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(54) SCROLL FLUID MACHINE AND VEHICLE

(57) A scroll fluid machine (10) includes a case (15), a fixed scroll (20) fixed to the case, and an orbiting scroll (30) that is disposed in a space S formed between the case and the fixed scroll and orbits while contacting the fixed scroll. Orbiting motion of the orbiting scroll relative to the fixed scroll acts on a fluid in a working room (11) formed between the fixed scroll and the orbiting scroll. A flow regulator (50) including a shielding plate (55) that is positioned on the extension of a surface (sfb) of the orbiting scroll contacting the fixed scroll and extends in a direction non-parallel to the surface (sfb) is further provided.

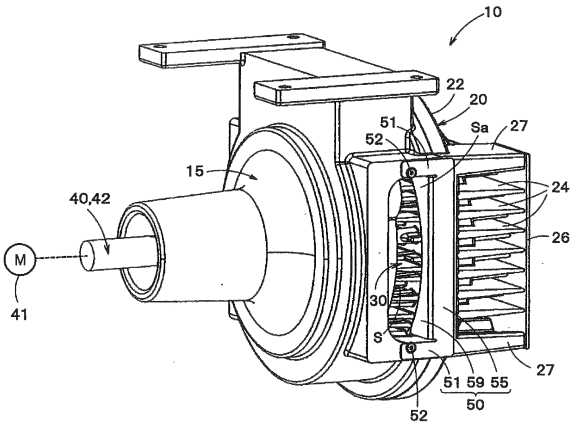

Fig. 1

EP 3 564 530 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a scroll fluid machine excellent in durability and a vehicle equipped with the scroll fluid machine.

BACKGROUND

[0002] As disclosed in, for example, Japanese Patent Application Publication H7-208353 (JPH7-208353A), a scroll fluid machine has a working room formed between a fixed scroll and an orbiting scroll. When the orbiting scroll orbits relative to the fixed scroll, the working room moves and the volume of the working room is gradually reduced to compress the fluid. At this point, the orbiting scroll contacts the fixed scroll, and the space between the orbiting scroll and the fixed scroll may be hermetically sealed. As a result, in the example shown in JPH7-208353A, a fluid is suctioned from the inlet located at an outer peripheral portion, and the compressed fluid is discharged from the outlet located at the center.

[0003] However, there was a problem of early deterioration of a tip seal provided at the tip of the spiral wrap. The early deterioration becomes more conspicuous when a conventional scroll fluid machine is used under a dusty environment. For example, a scroll fluid machine used as an air compressor mounted on a railway vehicle may be used in various outdoor environments where railway vehicles travel, such as urban areas, rural areas, and mountain forest areas. Therefore, such a scroll fluid machine is exposed to more dusty environment as compared with indoor use.

[0004] We investigated the cause of early deterioration of the tip seal, and found that dust in the environment flows into the working room through contact points between the fixed scroll and the orbiting scroll, and the dust enters into between the tip seal and each scroll, which causes abrasion and deterioration of the tip seal.

DISCLOSURE OF INVENION

[0005] It is an object of the invention to effectively prevent dust in the ambient air around the scroll fluid machine from flowing into the working room.

[0006] A scroll fluid machine according to a first aspect of the invention includes a fixed scroll, an orbiting scroll disposed to face the fixed scroll and moving to the fixed scroll, and a flow regulator regulating an air flow from the outside to an outer peripheral portion of a region where the fixed scroll and the orbiting scroll face each other.

[0007] In the scroll fluid machine according to the first aspect of the invention, the orbiting scroll relatively moves while being in contact with the fixed scroll, and the flow regulator may be situated on the extension of a surface of the orbiting scroll that contacts the fixed scroll.

[0008] The scroll fluid machine according to the first aspect further includes a case fixed to the fixed scroll. The orbiting scroll may be disposed in a space between the case and the fixed scroll, an inlet port and an outlet port for a cooling fluid may be provided so as to communicate with the space, and the flow regulator may be disposed at the inlet port or between the inlet port and the orbiting scroll.

[0009] The scroll fluid machine according to the first aspect further includes a case fixed to the fixed scroll. The orbiting scroll may be disposed in a space between the case and the fixed scroll, an inlet port and an outlet port for a cooling fluid may be provided so as to communicate with the space, and the flow regulator may be disposed at the inlet port or so as to face the inlet port.

[0010] In the scroll fluid machine according to the first aspect of the invention, the orbiting scroll may have a base plate portion having a first surface that includes a surface contacting the fixed scroll and a second surface that faces opposite to the first surface. In a direction in which the fixed scroll and the orbiting scroll face each other, one end portion of the flow regulator may be situated closer to the fixed scroll than the surface, and the other end portion of the flow regulator may be situated more distant from the fixed scroll than the second surface.

[0011] In the scroll fluid machine according to the first aspect of the invention, the orbiting scroll may further include a heat radiation fin extending from the second surface of the base plate portion. In the direction in which the fixed scroll and the orbiting scroll face each other, the other end portion of the flow regulator may be situated between the second surface and a tip of the heat radiation fin most distant from the base plate portion.

[0012] In the scroll fluid machine according to the first aspect of the invention, the flow regulator may include a shielding plate extending in a direction non-parallel to the surface, and an extension portion extending from the shielding plate toward the orbiting scroll.

[0013] In the scroll fluid machine according to the first aspect of the invention, in the direction in which the fixed scroll and the orbiting scroll face each other, the extension portion may be situated between the second surface and the tip of the heat radiation fin most distant from the base plate portion.

[0014] In the scroll fluid machine according to the first aspect of the invention, an edge of the extension portion situated opposite to a side connected to the shielding plate may have an arc profile.

[0015] In the scroll fluid machine according to the first aspect of the invention, the shielding plate and the extension portion may be formed of a bent metal plate.

[0016] In the scroll fluid machine according to the first aspect of the invention, the shielding plate may cover the orbiting scroll over an angular range of 90° or more, preferably over an angular range of 180° or more, more preferably over an angular range of 270°, and most preferably over 360°.

[0017] In the scroll fluid machine according to the first aspect of the invention, the flow regulator may be pro-

vided on the fixed scroll.

[0018] In the scroll fluid machine according to the first aspect of the invention, the flow regulator may be provided on the orbiting scroll.

[0019] In the scroll fluid machine according to the first aspect of the invention, the flow regulator (flow guiding member) may extend from the orbiting scroll toward a side away from the fixed scroll in a direction in which the fixed scroll and the orbiting scroll face each other.

[0020] The scroll fluid machine according to the first aspect of the invention may further include a case fixed to the fixed scroll. The orbiting scroll may be disposed in a space between the case and the fixed scroll, an inlet port and an outlet port for a cooling fluid may be provided so as to communicate with the space, and the flow regulator (flow guiding member) may extend from the orbiting scroll such that it is disposed closer to the outlet port and away from the inlet port in the direction connecting the inlet port and the outlet port.

[0021] The scroll fluid machine according to the first aspect of the invention may further include a case fixed to the fixed scroll. The orbiting scroll may be disposed in a space between the case and the fixed scroll, an inlet port and an outlet port for a cooling fluid may be provided so as to communicate with the space, and the flow regulator (flow guiding member) may guide a flow of the cooling fluid from the inlet port to the outlet port such that the flow of the cooling fluid moves away from the fixed scroll in the direction in which the fixed scroll and the orbiting scroll face each other.

[0022] The scroll fluid machine according to the first aspect further includes a case fixed to the fixed scroll. The orbiting scroll may be disposed in a space between the case and the fixed scroll, an inlet port and an outlet port for a cooling fluid may be provided so as to communicate with the space, a first flow regulator may be situated between a second flow regulator (flow guiding member) and the inlet port, and the second flow regulator (flow guiding member) may be situated between the first flow regulator and the outlet port.

[0023] A scroll fluid machine according to a second aspect of the invention includes a fixed scroll, an orbiting scroll disposed to face the fixed scroll and moving to the fixed scroll, and a flow regulator (flow guiding member) extends from the orbiting scroll toward a side away from the fixed scroll in a direction in which the fixed scroll and the orbiting scroll face each other.

[0024] A scroll fluid machine according to a third aspect of the invention includes a fixed scroll, and an orbiting scroll disposed to face the fixed scroll and moving to the fixed scroll. An inlet port and an outlet port for a cooling fluid may be provided so as to communicate with the space. The scroll fluid machine further includes a flow regulator that guides a flow of the cooling fluid from the inlet port to the outlet port such that the flow of the cooling fluid moves away from the fixed scroll in the direction in which the fixed scroll and the orbiting scroll face each other.

[0025] In the scroll fluid machine according to the first to third aspects of the invention, the orbiting scroll may have a base plate portion having a first surface that includes a surface contacting the fixed scroll and a second surface that faces the first surface, and an orbiting scroll extending from the first surface of the base plate portion toward the fixed scroll. The flow regulator (flow guiding member) may extend from the second surface of the base plate portion.

[0026] In the scroll fluid machine according to the first to third aspects of the invention, an inlet port and an outlet port for a cooling fluid may be provided so as to communicate with the space. The distance from the flow regulator (flow guiding member) to the outlet port may be smaller than the distance from the flow regulator (flow guiding member) to the inlet port.

[0027] A scroll fluid machine according to a fourth aspect of the invention includes a fixed scroll, and the orbiting scroll orbiting while being in contact with the fixed scroll. A flow regulator disposed on the extension of a surface of the orbiting scroll contacting the fixed scroll and extends in a direction non-parallel to the surface is further provided. The shielding plate covers the orbiting scroll over an angular range of 90° or more, preferably over an angular range of 180° or more, more preferably over an angular range of 270°, and most preferably over 360°.

[0028] In the scroll fluid machine according to the first or fourth aspect of the invention, the shielding plate may be provided separately from the case.

[0029] In the scroll fluid machine according to the first to fourth aspects of the invention, the scroll fluid machine may be an air compressor used for railway vehicles.

[0030] A vehicle according to the present invention is provided with a vehicle body, and the scroll fluid machine of any one of the first to fourth aspects mounted on the vehicle body.

[0031] According to the aspects, it is possible to effectively prevent inflow of dust into the working room of the scroll fluid machine, thereby effectively suppressing deterioration of the tip seal.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032]

Fig. 1 is a perspective view of a scroll fluid machine for describing an embodiment of the invention.

Fig. 2 is a longitudinal sectional view of the scroll fluid machine shown in Fig. 1.

Fig. 3 is an partially enlarged view of Fig. 2.

Fig. 4 is a perspective view of the scroll fluid machine of Fig. 1 with a case and a drive mechanism removed.

Fig. 5 is a plan view of the scroll fluid machine of Fig. 1 from the axial direction with the case and the drive mechanism removed.

Fig. 6 is a perspective view of a fixed scroll included

in the scroll fluid machine shown in Fig. 1.

Fig. 7 is a view corresponding to Fig. 2 and illustrates a modification example of a flow regulator.

Fig. 8 is a view corresponding to Fig. 5 and illustrates another modification example of the flow regulator.

Fig. 9 is a view corresponding to Fig. 2 for describing the modification example shown in Fig. 8.

Fig. 10 is a view corresponding to Fig. 2 and illustrates a modification example of the scroll fluid machine.

Fig. 11 is a view corresponding to Fig. 2 and illustrates another modification example of the scroll fluid machine.

Fig. 12 illustrates one application example of the scroll fluid machine.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0033] Hereinafter, one embodiment of the invention will be described with reference to the appended drawings. In the drawings appended hereto, for the sake of convenience of illustration and ease of understanding, a scale size, an aspect ratio, and so on are altered as appropriate from those of real things for emphasis.

[0034] Figs. 1 to 6 are drawings for describing one embodiment of the invention. Figs. 1 and 2 are for explaining the overall configuration of the scroll fluid machine. As shown in Figs. 1 and 2, a scroll fluid machine 10 includes a fixed scroll 20 and an orbiting scroll 30 as main components. The fixed scroll 20 and the orbiting scroll 30 move relative to each other to act on a fluid. The illustrated scroll fluid machine 10 further includes a case 15 and a drive mechanism 40 in addition to the fixed scroll 20 and the orbiting scroll 30. As shown in Fig. 2, the fixed scroll 20 is fixed to the case 15 via a fastener 13. The orbiting scroll 30 is disposed in a space defined by the case 15 and the fixed scroll 20. The orbiting scroll 30 faces the fixed scroll 20 in an axial direction "ad" defined by the drive mechanism 40. A working room 11 is formed between the fixed scroll 20 and the orbiting scroll 30. In the scroll fluid machine 10, the orbiting scroll 30 moves relatively to the fixed scroll 20 to act on the fluid in the working room 11.

