

Description

This invention relates to scroll-type fluid displacement apparatus.

Scroll-type apparatus have been well known in the prior art. For example, U.S. Patent No. 801,182 discloses a device including two scroll members each having an end plate and a spiroidal or involute spiral element on the end plate. The scroll members are maintained angularly offset so that the spiral elements interfit at a plurality of line contacts between their spiral curved surfaces, thereby to seal off and define at least one pair of fluid pockets. The relative orbital motion of these scroll members causes the line contacts to be shifted along the spiral curved surfaces and, therefore, changes the volume of the fluid pockets. The volume of the fluid pockets increases or decreases dependent on the direction of orbital motion. Therefore, the scroll-type apparatus can be used to compress, expand or pump fluids. In comparison with conventional compressors of the piston-type, a scroll-type compressor has certain advantages such as fewer parts and continuous compression of fluid. However, there have been several problems, primarily sealing of the fluid pockets, wear of the spiral elements, and outlet and inlet porting.

Although various improvements in scroll-type compressors have been disclosed in many patents, for example, U.S. Patent Nos. 3,884,599, 3,924,977, 3,994,633, 3,994,635 and 3,994,636, such improvements have not sufficiently resolved these and other problems.

In particular, it is desired that sealing force at each line contact be sufficiently maintained in a scroll-type compressor, because the fluid pockets are defined by the line contacts between two spiral elements which are interfitted together, and the line contacts are shifted along the surface of the spiral elements toward the center of spiral elements by the orbital motion of scroll member, thereby to move the fluid pockets to the center of the spiral elements with a consequent reduction of volume and compression of the fluid in the pockets. On the other hand, if the contact force which is maintaining the sealing line contact between the spiral elements becomes too large, wear of the spiral elements surfaces increases. In view of this, the contact force of both spiral elements must be suitably maintained. However, these contact forces cannot be precisely maintained because of dimensional errors in manufacturing the spiral elements, and because to decrease the dimensional errors of spiral elements during manufacture, would complicate the manufacture of spiral elements.

Furthermore, at least one of spiral elements undertakes orbital motion to accomplish the fluid compression. Therefore, the compressor can vibrate by virtue of centrifugal force caused by this orbital motion.

These problems, that is, sealing of the fluid pockets or vibration, are not completely resolved by the above-mentioned patents.

U.S. Patent No. 3,986,799 discloses a scroll type apparatus wherein a driving mechanism for an orbiting scroll member include means which are designed to resolve the problem of wear of the spiral elements and to maintain the sealing of the fluid pockets. The driving mechanism comprises a drive shaft, a pivot pin projecting from end surface of the drive shaft at a location offset from the axis of the shaft, a scroll shaft projecting from an end plate of the orbiting scroll member and a swing link which is operatively connected between the pivot pin and scroll shaft. In this construction, the orbital radius of the orbiting scroll member may change due to wear of the spiral elements or due to dimensional inaccuracies of the spiral elements. The swing link has a counter weight for overcoming a portion of the centrifugal force acting upon the fixed scroll member, and also is urged outwardly by a spring mechanism so as to maintain sealing of the line contacts. Accordingly, the sealing force is partly provided by a portion of the centrifugal force and partly by an elastic force caused by the spring member. However, in the arrangement disclosed in U.S. Patent No. 3,986,799 the sealing force is such as to cause abnormal wear of the spiral elements and the spring mechanism for providing the sealing force is complicated.

It is an object of this invention to provide a fluid displacement apparatus, in particular a compressor unit of the scroll-type which has excellent sealing of the fluid pockets and anti-wearing of spiral elements surfaces.

It is another object of this invention to provide a fluid displacement apparatus, in particular a compressor unit of the scroll-type which holds a dynamic balance and, therefore, prevents or almost prevents vibration of the compressor.

According to the present invention there is provided a scroll-type fluid displacement apparatus including a housing having a fluid inlet port and a fluid outlet port, a fixed scroll member fixedly disposed within said housing and having first end plate means from which first wrap means extend, an orbiting scroll member having second end plate means from which second wrap means extend, said first and second wrap means interfitting at an angular offset to make a plurality of line contacts to define at least one pair of sealed off fluid pockets, a drive shaft rotatably supported by said housing, a drive pin eccentrically disposed with respect to the axis of the drive shaft at an inner end of said drive shaft and connected to said orbiting scroll member for transmitting orbiting movement, and a rotation preventing means for preventing the rotation of said orbiting scroll member during the orbital motion of said orbiting scroll member, whereby said fluid pockets change volume by the orbital motion of said orbiting scroll member, characterized in that said second end plate means of said orbiting scroll member has an extension disposed on a side opposite to a side surface from which said second wrap means extends, a linkage



member is operatively connected to said extension, said linkage member has an eccentric hole disposed eccentrically with respect to the center of said linkage member, said drive pin is inserted in said eccentric hole and is rotatably connected to said linkage member, a center of said drive pin is located on an opposite side to a center of said drive shaft with regard to a straight line which passes through the center of said linkage member and is perpendicular to a connecting line passing through the center of said shaft and the center of said linkage member, said center of said drive pin (154) is also beyond the straight line which passes through the center of said shaft and the center of said linkage member in the direction of rotation of said drive shaft, and said linkage member has a first balance weight for causing a centrifugal force which equals or is slightly less than the centrifugal force which arises from orbiting motion of said orbiting parts, whereby the contact force between said first and second wrap means is generated by only the moment created by the positional relationship of said drive shaft, said drive pin and said linkage member.

A preferred form of scroll-type fluid displacement apparatus according to this invention includes a housing having a fluid inlet port and a fluid outlet port. A fixed scroll member is fixedly disposed within the housing and has first end plate means to which first wrap means are affixed. An orbiting scroll member has second plate means to which second wrap means are affixed. The first and second wrap means interfit at an angular offset of 180° to make a plurality of line contacts to define at least one sealed off fluid pocket. A drive pin is eccentrically disposed at inner end of the drive shaft and connected to the orbiting scroll member for transmitting an orbital movement through a bushing. A rotation preventing means is disposed in the housing for preventing the rotation of the orbiting scroll member during the orbital motion of the orbiting scroll member. Therefore, the fluid pockets changes volume due to the orbital motion of the orbiting scroll member. The second end plate means of the orbiting scroll member has a boss which is disposed on an opposite side surface of the second end plate means from the second wrap means. A bushing is disposed in the boss and is rotatably supported therein. An eccentric hole is formed in an end surface of the bushing. The drive pin is inserted into the eccentric hole, therefore, the bushing is rotatably supported by the drive pin. A center of drive pin located in an opposite side to a center of the drive shaft with regard to a straight line which passes through the center of the bushing and perpendicular to a connecting line passing through the center of the shaft and the center of the bushing, and beyond the straight line passing through the center of the shaft and the center of the bushing in the direction of rotation of the drive shaft. The bushing has a balance weight to cancel a centrifugal force which arises because of the orbital

motion of the orbiting scroll member and the bushing.

