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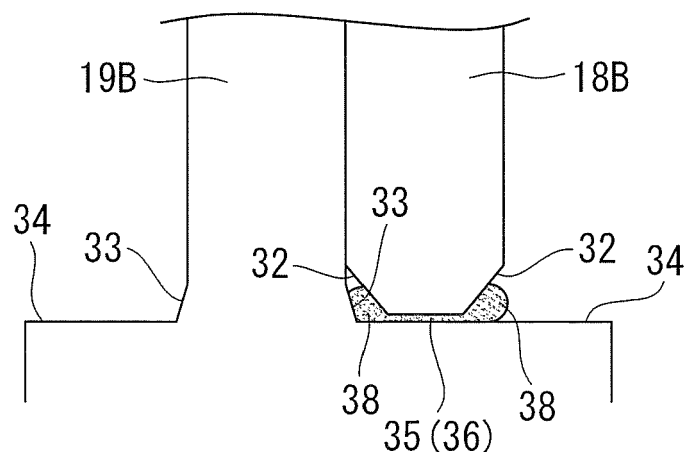
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(54) **Scroll fluid machine**

(57) Scroll fluid machine configured by engaging spiral wraps (18B and 19B) of a pair of fixed (18) and orbiting (19) scrolls in which the spiral wraps (18B and 19B) are erected on end plates (18A and 19A), wherein a micro chamfer (32) is provided on a corner portion of a wrap

tooth crest (31) of each of the spiral wraps (18B and 19B) of the fixed scroll (18) and the orbiting scroll (19), and the wrap tooth crest (31) is coated with an abradable seal material (36) having machinability.

FIG. 3



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Description

Citation List

Technical Field

Patent Literature

[0001] The present invention relates to a scroll fluid machine configured by engaging a fixed scroll and an orbiting scroll with each other.

5 **[0006]**

{Background Art}

{PTL 1}
Japanese Unexamined Patent Application, Publication No. 2001-304151
{PTL 2}
Japanese Unexamined Patent Application, Publication No. 2003-42078
{PTL 3}
Japanese Unexamined Patent Application, Publication No. 2008-151009
{PTL 4}
Japanese Unexamined Patent Application, Publication No. Hei5-187371

[0002] Scroll fluid machines used for compressors, expanders, or the like have a configuration in which spiral wraps of a pair of fixed and orbiting scrolls, in each of which the spiral wrap is erected on an end plate, are engaged with each other. To improve the efficiency and performance of such compressors and expanders, it is important to reduce gas leakage during a compressing process and an expanding process.

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[0003] A gas compression or expansion chamber is sealed between side surfaces of the spiral wraps of the fixed scroll and the orbiting scroll, and between a tooth crest of one of the spiral wraps and a bottom land of the other of the spiral wraps. If a wrap tooth tip clearance between the tooth crest and the bottom land is too small, the tooth crest possibly comes into contact with the bottom land to cause a seizure when the spiral wraps thermally expand. Thus, a method for sealing the wrap tooth tip clearance by ensuring a given clearance, and mounting a tip seal on the tooth crest of the spiral wrap is generally employed.

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20 Summary of Invention

Technical Problem

[0004] As a method for making the above clearance as small as possible, there has been known a method of providing a coating layer having machinability, such as a fluorine-based resin layer of PTFE or the like and a PTFE composite electroless nickel plating layer having conformability, self-lubricity and slidability, on any or all of the tooth crest, the bottom land, and the side surface of the spiral wrap of the fixed scroll and/or the orbiting scroll (see PTLs 1, 2, and 3) in addition to the method of mounting a tip seal on the tooth crest of the spiral wrap.

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[0007] However, in consideration of the generation of cut powder or cut chips, it is not necessarily desirable to coat (apply) the coating layer having machinability (referred to as an abradable seal material below) on all of the tooth crest, the bottom land, and the side surface of the spiral wrap as described above. A method of coating (applying) the abradable seal material only on the wrap tooth crest, the sealability of which is required to be improved, has been also proposed. However, when only the wrap tooth crest is coated with the seal material, the following problems occur due to limitations on a construction method or the like.

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(1) Although masking or the like needs to be performed so as to prevent the seal material from being applied to a region other than the tooth crest, it is difficult to perform making or the like due to a complicated shape.

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(2) It is necessary to introduce a sophisticated (expensive) facility so as to increase the application accuracy of the seal material.

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(3) Maintenance man-hours are increased and quality maintenance and management is required after the application of the seal material.

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(4) It is necessary to select a material that does not affect the strength or performance, and has abradability at the same time even when the seal material is applied to a region other than the tooth crest.

[0005] On the other hand, the spiral wrap is machined by end milling. To reduce gas leakage, it is desirable to machine corner portions of a base portion (the bottom land) and the tooth crest of the spiral wrap into a right angle. However, when the corner portions are machined into a right angle, an end of an end mill tool is easily abraded. To maintain machining accuracy, the end mill tool needs to be replaced frequently. If the end mill tool is not replaced frequently, an uncut region is formed in the side surface of the base portion of the wrap due to the abraded portion in the tool, and interferes with the wrap tooth crest to cause damage to the spiral wrap or abnormal sound. To solve the problem, PTL 4 discloses a configuration in which the machining accuracy is stabilized and the lifetime of the end mill tool is extended by providing chamfers on the corner portions of the base portion and the tooth crest of the wrap, and thereby mitigating abrasion of the end of the end mill tool.