[0035] Components of the scroll fluid machine 10 will be described below. First, with reference to Figs. 2, 3 and 6, the fixed scroll 20 will be described. Fig. 3 is a partially enlarged view of Fig. 2, and Fig. 6 is a perspective view of the fixed scroll 20 included in the scroll fluid machine 10.

[0036] As shown in Figs. 2 and 3, the fixed scroll 20 has a base plate portion 21 having a substantially circular disk profile. An annular wall portion 22 is provided on the peripheral edge of the base plate portion 21. The annular wall portion 22 extends from the base plate portion 21 toward the orbiting scroll 30 in a direction in which the fixed scroll and the orbiting scroll 30 face each other, in other words, in the axial direction "ad" of the scroll fluid machine 10. The annular wall portion 22 of the fixed scroll 20 is fixed to the case 15 with the fastener 13.

[0037] As shown in Fig. 6, the annular wall portion 22 defines a surface (contact surface, opposing surface) "sfa" that faces the orbiting scroll 30. In the illustrated example, the surface "sfa" is flat. The surface "sfa" contacts the orbiting scroll 30 during the operation of the scroll fluid machine 10. A groove 25 is formed in the perimeter (in particular, circle's perimeter) of the surface "sfa". As shown in Figs. 2 and 3, the biasing means 46 and the dustproof seal member 47 are provided in the groove 25. In a precise sense, the dustproof seal member 47 contacts the orbiting scroll 30. The biasing means 46 presses the dustproof seal member 47 in the axial direction "ad" to bring the dustproof seal member 47 into contact with the orbiting scroll 30. Sealing between the fixed scroll 20 and the orbiting scroll 30 is effectively provided by the dustproof seal member 47 urged by the biasing means.

[0038] As shown in Figs.2, 3 and 6, a fixed wrap 23 is provided in a region surrounded by the annular wall portion 22 of the base plate portion 21. The fixed wrap 23 is a standing wall provided along a spiral path when observed from the axial direction "ad" of the scroll fluid machine 10. The fixed wrap 23 extends from the base plate portion 21 toward the orbiting scroll 30 in the axial direction "ad" of the scroll fluid machine 10. As shown in Fig. 3, at the tip of the fixed wrap 23, a tip seal 23a is provided. The tip seal 23a contacts the orbiting scroll 30. The tip seal 23a is formed of a material having excellent airtightness such as rubber or resin and seals between the fixed wrap 23 and the orbiting scroll 30.

[0039] As shown in Fig. 2, the base plate portion 21 has through holes. The through holes form an inlet 11a and an outlet 11b respectively for communicating the working room 11 with the outside. In the illustrated example, the inlet 11a is provided at the outer peripheral portion along the spiral path of the fixed wrap 23 and the outlet 11b is provided at the center of the spiral path of the fixed wrap 23.

[0040] Further, as shown in Fig. 2, heat radiation fins 24, a cover 26, and side wall portion 27 are provided on the base plate portion 21 on the side opposite to the fixed wrap 23. The cover member 26 is formed in a plate shape and is disposed to face the base plate portion 21. A pair of side wall portions 27 are provided between the base plate portion 21 and the cover 26. Each side wall portion 27 extends in the axial direction "ad" of the scroll fluid machine 10 and connects the base plate portion 21 and the cover 26. A tubular flow path is defined by the base plate portion 21, the cover 26, and the pair of side wall portions 27, with an inlet port Sa2 and an outlet port Sb2 formed at both ends. A cooling fluid from a delivery mechanism 70, which will be described later, passes through the flow path. The plurality of heat radiation fins 24 are provided between the base plate portion 21 and the cover 26 where is in the flow path. The heat radiation fins 24 extend between the base plate portion 21 and the cover

26 in the axial direction "ad" of the scroll fluid machine 10.

[0041] Next, the orbiting scroll 30 will be described. The orbiting scroll 30 disposed in the space S orbits while being in contact with the fixed scroll 20. As shown in Figs. 2 and 3, the orbiting scroll 30 has a base plate portion 31 arranged to face the fixed scroll 20. The base plate portion 31 has a first surface 31a facing the fixed scroll 20 and a second surface 31b facing the side opposite to the fixed scroll 20.

[0042] An orbiting wrap 33 is formed in a region of the first surface 31a of the base plate portion 31 facing the working room 11. The orbiting wrap 33 is a wall portion standing along a spiral path when observed from the axial direction "ad" of the scroll fluid machine 10 and has a configuration complementary to the fixed wrap 23. The orbiting wrap 33 extends from the base plate portion 31 toward the fixed scroll 20 in the axial direction "ad" of the scroll fluid machine 10. At the tip of the orbiting wrap 33, a tip seal 33a is provided as shown in Fig. 3. The tip seal 33a contacts the fixed scroll 20. The tip seal 33a is formed of a material having excellent hermeticity such as rubber and resin and hermetically seals between the orbiting wrap 33 and the fixed scroll 20.

[0043] A circumferential surface "sfb" (contact surface) is formed on the first surface 31a of the base plate portion 31 in an outer peripheral of a region where the orbiting wrap 33 is provided. In the illustrated example, the surface "sfb" is flat. The surface "sfb" of the orbiting scroll 30 contacts the surface "sfa" of the fixed scroll 20 during the operation of the scroll fluid machine 10 and hermetically seals between the fixed scroll 20 and the orbiting scroll 30. More specifically, the surface "sfb" of the orbiting scroll 30 contacts the dust-proof seal member 47 provided on the surface "sfa" of the fixed scroll 20 during the operation of the scroll fluid machine 10.

[0044] As shown in Figs. 2, 4, and 5, heat radiation fins 34 and a connecting boss 35 are provided on the second surface 31b of the base plate portion 31. The heat radiation fins 34 and the connecting boss 35 extend in the axial direction "ad" from the second surface 31b.

[0045] Next, a description is given of the drive mechanism 40. The drive mechanism 40 is a mechanism for moving the orbiting scroll 30 relative to the fixed scroll 20. In the embodiment, the drive mechanism 40 causes the orbiting scroll 30 to orbit relative to the fixed scroll 20 in a plane orthogonal to the axial direction "ad" of the scroll fluid machine 10. The orbiting scroll 30 is driven by the drive mechanism 40 to translate relative to the fixed scroll 20, in particular, translate along a circumferential path.

[0046] The drive mechanism 40 has an electric motor 41 that supplies a rotational force and a conversion mechanism 42 that converts the rotational motion output by the electric motor 41 into a translational motion along the circumferential orbit. As the conversion mechanism 42, various known configurations may be adopted, for example, the configuration disclosed in the aforementioned patent literature (JPH7-208353A) may be adopted. In the example shown in Fig. 2, the conversion mechanism 42 includes a crankshaft 43 rotatally driven by the electric motor 41 and a bearing 44 fixed in the connecting boss 35 of the orbiting scroll 30. The crankshaft 43 includes a first shaft 43a disposed on a rotation axis "ra" of the electric motor 41 and rotationally driven by the electric motor 41, and a second shaft portion 43b defining an eccentric axis "ea" decentered from the rotation axis "ra". The second shaft 43a is held by a bearing 44. When the first shaft 43a is rotationally driven, the second shaft 43b moves in a circle about the rotation axis "ra." The radius of the circle corresponds to the amount of eccentricity from the rotation axis "ra" to the eccentric axis "ea". The orbiting scroll 30 is then capable of rotating about the eccentric axis "ea" with respect to the second shaft 43b via the bearing 44. With this configuration, the orbiting scroll 30 is able to orbit relative to the fixed scroll 20 through the rotation output by the electric motor 41. Although not shown, a mechanism for restricting the rotation of the orbiting scroll 30 relative to the fixed scroll 20, for example, a crankshaft or the like may be additionally provided.

[0047] The axial direction "ad" of the scroll fluid machine 10 is defined by the rotation axis "ra" of the electric motor 41. The axial direction "ad" of the scroll fluid machine 10 is the direction parallel to the rotation axis "ra" of the electric motor 41. In the illustrated example, the axial direction "ad" is also parallel to the eccentric axis "ea". The fixed scroll 20 opposes the orbiting scroll 30 in the axial direction "ad" of the scroll fluid machine 10.

[0048] Among the above-described constituent elements, the case 15, the fixed scroll 20 and the orbiting scroll 30 are made of metal having high strength and excellent heat resistance. In particular, aluminum or aluminum alloy is advantageous in that it is lightweight and excellent in heat dissipation property. On the other hand, the biasing means 46 is formed of a material itself having elasticity, a material having form elasticity, and the like. In the example shown in Fig. 3, the biasing means 46 is formed of a rubber tube. The dustproof seal member 47 is made of a material having abrasion resistance and high sealing property when used with the surface "sfb" of the orbiting scroll 30, for example, rubber, resin, or the like.

[0049] In the above-described scroll fluid machine 10, when the orbiting scroll 30 orbits relative to the fixed scroll 20 as driven by the drive mechanism 40, the fixed wrap 23 and the orbiting wrap 33 repeatedly approach and separate to/from each other in the radial direction "rd" orthogonal to the axial direction "ad" in regions along the spiral path of the fixed wrap 23. Thereby a working fluid as an internal medium is compressed or expanded along the spiral path of the fixed wrap 23 in the working room 11. In the illustrated example, the air is compressed from the outer peripheral region along the spiral path of the fixed wrap 23 toward the center region. At the center region along the spiral path of the fixed wrap 23, the air with increased pressure is obtained and supplied to the outside through the outlet 11b. At the same time, the air

is sucked from the inlet 11a located at the outer peripheral portion along the spiral path of the fixed wrap 23. In other words, in the illustrated example, the scroll fluid machine 10 functions as a compressor.

[0050] In the illustrated example, during the operation of the scroll fluid machine 10, the working fluid, which is the air in the illustrated example, is compressed in the working chamber 11 between the orbiting scroll 30 and the fixed scroll 20 and consequently heat is generated. Due to this heat generation, in particular, the fixed scroll 20 and the orbiting scroll 30 are heated. When the fixed scroll 20 and the orbiting scroll 30 are heated, thermal deformation may occur, and the sealing between the fixed scroll 20 and the orbiting scroll 30 may become insufficient.

[0051] In order to handle this, provided is the delivery mechanism 70 for delivering a cooling fluid "cf" to the scroll fluid machine 10. The cooling fluid "cf" can efficiently cool the scroll fluid machine 10 by performing heat exchange with the heat radiation fins 24, 34 of the fixed scroll 20 and the orbiting scroll 30. As shown in Figs. 1 and 2, the scroll fluid machine 10 is provided with an inlet port Sa and an outlet port Sb that are communicated with the space S. Moreover, in the fixed scroll, the tubular flow path is defined by the base plate portion 21, the cover 26, and the pair of side wall portions 27, with the inlet port Sa2 and the outlet port Sb2 formed at both ends. The cooling fluid "cf' delivered from the delivery mechanism 70 is introduced into the inlet port Sa and the inlet port Sa2. The cooling fluid "cf' entered into the space S from the inlet port Sa passes through the outlet port Sb to flow out from the space S. The cooling fluid "cf' passing through the space S can efficiently cool the orbiting scroll 30. The cooling fluid "cf' flowing into the flow path in the fixed scroll 20 from the inlet port Sa2 passes through the outlet port Sb2 to flow out from the flow path in the fixed scroll 20. The cooling fluid "cf' flowing through the flow path in the fixed scroll 20 can efficiently cool the fixed scroll 20.

[0052] Various fluids may be used as the cooling fluid "cf' that is delivered from the delivery mechanism 70 to the scroll fluid machine 10. However, the air around the scroll fluid machine 10 is preferably used as the cooling fluid "cf' since the configuration of the machine can be simplified and the operation cost of the scroll fluid machine 10 can be reduced. In this case, the delivery mechanism 70 is configured as a blower. A duct or the like may be provided between the delivery mechanism 70 and the inlet port Sa of the scroll fluid machine 10 to supply the cooling fluid "cf" only to the internal space S of the scroll fluid machine 10. Alternatively, the delivery mechanism 70 may supply the cooling fluid "cf' to both the inner space S and the outer surface of the scroll fluid machine 10.