The drive shaft and bushing are connected by the drive pin for transmitting the orbital motion. The drive shaft can be provided with another pin connected to the bushing, to thereby restrict the range of swing of the bushing around the drive pin.

The drive shaft can also be provided with two additional balance weights to cancel the moment caused by the centrifugal force of the orbiting scroll member and the balance weight.

The invention will now be described, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 shows a vertical sectional view of a compressor unit of the scroll-type according to an embodiment of this invention;

Fig. 2 is an exploded perspective view of the driving mechanism in the embodiment of Fig. 1;

Fig. 3 is a sectional view taken along a line III—III in Fig. 1;

Fig. 4 is an explanatory diagram of the motion of the eccentric bushing in the embodiment of Fig. 1;

Fig. 5 is a perspective view of a modified driving mechanism;

Fig. 6 is an explanatory view of the dynamic balance in the embodiment of Fig. 1;

Fig. 7 is a perspective view of a rotation preventing mechanism in the embodiment of Fig. 1; and

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

Detailed description of the preferred embodiments

Referring to Fig. 1, a fluid displacement apparatus in accordance with the present invention, in particular a refrigerant compressor unit 1 of an embodiment of the present invention is shown. The unit 1 includes a compressor housing 10 comprising a cylindrical housing 11, a front end plate 12 disposed to front end portion of the cylindrical housing 11 and a rear end plate 13 disposed to rear end portion of the cylindrical housing 11. An opening is formed in front end plate 12 and a drive shaft 15 is rotatably supported by a ball bearing 14 which is disposed in the opening. Front end plate 12 has a sleeve portion 16 projecting from the front surface thereof and surrounding drive shaft 15 to define a shaft seal cavity. A shaft seal assembly 17 is assembled on drive shaft 15 within the shaft seal cavity. A pulley 19 is rotatably supported by a bearing means 18 which is disposed on outer surface of sleeve portion 16. An electromagnetic annular coil 20 is fixed to the outer surface of sleeve portion 16 and is received in an annular cavity of the pulley 19. An armature plate 21 is elastically supported on the outer end of the drive shaft 15 which extends from sleeve portion 16. A magnetic clutch comprising pulley 19, magnetic coil 20 and armature plate 21 is thereby formed.

(12)

Thus, drive shaft 15 is driven by an external drive power source, for example, a motor of a vehicle, through a rotational force transmitting means such as the magnetic clutch.

Front end plate 12 is fixed to front end portion of cylindrical housing 11 by a bolt (not shown) to thereby cover an opening of cylindrical housing 11 and is sealed by an O-ring 22. Rear end plate 13 is provided with an annular projection 23 on its inner surface to partition a suction chamber 24 from a discharge chamber 25. Rear end plate 13 has a fluid inlet port 26 and fluid outlet port (not shown), which respectively are connected to the suction and discharge chambers 24, 25. Rear end plate 13, together with a circular end plate 281 are fixed to the rear end portion of cylindrical housing 11 by a bolt-nut 27. The circular end plate 281 of a fixed scroll member 28 is disposed in a hollow space between cylindrical housing 11 and rear end plate 13 and is secured to cylindrical housing 11. Reference numerals 2 and 3 represent gaskets for preventing fluid leakage past the outer perimeter of the end plate 28 and between suction chamber 24 and discharge chamber 25.

Fixed scroll member 28, having an involute center O, includes the circular end plate 281 and a wrap means or spiral element 282 affixed to or extending from one side surface of circular plate 281. Circular plate 281 is fixedly disposed between the rear end portion of cylindrical housing 11 and rear end plate 13. The opening of the rear end portion of cylindrical housing 11 is thereby covered by the circular plate 281. Spiral element means 282 is disposed in an inner chamber 29 of cylindrical housing 11.

An orbiting scroll member 30, having an involute center O', is also disposed in the chamber 29. Orbiting scroll member 30 also comprises a circular end plate 301 and a wrap means or spiral element 302 affixed to or extending from one side surface of circular plate 301. The spiral element 302 and spiral element 282 of fixed scroll member 28 interfit at an angular offset of 180° and at a determined radial offset. Orbiting scroll member 30 is connected to a drive mechanism and to a rotation preventing/thrust bearing mechanism. These last two mechanisms effect orbital motion at a circular radius Ro by rotation of drive shaft 15 to thereby compress fluid passing through the compressor unit.

Generally, radius Ro of orbital motion is given by

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

2

As seen in Fig. 8, the pitch (P) of the spiral elements can be defined by $2\pi r_g$, where r_g is the involute circle radius. The radius of orbital motion Ro is also illustrated in Fig. 8 as a locus of an arbitrary point Q on an orbiting scroll member 30. Center of spiral element 302 is placed radially offset from an involute center of spiral element

282 of fixed scroll member 28 by the distance Ro. Thereby, orbiting scroll member 30 is allowed to make orbital motion of a radius Ro by the rotation of drive shaft 15. As the scroll member 30 orbits, line contact between both spiral elements 282, and 302 shifts to the center of spiral elements along the surface of the spiral elements. Fluid pockets defined between the spiral elements 282 and 302 move to the center with a consequent reduction of volume, to thereby compress the fluid in the pockets. Circular plate 281 of fixed scroll member 28 is provided with a hole or suction port 283 which communicates between suction chambers 24 and inner chambers 29 of cylindrical housing 11. A hole or discharge port 284 is formed through the circular plate 281 at a position near the center of spiral element 282 and is connected to discharge chamber 25. Therefore, fluid, or refrigerant gas, introduced into chamber 29 from an external fluid circuit through inlet port 26, suction chamber 24 and hole 283 is taken into fluid pockets formed between both spiral elements 282 and 302. As scroll member 30 orbits, fluid in the fluid pockets is compressed and the compressed fluid is discharged into discharge chamber 25 from the fluid pocket of the spiral element center through hole 284, and therefrom, discharged through an outlet port to an external fluid circuit, for example, a cooling circuit.

