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Description

This invention relates to a fluid displacement apparatus according to the preamble of the main claim. In particular this invention refers to an improvement in a rotation preventing/thrust bearing device for an orbiting piston type fluid displacement apparatus.

There are several types of fluid apparatus which utilize an orbiting piston or fluid displacing member driven by a Scotch yoke type shaft coupled to an end surface of the piston or member. One apparatus, disclosed in U.S. Patent No. 1,906,142 to John Ekelof, is a rotary machine provided with an annular and eccentrically movable piston adapted to act within an annular cylinder provided with a radial transverse wall. One end wall of the cylinder is fixedly mounted and the other wall consists of a cover disc connected to the annular piston, which is driven by a crank shaft. Another prior art apparatus of this type is shown in U.S. Patent No. 801,182. Though the present invention applies to either type of fluid apparatus, i.e., using either an annular piston or a scroll-type piston, description will be limited to the scroll type compressor. The general term "orbiting member" is used to describe any movable member of any suitable configuration to effect a fluid displacement in connection with the fixed member, which may be realized as an annular cylinder or a second scroll.

A fluid displacement apparatus of the above kind is known from the FR—A—2,455,196. This publication discloses a scroll type fluid displacement apparatus having one scroll member fixed to a housing and another scroll member, which is the orbiting fluid displacing member, eccentrically supported on a crank pin of a rotating shaft to cause orbital motion. The scroll type apparatus also includes a rotation preventing/thrust bearing device in order to prevent rotation of the orbiting scroll member to thereby maintain the scroll members in a predetermined angular relationship during operation of the apparatus, and to carry axial thrust load from the orbiting scroll member. The rotation preventing/thrust bearing device described in this patent application comprises one set of indentations formed on the end surface of the circular plate of the orbiting scroll member and a second set of indentations formed on an end surface of a fixed plate attached to the housing. A plurality of spheres are placed between facing indentations. However, the indentations are formed directly on the end surface of the orbiting scroll member or the fixed plate. The production of this type of mechanism is therefore very intricate.

From the EP—A—0,038,152 a scroll-type fluid displacement apparatus is known having a rotation preventing/thrust bearing device comprising a first fixed ring and a second ring slidable linearly with respect to the first ring by means of corresponding key ways. Also this solution is rather intricate and requires an exact sliding fit for proper operation.

Referring to Figs. 1, 2 and 3, one solution to above disadvantage will be described. Fig. 1 is a vertical sectional view of a part of compressor and Fig. 2 is an exploded perspective view of rotation preventing/thrust bearing device. The rotation preventing/thrust bearing device 37' surrounds boss 273' of orbiting scroll member 27' and includes an orbital portion, a fixed portion and bearings, such as a plurality of balls. The fixed portions includes (1) an annular fixed race 371' having one end surface fitted against the axial end surface of annular projection 112' of front end plate 11', and (2) a fixed ring 372' fitted against the other axial end surface of fixed race 371' to extend outwardly therefrom and cover the other end surface of fixed race 371'. Fixed race 371' and ring 372' are attached to the axial end surface of annular projection 112' by pins 373'. The orbital portion also includes (1) an annular orbital race 374', which has one end surface fitted against an axial end surface of circular plate 271' and (2) an orbital ring 375' fitted against the other axial end surface of orbital race 374' to extend outwardly therefrom and cover the other axial end surface of orbital race 374'. A small clearance is maintained between the end surface of fixed ring 372' and the end surface of orbital ring 375'. Orbital race 374' and ring 375' are attached to the end surface of circular plate 271' by pin 376'.

Fixed ring 372' and orbital ring 375' each have a plurality of holes or pockets 372a' and 375a' in the axial direction, the number of holes or pockets in each ring 372', 375' being equal. Bearing elements, such as balls or spheres 377', are placed between facing generally aligned pairs of pockets 372a', 375a' of fixed and orbital rings 372', 375', with the rings 372', 375' facing one another at a predetermined clearance.

Referring to Fig. 3, the operation of the rotation preventing/thrust bearing device 37' will be described. In Fig. 3 the center of orbital ring 375' is placed at the right side and the direction of rotation of the drive shaft is clockwise as indicated by arrow A. When orbiting scroll 27' is driven by the rotation of the drive shaft, the center of orbital ring 375' orbits about a circle of radius R_0 (together with orbiting scroll 27'). However, a rotating force, i.e., moment, which is caused by the offset of the acting point of the reaction force of compression and the acting point of drive force, acts on orbiting scroll 27'. This reaction force tends to rotate orbiting scroll 27' in a clockwise direction about the center of orbital ring 375'. But, as shown in Fig. 3, eighteen balls 377' are placed between the corresponding pockets 372a' and 375a' of rings 372' and 375'. In the position shown in Fig. 3, the interaction between the nine balls 377' at the top of the rotation preventing/thrust bearing device and the edges of the pockets 372a' and 375a' prevents the rotation of orbiting scroll 27'. The magnitude of the rotation preventing forces are shown as f_{c1} — f_{c9} in Fig. 3.