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[0008] On the other hand, to avoid frequent replacement of the end mill tool for the purpose of ensuring the machining accuracy of the base portion (the bottom land) and the tooth crest of the spiral wrap, it is also possible to employ the configuration in which the chamfers are provided on the corner portions of the base portion and

the tooth crest of the wrap as described in PTL 4. However, when the chamfers are simply provided, the lifetime of the tool can be extended, but a leakage clearance is enlarged by chamfering, so that there occurs a problem that the efficiency is lowered due to an increase in gas leakage amount. The inventors have confirmed that the performance is lowered by about 5 to 6% when, for example, a chamfer of about 0.5 mm is provided.

[0009] As described above, an increase in the efficiency by reducing the gas leakage in the scroll fluid machine substantially reaches its peak, and an improvement in the performance by increasing the efficiency is also approaching its limit. Currently, it is expected to achieve both of a further increase in the efficiency and performance of the scroll fluid machine by solving the above problems, and extension of the lifetime of the end mill tool at the same time.

[0010] The present invention has been made in view of such circumstances, and an object thereof is to provide a scroll fluid machine which can achieve both of an increase in efficiency and performance by reducing leakage from a wrap tooth tip clearance, and extension of the lifetime of an end mill tool for machining a spiral wrap at the same time. Solution to Problem

[0011] A scroll fluid machine according to the present invention is a scroll fluid machine configured by engaging spiral wraps of a pair of fixed and orbiting scrolls in each of which the spiral wrap is erected on an end plate, wherein a micro chamfer is provided on a corner portion of a wrap tooth crest of each of the spiral wraps of the fixed scroll and the orbiting scroll, and the wrap tooth crest is coated with an abrasible seal material having machinability.

[0012] In accordance with the configuration, the micro chamfer is provided on the corner portion of the wrap tooth crest of each of the spiral wraps of the fixed scroll and the orbiting scroll. Thus, even when an end edge portion of an end mill tool that is most easily abraded is slightly abraded, and an uncut region is thereby formed in a corner portion of a base portion of one of the spiral wraps to form a micro chamfered portion at the time of cutting the spiral wraps by the end mill tool, the micro chamfered portion does not interfere with the wrap tooth crest of the other spiral wrap, thereby extending the lifetime of the end mill tool. Furthermore, by providing the chamfer on the corner portion of the wrap tooth crest, the seal material inevitably adhering to a wrap side surface by forming a droop when a coating roll or the like where the seal material adheres to the surface is brought into contact with the wrap tooth crest to transfer the seal material in order to coat the wrap tooth crest with the abrasible seal material can be stopped within the plane of the chamfer. The seal material can be used for sealing the chamfered portion. Therefore, even when masking or a sophisticated (expensive) facility is not introduced, the abrasible seal material can be easily coated only on the wrap tooth crest by use of a versatile means such as a roll coater, so that an influence caused when the seal

material adheres to the wrap side surface can be eliminated. By filling a wrap tooth tip clearance and a clearance generated by the chamfer with the abrasible seal material, the respective clearances are minimized to reduce gas leakage, thereby increasing efficiency and performance. At the same time, the permissible abrasion loss of the end edge portion of the end mill tool is increased, thereby extending the lifetime of the tool. Both of the increase in the efficiency and performance, and the extension of the lifetime of the tool can be thereby achieved at the same time.

[0013] In the above scroll fluid machine, a micro chamfer may be provided on a base portion of each of the spiral wraps of the fixed scroll and the orbiting scroll corresponding to the micro chamfer provided on the corner portion of the wrap tooth crest of the other spiral wrap.

[0014] In accordance with the configuration, a chamfered portion corresponding to the micro chamfer on the wrap base portion can be previously provided on the end edge portion of the end mill tool that is most easily abraded at the time of cutting the spiral wraps by the end mill tool. Thus, the progress of abrasion of the end edge portion of the end mill tool can be significantly mitigated, and the lifetime of the end mill tool can be extended. Therefore, the replacement frequency of the end mill tool can be dramatically reduced, and the production efficiency can be improved. Also, by providing the chamfers on both the corner portions of the base portion and the tooth crest of the spiral wrap, an increase in a leakage clearance by providing the chamfers can be suppressed, and sealability provided by the abrasible seal material can be improved.

[0015] In any of the above scroll fluid machines, a coating thickness of the abrasible seal material may be set to a thickness corresponding to a wrap tooth tip clearance set between the wrap tooth crest of each of the spiral wraps and a bottom land of the other spiral wrap.

[0016] In accordance with the configuration, the wrap tooth tip clearance currently set to a size where the tooth crest does not come into contact with the bottom land to cause a seizure when the spiral wraps thermally expand can be filled with a coating film of the abrasible seal material. Consequently, the gas leakage from the wrap tooth tip clearance can be minimized, and the efficiency and performance of the scroll fluid machine can be further increased.

[0017] In the above scroll fluid machine, the coating thickness of the abrasible seal material may be set to 0.02 to 0.05 mm.

[0018] In accordance with the configuration, by setting the coating thickness of the abrasible seal material to the thickness corresponding to the wrap tooth tip clearance set to a size where the tooth crest does not come into contact with the bottom land even when the spiral wraps thermally expand by clearance management, the wrap tooth tip clearance can be filled with the coating film. Accordingly, the gas leakage from the wrap tooth tip clearance can be minimized to increase the efficiency

and performance, and the coating film can be prevented from being cut unnecessarily.

[0019] In any of the above scroll fluid machines, the micro chamfer may be set to 0.05 to 0.2 mm.

[0020] In accordance with the configuration, an increase in the leakage clearance by providing the chamfer can be minimized. The droop onto the wrap side surface during coating of the coating film of the abrasible seal material having a thickness of about 0.02 to 0.05 mm can be also stopped within the plane of the chamfer of 0.05 to 0.2 mm, and can be used for sealing the chamfered portion. Therefore, the gas leakage can be minimized by solving the problem of the increase in the leakage clearance due to the chamfer, and the influence caused when the seal material droops onto the wrap side surface can be also eliminated.

