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(54) **SCROLL FLUID MACHINE**

(57) Provided is a scroll fluid machine that is capable of improving performance of the scroll fluid machine by effectively exhibiting a tip seal function even when a continuous slope is provided to a wall body and an end plate. A slope in which the distance between opposing surfaces of opposing end plates (3a, 5a) reduces from the outer peripheral side toward the inner peripheral side is provided, and a tip seal (7) that comes into contact with an opposing tooth bottom so as to seal a fluid is provided to a tip seal groove (3d) formed at a tooth tip of the wall body (3b, 5b) corresponding to the slope. A plate spring (11) that urges the tip seal (7) to the tooth bottom side is provided between the tip seal (7) and the groove bottom (3d1) of the tip seal groove (3d).

FIG. 8A

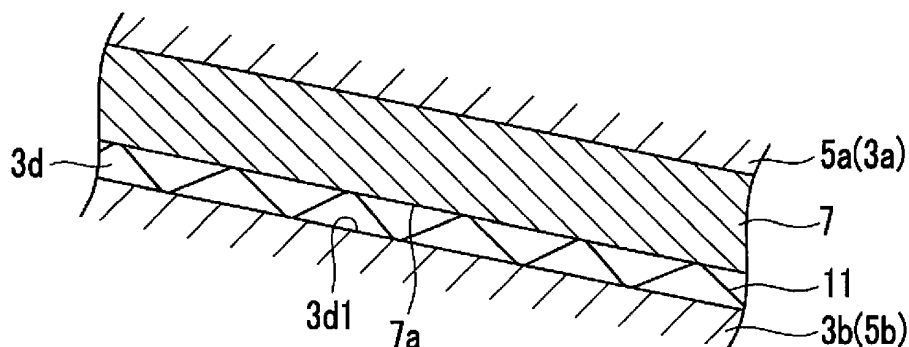
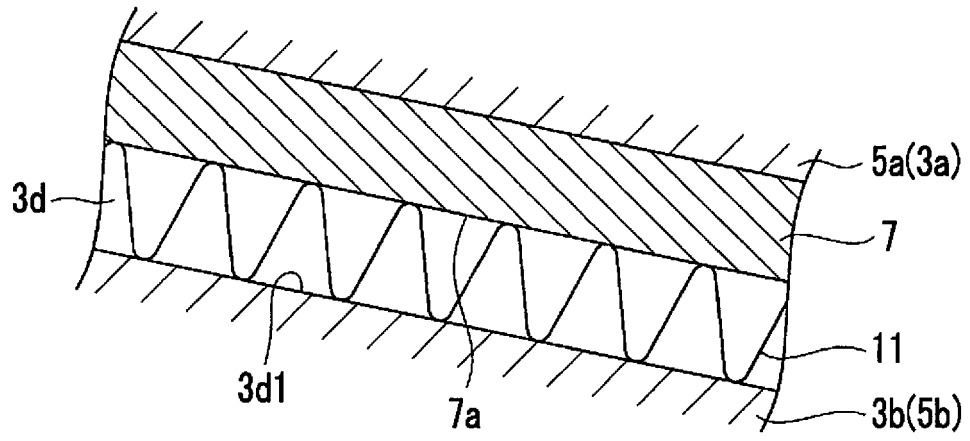


FIG. 8B



Description

Technical Field

[0001] The present invention relates to a scroll fluid machine.

Background Art

[0002] In general, a scroll fluid machine is known, in which a fixed scroll member and an orbiting scroll member each having a spiral wall provided on an end plate mesh with each other so as to perform a revolution orbiting movement and a fluid is compressed or expanded.

[0003] As the scroll fluid machine, a so-called stepped scroll compressor which is described in PTL 1 is known. In the stepped scroll compressor, step portions are provided at positions of tooth tip surfaces and tooth bottom surfaces of spiral walls of a fixed scroll and an orbiting scroll in a spiral direction and a height on an outer peripheral side of each wall is higher than a height on an inner peripheral side thereof with each step portion as a boundary. The stepped scroll compressor is compressed (three-dimensionally compressed) not only in a circumferential direction of the wall but also in a height direction thereof, and thus, compared to a general scroll compressor (two-dimensional compressed) which does not have the step portion, an amount of displacement increases, and thus, compressor capacity can increase.

Citation List

Patent Literature

[0004] [PTL 1] Japanese Unexamined Patent Application Publication No. 2015-55173

Summary of Invention

Technical Problem

[0005] However, in the stepped scroll compressor, there is a problem that fluid leakage in the step portion is large. In addition, there is a problem that stress concentrates on a base portion of the step portion and strength decreases.

[0006] Meanwhile, the inventors are studying to provide a continuously inclined portion instead of the step portion provided on the wall and the end plate.

[0007] A groove portion for receiving a tip seal is formed on a tooth tip, which is a tip of the wall, along a spiral direction of the wall. During an operation of the scroll compressor, the tip seal comes into contact with a tooth bottom facing the tooth tip while sliding on the tooth bottom, and thus, a fluid leakage is suppressed.

[0008] If a continuously inclined portion is provided on the wall and the end plate, when both scroll members perform the revolution orbiting movement, the positions

of the tooth tip and the tooth bottom are relatively deviated from each other, and thus, a tip clearance between the tooth tip and tooth bottom is changed for each an orbiting angle. Therefore, if the tip clearance is changed for each orbiting angle, the tip seal cannot follow the tip clearance, and there is a concern that seal performance decreases.

[0009] The present invention is made in consideration of the above-described circumstances, and an object thereof is to provide a scroll fluid machine capable of effectively exerting a function of the tip seal even in a case where the continuously inclined portion is provided on the wall and the end plate so as to improve performance. Solution to Problem

[0010] In order to achieve the above-described objects, and a scroll fluid machine of the present invention adopts the following means.

[0011] According to an aspect of the present invention, there is provided a scroll fluid machine including: a first scroll member in which a spiral first wall is provided on a first end plate; a second scroll member in which a spiral second wall is provided on a second end plate disposed to face the first end plate and the second wall meshes with the first wall such that the second scroll member performs a revolution orbiting movement relative to the first scroll member; and an inclined portion in which an inter-facing surface distance between the first end plate and the second end plate facing each other continuously decreases from outer peripheral sides of the first wall and the second wall toward inner peripheral sides thereof, in which a tip seal which comes into contact with a facing tooth bottom so as to seal a fluid is provided in a groove portion formed on a tooth tip of each of the first wall and the second wall corresponding to the inclined portion, and a biasing member which biases the tip seal toward the tooth bottom side is provided between the tip seal and the groove bottom of the groove portion.

[0012] The inclined portion is provided in which the inter-facing surface distance between the first end plate and the second end plate continuously decreases from outer peripheral side of the wall toward inner peripheral side thereof. Accordingly, as a fluid sucked from the outer peripheral side flows toward the inner peripheral side, the fluid not only is compressed by a decrease of a compression chamber according to a spiral shape of the wall but also is further compressed by a decrease of the inter-facing surface distance between the end plates.

[0013] If both scroll members perform the revolution orbiting movement, in the inclined portion, positions of the tooth tip and the tooth bottom are relatively deviated, and thus, a tip clearance between the tooth tip and the tooth bottom is changed for each orbiting angle. Accordingly, the biasing member which biases the tip seal toward the tooth bottom side is provided between the tip seal and the groove bottom, and thus, even in a case where the tip clearance is changed for each orbiting angle, the tip clearance can follow the tip seal. Accordingly, a fluid leakage is reduced, a function of the tip seal is effectively exerted, and performance of the scroll fluid

machine can be improved.

[0014] In addition, in the scroll fluid machine of the present invention, the biasing member has a deformation amount which is equal to or more than a change amount of a tip clearance between the tooth tip of the wall and the tooth bottom of the end plate facing the tooth tip.

[0015] The biasing member can be deformed to be equal to or more than the change amount of the tip clearance, and thus, the tip seal can be always pressed to the tooth bottom over the entire orbiting angle.

[0016] If an orbiting radius is defined as ρ and an inclination of the inclined portion is defined as φ , the change amount of the tip clearance becomes $2\rho \times \tan\varphi$.

[0017] Moreover, in the scroll fluid machine of the present invention, the biasing member has a deformation amount which is smaller than a depth of the groove portion.

[0018] The deformation amount of the biasing member is smaller than the depth of the groove portion, and thus, during assembly, it is possible to prevent the tip seal from falling off from the groove portion.

[0019] In addition, in the scroll fluid machine of the present invention, the biasing member is a spring member which is disposed between the tip seal and the groove bottom.

[0020] As the biasing member, the spring member is disposed the tip seal and the groove bottom. For example, a leaf spring is used as the spring member.

[0021] Moreover, in the scroll fluid machine of the present invention, the biasing member is a plurality of protrusion portions which are formed on a bottom portion of the tip seal.

