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(54) **SCROLL MEMBER AND SCROLL-TYPE FLUID MACHINE**

ROLLENELEMENT UND FLUIDMASCHINE MIT ROLLEN

ÉLÉMENT DE VOLUTE ET MACHINE À FLUIDE DU TYPE À VOLUTE

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Description

Technical Field

[0001] The present invention relates to a scroll-type fluid machine used as a compressor or an expander.

Background Art

[0002] As a scroll compressor that can increase a compressor capacity without increasing an outer diameter of a scroll member, a compressor has been proposed in which step portions are provided on a top end side and a base end side of a spiral lap of each of a fixed scroll and an orbiting scroll in a pair, a lap height on an outer peripheral end side of the spiral lap from the step portion is higher than a lap height on a center side, and that performs three-dimensional compression in a circumferential direction and a height direction of the spiral lap (for example, Patent Literatures 1 and 2). The compressor can perform compression in the circumferential direction and also in the height direction of the spiral lap, thereby increasing displacement and increasing a compressor capacity. The compressor referred to as a three-dimensional scroll compressor can be reduced in size and weight as compared to a compressor having the same capacity.

Patent Literature 3 discloses a scroll member comprising offset parts which reduce wrap thickness along the entire length of the wrap.

Other scroll members for scroll compressors have been disclosed in Patent Literatures 4, 5 and 6.

Citation List

Patent Literature

[0003]

Patent Literature 1: Japanese Patent Laid-Open No. 2002-364560

Patent Literature 2: Japanese Patent Laid-Open No. 2007-224775

Patent Literature 3: Japanese Patent Laid-Open No. 2011-074884

Patent Literature 4: European Patent Application Publication EP 2 055 955 A1

Patent Literature 5: European Patent Application Publication EP 0 318 189 A1

Patent Literature 6: Japanese Patent Laid-Open No. 2001-020878

Summary of Invention

Technical Problem

[0004] The scroll compressor is such that an orbiting scroll revolves with respect to a fixed scroll to gradually

reduce a volume of a compression chamber formed between laps of the scrolls to compress a fluid in the compression chamber. In this process, the lap (fixed lap) of the fixed scroll and the lap (orbiting lap) of the orbiting scroll slide, and the fixed lap receives a load from the orbiting lap, and the orbiting lap receives a load from the fixed lap. The load is referred to as a tooth flank load.

[0005] However, as described above, in the three-dimensional scroll compressor, an orbiting scroll 100 (or a fixed scroll) has a step portion. In particular, as shown in FIG. 8, for a step portion 103 provided on a top end side of the lap 101, an excessive tooth flank load F_t applied to the top end side of the step portion 103 causes stress concentration on a base 105 of the step portion 103, and the orbiting scroll 100 may be broken from the base 105.

[0006] The present invention is achieved in view of such a problem, and has an object to provide a scroll member that can prevent stress concentration on a base of a step portion.

[0007] The present invention has an object to provide a scroll-type fluid machine that includes such scroll member, and can maintain high reliability for long periods.

Solution to Problem

[0008] To achieve the object, the present invention provides a scroll member which is defined in appended claim 1 and includes: an end plate; a spiral lap standing on one side surface of the end plate, and extending from a center side to an outer peripheral end side; a top end side step portion provided on a top end side of the lap, the center side of the top end side step portion being lower than the outer peripheral end side of the top end side step portion; and a base end side step portion provided on a base end side of the lap, the center side of the base end side step portion being higher than the outer peripheral end side of the base end side step portion. The scroll member can perform three-dimensional compression in a circumferential direction and a height direction of the lap.

[0009] According to the invention, the scroll member has a feature that a thinned portion is provided only in a predetermined engagement range from at least an engagement start position of the lap in one or both of the top end side step portion and the base end side step portion.

[0010] The scroll member of the present invention includes the thinned portion provided in the predetermined engagement range, thereby preventing one lap from coming into contact with the other lap in the engagement range. This can prevent stress concentration on a base of the top end side step portion.

[0011] The scroll member of the present invention can be applied to one or both of an orbiting scroll and a fixed scroll. If the scroll member of the present invention is applied to the orbiting scroll, a lap of the fixed scroll as a counterpart of engagement can be prevented from coming into contact with a lap of the orbiting scroll in a top end side step portion (base end side step portion).

[0012] Preferred aspects of the present invention will be mentioned below, and advantages of using the aspects will become apparent in the description of an embodiment.

[0013] In the scroll member of the present invention, when the thinned portion is provided in the top end side step portion, the thinned portion can be provided in an entire region in a height direction from a top end of the lap to one side surface of the end plate, and also a thinned portion can be provided in a specific region from the top end of the lap to a predetermined position in the height direction.

[0014] Also in the present invention, the thinned portion may be also provided in front of the engagement start position in the circumferential direction.

[0015] Also in the present invention, the thinned portion may be reduced in height with distance from the engagement start position in the circumferential direction.

[0016] Further, in the present invention, an amount of thinning may be reduced with distance from the engagement start position in the circumferential direction, or with distance from the top end of the lap in the height direction.

[0017] The scroll member of the present invention described above can be applied to the scroll-type fluid machine. Specifically, the scroll-type fluid machine includes: a spindle rotatably supported in a housing that forms an outer shell; an orbiting scroll rotatably coupled to a position offset from a center of the spindle; and a fixed scroll that is fixed to the housing, and faces the orbiting scroll to form a compression space between the fixed scroll and the orbiting scroll, in which space a fluid is compressed, and one or both of the orbiting scroll and the fixed scroll include the scroll member described above.

[0018] The fluid machine of the present invention is implemented as a compressor or an expander, which commonly includes the housing, the spindle, the orbiting scroll, and the fixed scroll described above.

[0019] The scroll-type fluid machine sometimes includes an orbiting scroll and a fixed scroll made of different materials. As a typical example, the orbiting scroll that moves is made of a lightweight aluminum alloy, and the fixed scroll is made of an iron alloy having high mechanical strength. In this case, a thinned portion is preferably provided in the fixed scroll made of a material having higher mechanical strength. Since the thinned portion reduces mechanical strength of the lap, the thinned portion is provided in the fixed scroll rather than in the orbiting scroll made of an aluminum alloy having lower mechanical strength. For easy understanding, the example is shown in which the orbiting scroll is made of an aluminum alloy and the fixed scroll is made of an iron alloy. However, this is a mere example, and the point is providing a thinned portion in an orbiting scroll or a fixed scroll made of a material having higher mechanical strength.

Advantageous Effects of Invention

[0020] The scroll member of the present invention in-

cludes the thinned portion, thereby preventing contact with the counterpart lap in a predetermined engagement range and preventing stress concentration on a base of the top end side step portion. The scroll-type fluid machine including the scroll member can maintain high reliability for long periods.

Brief Description of Drawings

[0021]

[FIG. 1] FIG. 1 is a sectional view showing a schematic configuration of a scroll-type compressor according to an embodiment.

[FIG. 2] FIG. 2 is a sectional view showing an engagement state between a fixed scroll and an orbiting scroll in a plane along a spindle.

[FIG. 3A] FIG. 3A is a perspective view of the fixed scroll.

[FIG. 3B] FIG. 3B is a perspective view of the orbiting scroll.

[FIG. 4] FIG. 4 is a partial enlarged view of the orbiting scroll including a thinned portion.

[FIG. 5] FIG. 5 is a partial enlarged view of the orbiting scroll showing a thinned portion of a different shape.

[FIG. 6] FIG. 6 is a partial enlarged view of the orbiting scroll showing a thinned portion of a different shape.

[FIG. 7] FIG. 7 is a partial enlarged view of the orbiting scroll showing a thinned portion of a different shape.

[FIG. 8] FIG. 8 is a perspective view showing a conventional orbiting scroll.

Description of Embodiment

[0022] Now, the present invention will be described in detail based on an embodiment shown in the accompanying drawings.

[0023] As shown in FIG. 1, a vertical compressor 10 includes, in a housing 11, a spindle 12, an orbiting scroll 20 that rotates with the spindle 12, and a fixed scroll 30 fixed to the housing 11. In this embodiment, an example is taken in which the compressor 10 is used in an air conditioning refrigeration cycle system.