Referring to Figs. 1, 2 and 3 a driving mechanism of orbiting scroll member 30 will be described. Drive shaft 15, which is rotatably supported by front end plate 12 through ball bearing 14 is formed with disk portion 151. Disk portion 151 is rotatably supported by ball bearing 31 which is disposed in a front end opening of cylindrical housing 11. An inner ring of the ball bearing 31 is fitted against a collar 152 formed with disk portion 151, and other outer ring is fitted against a collar 111 formed at front end opening of cylindrical housing 11. An inner ring of ball bearing 14 is fitted against a stepped portion 153 of drive shaft 15 and an outer ring of ball bearing 14 is fitted against a shoulder portion 121 of the opening of front end plate 12. Therefore, drive shaft 15, ball bearing 14 and ball bearing 31 are supported for rotation without axial motion.

A crank pin or drive pin 154 axially projects from an end surface of disk portion 151 and, hence, from an end of drive shaft 15, and is radially offset from the center of drive shaft 15.

Circular plate 301 of orbiting scroll member 30 is provided with a tubular boss 303 axially projecting from an end surface of the plate 301. The spiral element 302 extends from an opposite end surface of the circular plate 301. A discoid or short axial bushing 33 is fitted into boss 303, and rotatably supported therein by bearing means, such as a needle bearing 34. Bushing 33 has a balance weight 331 which is shaped as a portion of a disc or ring and extends radially from the bushing 33 along a front surface thereof. An eccentric hole 332 is formed in the bushing 33 radially offset from center of the bushing 33. Drive

pin 154 is fitted into the eccentrically disposed hole 332 within which a bearing 32 may be applied. Bushing 33 is therefore driven by the revolution of drive pin 154 and permitted to rotate by the needle bearing 34. Respective placement of center Os of shaft 15, center Oc of bushing 33, and center Od of hole 332 and thus of drive pin 154, is shown in Fig. 3. In the position shown in Fig. 3, the distance between Os and Oc is the radius Ro of orbital motion, which is shown there for purposes of explanation, and when drive pin 154 is fitted to eccentric hole 332, center Od of drive pin 154 is placed, with respect to Os, on the opposite side of a line L1, which is through Oc and perpendicular to a line L2 through Oc and Os, and also beyond the line through Oc and Os in direction of rotation A of shaft 15. This relationship of centers Os, Oc and Od holds true in all rotative positions of drive shaft 15. As seen in Figures 3 and 4, Od, at this particular point of motion, is located in the upper left hand quadrant defined by the lines L1 and L2.

In this construction of a driving mechanism, center Oc of bushing 33 is permitted to swing about the center Od of drive pin 154 at a radius E2, as shown in Fig. 4. Such swing motion of center Oc is illustrated as are Oc'—Oc" in Fig. 4. This permitted swing motion allows the orbiting scroll member 30 to compensate its motion for changes in Ro due to wear on the spiral elements 282, 302 or due to other dimensional inaccuracies of the spiral elements. When drive shaft 15 rotates, drive force Fd is exerted at Od to the left and reaction force Fr of gas compression appears at Oc to the right, both forces being parallel to line L1. Therefore, the arm Od—Oc can swing outward by the creation of the moment generated by forces Fd and Fr. Therefore, spiral element 302 of orbiting scroll member 30 is forced toward spiral element 282 of fixed scroll member 28 and the orbiting scroll member 30 orbits with the radius Ro around center Os of drive shaft 15 of necessity. The rotation of orbiting scroll member 30 is prevented by a rotation preventing mechanism, described more fully hereinafter, whereby orbiting scroll member 30 orbits and keeps its relative angular relationship. The fluid pocket moves because of the orbital motion of orbiting scroll member 30, to thereby compress the fluid.

The use of the bushing 33 with eccentric hole 332 has the following advantages.

When fluid is compressed by orbital motion of orbiting scroll member 30, reaction force Fr, caused by the compression of the fluid, acts on spiral element 302. This reaction force Fr acts in a direction tangential to the circle of orbiting motion. This reaction force, which is shown as Fr of Fig. 4, in the final analysis, acts on center Oc of bushing 33. Bushing 33 is rotatably supported by drive pin 154, therefore, bushing 33 is subject to a rotating moment generated by Fd and Fr with radius E2 around center Od of drive pin 154. This moment is defined as $Fd(E2)(\sin \theta)$, where θ is the angle between the line Od—Oc and line L1, because $Fd=Fr$. Orbiting scroll member 30 which

is supported by bushing 33 is also subject to the rotating moment with radius E2 around center Od of drive pin 154 and, hence, the rotating moment is also transferred to spiral element 302. This moment urges spiral element 302 against spiral element 282 with an urging force Fp. Fp acts through a moment arm $E3=E2 \cos \theta$. Since the moments are equal $Fp E2 \cos \theta = Fd E2 \sin \theta$. Thus, urging force $Fp = Fd \tan \theta$. When orbiting scroll member 30 is driven through a bushing 33 having eccentric hole 332, the urging force which acts at the line contact between both spiral element 302 and 282 will be automatically derived from the reaction force whereby a seal of the fluid pockets is attained.

In addition, center Oc of bushing 33 is rotatable around center Od of drive pin 154, therefore, if a pitch of a spiral element or a wall thickness of a spiral element, due to manufacturing inaccuracy or wear, has a dimensional error, distance Oc—Os changes to correspond the error. Orbiting scroll member 30 thereby moves smoothly along the line contacts between the spiral elements. So that, if only the urging force Fp acts on the spiral element 302 of orbiting scroll member 30 to press it against spiral 282, the center Oc swings as seen in Fig. 4, and a balance weight is not needed when the centrifugal force is not excessive. But, in a dynamic situation, if bush 33 is not provided with balance weight 331, a centrifugal force F1 caused by orbiting motion of orbiting scroll member 30, bearing 34 and bush 33 is added to the urging force of spiral element 302 acting on spiral element 282. Therefore, the contact force between the spiral elements 282, 302 would also increase as shaft speed increases. Friction force between spiral element 302 and 282 would thereby be increased, and wearing of both spiral elements and also mechanical friction loss would increase. In a situation where the needle bearing 34 is omitted, the centrifugal force F1 would arise from the orbiting of the scroll member 30 and the bushing 33.

Therefore, if bushing 33 is provided with a properly designed balance weight, centrifugal force F1 can be cancelled by centrifugal force F2 of the balance weight. The mass of the balance weight is selected so that the centrifugal force F2 is equal in magnitude to the centrifugal force F1 and located so that the centrifugal forces F1 and F2 are opposite in direction. Wear of both spiral elements will thereby also be decreased; the sealing force of fluid pockets, which is independent of shaft speed, will be secured by the contact between the spiral elements described in Fig. 4.