[0022] The plurality of protrusion portions formed on the bottom portion of the tip seal are set to the biasing member. An elastic deformation is performed by extending or contracting the protrusion portions or bending the protrusion portions. In addition, the protrusion portions are formed together with the tip seal, and thus, the number of parts is reduced and the assembly is easily performed.

[0023] In addition, in the scroll fluid machine of the present invention, the biasing member has a deformation amount which is less than a change amount of a tip clearance between the tooth tip of the wall and the tooth bottom of the end plate facing the tooth tip, and is a plurality of protrusion portions formed on a bottom portion of the tip seal.

[0024] The deformation amount of the biasing member is less than the change amount of the tip clearance, and thus, if the tip clearance is equal to or more than a predetermined value, the tip seal floats from the groove bottom due to a pressure of the fluid entering the bottom surface side of the tip seal. In this case, the plurality of protrusion portions are formed on the bottom portion of the tip seal, and thus, the flow of the fluid is obstructed by a labyrinth seal effect. Accordingly, it is possible to reduce the fluid leakage.

[0025] In addition, excessive pressing of the tip seal to

the tooth bottom can be avoided, and reliability of the tip seal can be improved.

[0026] Preferably, the respective protrusion portions are provided to be repeated in the spiral direction of the tip seal. Accordingly, it is possible to suppress the fluid leakage in the spiral direction.

Advantageous Effects of Invention

[0027] The biasing member which biases the tip seal toward the tooth bottom side is provided between the tip seal and the groove bottom, and thus, even in a case where the tip clearance is changed for each orbiting angle, the tip clearance can follow the tip seal. Accordingly, a fluid leakage is reduced, a function of the tip seal is effectively exerted, and performance of the scroll fluid machine can be improved.

Brief Description of Drawings

[0028]

Figs. 1A and 1B show a fixed scroll and an orbiting scroll of a scroll compressor according to a first embodiment of the present invention, Fig. 1A is a longitudinal section view, and Fig. 1B is a plan view when the fixed scroll is viewed from a wall side.

Fig. 2 is a perspective view showing the orbiting scroll of Figs. 1A and 1B.

Fig. 3 is a plan view showing an end plate flat portion provided in the fixed scroll.

Fig. 4 is a plan view showing a wall flat portion provided in the fixed scroll.

Fig. 5 is a schematic view showing a wall which is displayed to extend in a spiral direction.

Fig. 6 is a partially enlarged view showing a region indicated by a reference numeral Z in Fig. 1B in an enlarged manner.

Figs. 7A and 7B show a tip clearance of a portion shown in Fig. 6, Fig. 7A is a side view showing a state where the tip clearance relatively decreases, and Fig. 7B is a side view showing a state where the tip clearance relatively increases.

Figs. 8A and 8B show a leaf spring which is provided on a bottom portion of a tip seal, Fig. 8A is a side view showing a state where the tip clearance is the smallest tip clearance, and Fig. 8B is a side view showing a state where the tip clearance is the greatest tip clearance.

Figs. 9A and 9B show the leaf spring provided on the bottom portion of the tip seal, Fig. 9A is a horizontal sectional view showing the state where the tip clearance is the smallest tip clearance, and Fig. 9B is a horizontal sectional view showing the state where the tip clearance is the greatest tip clearance. Figs 10A and 10B show a protrusion portion provided on the bottom portion of the tip seal according to a second embodiment of the present invention, Fig.

10A is a side view showing a state where the tip clearance is the smallest tip clearance, and Fig. 10B is a side view showing a state where the tip clearance is the greatest tip clearance.

Figs 11A and 11B show a protrusion portion provided on the bottom portion of the tip seal according to a third embodiment of the present invention, Fig. 11A is a side view showing a state where the tip clearance is the smallest tip clearance, and Fig. 11B is a side view showing a state where the tip clearance is the greatest tip clearance.

Figs. 12A and 12B show a modification example, Fig. 12A is a longitudinal section view showing a combination with a scroll which does not have a step portion, and Fig. 10B is a longitudinal section view showing a combination with a stepped scroll.

Description of Embodiments

[First Embodiment]

[0029] Hereinafter, a first embodiment according to the present invention will be described with reference to the drawings.

[0030] In Figs. 1A and 1B, a fixed scroll (first scroll member) 3 and an orbiting scroll (second scroll member) 5 of a scroll compressor (scroll fluid machine) 1 are shown. For example, the scroll compressor 1 is used as a compressor which compresses a gas refrigerant (fluid) which performs a refrigerating cycle of an air conditioner or the like.

[0031] Each of the fixed scroll 3 and the orbiting scroll 5 is a metal compression mechanism which is formed of an aluminum alloy or steel, and is accommodated in a housing (not shown). The fixed scroll 3 and the orbiting scroll 5 suck a fluid, which is introduced into the housing, from an outer peripheral side, and discharge the compressed fluid from a discharge port 3c positioned at a center of the fixed scroll 3 to the outside.

[0032] The fixed scroll 3 is fixed to the housing, and as shown in Figs. 1A, includes an approximately disk-shaped end plate (first end plate) 3a, and a spiral wall (first wall) 3b which is erected on one side surface of the end plate 3a. The orbiting scroll 5 includes an approximately disk-shaped end plate (second end plate) 5a and a spiral wall (second wall) 5b which is erected on one side surface of the end plate 5a. For example, a spiral shape of each of the walls 3b and 5b is defined by using an involute curve or an Archimedes curve.

[0033] The fixed scroll 3 and the orbiting scroll 5 are assembled to each other such that centers thereof are separated from each other by an orbiting radius p , the walls 3b and 5b mesh with each other with phases deviated from each other by 180° , and a slight clearance (tip clearance) in a height direction at the room temperature is provided between tooth tips and tooth bottoms of the walls 3b and 5b of both scrolls. Accordingly, a plurality pairs of compression chambers which are formed to be

surrounded by the end plates 3a and 5a and the walls 3b and 5b are symmetrically formed about a scroll center between both scrolls 3 and 5. The orbiting scroll 5 performs a revolution orbiting movement around the fixed scroll 3 by a rotation prevention mechanism such as an Oldham ring (not shown).

[0034] As shown in Fig. 1A, an inclined portion is provided, in which an inter-facing surface distance L between both end plates 3a and 5a facing each other continuously decrease from an outer peripheral side of each of the spiral walls 3b and 5b toward an inner peripheral side thereof.

[0035] As shown in Fig. 2, in the wall 5b of the orbiting scroll 5, a wall inclined portion 5b1 whose height continuously decreases from an outer peripheral side toward an inner peripheral side is provided. In a tooth bottom surface of the fixed scroll 3 facing a tooth tip of the wall inclined portion 5b1, an end plate inclined portion 3a1 (refer to Fig. 1A) which is inclined according to an inclination of the wall inclined portion 5b1 is provided. A continuously inclined portion is formed by the wall inclined portion 5b1 and the end plate inclined portion 3a1. Similarly, a wall inclined portion 3b1 whose height is continuously inclined from the outer peripheral side toward the inner peripheral side is provided on the wall 3b of the fixed scroll 3, and an end plate inclined portion 5a1 facing a tooth tip of the wall inclined portion 3b1 is provided on the end plate 5a of the orbiting scroll 5.

[0036] In addition, the meaning of the continuity in the inclined portion in the present embodiment is not limited to a smoothly connected inclination but also includes an inclined portion in which small step portions inevitably generated during processing are connected to each other in a stepwise fashion and the inclined portion is continuously inclined as a whole. However, the inclined portion does not include a large step portion such as a so-called stepped scroll.

[0037] Coating is applied to the wall inclined portions 3b1 and 5b1 and/or the end plate inclined portions 3a1 and 5a1. For example, the coating includes manganese phosphate processing, nickel phosphorus plating, or the like.

[0038] As shown in Fig. 2, wall flat portions 5b2 and 5b3 each having a constant height are respectively provided on the innermost peripheral side and the outermost peripheral side of the wall 5b of the orbiting scroll 5. Each of the wall flat portions 5b2 and 5b3 is provided over a region of 180° around a center O2 (refer to Fig. 1A) of the orbiting scroll 5. Wall inclined connection portions 5b4 and 5b5 which become curved portions are respectively provided at positions at which the wall flat portions 5b2 and 5b3 and the wall inclined portion 5b1 are connected to each other.

[0039] Similarly, in the tooth bottom of the end plate 5a of the orbiting scroll 5, end plate flat portions 5a2 and 5a3 each having a constant height are provided. Each of the end plate flat portions 5a2 and 5a3 is provided over a region of 180° around the center of the orbiting scroll

5. End plate inclined connection portions 5a4 and 5a5 which become curved portions are respectively provided at positions at which the end plate flat portions 5a2 and 5a3 and the end plate inclined portion 5a1 are connected to each other.