[0021] In any of the above scroll fluid machines, the abrasible seal material may be coated on the wrap tooth crest by using a roll coater.

[0022] In accordance with the configuration, even when the abrasible seal material is coated on the wrap tooth crest by using the roll coater that is a versatile means, the seal material that is to droop onto the wrap side surface when the coating roll is brought into contact with the wrap tooth crest to transfer the seal material can be stopped within the chamfered plane since the chamfer is provided on the corner portion of the wrap tooth crest. Thus, even when masking or a sophisticated facility is not introduced, the abrasible seal material can be easily coated only on the wrap tooth crest by using the roll coater that is a versatile means. Advantageous Effects of Invention

[0023] In accordance with the present invention, even when masking or a sophisticated (expensive) facility is not introduced, the abrasible seal material can be easily coated only on the wrap tooth crest by use of the versatile means such as the roll coater, so that the influence caused when the seal material adheres to the wrap side surface can be surely eliminated. By filling the wrap tooth tip clearance and the clearance generated by the chamfer with the abrasible seal material, the respective clearances are minimized to reduce the gas leakage, thereby increasing the efficiency and performance. At the same time, the permissible abrasion loss of the end edge portion of the end mill tool is increased, thereby extending the lifetime of the tool. Both of the increase in the efficiency and performance, and the extension of the lifetime of the tool can be thereby achieved at the same time.

Brief Description of Drawings

[0024]

{Fig. 1}

Fig. 1 is a longitudinal sectional view of a hermetic scroll compressor according to one embodiment of the present invention.

{Fig. 2}

Fig. 2 is a configuration view of a wrap tooth crest of each of spiral wraps of a fixed scroll and an orbiting scroll of the hermetic scroll compressor.

{Fig. 3}

Fig. 3 is a configuration view of a state in which the spiral wraps of the fixed scroll and the orbiting scroll are engaged with each other.

{Fig. 4}

Fig. 4 is an explanatory view for explaining a problem caused when an abrasible seal material is coated on the tooth crest of the spiral wrap.

{Fig. 5}

Figs. 5 are explanatory views for explaining a problem of a case in which the tooth crest of the spiral wrap is chamfered.

[0025] {Description of Embodiments}

[0026] In the following, one embodiment of the present invention is described by reference to Figs. 1 to 5.

[0027] Fig. 1 is a longitudinal sectional view of a hermetic scroll compressor according to one embodiment of the present invention. Fig. 2 is a configuration view of a wrap tooth crest of a spiral wrap thereof. Fig. 3 is a configuration view of a state in which the spiral wraps of two scrolls are engaged with each other.

[0028] Although an example of a case in which a scroll fluid machine is used as a hermetic scroll compressor 1 is hereinafter described, the present invention is not limited thereto. Of course, the present invention can be applied to a pump, an expander or the like in addition to general compressors.

[0029] The hermetic scroll compressor 1 as the scroll fluid machine includes a cylindrical hermetically-sealed housing 2 that is long in a vertical direction with a bottom portion hermetically sealed by a lower cover. An upper portion of the hermetically-sealed housing 2 is hermetically sealed by a discharge cover 3 and an upper cover 4, so that a discharge chamber 5 where a compressed high-pressure gas is discharged is formed between the discharge cover 3 and the upper cover 4.

[0030] In the hermetically-sealed housing 2, an upper bearing member (frame member) 6 is fixedly mounted, and a scroll compressor 7 is incorporated via the upper bearing member 6 in an upper region, and an electric motor 10 composed of a stator 8 and a rotor 9 is mounted in a lower region. The electric motor 10 is incorporated with the stator 8 fixedly mounted to the hermetically-sealed housing 2, and a crankshaft 11 is fixed to the rotor 9.

[0031] A crankpin 12 whose axis is decentered by a predetermined dimension is provided at an upper end of the crankshaft 11. By coupling the crankpin 12 to the scroll compressor 7, the scroll compressor 7 can be driven by the electric motor 10. An upper portion of the crankshaft 11 is rotationally supported by a journal bearing section 6A of the upper bearing member 6, and a lower end portion of the crankshaft 11 is rotationally supported by a journal lower bearing 13 provided in the lower region

of the hermetically-sealed housing 2.

[0032] A displacement-type oil pump 14 is provided between the journal lower bearing 13 and the lower end portion of the crankshaft 11, and is configured to suck lubricating oil 15 stored in the bottom portion of the hermetically-sealed housing 2 through a suction pipe 16, and discharge the lubricating oil 15 to an oil feed hole 17 that is pierced axially into the crankshaft 11. The lubricating oil 15 can be fed to a portion requiring lubrication, such as the upper bearing member 6, the scroll compressor 7, and the lower bearing 13, through the oil feed hole 17.

[0033] The upper bearing member 6 is one of constituent components of the scroll compressor 7. The scroll compressor 7 includes a fixed scroll 18 that is fixedly mounted on the upper bearing member 6, an orbiting scroll 19 that is slidably supported on a thrust bearing section 6B of the upper bearing member 6, and is engaged with the fixed scroll 18 to form a compression chamber 20, a rotation preventing mechanism 21, such as an oldham ring, that is interposed between the upper bearing member 6 and the orbiting scroll 19, and prevents rotation of the orbiting scroll 19 on its axis but allows revolution orbiting motion of the orbiting scroll 19, and a drive bushing 22 and an orbiting bearing (needle bearing) 23 that are provided between the crankpin 12 of the crankshaft 11 and a bearing boss 19C provided on a back surface of the orbiting scroll 19, and transmit a rotating force of the crankshaft 11 to the orbiting scroll 19. The scroll compressor 7 is mounted on the upper bearing member 6 with a center portion of an end plate of the fixed scroll 18 connected to the discharge cover 3.