It is advantageous that bushing 33 is freely rotatable on the drive pin 154, so that bushing 33 is movable vertically, but if bushing 33 would be fully freely rotatable around drive pin 154, the balance weight would interfere with interior wall of the housing. Therefore, to limit the rotational movement of bushing 33 around drive pin 154, the unit is provided with a swing angle limiting means which is shown in Fig. 5.



The swing angle limiting means is formed as a projection, such as a pin 155, from either the bushing 33 or the disk portion 151, and a reception opening for the projection, such as an arc-shaped groove 333, in the other of the bushing 33 or disk portion 15. Disk portion 151 of drive shaft 15 is provided with the coupling pin 155 at its end surface and bushing 33 has the arc-shaped groove 333 formed on the end surface of the disk portion 151 for receiving the pin 155. Groove 333 extends in an arc with its center at the center of eccentric hole 332 and a radius of the distance between drive pin 154 and pin 155. The reception of the coupling pin 155 within the groove 333 limits the amount of swing of the bushing 33 to a selected degree.

As mentioned above, suitable sealing force of the fluid pocket is accomplished by using bushing 33 having balance weight 331. However, a centrifugal force F_1 arises due to orbiting of scroll member 30, bearing 34 and bushing 33 (except balance weight); and centrifugal force F_2 arises due to orbiting of balance weight 331. The centrifugal forces F_1 , F_2 are made equal in magnitude, however, direction of the forces is opposed. Therefore, as the acting points of these forces are apart axially, a moment arises and vibration of the unit can occur.

Acting point of F_1 is a centroid, i.e., center of mass, G30 of orbiting scroll member 30, bearing 34 and bushing 33, and acting point of F_2 is a centroid G331 of balance weight 331. Balance weight 331, which is attached to bushing 33 and thereby coupled to orbiting scroll member 30, is axially offset from the scroll member 30. Therefore, centroid G30 is not aligned with centroid G331 in an axial direction of the shaft 15. To prevent vibration caused by the moment created by this axial offset, the unit is provided with a cancelling mechanism which is shown in Fig. 1. Drive shaft 15 is provided with a pair of balance weights 35, 36. The balance weight 35 is placed on the shaft 15 near or adjacent to the balance weight 331 to cause a centrifugal force in the same direction as the centrifugal force of the balance weight 331. The balance weight 36 is placed on the shaft 15 on an opposite radial side of the drive shaft 15 as the balance weight 35 and on an opposite side in the axial direction relative to the balance weight 331. The balance weight 36 causes centrifugal force in an opposite direction to the centrifugal force of said balance weight 35.

Namely, as shown by Fig. 1, balance weight 35 is disposed in a counterbore 130 which is formed at the front end opening of cylindrical housing 11 and is fixed by a bolt 37 to a front end surface of disk portion 151. Balance weight 36 is fixed to or formed integral with a stopper plate 38 which is supported by armature 21 of the magnetic clutch.

Centrifugal force of balance weight 35 and 36 is designated as F_3 and F_4 , respectively, and the relation of the centrifugal forces F_1 , F_2 , F_3 and F_4 is shown in Fig. 6. As mentioned above, $F_1 = F_2$ so that this moment, i.e., the moment created due to the axial offset of centroids G30 and G331, is

defined in $F_1(X_1)$, where X_1 is distance from centroid G30 of orbiting scroll member 30, bearing 34 and bushing 33 to centroid 331 of balance weight 331 along the axis of shaft 15. The direction of the moment is shown by curved arrows M1 in Fig. 6 and is made up of the moments created by the forces F_1 and F_2 . Another moment is created due to the centrifugal forces created by the rotation of axially spaced balance weights 35, 36. The mass of balance weight 35 and 36 is designed so that $F_3 = F_4$. This moment is shown as $F_3(X_2)$ and the direction of rotation by this moment is opposed to the moment $F_1(X_1)$ where X_2 is a distance between centroid G35 and G36 along the axis of shaft 15. The direction of the second moment is shown by curved arrow M2 in Fig. 6. The distance X_2 and/or the unbalance amount (i.e., mass) of 35, 36 is selected so that $F_1(X_1) = F_3(X_2)$ to thereby prevent vibration of the unit.

Another technique for better sealing between the two spiral surfaces can be added to the aforementioned balancing technique with an acceptable amount of sacrifice of a very low mechanical loss of the machine. In this technique the centrifugal force F_1 is slightly smaller than F_2 by S . In order to attain a static balance F_3 must be larger than F_4 by the same amount S . Then dynamic unbalance of the amount $X_3 S$ appears, however, an appropriate compromise between static and dynamic balance can result in an acceptable level of vibration at a maximum shaft speed of the machine.

Also this technique becomes necessary when the space for the eccentric bush balance weight is limited so that complete cancellation of the centrifugal force F_1 of the orbiting parts assembly cannot be attained. By sacrificing the perfect dynamic balance slightly, a better seal between the two spiral surfaces can be obtained to result in a higher volumetric efficiency. In turn, this generates a better performance coefficient, which is defined as the refrigerant capacity per unit horsepower in some operating range of the compressor and also an optimum space arrangement is accomplished which results in a more compact compressor with less weight.

Referring to Fig. 7 and Fig. 1, a rotation preventing means 39 will be described. Rotation preventing means 39 is disposed to surround boss 303 and is comprised of a fixed ring 391 and an Oldham ring 392. Ring 391 is secured to a stepped portion of the inner surface of cylindrical housing 11 by pin 40. Fixed ring 391 is provided with a pair of keyways 391a and 391b in an axial end surface facing orbiting scroll member 30. Oldham ring 392 is disposed in a hollow space between fixed ring 391 and circular plate 301 of orbiting scroll member 30. Oldham ring 392 is provided with a pair of keys 392a and 392b on the surface facing fixed ring 391, which are received in keyways 391a and 391b. Therefore, Oldham ring 392 is slidable in the radial direction by the guide of keys 392a and 392b within keyways 391a and 391b. Oldham ring 392 is also provided with a

pair of keys 392c and 392d on its opposite surface. Keys 392c and 392d are arranged along a diameter perpendicular to the diameter along which keys 392a and 392b are arranged. Circular plate 301 of orbiting scroll member 30 is provided with a pair of keyways, one of which is shown as 301a in Fig. 7, on a surface facing Oldham ring 392 in which are received keys 392c and 392d. The keyways of plate 301 are formed outside the diameter of boss 303. Therefore, orbiting scroll member 30 is slidable in a radial direction by guide of keys 392c and 392d within the keyways of circular plate 301.