[0053] Scroll fluid machines serving as compressors are used in various fields including vehicles such as train cars and automobiles. However, when a conventional scroll fluid machine is used under dusty environment, a trouble could occur such that the life of the tip seal provided at the tip of the wrap becomes extremely short. For example, a scroll fluid machine used as an air compressor mounted on a railway vehicle may be used in various outdoor environments where railway vehicles travel, such as urban areas, rural areas, and mountain forest areas. Therefore, such scroll fluid machines are exposed to more dusty environment as compared to ones used in door. Further, as the environment changes depending on operation area and time of railway vehicles, it is difficult to take permanent measures. The air-cooled scroll fluid machines may be configured as oilless, and unlike oil scroll fluid machines that includes cooling oil in the working room, it has been regarded as a major advantage of the oilless fluid machines that it is not necessary to perform maintenance over a certain period of time. In this respect, early deterioration of the tip seal occurred when the machine is used under dusty environment can be a reason for limiting the fields where the scroll fluid machines are used.

[0054] The inventors of the present application investigated the cause of early deterioration of the tip seal, and found that foreign substances such as dust in the environment flow into the working room through contact points between the fixed scroll and the orbiting scroll, and the foreign substances enter into between the tip seal material and each scroll, which causes abrasion and deterioration of the tip seal. Further studies have revealed that a part of the cooling fluid for cooling the scroll is directed to a gap between the fixed scroll and the orbiting scroll, and the cooling fluid directed to the gap guides dust into the working room. This result is consistent with the fact that the above problem becomes more conspicuous in dusty environments.

[0055] In the scroll fluid machine 10 of the embodiment, improvements have been made to deal with such problems. In other words, it is possible to effectively prevent dust from flowing into the working room 11 together with fluid in the scroll fluid machine 10. Consequently it possible to effectively suppress deterioration of the structure and elements disposed in the working room 11 and to reduce the frequency of maintenance and inspection of the scroll fluid machine 10 even in use under a harsh environment such as a dusty environment. Furthermore it is possible to realize a long life of the scroll fluid machine 10. This advantageous effect is particularly useful for an oilless scroll fluid machine to which an overhaul maintenance is supposed not to carry out for a long period of time. Further, the scroll fluid machine having this advantageous effect is suitable for railway vehicles, trucks, buses, work vehicles such as vehicles for work at height, etc., which are used in various environments. The improvements will be specifically described below.

[0056] As shown in Figs. 1, 2, 4, and 5, the scroll fluid machine 10 further includes a flow regulator (flow regulation means) 50. The flow regulator 50 regulates the air flow from the outside to an outer peripheral portion of the region where the fixed scroll 20 and the orbiting scroll 30

face each other. More specifically, the flow regulator 50 is disposed in the outer peripheral portion surrounding the working room in the area where the fixed scroll 20 and the orbiting scroll 30 are opposed and at a position where the gap between the fixed scroll 20 and the orbiting scroll 30 opens. The flow regulator regulates a fluid that comes from the outside, which is the side opposite to the working chamber, to the portion where the regulator disposed such that the flow rate or speed of the fluid is reduced.

[0057] In the illustrated example, the flow regulator 50 faces the inlet port Sa or the inlet port Sa. The flow regulator 50 is provided at the inlet port Sa or between the inlet port Sa and the orbiting scroll 30. The flow regulator 50 regulates the flow of the cooling fluid "cf' so as to prevent the cooling fluid "cf" supplied from the delivery mechanism 70 from directly flowing into the gap between the fixed scroll 20 and the orbiting scroll 30. Regulation of the airflow encompasses reduction of the flow speed of the cooling fluid "cf" flowing to the gap between the fixed scroll 20 and the orbiting scroll 30 or reduction of the flow rate of the cooling fluid "cf" flowing to the gap by the flow regulator 50. By regulating the air flow directed to the gap between the fixed scroll 20 and the orbiting scroll 30 with the flow regulator 50, the amount of dust flowing into the working room 11 was successfully reduced.

[0058] As best illustrated in Fig. 1, the flow regulator 50 includes an attachment piece 51, a shielding plate 55, and an extension portion 59. The attachment piece 51 is used to fix the flow regulator 50 to the case 15, the fixed scroll 20 or the orbiting scroll 30. In the example shown in Fig. 1, a fastener 52 penetrates the attachment piece 51 and is fixed to the case 15, so that the flow regulator 50 is supported by the case 15 at a predetermined position. The shielding plate 55 and the extension portion 59 are provided for adjusting the flow of the cooling fluid "cf" delivered by the delivery mechanism 70.

[0059] In the illustrated example, the flow regulator 50 is formed by bending a single metal plate. The flow regulator 50 is formed using the same material as the case 15, the fixed scroll 20 or the orbiting scroll 30, for example, the same aluminum or aluminum alloy. By providing the flow regulator 50 made of the same material as the case 15, the fixed scroll 20, or the orbiting scroll 30, it is possible to effectively reduce the difference in thermal expansion between the flow regulator 50 and the case 15 and/or the scrolls 20, 30. Thereby it is possible to effectively prevent the thermal deformation of the flow regulator 50.

[0060] Next, a description is given of the shielding plate 55. As shown in Fig. 2, the shielding plate 55 is situated on the extension of the surface "sfb" of the orbiting scroll 30 that contacts the fixed scroll 20. The shielding plate 55 extends nonparallel to the surface "sfb" of the orbiting scroll 30. Therefore, the shielding plate 55 can deflect a traveling direction of the cooling fluid "cf' delivered by the delivery mechanism 70 from the gap between the fixed scroll 20 and the orbiting scroll 30.

[0061] In the illustrated example, the surface "sfb" of the orbiting scroll 30 is a flat surface that extends in the radial direction "rd" orthogonal to the axial direction "ad". The shielding plate 55 extends in a direction perpendicular to the surface "sfb" of the orbiting scroll 30. In view of efficient cooling of the orbiting scroll 30, the direction connecting the inlet port Sa and the outlet port Sb is preferably along the radial direction "rd" as shown in Fig. 2. When the inlet port Sa is provided in this manner, a portion "cfx" of the cooling fluid flows in a direction parallel to the surface "sfb" of the orbiting scroll 30 as shown by the dotted arrow in Fig. 2 and is directed to the gap between the fixed scroll 20 and the orbiting scroll 30. With the shielding plate 55 extending in the direction perpendicular to the surface "sfb", it is possible to effectively deflect the flow direction of the cooling fluid "cfx" from the gap between the fixed scroll 20 and the movable scroll 30.

[0062] As shown in Fig. 2, the shielding plate 55 not only faces the surface "sfb" of the orbiting scroll 30 from the radial direction "rd", but also faces the surface (opposing surface) "sfa" of the fixed scroll 20 from the radial direction "rd". In other words, the shielding plate 55 is disposed at a position where the plate covers the gap between the fixed scroll 20 and the orbiting scroll 30 from the radial direction "rd". According to the shielding plate 55, it is possible to effectively shield the gap between the fixed scroll 20 and the orbiting scroll 30 from the radial direction "rd". Thus, it is possible to effectively prevent foreign substances from flowing into the working room 11.

[0063] Further, as shown in Fig. 2, a first end portion (one end portion) 55a of the shielding plate 55 extends further than the surface "sfb" of the orbiting scroll 30 toward the fixed scroll 20 in the direction "ad" in which the fixed scroll 20 and the orbiting scroll 30 face each other (that is, in the axial direction). A second end portion (the other end portion) 55b of the shielding plate 55 extends further than the second surface 31b of the base plate portion 31 in the direction away from the fixed scroll 20. In other words, the shielding plate 55 is arranged at a position where the shielding plate covers the base plate portion 31 of the orbiting scroll 30 over the entire thickness of the base plate portion from the radial direction "rd" in at least a part of the circumferential region surrounding the orbiting scroll 30. With the above-described shielding plate 55, not only the traveling direction of the cooling fluid "cf" is deflected from the gap between the fixed scroll 20 and the orbiting scroll 30, but also the cooling fluid "cf' is guided toward the second surface 31b of the base plate portion 31. Thus, it is possible to more effectively prevent the inflow of foreign substances into the working room 11.

[0064] In the illustrated example, the heat radiation fins 34 are provided on the second surface 31b of the base plate portion 31. As shown in Fig. 2, in the axial direction "ad" where the fixed scroll 20 and the orbiting scroll 30 face each other, the second end portion 55b of the shield-

ing plate 55 is situated between the second surface 31b and a tip 34a of the heat radiation fin 34 most distant from the base plate portion 31. Thus, the cooling fluid "cf" that has been deflected by the shielding plate 55 is directed to the heat radiation fins 34 of the orbiting scroll 30. Consequently it is possible to effectively prevent foreign substances from entering into the working room 11 while the orbiting scroll 30 is efficiently cooled.

[0065] Next, a description is given of the extension portion 59. As shown in Figs. 2 and 4, the extension portion 59 extends from the shielding plate 55 toward the orbiting scroll 30. Fig. 4 is a perspective view of the scroll fluid machine 10 with the case 15 and the drive mechanism 40 removed. In the illustrated example, the extension portion 59 extends from the second end portion 55b of the shielding plate 55. The extension portion 59 is formed in a plate shape and extends in the radial direction "rd" perpendicular to the axial direction "ad". That is, the extension portion 59 extends perpendicularly to the plane in which the shielding plate 55 extends, and extends in a plane parallel to the surface "sfb" of the orbiting scroll 30. By providing the extension portion 59, the flow speed of the cooling fluid "cf" flowing toward the gap between the fixed scroll 20 and the orbiting scroll 30 is greatly reduced by bypassing the extension portion 59, and the amount of the cooling fluid "cf" flowing toward the gap is also greatly reduced.

[0066] As shown in Fig. 2, in the axial direction "ad" in which the fixed scroll 20 and the orbiting scroll 30 face each other, the extension portion 59 is situated between the tip 34a of the heat radiation fin 34 of the orbiting scroll 30 and the second surface 31b of the base plate portion 31. Thus, the cooling fluid "cf' whose traveling direction has been regulated by the extension portion 59 is directed toward the heat radiation fins 34 of the orbiting scroll 30, and therefore it is possible to effectively prevent foreign substances from entering into the working room 11 while efficiently cooling the orbiting scroll 30.

[0067] Further, as shown in Fig. 5, an edge 59a of the extension portion 59 situated opposite to the side connected to the shielding plate 55 has an arc profile. Fig. 5 is a plan view of the scroll fluid machine 10 with the case 15 and the drive mechanism 40 removed. Since the edge 59a of the extension portion 59 situated on the side remote from the shielding plate 55 has the arc profile, the extension portion 59 can be disposed close to the orbiting scroll 30 and thereby it is possible to reduce the gap between the orbiting scroll 30 and the extension portion 59. In this case, the flow rate of the cooling fluid "cf' flowing toward the gap between the fixed scroll 20 and the orbiting scroll 30 is more effectively reduced, and the flow speed of the cooling fluid "cf" toward the gap is more effectively reduced. In particular, in the example shown in Fig. 5, the profile of the edge 59a of the extension portion 59 is along a circular arc centered on the rotation axis "ra" of the electric motor 41, that is, concentric with the circumferential orbit of the translational movement of the orbiting scroll 30. With the edge 59a having such a profile, it is possible to arrange the extension portion 59 closer to the orbiting scroll 30.

[0068] In the embodiment described above, the scroll fluid machine 10 includes the fixed scroll 20 and the orbiting scroll 30 that orbits while contacting the fixed scroll 20. Further, the scroll fluid machine 10 includes the flow regulator 50 for regulating the flow of the cooling fluid "cf". The flow regulator 50 (the shielding plate 55) regulates the air flow flowing toward between the fixed scroll 20 and the orbiting scroll 30. In other words, the flow regulator 50 regulates the air flow from the outside to the outer peripheral portion of the region where the fixed scroll 20 and the orbiting scroll 30 face each other. In the scroll fluid machine 10 described above, it is possible to effectively prevent a large amount of the cooling fluid "cf" from flowing at high pressure or high speed into the space between the fixed scroll 20 and the orbiting scroll 30 where should be sealed. Thus, it is possible to effectively prevent the cooling fluid "cf' from flowing into the working room 11 together with dust, and consequently it is possible to effectively prevent premature deterioration of the tip seals 23a, 33a of the wraps 23, 33 of the scrolls 20, 30 caused by the friction with the dust. Therefore, it is possible to extend the life of the tip seals 23a, 33a, and thereby it is possible to reduce the frequency of overhaul maintenance of the scroll fluid machine 10. The above described flow regulator 50 is particularly useful for an oilless scroll fluid machine 10 for which an overhaul maintenance is supposed not to carry out for a long period of time.