[0034] The fixed scroll 18 includes an end plate 18A, and a spiral wrap 18B that is erected on the end plate 18A. A discharge port 24 is provided in the center portion of the end plate 18A, and a tip seal 25 is mounted on a wrap tooth crest of the spiral wrap 18B. The orbiting scroll 19 includes an end plate 19A, and a spiral wrap 19B that is erected on the end plate 19A. The bearing boss section 19C is provided on the back surface of the end plate 19A, and a tip seal 26 is mounted on a wrap tooth crest of the spiral wrap 19B.

[0035] The scroll compressor 7 sucks a refrigerant gas, which is sucked into the hermetically-sealed housing 2 via a suction pipe arrangement 27 that opens at a position facing a stator winding 8A of the electric motor 10, into the compression chamber 20 from a suction port 28 that opens within the hermetically-sealed housing 2, and thereby compresses the gas into a high-temperature and high-pressure gas. The compressed gas is discharged into the discharge chamber 5 through the discharge port 24 provided in the center portion of the fixed scroll 18, and a discharge valve 29 provided in the discharge cover 3. The compressed gas is further sent outside of the compressor through a discharge pipe arrangement 30 that is connected to the discharge chamber 5.

[0036] In the hermetic scroll compressor 1, micro chamfers 32 are provided on both corner portions (edge

portions) of a wrap tooth crest 31 of each of the spiral wraps 18B and 19B of the fixed scroll 18 and the orbiting scroll 19 as shown in Fig. 2. Also, chamfers 33 are provided on corner portions of a base portion (bottom land) of each of the spiral wraps 18B and 19B corresponding to the chamfers 32 on the wrap tooth crest 31 as shown in Fig. 3. The chamfers 32 and 33 generally have a size of 0.05 to 0.2 mm, and an angle of, for example, 45 to 60°.

[0037] To fill a clearance set between the wrap tooth crest 31 of each of the spiral wraps 18B and 19B where the chamfers 32 are formed and a bottom land 34 of the spiral wrap 18B or 19B of the other scroll, a coating film 35 of an abradable seal material having machinability, which is made of a PTFE-based material or the like, is provided on the wrap tooth crest 31 as shown in Figs. 2 and 3. The coating film 35 is set to a thickness corresponding to a wrap tooth tip clearance that is set so as not to cause a seizure with the wrap tooth crest 31 coming into contact with the bottom land 34 of the other spiral wrap 18B or 19B when the spiral wraps 18B and 19B are extended by thermal expansion. The thickness is generally set to 0.02 to 0.05 mm.

[0038] The coating film 35 of the abradable seal material is transferred by contact by pressing a coating roll 37 where a seal material 36 adheres to the surface by use of a roll coater or the like as shown in Fig. 4. When the corner portions (edge portions) of the wrap tooth crest 31 have a right angle, droops 38 are inevitably formed on wrap side surfaces of the spiral wraps 18B and 19B when the coating roll 37 is pressed, so that the abradable seal material 36 also partially adheres to the wrap side surfaces. However, by providing the micro chamfers 32 on the corner portions (edge portions) of the wrap tooth crest 31 as described above, the droops 38 can be stopped within the planes of the chamfers 32 as shown in Fig. 2. Therefore, the abradable seal material 36 can be coated only on the wrap tooth crest 31 even without performing masking or the like.

[0039] Moreover, when the micro chamfers 32 are provided on the wrap tooth crest 31 of each of the spiral wraps 18B and 19B, it is desirable to provide the micro chamfers 33 on the corner portions of the base portion (bottom land) of each of the spiral wraps 18B and 19B corresponding to the micro chamfers 32 in order to suppress an increase in a leakage clearance caused by providing the micro chamfers 32. The micro chamfers 33 provided on the base portion of each of the spiral wraps 18B and 19B serve as effective measures in significantly mitigating the progress of abrasion of an end edge portion of an end mill tool used for cutting the spiral wraps 18B and 19B, and extending the lifetime of the end mill tool to reduce the replacement frequency of the tool.

[0040] That is, when both the tooth crests and the base portions of the spiral wraps 18B and 19B have a right angle, the end edge portion of the end mill tool also has a right angle. In this case, in a state in which the end mill tool has been replaced recently and has not been abraded yet, the tooth crests and the base portions can be cut

into a right angle. Thus, the tooth crests and the base portions do not interfere with each other as shown in Fig. 5(a). When the end edge portion of the end mill tool is abraded, an uncut region (micro chamfered portion) 39 is formed in the base portion as shown in Fig. 5(b), and interferes with the tooth crest of the other spiral wrap 18B or 19B, thereby causing damage to the spiral wraps 18B and 19B or abnormal sound. Thus, it is necessary to machine the tooth crests and the base portions into a right angle by replacing the end mill tool frequently before the abrasion of the end edge portion of the end mill tool progresses.

[0041] When the micro chamfers 32 are provided on the wrap tooth crest 31 of each of the spiral wraps 18B and 19B, it is desirable to correspondingly provide the micro chamfers 33 on the base portion of each of the spiral wraps 18B and 19B. Accordingly, the end edge portion of the end mill tool also employs a chamfered configuration. Thus, as compared with rapid abrasion in a case in which the end edge portion has a right angle, the abrasion progress can be significantly mitigated. Thus, the replacement frequency of the end mill tool can be dramatically reduced, and the production efficiency can be improved.