Oldham ring 392 reciprocates along the direction of key 392a—b or keyway 391a—b, which creates vibration due to inertia. This cannot be cancelled by the aforementioned technology, however, by making Oldham ring 392 light, the vibration can be of an acceptable level.

Accordingly, orbiting scroll member 30 is slidable in one radial direction with Oldham ring 392, and is slidable in another radial direction independently. The second sliding direction is perpendicular to the first radial direction. Therefore, orbiting scroll member 30 is prevented from rotation, but is permitted to move in two radial directions perpendicular to one another.

In addition, bearing elements 41 are supported in openings of Oldham ring 392, and between fixed ring 391 and circular plate 301, and therefore function as a thrust bearings for the orbiting scroll member.

This invention has been described in detail in connection with the preferred embodiments, but these are examples only and this invention is not restricted thereto. It will be easily understood by those skilled in the art that the other variations and modifications can be easily made within the scope of this invention.

The scroll-type fluid displacement apparatus described above with reference to Figures 1 to 8 are also disclosed in our co-pending European Application No. 83101538.3 which is divided on the present application and claims a scroll-type fluid displacement apparatus including a housing having a fluid inlet port and a fluid outlet port, a fixed scroll member fixedly disposed relative to said housing and having an end surface from which first wrap means extends into the interior of said housing, an orbiting scroll member having end plate means from which second wrap means extends, said first and second wrap means interfitting at an angular offset to make a plurality of line contacts to define at least one pair of sealed off fluid pockets, a drive mechanism connected to said orbiting scroll member for transmitting orbital motion to said orbiting scroll member, and rotation preventing means for preventing rotation of said orbiting scroll member during the orbital motion of said orbiting scroll member, whereby said fluid pockets change volume by the orbital motion of said orbiting scroll member, wherein said rotation preventing means comprise a fixed ring disposed within said housing, spaced from and opposed to said end plate means, and a

sliding ring which is slidably connected to said fixed ring by keys and keyways, thereby to permit relative motion in a first direction parallel with a diameter, and slidably connected to said end plate means by keys and keyways, thereby to permit relative motion in a second direction perpendicular to said first direction, said sliding ring has formed therein a plurality of pockets which penetrate axially and are circumferentially spaced, and said pockets retain bearing elements for transmitting an axial thrust load from said orbiting scroll member to said fixed ring.

Claims

1. A scroll-type fluid displacement apparatus including a housing (10) having a fluid inlet port (26) and a fluid outlet port, a fixed scroll member (28) fixedly disposed within said housing (10) and having first end plate means (281) from which first wrap means (282) extend, an orbiting scroll member (30) having second end plate means (301) from which second wrap means (302) extend, said first and second wrap means (282, 302) interfitting at an angular offset to make a plurality of line contacts to define at least one pair of sealed off fluid pockets, a drive shaft (15) rotatably supported by said housing (10), a drive pin (154) eccentrically disposed with respect to the axis of the drive shaft (15) at an inner end of said drive shaft and connected to said orbiting scroll member (30) for transmitting orbiting movement, and a rotation preventing means (39) for preventing the rotation of said orbiting scroll member (30) during the orbital motion of said orbiting scroll member, whereby said fluid pockets change volume by the orbital motion of the said orbiting scroll member (301), characterised in that said second end plate means (301) of said orbiting scroll member (30) has an extension (303) disposed on a side opposite to a side surface from which said second wrap means (302) extends, a linkage member (33) is operatively connected to said extension (303), said linkage member (33) has an eccentric hole (332) disposed eccentrically with respect to the center of said linkage member, said drive pin (154) is inserted in said eccentric hole (332) and is rotatably connected to said linkage member (33), a center of said drive pin (154) is located on an opposite side to a center of said drive shaft (15) with regard to a straight line which passes through the center of said linkage member (33) and is perpendicular to a connecting line passing through the center of said shaft (15) and the center of said linkage member (33), said center of said drive pin (154) is also beyond the straight line which passes through the center of said shaft (15) and the center of said linkage member (33) in the direction of rotation of said drive shaft, and said linkage member (33) has a first balance weight (331) for causing a centrifugal force which equals or is slightly less than the centrifugal force which arises from orbiting motion of said orbiting parts (30, 34, 33), whereby the contact force between said first and second

(15)

pair of keys 392c and 392d on its opposite surface. Keys 392c and 392d are arranged along a diameter perpendicular to the diameter along which keys 392a and 392b are arranged. Circular plate 301 of orbiting scroll member 30 is provided with a pair of keyways, one of which is shown as 301a in Fig. 7, on a surface facing Oldham ring 392 in which are received keys 392c and 392d. The keyways of plate 301 are formed outside the diameter of boss 303. Therefore, orbiting scroll member 30 is slidable in a radial direction by guide of keys 392c and 392d within the keyways of circular plate 301.

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This invention has been described in detail in connection with the preferred embodiments, but these are examples only and this invention is not restricted thereto. It will be easily understood by those skilled in the art that the other variations and modifications can be easily made within the scope of this invention.

The scroll-type fluid displacement apparatus described above with reference to Figures 1 to 8 are also disclosed in our co-pending European Application No. 83101538.3 which is divided on the present application and claims a scroll-type fluid displacement apparatus including a housing having a fluid inlet port and a fluid outlet port, a fixed scroll member fixedly disposed relative to said housing and having an end surface from which first wrap means extends into the interior of said housing, an orbiting scroll member having end plate means from which second wrap means extends, said first and second wrap means interfitting at an angular offset to make a plurality of line contacts to define at least one pair of sealed off fluid pockets, a drive mechanism connected to said orbiting scroll member for transmitting orbital motion to said orbiting scroll member, and rotation preventing means for preventing rotation of said orbiting scroll member during the orbital motion of said orbiting scroll member, whereby said fluid pockets change volume by the orbital motion of said orbiting scroll member, wherein said rotation preventing means comprise a fixed ring disposed within said housing, spaced from and opposed to said end plate means, and a

sliding ring which is slidably connected to said fixed ring by keys and keyways, thereby to permit relative motion in a first direction parallel with a diameter, and slidably connected to said end plate means by keys and keyways, thereby to permit relative motion in a second direction perpendicular to said first direction, said sliding ring has formed therein a plurality of pockets which penetrate axially and are circumferentially spaced, and said pockets retain bearing elements for transmitting an axial thrust load from said orbiting scroll member to said fixed ring.