[0069] In the above-described embodiment, the flow regulator 50 (the shielding plate 55) is situated on the extension of the surface "sfb" of the orbiting scroll 30 that contacts the fixed scroll 20. The flow regulator 50 (the shielding plate 55) extends in a direction non-parallel to the surface "sfb". In the above-described scroll fluid machine 10, the flow regulator 50 shields the portion between the fixed scroll 20 and the orbiting scroll 30 from the direction parallel to the sliding contact surface "sfb". Thereby, it is possible to more effectively prevent the cooling fluid "cf' from flowing into the working room 11 together with the dust.

[0070] Further, in the above-described embodiment, the scroll fluid machine 10 further includes the case 15 that defines, with the fixed scroll 20, the space S in which the orbiting scroll 30 is disposed. The inlet port Sa and the outlet port Sb for the cooling fluid "cf" communicating with the space S are provided. The flow regulator 50 faces the inlet port Sa or the inlet port Sa2. Thus, the flow regulator 50 is disposed close to the orbiting scroll 30 and thereby it is possible to more effectively prevent the inflow of dust into the working room 11.

[0071] The flow regulator 50 is provided between the orbiting scroll 30 and the inlet port Sa or the inlet port Sa2. Thus, the flow regulator 50 is disposed close to the orbiting scroll 30 and thereby it is possible to more effectively prevent the inflow of dust into the working room 11.

[0072] Furthermore, in the above-described embodi-

ment, the orbiting scroll 30 has the base plate portion 31 that has the first surface 31a facing the working room 11 and including the surface "sfb" and the second surface 31b facing away from the working room. In the axis direction "ad" in which the fixed scroll 20 and the orbiting scroll 30 face each other, one end portion (the first end portion) 55a of the shielding plate 55 extends further than the surface "sfb" toward the fixed scroll 20, and the other end portion (the second end portion) 55b of the shielding plate 55 extends further than the second surface 31b in the direction away from the fixed scroll 20. In other in other words, the shielding plate 55 covers the base plate portion 31 over the entire thickness of the base plate portion from the radial direction "rd" in at least a part of the circumferential region surrounding the orbiting scroll 30. In the above-described scroll fluid machine 10, not only the shielding plate 55 of the flow regulator 50 shields the contact portion between the fixed scroll 20 and the orbiting scroll 30 from the direction parallel to the surface "sfb", but also it can guide the cooling fluid "cf" toward the second surface 31b of the base plate portion 31. Thereby, it is possible to more effectively prevent the cooling fluid "cf" from flowing into the working room 11 together with the dust.

[0073] Furthermore, in the above-described embodiment, the orbiting scroll 30 further includes heat radiation fins 34 extending from the second surface 31b of the base plate portion 31. In the axial direction "ad", the other end portion 55b of the shielding plate 55 (the flow regulator 50) is situated between the second surface 31b and the tip 34a of the heat radiation fin 34 distant from the base plate portion 31. In the above-described scroll fluid machine 10, not only the shielding plate 55 of the flow regulator 50 shields the contact portion between the fixed scroll 20 and the orbiting scroll 30 from the direction parallel to the surface "sfb", but also it can guide the cooling fluid "cf' toward the heat radiation fins 34 provided on the side of the second surface 31b of the base plate portion 31. Thereby, it is possible to more effectively prevent the cooling fluid "cf" from flowing into the working room 11 together with dust, and moreover it is possible to promote cooling of the orbiting scroll 30. By promoting cooling of the orbiting scroll 30, it is possible to effectively prevent leakage between the fixed scroll 20 and the orbiting scroll 30 caused by thermal deformation of the orbiting scroll 30.

[0074] Further, in the above-described embodiment, the flow regulator 50 includes the shielding plate 55 extending in the direction non-parallel to the surface "sfb", and the extension portion 59 extending from the shielding plate 55 toward the fixed scroll 20. In the above-described scroll fluid machine 10, the cooling fluid "cf" is unable to reach between the fixed scroll 20 and the orbiting scroll 30 unless it bypasses the extension portion 59. The extension portion 59 can effectively prevent the cooling fluid "cf" from flowing into the portion to be sealed between the fixed scroll 20 and the orbiting scroll 30. This also greatly reduces the flow speed of the cooling fluid "cf' flowing into the portion to be sealed between the fixed scroll 20 and the orbiting scroll 30 and greatly reduces the flow rate of the cooling fluid "cf' flowing into the portion. Thereby, it is possible to more effectively prevent the cooling fluid "cf" from flowing into the working room 11 together with the dust.

[0075] Furthermore, in the above embodiment, the extension portion 59 is situated between the tip 34a of the heat radiation fin 34 and the second surface 31b of the base plate portion 31 in the axial direction "ad". In this scroll fluid machine 10, it is possible to more effectively prevent the cooling fluid "cf" from flowing into the portion to be sealed between the fixed scroll 20 and the orbiting scroll 30, and to reliably guide the cooling fluid "cf" to the radiation fins 34 provided on the second surface 31b of the base plate portion 31. Thereby, it is possible to more effectively prevent the cooling fluid "cf' from flowing into the working room 11 together with dust, and moreover it is also possible to promote cooling of the orbiting scroll 30.

[0076] Further, in the embodiment, the edge 59a of the extension portion 59 opposite to the side connected to the shielding plate 55 has an arc profile. The extension portion 59 can be extended to the vicinity of the orbiting scroll 30 that is capable of orbiting relative to the fixed scroll 20. Thus it is possible to more effectively prevent the cooling fluid "cf" from flowing into the portion to be sealed between the fixed scroll 20 and the orbiting scroll 30, and to reliably guide the cooling fluid "cf" to the radiation fins 34 provided on the second surface 31b of the base plate portion 31.

[0077] Furthermore, in the above-described embodiment, the shielding plate portion 55 and the extension portion 59 may be formed of a bent metal plate. The flow regulator 50 configured in this manner has a simple structure and can be manufactured at low cost. Further, in a typical general scroll fluid machine 10, the fixed scroll 20, the orbiting scroll 30, and the case 15 are made of metal, so that the flow regulator 50 made of metal hardly has a difference in thermal expansion from these components. Therefore, it is possible to effectively prevent thermal deformation of the flow regulator 50, whereby the flow regulator 50 can stably achieve its expected function.

[0078] For example, the scroll fluid machine 10 described above is used as an air compressor in a vehicle 1 as shown in Fig. 12. Although a railway vehicle will be described as an example of the vehicle 1, the invention is not limited to this and can also be applied to work vehicles such as trucks, buses, vehicles for work at height, and the like. The vehicle 1 shown in Fig. 12 includes a vehicle body 5 and the scroll fluid machine 10 mounted on the vehicle body 5.

[0079] Various modifications can be made to the foregoing embodiment. With reference to the appended drawings, the following describes a modification example. In the following description and the drawings referred therein, elements that can be configured in a similar manner to those in the foregoing embodiment are denoted

by the same reference characters as those used for corresponding elements in the foregoing embodiment, and duplicate descriptions thereof are omitted.

[0080] In the above-described embodiment, the shielding plate 55 of the flow regulator 50 extends in parallel to the axial direction "ad" has been described. However the invention is not limited to this example. Alternatively, the shielding plate 55 may extend in a direction inclined with respect to the axial direction "ad" as shown in Fig. 7. The shielding plate 55 shown in Fig. 7 is situated on a line extended from the surface "sfb" of the orbiting scroll 30 and extends in a direction non-parallel to the surface "sfb". Therefore, the shielding plate 55 of the flow regulator 50 configured this way can also shield the contact portion between the fixed scroll 20 and the orbiting scroll 30 from the direction parallel to the surface "sfb" in the same manner as the above-described embodiment, and it is possible to effectively prevent foreign substances from flowing into the working room 11. Further, the first end portion 55a of the shielding plate 55 shown in Fig. 7 is situated closer to the fixed scroll 20 than the surface "sfb" of the orbiting scroll 30 in the axial direction "ad". Further, the second end portion 55b of the shielding plate 55 is positioned on the side away from the fixed scroll 20 with respect to the second surface 31b of the base plate portion 31 in the axial direction "ad", and is situated between the tip end 34a of the heat radiation fin 34 and the second surface 31b. With the shielding plate 55 configured as described above, it is possible to effectively prevent foreign substances from flowing into the working chamber 11 in the same manner as the above-described embodiment, and moreover, the orbiting scroll 30 can be efficiently cooled.

[0081] Further, in the above-described embodiment, the flow regulator 50 has the extension portion 59 separately from the shielding plate 55, however the invention is not limited thereto. As shown in Fig. 7, the extension portion 59 may be omitted. In the example shown in Fig. 7, the shielding plate 55 is inclined with respect to the radial direction "rd". More specifically, the shielding plate 55 is disposed closer to the orbiting scroll 30 in the radial direction "rd" as it is disposed more away from the fixed scroll 20 in the axial direction "ad". When the shielding plate 55 is configured in this way, since the second end portion 55b of the shielding plate 55 is disposed close to the orbiting scroll 30, it is possible to effectively prevent foreign substances from flowing into the working room 11 in the same manner as the extension portion 59 in the above-described embodiment.

[0082] Further, the flow regulator 50 is provided at the inlet port Sa in the above-described embodiment, however the invention is not limited to this example. For example, as shown in Figs. 8 and 9, the flow regulator 50 may be provided at any position within the space S between the inlet port Sa and the orbiting scroll 30. In this case, the flow regulator 50 is disposed closer to the orbiting scroll 30 and thereby it is possible to more effectively prevent the inflow of foreign substances into the working room 11. In the above-described embodiment, the shielding plate 55 faces the surface "sfb" in the region where the inlet port Sa is provided in the circumferential direction "cd" surrounding the orbiting scroll 30 as shown in Fig. 5 In order to prevent foreign substances from flowing into the working room 11, it is preferable that the shielding plate 55 covers the surface "sfb" of the orbiting scroll 30 from the radial direction "rd" over an angular range of 90° or more, preferably over an angular range of 180° or more, more preferably over an angular range of 270°, and most preferably over 360° along the circumferential direction "cd". In the example shown in Fig. 8, the shielding plate 55 extends along the circle centered on the rotation axis "ra" of the electric motor 41, that is, a circle concentric with the circumferential orbit of the translational motion of the orbiting scroll 30, and surrounds the surface "sfb" of the orbiting scroll 30 from the radial direction "rd" over an angular range of 180°.

[0083] It is preferable that the extension portion 59 connected to the shielding plate 55 extend from the shielding plate 55 along the flow direction of the cooling fluid "cf" from the inlet port Sa to the outlet port Sb. For example, the extension portion 59 preferably extends from the shielding plate portion 55 that extends in the circumferential direction "cd" toward the center in the radial direction in the region of the angular range of 180° along the circumferential direction "cd" about the inlet port Sa. Further, in the region of the angular range of 180 ° along the circumferential direction "cd" about the outlet port Sb, the extension portion 59 extends radially outward (the side opposite to the center side) from the shielding plate 55 that extends in the circumferential direction "cd". When the extension portion 59 extends from the shielding plate 55 along the flow direction of the cooling fluid "cf", the dust guided by the cooling fluid smoothly flows toward the outlet port without being caught by the extension portion 59.

[0084] Further, the flow regulator (flow regulation means) 50 formed as a plate member has been illustrated in the above-described embodiment, the invention is not limited thereto. The flow regulator (flow regulation means) 50 may be configured as various means capable of restricting the air flow directed between the fixed scroll 20 and the orbiting scroll 30. For example, the flow regulator (flow regulation means) 50 may be an air curtain.

[0085] In addition to or in place of the above-described flow regulator 50, a flow regulator (a second flow regulator, a flow guiding member, flow guiding means) 60 may be provided in the scroll fluid machine 10 as shown in Figs. 10 and 11. The flow regulator 60 is also capable of regulating the air flow from the outside to the outer peripheral portion of the region where the fixed scroll 20 and the orbiting scroll 30 face each other. More specifically, the flow regulator (flow guiding member) 60 guides the flow of the cooling fluid "cf" flowing from the inlet port Sa to the outlet port Sb to the side away from the fixed scroll 20 in the axial direction "ad" where the fixed scroll 20 and the orbiting scroll 30 face each other. The flow

regulator (flow guiding member) 60 shown in Figs. 10 and 11 extends from the orbiting scroll 30 toward the side away from the fixed scroll 20 in the axial direction "ad" where the fixed scroll 20 and the orbiting scroll 30 face each other.