In the construction, as described above, the rotation preventing/thrust bearing device is made

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up of a pair of races and a pair of rings, with each race and ring formed separately. Therefore, the parts of the rotation preventing/thrust bearing device are easy to construct and the most suitable material for each part can be selected. However, each ring is attached by a pin, respectively. The rotation preventing force of rings is thus transmitted to the attachment pins. Since the location at which the rotation preventing force of the rings act on the respective attachment pins is spaced from the location at which the pins are attached to the orbiting scroll or housing, a moment is generated which acts on the pins. If both an associated ring and race are attached by a respective pin this spacing increases, with the result that the stress on the pin also is increased. Also, stress is placed on the attachment pins by the impact load which occurs when the compressor unit is driven at high speed. Because of these factors, it is desirable to reduce the stress in the attachment pins.

It is a primary object of this invention to provide an improved rotation preventing/thrust bearing device for an orbiting piston type fluid displacement apparatus which is reduced in weight and simple in construction and which can simply and reliably be manufactured.

This object is achieved by a fluid displacement apparatus which, according to the invention is characterized in that said orbital portion includes an orbital annular race placed within an annular groove formed on said end plate on an opposite side from which said fluid displacing member extends and an orbital ring attached to said end plate to cover said race, said orbital ring having a plurality of first pockets extending axially toward said orbital race, said fixed portion including a fixed annular race placed within an annular groove formed on said housing and a fixed ring attached to said housing to cover said fixed race and facing said orbital ring, said fixed ring having a plurality of second pockets extending axially towards said fixed race, said bearing elements each being carried within a generally aligned pair of said first and second pockets and contacting said orbital and fixed races to prevent the rotation of said orbiting member by said bearing elements interacting with said orbital and fixed rings.

Thus, according to the invention the rotation of the orbiting member is prevented by the bearing elements which are placed in the pockets of both rings and the thrust load from the orbiting member is supported by the fixed race through the bearings.

Further objects, features and other aspects of this invention will be understood from the following detailed description of preferred embodiments of this invention, referring to the annexed drawings.

Fig. 1 is a vertical sectional view of a part of a compressor illustrating a prior art construction of the rotation preventing/thrust bearing device;

Fig. 2 is an exploded perspective view of the rotation preventing/thrust bearing device shown in Fig. 1;

Fig. 3 is a diagrammatic front view of rotation preventing/thrust bearing device illustrating the manner by which rotation is prevented;

Fig. 4 is a vertical sectional view of a compressor unit according to one embodiment of this invention;

Fig. 5 is an exploded perspective view of the driving mechanism in the embodiment of Fig. 4;

Fig. 6 is a vertical sectional view of a part of a compressor according to another embodiment of this invention;

Fig. 7 is a vertical sectional view of a part of a modification of the embodiment in Fig. 6; and

Fig. 8 is a diagrammatic sectional view illustrating the spiral elements of the fixed and orbiting scroll members.

Referring to Fig. 4, an embodiment of a fluid displacement apparatus in accordance with the present invention, in particular a scroll type refrigerant compressor unit 1 is shown. The compressor unit 1 includes a compressor housing 10 having a front end plate 11 and a cup shaped casing 12 which is attached to an end surface of front end plate 11. An opening 111 is formed in the center of front end plate 11 for the penetration or passage of a drive shaft 13. An annular projection 112 is formed in a rear end surface of front end plate 11. Annular projection 112 faces cup shaped casing 12 and is concentric with opening 111. An outer peripheral surface of annular projection 112 extends into an inner wall of the opening of cup shaped casing 12. Cup shaped casing 12 is fixed on the rear end surface of front end plate 11 by a fastening device, for example, bolts and nuts. The opening portion of cup shaped casing 12 is thus covered by front end plate 11. An O-ring 14 is placed between the outer peripheral surface of annular projection 112 and the inner wall of the opening of cup shaped casing 12, to seal the mating surfaces of front end plate 11 and cup shaped casing 12. Front end plate 11 has an annular sleeve 15 projecting from the front end surface thereof which surrounds drive shaft 13 and defines a shaft seal cavity. In the embodiment shown in Fig. 4, sleeve 15 is separate from front end plate 11. Therefore, sleeve 15 is fixed to the front end surface of front end plate 11 by screws (not shown). An O-ring 16 is placed between the end surface of front end plate 11 and an end surface of sleeve 15 to seal fitting surface of front end plate 11 and sleeve 15. Alternatively, sleeve 15 may be integral with front end plate 11.

Drive shaft 13 is rotatably supported by sleeve 15 through a bearing device 17 located within the front end of sleeve 15. Drive shaft 13 has a disk 18 at its inner which is rotatably supported by front end plate 11 through a bearing device 19 located within opening 111 of front end plate 11. A shaft seal assembly 20 is coupled to drive shaft 13 within the shaft seal cavity of sleeve 15.