[0024] In such a compressor 10, a refrigerant (fluid) is introduced into the housing 11 through a refrigerant introduction port P1 formed in a side surface of the housing 11, and compressed in a compression space formed between the orbiting scroll 20 and the fixed scroll 30. The compressed refrigerant is discharged from a refrigerant discharge port P2 provided in an upper end of the housing 11.

[0025] As shown in Figures 1 to 3, in the orbiting scroll 20, a spiral lap 22 having a predetermined height is integrally formed with one side surface of a disk-shaped end plate 21. An inner peripheral surface IS and an outer peripheral surface OS of the lap 22 are formed along an involute curve. However, a thinned portion 66 described later is not formed along the involute curve.

[0026] Meanwhile, in the fixed scroll 30, a spiral lap 32 that faces and engages the lap 22 of the orbiting scroll 20 is formed on one side surface of an end plate 31 facing the orbiting scroll 20. An inner peripheral surface IS and an outer peripheral surface OS of the lap 32 are also formed along the involute curve. However, a thinned portion 66 is the same as for the lap 22.

[0027] For each of the orbiting scroll 20 and the fixed scroll 30, generally, an iron alloy or an aluminum alloy is casted to obtain a scroll intermediate body, which is then machined to obtain a necessary final shape.

[0028] As shown in FIG. 2, chip seals 28, 38 (omitted in Figures 1 and 3) made of a resin-based material or the like are provided to increase a sealing property on top ends of the lap 22 of the orbiting scroll 20 and the lap 32 of the fixed scroll 30 which face the end plate 31 of the fixed scroll 30 and the end plate 21 of the orbiting scroll 20, respectively.

[0029] As such, the lap 22 of the orbiting scroll 20 and the lap 32 of the fixed scroll 30 are combined with each other in the housing 11. This forms a compression space 50 between the orbiting scroll 20 and the fixed scroll 30.

[0030] The refrigerant introduced from an outer peripheral end OT of each of the orbiting scroll 20 and the fixed scroll 30 into the compression space 50 is successively delivered from the outer peripheral end OT to a center ST by revolution of the orbiting scroll 20 with respect to the fixed scroll 30 and is compressed. The refrigerant compressed in the compression space 50 is discharged through the refrigerant discharge port P2 formed in the upper end of the housing 11 via a reed valve 40 mounted to an upper cover 39 provided to cover the fixed scroll 30.

[0031] The spindle 12 has opposite ends rotatably supported by the housing 11 via bearings 13, 14. The spindle 12 is rotationally driven by a motor 17 including a stator 15 fixed to an inner surface of the housing 11 and a rotor 16 fixed to an outer peripheral surface of the spindle 12 and facing the stator 15. The spindle 12 may be rotationally driven in such a manner that one end of the spindle 12 extends through the housing 11 and protrudes outwards, and an unshown drive source such as an engine or a motor provided outside is coupled to one end of the spindle 12.

[0032] A boss 18 is formed to protrude from the other end of the spindle 12, in a position offset from a central axis of the spindle 12 by a predetermined amount. A recess 25 that houses the boss 18 is formed in the orbiting scroll 20 on the side of the spindle 12. The boss 18 is inserted via a drive bush (bearing) 24 into the recess 25, and thus the orbiting scroll 20 is rotatably held in the boss 18. Thus, the orbiting scroll 20 is provided to be offset from the center of the spindle 12 by a predetermined amount, and when the spindle 12 rotates around its axis, the orbiting scroll 20 turns (revolves) with a radius that is the amount of offset from the center of the spindle 12. An Oldham's ring (not shown) is interposed between the orbiting scroll 20 and the spindle 12 so that the orbiting scroll 20 revolves but does not rotate.

[0033] In the spindle 12, a lubricant channel 12a is formed for supplying a lubricant sucked from an oil reservoir in a bottom of the housing 11, from the upper end of the spindle 12 to the drive bush 24 or the like between the spindle 12 and the recess 25.

[0034] A sectional area of the compression space 50 formed between the orbiting scroll 20 and the fixed scroll 30 is gradually reduced from an outer peripheral end side to a center side to increase compressibility, and thus lap heights of both the orbiting scroll 20 and the fixed scroll 30 are gradually reduced from the outer peripheral end side to the center side. This will be more specifically described below.

[0035] As shown in Figures 2 and 3, the end plate 21 of the orbiting scroll 20 includes, on a base end portion as one side surface on which the lap 22 stands, a step portion 70 (base end side step portion) formed so that a side of the center ST is higher than a side of the outer peripheral end OT in a spiral direction of the lap 22. Similarly to the end plate 21 of the orbiting scroll 20, the end plate 31 of the fixed scroll 30 includes, on a base end portion as one side surface on which the lap 32 stands, a step portion 70 (base end side step portion) formed so that a side of the center ST is higher than a side of the outer peripheral end OT in a spiral direction of the lap 32.

[0036] A bottom surface (one side surface) of the end plate 21 is divided by the formation of the step portion 70 into two parts: a deep bottom surface 21A provided on the side of the outer peripheral end OT and a shallow bottom surface 21B provided on the side of the center ST. Similarly to the end plate 21 described above, the bottom surface of the end plate 31 is divided by the formation of the step portion 70 into two parts: a deep bottom surface 31A provided on the side of the outer peripheral end OT and a shallow bottom surface 31B provided on the side of the center ST.

[0037] In the orbiting scroll 20 and the fixed scroll 30, a spirally continuous groove is formed by the end plates 21, 31 and the spiral laps 22, 32. The laps 22, 32 each include an inner peripheral surface IS and an outer peripheral surface OS, and stand from the end plates 21, 31, respectively. A bottom surface of the spirally continuous groove is formed by bottom surfaces 21A, 21B, 31A, 31B. The step portions 70 between the bottom surfaces 21A, 31A on the side of the outer peripheral end OT and the bottom surfaces 21B, 31B on the side of the center ST are formed to have a semicircular shape with a diameter that is an interval between the laps 22, 32 on opposite sides of the groove.

[0038] The lap 22 of the orbiting scroll 20 has a step portion 62 (top end side step portion) that corresponds to the step portion 70 of the fixed scroll 30, and divides the spiral top end side into two parts so that the side of the center ST of the spiral is lower than the side of the outer peripheral end OT. Specifically, the lap 22 is divided into a high wall portion 22H with a large height, and a low wall portion 22L with a smaller height than the high wall portion 22H with the step portion 62 as a boundary. In

the step portion 62, a rising wall portion 63 rising perpendicularly to a top surface 22t of the low wall portion 22L is formed between the high wall portion 22H and the low wall portion 22L, and the rising wall portion 63 forms an end of the high wall portion 22H.

[0039] Similarly to the lap 22, the lap 32 of the fixed scroll 30 has a step portion 62 (top end side step portion) that corresponds to the step portion 70 of the orbiting scroll 20, and divides the spiral top end side into two parts so that the side of the center ST of the spiral is lower than the side of the outer peripheral end OT. Specifically, the lap 32 is divided into a high wall portion 32H with a large height, and a low wall portion 32L with a smaller height than the high wall portion 32H with the step portion 62 as a boundary. In the step portion 62, a rising wall portion 63 rising perpendicularly to a top surface 32t of the low wall portion 32L is formed between the high wall portion 32H and the low wall portion 32L, and the rising wall portion 63 forms an end of the high wall portion 32H.

[0040] The rising wall portion 63 protrudes from the high wall portions 22H, 32H in a semicircular shape with a diameter equal to a thickness of the high wall portions 22H, 32H on plan view. The rising wall portion 63 is continuous with the laps 22, 32 in the engagement start position 65. In a process of revolution of the orbiting scroll 20, the step portion 62 of the lap 22 starts engaging the lap 32 (outer peripheral surface) of the fixed scroll 30 from the engagement start position 65. Similarly, the step portion 62 of the lap 32 starts engaging the lap 22 (outer peripheral surface) of the orbiting scroll 20 from the engagement start position 65.

[0041] In this embodiment, a thinned portion 66 is provided in one or both of the orbiting scroll 20 and the fixed scroll 30. A specific shape of the thinned portion 66 will be described below for the orbiting scroll 20 as an example.

