference between the fixing portion and

high-velocity air flowing in through the housing inlet. As a result, the air-conditioning apparatus inhibits separation of air flowing in a bell mouth and is thus capable of inhibiting a reduction in the amount of gas flowing into the scroll casing. Brief Description of Drawings

[0009]

[Fig. 1] Fig. 1 is a perspective view of a centrifugal air-sending device according to Embodiment 1.

[Fig. 2] Fig. 2 is a schematic diagram of the interior of the centrifugal air-sending device according to Embodiment 1 when the centrifugal air-sending device is viewed in the axial direction of a rotation axis.

[Fig. 3] Fig. 3 is a schematic diagram of the exterior of the centrifugal air-sending device according to Embodiment 1 when the centrifugal air-sending device is viewed in the axial direction of the rotation axis.

[Fig. 4] Fig. 4 is a perspective view schematically illustrating an example of an air-conditioning apparatus according to Embodiment 1.

[Fig. 5] Fig. 5 is a schematic diagram illustrating an example of the internal configuration of the air-conditioning apparatus according to Embodiment 1.

[Fig. 6] Fig. 6 is a side view schematically illustrating an example of the internal configuration of the air-conditioning apparatus according to Embodiment 1.

[Fig. 7] Fig. 7 is a side view schematically illustrating the internal configuration of a modification example of the air-conditioning apparatus according to Embodiment 1.

[Fig. 8] Fig. 8 is a schematic diagram of a centrifugal air-sending device according to a comparative example when the centrifugal air-sending device is viewed in the axial direction of a rotation axis.

[Fig. 9] Fig. 9 is a schematic diagram of the separated centrifugal air-sending device according to the comparative example.

[Fig. 10] Fig. 10 is a schematic diagram illustrating an example of the internal configuration of an air-conditioning apparatus according to the comparative example.

[Fig. 11] Fig. 11 is a side view schematically illustrating an example of the internal configuration of an air-conditioning apparatus according to Embodiment 2.

[Fig. 12] Fig. 12 is a side view schematically illustrating an example of the internal configuration of an air-conditioning apparatus according to Embodiment 3.

[Fig. 13] Fig. 13 is a side view schematically illustrating an example of the internal configuration of an air-conditioning apparatus according to Embodiment 4.

[Fig. 14] Fig. 14 is a side view schematically illustrating an example of the internal configuration of an air-conditioning apparatus according to Embodiment 5.

[Fig. 15] Fig. 15 is a side view schematically illustrating an example of the internal configuration of an air-conditioning apparatus according to Embodiment 6.

Description of Embodiments

[0010] An air-conditioning apparatus 40 according to an embodiment of the present disclosure will be described below with reference to the drawings, for example. For example, the relative size relationships or the shapes of the components in the following drawings including Fig. 1 may differ from those of actual ones. In the following drawings, components having the same reference signs are the same or corresponding components, and this applies to the entire description. Terms that mean directions (for example, "up", "down", "right", "left", "forward", and "backward") are used as appropriate to make the description easy to understand. However, these terms are merely used for convenience of description and do not limit the locations and the orientations of apparatuses or components.

Embodiment 1

[Centrifugal Air-sending Device 1]

[0011] Fig. 1 is a perspective view of a centrifugal air-sending device 1 according to Embodiment 1. Fig. 2 is a schematic diagram of the interior of the centrifugal air-sending device 1 according to Embodiment 1 when the centrifugal air-sending device 1 is viewed in the axial direction of a rotation axis RS. Fig. 3 is a schematic diagram of the exterior of the centrifugal air-sending device 1 according to Embodiment 1 when the centrifugal air-sending device 1 is viewed in the axial direction of the rotation axis RS. Fig. 2 does not illustrate a bell mouth 3 to illustrate the internal structure of the centrifugal air-sending device 1.

[0012] The centrifugal air-sending device 1 is a double suction centrifugal air-sending device 1, into which air is sucked from both sides of the centrifugal air-sending device 1 in the axial direction of the rotation axis RS of a fan 2. The configuration of the part of the centrifugal air-sending device 1 on one surface of a main plate 2a is similar to the configuration of the part of the centrifugal air-sending device 1 on the other surface of the main plate 2a. Thus, the configuration of the centrifugal air-sending device 1 is described by use of Fig. 1, and the configuration of the part opposite to the part of the centrifugal air-sending device 1 illustrated in Fig. 1 is not illustrated.

[0013] First, the basic structure of the centrifugal air-sending device 1 will be described by use of Figs. 1 to 3. The centrifugal air-sending device 1 is, for example, a multiblade centrifugal air-sending device 1, such as a sirocco fan and a turbo fan. The centrifugal air-sending device 1 has the fan 2, which is configured to generate airflow, and a scroll casing 4, which houses the fan 2.

(Fan 2)

[0014] The fan 2 is driven to rotate by, for example, a

motor (not illustrated) and forcibly sends air outward in radial directions with the centrifugal force generated by the rotation. As illustrated in Figs. 1 and 2, the fan 2 has the main plate 2a, which has a disk shape, and a plurality of blades 2d, which are installed on a peripheral portion 2a1 of the main plate 2a. The main plate 2a may have any shape, such as a polygonal shape, other than a disk shape as long as the main plate 2a has a plate-like shape. An axial portion 2b, to which the motor (not illustrated) is connected, is located at the center of the main plate 2a. The main plate 2a is driven to rotate by the motor via the axial portion 2b.

[0015] The blades 2d are located on the circumference around the axial portion 2b. The base ends of the blades 2d are fixed to the main plate 2a. The blades 2d are located on both sides of the main plate 2a in the axial direction of the rotation axis RS of the fan 2. The blades 2d are located on the peripheral portion 2a1 of the main plate 2a with certain spaces between the blades 2d. The blades 2d each have, for example, a curved rectangular plate-like shape and are each installed to extend in a radial direction or to be inclined at a predetermined angle to a radial direction.

[0016] The blades 2d are each formed into a two-dimensional blade in which the same sectional shape is continuous in the axial direction of the rotation axis RS but may be each formed into a three-dimensional blade having a twisted shape. The blades 2d are located to stand substantially perpendicularly to the main plate 2a, but the configuration of the blades 2d is not limited to this description. The blades 2d may be located to be inclined to a direction perpendicular to the main plate 2a.

[0017] The fan 2 has side plates (not illustrated) that each have an annular shape and that are each located at the corresponding ends of the blades 2d in the axial direction of the rotation axis RS. The end of each of the blades 2d to which the side plate is attached is one end opposite to the other end of the blade 2d connected to the main plate 2a. The side plate maintains the positional relationship between the tips of the blades 2d and reinforces the blades 2d by being connected to the blades 2d.

[0018] As illustrated in Fig. 1, the fan 2 has a cylindrical shape formed by the blades 2d located on the main plate 2a. At respective ends of the blades 2d opposite to the main plate 2a in the axial direction of the rotation axis RS, the fan 2 has suction ports 2e for allowing gas to flow through into the spaces defined by the main plate 2a and the blades 2d. In the fan 2, the blades 2d are located at each side of the main plate 2a, and the suction ports 2e are formed at each side of the main plate 2a.

[0019] The fan 2 is driven to rotate around the rotation axis RS by driving the motor (not illustrated). By rotating the fan 2, gas outside the centrifugal air-sending device 1 flows along bell mouths 3 and is sucked into the spaces defined by the main plate 2a and the blades 2d through suction ports 5, which are each formed in the scroll casing 4, and the suction ports 2e of the fan 2. By rotating the fan 2, the air sucked into the spaces defined by the main

plate 2a and the blades 2d is then sent outward in a radial direction through a space between each blade 2d and the corresponding adjacent blade 2d.

5 (Scroll Casing 4)

[0020] As illustrated in Fig. 1, the scroll casing 4 houses the fan 2 in its inside. The scroll casing 4 rectifies the flow of air blown out of the fan 2. The scroll casing 4 is made of a resin, but the material for the scroll casing 4 is not limited to such a resin. The scroll casing 4 has a scroll part 41 and a discharge part 42.

(Scroll Part 41)

[0021] The scroll part 41 defines an air passage in which the dynamic pressure of airflow generated by the fan 2 is converted into a static pressure. The scroll part 41 has side walls 4a, which surround the fan 2 in the axial direction of the rotation axis RS of the axial portion 2b included in the fan 2, and a circumferential wall 4c, which surrounds the fan 2 in radial directions from the rotation axis RS. The side walls 4a have the respective suction ports 5 through which air is let in.

[0022] In addition, the scroll part 41 has a tongue portion 43, which has a curved surface between the discharge part 42 and an inner end portion 41a of the circumferential wall 4c and which is a restriction portion required for blowing out, in a centrifugal direction, the air that has flowed in through the suction ports 5 and increasing the air pressure. A radial direction from the rotation axis RS means a direction perpendicular to the rotation axis RS. The internal space of the scroll part 41 defined by the circumferential wall 4c and the side walls 4a is a space in which the air that has blown out of the fan 2 flows along the circumferential wall 4c.

(Side Walls 4a)

[0023] The side wall 4a is located at each side of the fan 2 in the axial direction of the rotation axis RS of the fan 2. As illustrated in Figs. 1 and 3, the side walls 4a of the scroll casing 4 have the respective suction ports 5 for letting air in in such a manner that air is allowed to flow between the fan 2 and the outside of the scroll casing 4.

[0024] The suction ports 5 each have a circular shape. The fan 2 is located in such a manner that the center of each of the suction ports 5 substantially coincides with the center of the axial portion 2b of the fan 2. The shape of the suction port 5 is not limited to a circular shape and may be a different shape such as an oval shape.

[0025] The scroll casing 4 of the centrifugal air-sending device 1 is a double suction casing having the side wall 4a having the suction port 5 at each side of the main plate 2a in the axial direction of the rotation axis RS of the fan 2. In the centrifugal air-sending device 1, the scroll casing 4 has two side walls 4a, and the two side walls 4a are

located to face each other.

[0026] As illustrated in Fig. 1, the scroll casing 4 has, as the side walls 4a, a first side wall 4a1 and a second side wall 4a2. The first side wall 4a1 extends along a first end 4c11, which is one end of the circumferential wall 4c in the axial direction of the rotation axis RS. The second side wall 4a2 extends along a second end 4c12, which is the other end of the circumferential wall 4c in the axial direction of the rotation axis RS. The first side wall 4a1 has the suction port 5 facing one surface of the main plate 2a. The second side wall 4a2 has the suction port 5 facing the other surface of the main plate 2a.

[0027] As illustrated in Figs. 1 and 3, the suction ports 5 of air located in the respective side walls 4a are each formed by the bell mouth 3. The bell mouths 3 rectify the flow of gas to be sucked into the fan 2 and allow the gas to flow through into the suction ports 2e of the fan 2. The bell mouths 3 are each formed in such a manner that the opening diameter is gradually reduced from the outside toward the inside of the scroll casing 4. With the side walls 4a having this configuration, air in the vicinity of the suction ports 5 flows smoothly along the bell mouths 3 and efficiently into the fan 2 through the suction ports 5.

(Circumferential Wall 4c)

[0028] The circumferential wall 4c is a wall located between the side walls 4a facing each other and has a curved surface in a rotation direction R of the fan 2. The circumferential wall 4c guides, along the curved wall surface, airflow generated by the fan 2 to a discharge port 42a via the scroll part 41. For example, the circumferential wall 4c is located parallel to the axial direction of the rotation axis RS of the fan 2 to surround the fan 2. The circumferential wall 4c may be inclined to the axial direction of the rotation axis RS of the fan 2 and is not limited to the circumferential wall 4c located parallel to the axial direction of the rotation axis RS. The circumferential wall 4c surrounds the fan 2 in radial directions from the rotation axis RS and has an inner circumferential surface facing the blades 2d. The circumferential wall 4c faces the air discharge sides of the blades 2d of the fan 2.

[0029] As illustrated in Figs. 2 and 3, the circumferential wall 4c is located to extend from the inner end portion 41a located at the boundary between the circumferential wall 4c and the tongue portion 43 to an outer end portion 41b located at the boundary between the scroll part 41 and the discharge part 42 away from the tongue portion 43 in the rotation direction R of the fan 2. The inner end portion 41a is an end portion of the circumferential wall 4c having the curved surface, the end portion being upstream for airflow generated by rotation of the fan 2. The outer end portion 41b is an end portion of the circumferential wall 4c having the curved surface, the end portion being downstream for airflow generated by rotation of the fan 2.

[0030] The circumferential wall 4c has a volute shape in the rotation direction R. Examples of such a volute

shape include volute shapes by use of a logarithmic spiral, an Archimedean spiral, and an involute curve. The inner circumferential surface of the circumferential wall 4c is a surface smoothly curved in the circumferential direction of the fan 2 from the inner end portion 41a, which is an inner end of the volute shape, to the outer end portion 41b, which is an outer end of the volute shape. With such a configuration, the air sent out of the fan 2 flows smoothly in the internal space between the fan 2 and the circumferential wall 4c in a direction toward the discharge part 42. Thus, in the scroll casing 4, the static pressure of air increases efficiently from the tongue portion 43 toward the discharge part 42.

15 (Discharge Part 42)

[0031] The discharge part 42 forms the discharge port 42a, through which the airflow that has been generated by the fan 2 and that has passed through the scroll part 41 is discharged. The discharge part 42 is made of a hollow pipe whose section orthogonal to a direction in which air flows along the circumferential wall 4c has a rectangular shape. The sectional shape of the discharge part 42 is not limited to a rectangular shape. The discharge part 42 defines a passage for guiding, to be discharged to the outside of the scroll casing 4, the air that flows between the circumferential wall 4c and the fan 2 after being sent out of the fan 2.

[0032] As illustrated in Fig. 1, the discharge part 42 has an extended plate 42b, a diffuser plate 42c, a portion of the first side wall 4a1, and a portion of the second side wall 4a2. The extended plate 42b is a plate-like portion integrally formed with the circumferential wall 4c and that extends from the outer end portion 41b of the circumferential wall 4c. The diffuser plate 42c is a plate-like portion that is integrally formed with the tongue portion 43 of the scroll casing 4 and that is located to face the extended plate 42b. The diffuser plate 42c is formed to have a predetermined angle with the extended plate 42b in such a manner that the sectional area of the passage increases gradually in the direction in which air flows in the discharge part 42.