A pulley 21 is rotatably supported by a bearing assembly 22 which is carried on the outer surface of sleeve 15. An electromagnetic coil 23 is fixed about the outer surface of sleeve 15 by a support

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plate 24 and is received in an annular cavity of pulley 21. An armature plate 25 is elastically supported on the outer end of drive shaft 13 which extends from sleeve 15. A magnetic clutch thus includes pulley 21, magnetic coil 23 and armature plate 25. In operation, drive shaft 13 is driven by an external drive power source, for example, a vehicle engine, through a rotation force transmitting device such as the above described magnetic clutch.

A fixed scroll 26, an orbiting scroll 27, a driving-mechanism for orbiting scroll 27 and a rotation preventing/thrust bearing device for orbiting scroll 27 are located within an inner chamber of cup shaped casing 12. The inner chamber is formed between the inner wall of cup shaped casing 12 and front end plate 11.

Fixed scroll 26 includes a circular end plate 261, a wrap or spiral element 262 affixed to or extending from one side surface of circular end plate 261, and a plurality of internally threaded bosses 263 axially projecting from the other end surface of circular plate 261. An end surface of each boss 263 is seated on the inner surface of an end plate 121 of cup shaped casing 12 and is fixed to end plate 121 by bolts 28. Fixed scroll 26 is thus fixed within cup shaped casing 12. Circular end plate 261 of fixed scroll 26 divides the inner chamber of cup shaped casing 12 into a discharge chamber 30 and a suction chamber 29 with a seal ring 31 placed between the outer peripheral surface of circular plate 261 and the inner wall of cup shaped casing 12. A hole or discharge port 264 is formed through circular plate 261 at a position near the center of spiral element 262; discharge port 264 is connected between the fluid pockets of the spiral element 262 and discharge chamber 30.

Orbiting scroll 27 also includes a circular end plate 271 and a wrap or spiral element 272 affixed to or extending from one side surface of circular end plate 271. Spiral element 272 and spiral element 262 of fixed scroll 26 interfit at angular offset of 180° and a predetermined radial offset. At least a pair of fluid pockets are thereby defined between both spiral elements 262 and 272. Orbiting scroll 27 which is connected to the drive mechanism and to the rotation preventing/thrust bearing device, is driven in an orbital motion at a circular radius R_o by rotation of drive shaft 13 to thereby compress fluid passing through the compressor unit, generally, radius R_o of orbital motion given by the following formula;

$$R_o = \frac{\text{(pitch of spiral element)} - 2(\text{wall thickness of spiral element})}{2}$$

As shown in Fig. 8, the pitch (P) of the spiral elements can be defined by $2 r_g$, where r_g is the involute generating circle radius. The radius of orbital motion R_o is also illustrated in Fig. 8 as the locus of an arbitrary point Q on wrap 272 of orbiting scroll 27. The spiral element 272 is

radially offset from spiral element 262 of fixed scroll 26 by the distance R_o . Thus, orbiting scroll 27 undergoes orbital motion of a radius R_o upon rotation of drive shaft 13. As the orbiting scroll 27 orbits, the line contacts between both spiral element 262 and 272 moves toward the center of the spiral elements along the surfaces of the spiral elements. Fluid pockets which are defined between spiral elements 262 and 272, also move to the center with a consequent reduction in volume and compression of the fluid in the fluid pockets. The fluid or refrigerant gas, which is introduced into suction chamber 29 from an external fluid circuit through an inlet port 31, is taken into fluid pockets formed between spiral elements 262 and 272 from the outer end portions of the spiral elements. As orbiting scroll 27 orbits, fluid in the fluid pockets is compressed and the compressed fluid is discharged into discharge chamber 30 from the central fluid pocket of the spiral element through hole 264. The fluid then is discharged to the external fluid circuit through an outlet port 32.

Referring again to Figs. 4 and 5, the driving mechanism of orbiting scroll 27 will be described in greater detail. Drive shaft 13, which is rotatably supported by sleeve 15 through bearing device 17, is connected to disk 18. Disk 18 is rotatably supported by front end plate 11 through bearing device 19 located within opening 111 of front end plate 11. A crank pin or drive pin 33 projects axially from an axial end surface of disk 18 at a position which is radially offset from the center of drive shaft 13. Circular end plate 271 of orbiting scroll 27 has a tubular boss 273 axially projecting from the end surface opposite the surface from which spiral element 272 extends. A discoid or short axial bushing 34 fits into boss 273 and is rotatably supported therein by a bearing such as a needle bearing 35. Bushing 34 has a balance weight 341, which has the shape of a portion of a disk or ring and extends radially from bushing 34 along a front surface thereof. An eccentric hole 342 is formed in bushing 34 at a position radially offset from center of bushing 34. Drive pin 33 fits into the eccentrically disposed hole 342 together with a bearing 36. Bushing 34 is therefore driven in an orbital path by the revolution of drive pin 33 and rotates within needle bearing 35.