[0042] On the other hand, when the micro chamfers 32 and 33 are respectively provided on the tooth crest 31 and the base portion of each of the spiral wraps 18B and 19B, an increase in a leakage clearance cannot be avoided as shown in Fig. 5(c) as compared to the case in which the tooth crest and the base portion have a right angle. However, the clearance can be filled with the droops 38 of the abrasible seal material 36 drooping onto the chamfered surfaces of the micro chamfers 32 when the wrap tooth crest 31 is coated with the abrasible seal material 36 as shown in Figs. 2 and 3.

[0043] Accordingly, not only the wrap tooth tip clearance, but also the leakage clearance generated by the micro chamfers 32 and 33 can be sealed by the coating film 35 of the abrasible seal material 36 coated on the wrap tooth crest 31.

[0044] Because of the configuration described above, the present embodiment provides the following effects.

[0045] In the above hermetic scroll compressor 1, the compression chamber 20 formed between the pair of the fixed scroll 18 and the orbiting scroll 19 is formed by engaging the pair of the fixed scroll 18 and the orbiting scroll 19 with each other by a phase difference of 180° with the spiral wraps 18B and 19B facing each other.

[0046] The compression chamber 20 is sealed by bringing into contact an inner-side wrap surface of the spiral wrap 18B of the fixed scroll 18 and an outer-side wrap surface of the spiral wrap 19B of the orbiting scroll 19, and an outer-side wrap surface of the spiral wrap 18B of the fixed scroll 18 and an inner-side wrap surface of the spiral wrap 19B of the orbiting scroll 19 respectively at two positions in a circumferential direction, and is also sealed by bringing the wrap tooth crest 31 of each of the spiral wraps 18B and 19B into contact with the bottom

land 34 of the other spiral wrap 18B or 19B via the tip seals 25 and 26. The compression chamber 20 moves from an outer peripheral position to a center position with the volume being reduced by the revolution orbiting motion of the orbiting scroll 19 to thereby perform a gas compressing operation.

[0047] Therefore, the compression efficiency depends on how much gas leakage is reduced during the above compressing process.

[0048] In the present embodiment, the micro chamfers 32 and 33 are respectively provided on the corner portions of the base portion and the wrap tooth crest 31 of each of the spiral wraps 18B and 19B of the fixed scroll 18 and the orbiting scroll 19. The abrasible seal material 36 having machinability is also coated on the wrap tooth crest 31, to form the coating film 35.

[0049] Therefore, it becomes unnecessary to form the end edge portion of the end mill tool for cutting the spiral wraps 18B and 19B into a right angle, so that an end configuration corresponding to the micro chamfers 33 on the base portion can be employed. By mitigating the rapid abrasion as in the case of the right angle, the lifetime of the end mill tool for machining the spiral wraps 18B and 19B can be extended, and the machining accuracy can be improved.

[0050] Furthermore, by providing the chamfers 32 on the corner portions of the wrap tooth crest 31, the seal material 36 inevitably adhering to the wrap side surfaces by forming the droops 38 when the coating roll 37 or the like where the seal material 36 adheres to the surface is brought into contact with the wrap tooth crest 31 to transfer the seal material 36 in order to coat the wrap tooth crest 31 with the abrasible seal material 36 can be stopped within the planes of the chamfers 32. The seal material 36 can be used for sealing the chamfered portions.

[0051] Accordingly, even when masking or a sophisticated (expensive) facility is not introduced, the abrasible seal material 36 can be easily coated only on the wrap tooth crest 31 by use of a versatile means such as a roll coater, so that an influence caused when the seal material 36 adheres to the wrap side surfaces can be eliminated. By filling the wrap tooth tip clearance and the clearance generated by the chamfers 32 with the coating film 35 of the abrasible seal material 36, the respective clearances are minimized to reduce gas leakage, thereby increasing efficiency and performance as shown in Fig. 3. At the same time, the rapid abrasion of the end edge portion of the end mill tool is mitigated, thereby extending the lifetime of the tool. Both of the increase in the efficiency and performance, and the extension of the lifetime of the tool can be thereby achieved at the same time.

[0052] The coating film 35 of the abrasible seal material 36 coated on the wrap tooth crest 31 is set to the thickness corresponding to the wrap tooth tip clearance set between the wrap tooth crest 31 of each of the spiral wraps 18B and 19B and the bottom land 34 of the other spiral wrap 18B or 19B. Therefore, the wrap tooth tip

clearance currently set to a size where the tooth crest 31 does not come into contact with the bottom land 34 to cause a seizure when the spiral wraps 18B and 19B thermally expand can be filled with the coating film 35 of the abrasible seal material 36. Consequently, the gas leakage from the wrap tooth tip clearance can be minimized, and the efficiency and performance of the hermetic scroll compressor 1, i.e., the scroll fluid machine can be further increased.

[0053] Moreover, the thickness of the coating film 35 of the above abrasible seal material 36 is set to 0.02 to 0.05 mm. By setting the coating film 35 to the thickness corresponding to the wrap tooth tip clearance set to a size where the tooth crest 31 does not come into contact with the bottom land 34 even when the spiral wraps 18B and 19B thermally expand by clearance management, the wrap tooth tip clearance can be filled with the coating film 35. Accordingly, the gas leakage from the wrap tooth tip clearance can be minimized to increase the efficiency and performance, and the coating film 35 can be prevented from being cut unnecessarily.

[0054] In the present embodiment, since the micro chamfers 32 and 33 are set to 0.05 to 0.2 mm, an increase in the leakage clearance by providing the chamfers 32 and 33 can be minimized. The droops onto the wrap side surfaces during coating of the coating film 35 having a thickness of about 0.02 to 0.05 mm can be also stopped within the planes of the chamfers 32 of 0.05 to 0.2 mm, and can be used for sealing the chamfered portions. Therefore, the gas leakage can be minimized by solving the problem of the increase in the leakage clearance due to the chamfers 32, and the influence caused when the seal material 36 droops onto the wrap side surfaces can be also eliminated.