[0040] As shown by hatching in Figs. 3 and 4, similarly to the orbiting scroll 5, in the fixed scroll 3, end plate flat portions 3a2 and 3a3, wall flat portions 3b2 and 3b3, end plate inclined connection portions 3a4 and 3a5, and wall inclined connection portions 3b4 and 3b5 are provided.

[0041] Fig. 5 is a schematic view showing the walls 3b and 5b which are displayed to extend in a spiral direction. As shown in Fig. 5, the wall flat portions 3b2 and 5b2 on the innermost peripheral side are provided over a distance D2, and the wall flat portions 3b3 and 5b3 on the outermost peripheral side are provided over a distance D3. Each of the distance D2 and the distance D3 is a length corresponding to the region which becomes 180° around each of the centers O1 and O2 of the respective scrolls 3 and 5. The wall inclined portions 3b1 and 5b1 are provided over the distance D1 between the wall flat portions 3b3 and 5b2 on the innermost peripheral side and the wall flat portions 3b3 and 5b3 on the outermost peripheral side. If a height difference between each of the wall flat portions 3b2 and 5b2 on the innermost peripheral side and each of the wall flat portions 3b3 and 5b3 on the outermost peripheral side is defined as h, an inclination of each of the wall inclined portions 3b1 and 5b1 is represented by the following Expression.

$$\varphi = \tan^{-1} (h/D1) \dots (1)$$

[0042] In this way, the inclination φ of the inclined portion is constant in a circumferential direction in which each of the spiral walls 3b and 5b extends.

[0043] Fig. 6 is a partially enlarged view showing a region indicated by a reference numeral Z in Fig. 1B in an enlarged manner. As shown Fig. 6, a tip seal 7 is provided in the tooth tip of the wall 3b of the fixed scroll 3. The tip seal 7 is formed of a resin and comes into contact with the tooth bottom of the end plate 5a of the facing orbiting scroll 5 so as to seal a fluid. The tip seal 7 is accommodated in a tip seal groove 3d which is formed on the tooth tip of the wall 3b in the circumferential direction. A compressed fluid enters the tip seal groove 3d, presses the tip seal 7 from a rear surface thereof to push the tip seal 7 toward the tooth bottom side, and thus, the tip seal 7 comes into contact with the facing tooth bottom. In addition, similarly, a tip seal is also provided in the tooth tip of the wall 5b of the orbiting scroll 5.

[0044] As shown in Figs. 7A and 7B, a height Hc of the tip seal 7 in the height direction of the wall 3b is constant in the circumferential direction.

[0045] If both the scrolls 3 and 5 perform the revolution orbiting movement relative to each other, the positions of the tooth tip and the tooth bottom are relatively deviated

by an orbiting diameter (orbiting radius $\rho \times 2$). In the inclined portion, the tip clearance between the tooth tip and the tooth bottom is changed due to the positional deviation between the tooth tip and the tooth bottom. For example, in Fig. 7A, a tip clearance T decreases, and in Fig. 7B, the tip clearance T increases. Even when the tip clearance T is changed by an orbiting movement, the tip seal 7 is pressed to the tooth bottom side of the end plate 5a by the compressed fluid from the rear surface, and the tip seal 7 can follow the tooth bottom so as to seal the tooth bottom.

[0046] The present embodiment has the following configuration such that the tip seal 7 follows the tip clearance T changed for each orbiting angle as shown in Fig. 7.

[0047] As shown in Figs. 8A and 8B, a leaf spring (spring member) 11 is installed between a bottom portion 7a of the tip seal 7 and a groove bottom 3d1 of the tip seal groove 3d. The leaf spring 11 biases the tip seal 7 to the facing tooth bottom side (upper side in Figs. 8A and 8B).

[0048] An elastic deformation amount of the leaf spring 11 is set to be equal to or more than a tip clearance change amount ΔT . The tip clearance change amount ΔT is an amount by which the tip clearance T is changed in the orbiting angle of 360° and is expressed by the following Expression using the orbiting radius ρ and the inclination φ of each of the wall inclined portions 3b1 and 5b1.

$$\Delta T = 2\rho \times \tan\varphi \dots (2)$$

[0049] A deformation amount of the leaf spring 11 is set to be smaller than a depth of the tip seal groove 3d. That is, in a case where only weight of the tip seal 7 is applied to the leaf spring 11, a spring constant of the leaf spring 11 is set such that a height (a dimension in a vertical direction in Figs. 8A and 8B) of the leaf spring 11 is smaller than that of the tip seal groove 3d.

[0050] Fig. 8A shows a state in which the tip clearance T is the smallest tip clearance in the orbiting angle of 360°, the leaf spring 11 is greatly contracted, and the tip seal 7 is pressed to the facing tooth bottom side (refer to Fig. 9A).

[0051] Fig. 8B shows a state in which the tip clearance T is the greatest tip clearance in the orbiting angle of 360° (refer to Fig. 9B). Even in this state, the elastic deformation amount of the leaf spring 11 is sufficiently secured, and thus, the tip seal 7 is pressed to the facing tooth bottom side.

[0052] The above-described scroll compressor 1 is operated as follows.

[0053] The orbiting scroll 5 performs the revolution orbiting movement around the fixed scroll 3 by a drive source such as an electric motor (not shown). Accordingly, the fluid is sucked from the outer peripheral sides of the respective scrolls 3 and 5, and the fluid is taken

into the compression chambers surrounded by the respective walls 3b and 5b and the respective end plates 3a and 5a. The fluid in the compression chambers is sequentially compressed while being moved from the outer peripheral side toward the inner peripheral side, and finally, the compressed fluid is discharged from a discharge port 3c formed in the fixed scroll 3. When the fluid is compressed, the fluid is compressed in the height directions of the walls 3b and 5b in the inclined portions formed by the end plate inclined portions 3a1 and 5a1 and the wall inclined portions 3b1 and 5b1, and thus, the fluid is three-dimensionally compressed.

[0054] According to the present embodiment, the following operational effects are exerted.

[0055] The leaf spring 11 which biases the tip seal 7 toward the tooth bottom side is provided between the tip seal 7 and the groove bottom 3d1, and thus, even in a case where the tip clearance T is changed for each orbiting angle, the tip clearance T can follow the tip seal 7. Accordingly, a fluid leakage is reduced, a function of the tip seal 7 is effectively exerted, and performance of the scroll compressor 1 can be improved.

[0056] The deformation amount of the leaf spring 11 is set to be equal or more than the tip clearance change amount ΔT , and thus, the tip seal 7 can be always pressed to the tooth bottom over the entire orbiting angle.

[0057] In addition, the deformation amount of the leaf spring 11 is set to be smaller than the depth of the tip seal groove 3d, and thus, during assembly, it is possible to prevent the tip seal 7 from falling off from the tip seal groove 3d.

[Second Embodiment]

[0058] Next, a second embodiment of the present invention will be described. The present embodiment is different from the first embodiment in that a protrusion portion 7c is provided in the tip seal 7 instead of the leaf spring 11 of the first embodiment, and other configurations are similar to those of the first embodiment. Accordingly, hereinafter, only matters different from the first embodiment will be described.

[0059] As shown in Fig. 10A, a plurality of protrusion portions (biasing members) 7c are integrally formed in the bottom portion 7a of the tip seal 7. Each protrusion portion 7c is formed so as to protrude downward, that is, toward the groove bottom 3d1 side, from the bottom portion 7a. The protrusion portions 7c are provided at predetermined intervals in the spiral direction (longitudinal direction) of the tip seal 7.

[0060] As shown in Fig. 10B, a length in an extension direction (approximately horizontal direction in Figs. 10A and 10B) of the protrusion portion 7c is set to a length in which a tip of the protrusion portion 7c comes into contact with the groove bottom 3d1 even when the tip clearance is the greatest tip clearance in the orbiting angle of 360° and is elastically deformed. Accordingly, an elastic deformation amount of the protrusion portion 7c is equal to

or more than the tip clearance change amount ΔT .

[0061] In this way, in the present embodiment, the plurality of protrusion portion 7c are bent, and thus, a biasing force is applied to the tip seal 7.

[0062] In addition, instead of (or in addition to) the protrusion portion 7c being bent, the protrusion portion may be extend or contracted in the extension direction of the protrusion portion. That is, the tip seal 7 may be biased using an elastic force generated when the protrusion portion is extended or contracted in the extension direction.

[0063] In the present embodiment, the plurality of protrusion portions 7c are integrally formed in the bottom portion 7a of the tip seal 7, and thus, biasing means can be applied to the tip seal as one member, the number of parts are reduced, and the assembly is easily performed.

[Third Embodiment]

[0064] Next, a third embodiment of the present invention will be described. The present embodiment is different from the second embodiment in that the deformation amount of the protrusion portion of the second embodiment is less than the tip clearance change amount ΔT , and other configurations are similar to those of the second embodiment. Accordingly, hereinafter, only matters different from the second embodiment will be described.