[0042] As shown in FIG. 4A, the orbiting scroll 20 includes the thinned portion 66 in an inner peripheral surface IS of the lap 22. The thinned portion 66 is formed in a range between the engagement start position 65 of the lap 22 and a predetermined engagement position toward the outer peripheral end OT. The thinned portion 66 is retracted from the inner peripheral surface IS toward the outer peripheral surface OS of the lap 22, and is thus reduced in thickness as compared to other parts of the lap 22. The thinned portion 66 is provided to prevent contact between the lap 22 and the lap 32. Hereinafter, in some cases, the engagement start position 65 is referred to as a front end of the thinned portion 66 and the predetermined position on the side of the outer peripheral end OT is referred to as a rear end of the thinned portion 66.

[0043] In the process of revolution of the orbiting scroll 20, the lap 32 of the fixed scroll 30 starts engaging the lap 22 from the engagement start position 65. However, the lap 22 has the thinned portion 66, and thus the lap 22 and the lap 32 do not come into contact with each other in the region provided with the thinned portion 66.

Thus, stress due to a tooth flank load applied from the fixed scroll 30 do not act or slightly acts on a base 63a of the step portion 62 of the orbiting scroll 20, thereby preventing the lap 22 from being broken from the base 63a.

[0044] The thinned portion 66 can be easily formed, for example, by increasing a cutting depth as compared to other parts in a process of machining the inner peripheral surface IS of the lap 22 using an end mill.

<Formation region of thinned portion 66 (circumferential direction)>

[0045] Next, a front end of the thinned portion 66 matches the engagement start position 65 of the lap 22. This is because the lap 22 and the lap 32 theoretically start contact with each other in the engagement start position 65. Thus, the front end of the thinned portion 66 may be theoretically matched with the engagement start position 65. However, in actual design, the lap 22 and the lap 32 may come into contact with each other on a side of the center ST from the engagement start position 65 depending on machining accuracy and assembling accuracy. In view of this, as shown in FIG. 4B, the front end of the thinned portion 66 is preferably set on the side of the center ST from the engagement start position 65, that is, on the front in the circumferential direction. In this case, in addition to the thinned portion 66 reaching the low wall portion 22L beyond the engagement start position 65, the thinned portion 66 is formed to also reach the rising wall portion 63, thereby more reliably preventing contact between the lap 22 and the lap 32.

[0046] Meanwhile, the stress applied to the base 63a can be reduced with distance of the rear end of the thinned portion 66 from the engagement start position 65 in the circumferential direction. However, an advantage of stress reduction is saturated with too large a distance of the rear end of the thinned portion 66 from the engagement start position 65. The inventor's study has showed that an advantage of stress reduction is saturated if the rear end of the thinned portion 66 is provided at a turn angle of 20° or more from the engagement start position 65. Meanwhile, a larger amount of refrigerant leaks with distance of the rear end of the thinned portion 66 from the engagement start position 65. Thus, the rear end of the thinned portion 66 is preferably set within a range of the turn angle of 20° from the engagement start position 65.

<Formation region of thinned portion 66 (lap height direction)>

[0047] Next, in the example shown in Figures 4A and 4B, the thinned portion 66 is provided in the entire region in the height direction from the top end of the lap 22 to the base end (bottom surface 21B), but the present invention is not limited to this.

[0048] For example, as shown in FIG. 5A, a region that

is not thinned is left from the bottom surface 21B to a predetermined position in the height direction of the lap 22. As such, the thinned portion 66 is provided in a specific region from the front end of the high wall portion 22H of the lap 22 to the predetermined position in the height direction toward the base end (bottom surface 21B), thereby providing the advantage described below.

[0049] Since the lap 22 (high wall portion 22H) has the region that is not thinned below the thinned portion 66, the lap 22 has higher strength than the example in FIG. 4 in which the thinned portion 66 is provided in the entire region in the height direction. Also, the region provided with the thinned portion 66 is small, thereby reducing leak of the refrigerant. Further, if the lap 32 reaches the engagement start position 65, the lap 32 preferentially comes into contact with the lap 22 and the region that is not thinned, and is thus positioned. Thus, in the region corresponding to the thinned portion 66, the contact between the lap 22 and the lap 32 can be more reliably prevented. This advantage is noticeable when considering actual machining accuracy and assembling accuracy.

[0050] Meanwhile, the lap 32 comes into contact with the lap 22 at a position close to the bottom surface 21B of the lap 22, and thus lower stress is applied to the base 63a, and an influence of the stress on the base 63a is sufficiently small even if the region that is not thinned is left below the thinned portion 66.

[0051] As shown in FIG. 5B, in the present invention, the thinned portion 66 can be provided only on an upper side of the upper end of the low wall portion 22L of the lap 22. In this case, the thinned portion 66 can be machined in the process of machining the inner peripheral surface IS of the lap 22, thereby contributing to reduction in production costs than the example in FIG. 5A.

<Shape of thinned portion 66 (reduction in lap height direction)>

[0052] Next, the thinned portion 66 described above has a constant height from the front end (engagement start position 65) to the rear end, but the present invention is not limited to this.

[0053] For example, as shown in FIG. 6, a region provided with the thinned portion 66 can be reduced from the front end toward the rear end. In this case, as shown in FIG. 6A, a lower edge of the thinned portion 66 may linearly rise toward the rear end, or as shown in FIG. 6B, the lower edge of the thinned portion 66 may rise stepwise. Also in this case, the thinned portion 66 is formed to the upper end of the high wall portion 22H.

[0054] The thinned portion 66 shown in FIG. 6 can more easily ensure strength of the lap 22 than the thinning in FIG. 5, and also can reduce leak of the refrigerant.

<Amount of thinning of thinned portion 66 (as a whole)>

[0055] An amount of retraction of the thinned portion 66 toward the outer peripheral surface OS (amount of

thinning) needs to be sufficient for preventing contact between the lap 22 and the lap 32. Also in view of machining accuracy, an amount of thinning of several tens μm is desired to be ensured. A larger amount of thinning reduces airtightness between the orbiting scroll 20 and the fixed scroll 30, which may cause leak of the refrigerant. Thus, a preferable amount of thinning is 100 μm or less. Since the amount of thinning depends on specifications such as sizes or shapes of the orbiting scroll 20 and the fixed scroll 30, an optimum value should be individually set from the range described above. As described above, the inner peripheral surface IS and the outer peripheral surface OS of the lap 22 are formed along an involute curve, but the thinned portion 66 needs not be formed along the involute curve.

<Amount of thinning of thinned portion 66 (circumferential direction, height direction)>

[0056] The amount of thinning may be constant or varied in the entire region of the thinned portion 66.

[0057] As an example, FIG. 7A shows a shape with a varying amount of thinning from the front end toward the rear end. In this example, the amount of thinning near the engagement start position 65 is maximum, and is gradually reduced toward the front end and the rear end.

[0058] Also, as shown in FIG. 7B, the amount of thinning may be varied in the height direction of the lap 22. In this example, the amount of thinning is constant on an upper side of the low wall portion 22L, while the amount of thinning is gradually reduced toward the bottom on a lower side of the low wall portion 22L.

[0059] The amount of thinning can be varied as described above, thereby more easily ensuring strength of the lap 22, and more effectively prevent leak of the refrigerant.

[0060] In the above embodiment, the example has been described in which the thinned portion 66 is provided in the step portion 62 of the orbiting scroll 20. However, in the present invention, the thinned portion 66 may be provided in the step portion 62 of the fixed scroll 30, and the thinned portions 66 may be provided in both the orbiting scroll 20 and the fixed scroll 30.

[0061] In the above embodiment, the example has been described in which the thinned portion 66 is provided in the step portion 62 (top end side step portion) in which the high wall portion 22H and the low wall portion 22L of the orbiting scroll 20 are connected at the rising wall portion 63. However, the thinned portion 66 may be provided in the step portion 70 (base end side step portion) between the bottom surface 21A and the bottom surface 21B of the fixed scroll 30. The lap 22 of the orbiting scroll 20 and the lap 32 of the fixed scroll 30 come into contact with each other at the step portion 62 and the step portion 70, and thus providing the thinned portion 66 in one of the step portion 62 and the step portion 70 can prevent contact between the lap 22 and the lap 32 in the region. Thus, providing the thinned portion 66 in

the step portion 62 of the fixed scroll 30 is equal to providing the thinned portion 66 in the step portion 70 of the orbiting scroll 20. Specifically, the present invention includes providing the thinned portion 66 in at least one region of the step portion 62 and the step portion 70 of the orbiting scroll 20, and the step portion 62 and the step portion 70 of the fixed scroll 30.