[0055] Furthermore, the abrasible seal material 36 can be coated on the wrap tooth crest 31 by using the roll coater. That is, even when the abrasible seal material 36 is coated on the wrap tooth crest 31 by using the roll coater that is a versatile means, the seal material 36 that is to droop onto the wrap side surfaces when the coating roll 37 is brought into contact with the wrap tooth crest 31 to transfer the seal material 36 can be stopped within the chamfered planes since the chamfers 32 are provided on the corner portions of the wrap tooth crest 31. Thus, even when masking or a sophisticated facility is not introduced, the abrasible seal material 36 can be easily coated only on the wrap tooth crest 31 by using the roll coater that is a versatile means.

[0056] The present invention is not limited to the invention according to the above embodiment, and can be appropriately modified without departing from the scope. For example, in the above embodiment, the example in which the micro chamfers 32 and 33 are provided on the corner portions of both the base portion and the wrap tooth crest 31 of each of the spiral wraps 18B and 19B of the fixed scroll 18 and the orbiting scroll 19 has been described. However, a configuration in which only the micro chamfers 32 are provided on the corner portions

of the wrap tooth crest 31, the base portion of each of the spiral wraps 18B and 19B has a right angle, and the abrasible seal material 36 is coated on the wrap tooth crest 31 may be also employed in the present invention.

[0057] In such a configuration, even when the end edge portion of the end mill tool that is most easily abraded is slightly abraded, and the uncut region 39 is thereby formed in the corner portion of the base portion of one of the spiral wraps 18B and 19B to form the micro chamfered portion at the time of cutting the spiral wraps 18B and 19B by the end mill tool, the micro chamfered portion does not interfere with the wrap tooth crest 31 of the other spiral wrap 18B or 19B, thereby extending the lifetime of the end mill tool. Even when masking or a sophisticated (expensive) facility is not introduced, the abrasible seal material can be easily coated only on the wrap tooth crest by use of a versatile means such as a roll coater, so that an influence caused when the seal material adheres to the wrap side surfaces can be eliminated. By filling the wrap tooth tip clearance and the clearance generated by the chamfers 32 with the abrasible seal material 36, the respective clearances are minimized to reduce gas leakage, thereby increasing efficiency and performance. At the same time, the permissible abrasion loss of the end edge portion of the end mill tool is increased, thereby extending the lifetime of the tool. Both of the increase in the efficiency and performance, and the extension of the lifetime of the tool can be thereby achieved at the same time.

[0058] Moreover, in the above embodiment, the example in which the present invention is applied to the hermetic scroll compressor 1 has been described. However, it goes without saying that the present invention can be similarly applied to a scroll compressor other than the hermetic scroll compressor, and a scroll fluid machine, such as a pump and an expander, other than the compressor. Also, the abrasible seal material 36 is not limited to the aforementioned PTFE-based material. The abrasible seal material 36 can be appropriately selected from free-cutting materials such as a CoNiCrAlY-based material of nickel and chromium, a NiCrAl-based material of aluminum, and a NiCrFeAlBN-based material of nickel, chromium, iron, aluminum, boron, and nitrogen.

{Reference Signs List}

[0059]

1	Hermetic scroll compressor (scroll fluid machine)
7	Scroll compressor
18	Fixed scroll
18A	End plate
18B	Spiral wrap
19	Orbiting scroll
19A	End plate
19B	Spiral wrap
31	Wrap tooth crest

32, 33	Chamfer	
34	Bottom land	
35	Coating film	
36	Abradable seal material	
37	Coating roll	5
38	Droop	

Claims

- 10
1. A scroll fluid machine (1) configured by engaging spiral wraps (18B, 19B) of a pair of fixed and orbiting scrolls (18, 19) in each of which the spiral wrap (18B, 19B) is erected on an end plate (18A, 19A), the scroll fluid machine being **characterized in that:** 15

a micro chamfer (32) is provided on a corner portion of a wrap tooth crest (31) of each of the spiral wraps (18B, 19B) of the fixed scroll (18) and the orbiting scroll (19), and 20

the wrap tooth crest (31) is coated with an abrasadable seal material (36) having machinability.
 2. The scroll fluid machine (1) according to claim 1, 25

wherein a micro chamfer (33) is provided on a base portion of each of the spiral wraps (18B, 19B) of the fixed scroll (18) and the orbiting scroll (19) corresponding to the micro chamfer (32) provided on the corner portion of the wrap tooth crest (31) of the other spiral wrap. 30
 3. The scroll fluid machine (1) according to claim 1 or 2, wherein a coating thickness of the abrasadable seal material (36) is set to a thickness corresponding to a wrap tooth tip clearance set between the wrap tooth crest (31) of each of the spiral wraps (18, 19) and a bottom land (34) of the other spiral wrap. 35
 4. The scroll fluid machine (1) according to claim 3, 40

wherein the coating thickness of the abrasadable seal material (36) is set to 0.02 to 0.05 mm.
 5. The scroll fluid machine (1) according to any of claims 1 to 4, wherein the micro chamfer (32, 33) is set to 0.05 to 0.2 mm. 45
 6. The scroll fluid machine (1) according to any of claims 1 to 5, wherein the abrasadable seal material (36) is coated on the wrap tooth crest (31) by using a roll coater. 50