[0086] With the above described flow regulator (flow guiding member) 60, it is possible to effectively prevent a large amount of the cooling fluid "cf' from flowing at high pressure or high speed into the space between the fixed scroll 20 and the orbiting scroll 30 where should be sealed. Thus, it is possible to effectively prevent the cooling fluid "cf" from flowing into the working room 11 together with dust, and consequently it is possible to effectively prevent premature deterioration of the tip seals 23a, 33a of the wraps 23, 33 of the scrolls 20, 30 caused by the friction with foreign substances. Therefore, it is possible to extend the life of the tip seals 23a, 33a, and thereby it is possible to reduce the frequency of overhaul maintenance of the scroll fluid machine 10. The above-described flow guiding member 60 is particularly useful for an oilless scroll fluid machine 10 for which an overhaul maintenance is supposed not to carry out for a long period of time.

[0087] In the examples shown in Figs. 10 and 11, the flow regulator (flow guiding member) 60 has a base end portion 60a connected to the orbiting scroll 30, and a distal end portion 60b remote from the orbiting scroll 30. In the axial direction "ad" of the scroll fluid machine 10, the distal end portion 60b is situated more distant from the portion to be sealed between the fixed scroll 20 and the orbiting scroll 30 than the base end portion 60a. The flow regulator (flow guiding member) 60 extends into the space S from the second surface 31b of the base plate portion 31 of the orbiting scroll 30. In the example shown in Figs. 10 and 11, the flow regulator (flow guiding member) 60 is situated between the inlet port Sa and the outlet port Sb. The flow regulator (flow guiding member) 60 is situated between the flow regulator 50 and the outlet port Sb. The flow regulator 50 is situated between the flow regulator (flow guiding member) 60 and the inlet port Sa. The distance from the flow regulator (flow guiding member) 60 to the outlet port Sb is smaller than the distance from the flow regulator (flow guiding member) 60 to the inlet port Sa. The flow regulator (flow guiding member) 60 is situated in the vicinity of the outlet port Sb. These configurations and arrangements are effective for more remarkably obtaining the advantageous effect of the above-described flow regulator (flow guiding member) 60.

[0088] The flow regulator (flow guiding member) 60 shown in Fig. 10 extends from the orbiting scroll 30 such that it is disposed closer to the outlet port Sb and away from the inlet port Sa in the direction connecting the inlet port Sa and the outlet port Sb. Therefore, the flow of the cooling fluid "cf' away from the inlet port Sa toward the outlet port Sb can be guided so as to be separated from the portion to be sealed between the fixed scroll 20 and the movable scroll 30 without significantly disturbing it can do.

[0089] The flow regulator (flow guiding member) 60 shown in Fig. 11 includes a guiding plate 61 that extends from the orbiting scroll 30 and a flow regulating plate 62 that extends from an end of the guiding plate 61 situated away from the orbiting scroll 30. The guiding plate 61 extends substantially in parallel with the axial direction "ad" of the scroll fluid machine 10. The flow regulating plate 62 extends toward the outlet port Sb substantially in parallel with the direction connecting the inlet port Sa and the outlet port Sb. With this flow regulator (flow guiding member) 60, the cooling fluid "cf' whose traveling direction is changed by the guiding plate 61 can be stably directed to the outlet port Sb by the flow regulating plate 62.

[0090] In the examples shown in Figs. 10 and 11, the distal end portion 60b of the flow regulator (flow guiding member) 60 is situated closer to the outlet port Sb than the end of the base plate portion 21 in the direction connecting the inlet port Sa and the outlet port Sb. With the flow regulator (flow guiding member) 60 configured in the above-described way, it is possible to effectively prevent the cooling fluid "cf' guided by the flow regulator (flow guiding member) 60 from flowing into the space where should be sealed between the fixed scroll 20 and the orbiting scroll 30.

[0091] Although the flow regulator 50 and the flow regulator (flow guiding member) 60 in the above-described embodiment respectively have a plate-like cross section, they may have a different cross section such as a curved shape. For example, to obtain a smooth flow of the cooling fluid "cf", the cross-sectional shape may be made into a curve. In the case of a plate-like cross section with straight lines, molding is relatively easy.

[0092] While several modification examples with respect to the foregoing embodiment have thus been described, needless to say, plural ones of these modification examples can be combined as appropriate, and such combinations are also applicable to the present invention.

Claims

1. A scroll fluid machine, comprising:

a fixed scroll;
an orbiting scroll disposed to face the fixed scroll and moving relative to the fixed scroll; and
a flow regulator regulating air flow from the outside to an outer peripheral portion of a region where the fixed scroll and the orbiting scroll face each other.

2. The scroll fluid machine of claim 1, wherein

the orbiting scroll relatively moves while being in contact with the fixed scroll, and

the flow regulator is situated on the extension of a surface of the orbiting scroll that contacts the fixed scroll.

3. The scroll fluid machine of claim 1 or 2, further comprising:

a case fixed to the fixed scroll,
wherein the orbiting scroll is disposed in a space between the case and the fixed scroll,
an inlet port and an outlet port for a cooling fluid are provided so as to communicate with the space, and
the flow regulator is disposed at the inlet port or between the inlet port and the orbiting scroll.

4. The scroll fluid machine of any one of claims 1 to 3, wherein
the orbiting scroll relatively moves while being in contact with the fixed scroll,
the orbiting scroll has a base plate portion having a first surface that includes a surface contacting the fixed scroll and a second surface that faces opposite to the first surface,
in a direction in which the fixed scroll and the orbiting scroll face each other, one end portion of the flow regulator is situated closer to the fixed scroll than the surface, and the other end portion of the flow regulator is situated more distant from the fixed scroll than the second surface.

5. The scroll fluid machine of claim 4, wherein
the orbiting scroll further includes a heat radiation fin extending from the second surface of the base plate portion, and
in the direction in which the fixed scroll and the orbiting scroll face each other, the other end portion of the flow regulator is situated between the second surface and a tip of the heat radiation fin most distant from the base plate portion.

6. The scroll fluid machine of claim 5, wherein the flow regulator includes a shielding plate extending in a direction non-parallel to the surface, and an extension portion extending from the shielding plate toward the orbiting scroll.

7. The scroll fluid machine of claim 6, wherein in the direction in which the fixed scroll and the orbiting scroll face each other, the extension portion is situated between the second surface and the tip of the heat radiation fin most distant from the base plate portion.

8. The scroll fluid machine of claim 6 or 7, wherein an edge of the extension portion situated opposite to a side connected to the shielding plate has an arc profile.

9. The scroll fluid machine of any one of claims 6 to 8, wherein the shielding plate and the extension portion are formed of a bent metal plate.

10. The scroll fluid machine of any one of claims 1 to 9, wherein the flow regulator is provided on the fixed scroll.

11. The scroll fluid machine of claim 1, wherein the flow regulator is provided on the orbiting scroll.

12. The scroll fluid machine of claim 11, wherein the flow regulator extends from the orbiting scroll toward a side away from the fixed scroll in a direction in which the fixed scroll and the orbiting scroll face each other.

13. The scroll fluid machine of claim 11 or 12, further comprising:

a case fixed to the fixed scroll,
wherein the orbiting scroll is disposed in a space between the case and the fixed scroll,
an inlet port and an outlet port for a cooling fluid are provided so as to communicate with the space, and
the flow regulator guides a flow of the cooling fluid from the inlet port to the outlet port such that the flow of the cooling fluid moves away from the fixed scroll in the direction in which the fixed scroll and the orbiting scroll face each other.

14. The scroll fluid machine of any one of claims 1 to 13, wherein the scroll fluid machine is an air compressor used for railway vehicles.

15. A railway vehicle, comprising;
a vehicle body; and
the scroll fluid machine of any one of claims 1 to 14 mounted on the vehicle body.