Now, the rotation of orbiting scroll 27 is prevented by a rotation preventing/thrust bearing 37 which is located between the inner surface of housing 10 and circular plate 271 of orbiting scroll 27. As a result, orbiting scroll 27 orbits while maintaining its angular orientation relative to the fixed scroll 26.

Rotation preventing/thrust bearing device 37 surrounds boss 273 of orbiting scroll 27 and includes an orbital portion, a fixed portion and bearings, such as a plurality of balls. The fixed portion includes: (1) an annular fixed race 371 which is placed within a groove 113 formed on the axial end surface of annular projection 112 of front end plate 11, and (2) a fixed ring 372 fitted against the axial end surface of annular projection

112 of front end plate 11 to cover the end surface of fixed race 371. Fixed ring 372 is attached to the axial end surface of annular projection 112 by pins 373 and fixed race 371 is fixed in groove 113 by fitting, i.e., a friction fit. The orbital portion also includes (1) an annular orbital race 374, which is placed within a groove 274 formed on the axial end surface of circular plate 271 of orbiting scroll 27, and (2) an orbital ring 375 fitted against the axial end surface of circular end plate 271 of orbiting scroll 27 to cover the axial end surface of orbital race 374. A small clearance is maintained between the end surface of fixed ring 372 and the end surface of orbital ring 375. Orbital ring 375 is attached to the end surface of circular end plate 271 by pins 376 and orbital race is fixed in groove 274 by fitting.

Fixed ring 372 and orbital ring 375 each have a plurality of holes or pockets 372a and 375a in the axial direction, the number of holes or pockets in each rings 372, 375 being equal. The holes or pockets 372a on fixed ring 372 correspond to or are a mirror image of the holes or pockets 375a on orbital ring 375, i.e., each pair of pockets facing each other have the same size and pitch, and the radial distance of the pockets from the center of their respective rings 372 and 375 is the same, i.e., the centers of the pockets are located at the same distance from the center of the rings 372 and 375. Thus, if the centers of the rings 372 and 375 were aligned, which they are not in actual operation of the rotation preventing/thrust bearing device 37, the holes or pockets 372a and 375a would be identical or in alignment. Bearing elements, such as balls or spheres 377, are placed between the edge of pocket 372a of fixed ring 372 and the edge of pocket 375a of orbital ring 375. Therefore, the rotation of orbiting scroll 27 is prevented by balls 377, which interact with the edges of pockets 372a and 375a to prevent rotation. Also, these balls 377 carry the axial thrust load for orbiting scroll 27.

In this embodiment device 37, the distance between the supporting point of the pins and the acting point of the rotation preventing force is reduced since the pin only has to penetrate the ring, rather than both the ring and the race. The stress on the supporting point of the pins is thereby reduced and likelihood of breakage of the attachment pins is reduced. Groove 274 does not extend radially inward as far as the radially innermost edge of ring 375, so that the width, i.e., the distance between the inner and outer diameters of race 374 can be kept small. Similarly, groove 113 does not extend radially outward as far as the radially outward most edge of ring 372, so that the width of race 371 can be kept small. Thus, this embodiment of rotation preventing/thrust bearing devices both reduces stress on the attachment pins and reduces the weight of the races.

In this type of rotation preventing/thrust bearing device, rotation prevention is more effective if the distance between the contact point of the ball and the edge of the pockets and the end surface of the race is larger, i.e., the contact point

of the ball and the edge of pockets is placed close to a center line passing through the center of the ball and parallel to the end surfaces of the rings.

Referring to Fig. 6, still another embodiment of this invention is shown, illustrating a modification of the construction for fixing the rings to improve rotation preventing. In this embodiment, the thickness of rings 372 and 375 is reduced so that a thinner portion of the rings bears the attachment force of pins 373 and 376. The rings 372 and 375 are attached to the outermost surfaces of annular projection 112 and circular plate 271 by fasteners 373 and 376, respectively. These outermost surfaces are located as close to one another as possible in order to place the thinner rings 372 and 375 as close as possible to the center line of balls 377 while still maintaining a clearance between the rings.

A first groove 113 and a second groove 115 are formed in the end surface of annular projection 112. First groove 113 is radially innermost and deepest. Fixed race 371 is carried in groove 113 and has an axial end surface flush with the axial end surface of second groove 115. The depth of second groove 115 defines a clearance (G) between fixed race 371 and fixed ring 372. Similarly, a first groove 274 and a second groove 275 are formed in the end surface of circular plate 271. First groove 274 is radially outermost and deepest. Orbital race 374 is carried in groove 274 and has an axial end surface flush with the axial end surface of second groove 275. The depth of second groove 275 defines a clearance (G) between orbital race 374 and orbital ring 375.

In the embodiment of rotation preventing/thrust bearing device 37 of Fig. 6, the rotation preventing function is optimized by placing rings 372 and 375 as close as possible to the center line of balls 377, while at the same time reducing the weight of device 37 by making the rings 372 and 375 thin and keeping the width of races 371 and 374 small.