[0033] The extended plate 42b and the diffuser plate 42c are each formed between the first side wall 4a1 and the second side wall 4a2. In such a manner, the discharge part 42 has the passage whose section has a rectangular shape and that is defined by the extended plate 42b, the diffuser plate 42c, the first side wall 4a1, and the second side wall 4a2.

50 (Tongue Portion 43)

[0034] The scroll casing 4 has the tongue portion 43 between the diffuser plate 42c of the discharge part 42 and the inner end portion 41a of the circumferential wall 4c. The tongue portion 43 is formed with a predetermined curvature radius. The circumferential wall 4c is smoothly continuous with the diffuser plate 42c via the tongue por-

tion 43.

[0035] The tongue portion 43 inhibits air from flowing from the outer end into the inner end of the volute-shaped passage formed in the scroll casing 4. The tongue portion 43 is located in an upstream section of the air passage and has a function of separating air flowing in the rotation direction R of the fan 2 and air flowing in the discharge direction from a downstream section of the air passage toward the discharge port 42a. In addition, the static pressure of air flowing into the discharge part 42 increases during the air passing through the scroll casing 4 and becomes higher than the pressure in the scroll casing 4. Thus, the tongue portion 43 has a function of separating areas different from each other in pressure as described above.

(Specific Configuration of Scroll Casing 4)

[0036] As illustrated in Figs. 1 and 3, the scroll casing 4 has a first casing part 45, a second casing part 46, and fixing portions 20. The scroll casing 4 is allowed to be separated into the first casing part 45 and the second casing part 46. That is, the scroll casing 4 is formed by combining the first casing part 45 and the second casing part 46.

[0037] The first casing part 45 has a portion of the scroll part 41 and the discharge part 42, which forms the discharge port 42a. The first casing part 45 has a portion of the circumferential wall 4c and a portion of each of the side walls 4a. In addition, the first casing part 45 has a portion of each of the bell mouths 3.

[0038] The second casing part 46 is formed by a portion of the scroll part 41. The second casing part 46 has a portion of the circumferential wall 4c and a portion of each of the side walls 4a. In addition, the second casing part 46 has a portion of each of the bell mouths 3. The second casing part 46 is fixed to the first casing part 45 in such a manner that the second casing part 46 is capable of being detached. The fan 2 is exposed by detaching the second casing part 46 from the first casing part 45.

[0039] The bell mouths 3, each of which has an annular shape when viewed parallelly to the axial direction of the rotation axis RS, are each formed by combining the first casing part 45 and the second casing part 46. That is, when viewed parallelly to the axial direction of the rotation axis RS, the suction ports 5 of the scroll casing 4 are each formed by combining the first casing part 45 and the second casing part 46.

[0040] The scroll casing 4 contains the fan 2 and thus has boundaries 60 for convenience of assembly. The boundaries 60, at which the first casing part 45 and the second casing part 46 are fixed to each other, extend over the side walls 4a and the circumferential wall 4c of the scroll casing 4. In addition, the boundaries 60 are each located in a portion other than the discharge part 42. More specifically, the boundaries 60 are each located in an area other than an area SA located between the inner end portion 41a, which is an inner end of the scroll

casing 4, and the discharge port 42a in the direction in which air flows in the discharge part 42.

[0041] As illustrated in Fig. 3, the area SA is, for example, an area between an edge 42d and a boundary line 42e when viewed in a direction parallel to the axial direction of the rotation axis RS of the fan 2. The edge 42d is an end edge of each of the side walls 4a, and the end edges are each included in the discharge port 42a. When viewed in the direction parallel to the axial direction of the rotation axis RS of the fan 2, the boundary line 42e is a virtual line that includes the inner end portion 41a and that is parallel to the edge 42d. The parallel relationship between the boundary line 42e and the edge 42d includes a completely parallel relationship between the boundary line 42e and the edge 42d and a substantially parallel relationship between the boundary line 42e and the edge 42d.

[0042] As illustrated in Figs. 2 and 3, the boundaries 60 include a first boundary 61, which is located upstream for airflow in a direction in which air flows in the circumferential wall 4c, the direction being represented by airflow AR illustrated in Fig. 2, and a second boundary 62, which is located downstream for airflow in the direction in which air flows in the circumferential wall 4c. The first casing part 45 and the second casing part 46 of the scroll casing 4 are fixed to each other at the two boundaries 60, which are the first boundary 61 and the second boundary 62. In other words, the scroll casing 4 is separated into the two components, which are the first casing part 45 and the second casing part 46, at the two boundaries 60, which are the first boundary 61 and the second boundary 62.

[0043] The fixing portions 20 are located at the boundaries 60 of the scroll casing 4. The fixing portions 20 are used to fix the first casing part 45 and the second casing part 46 to each other. The fixing portions 20 are located in the side wall 4a of the scroll casing 4.

[0044] As illustrated in Fig. 3, the fixing portions 20 include first fixing portions 20A and second fixing portions 20B. The first fixing portions 20A are each located at the first boundary 61. The second fixing portions 20B are each located at the second boundary 62. That is, the first fixing portion 20A is located upstream, for airflow, of the second fixing portion 20B in the direction in which air flows in the circumferential wall 4c, the direction being represented by the airflow AR illustrated in Fig. 2, and the second fixing portion 20B is located downstream, for airflow, of the first fixing portion 20A in the direction in which air flows in the circumferential wall 4c.

[0045] For example, the fixing portion 20 is formed by fitting and joining a first engagement portion 21, which is located in the first casing part 45, and a second engagement portion 22, which is located in the second casing part 46, to each other. Alternatively, the fixing portion 20 may be formed by screwing together the first engagement portion 21, which is located in the first casing part 45, and the second engagement portion 22, which is located in the second casing part 46. The configuration of

the fixing portion 20 is not limited to these configurations.

[Air-conditioning Apparatus 40]

[0046] Fig. 4 is a perspective view schematically illustrating an example of the air-conditioning apparatus 40 according to Embodiment 1. Fig. 5 is a schematic diagram illustrating an example of the internal configuration of the air-conditioning apparatus 40 according to Embodiment 1. Fig. 6 is a side view schematically illustrating an example of the internal configuration of the air-conditioning apparatus 40 according to Embodiment 1. Fig. 5 does not illustrate top components such as a top portion 16a to illustrate the internal configuration of the air-conditioning apparatus 40. The air-conditioning apparatus 40 including the centrifugal air-sending devices 1 will be described by use of Figs. 4 to 6.

[0047] The air-conditioning apparatus 40 is an apparatus that is configured to condition air in an air-conditioning target space and that is configured to control the temperature and the humidity of sucked air to discharge the air into an air-conditioning target space. The air-conditioning apparatus 40 is a ceiling suspended apparatus, which is suspended from a ceiling, but is not limited to such a ceiling suspended apparatus.

[0048] The air-conditioning apparatus 40 includes the centrifugal air-sending devices 1, a driving power supply 6, which is configured to supply driving power to the fan 2 of each of the centrifugal air-sending devices 1, and a heat exchanger 10, which is located to face the discharge ports 42a of air, the discharge port 42a being formed in each of the scroll casings 4 of the centrifugal air-sending devices 1. In addition, the air-conditioning apparatus 40 includes a housing 16, which houses, in its inside, the centrifugal air-sending devices 1, the driving power supply 6, and the heat exchanger 10 and which is installed on a ceiling of an air-conditioning target space. Furthermore, the air-conditioning apparatus 40 may include a heat-insulating material 13 in a heat-exchanging chamber 26, which will be described later.

(Housing 16)

[0049] As illustrated in Fig. 4, the housing 16 has a box shape and has the top portion 16a, a bottom portion 16b, and side portions 16c to form a cuboid shape. The shape of the housing 16 is not limited to a cuboid shape and may be a different shape such as a cylindrical shape, a rectangular column shape, a circular cone shape, a shape having a plurality of corners, and a shape having a plurality of curved surfaces.

[0050] The housing 16 has, as one of the side portions 16c, an inlet wall 16c1 having a housing inlet 18. A filter for removing dust in air may be located at the housing inlet 18. In addition, the housing 16 has, as one of the side portions 16c, an outlet wall 16c2 having a housing outlet 17.

[0051] The inlet wall 16c1 and the outlet wall 16c2 of

the housing 16 form side wall surfaces located opposite to each other across the heat exchanger 10 and the centrifugal air-sending devices 1. The housing inlet 18 is only required to be located at a position perpendicular to the axial direction of the rotation axis RS of each of the centrifugal air-sending devices 1. Thus, for example, the bottom portion 16b may have the housing inlet 18.

[0052] Air that flows into an air-sending chamber 25, which will be described later, passes through the housing inlet 18 of the housing 16. An arrow IR illustrated in Fig. 6 represents air to be sucked into the housing inlet 18. Air that flows out of the heat-exchanging chamber 26, which will be described later, passes through the housing outlet 17 of the housing 16. An arrow OR illustrated in Fig. 6 represents air to be blown out of the housing outlet 17.

[0053] As illustrated in Figs. 4 and 5, the housing outlet 17 and the housing inlet 18 each have a rectangular shape. Each shape of the housing outlet 17 and the housing inlet 18 is not limited to a rectangular shape and may be a different shape such as a circular shape and an oval shape.

[0054] A partition plate 19 partitions the internal space of the housing 16 into the air-sending chamber 25, which is a space located at the suction sides of the scroll casings 4, and the heat-exchanging chamber 26, which is a space located at the discharge sides of the scroll casings 4. That is, the partition plate 19 partitions the internal space of the housing 16 into the air-sending chamber 25, in which the fans 2 are located, and the heat-exchanging chamber 26, in which the heat exchanger 10 is located. As illustrated in Fig. 5, the housing 16 houses, in its inside, the driving power supply 6, the two centrifugal air-sending devices 1, and the heat exchanger 10.

(Driving Power Supply 6)

[0055] The driving power supply 6 is, for example, a motor. The driving power supply 6 is supported by a motor support 9a, which is fixed to the top portion 16a of the housing 16. The driving power supply 6 has an output shaft 6a. The output shaft 6a is located to extend parallel to the inlet wall 16c1 having the housing inlet 18 and the outlet wall 16c2 having the housing outlet 17.

(Centrifugal Air-sending Devices 1)

[0056] The centrifugal air-sending devices 1 each have the fan 2 and the scroll casing 4 having the bell mouths 3. As illustrated in Figs. 5 and 6, the discharge part 42 of the scroll casing 4 of the centrifugal air-sending device 1 is fixed to the partition plate 19.

[0057] As illustrated in Fig. 5, the fan 2 of each of the two centrifugal air-sending devices 1 of the air-conditioning apparatus 40 is attached to the output shaft 6a. The centrifugal air-sending device 1 having the fan 2 forms airflow to be sucked into the housing 16 from the housing inlet 18 and blown out into an air-conditioning target

space from the housing outlet 17. The number of the centrifugal air-sending devices 1 to be located in the housing 16 is not limited to two and may be one or three or more.

[0058] As illustrated in Fig. 6, the second casing part 46 of the scroll casing 4 has a portion of the circumferential wall 4c facing the housing inlet 18. Other components are not located between the housing inlet 18 and the portion of the circumferential wall 4c facing the housing inlet 18. Thus, the portion of the circumferential wall 4c and the housing inlet 18 directly face each other.

[0059] Here, as illustrated in Fig. 6, when viewed in the axial direction of the rotation axis RS of the fan 2, virtual lines that connect opposite ends 18a and 18b of the housing inlet 18 and the rotation axis RS are defined as first virtual lines CL. When viewed in the axial direction of the rotation axis RS, the end 18a is a top end of the housing inlet 18, and the end 18b is a bottom end of the housing inlet 18.

[0060] Then, as illustrated in Fig. 6, when viewed in the axial direction of the rotation axis RS of the fan 2, a substantially triangular area defined by the first virtual lines CL and a line that represents the housing inlet 18 is defined as an area SB. As illustrated in Fig. 6, the fixing portions 20 of the centrifugal air-sending device 1 are each located, when viewed in the axial direction of the rotation axis RS of the fan 2, in an area other than the area SB defined by the first virtual lines CL and the line that represents the housing inlet 18.

[0061] The first fixing portion 20A is located opposite to the second fixing portion 20B across the rotation axis RS. The second fixing portion 20B is located opposite to the first fixing portion 20A across the rotation axis RS. The positional relationship between the first fixing portion 20A and the second fixing portion 20B is not limited to this relationship.

[0062] Similarly, the first boundary 61 is located opposite to the second boundary 62 across the rotation axis RS. The second boundary 62 is located opposite to the first boundary 61 across the rotation axis RS. The positional relationship between the first boundary 61 and the second boundary 62 is not limited to this relationship.

(Heat Exchanger 10)

[0063] As described above, the heat exchanger 10 is located to face the discharge port 42a of the centrifugal air-sending device 1. The heat exchanger 10 is located in an air passage in the housing 16 for air discharged by the centrifugal air-sending device 1. The heat exchanger 10 adjusts the temperature of air sucked into the housing 16 through the housing inlet 18 and to be blown out into an air-conditioning target space through the housing outlet 17. A heat exchanger having a known structure is applicable to the heat exchanger 10.

[0064] The air-conditioning apparatus 40 is configured in such a manner that the housing inlet 18, the scroll casings 4 of the centrifugal air-sending devices 1, the

heat exchanger 10, and the housing outlet 17 are arranged in the named order in a direction from the housing inlet 18 toward the housing outlet 17 of the air-conditioning apparatus 40. In the case of such a ceiling suspended air-conditioning apparatus 40, these components are arranged in a horizontal direction.