[0065] As shown in Figs. 11A and 11B, each of protrusion portions 7d provided in the tip seal 7 of the present embodiment is shorter than the protrusion portion 7c of the second embodiment. In addition, the deformation amount of the protrusion portion 7d is less than the tip clearance change amount ΔT .

[0066] Accordingly, as shown in Fig. 11A, in a case where the tip clearance T is the smallest tip clearance in the orbiting angle of 360° , a tip of the protrusion portion 7d comes into contact with the groove bottom 3d1, and thus, the tip seal 7 can be biased. Meanwhile, as shown in Fig. 11B, in a case where the tip clearance T is the greatest tip clearance in the orbiting angle of 360° , the tip of the protrusion portion 7d floats from the groove bottom 3d1 due to a pressure of the fluid entering the bottom portion 7a side of the tip seal 7.

[0067] As shown in Fig. 11B, if the tip of the protrusion portion 7d of the tip seal 7 floats from the groove bottom 3d1, the plurality of protrusion portions 7d exert a labyrinth seal effect. That is, the plurality of protrusion portions 7d are provided in the spiral direction of the tip seal 7, and thus, it is possible to reduce the flow of the fluid flowing in the spiral direction by the labyrinth seal effect. As a result, the fluid leakage in the spiral direction can be suppressed, and the performance of the scroll compressor 1 can be improved.

[0068] In addition, the deformation amount of the protrusion portion 7d is set to be less than the tip clearance change amount ΔT , and thus, excessive pressing of the tip seal 7 to the tooth bottom can be avoided, and reliability of the tip seal 7 can be improved.

[0069] In addition, in the above-described embodi-

ments, the end plate inclined portions 3a1 and 5a1 and the wall inclined portions 3b1 and 5b1 are provided on both scrolls 3 and 5. However, the end plate inclined portions 3a1 and 5a1 and the wall inclined portions 3b1 and 5b1 may be provided at any one of both scrolls 3 and 5.

[0070] Specifically, as shown in Fig. 12A, in a case where the wall inclined portion 5b1 is provided on the one wall (for example, orbiting scroll 5) and the end plate inclined portion 3a1 is provided on the other end plate 3a, the other wall and the one end plate 5a may be flat. In addition, as shown in Fig. 12B, it may be combined with a stepped shape of the related art, that is, it may be combined with a shape in which a step portion is provided on the end plate 5a of the orbiting scroll 5 while the end plate inclined portion 3a1 is provided on the end plate 3a of the fixed scroll 3.

[0071] In the above-described embodiments, the wall flat portions 3b2, 3b3, 5b2, and 5b3 and the end plate flat portions 3a2, 3a3, 5a2, and 5a3 are provided. However, the flat portions on the inner peripheral side and/or the outer peripheral side may be omitted, and the inclined portion may be provided so as to extend to the entire walls 3b and 5b.

[0072] In the above-described embodiments, the scroll compressor is described. However, the present invention can be applied to a scroll expander which is used as an expander.

Reference Signs List

[0073]

- 1: scroll compressor (scroll fluid machine)
- 3: fixed scroll (first scroll member)
- 3a: end plate (first end plate)
- 3a1: end plate inclined portion
- 3a2: end plate flat portion (inner peripheral side)
- 3a3: end plate flat portion (outer peripheral side)
- 3a4: end plate inclined connection portion (inner peripheral side)
- 3a5: end plate inclined connection portion (outer peripheral side)
- 3b: wall (first wall)
- 3b1: wall inclined portion
- 3b2: wall flat portion (inner peripheral side)
- 3b3: wall flat portion (outer peripheral side)
- 3b4: wall inclined connection portion (inner peripheral side)
- 3b5: wall inclined connection portion (outer peripheral side)
- 3c: discharge port
- 3d: tip seal groove
- 3d1: groove bottom
- 5: orbiting scroll (second scroll member)
- 5a: end plate (second end plate)
- 5a1: end plate inclined portion
- 5a2: end plate flat portion (inner peripheral side)
- 5a3: end plate flat portion (outer peripheral side)

- 5a4: end plate inclined connection portion (inner peripheral side)
- 5a5: end plate inclined connection portion (outer peripheral side)
- 5b: wall (second wall)
- 5b1: wall inclined portion
- 5b2: wall flat portion (inner peripheral side)
- 5b3: wall flat portion (outer peripheral side)
- 5b4: wall inclined connection portion (inner peripheral side)
- 5b5: wall inclined connection portion (outer peripheral side)
- 7: tip seal
- 7a: bottom portion
- 7c: protrusion portion (biasing member)
- 7d: protrusion portion (biasing member)
- 11: leaf spring (biasing member)
- L: inter-facing surface distance
- T: tip clearance
- ϕ : inclination

Claims

1. A scroll fluid machine comprising:

a first scroll member in which a spiral first wall is provided on a first end plate;
 a second scroll member in which a spiral second wall is provided on a second end plate disposed to face the first end plate and the second wall meshes with the first wall such that the second scroll member performs a revolution orbiting movement relative to the first scroll member; and
 an inclined portion in which an inter-facing surface distance between the first end plate and the second end plate facing each other continuously decreases from outer peripheral sides of the first wall and the second wall toward inner peripheral sides thereof,
 wherein a tip seal which comes into contact with a facing tooth bottom so as to seal a fluid is provided in a groove portion formed on a tooth tip of each of the first wall and the second wall corresponding to the inclined portion, and
 wherein a biasing member which biases the tip seal toward the tooth bottom side is provided between the tip seal and the groove bottom of the groove portion.

2. The scroll fluid machine according to claim 1, wherein the biasing member has a deformation amount which is equal to or more than a change amount of a tip clearance between the tooth tip of the wall and the tooth bottom of the end plate facing the tooth tip.

3. The scroll fluid machine according to claim 1 or 2,

wherein the biasing member has a deformation amount which is smaller than a depth of the groove portion.

4. The scroll fluid machine according to any one of claims 1 to 3,
wherein the biasing member is a spring member which is disposed between the tip seal and the groove bottom. 5
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5. The scroll fluid machine according to any one of claims 1 to 3,
wherein the biasing member is a plurality of protrusion portions which are formed on a bottom portion of the tip seal. 15
6. The scroll fluid machine according to claim 1,
wherein the biasing member has a deformation amount which is less than a change amount of a tip clearance between the tooth tip of the wall and the tooth bottom of the end plate facing the tooth tip, and is a plurality of protrusion portions formed on a bottom portion of the tip seal. 20