Fig. 7 illustrates a modification of the ring construction shown in Fig. 6. Only a single groove 113 is formed in annular projection 112, and only a single groove 274 is formed in the end surface of circular plate 271. Fixed race 371 is supported in groove 113 and orbital race 374 is supported in groove 274. Fixed ring 372 has a thin radially inner portion and a thick radially outer portion. Pockets 372a are formed in the thin portion and the thick portion is placed in contact with the end surface of annular projection 112. Fasteners 373 penetrate the thick portion of fixed ring 372 and attached it to projection 112. A clearance (G) is defined between the end surface fixed race 371, which is flush with the end surface of projection 112, and the axial surface of the thin portion of fixed ring 372 which faces race 371.

Similarly, orbital ring 375 has a thin radially outer portion and a thick radially inner portion. Pockets 375a are formed in the thin portion and the thick portion is placed in contact with the end surface of circular plate 271. Fasteners 376 penetrate the thick portion of ring 375 and attach

it to plate 271. A clearance (G) is defined between the end surface of orbital race 374, which is flush with the end surface of plate 271, and the axial surface of the thin portion of orbital ring 375 which faces race 374.

The rotation preventing/thrust bearing device 37 of Fig. 7 also optimizes the rotation preventing function by placing rings 372 and 375 as close as possible to the center line of balls 377, while at the same time reducing the weight of the device by making a portion of rings 372 and 375 thin and keeping the width of races 371 and 374 small.

Claims

1. Fluid displacement apparatus including a housing (10), a fixed member (26) attached to or integral with said housing (10), an orbiting member (27) having an end plate (271) from which a fluid displacing member (272) extends, said fixed member (26) and fluid displacing member (272) interfitting at a radial offset to make a line contact to separate an outlet fluid from the inlet fluid, and driving mechanism including a rotatable drive shaft (13) connected to said orbiting member (27) to drive said orbiting member (27) in an orbital motion, rotation preventing/thrust bearing means (37) connected to said orbiting member (27) for preventing the rotation of said orbiting member (27) and for carrying axial thrust load from said orbital member (27) during orbital motion so that the line contact moves toward the discharge, said rotation preventing/thrust bearing means (37) comprising a discrete orbital portion, a discrete fixed portion and bearing elements coupled between said portions, characterized in that said orbital portion includes an orbital annular race (374) placed within an annular groove (274) formed on said end plate (271) on an opposite side from which said fluid displacing member (272) extends and an orbital ring (375) attached to said end plate (271) to cover said race (374), said orbital ring (375) having a plurality of first pockets extending axially toward said orbital race (374), said fixed portion including a fixed annular race (371) placed within an annular groove (113) formed on said housing and a fixed ring (372) attached to said housing to cover said fixed race (371) and facing said orbital ring (375), said fixed ring (372) having a plurality of second pockets extending axially toward said fixed race, said bearing elements (377) each being carried within a generally aligned pair of said first and second pockets and contacting said orbital and fixed races (374, 371) to prevent the rotation of said orbiting member (27) by said bearing elements (377) interacting with said orbital and fixed rings.

2. Fluid displacement apparatus according to claim 1, characterized in that said orbital ring (375) extends radially further inwardly than said orbital race (374) and is attached to the said end plate (271) by means of a plurality of fasteners (376) disposed radially inwardly from said orbital race (374), and that said fixed ring (372) extends

radially further outwardly than said fixed race (371) and is attached to said housing (10) by means of a plurality of fasteners (373) disposed radially outwardly from said fixed race (371).

3. Fluid displacement apparatus according to claim 2, characterized in that a clearance (G) is maintained between the orbital race (374) and orbital ring (375), and between the fixed race (371) and the fixed ring (372).

4. Fluid displacement apparatus according to claim 3, characterized in that said orbital ring (375) has a thick portion and a thin portion, said thick portion being in contact with said end plate (271) and said fasteners (376) attaching said orbital ring (375) penetrating said thick portion, the pockets (375a) in said orbital ring (375) extending into the thin portion thereof, and that said fixed ring (372) has a thick portion and a thin portion, said thick portion being in contact with said housing (10), and said fasteners (373) attaching said fixed ring (372) penetrating said thick portion, the pockets (372a) in said fixed ring (372) extending into the thin portion thereof.

5. Fluid displacement apparatus according to claim 3 or 4, characterized in that a second annular groove (275) is formed in said end plate (271), and a second annular groove (115) is formed on said housing (10), the depth of said second groove (275) in said end plate (271) defining at least a part of the clearance (G) between said orbital race (374) and orbital ring (375), and the depth of said second groove (115) on said housing (10) defining at least a part of the clearance (G) between said fixed race (371) and fixed ring (372).