[0062] The orbiting scroll 20 and the fixed scroll 30 can be made of an iron alloy or an aluminum alloy, but in some cases, the orbiting scroll 20 is made of an aluminum alloy having a low specific gravity, and the fixed scroll 30 is made of an iron alloy having high strength. In this case, the thinned portion 66 is preferably provided in the fixed scroll 30 made of an iron alloy with high strength. Since the thinned portion 66 reduces mechanical strength of the laps 22, 32, the thinned portion 66 is provided in the fixed scroll 30 rather than in the orbiting scroll 20 made of an aluminum alloy having low mechanical strength.

[0063] Further, the configurations described in the embodiment may be chosen or changed to other configurations without departing from the scope of the present invention as defined in the claims.

Reference Signs List

[0064]

10 compressor
11 housing
20 orbiting scroll
30 fixed scroll
21, 31 end plate
21A, 21B, 31A, 31B bottom surface
22, 32 lap
22H, 32H high wall portion
22L, 32L low wall portion
22t, 32t top surface
62 step portion (top end side step portion)
63 rising wall portion
63a base
65 engagement start position
66 thinned portion
70 step portion (base end side step portion)
ST center
OT outer peripheral end

Claims

1. A scroll member (20) comprising:
 - an end plate (21);
 - a spiral lap (22) standing on one side surface of the end plate (21), and extending from a center side to an outer peripheral end side;
 - a top end side step portion (62) provided on a top end side of the lap (22), the center side (22L) of the top end side step portion (62) being lower

than the outer peripheral end side (22H) of the top end side step portion (62); and
a base end side step portion (70) provided on a base end side of the lap, the center side (21B) of the base end side step portion (70) being higher than the outer peripheral end side (21A) of the base end side step portion (70),

characterized in that a thinned portion (66) is provided only in a predetermined engagement range from at least an engagement start position (65) of the lap (22) in one or both of the top end side step portion (62) and the base end side step portion (70).

2. The scroll member according to claim 1, wherein the thinned portion (66) is provided in the top end side step portion (62), and formed in an entire region in a height direction from a top end of the lap (22) to the one side surface, or in a specific region from the top end of the lap (22) to a predetermined position in the height direction.
3. The scroll member according to claim 1 or 2, wherein the thinned portion (66) is also provided in front of the engagement start position (65) in the circumferential direction.
4. The scroll member according to any one of claims 1 to 3, wherein the thinned portion (66) is reduced in height with distance from the engagement start position (65) in the circumferential direction.
5. The scroll member according to any one of claims 1 to 4, wherein an amount of thinning is reduced with distance from the engagement start position (65) in the circumferential direction, or with distance from the top end of the lap (22) in the height direction.
6. The scroll member according to any one of claims 1 to 5, wherein the predetermined engagement range is between an engagement start position (65) of the lap (22) and a predetermined engagement position toward the outer peripheral end side of the lap (22).
7. A scroll-type fluid machine (10) comprising:

a spindle (12) rotatably supported in a housing (11) that forms an outer shell;
an orbiting scroll (20) rotatably coupled to a position offset from a center of the spindle (12); and
a fixed scroll (30) that is fixed to the housing (11), and faces the orbiting scroll (20) to form a compression space (50) between the fixed scroll (30) and the orbiting scroll (20), in which space a fluid is compressed,
characterized in that one or both of the orbiting scroll (20) and the fixed scroll (30) include the scroll member according to any one of claims 1

to 6.

8. The scroll-type fluid machine according to claim 7, wherein the orbiting scroll (20) and the fixed scroll (30) are made of different materials, and the orbiting scroll (20) or the fixed scroll (30) made of the material having higher mechanical strength includes the scroll member according to any one of claims 1 to 6.

Patentansprüche

1. Rollenelement (20), umfassend:

eine Endplatte (21),
eine spiralförmige Wicklung (22), die auf einer Seitenfläche der Endplatte (21) steht und sich von einer Mittelseite zu einer Außenumfangsendseite erstreckt,
einen oberen Endseiten-Stufenabschnitt (62), der an einer oberen Endseite der Wicklung (22) vorgesehen ist, wobei die Mittelseite (22L) des oberen Endseiten-Stufenabschnitts (62) niedriger als die Außenumfangsendseite (22H) des oberen Endseiten-Stufenabschnitts (62) ist, und einen Basisendseiten-Stufenabschnitt (70), der an einer Basisendseite der Wicklung vorgesehen ist, wobei die Mittelseite (21B) des Basisendseiten-Stufenabschnitts (70) höher als die Außenumfangsendseite (21A) des Basisendseiten-Stufenabschnitts (70) ist,
dadurch gekennzeichnet, dass ein verdünnter Abschnitt (66) nur in einem vorbestimmten Eingriffsbereich von mindestens einer Eingriffsstartposition (65) der Wicklung (22) in einem oder beiden des oberen Endseiten-Stufenabschnitts (62) und des Basisendseiten-Stufenabschnitts (70) vorgesehen ist.

2. Rollenelement nach Anspruch 1, wobei der verdünnte Abschnitt (66) in dem oberen Endseiten-Stufenabschnitt (62) vorgesehen ist, und in einem gesamten Bereich in einer Höhenrichtung von einem oberen Ende der Wicklung (22) zu der einen Seitenfläche oder in einem speziellen Bereich von dem oberen Ende der Wicklung (22) zu einer vorbestimmten Position in der Höhenrichtung gebildet ist.
3. Rollenelement nach Anspruch 1 oder 2, wobei der verdünnte Abschnitt (66) in der Umfangsrichtung auch vor der Eingriffsstartposition (65) vorgesehen ist.
4. Rollenelement nach einem der Ansprüche 1 bis 3, wobei der verdünnte Abschnitt (66) mit einem Abstand von der Eingriffsstartposition (65) in der Umfangsrichtung in der Höhe verringert ist.

5. Rollenelement nach einem der Ansprüche 1 bis 4, wobei ein Ausmaß der Verdünnung mit einem Abstand von der Eingriffsstartposition (65) in der Umfangsrichtung oder mit einem Abstand von dem oberen Ende der Wicklung (22) in der Höhenrichtung verringert ist.

6. Rollenelement nach einem der Ansprüche 1 bis 5, wobei sich der vorbestimmte Eingriffsbereich zwischen einer Eingriffsstartposition (65) der Wicklung (22) und einer vorbestimmten Eingriffsposition in Richtung der äußeren Umfangsendseite der Wicklung (22) befindet.

7. Fluidmaschine (10) mit Rollen, umfassend:

eine Spindel (12), die drehbar in einem Gehäuse (11) gelagert ist, das eine äußere Hülle bildet, eine umlaufende Rolle (20), die drehbar an einer Position verbunden ist, die von einer Mitte der Spindel (12) versetzt ist, und eine feste Rolle (30), die an dem Gehäuse (11) befestigt ist und der umlaufenden Rolle (20) zugewandt ist, um einen Kompressionsraum (50) zwischen der festen Rolle (30) und der umlaufenden Rolle (20) zu bilden, wobei in diesem Raum ein Fluid komprimiert wird,
dadurch gekennzeichnet, dass eine oder beide der umlaufenden Rolle (20) und der festen Rolle (30) das Rollelement nach einem der Ansprüche 1 bis 6 aufweisen.

8. Fluidmaschine mit Rollen nach Anspruch 7, wobei die umlaufende Rolle (20) und die feste Rolle (30) aus unterschiedlichen Materialien hergestellt sind, und die umlaufende Rolle (20) oder die feste Rolle (30), die aus dem Material mit höherer mechanischer Festigkeit hergestellt ist, das Rollelement nach einem der Ansprüche 1 bis 6 aufweist.