[0065] Fig. 7 is a side view schematically illustrating the internal configuration of a modification example of the air-conditioning apparatus 40 according to Embodiment 1. As described above, for example, as illustrated in Fig. 3, the area SA is described as an area between the edge 42d and the boundary line 42e when viewed in the direction parallel to the axial direction of the rotation axis RS of the fan 2. However, the area SA is not limited to this area. For example, as illustrated in Fig. 7, a vertical virtual line that passes through the inner end portion 41a of the scroll casing 4 and that connects the top portion 16a, which forms the top surface of the housing 16, and the bottom portion 16b, which forms the bottom surface of the housing 16, is defined as a virtual line FL.

[0066] In this case, the area SA may be an area of the scroll casing 4 defined by the virtual line FL and a line that represents the discharge port 42a.

[Operation Example of Air-conditioning Apparatus 40]

[0067] When the fans 2 are rotated by driving the driving power supply 6, air in an air-conditioning target space is sucked into the housing 16 through the housing inlet 18. The air sucked into the housing 16 flows along the bell mouths 3 and is sucked into the fans 2. The air sucked into the fans 2 is blown out in radial directions of the fans 2.

[0068] The pressure of the air blown out of the fans 2 increases while the air passes through the scroll casings 4. The air whose pressure is increased is blown out through the discharge ports 42a of the scroll casings 4 and is then supplied to the heat exchanger 10. The air supplied to the heat exchanger 10 is subjected to heat exchange with a heat exchange medium such as refrigerant flowing in the heat exchanger 10 while the air passes through the heat exchanger 10, and the temperature and the humidity of the air are adjusted. The air that has passed through the heat exchanger 10 is blown out into the air-conditioning target space through the housing outlet 17.

[Operation and Effect of Air-conditioning Apparatus 40]

[0069] The centrifugal air-sending device 1 has the fixing portions 20, at which the first casing part 45 and the second casing part 46 are fixed to each other. The fixing portions 20 are located in the side wall 4a. The fixing portions 20 are each located, when viewed in the axial direction of the rotation axis RS of the fan 2, in an area other than the area SB defined by the first virtual lines CL and the line that represents the housing inlet 18, the first virtual lines CL being the virtual lines that connect the opposite ends of the housing inlet 18 and the rotation

axis RS. The fixing portions 20 are located away from the housing inlet 18 of the air-conditioning apparatus 40, and the air-conditioning apparatus 40 is thus capable of inhibiting interference between the fixing portions 20 and high-velocity air flowing in through the housing inlet 18. As a result, the air-conditioning apparatus 40 inhibits separation of air flowing in the bell mouths 3 and is thus capable of inhibiting a reduction in the amount of gas flowing into the scroll casing 4.

[0070] Fig. 8 is a schematic diagram of a centrifugal air-sending device 1L according to a comparative example when the centrifugal air-sending device 1L is viewed in the axial direction of the rotation axis RS. Fig. 9 is a schematic diagram of the separated centrifugal air-sending device 1L according to the comparative example. Fig. 10 is a schematic diagram illustrating an example of the internal configuration of an air-conditioning apparatus 40L according to the comparative example. The centrifugal air-sending device 1L and the air-conditioning apparatus 40L according to the comparative example will be described by use of Figs. 8 to 10.

[0071] As illustrated in Fig. 10, the air-conditioning apparatus 40L according to the comparative example includes the centrifugal air-sending devices 1L. As illustrated in Figs. 8 and 9, a scroll casing 4L of each of the centrifugal air-sending devices 1L is separated into two parts, which are a lower casing part 47L and an upper casing part 48L, to contain the fan 2. The scroll casing 4L separated into the two parts, which are the lower casing part 47L and the upper casing part 48L, has a boundary 60L, which is located in a discharge part 42L forming the discharge port 42a of the scroll casing 4L and at which the two parts are fixed to each other. In addition, the scroll casing 4L has another boundary 60L, which is located opposite to a boundary 60 of the discharge part 42L across the suction port 5 of the scroll casing 4L.

[0072] To fix the two separated parts, which are the lower casing part 47L and the upper casing part 48L, to each other, the centrifugal air-sending device 1L according to the comparative example has a fixing portion 20L located at a position in a side wall surface of the scroll casing 4L in the vicinity of each boundary 60L.

[0073] Typically, when air that has flowed in through an inlet of an air-conditioning apparatus flows into a fan along a bell mouth of a scroll casing, the airflow varies in velocity with positions in the circumferential direction of the rotation axis of the fan, and the air velocity increases at the inlet of the air-conditioning apparatus. Thus, as illustrated in the area defined by a broken line BD illustrated in Fig. 10, in the air-conditioning apparatus 40L according to the comparative example, airflow AR and the fixing portion 20L located and facing the housing inlet 18 of the air-conditioning apparatus 40L may interfere with each other. Such interference between the airflow AR and the fixing portion 20L located and facing the housing inlet 18 of the air-conditioning apparatus 40L may cause separation of air flowing in a bell mouth and thus may reduce the amount of gas flowing into the scroll cas-

ing 4L.

[0074] On the other hand, the air-conditioning apparatus 40 according to Embodiment 1 has the configuration described above in which the fixing portions 20 are located away from the housing inlet 18 of the air-conditioning apparatus 40 and is thus capable of inhibiting interference between the fixing portions 20 and high-velocity air flowing in through the housing inlet 18. As a result, the air-conditioning apparatus 40 inhibits separation of air flowing in the bell mouths 3 and is thus capable of inhibiting a reduction in the amount of gas flowing into the scroll casings 4.

[0075] In addition, interference between the airflow AR and the fixing portion 20L located and facing the housing inlet 18 of the air-conditioning apparatus 40L according to the comparative example may cause noise and thus may increase noise emitted from the air-conditioning apparatus 40L.

[0076] On the other hand, the air-conditioning apparatus 40 according to Embodiment 1 has the configuration described above in which the fixing portions 20 are located away from the housing inlet 18 of the air-conditioning apparatus 40 and is thus capable of inhibiting interference between the fixing portions 20 and high-velocity air flowing in through the housing inlet 18. As a result, the air-conditioning apparatus 40 is capable of inhibiting generation of noise caused by interference between the fixing portions 20 and high-velocity air flowing in through the housing inlet 18 and is thus capable of reducing noise emitted from the air-conditioning apparatus 40 compared with the air-conditioning apparatus 40L according to the comparative example.

[0077] Furthermore, typically, the pressure of air flowing in a scroll casing increases while the air moves toward a discharge port of the scroll casing. In the air-conditioning apparatus 40L according to the comparative example, the boundary 60L is located in the discharge part 42L forming the discharge port 42a of the scroll casing 4L. Thus, high-pressure air whose pressure is increased is prone to leak through the boundary 60L of the discharge part 42L.

[0078] On the other hand, in the air-conditioning apparatus 40 according to Embodiment 1, the boundaries 60 are each located in a portion other than the discharge part 42. Since the boundaries 60 are not located in the discharge part 42, through which high-pressure air passes, the air-conditioning apparatus 40 according to Embodiment 1 is capable of inhibiting air leakage through the boundaries 60 compared with the air-conditioning apparatus 40L according to the comparative example.

[0079] Furthermore, in the air-conditioning apparatus 40 according to Embodiment 1, the boundaries 60 are each located in an area other than the area SA located between the inner end portion 41a, which is the inner end of the scroll casing 4, and the discharge port 42a in the direction in which air flows in the discharge part 42. That is, the boundaries 60 of the air-conditioning apparatus 40 according to Embodiment 1 are not located in the dis-

charge part 42. Since the boundaries 60 are not located in the discharge part 42, through which high-pressure air passes, the air-conditioning apparatus 40 according to Embodiment 1 is capable of inhibiting air leakage through the boundaries 60 compared with the air-conditioning apparatus 40L according to the comparative example.

[0080] Furthermore, the inlet wall 16c1 having the housing inlet 18 and the outlet wall 16c2 having the housing outlet 17 of the air-conditioning apparatus 40 form the side wall surfaces located opposite to each other across the heat exchanger 10 and the centrifugal air-sending devices 1. Thus, the air-conditioning apparatus 40 is allowed to be configured in such a manner that the inlet wall 16c1, the centrifugal air-sending devices 1, the heat exchanger 10, and the outlet wall 16c2 are arranged in the horizontal direction. It is thus possible to make, with a simple form, the air passage from the housing inlet 18 to the housing outlet 17. Furthermore, since these components are allowed to be arranged in the horizontal direction, the air-conditioning apparatus 40 is usable as, for example, a ceiling suspended air-conditioning apparatus.

Embodiment 2

[Air-conditioning Apparatus 40A]

[0081] Fig. 11 is a side view schematically illustrating an example of the internal configuration of an air-conditioning apparatus 40A according to Embodiment 2. Parts having the same configurations as those of the air-conditioning apparatus 40 illustrated in Figs. 1 to 10 have the same reference signs, and their descriptions are omitted. The positions of the boundaries 60 and the fixing portions 20 of a centrifugal air-sending device 1A housed in the air-conditioning apparatus 40A according to Embodiment 2 are further specified. Thus, the configurations in which the boundaries 60 and the fixing portions 20 of the centrifugal air-sending device 1A are located will be mainly described below by use of Fig. 11. The configurations of the air-conditioning apparatus 40A and the centrifugal air-sending device 1A according to Embodiment 2 are the same as the respective configurations of the air-conditioning apparatus 40 and the centrifugal air-sending device 1 according to Embodiment 1 unless otherwise described.

[0082] The boundaries 60 of the centrifugal air-sending device 1A include the first boundary 61, which is located upstream in the direction in which air flows in the circumferential wall 4c, and the second boundary 62, which is located downstream in the direction in which air flows in the circumferential wall 4c. Between the housing inlet 18 and the housing outlet 17 of the air-conditioning apparatus 40A, one of the first boundary 61 and the second boundary 62 is located closer to the housing outlet 17 than is the other of the first boundary 61 and the second boundary 62. That is, unlike Embodiment 1, the first boundary 61 and the second boundary 62 of the centrifugal air-sending device 1A are not located in line with each other but are located to be shifted from each other in a left-right direction.

ugal air-sending device 1A are not located in line with each other but are located to be shifted from each other in a left-right direction.

[0083] The fixing portions 20 are located at the boundaries 60 of the air-conditioning apparatus 40A. Thus, between the housing inlet 18 and the housing outlet 17 of the air-conditioning apparatus 40A, one of the first fixing portion 20A and the second fixing portion 20B is located closer to the housing outlet 17 than is the other of the first fixing portion 20A and the second fixing portion 20B. That is, the first fixing portion 20A and the second fixing portion 20B of the centrifugal air-sending device 1A are located to be shifted from each other in the left-right direction.

[0084] Here, when viewed in the axial direction of the rotation axis RS of the fan 2, a portion of the first boundary 61 located at the inner edge of the suction port 5 is defined as a first inner edge 5a, and a portion of the second boundary 62 located at the inner edge of the suction port 5 is defined as a second inner edge 5b. In the scroll casing 4, when viewed in the axial direction of the rotation axis RS of the fan 2, a second virtual line TL, which is a virtual line that connects the first inner edge 5a and the second inner edge 5b, may be located closer to the housing outlet 17 than is the rotation axis RS.

[Operation and Effect of Air-conditioning Apparatus 40A]

[0085] The air-conditioning apparatus 40A is the same, as the air-conditioning apparatus 40 in Embodiment 1, in the positions at which the boundaries 60 are located and the positions at which the fixing portions 20 are located and thus achieves effects similar to those of the air-conditioning apparatus 40.

[0086] Between the housing inlet 18 and the housing outlet 17 of the air-conditioning apparatus 40A, one of the first boundary 61 and the second boundary 62 is located closer to the housing outlet 17 than is the other of the first boundary 61 and the second boundary 62. When the air-conditioning apparatus 40A has this configuration, one of the first fixing portion 20A and the second fixing portion 20B is located away from the housing inlet 18.

[0087] Thus, in the air-conditioning apparatus 40A, the velocity of airflow that interferes with the fixing portions 20 located away from the housing inlet 18 is low. When the velocity of airflow that interferes with the fixing portions 20 is low, separation of air flowing in the bell mouths 3 is inhibited. Thus, the air-conditioning apparatus 40A is capable of inhibiting a reduction in the amount of gas flowing into the scroll casing 4. In addition, when the velocity of airflow that interferes with the fixing portions 20 is low, the air-conditioning apparatus 40A is capable of inhibiting generation of noise caused by interference between the airflow and the fixing portions 20 and is thus capable of reducing noise emitted from the air-conditioning apparatus 40A compared with the air-conditioning apparatus 40L.

[0088] The centrifugal air-sending device 1A is formed

in consideration of the balance between the surface area of the first casing part 45 and the surface area of the second casing part 46. When the air-conditioning apparatus 40A has the configuration described above, it is possible to maintain a sufficient distance between the housing inlet 18 and each fixing portion 20 while balancing the surface area of the first casing part 45 and the surface area of the second casing part 46 with each other.

[0089] In addition, in the scroll casing 4, the second virtual line TL may be located closer to the housing outlet 17 than is the rotation axis RS. When the air-conditioning apparatus 40L has this configuration, both the first fixing portion 20A and the second fixing portion 20B are located further away from the housing inlet 18 than is the first fixing portion 20A and the second fixing portion 20B located opposite to each other across the rotation axis RS.

[0090] Thus, in the air-conditioning apparatus 40A, the velocity of airflow that interferes with the fixing portions 20 is low. When the velocity of airflow that interferes with the fixing portions 20 is low, separation of air flowing in the bell mouths 3 is inhibited. Thus, the air-conditioning apparatus 40A is capable of inhibiting a reduction in the amount of gas flowing into the scroll casing 4. In addition, when the velocity of airflow that interferes with the fixing portions 20 is low, the air-conditioning apparatus 40A is capable of inhibiting generation of noise caused by interference between the airflow and the fixing portions 20 and is thus capable of reducing noise emitted from the air-conditioning apparatus 40A compared with the air-conditioning apparatus 40L.