Patentansprüche

1. Fluidverdrängervorrichtung mit einem Gehäuse (10), einem feststehenden Element (26), das an dem Gehäuse (10) befestigt ist oder damit einstückig ausgebildet ist, einem umlaufenden Element (27) mit einer Endplatte (271), von der sich ein Fluidverdrängerelement erstreckt, wobei das feststehende Element und das Fluidverdrängerelement mit einer radialen Versetzung zum Bilden eines Linienkontakts zum Trennen eines Auslaßfluids vom Einlaßfluid ineinandergreifen, und einer Antriebsvorrichtung mit einer drehbaren Antriebswelle (13), die mit dem umlaufenden Element (27) zum Antreiben des umlaufenden Elements (27) in einer Umlaufbewegung verbunden ist, einer mit dem umlaufenden Element (27) verbundenen Rotationsverhinderungs- / Drucklagereinrichtung (37) zum Verhindern der Rotation des umlaufenden Elementes (27) und zum Aufnehmen der Axialdrucklast vom umlaufenden Element (27) während der Umlaufbewegung, so daß der Linienkontakt zum Auslaß wandert, wobei die Rotationsverhinderungs- / Drucklagereinrichtung (37) einen diskreten umlaufenden Teil, einen diskreten feststehenden Teil und zwischen diesen Teilen gekoppelte Lagerelemente aufweist.

it to plate 271. A clearance (G) is defined between the end surface of orbital race 374, which is flush with the end surface of plate 271, and the axial surface of the thin portion of orbital ring 375 which faces race 374.

The rotation preventing/thrust bearing device 37 of Fig. 7 also optimizes the rotation preventing function by placing rings 372 and 375 as close as possible to the center line of balls 377, while at the same time reducing the weight of the device by making a portion of rings 372 and 375 thin and keeping the width of races 371 and 374 small.

Claims

1. Fluid displacement apparatus including a housing (10), a fixed member (26) attached to or integral with said housing (10), an orbiting member (27) having an end plate (271) from which a fluid displacing member (272) extends, said fixed member (26) and fluid displacing member (272) interfitting at a radial offset to make a line contact to separate an outlet fluid from the inlet fluid, and driving mechanism including a rotatable drive shaft (13) connected to said orbiting member (27) to drive said orbiting member (27) in an orbital motion, rotation preventing/thrust bearing means (37) connected to said orbiting member (27) for preventing the rotation of said orbiting member (27) and for carrying axial thrust load from said orbital member (27) during orbital motion so that the line contact moves toward the discharge, said rotation preventing/thrust bearing means (37) comprising a discrete orbital portion, a discrete fixed portion and bearing elements coupled between said portions, characterized in that said orbital portion includes an orbital annular race (374) placed within an annular groove (274) formed on said end plate (271) on an opposite side from which said fluid displacing member (272) extends and an orbital ring (375) attached to said end plate (271) to cover said race (374), said orbital ring (375) having a plurality of first pockets extending axially toward said orbital race (374), said fixed portion including a fixed annular race (371) placed within an annular groove (113) formed on said housing and a fixed ring (372) attached to said housing to cover said fixed race (371) and facing said orbital ring (375), said fixed ring (372) having a plurality of second pockets extending axially toward said fixed race, said bearing elements (377) each being carried within a generally aligned pair of said first and second pockets and contacting said orbital and fixed races (374, 371) to prevent the rotation of said orbiting member (27) by said bearing elements (377) interacting with said orbital and fixed rings.

2. Fluid displacement apparatus according to claim 1, characterized in that said orbital ring (375) extends radially further inwardly than said orbital race (374) and is attached to the said end plate (271) by means of a plurality of fasteners (376) disposed radially inwardly from said orbital race (374), and that said fixed ring (372) extends

radially further outwardly than said fixed race (371) and is attached to said housing (10) by means of a plurality of fasteners (373) disposed radially outwardly from said fixed race (371).

3. Fluid displacement apparatus according to claim 2, characterized in that a clearance (G) is maintained between the orbital race (374) and orbital ring (375), and between the fixed race (371) and the fixed ring (372).

4. Fluid displacement apparatus according to claim 3, characterized in that said orbital ring (375) has a thick portion and a thin portion, said thick portion being in contact with said end plate (271) and said fasteners (376) attaching said orbital ring (375) penetrating said thick portion, the pockets (375a) in said orbital ring (375) extending into the thin portion thereof, and that said fixed ring (372) has a thick portion and a thin portion, said thick portion being in contact with said housing (10), and said fasteners (373) attaching said fixed ring (372) penetrating said thick portion, the pockets (372a) in said fixed ring (372) extending into the thin portion thereof.

5. Fluid displacement apparatus according to claim 3 or 4, characterized in that a second annular groove (275) is formed in said end plate (271), and a second annular groove (115) is formed on said housing (10), the depth of said second groove (275) in said end plate (271) defining at least a part of the clearance (G) between said orbital race (374) and orbital ring (375), and the depth of said second groove (115) on said housing (10) defining at least a part of the clearance (G) between said fixed race (371) and fixed ring (372).