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FIG. 1

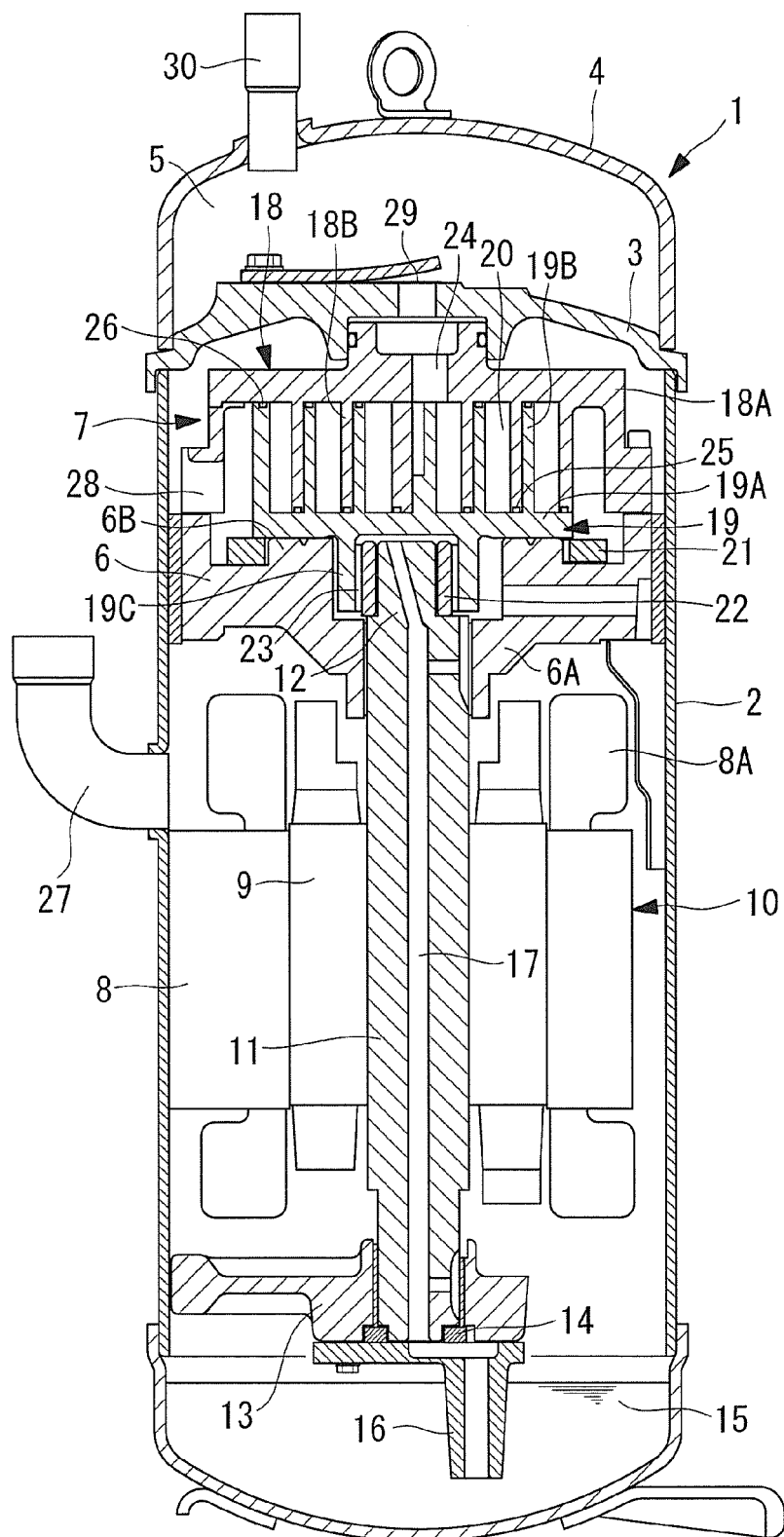


FIG. 2

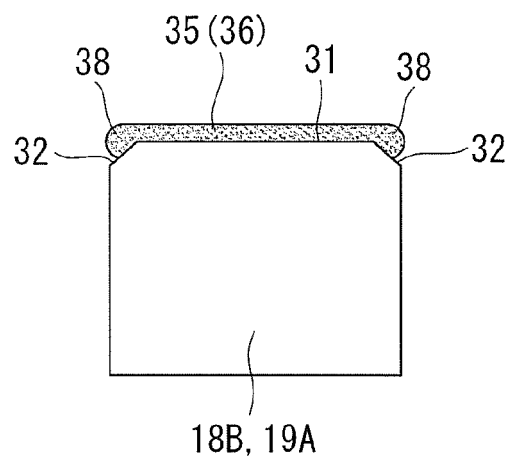


FIG. 3

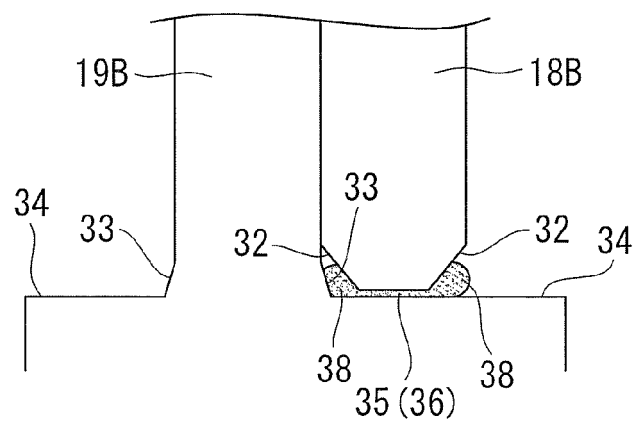


FIG. 4

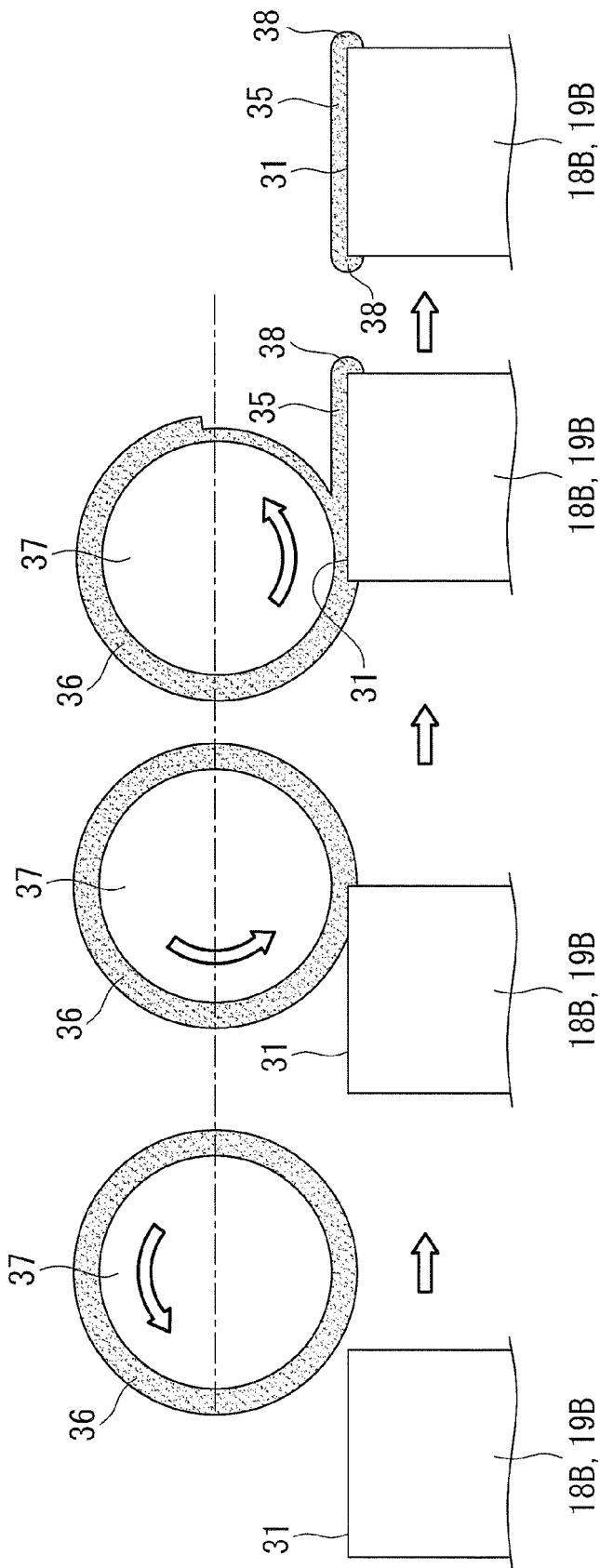
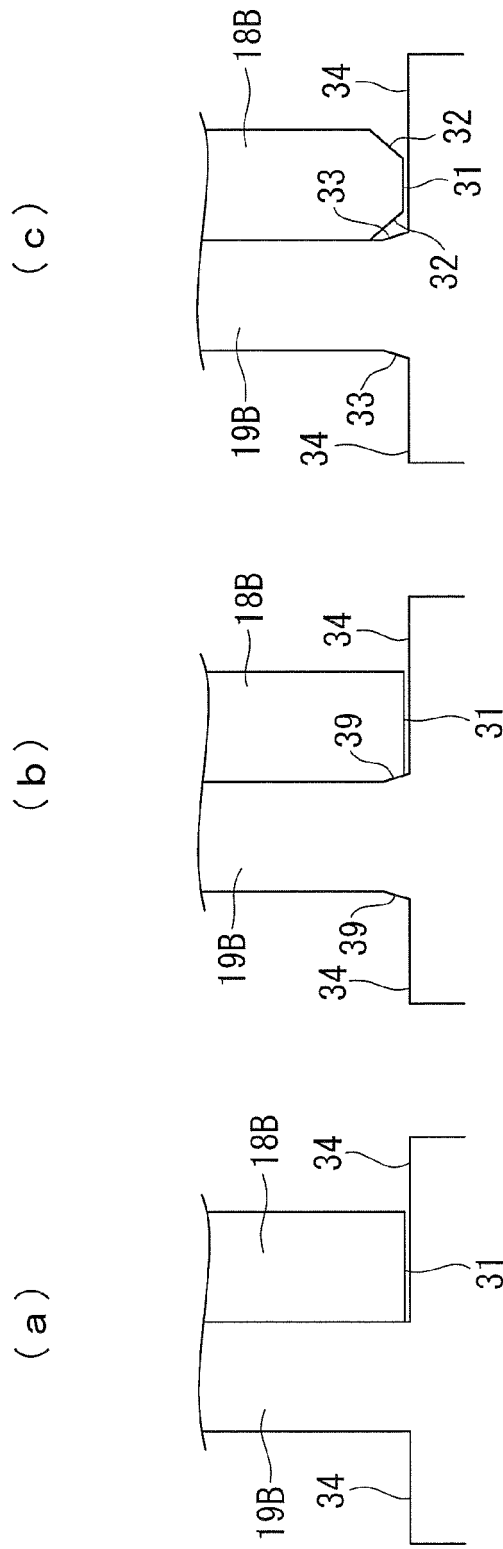


FIG. 5





EUROPEAN SEARCH REPORT

Application Number
EP 14 19 3066

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			F04C
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 5 June 2015	Examiner Descoubes, Pierre
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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