Embodiment 3

[Air-conditioning Apparatus 40B]

[0091] Fig. 12 is a side view schematically illustrating an example of the internal configuration of an air-conditioning apparatus 40B according to Embodiment 3. Parts having the same configurations as those of the air-conditioning apparatus 40 and other apparatuses illustrated in Figs. 1 to 11 have the same reference signs, and their descriptions are omitted. The configuration of the boundaries 60 of a centrifugal air-sending device 1B housed in the air-conditioning apparatus 40B according to Embodiment 3 is further specified. Thus, the configuration of the boundaries 60 of the centrifugal air-sending device 1B will be mainly described below by use of Fig. 12. The configurations of the air-conditioning apparatus 40B and the centrifugal air-sending device 1B according to Embodiment 3 are the same as the respective configurations of the air-conditioning apparatus 40 and the centrifugal air-sending device 1 according to Embodiment 1 unless otherwise described.

[0092] The centrifugal air-sending device 1B has a scroll casing 4B. The circumferential wall 4c of the scroll casing 4B has flat portions 65, each of which is a portion of the wall formed in a flat shape. The flat portion 65 is formed in a flat shape and located in a portion of the

circumferential wall 4c formed in a volute shape. When viewed in the axial direction of the rotation axis RS of the fan 2, the flat portion 65 is formed in a linear shape.

[0093] The scroll casing 4B is formed in such a manner that the boundary 60 separates the flat portion 65. That is, the flat portion 65 is located at the boundary 60. When viewed in the axial direction of the rotation axis RS of the fan 2, the flat portion 65 located at the first boundary 61 and the flat portion 65 located at the second boundary 62 may be located parallel to each other. However, the configuration of the scroll casing 4 is not limited to such a configuration in which the flat portion 65 located at the first boundary 61 and the flat portion 65 located at the second boundary 62 are located parallel to each other.

[Operation and Effect of Air-conditioning Apparatus 40B]

[0094] The air-conditioning apparatus 40B is the same, as the air-conditioning apparatus 40 in Embodiment 1, in the positions at which the boundaries 60 are located and the positions at which the fixing portions 20 are located and thus achieves effects similar to those of the air-conditioning apparatus 40.

[0095] In addition, the scroll casing 4B is formed in such a manner that the boundary 60 separates the flat portion 65. When the first casing part 45 and the second casing part 46 are each made of a resin, the boundary 60 provided with the flat portion 65 facilitates removal of the first casing part 45 and the second casing part 46 from a mold and thus facilitates production of the air-conditioning apparatus 40B.

[0096] Furthermore, when viewed in the axial direction of the rotation axis RS of the fan 2, the flat portion 65 located at the first boundary 61 and the flat portion 65 located at the second boundary 62 are located parallel to each other. When the first casing part 45 and the second casing part 46 are each made of a resin and the flat portion 65 located at the first boundary 61 and the flat portion 65 located at the second boundary 62 are located parallel to each other, removal of the first casing part 45 and the second casing part 46 from a mold is further facilitated and production of the air-conditioning apparatus 40B is thus facilitated.

Embodiment 4

[Air-conditioning Apparatus 40C]

[0097] Fig. 13 is a side view schematically illustrating an example of the internal configuration of an air-conditioning apparatus 40C according to Embodiment 4. Parts having the same configurations as those of the air-conditioning apparatus 40 and other apparatuses illustrated in Figs. 1 to 12 have the same reference signs, and their descriptions are omitted. The positions of the boundaries 60 and the fixing portions 20 of a centrifugal air-sending device 1C housed in the air-conditioning apparatus 40C according to Embodiment 4 are further specified. Thus,

the configurations in which the boundaries 60 and the fixing portions 20 of the centrifugal air-sending device 1C are located will be mainly described below by use of Fig. 13. The configurations of the air-conditioning apparatus 40C and the centrifugal air-sending device 1C according to Embodiment 4 are the same as the respective configurations of the air-conditioning apparatus 40 and the centrifugal air-sending device 1 according to Embodiment 1 unless otherwise described.

[0098] As illustrated in Fig. 13, when viewed in the axial direction of the rotation axis RS of the fan 2, the substantially triangular area defined by the first virtual lines CL and the line that represents the housing inlet 18 is defined as the area SB. As illustrated in Fig. 13, the fixing portions 20 of the centrifugal air-sending device 1C are each located, when viewed in the axial direction of the rotation axis RS of the fan 2, in an area other than the area SB defined by the first virtual lines CL and the line that represents the housing inlet 18.

[0099] In addition, as illustrated in Fig. 13, when viewed in the axial direction of the rotation axis RS of the fan 2, a virtual line that connects the inner end portion 41a and the rotation axis RS is defined as a first reference line SL1, and the position that is located on the first reference line SL1 and that is located at the middle between the inner end portion 41a and the rotation axis RS is defined as a middle position M1. In addition, a virtual line that includes the middle position M1 and that extends in an up-down direction is defined as a second reference line SL2. The second reference line SL2 is, for example, a line in a weight direction.

[0100] The fixing portions 20 are located in a portion of the side wall 4a located between the second reference line SL2 and the line that represents the housing inlet 18. Thus, as illustrated in Fig. 13, the fixing portions 20 are each located in an area SC of the side wall 4a, the area SC being located between the area SB and the second reference line SL2.

[Operation and Effect of Air-conditioning Apparatus 40C]

[0101] The air-conditioning apparatus 40C is the same, as the air-conditioning apparatus 40 in Embodiment 1, in the positions at which the boundaries 60 are located and the positions at which the fixing portions 20 are located and thus achieves effects similar to those of the air-conditioning apparatus 40.

[0102] In addition, the fixing portions 20 are located in the portion of the side wall 4a located between the second reference line SL2 and the line that represents the housing inlet 18. The fixing portions 20 are located away from the housing inlet 18 of the air-conditioning apparatus 40C, and the air-conditioning apparatus 40C is thus capable of inhibiting interference between the fixing portions 20 and high-velocity air flowing in through the housing inlet 18. As a result, the air-conditioning apparatus 40C inhibits separation of air flowing in the bell mouths 3 and is thus capable of inhibiting a reduction in the

amount of gas flowing into the scroll casing 4.

[0103] Furthermore, since the fixing portions 20 are located in the portion of the side wall 4a located between the second reference line SL2 and the line that represents the housing inlet 18, it is possible to balance the surface area of the first casing part 45 and the surface area of the second casing part 46 of the centrifugal air-sending device 1C with each other.

Embodiment 5

[Air-conditioning Apparatus 40D]

[0104] Fig. 14 is a side view schematically illustrating an example of the internal configuration of an air-conditioning apparatus 40D according to Embodiment 5. Parts having the same configurations as those of the air-conditioning apparatus 40 and other apparatuses illustrated in Figs. 1 to 13 have the same reference signs, and their descriptions are omitted. The air-conditioning apparatus 40D according to Embodiment 5 differs from the air-conditioning apparatus 40 according to Embodiment 1 in the position at which the housing inlet 18 is located in a housing 16D. The relationship between the housing 16D and the centrifugal air-sending device 1 will be mainly described below by use of Fig. 14. The configuration of the air-conditioning apparatus 40D according to Embodiment 5 is the same as the configuration of the air-conditioning apparatus 40 according to Embodiment 1 unless otherwise described.

[0105] The housing 16D has an inlet wall 16b1 having the housing inlet 18 and the outlet wall 16c2 having the housing outlet 17. The inlet wall 16b1 forms a portion of a bottom wall of the housing 16D. The inlet wall 16b1 is a portion of the bottom portion 16b. The outlet wall 16c2 forms a side wall of the housing 16D.

[0106] As illustrated in Fig. 14, the second casing part 46 of the scroll casing 4 has a portion of the circumferential wall 4c facing the housing inlet 18. Other components are not located between the housing inlet 18 and the portion of the circumferential wall 4c facing the housing inlet 18. Thus, the portion of the circumferential wall 4c and the housing inlet 18 directly face each other.

[0107] Here, as illustrated in Fig. 14, when viewed in the axial direction of the rotation axis RS of the fan 2, virtual lines that connect opposite ends 18d and 18e of the housing inlet 18 and the rotation axis RS are defined as first virtual lines CL. When viewed in the axial direction of the rotation axis RS, the end 18d is an end closer to the housing outlet 17 or an end closer to the front of the housing 16D than is the end 18e, which is an end closer to the rear of the housing 16D than is the end 18d. Here, the side of the housing 16D having the housing outlet 17 is the front of the housing 16D, and the side of the housing 16D opposite to the housing outlet 17 is the rear of the housing 16D.

[0108] Then, as illustrated in Fig. 14, when viewed in the axial direction of the rotation axis RS of the fan 2, a

substantially triangular area defined by the first virtual lines CL and a line that represents the housing inlet 18 is defined as an area SB. As illustrated in Fig. 14, the fixing portions 20 of the centrifugal air-sending device 1 are each located, when viewed in the axial direction of the rotation axis RS of the fan 2, in an area other than the area SB defined by the first virtual lines CL and the line that represents the housing inlet 18.

[Operation and Effect of Air-conditioning Apparatus 40D]

[0109] The air-conditioning apparatus 40D is the same, as the air-conditioning apparatus 40 in Embodiment 1, in the positions at which the boundaries 60 are located and the positions at which the fixing portions 20 are located and thus achieves effects similar to those of the air-conditioning apparatus 40.

[0110] In addition, the inlet wall 16b1 having the housing inlet 18 forms a portion of the bottom wall of the housing 16D, and the outlet wall 16c2 having the housing outlet 17 forms the side wall of the housing 16D. Thus, the air-conditioning apparatus 40D is capable of sucking air through the bottom and discharging conditioned air side-ward.

Embodiment 6

[Air-conditioning Apparatus 40E]

[0111] Fig. 15 is a side view schematically illustrating an example of the internal configuration of an air-conditioning apparatus 40E according to Embodiment 6. Parts having the same configurations as those of the air-conditioning apparatus 40 and other apparatuses illustrated in Figs. 1 to 14 have the same reference signs, and their descriptions are omitted. The air-conditioning apparatus 40E according to Embodiment 6 differs from the air-conditioning apparatus 40 according to Embodiment 1 in the position at which the housing inlet 18 is located in a housing 16E. The relationship between the housing 16E and the centrifugal air-sending device 1 will be mainly described below by use of Fig. 15. The configuration of the air-conditioning apparatus 40E according to Embodiment 6 is the same as the configuration of the air-conditioning apparatus 40 according to Embodiment 1 unless otherwise described.

[0112] The housing 16E has the inlet wall 16b1 having the housing inlet 18 and the outlet wall 16c2 having the housing outlet 17. The inlet wall 16b1 forms a portion of a bottom wall of the housing 16E. The inlet wall 16b1 is a portion of the bottom portion 16b. The outlet wall 16c2 forms a side wall of the housing 16E.

[0113] In addition, the housing 16E has, as one of the side portions 16c, the inlet wall 16c1 having the housing inlet 18. The inlet wall 16c1 and the outlet wall 16c2 of the housing 16E form side wall surfaces located opposite to each other across the heat exchanger 10 and the centrifugal air-sending devices 1. The housing 16E has two

air inlets, which are the housing inlet 18 formed in the inlet wall 16b1 and the housing inlet 18 formed in the inlet wall 16c1.

[0114] As illustrated in Fig. 15, the second casing part 46 of the scroll casing 4 has a portion of the circumferential wall 4c facing the two air inlets, which are the housing inlet 18 formed in the inlet wall 16b1 and the housing inlet 18 formed in the inlet wall 16c1. Other components are not located between the housing inlets 18 and the portion of the circumferential wall 4c facing the housing inlets 18. Thus, the portion of the circumferential wall 4c and the housing inlets 18 directly face each other.

[0115] Here, as illustrated in Fig. 15, when viewed in the axial direction of the rotation axis RS of the fan 2, the shortest virtual line that connects a surface that represents the housing inlet 18 of the inlet wall 16c1 and the rotation axis RS is defined as a lateral line EL1. The lateral line EL1 is a line perpendicular to the surface that represents the housing inlet 18 of the inlet wall 16c1.

[0116] In addition, when viewed in the axial direction of the rotation axis RS of the fan 2, the shortest virtual line that connects a surface that represents the housing inlet 18 of the inlet wall 16b1 and the rotation axis RS is defined as a longitudinal line EL2. The longitudinal line EL2 is a line perpendicular to the surface that represents the housing inlet 18 of the inlet wall 16b1.

[0117] Then, when viewed in the axial direction of the rotation axis RS of the fan 2, an area defined by a line that represents the housing inlet 18 of the inlet wall 16c1, the lateral line EL1, a line that represents the housing inlet 18 of the inlet wall 16b1, and the longitudinal line EL2 is defined as an area SE.

[0118] In the air-conditioning apparatus 40E, the area SE does not include the fixing portions 20 and the boundaries 60.

[Operation and Effect of Air-conditioning Apparatus 40E]

[0119] The area SE is an area that is close to two air inlets, which are the housing inlet 18 formed in the inlet wall 16b1 and the inlet wall 16c1, and into which the amount of sucked air is relatively large. In the air-conditioning apparatus 40E, the area SE does not include the fixing portions 20 and the boundaries 60. When the air-conditioning apparatus 40E has this configuration, the fixing portions 20 are not located in such an area into which the amount of sucked air is relatively large.

[0120] Thus, the air-conditioning apparatus 40E is capable of reducing the amount of airflow that interferes with the fixing portions 20. When the amount of airflow that interferes with the fixing portions 20 is reduced, separation of air flowing in the bell mouths 3 is inhibited. Thus, the air-conditioning apparatus 40E is capable of inhibiting a reduction in the amount of gas flowing into the scroll casing 4. In addition, when the amount of airflow that interferes with the fixing portions 20 is reduced, the air-conditioning apparatus 40E is capable of inhibiting generation of noise caused by interference between the

airflow and the fixing portions 20 and is thus capable of reducing noise emitted from the air-conditioning apparatus 40E compared with the air-conditioning apparatus 40L.