Patentansprüche

1. Fluidverdrängervorrichtung mit einem Gehäuse (10), einem feststehenden Element (26), das an dem Gehäuse (10) befestigt ist oder damit einstückig ausgebildet ist, einem umlaufenden Element (27) mit einer Endplatte (271), von der sich ein Fluidverdrängerelement erstreckt, wobei das feststehende Element und das Fluidverdrängerelement mit einer radialen Versetzung zum Bilden eines Linienkontakts zum Trennen eines Auslaßfluids vom Einlaßfluid ineinandergreifen, und einer Antriebsvorrichtung mit einer drehbaren Antriebswelle (13), die mit dem umlaufenden Element (27) zum Antreiben des umlaufenden Elements (27) in einer Umlaufbewegung verbunden ist, einer mit dem umlaufenden Element (27) verbundenen Rotationsverhinderungs- / Drucklagereinrichtung (37) zum Verhindern der Rotation des umlaufenden Elementes (27) und zum Aufnehmen der Axialdrucklast vom umlaufenden Element (27) während der Umlaufbewegung, so daß der Linienkontakt zum Auslaß wandert, wobei die Rotationsverhinderungs- / Drucklagereinrichtung (37) einen diskreten umlaufenden Teil, einen diskreten feststehenden Teil und zwischen diesen Teilen gekoppelte Lagerelemente aufweist,



dadurch gekennzeichnet, daß der umlaufende Teil einen umlaufenden ringförmigen Laufring (374), der in einer ringförmigen Nut (274) sitzt, die an der Endplatte (271) auf deren derjenigen Seite, von der sich das Fluidverdrängerelement (272) erstreckt, gegenüberliegenden Seite gebildet ist, und einen an der Endplatte (271) zum Überdecken des Laufrings (374) befestigten umlaufenden Ring (375), der eine Mehrzahl von ersten Taschen besitzt, die sich axial in Richtung zum umlaufenden Laufring (374) erstrecken, aufweist, daß der feststehende Teil einen ringförmigen feststehenden Laufring (371), der in einer am Gehäuse gebildeten ringförmigen Nut (113) sitzt, und einen feststehenden Ring (372), der am Gehäuse zum Überdecken des feststehenden Laufrings (371) befestigt ist, dem umlaufenden Ring (375) gegenüberliegt und eine Mehrzahl von zweiten Taschen besitzt, die sich axial zum feststehenden Laufring hin erstrecken, aufweist, und daß die Lagerelemente (377) jeweils innerhalb eines im wesentlichen ausgerichteten Paares der ersten und zweiten Taschen getragen ist und dem umlaufenden und feststehenden Laufring (374, 371) berühren, um die Rotation des umlaufenden Elements (27) durch die Lagerelemente (377), die mit dem umlaufenden und feststehenden Ring in Wechselwirkung stehen, zu verhindern.

2. Fluidverdrängervorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß sich der umlaufende Ring (375) radial weiter nach innen erstreckt als der umlaufende Laufring (374) und an der Endplatte (271) mittels einer Mehrzahl von Befestigungselementen (376) befestigt ist, die radial innerhalb des umlaufenden Laufrings (374) angeordnet sind, und daß sich der feststehende Ring (372) radial weiter nach außen erstreckt als der feststehende Laufring (371) und am Gehäuse (10) mittels einer Mehrzahl von Befestigungselementen (373) befestigt ist, die radial außerhalb des feststehenden Laufrings (371) angeordnet sind.

3. Fluidverdrängervorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß zwischen dem umlaufenden Laufring (374) und dem umlaufenden Ring (375) sowie zwischen dem feststehenden Laufring (371) und dem feststehenden Ring (372) ein Spalt (G) aufrechterhalten ist.

4. Fluidverdrängervorrichtung nach Anspruch 3, dadurch gekennzeichnet, daß der umlaufende Ring (375) einen dicken Bereich und einen dünnen Bereich aufweist, wobei der dicke Bereich die Endplatte (271) berührt und die Befestigungselemente (376) den umlaufenden Ring (375) durch den dicken Bereich hindurchgehend befestigen, wobei sich die Taschen (375a) in umlaufenden Ring (375) in dessen dünnen Bereich hinein erstrecken, und daß der feststehende Ring (372) einen dicken Bereich und einen dünnen Bereich aufweist, wobei der dicke Bereich das Gehäuse (10) berührt und die Befestigungselemente (373) den feststehenden Ring (372) durch den dicken Bereich hindurchgehend befestigen, wobei sich die Taschen (372a) im feststehenden Ring (372) in dessen dünnen Bereich hinein erstrecken.

5. Fluidverdrängervorrichtung nach Anspruch 3 oder 4, dadurch gekennzeichnet, daß in der Endplatte (271) eine zweite ringförmige Nut (275) und am Gehäuse (10) eine zweite ringförmige Nut (115) gebildet ist, wobei die Tiefe der zweiten Nut (275) in der Endplatte (271) zumindest einen Teil des Spaltes (G) zwischen dem umlaufenden Laufring (374) und dem umlaufenden Ring (375) festlegt und die Tiefe der zweiten Nut (115) am Gehäuse (10) zumindest einen Teil des Spaltes (G) zwischen dem feststehenden Laufring (371) und dem feststehenden Ring (372) festlegt.