Claims

1. A scroll-type fluid displacement apparatus including a housing (10) having a fluid inlet port (26) and a fluid outlet port, a fixed scroll member (28) fixedly disposed within said housing (10) and having first end plate means (281) from which first wrap means (282) extend, an orbiting scroll member (30) having second end plate means (301) from which second wrap means (302) extend, said first and second wrap means (282, 302) interfitting at an angular offset to make a plurality of line contacts to define at least one pair of sealed off fluid pockets, a drive shaft (15) rotatably supported by said housing (10), a drive pin (154) eccentrically disposed with respect to the axis of the drive shaft (15) at an inner end of said drive shaft and connected to said orbiting scroll member (30) for transmitting orbiting movement, and a rotation preventing means (39) for preventing the rotation of said orbiting scroll member (30) during the orbital motion of said orbiting scroll member, whereby said fluid pockets change volume by the orbital motion of the said orbiting scroll member (301), characterised in that said second end plate means (301) of said orbiting scroll member (30) has an extension (303) disposed on a side opposite to a side surface from which said second wrap means (302) extends, a linkage member (33) is operatively connected to said extension (303), said linkage member (33) has an eccentric hole (332) disposed eccentrically with respect to the center of said linkage member, said drive pin (154) is inserted in said eccentric hole (332) and is rotatably connected to said linkage member (33), a center of said drive pin (154) is located on an opposite side to a center of said drive shaft (15) with regard to a straight line which passes through the center of said linkage member (33) and is perpendicular to a connecting line passing through the center of said shaft (15) and the center of said linkage member (33), said center of said drive pin (154) is also beyond the straight line which passes through the center of said shaft (15) and the center of said linkage member (33) in the direction of rotation of said drive shaft, and said linkage member (33) has a first balance weight (331) for causing a centrifugal force which equals or is slightly less than the centrifugal force which arises from orbiting motion of said orbiting parts (30, 34, 33), whereby the contact force between said first and second



(16)

wrap means (282, 302) is generated by only the moment created by the positional relationship of said drive shaft (15), said drive pin (154) and said linkage member (33).

2. An apparatus as claimed in claim 1, wherein said linkage member (33) can swing about the center of said drive pin (154) through an arc, whereby the radius of orbiting motion can vary on necessity.

3. An apparatus as claimed in claim 2, wherein said drive shaft (15) and linkage member (33) have a swing angle limiting means (155, 333) for restricting the angle of swing of said linkage member.

4. An apparatus as claimed in claim 3, wherein said swing angle limiting means is comprised of a projection (155) extending from one of said linkage member (33) and said inner end of said drive shaft (15) and a reception opening (333) formed in the other of said linkage member (33) and said inner end of said drive shaft (15) for receiving said projection.

5. An apparatus as claimed in claim 1, wherein the center of mass of said orbiting parts (30, 34, 33) is axially offset from the center of mass of said first balance weight (331).

6. An apparatus as claimed in claim 1 or 5, wherein said first balance weight causes (331) a centrifugal force which cancels the centrifugal force which arises from orbiting motion of said orbiting parts (30, 34, 33), said drive shaft (15) has a second balance weight (35) for causing a centrifugal force which acts in the same direction as the centrifugal force of said first balance weight (331) and has a third balance weight (36) to thereby cancel the moment created by the couple of the centrifugal force of said orbiting parts (30, 34, 33) and the centrifugal force of said first balance weight (331) by a moment created by the couple of centrifugal force of said second and third balance weights (35, 36).

7. An apparatus as claimed in claim 6, wherein the centrifugal force of said third balance weight (36) is in a direction opposite the centrifugal force of said second balance weight (35) and of equal magnitude.

8. An apparatus as claimed in claim 6, wherein said second balance weight (35) is disposed adjacent an inner end portion of said drive shaft (15), and said third balance weight (36) is disposed adjacent an outer end portion of said drive shaft (15).

9. An apparatus as claimed in claim 8, wherein said second balance weight (35) is fixed to a front end surface of a disk portion (151).

10. An apparatus as claimed in claim 6, wherein said third balance weight (36) is fixed to a stopper plate (38) which comprises a portion of a magnetic clutch (19, 20, 21) for coupling said drive shaft (15) to a power source.

11. An apparatus as claimed in claim 9, wherein said third balance weight (36) is fixed to a stopper plate (38) which comprises a portion of a magnetic clutch (19, 20, 21) for coupling said drive shaft (15) to a power source.

12. An apparatus as claimed in claim 10, wherein said third balance weight (36) is formed integral with said stopper plate (38).

13. An apparatus as claimed in claim 1, including needle bearing (34) disposed in a hollow space between said extension (303) and said linkage member (33).

14. An apparatus as claimed in claim 1, including a bearing (32) disposed in a hollow space between said drive pin (154) and said eccentric hole (332).

15. An apparatus as claimed in claim 1, wherein said fluid displacement apparatus is a compressor whereby as said fluid pocket moves to the center of both wrap means (282, 302) its volume reduces to compress the fluid therein.

16. An apparatus as claimed in any one of the preceding claims, wherein said housing (10) has a sleeve portion (16), said drive shaft (15) is supported for rotary motion by said sleeve portion (16) of said housing (10), said drive shaft (15) has a disk portion (15) disposed at its inner end, said drive pin (154) extends from said disk portion (151), a clutch means (19, 20, 21) is coupled to the opposite end of said drive shaft (15) for selectively connecting said drive shaft to a power source and said linkage member (33) has a generally cylindrical circumferential surface rotatably supported in said extension (303) by bearing means (34).

17. An apparatus as claimed in claim 16, including a second balance weight (35) coupled to said drive shaft (15) adjacent said disk portion (151) and having its mass located to create a centrifugal force in a direction the same as the direction of the centrifugal force of said first balance weight (331), and a third balance weight (36) coupled to said drive shaft (15) adjacent its opposite end and having a mass located to create a centrifugal force equal in magnitude and opposite in direction to the centrifugal force of said second balance weight (35).

18. An apparatus as claimed in claim 17, wherein said second balance weight (35) is attached to a surface of said disk portion (151) opposite the surface from which said drive pin (154) extends and said third balance weight (36) being attached to a distal end of said drive shaft (15) and disposed exterior to said sleeve portion (16).

19. An apparatus as claimed in claim 17, wherein said third balance weight (36) is attached to a stopper plate (38) of offset clutch means (19, 20, 21).

20. An apparatus as claimed in claim 16, wherein said extension (303) is formed integral with said second end plate (301) of orbiting scroll member (30), and said bearing means (34) is comprised of a needle bearing.

21. An apparatus as claimed in claim 16, 17 or 18, wherein the center of mass of said first balance weight (331) is offset along the axis of said drive shaft (15) from the center of mass of said orbiting parts (30, 34, 33).