[0121] In addition, in the air-conditioning apparatus 40E, the area SE does not include the fixing portions 20 and the boundaries 60. In the air-conditioning apparatus 40E, the velocity of airflow that interferes with the fixing portions 20 located away from the two air inlets, which are the housing inlet 18 formed in the inlet wall 16b1 and the inlet wall 16c1, is low. When the velocity of airflow that interferes with the fixing portions 20 is low, separation of air flowing in the bell mouths 3 is inhibited. Thus, the air-conditioning apparatus 40E is capable of inhibiting a reduction in the amount of gas flowing into the scroll casing 4. In addition, when the velocity of airflow that interferes with the fixing portions 20 is low, the air-conditioning apparatus 40E is capable of inhibiting generation of noise caused by interference between the airflow and the fixing portions 20 and is thus capable of reducing noise emitted from the air-conditioning apparatus 40E compared with the air-conditioning apparatus 40L.

[0122] In each of Embodiments 1 to 6 described above, an example is described in which the double suction centrifugal air-sending device 1 having the double suction fan 2, in which the blades 2d are located on both sides of a main plate 11. However, Embodiments 1 to 6 are also applicable to a single suction centrifugal air-sending device 1 having a single suction fan 2, in which the blades 2d are located on only one side of the main plate 11.

[0123] Embodiments 1 to 6 described above may be combined with each other. The configurations in the embodiments above are examples. Thus, the configurations are allowed to be combined with other known techniques, and some of the configurations are allowed to be omitted or modified without departing from the gist.

Reference Signs List

[0124] 1: centrifugal air-sending device, 1A: centrifugal air-sending device, 1B: centrifugal air-sending device, 1C: centrifugal air-sending device, 1L: centrifugal air-sending device, 2: fan, 2a: main plate, 2a1: peripheral portion, 2b: axial portion, 2d: blade, 2e: suction port, 3: bell mouth, 4: scroll casing, 4B: scroll casing, 4L: scroll casing, 4a: side wall, 4a1: first side wall, 4a2: second side wall, 4c: circumferential wall, 4c11: first end, 4c12: second end, 5: suction port, 5a: first inner edge, 5b: second inner edge, 6: driving power supply, 6a: output shaft, 9a: motor support, 10: heat exchanger, 11: main plate, 13: heat-insulating material, 16: housing, 16D: housing, 16E: housing, 16a: top portion, 16b: bottom portion, 16b1: inlet wall, 16c: side portion, 16c1: inlet wall, 16c2: outlet wall, 17: housing outlet, 18: housing inlet, 18a: end, 18b: end, 18d: end, 18e: end, 19: partition plate, 20: fixing portion, 20A: first fixing portion, 20B: second fixing portion, 20L: fixing portion, 21: first engagement portion, 22: second engagement portion, 25: air-sending chamber,

26: heat-exchanging chamber, 40: air-conditioning apparatus, 40A: air-conditioning apparatus, 40B: air-conditioning apparatus, 40C: air-conditioning apparatus, 40D: air-conditioning apparatus, 40E: air-conditioning apparatus, 40L: air-conditioning apparatus, 41: scroll part, 41a: inner end portion, 41b: outer end portion, 42: discharge part, 42L: discharge part, 42a: discharge port, 42b: extended plate, 42c: diffuser plate, 42d: edge, 42e: boundary line, 43: tongue portion, 45: first casing part, 46: second casing part, 47L: lower casing part, 48L: upper casing part, 60: boundary, 60L: boundary, 61: first boundary, 62: second boundary, 65: flat portion, AR: airflow, BD: broken line, CL: first virtual line, EL1: lateral line, EL2: longitudinal line, FL: virtual line, IR: arrow, M1: middle position, OR: arrow, R: rotation direction, RS: rotation axis, SA: area, SB: area, SC: area, SE: area, SL1: first reference line, SL2: second reference line, TL: second virtual line

Claims

1. An air-conditioning apparatus, comprising:

a centrifugal air-sending device that has a fan driven to rotate and a scroll casing that houses the fan, the scroll casing having a circumferential wall and a side wall, the circumferential wall being formed in a volute shape, the side wall having a suction port of air;
a driving power supply configured to supply driving power to the fan;
a heat exchanger located to face a discharge port of air, the discharge port being formed in the scroll casing; and
a housing that houses the centrifugal air-sending device, the driving power supply, and the heat exchanger, the housing having a partition plate that partitions an interior of the housing into an air-sending chamber in which the fan is located and a heat-exchanging chamber in which the heat exchanger is located, the housing having a housing inlet through which air that flows into the air-sending chamber passes and a housing outlet through which air that flows out of the heat-exchanging chamber passes, the scroll casing having
a first casing part that has a discharge part that forms the discharge port, the discharge part being fixed to the partition plate,
a second casing part that has a portion of the circumferential wall that faces the housing inlet, the second casing part being fixed to the first casing part in such a manner that the second casing part is capable of being detached, and
a fixing portion located in the side wall and at which the first casing part and the second casing part are fixed to each other,

the first casing part and the second casing part being fixed to each other at a boundary, the boundary extending over the side wall and the circumferential wall, the boundary being located in a portion other than the discharge part, the fixing portion being located, when the fixing portion is viewed in an axial direction of a rotation axis of the fan, in an area other than an area defined by first virtual lines and a line that represents the housing inlet, the first virtual lines being virtual lines that connect opposite ends of the housing inlet and the rotation axis.

2. The air-conditioning apparatus of claim 1, wherein

the housing has an inlet wall having the housing inlet, and an outlet wall having the housing outlet, and the inlet wall and the outlet wall form side wall surfaces located opposite to each other across the heat exchanger and the centrifugal air-sending device.

3. The air-conditioning apparatus of claim 1 or 2, wherein

the boundary includes a first boundary located upstream in a direction in which air flows in the circumferential wall, and a second boundary located downstream in the direction in which air flows in the circumferential wall, and between the housing inlet and the housing outlet, one of the first boundary and the second boundary is located closer to the housing outlet than is an other of the first boundary and the second boundary.

4. The air-conditioning apparatus of claim 3, wherein in a case in which, when the scroll casing is viewed in the axial direction of the rotation axis, a portion of the first boundary located at an inner edge of the suction port is a first inner edge and a portion of the second boundary located at the inner edge of the suction port is a second inner edge, in the scroll casing, a second virtual line that is a virtual line that connects the first inner edge and the second inner edge is located closer to the discharge port than is the rotation axis.

5. The air-conditioning apparatus of any one of claims 1 to 4, wherein in a case where, when the fixing portion is viewed in the axial direction of the rotation axis, a virtual line that connects the rotation axis and an inner end portion that is an inner end of the scroll casing is a first reference line and a position located at a middle of the first reference line is a middle position, a virtual line that includes the middle position

and that extends in an up-down direction is a second reference line and the fixing portion is located in a portion of the side wall located between the line that represents the housing inlet and the second reference line.

6. The air-conditioning apparatus of claim 1, wherein

the housing has an inlet wall having the housing inlet, and an outlet wall having the housing outlet, the inlet wall forms a portion of a bottom wall of the housing, and the outlet wall forms a side wall of the housing.

7. The air-conditioning apparatus of any one of claims 1 to 5, wherein

the circumferential wall has a flat portion that is a portion of the wall formed in a flat shape, and the scroll casing is formed in such a manner that the boundary separates the flat portion.