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FIG. 1A

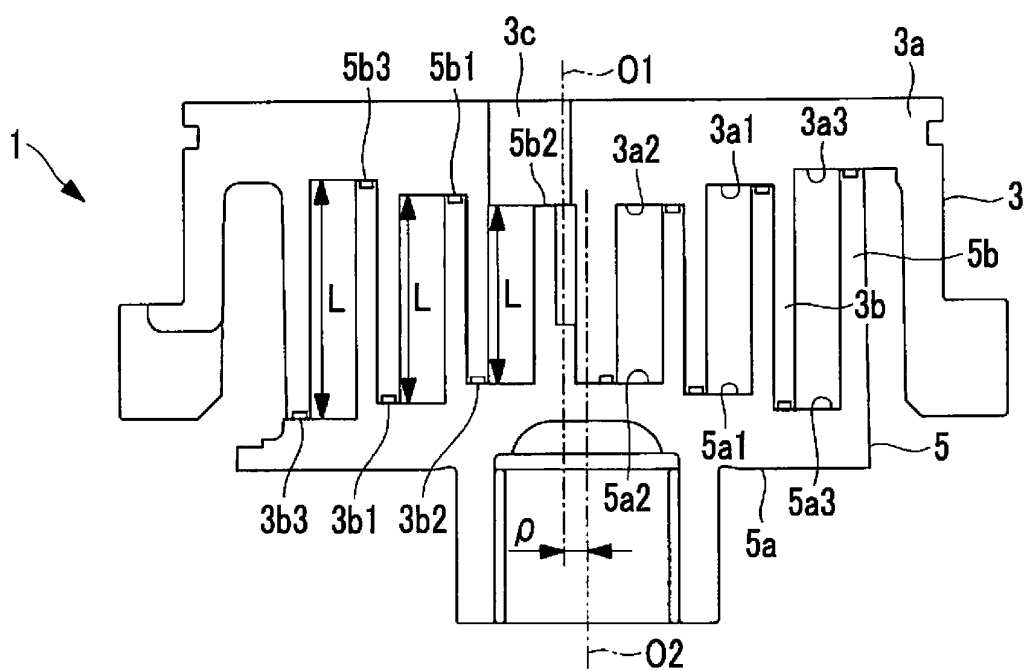


FIG. 1B

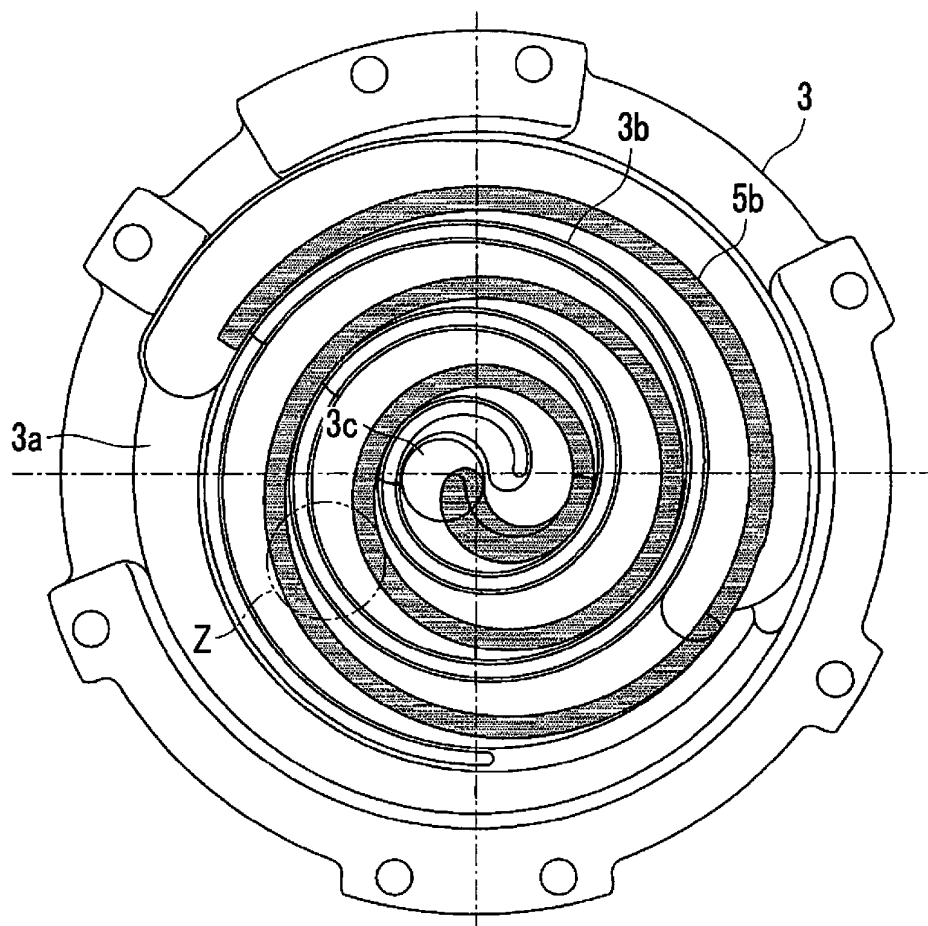


FIG. 2

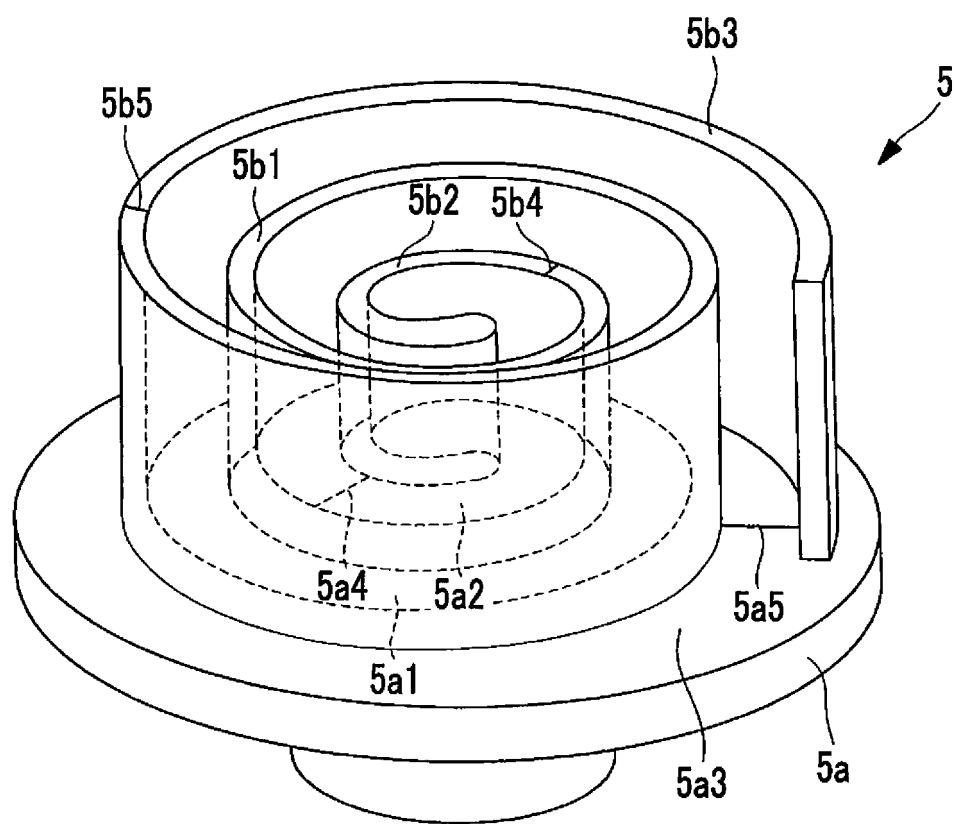


FIG. 3

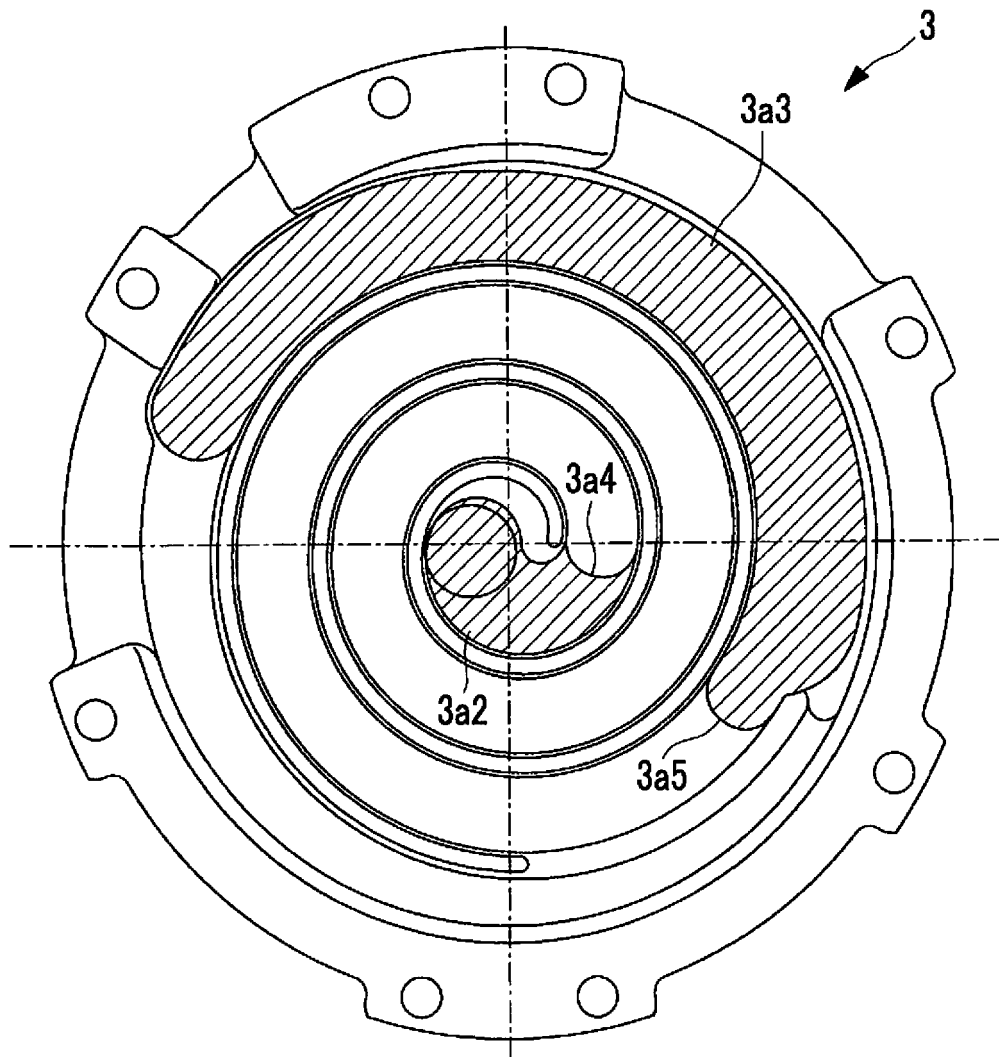


FIG. 4

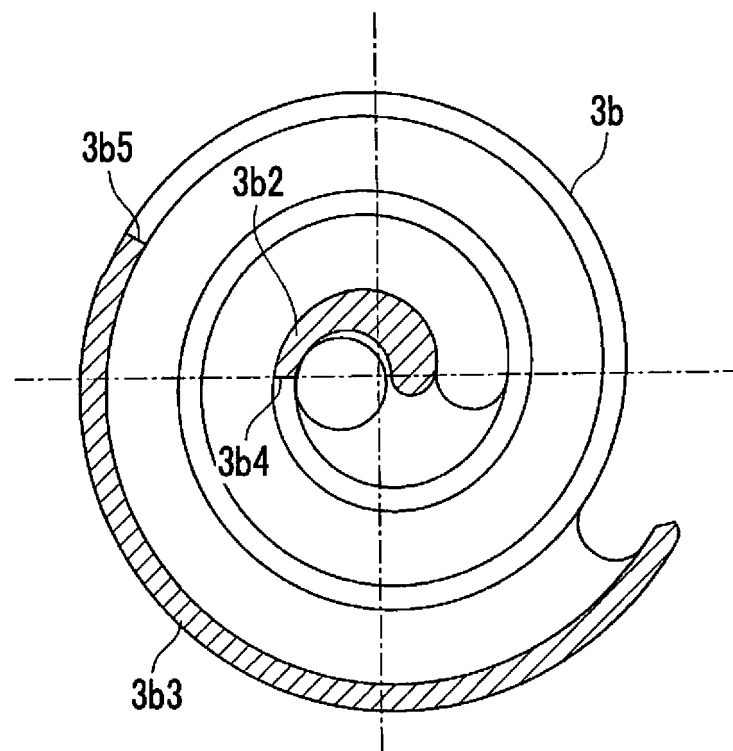


FIG. 5

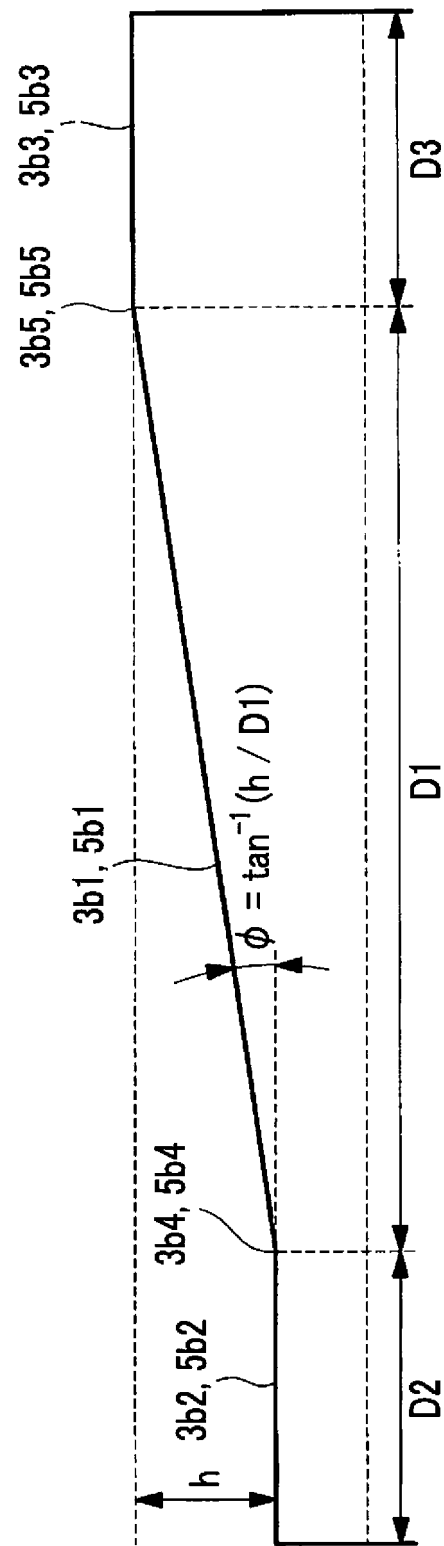


FIG. 6

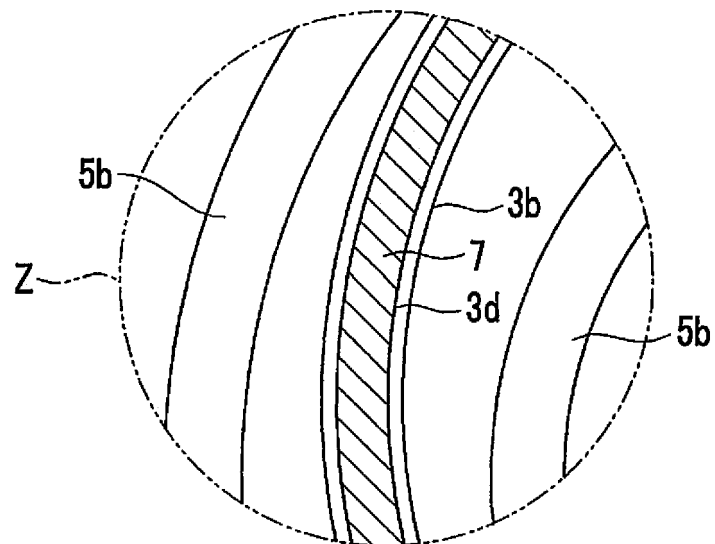


FIG. 7A

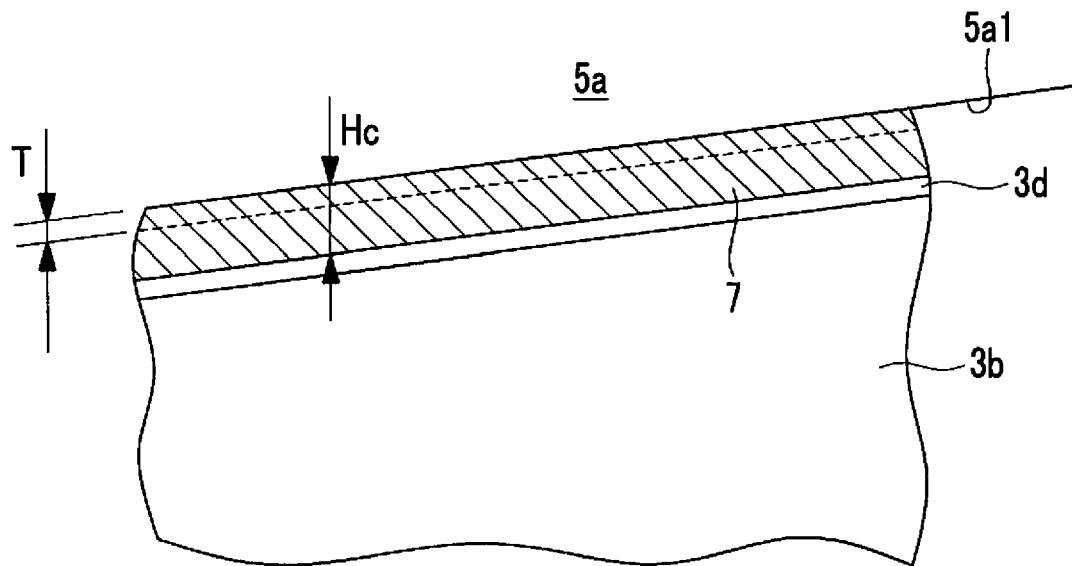


FIG. 7B

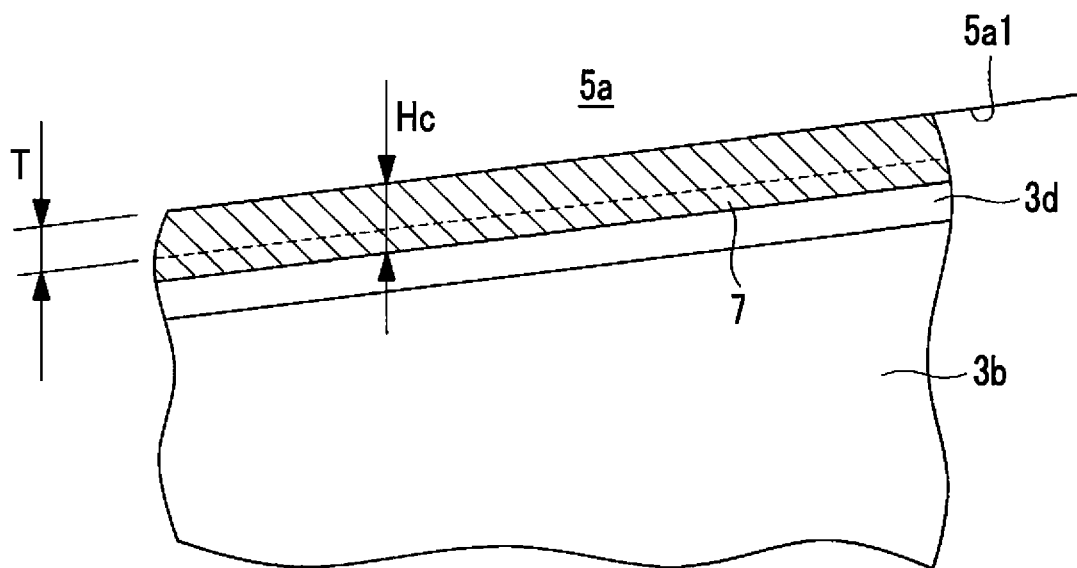


FIG. 8A

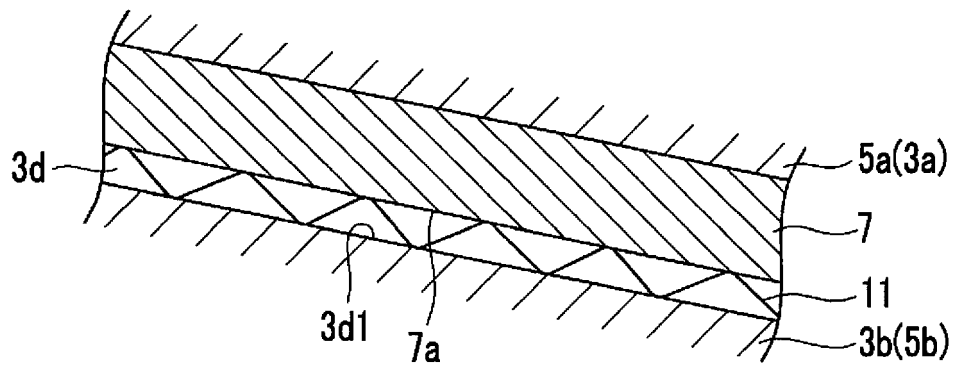


FIG. 8B

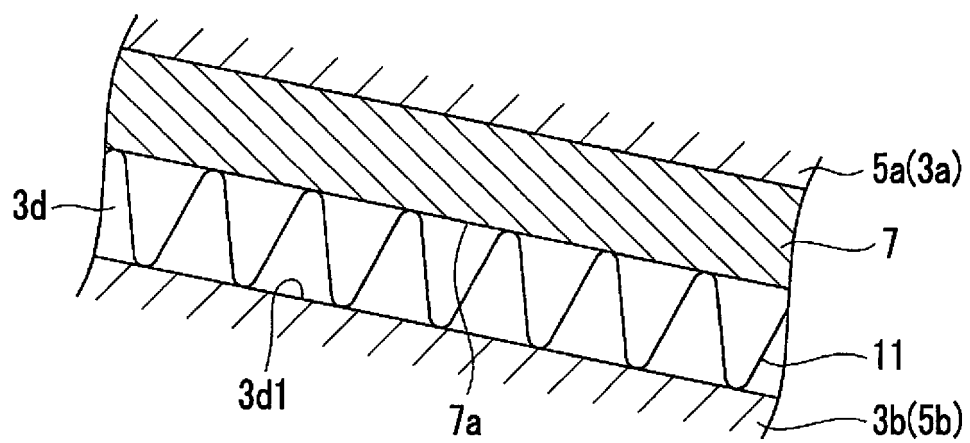


FIG. 9A