Revendications

1. Appareil de déplacement de fluide comprenant un corps (10), un élément fixe (26) fixé au corps (10) ou faisant corps avec lui, un élément à mouvement orbital (27) présentant une plaque terminale (271) de laquelle part un organe de déplacement de fluide (272), l'élément fixe (26) et l'organe de déplacement de fluide (272) s'adaptant entre eux avec un décalage radial pour former un contact linéaire pour séparer un fluide sortant du fluide entrant, et un mécanisme d'entraînement comprenant un arbre d'entraînement tournant (13) relié à l'élément à mouvement orbital (27) pour entraîner cet élément à mouvement orbital (27) en un mouvement orbital, un palier de butée empêchant la rotation (37) relié à l'élément à mouvement orbital (27) pour empêcher la rotation de cet élément à mouvement orbital (27) et pour supporter un effort de poussée axiale venant de l'élément à mouvement orbital (27) pendant la mouvement orbital, de sorte que le contact linéaire se déplace vers le refoulement, le palier de butée empêchant la rotation (37) comprenant une partie distincte à mouvement orbital, une partie fixe distincte et des éléments de palier accouplés entre ces parties, caractérisé par le fait que la partie à mouvement orbital comprend une cuvette annulaire à mouvement orbital (374) placée à l'intérieur d'une gorge annulaire (274) formée sur la plaque terminale (271) sur un côté opposé à celui d'où part l'organe de déplacement de fluide (272) et un anneau à mouvement orbital (375) fixé à la plaque terminale (271) pour couvrir la cuvette (374), l'anneau à mouvement orbital (375) présentant plusieurs premiers creux se dirigeant axialement vers la cuvette à mouvement orbital (374), la partie fixe comprenant une cuvette annulaire fixe (371) placée à l'intérieur d'une gorge annulaire (113) formée sur le corps et un anneau fixe (372) fixé au corps pour couvrir la cuvette fixe (371) et tourné, vers l'anneau à mouvement orbital (375), l'anneau fixe (372) présentant plusieurs deuxièmes creux se dirigeant axialement vers la cuvette fixe, les éléments de palier (377) étant portés chacun à l'intérieur d'une paire généralement alignée des premiers et deuxièmes creux et touchant les cuvettes à mouvement orbital et fixe (374, 371) pour empêcher la rotation de l'élément à mouvement orbital (27) par l'interaction des éléments de



palier (377) avec les anneaux à mouvement orbital et fixe.

2. Appareil de déplacement de fluide selon la revendication 1, caractérisé par le fait que l'anneau à mouvement orbital (375) s'étend radialement plus loin vers l'intérieur que la cuvette à mouvement orbital (374) et est fixé à la plaque terminale (271) au moyen de plusieurs attaches (376) disposées radialement plus à l'intérieur que la cuvette à mouvement orbital (374) et que l'anneau fixe (372) s'étend radialement plus loin vers l'extérieur que la cuvette fixe (371) et est fixé au corps (10) au moyen de plusieurs attaches (373) disposées radialement plus à l'extérieur que la cuvette fixe (371).

3. Appareil de déplacement de fluide selon la revendication 2, caractérisé par le fait qu'un jeu (G) est maintenu entre la cuvette à mouvement orbital (374) et l'anneau à mouvement orbital (375) et entre la cuvette fixe (371) et l'anneau fixe (372).

4. Appareil de déplacement de fluide selon la revendication 3, caractérisé par le fait que l'anneau à mouvement orbital (375) présente une partie épaisse et une partie mince, la partie

épaisse étant en contact avec la plaque terminale (271) et les attaches (376) qui fixent l'anneau orbital (375) pénétrant la partie épaisse, les creux (375a) de l'anneau orbital (375) s'étendant dans la partie mince de celui-ci, et en ce que l'anneau fixe (372) présente une partie épaisse et une partie mince, la partie épaisse étant en contact avec le corps (10) et les attaches (373) qui fixent l'anneau fixe (372) pénétrant la partie épaisse, les creux (372a) de l'anneau fixe (372) s'étendant dans la partie mince de celui-ci.

5. Appareil de déplacement de fluide selon l'une des revendications 3 et 4, caractérisé par le fait qu'une deuxième gorge annulaire (275) est formée dans la plaque terminale (271) et qu'une deuxième gorge annulaire (115) est formée sur le corps (10), la profondeur de la deuxième gorge (275) de la plaque terminale (271) définissant au moins une partie du jeu (G) entre la cuvette à mouvement orbital (374) et l'anneau à mouvement orbital (375) et la profondeur de la deuxième gorge (115) du corps (10) définissant au moins une partie du jeu (G) entre la cuvette fixe (371) et l'anneau fixe (372).

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