FIG. 1

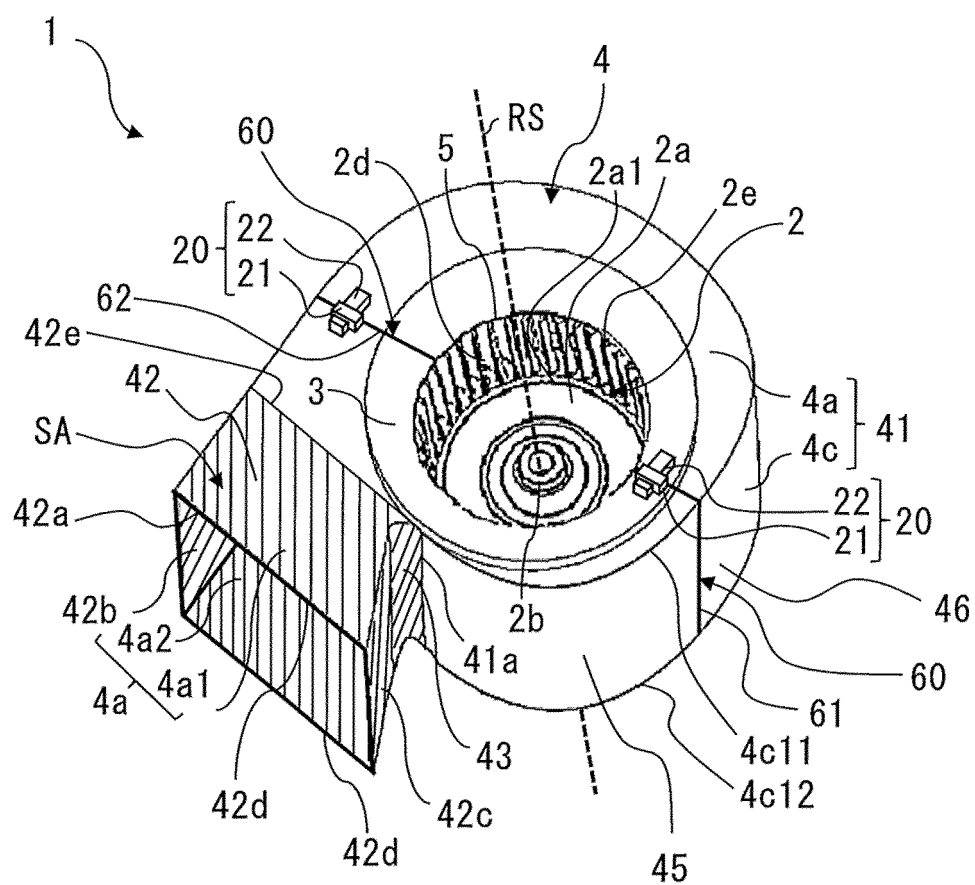


FIG. 2

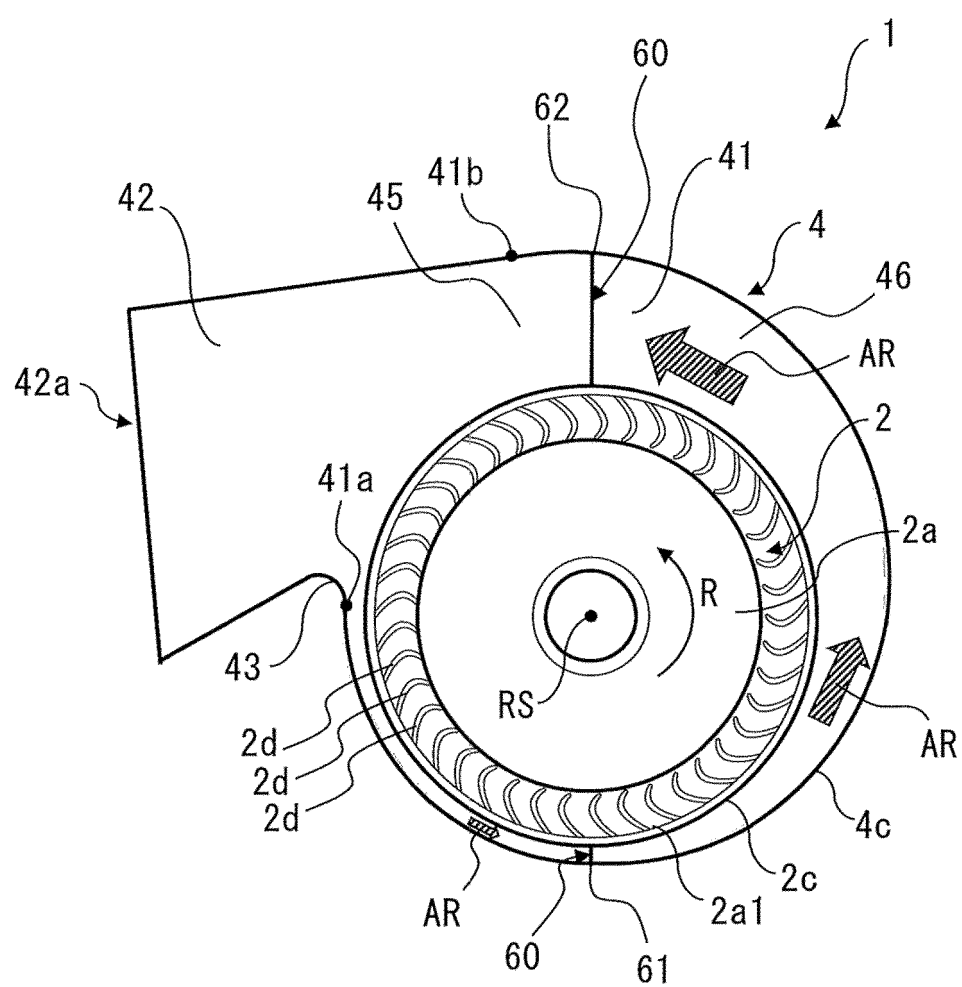


FIG. 3

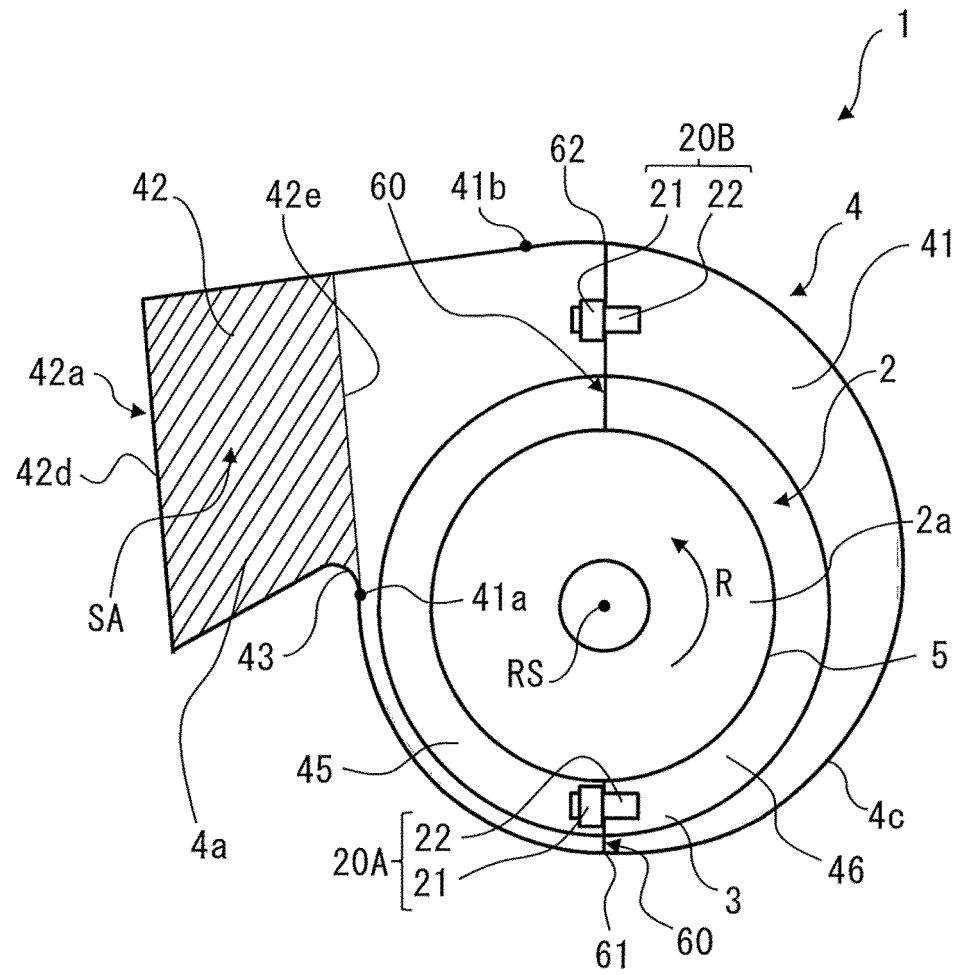


FIG. 4

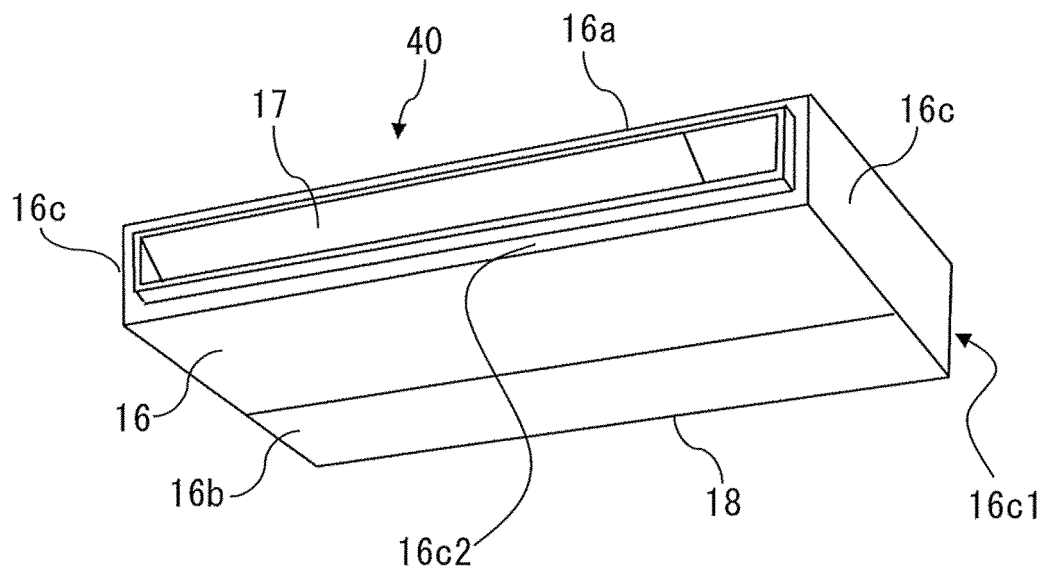


FIG. 5

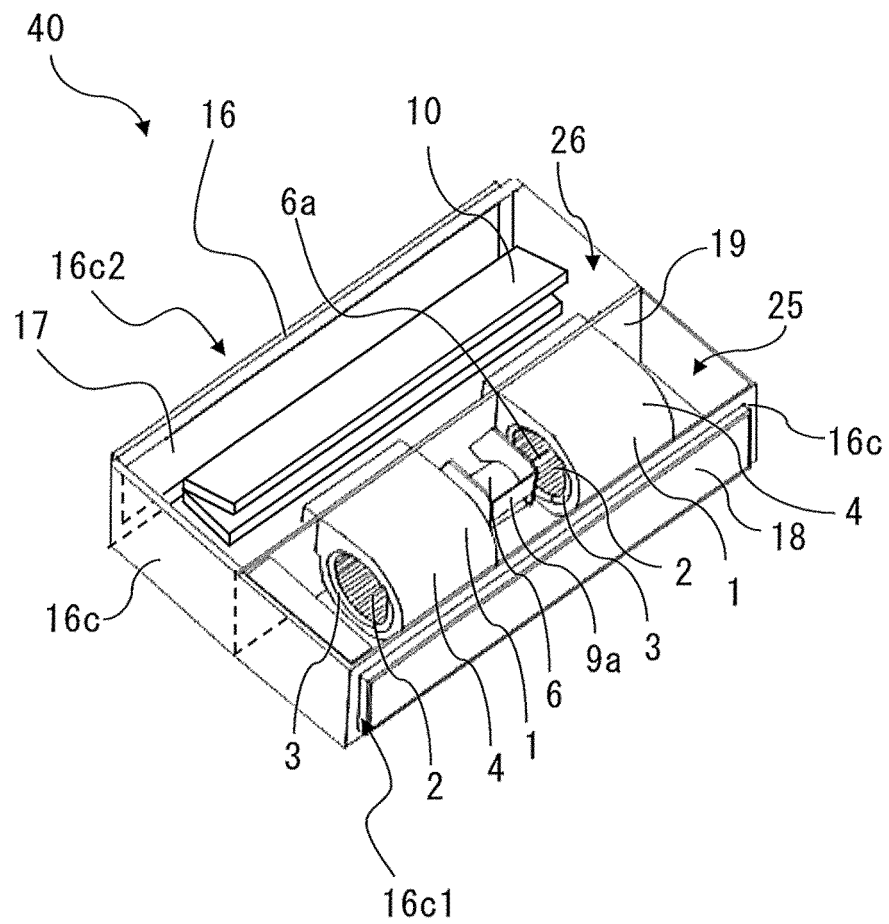


FIG. 6

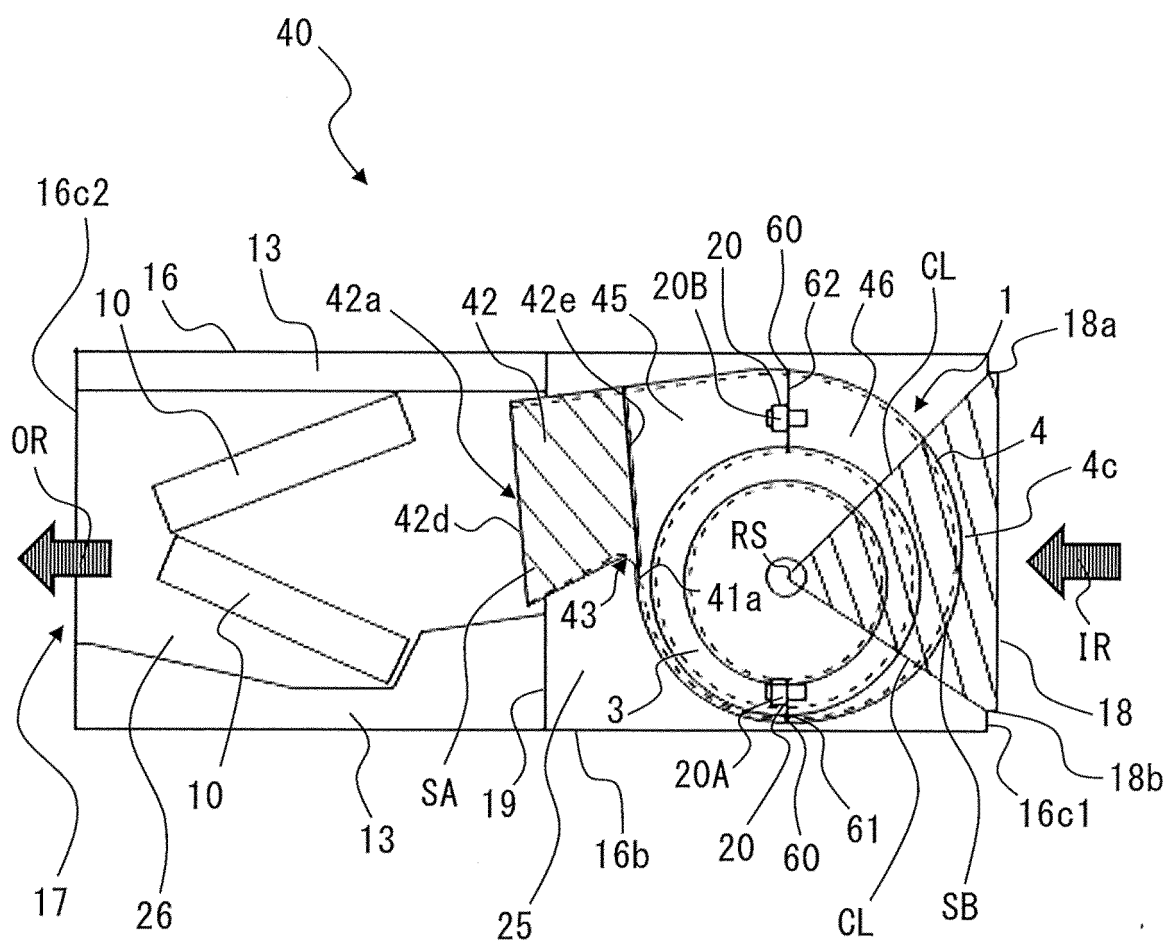


FIG. 7

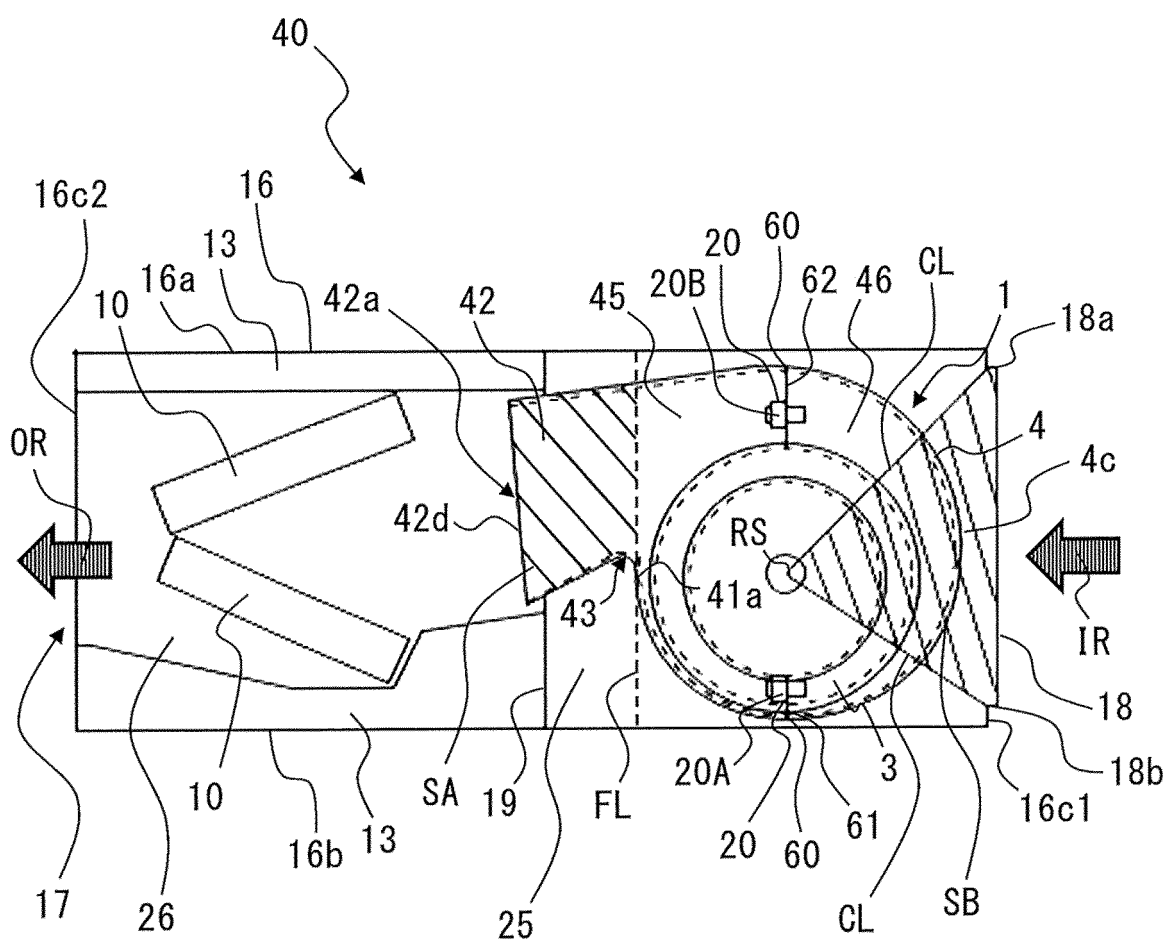


FIG. 8

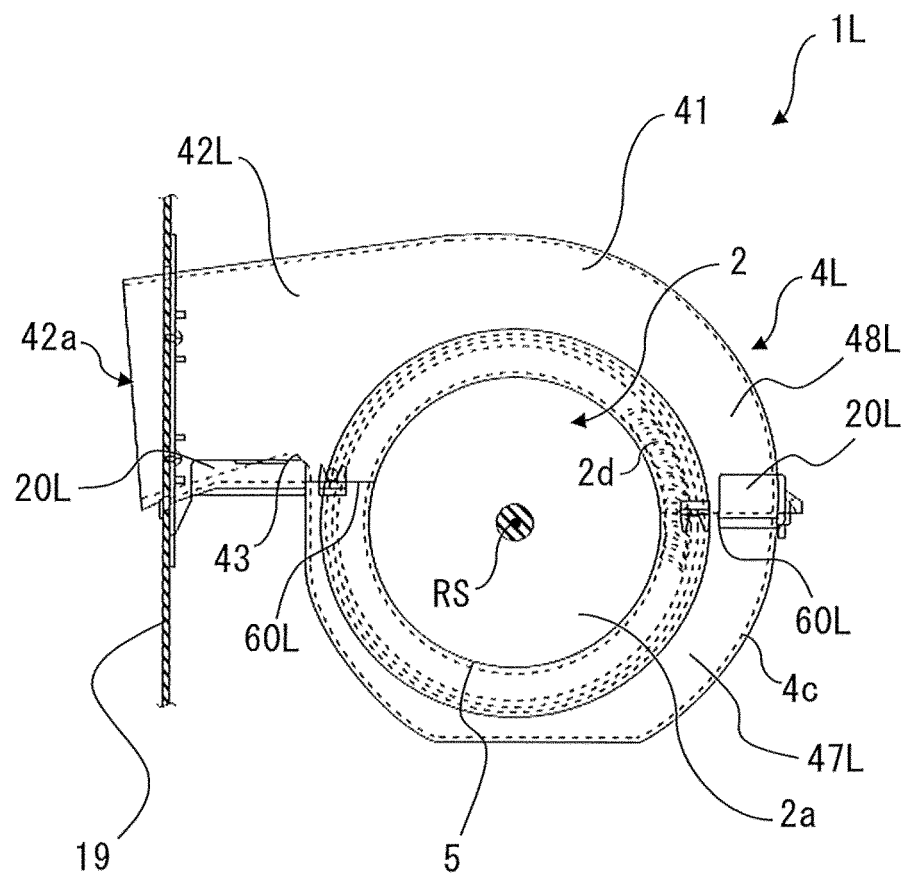


FIG. 9

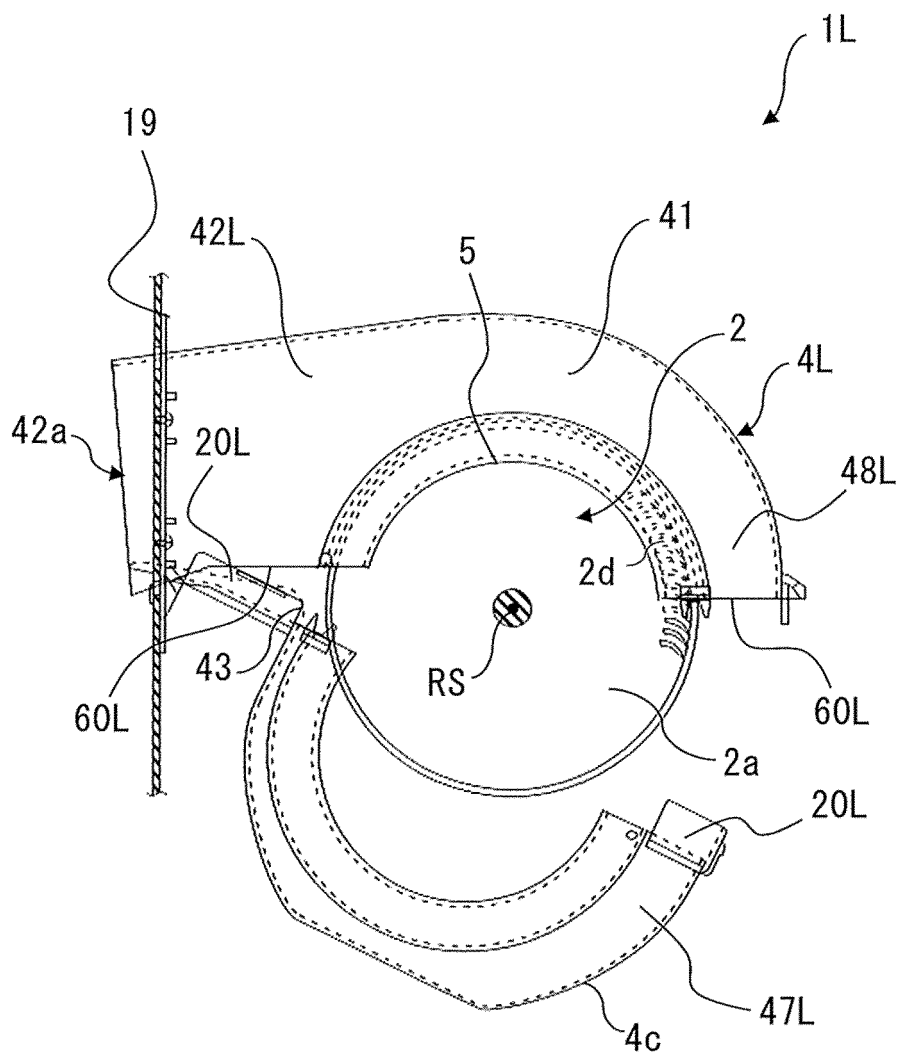


FIG. 10

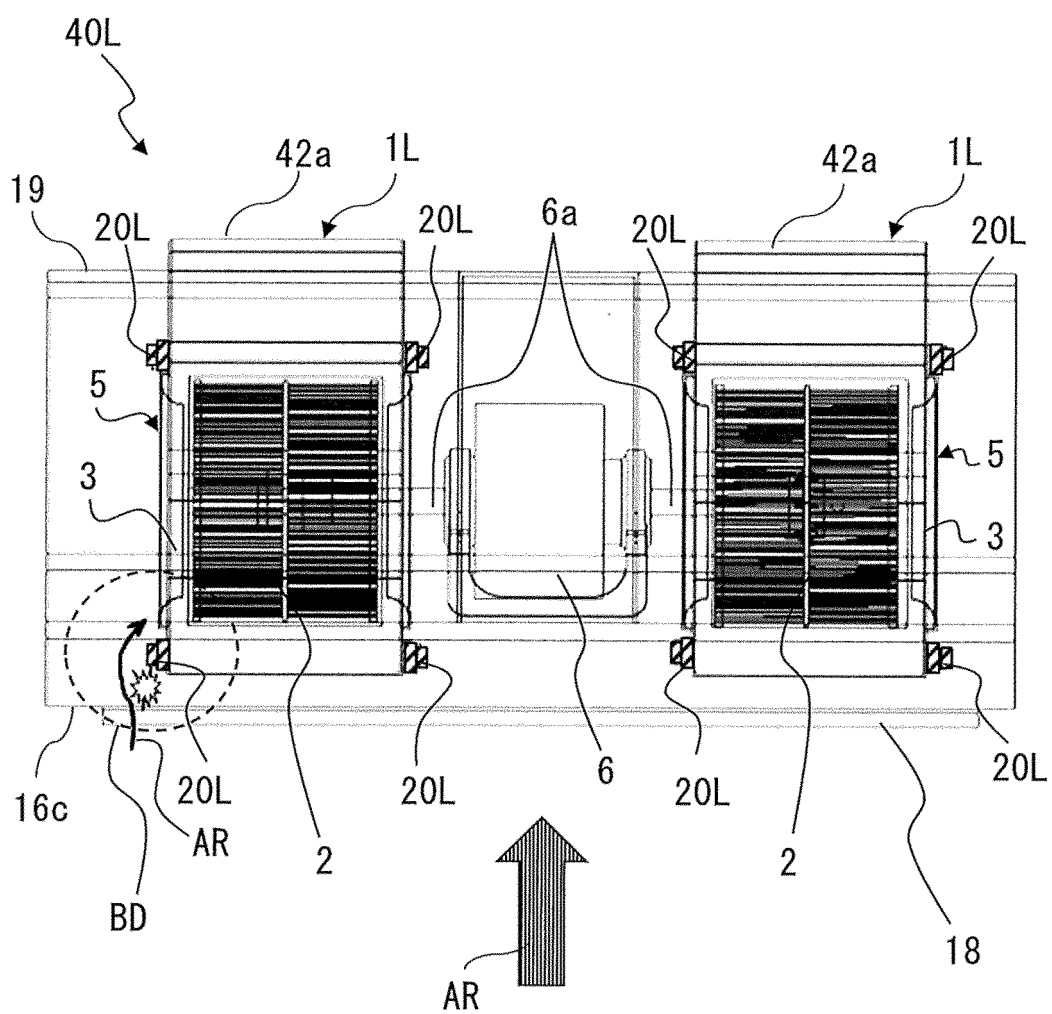


FIG. 11

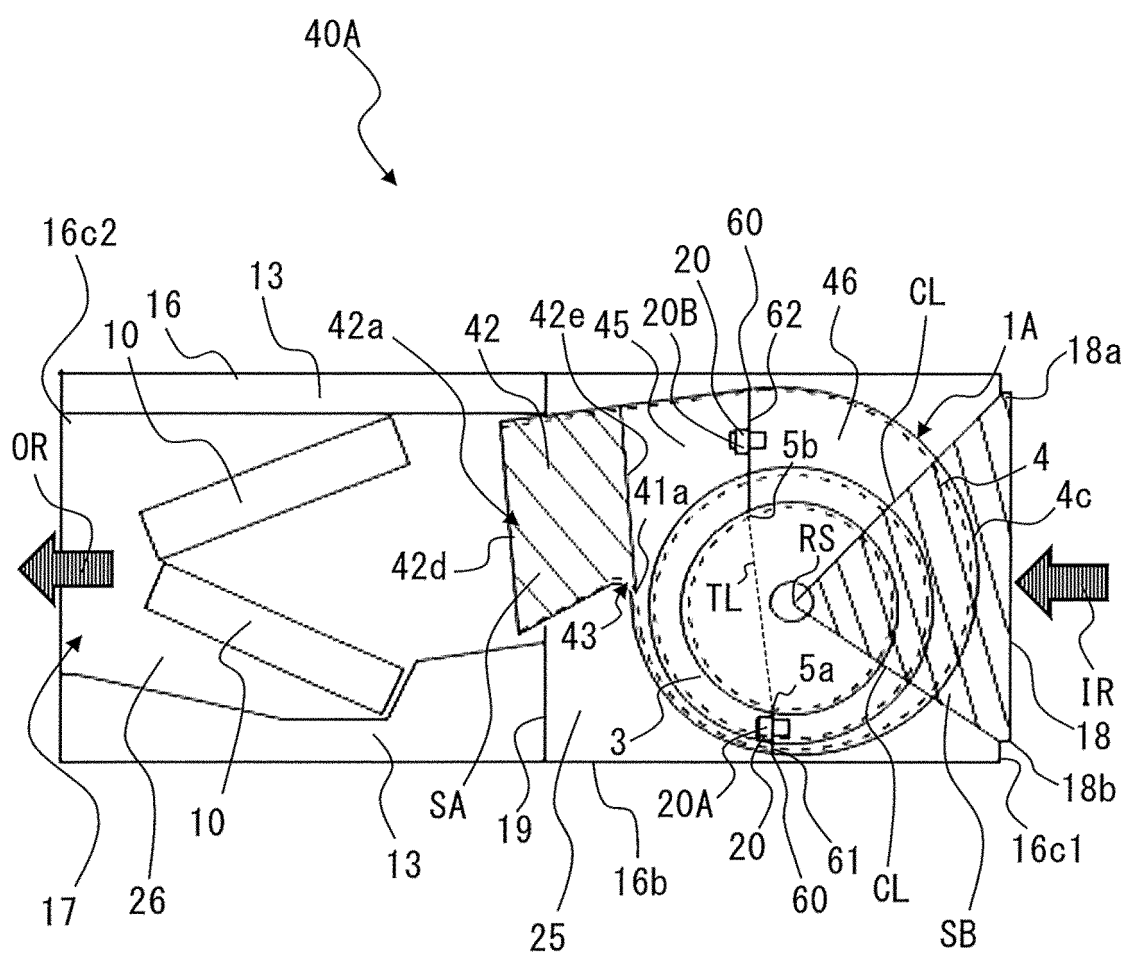


FIG. 12

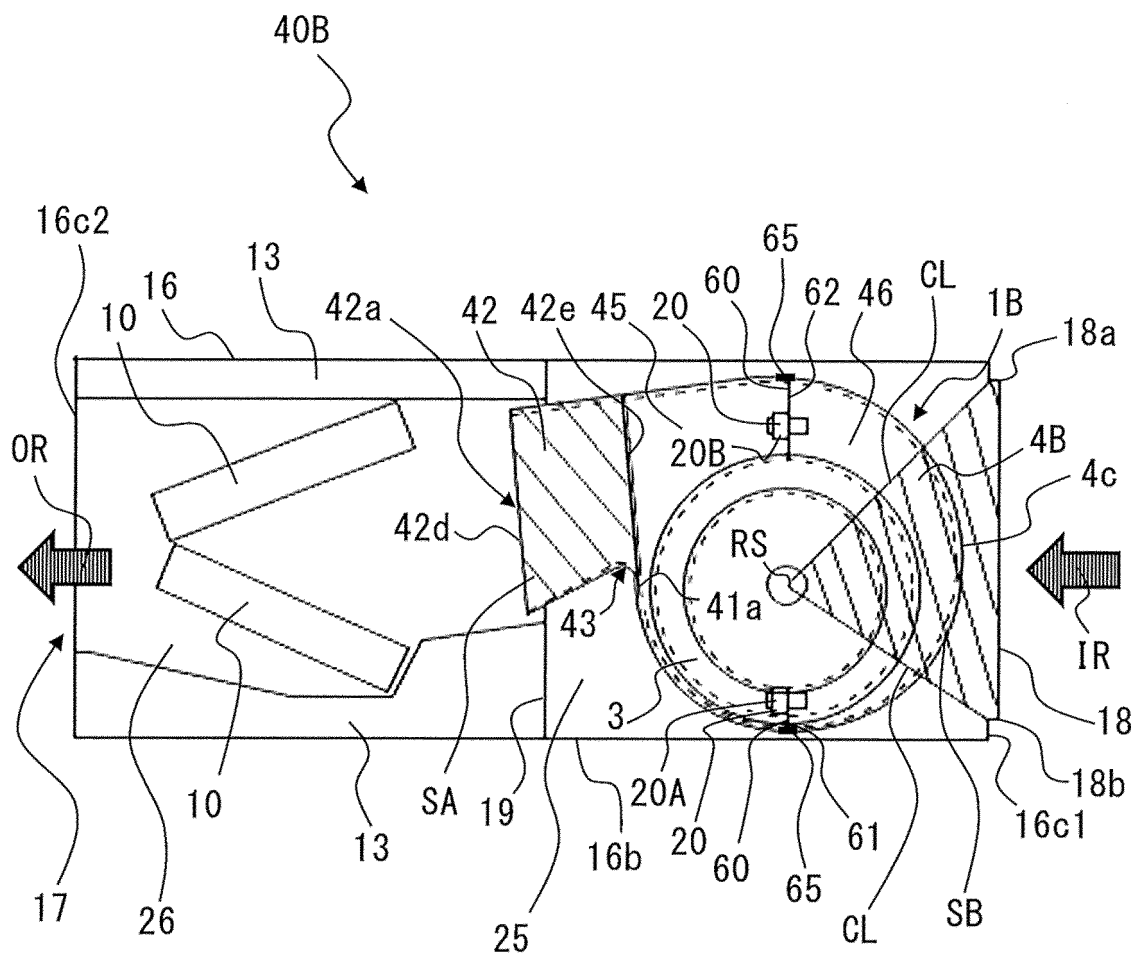


FIG. 13

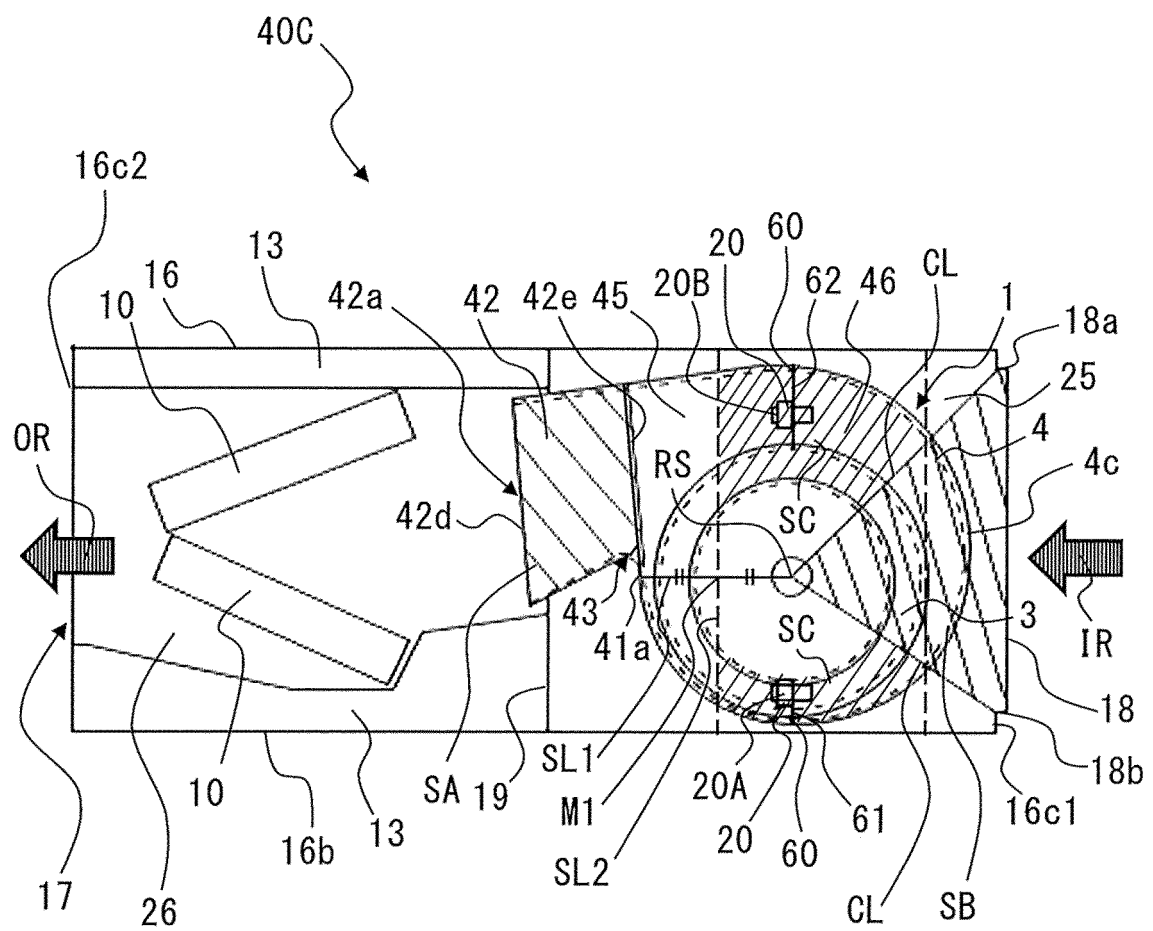


FIG. 14

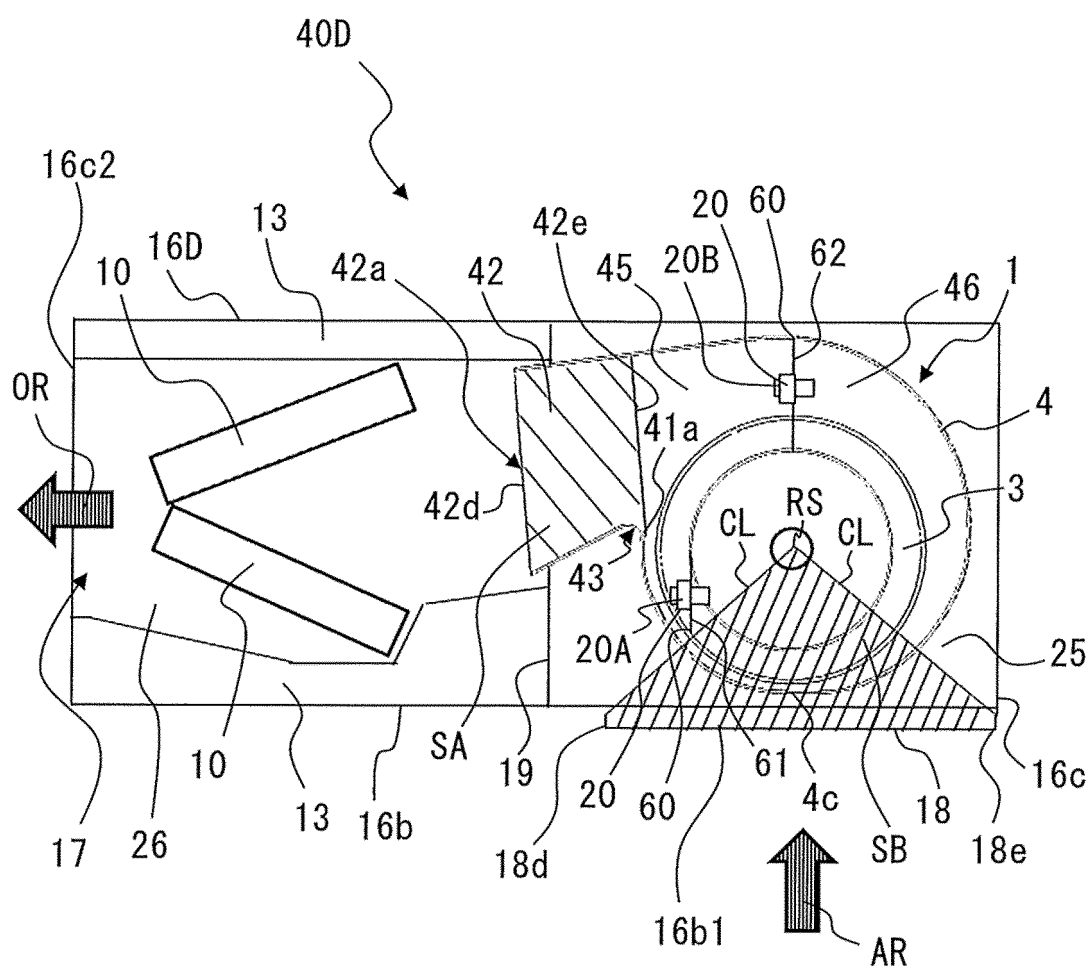
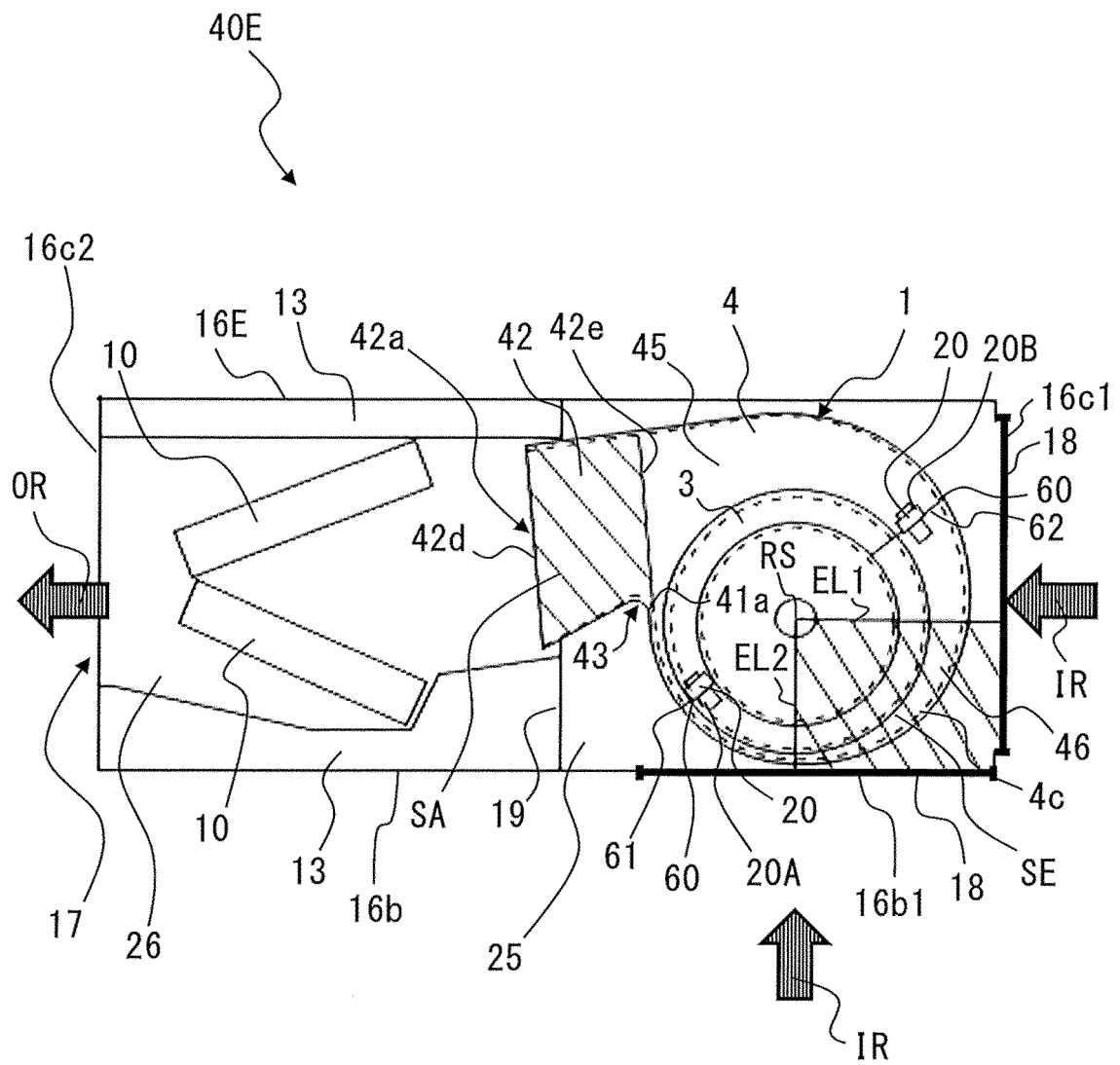


FIG. 15



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2020/017759