Revendications

1. Élément de spirale (20) comprenant :

une plaque d'extrémité (21) ;
une boucle de spirale (22) se dressant sur une surface latérale de la plaque d'extrémité (21), et s'étendant à partir d'un côté central vers un côté d'extrémité périphérique externe ;
une partie de gradin du côté de l'extrémité supérieure (62) prévue sur un côté d'extrémité supérieure de la boucle (22), le côté central (22L) de la partie de gradin du côté de l'extrémité supérieure (62) étant inférieur au côté d'extrémité périphérique externe (22H) de la partie de gradin du côté de l'extrémité supérieure (62) ; et

- une partie de gradin du côté de l'extrémité de base (70) prévue sur un côté d'extrémité de base de la boucle, le côté central (21B) de la partie de gradin du côté de l'extrémité de base (70) étant plus haut que le côté d'extrémité périphérique externe (21A) de la partie de gradin du côté de l'extrémité de base (70),
caractérisé en ce qu'une partie amincie (66) est prévue uniquement dans une plage de mise en prise prédéterminée, à partir d'au moins une position de début de mise en prise (65) de la boucle (22) dans l'une ou les deux parmi la partie de gradin du côté de l'extrémité supérieure (62) et la partie de gradin du côté de l'extrémité de base (70).
2. Élément de spirale selon la revendication 1, dans lequel la partie amincie (66) est prévue dans la partie de gradin du côté de l'extrémité supérieure (62), et formée dans toute une région dans une direction de hauteur à partir d'une extrémité supérieure de la boucle (22) jusqu'à une surface latérale, ou dans une région spécifique allant de l'extrémité supérieure de la boucle (22) jusqu'à une position prédéterminée dans le sens de la hauteur.
3. Élément de spirale selon la revendication 1 ou 2, dans lequel la partie amincie (66) est également prévue en face de la position de début de mise en prise (65) dans la direction circonférentielle.
4. Élément de spirale selon l'une quelconque des revendications 1 à 3, dans lequel la partie amincie (66) est réduite en hauteur avec une distance à partir de la position de début de mise en prise (65) dans la direction circonférentielle.
5. Élément de spirale selon l'une quelconque des revendications 1 à 4, dans lequel une quantité d'aminçissement est réduite avec la distance à partir de la position de début de mise en prise (65) dans la direction circonférentielle, ou avec la distance à partir de l'extrémité supérieure de la boucle (22) dans le sens de la hauteur.
6. Élément de spirale selon l'une quelconque des revendications 1 à 5, dans lequel la plage de mise en prise prédéterminée est entre une position de début de mise en prise (65) de la boucle (22) et une position de mise en prise prédéterminée vers le côté d'extrémité périphérique externe de la boucle (22).
7. Machine à fluide de type à spirale (10) comprenant :
- une broche (12) supportée, en rotation, dans un boîtier (11) qui forme une coque externe ;
 une spirale orbitale (20) couplée, en rotation, dans une position décalée d'un centre de la bro-

che (12) ; et
 une spirale fixe (30) qui est fixée sur le boîtier (11) et fait face à la spirale orbitale (20) afin de former un espace de compression (50) entre la spirale fixe (30) et la spirale orbitale (20), dans lequel espace, un fluide est comprimé,
caractérisée en ce que l'une ou les deux parmi la spirale orbitale (20) et la spirale fixe (30) comprennent l'élément de spirale selon l'une quelconque des revendications 1 à 6.

8. Machine à fluide de type à spirale selon la revendication 7, dans laquelle la spirale orbitale (20) et la spirale fixe (30) sont réalisées avec des matériaux différents, et
 la spirale orbitale (20) ou la spirale fixe (30) réalisée avec un matériau ayant une résistance mécanique supérieure comprend l'élément de spirale selon l'une quelconque des revendications 1 à 6.