22. An apparatus as claimed in claim 20, wherein a moment in a first rotative direction is



(F)

created by the axially offset centrifugal forces of the orbiting first balance weight (331) and orbiting parts (30, 34, 33), and a moment equal in magnitude and opposite in rotative direction is created by the axially offset centrifugal forces created by the orbiting motion of said second and third balance weights (35, 36) at locations spaced along the axis of said drive shaft (15).

23. An apparatus as claimed in claim 16, wherein said apparatus is comprised of a fluid compressor whereby as said fluid pocket moves to the center of both wrap means its volume reduces to compress the fluid therein.

24. An apparatus as claimed in claim 1, wherein said linkage member (33) has a first balance weight (331) which causes a centrifugal force which is slightly less than the centrifugal force which arises by orbiting motion of the orbiting parts (30, 34, 33), resulting in a small net centrifugal force which urges the orbiting scroll member (30) against the fixed scroll member (28) to improve the seal therebetween, and said shaft (15) has a second balance weight (35) for causing a centrifugal force which acts in the same direction as the centrifugal force of said first balance weight (331) and has a third balance weight (36), the centrifugal force caused by the second balance weight (35) being slightly greater than the centrifugal force caused by the third balance weight (36), whereby the moment created by the centrifugal forces of the second and third balance weight (35, 36) almost completely cancels the moment created by the centrifugal force of the orbiting parts (30, 34, 33) and the centrifugal force of said first balance weight (331).

25. An apparatus as claimed in any one of the preceding claims, wherein said extension (303) is a boss and said linkage member (33) is a bushing disposed in said boss.

Patentansprüche

1. Strömungsmaschine in Schneckenbauart, bestehend aus einem Gehäuse (10) mit einem Strömungsmiteleinlaß (26) und einem Strömungsmittelauslaß, einem fest im Gehäuse (10) angeordneten Schneckenkörper (28), der von einer ersten Stirnplatte (281) mit darauf befestigter vorragender erster Spiralwand (282) gebildet wird, einem kreisend bewegbaren Schneckenkörper (30), der von einer zweiten Stirnplatte (301) mit darauf angebrachter vorragender zweiter Spiralwand (302) gebildet wird, wobei erste und zweite Spiralwand (282, 302) winkelmäßig versetzt ineinandergreifen und sich entlang einer Mehrzahl von Linien so berühren, daß mindestens zwei abgedichtete Strömungsmitteltaschen entstehen, einer drehbar im Gehäuse (10) gelagerten Antriebswelle (15), die an ihrem inneren Ende einen exzentrisch angeordneten Kurbelzapfen (154) trägt, der mit dem umlaufenden Schneckenkörper (30) zu dessen kreisender Bewegung antriebsmäßig verbunden ist, einer mit dem umlaufenden Schneckenkörper

(30) verbundenen Sperre (39), die die Drehung des umlaufenden Schneckenkörpers (30) bei dessen kreisender Bewegung verhindert, so daß bei kreisender Bewegung des umlaufenden Schneckenkörpers (30) die Strömungsmitteltaschen ihr Volumen verändern, dadurch gekennzeichnet, daß die zweite Stirnplatte (301) des kreisend bewegten Schneckenkörpers (30) an der von der zweiten Spiralwand (302) abgelegenen Seite einen rohrförmigen Ansatz (303) trägt, in welche ein Kupplungsstück (33) eingreift, welches eine exzentrische Bohrung (332) aufweist für das Eingreifen des Kurbelzapfens (154) zur Herstellung einer Drehverbindung, daß die Mitte des Kurbelzapfens (154) bezüglich einer geraden Linie, die durch die Mitte des Kupplungsstückes (33) hindurchgeht und sich senkrecht zu einer Verbindungslinie zwischen der Mitte der Antriebswelle (15) und der Mitte des Kupplungsstückes (33) erstreckt, der Mitte der Antriebswelle (15) gegenüberliegt, wobei die Mitte des Kurbelzapfens (154) in Drehrichtung der Antriebswelle auch jenseits einer geraden Linie liegt, die durch die Mitte der Antriebswelle (15) und die Mitte des Kupplungsstückes (33) hindurchführt, und daß das Kupplungsstück (33) ein erstes Ausgleichsgewicht (331) trägt zur Erzeugung einer Zentrifugalkraft, die gleich oder geringfügig kleiner als die Zentrifugalkraft ist, die sich aus der Umlaufbewegung der umlaufenden Bauelemente (30, 34, 33) ergibt, so daß die Andrückkraft zwischen erster und zweiter Spiralwand (282, 302) nur durch das Moment hervorgerufen wird, welches sich aus der lagemäßigen Relation von Antriebswelle (15), Kurbelzapfen (154) und Kupplungsstück (33) ergibt.

2. Strömungsmaschine nach Anspruch 1, dadurch gekennzeichnet, daß das Kupplungsstück (33) um die Mitte des Kurbelzapfens (154) über einen Bogen verschwenken kann, so daß sich der Radius der Umlaufbewegung bei Bedarf verändern kann.

3. Strömungsmaschine nach Anspruch 2, dadurch gekennzeichnet, daß zwischen Antriebswelle (15) und Kupplungsstück (33) eine Anschlagvorrichtung (155, 333) angeordnet ist, die den Verschwenkungswinkel des Kupplungsstückes begrenzt.

4. Strömungsmaschine nach Anspruch 3, dadurch gekennzeichnet, daß die Anschlagvorrichtung zur Begrenzung des Schwenkwinkels aus einem Zapfen (155) besteht, der am Kupplungsstück (33) oder am inneren Ende der Antriebswelle (15) vorragt und mit einer Aufnahmeöffnung (333) zusammenarbeitet, die am inneren Ende der Antriebswelle (15) oder am Kupplungsstück (33) vorgesehen ist.

5. Strömungsmaschine nach Anspruch 1, dadurch gekennzeichnet, daß der Massenmittelpunkt der umlaufenden Bauteile (30, 34, 33) in axialer Richtung versetzt zum Massenmittelpunkt des ersten Ausgleichsgewichtes (331) angeordnet ist.