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F24F1/0022 (2019.01) i
FI: F24F1/0022

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. F24F1/0022

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	1971-2020
Registered utility model specifications of Japan	1996-2020
Published registered utility model applications of Japan	1994-2020

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.
Y	JP 2005-069177 A (DAIKIN INDUSTRIES, LTD.) 17 March 2005 (2005-03-17), paragraphs [0008]-[0055], fig. 1-15	1-7
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 123963/1981 (Laid-open No. 029199/1983) (MITSUBISHI ELECTRIC CORPORATION) 25 February 1983 (1983-02-25), specification, page 1, line 15 to page 4, line 5, fig. 1-3	1-7
A	US 2016/0238027 A1 (SAMSUNG ELECTRONICS CO., LTD.) 18 August 2016 (2016-08-18), entire text, all drawings	1-7



Further documents are listed in the continuation of Box C.



See patent family annex.

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"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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"&" document member of the same patent family

Date of the actual completion of the international search
08 July 2020

Date of mailing of the international search report
21 July 2020

Name and mailing address of the ISA/
Japan Patent Office
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Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2020/017759

JP 2005-069177 A 17 March 2005 CN 2807095 Y
JP 58-029199 U1 25 February 1983 (Family: none)
US 2016/0238027 A1 18 August 2016 EP 3059449 A1
KR 10-2016-0100720 A

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2005069177 A [0004]