FIG. 1

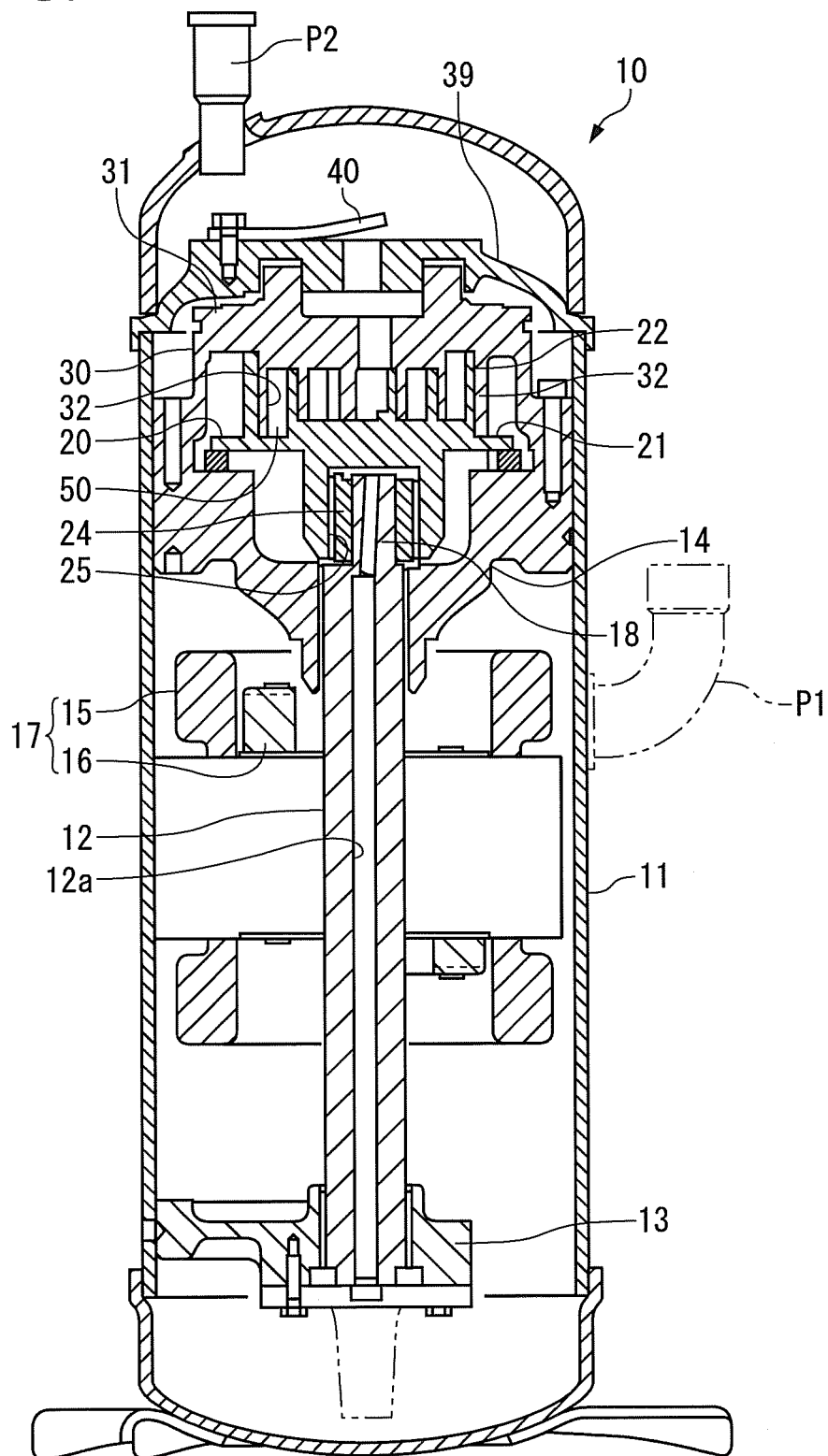


FIG. 2

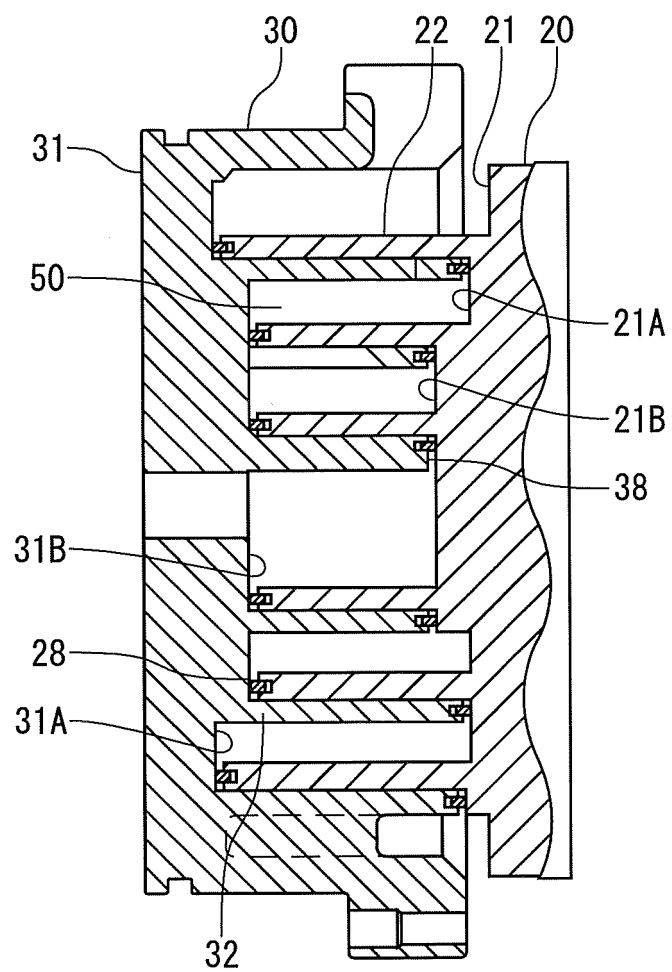


FIG. 3A

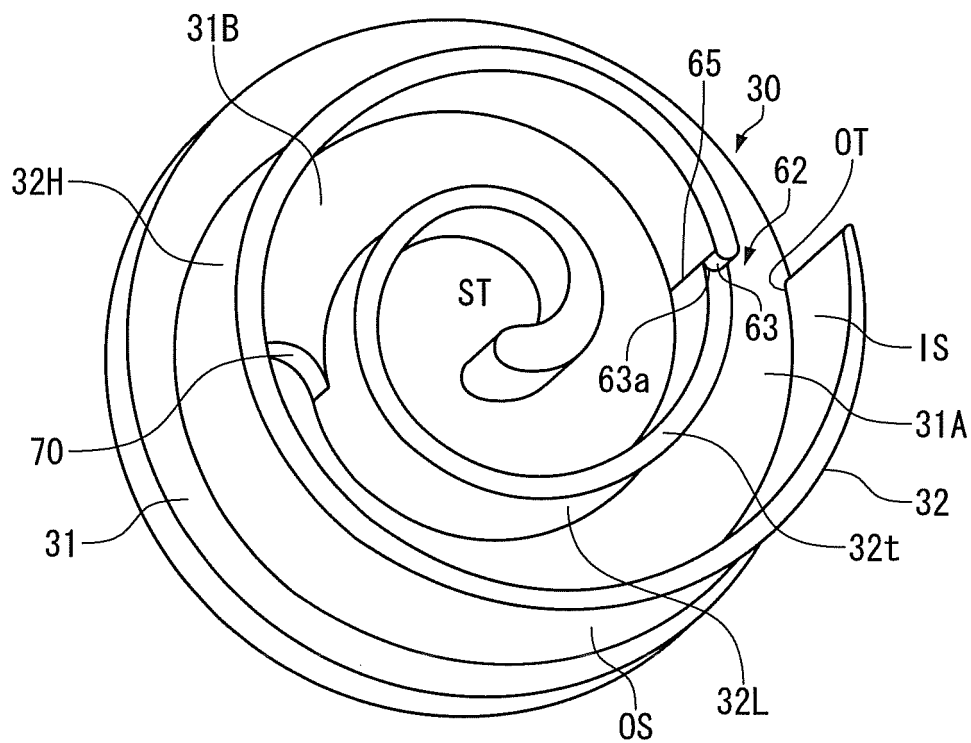


FIG. 3B

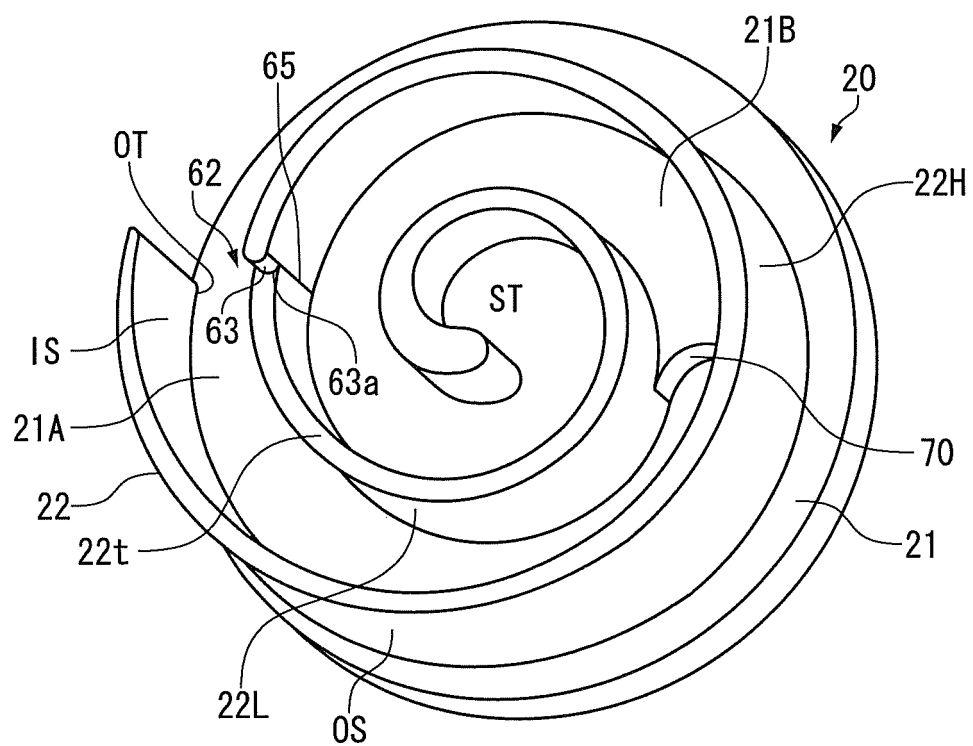


FIG. 4A

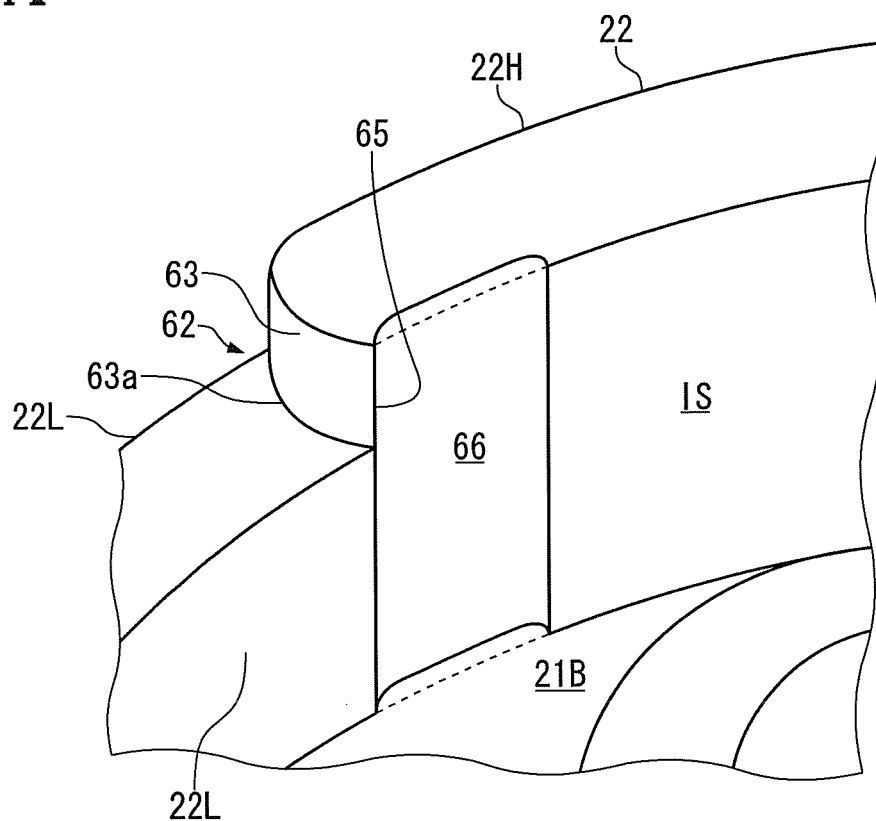