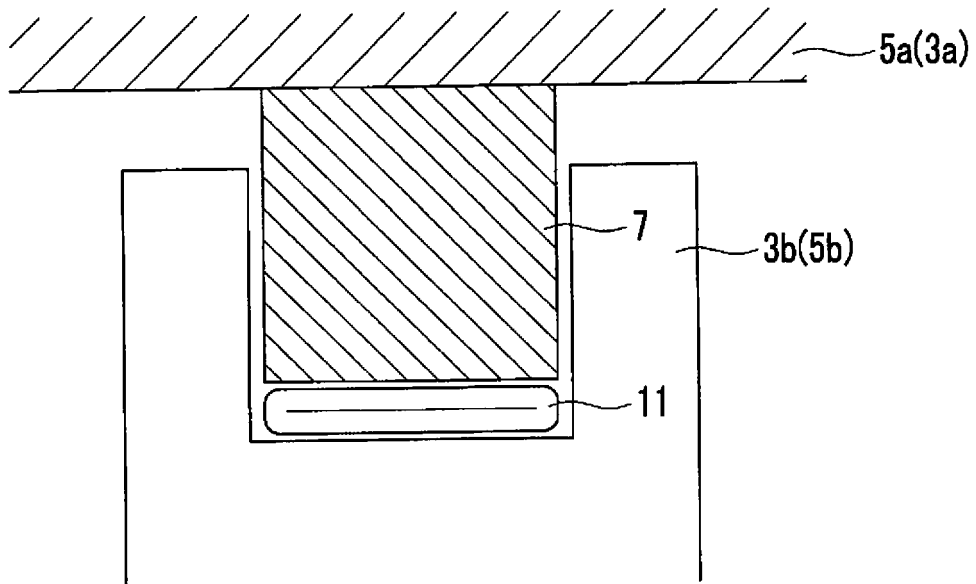


FIG. 9B

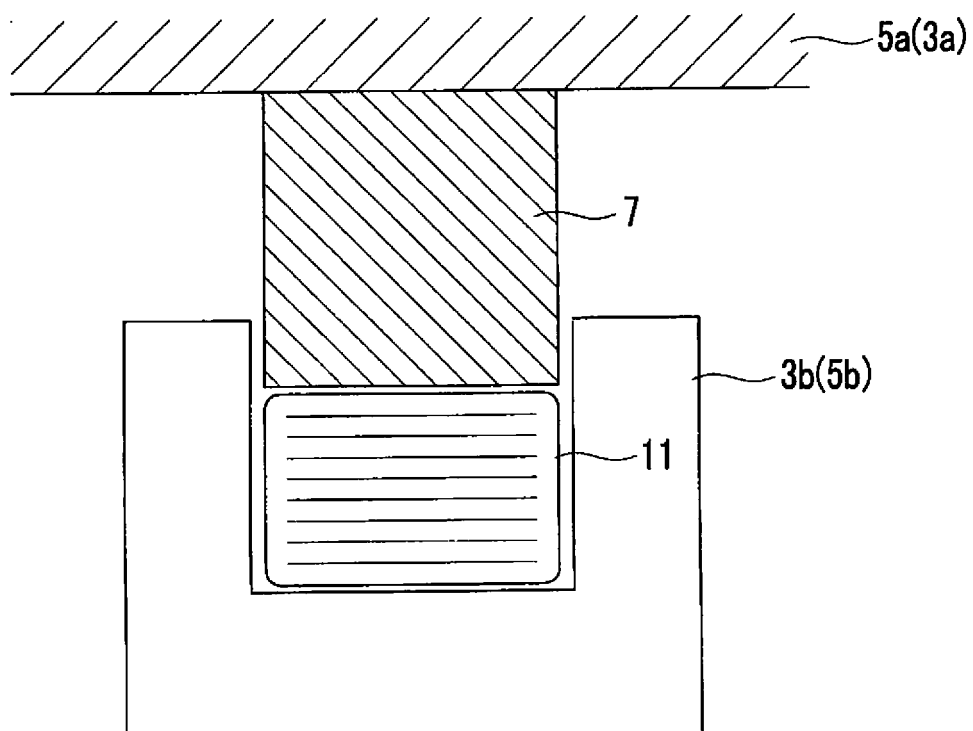


FIG. 10A

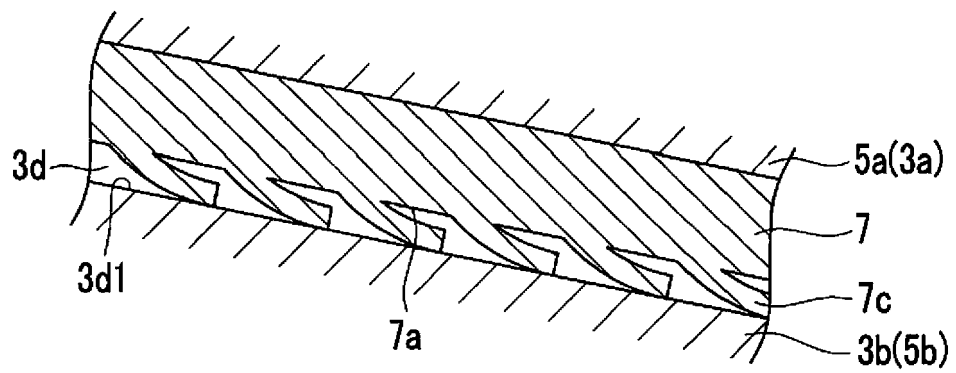


FIG. 10B

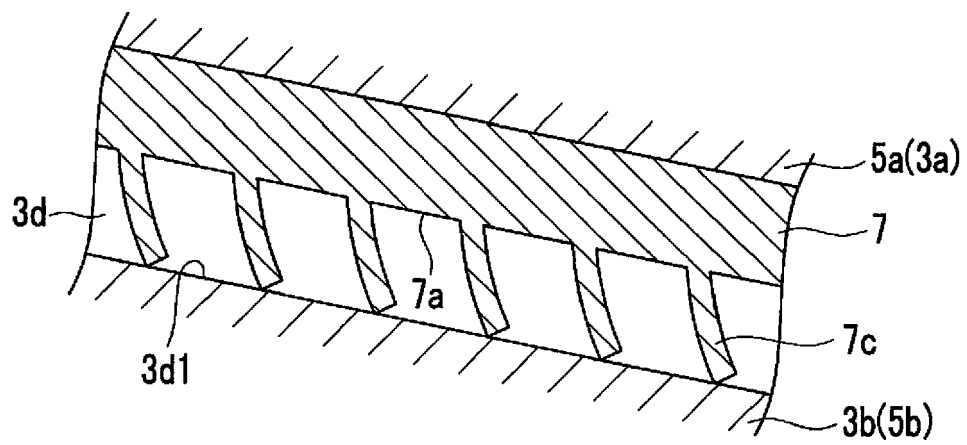


FIG. 11A

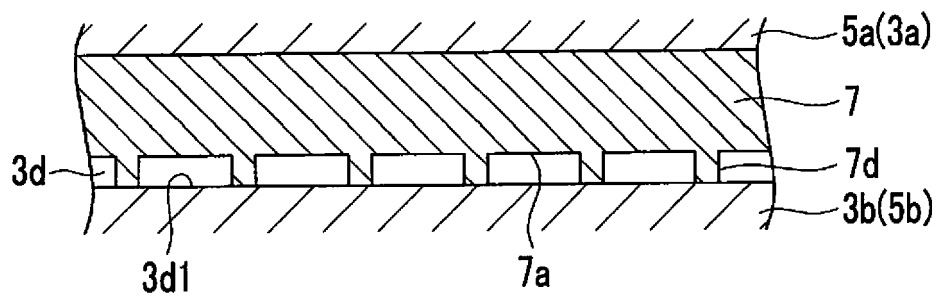


FIG. 11B

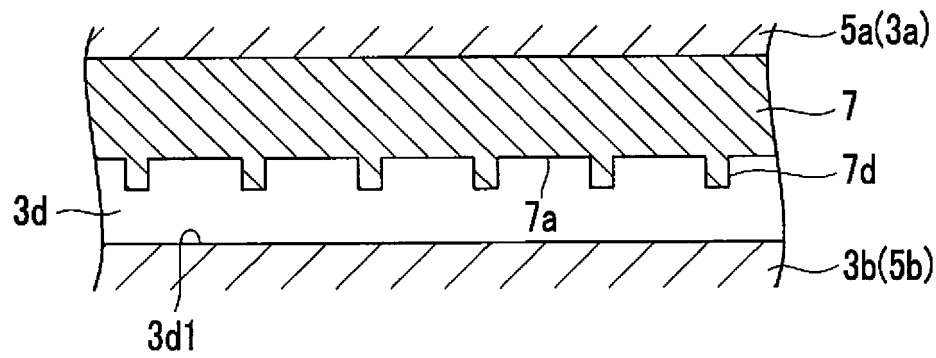


FIG. 12A

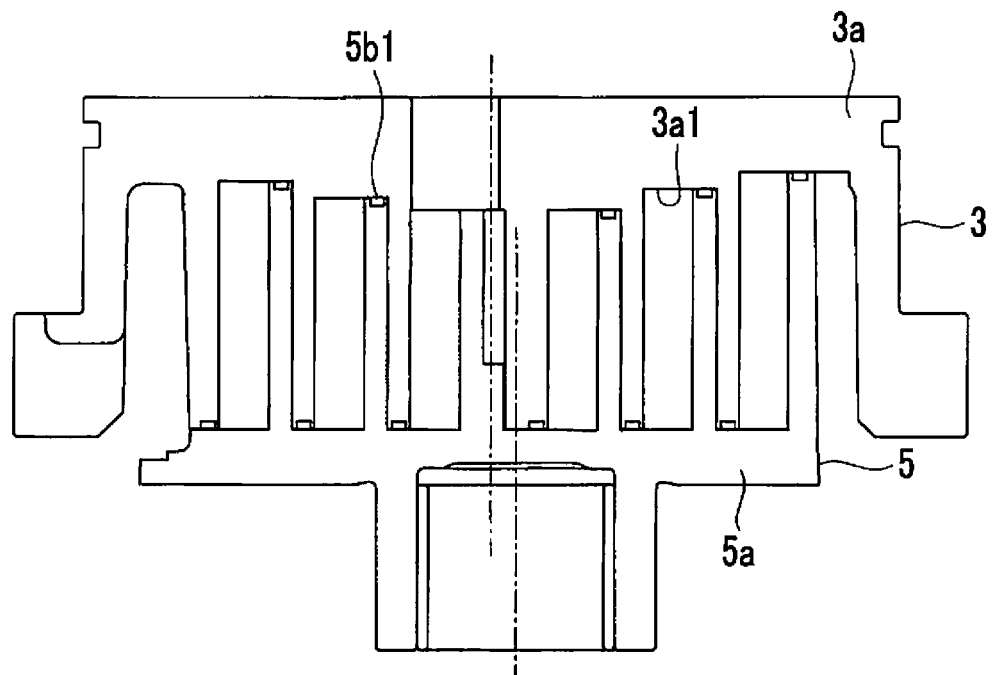
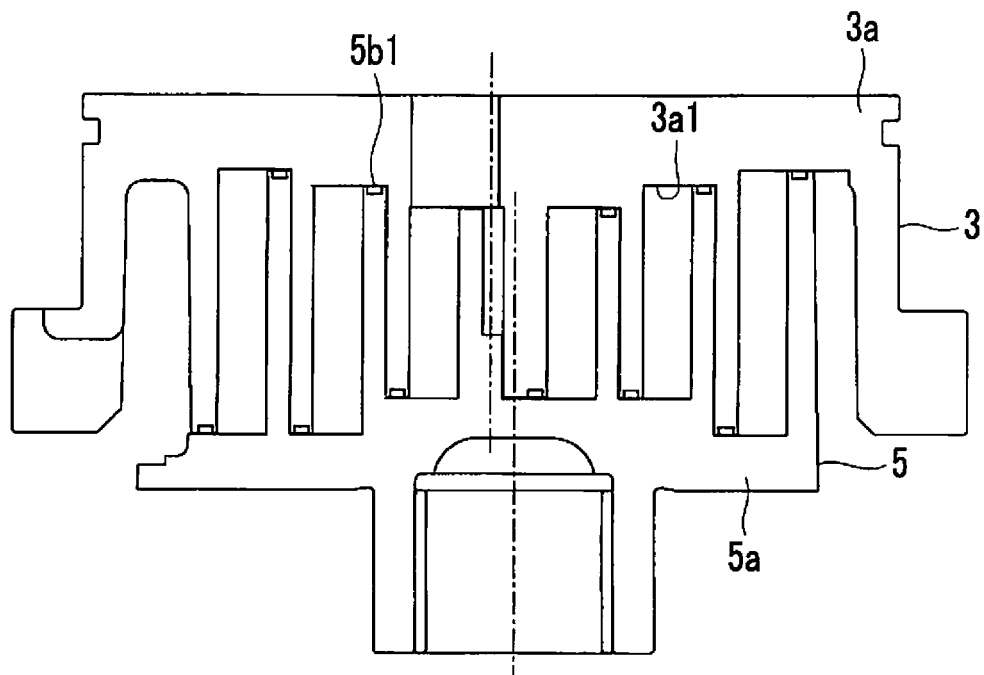


FIG. 12B



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2017/030636

A. CLASSIFICATION OF SUBJECT MATTER

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)

F04C18/02

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2017

Kokai Jitsuyo Shinan Koho 1971-2017 Toroku Jitsuyo Shinan Koho 1994-2017

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2002-303281 A (Mitsubishi Heavy Industries, Ltd.), 18 October 2002 (18.10.2002), paragraphs [0037] to [0066], [0085] to [0086], [0102]; fig. 1 to 8, 14 to 15 & US 2002/0054821 A1 paragraphs [0079] to [0109], [0130] to [0135], [0153]; fig. 1 to 8, 14 to 15 & US 2003/0194341 A1 & EP 1205665 A2 & CN 1353247 A & CN 1673543 A	1 2-6
Y	JP 7-259762 A (Tokico, Ltd.), 09 October 1995 (09.10.1995), paragraphs [0031] to [0035]; fig. 1 to 4 (Family: none)	2-6

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

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"&" document member of the same patent family

Date of the actual completion of the international search
25 October 2017 (25.10.17)Date of mailing of the international search report
07 November 2017 (07.11.17)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2017/030636

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 3-18601 A (Matsushita Electric Industrial Co., Ltd.), 28 January 1991 (28.01.1991), page 5, upper left column, lines 6 to 14; fig. 6 to 7 (Family: none)	4

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2015055173 A [0004]