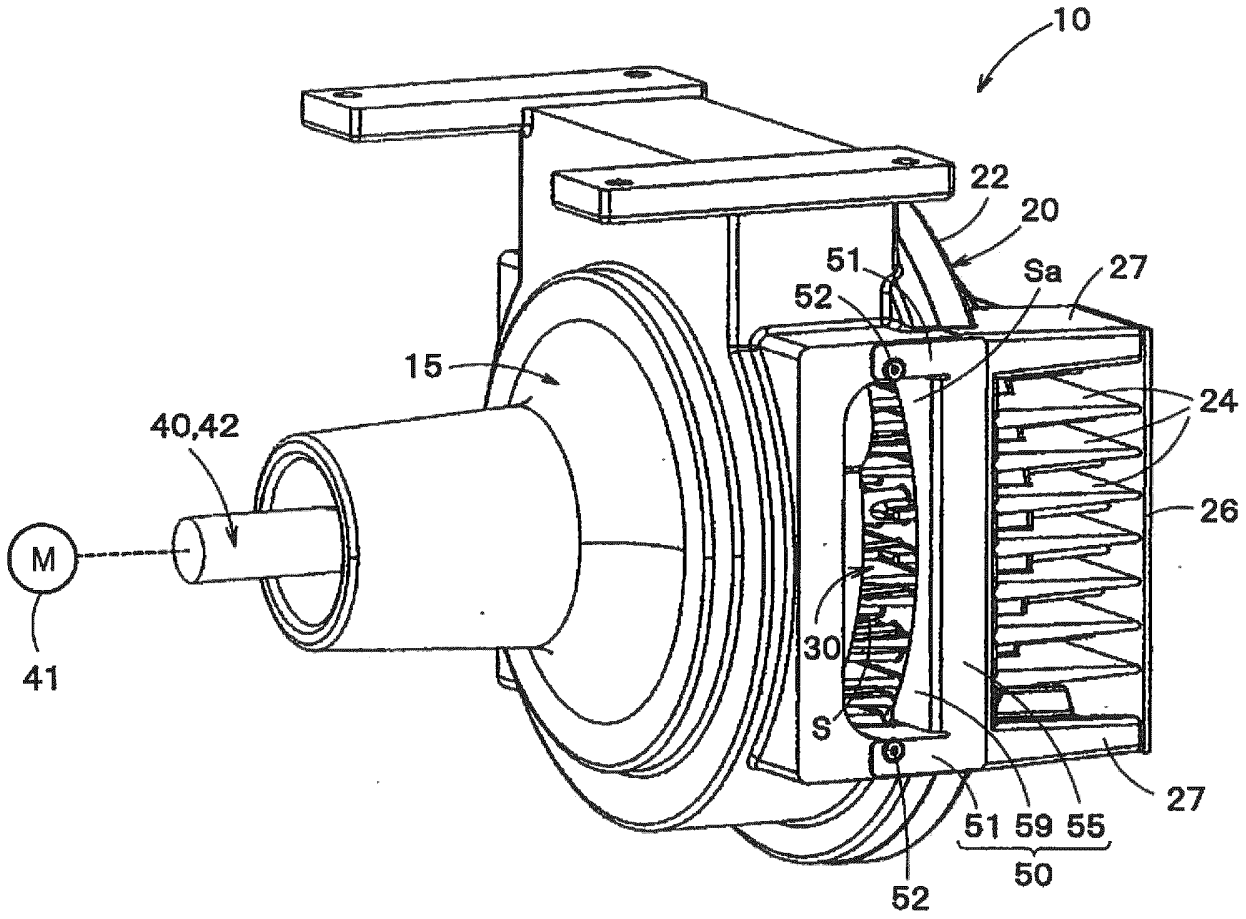

Fig. 1

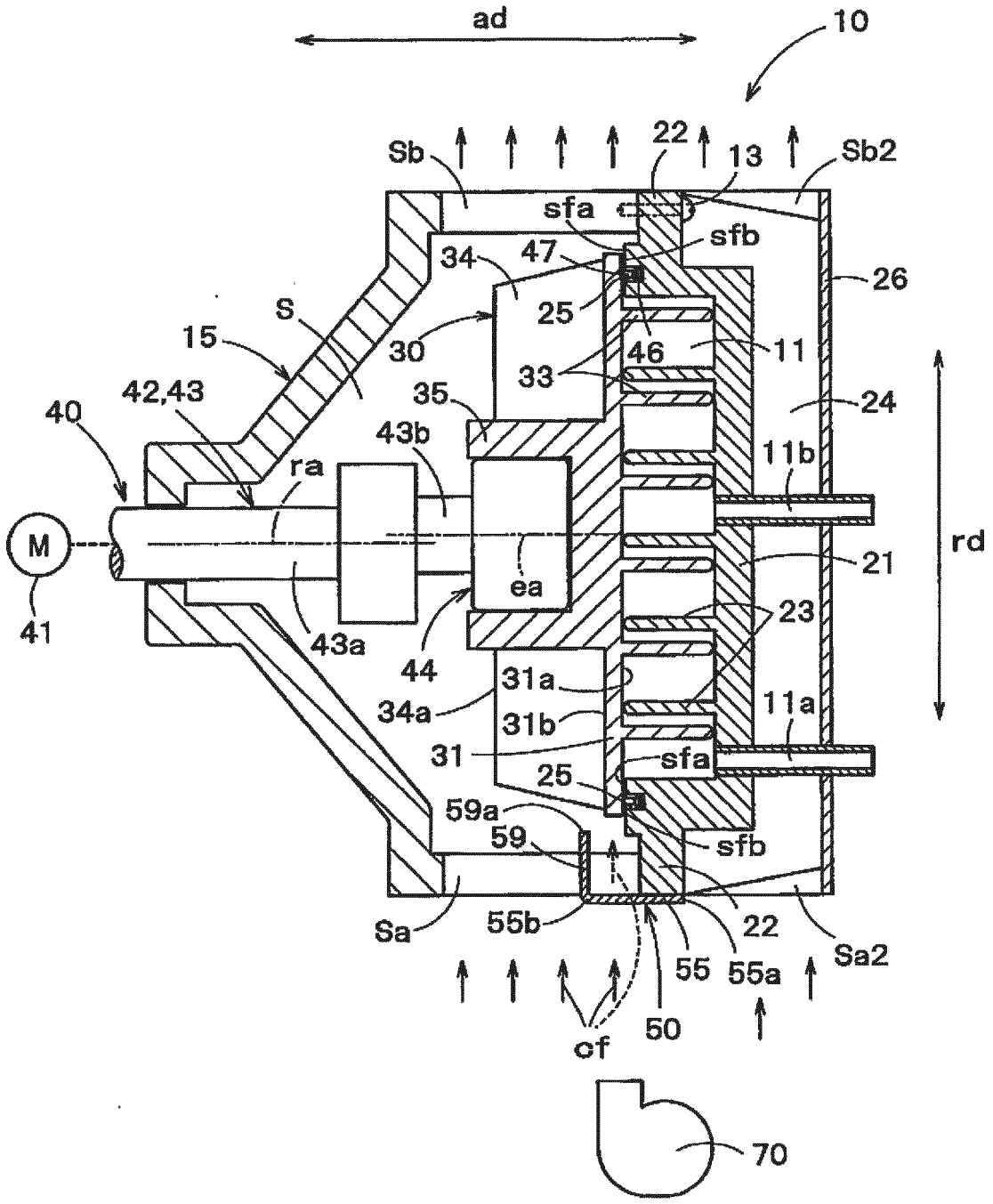
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Fig. 2

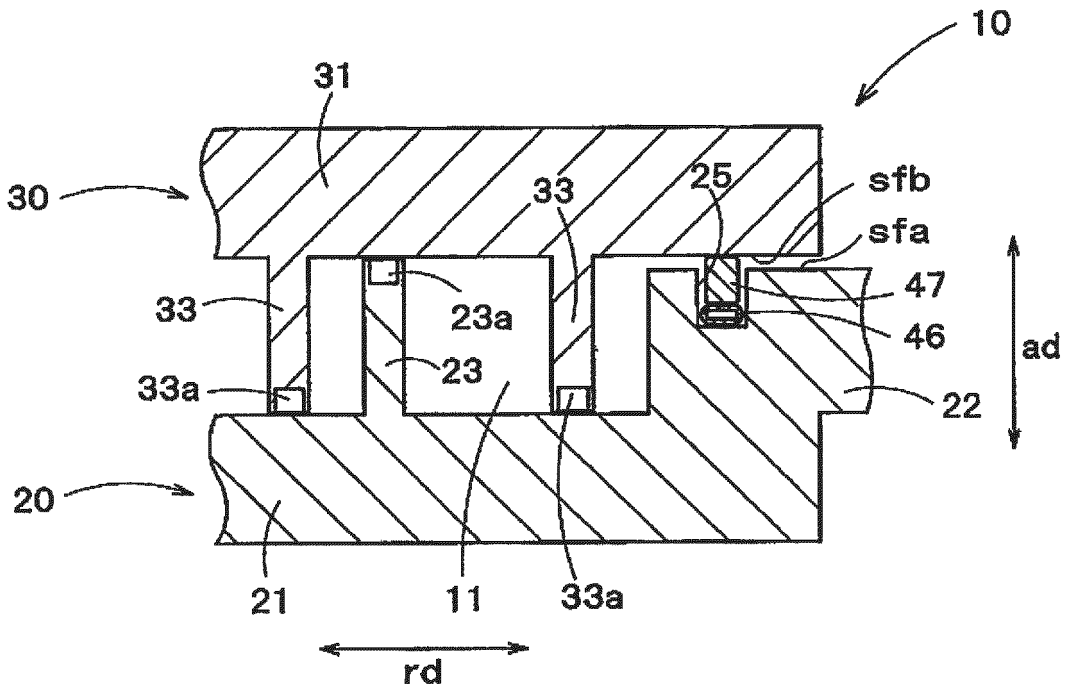
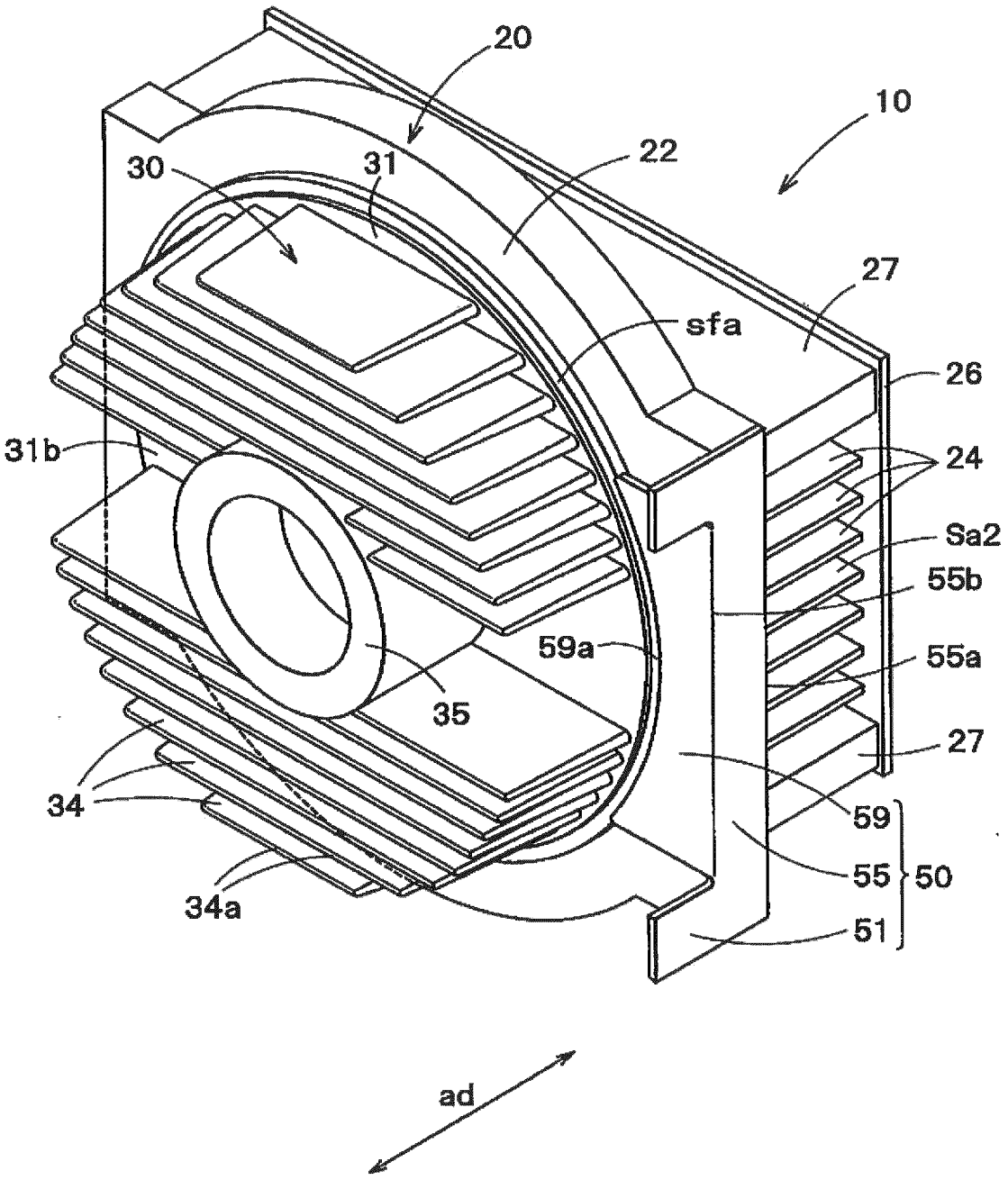


Fig. 3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34a
51
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Fig. 4