FIG. 4B

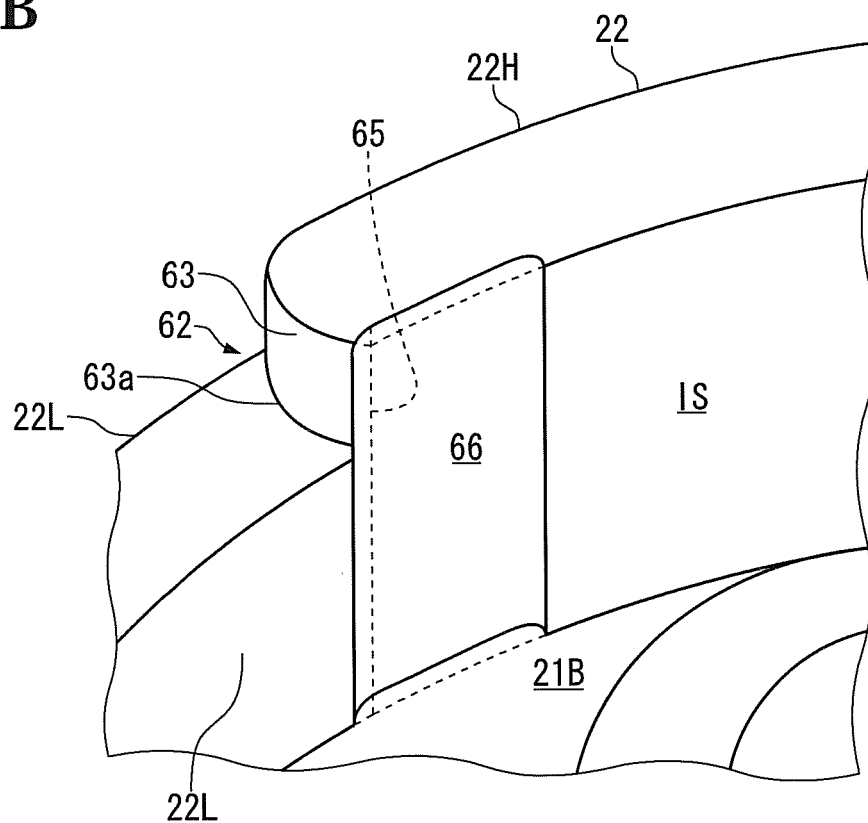


FIG. 5A

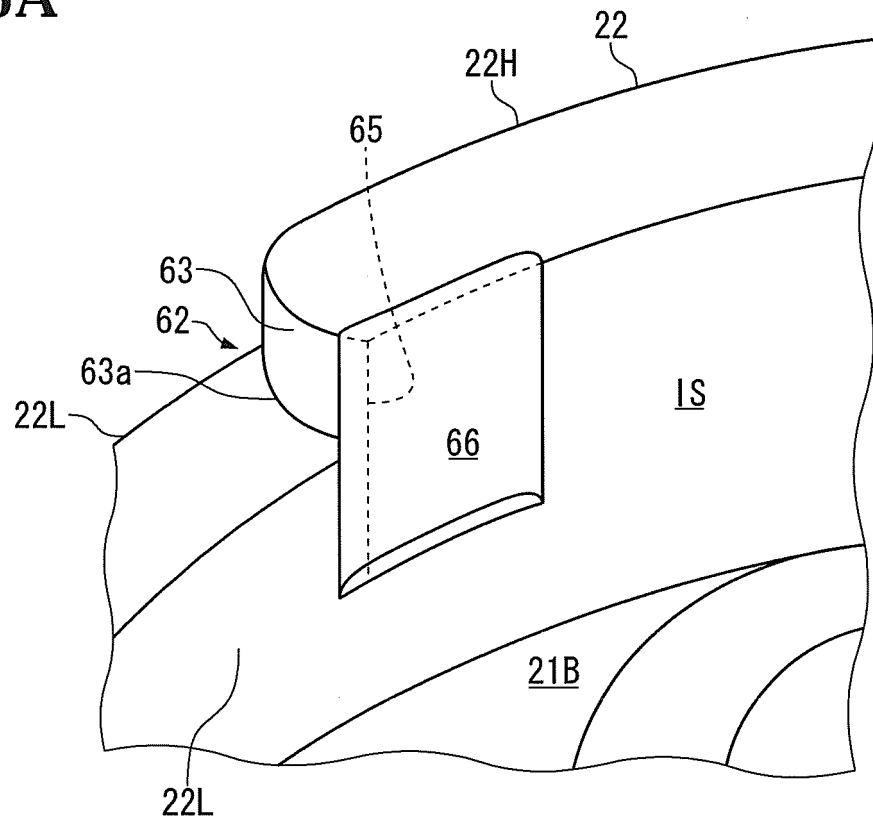


FIG. 5B

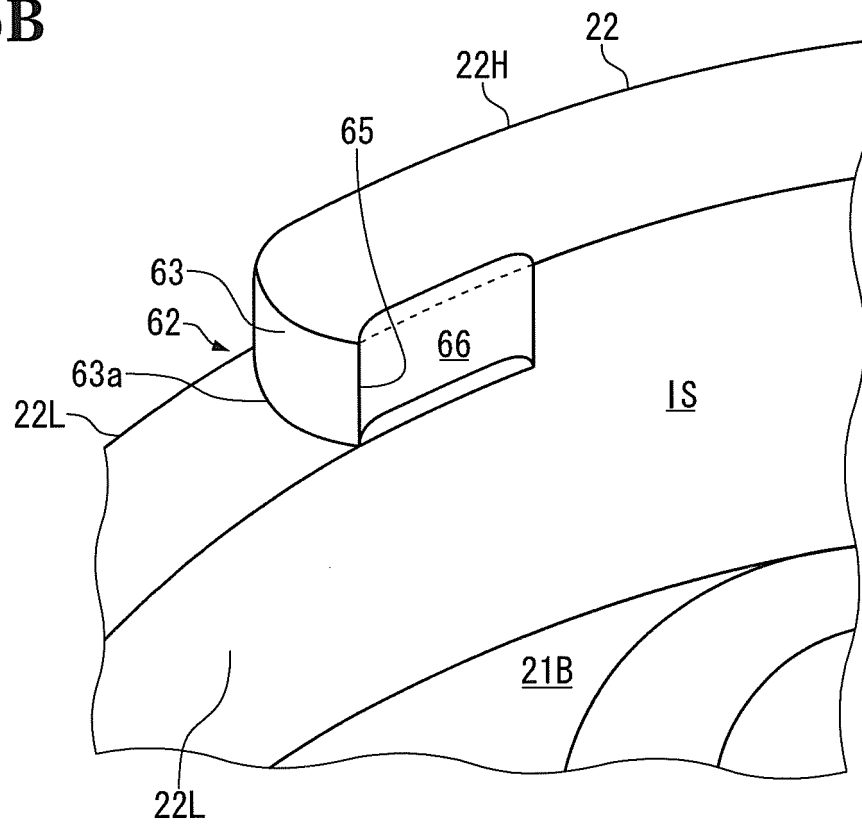


FIG. 6A

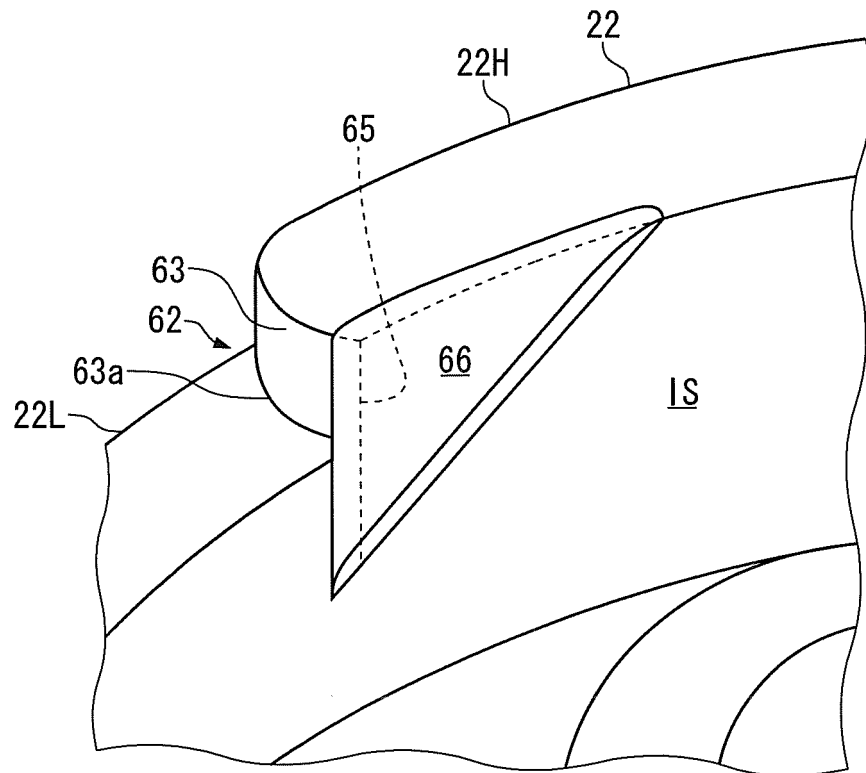


FIG. 6B

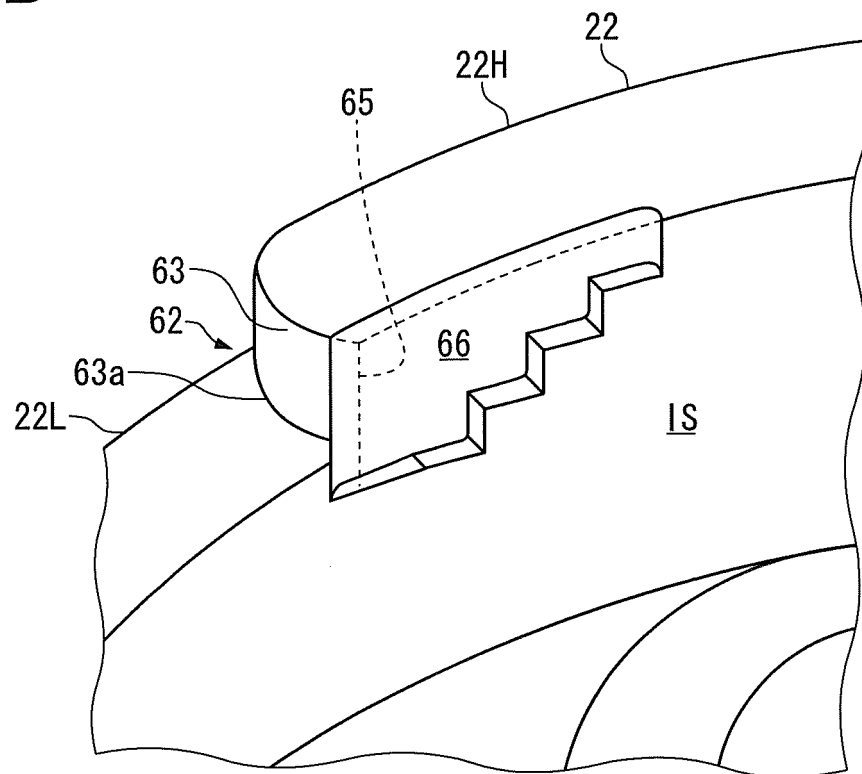