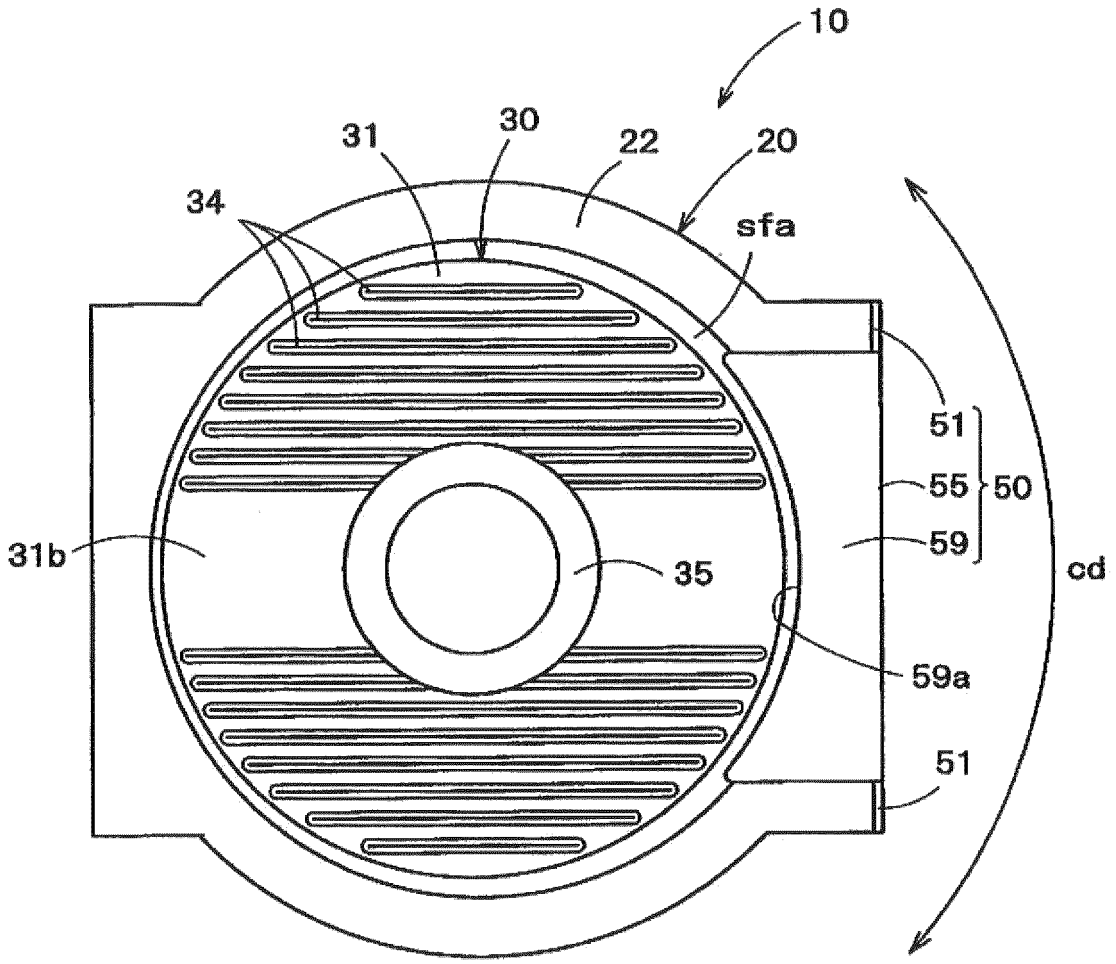


Fig. 5

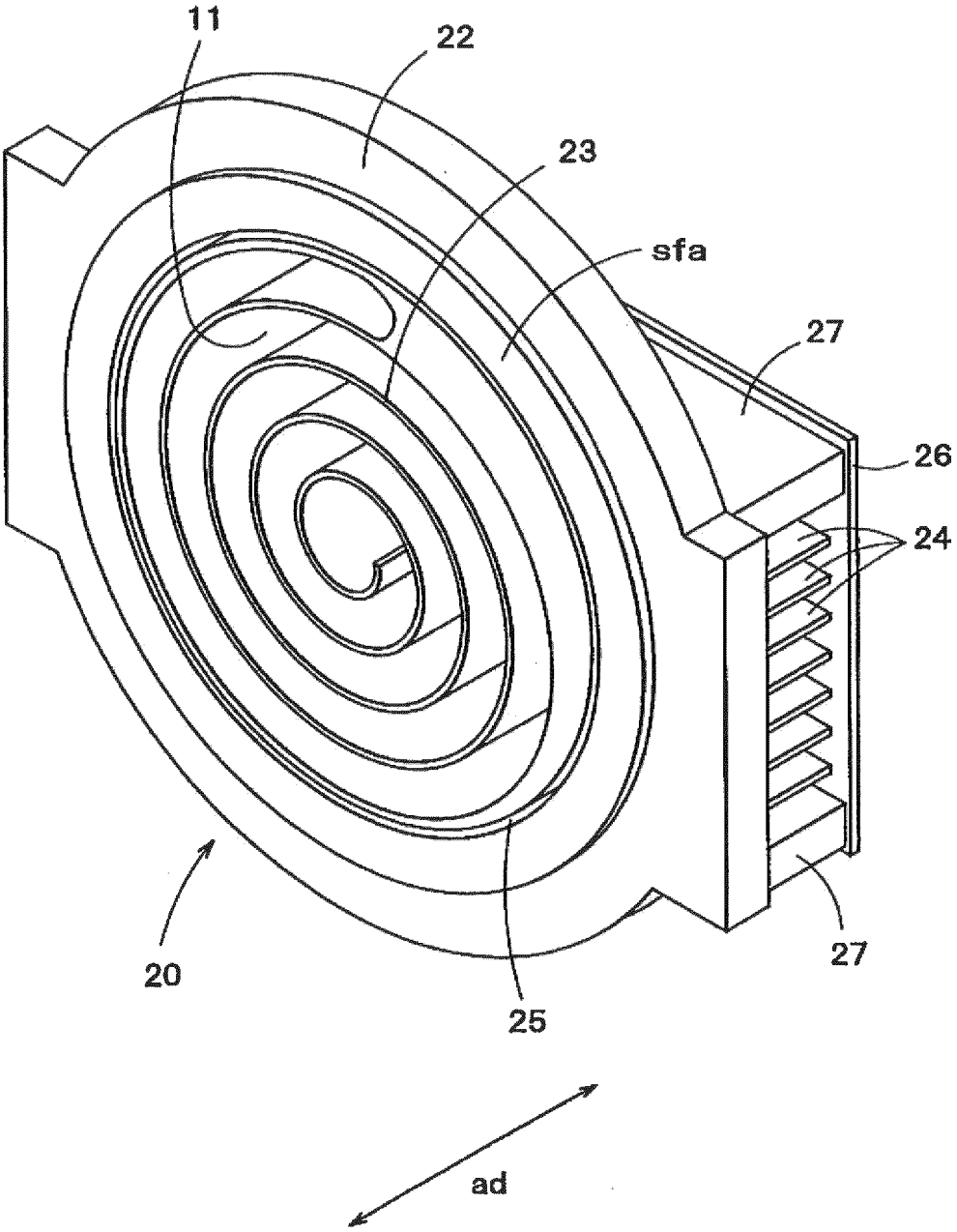
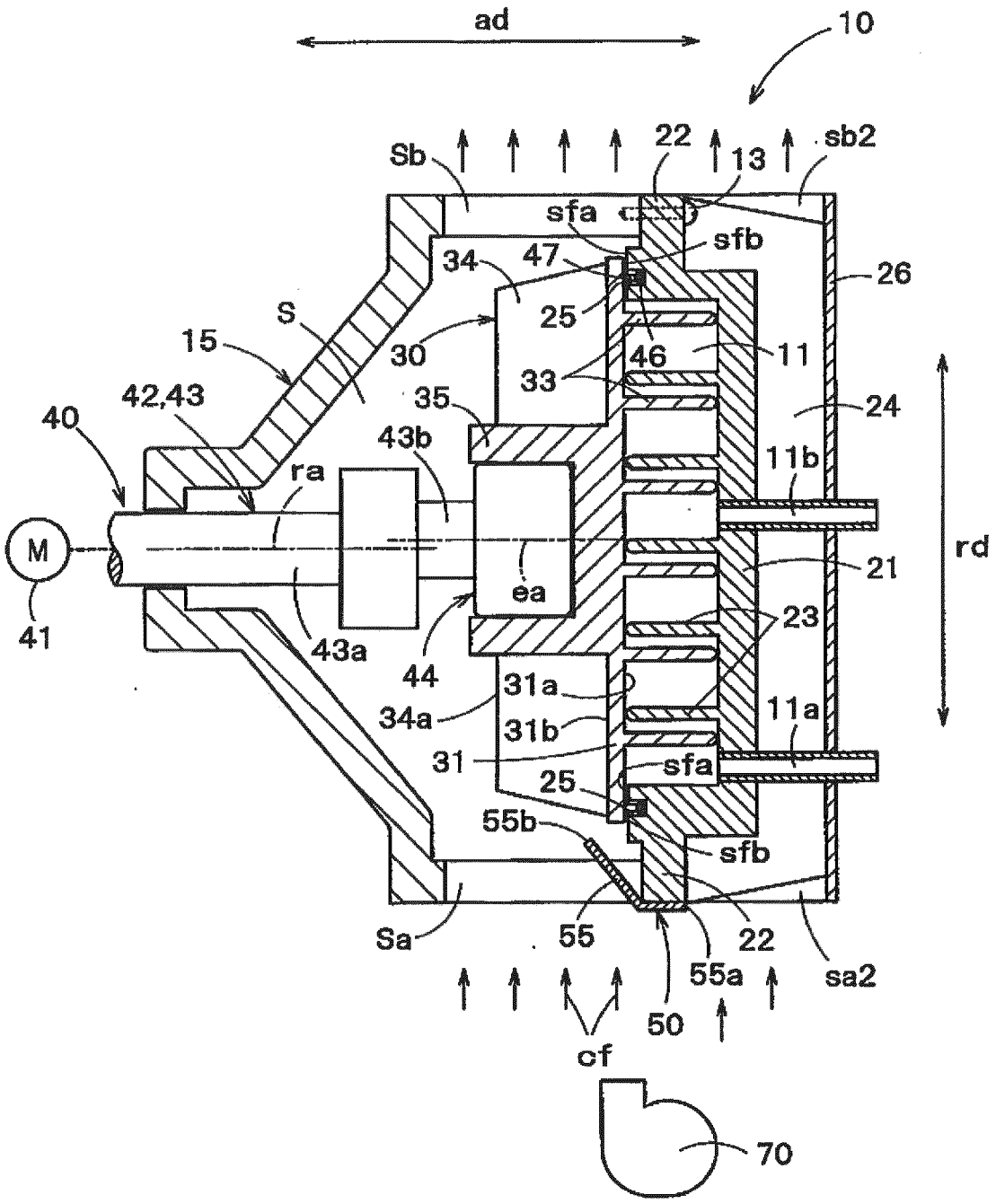


Fig. 6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sfa
sfb
34
47
26
S
25
15
30
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11
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42,43
35
24
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43b
11b
ra
M
rd
21
ea
41
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43a
44
31a
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Sa
55
22
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sa2
50
cf
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Fig. 7

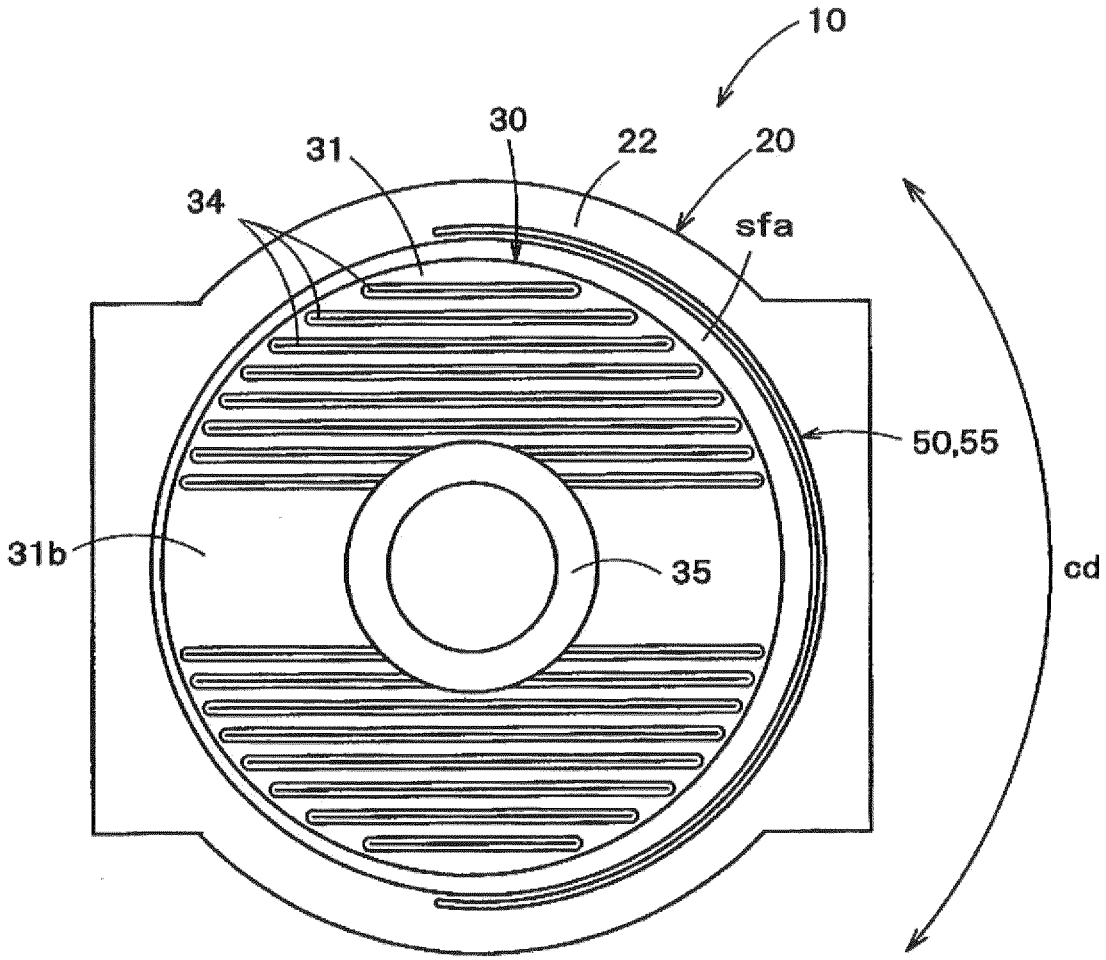
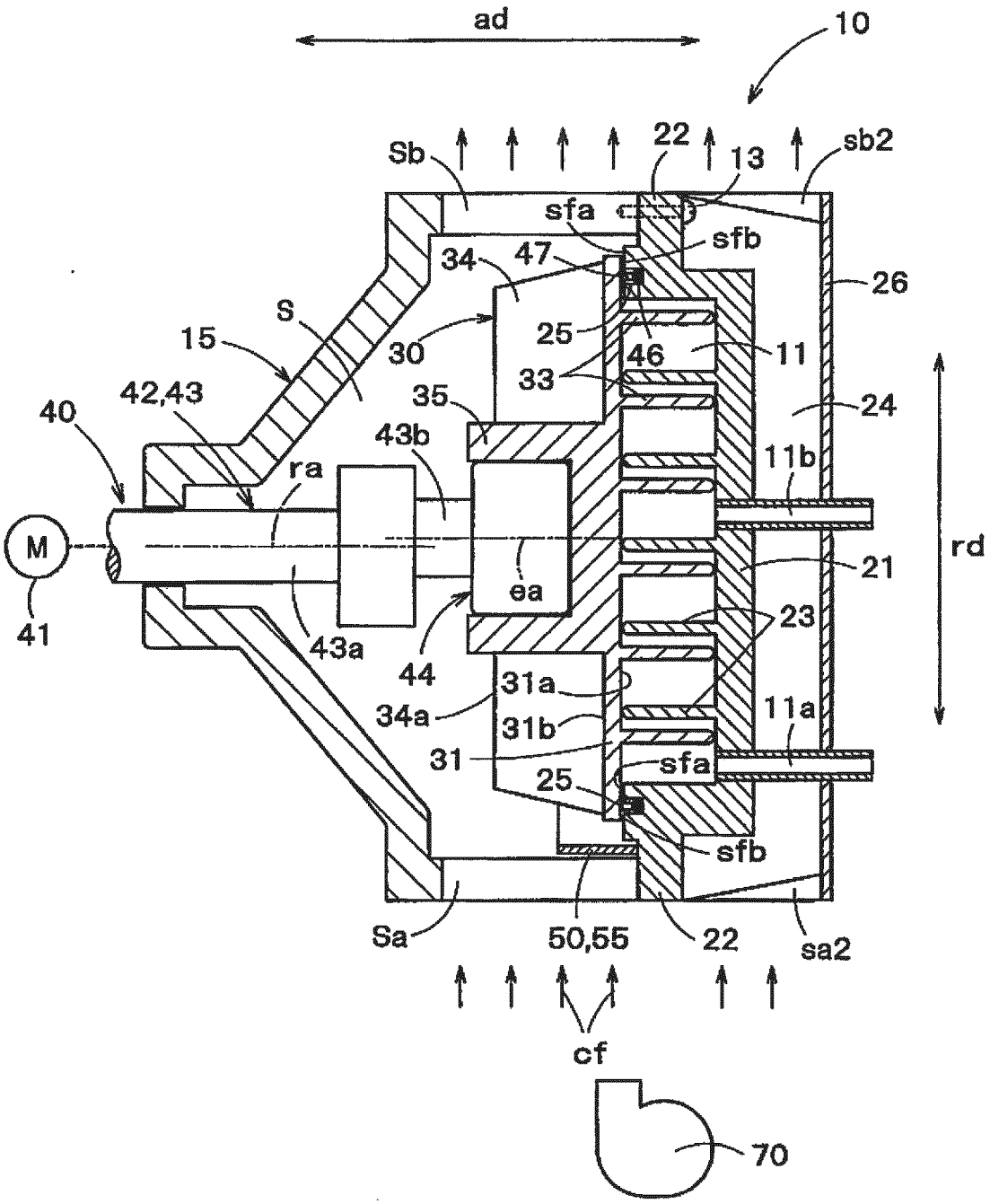