FIG. 7A

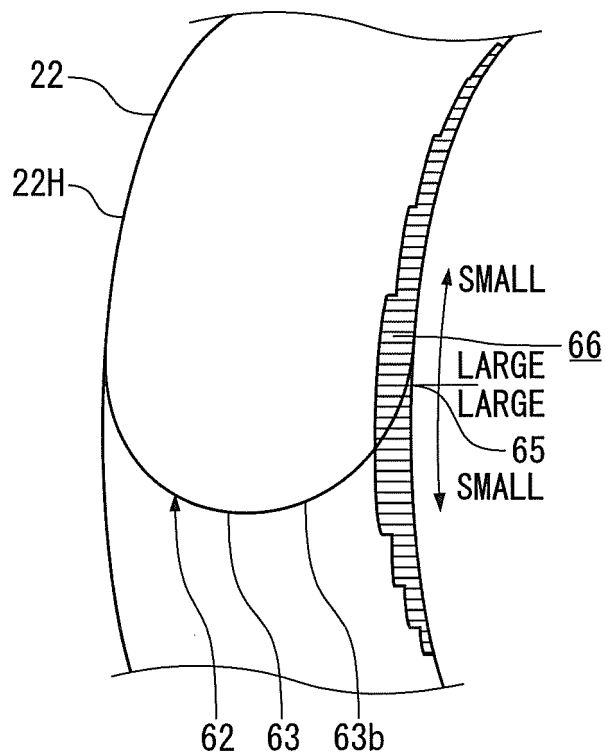


FIG. 7B

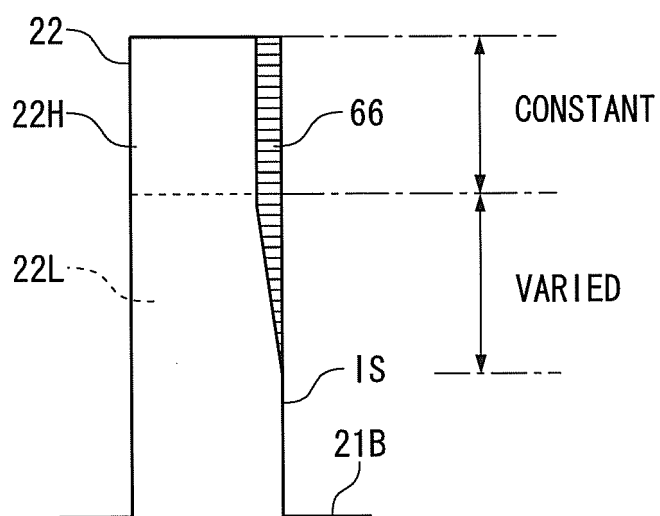
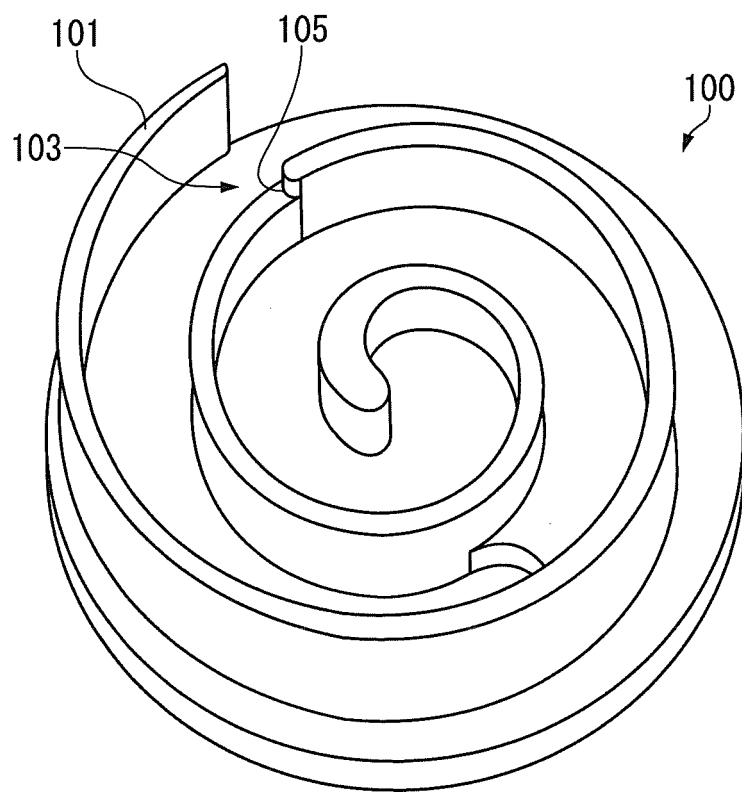


FIG. 8



REFERENCES CITED IN THE DESCRIPTION

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