Fig. 8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sb2
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ra
M
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rd
ea
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sfb
Sa
50,55
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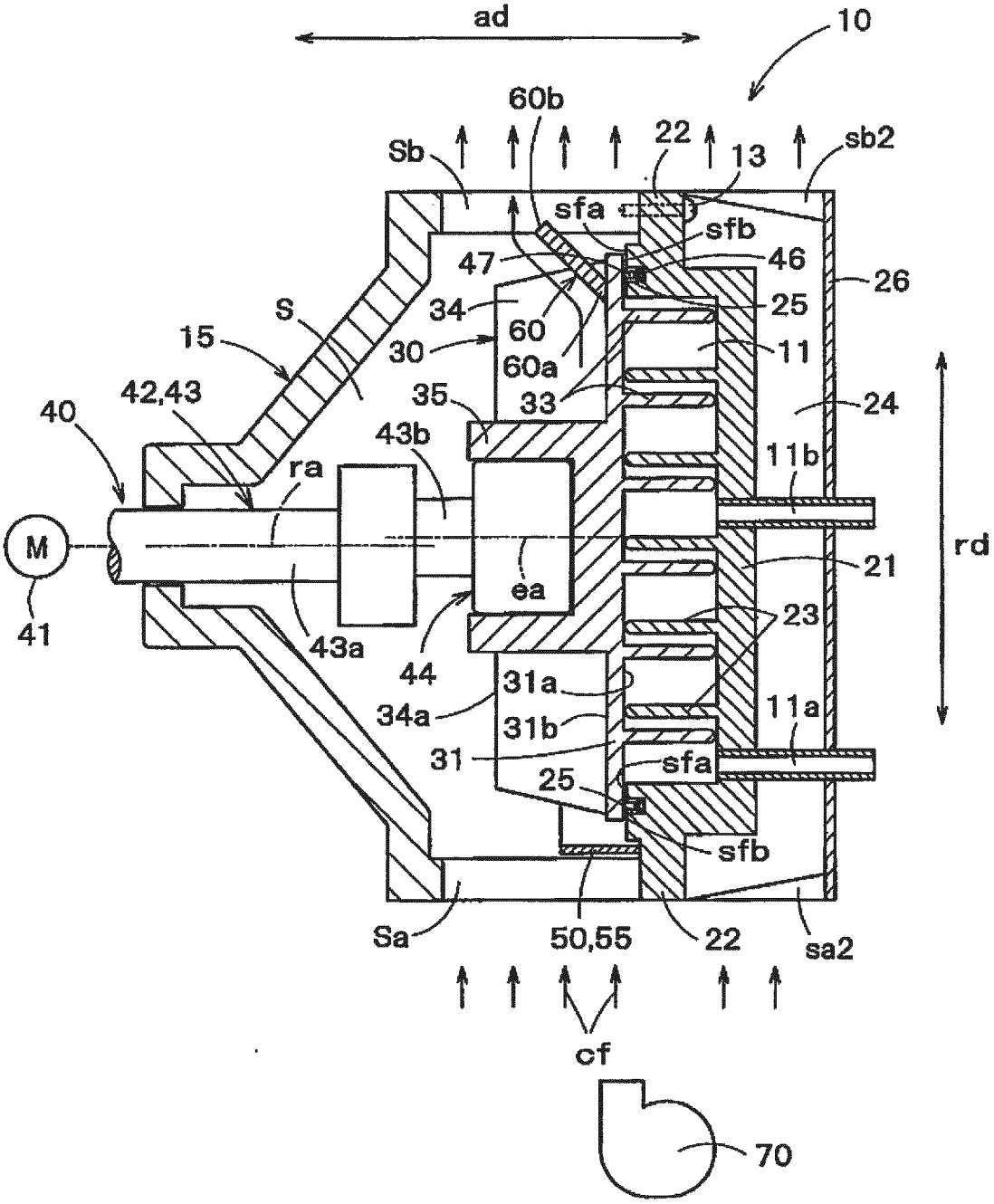
sa2
cf
70

Fig. 9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sfb
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35
33
24
40
43b
11b
ra
M
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rd
ea
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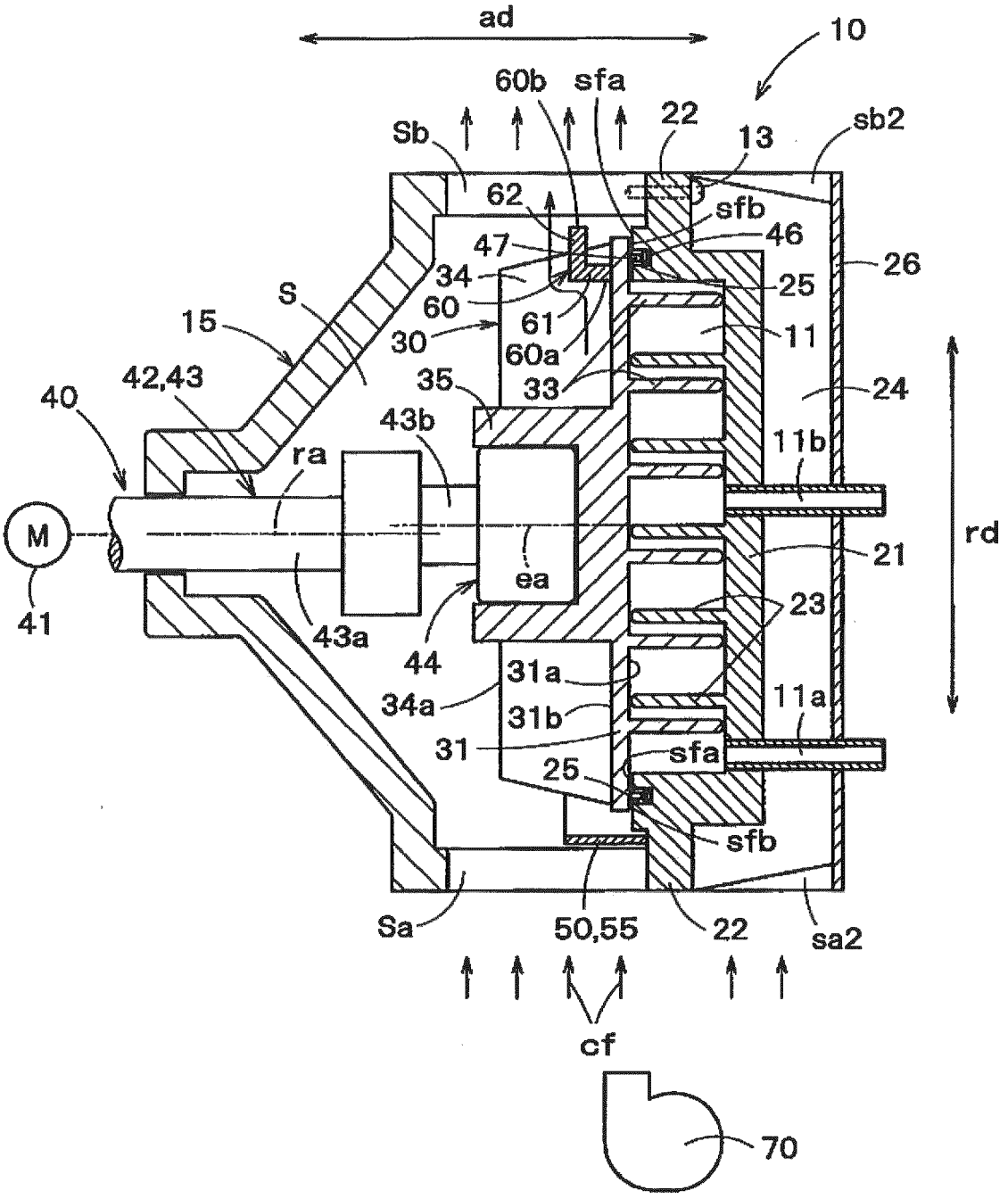
sfb
Sa
50,55
22
sa2
cf
70

Fig. 10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ra
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rd
ea
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Sa
50,55
22
sa2
cf
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Fig. 11

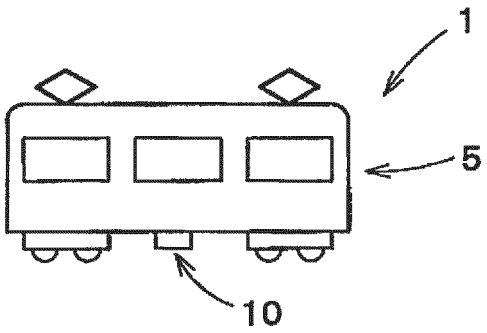

Fig. 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/046523

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F04C18/02(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl. F04C18/02

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	JP 8-261181 A (TOKICO, LTD.) 08 October 1996, paragraphs [0015]-[0043], fig. 1-2 (Family: none)	1-7, 10 8-9, 14-15 13
X Y	JP 2-173380 A (HITACHI, LTD.) 04 July 1990, page 3, upper left column, line 17 to page 5, upper left column, line 8, fig. 1-3 (Family: none)	1-4, 10 8-9, 14-15
X Y	JP 2-245488 A (HITACHI, LTD.) 01 October 1990, page 3, upper left column, line 15 to lower right column, line 5, page 4, lower right column, line 11 to upper left column, line 13, fig. 1, 4-5 (Family: none)	1-2, 10-12 14-15
Y	WO 2015/011875 A1 (MITSUBISHI HEAVY INDUSTRIES, LTD.) 29 January 2015, paragraphs [0025]-[0026], fig. 1 & EP 2998585 A1, paragraphs [0054]-[0059], fig. 1 & JP 2015-25387	14-15

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

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"O" document referring to an oral disclosure, use, exhibition or other means
"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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"&" document member of the same patent family

Date of the actual completion of the international search 05 March 2018 (05.03.2018)	Date of mailing of the international search report 13 March 2018 (13.03.2018)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

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Patent documents cited in the description

- JP H7208353 B **[0002]**
- JP H7208353 A **[0002]**