6. Strömungsmaschine nach Anspruch 1 oder 5, dadurch gekennzeichnet, daß das erste





Ausgleichsgewicht (331) eine Zentrifugalkraft erzeugt, die diejenige Zentrifugalkraft aufhebt, die sich durch die Umlaufbewegung der umlaufenden Bauelemente (30, 34, 33) ergibt, daß die Antriebswelle (15) mit einem zweiten Ausgleichsgewicht (35) versehen ist, welches eine Zentrifugalkraft erzeugt, die in gleicher Richtung wirkt wie die Zentrifugalkraft am ersten Ausgleichsgewicht (331) und daß an der Antriebswelle (15) ein drittes Ausgleichsgewicht (36) angeordnet ist, um das Moment aufzuheben, welches durch das Zentrifugalkraftpaar der umlaufenden Bauteile (30, 34, 33) und die Zentrifugalkraft des ersten Ausgleichsgewichtes (331) erzeugt wird mittels eines Momentes, welches vom Zentrifugalkraftpaar des zweiten und dritten Ausgleichsgewichtes (35, 36) erzeugt wird.

7. Strömungsmaschine nach Anspruch 6, dadurch gekennzeichnet, daß die Zentrifugalkraft des dritten Ausgleichsgewichtes (36) entgegengesetzt gleich der Zentrifugalkraft des zweiten Ausgleichsgewichtes (35) ist.

8. Strömungsmaschine nach Anspruch 6, dadurch gekennzeichnet, daß das zweite Ausgleichsgewicht (35) neben einem inneren Endteil der Antriebswelle (15) und das dritte Ausgleichsgewicht (36) neben einem äußeren Endteil der Antriebswelle (15) angeordnet ist.

9. Strömungsmaschine nach Anspruch 8, dadurch gekennzeichnet, daß das zweite Ausgleichsgewicht (35) an der Stirnfläche eines Scheibenteiles (151) angebracht ist.

10. Strömungsmaschine nach Anspruch 6, dadurch gekennzeichnet, daß das dritte Ausgleichsgewicht (36) an einer Anschlagplatte (38) befestigt ist, welche Teil einer Magnetkupplung (19, 20, 21) bildet, mit der die Antriebswelle (15) mit einer Kraftquelle kuppelbar ist.

11. Strömungsmaschine nach Anspruch 9, dadurch gekennzeichnet, daß das dritte Ausgleichsgewicht (36) an einer Anschlagplatte (38) befestigt ist, welche Teil einer Magnetkupplung (19, 20, 21) bildet, mit der die Antriebswelle (15) mit einer Kraftquelle kuppelbar ist.

12. Strömungsmaschine nach Anspruch 10, dadurch gekennzeichnet, daß das dritte Ausgleichsgewicht (36) fester Bestandteil der Anschlagplatte (38) ist.

13. Strömungsmaschine nach Anspruch 1, dadurch gekennzeichnet, daß in einem Hohlraum zwischen Schneckenkörperansatz (303) und Kupplungsstück (33) ein Nadellager (34) angeordnet ist.

14. Strömungsmaschine nach Anspruch 1, dadurch gekennzeichnet, daß in einem Hohlraum zwischen Kupplungszapfen (154) und exzentrischer Aufnahmebohrung (332) ein Nadellager (32) angeordnet ist.

15. Strömungsmaschine nach Anspruch 1, dadurch gekennzeichnet, daß sie als Kompressor ausgebildet ist, bei dem die Strömungsmitteltaschen ihr Volumen vermindern und das in ihnen enthaltene Strömungsmittel komprimieren,

wenn sich die Strömungsmitteltaschen zur Mitte der Spiralwände (282, 302) bewegen.

16. Strömungsmaschine nach einem der vorangegangenen Ansprüche, dadurch gekennzeichnet, daß das Gehäuse (10) einen Nabenteil (16) enthält, in dem die Antriebswelle (15) drehbeweglich gelagert ist, daß am inneren Ende der Antriebswelle (15) ein Scheibenteil (151) vorgesehen ist, an welchem der Kurbelzapfen (154) vorragt, daß am gegenüberliegenden Ende der Antriebswelle (15) eine Schaltkupplung (19, 20, 21) vorgesehen ist, um wahlweise die Antriebswelle mit einer Kraftquelle zu verbinden, und daß das Kupplungsstück (33) mit einer im wesentlichen zylindrischen Umfangsfläche drehbar im Schneckenkörperansatz (303) mit einem Lager (34) abgestützt ist.

17. Strömungsmaschine nach Anspruch 16, gekennzeichnet, durch ein zweites Ausgleichsgewicht (35), welches neben dem Scheibenteil (151) mit der Antriebswelle (15) gekuppelt und massenmäßig so angeordnet ist, daß eine Zentrifugalkraft entsteht, die in der gleichen Richtung wirkt wie die Zentrifugalkraft des ersten Ausgleichsgewichtes (331) und ferner gekennzeichnet durch ein drittes Ausgleichsgewicht (36), welches mit der Antriebswelle (15) neben dessen gegenüberliegenden Ende gekuppelt und massenmäßig so angeordnet ist, daß eine Zentrifugalkraft entsteht, die entgegengesetzt gleich ist mit der Zentrifugalkraft des zweiten Ausgleichsgewichtes (35).

18. Strömungsmaschine nach Anspruch 17, dadurch gekennzeichnet, daß das zweite Ausgleichsgewicht (35) an einer Oberfläche des Scheibenteiles (151) an der vom Kurbelzapfen (154) abgelegenen Seite befestigt ist und daß das dritte Ausgleichsgewicht (36) an einem ferngelegenen Ende der Antriebswelle (15) außerhalb des Nabenteiles (16) befestigt ist.

19. Strömungsmaschine nach Anspruch 17, dadurch gekennzeichnet, daß das dritte Ausgleichsgewicht (36) an einer Anschlagplatte (38) der versetzt angeordneten Schaltkupplung (19, 20, 21) befestigt ist.

20. Strömungsmaschine nach Anspruch 16, dadurch gekennzeichnet, daß der Schneckenkörperansatz (303) einteilig mit der zweiten Stirnplatte (301) des umlaufenden Schneckenkörpers (30) ausgebildet ist und als Lager (34) ein Nadellager dient.

21. Strömungsmaschine nach Anspruch 16, 17 oder 18, dadurch gekennzeichnet, daß das Massenzentrum des ersten Ausgleichsgewichtes (331) gegenüber dem Massenzentrum der umlaufenden Teile (30, 34, 33) entlang der Achse der Antriebswelle (15) versetzt ist.

22. Strömungsmaschine nach Anspruch 20, dadurch gekennzeichnet, daß durch die axial versetzt angreifenden Zentrifugalkräfte vom umlaufenden ersten Ausgleichsgewicht (331) und den umlaufenden Maschinenteilen (30, 34, 33) in einer ersten Umlaufrichtung ein Moment erzeugt wird und daß durch die axial versetzten Zentrifugalkräfte der Umlaufbewegung vom



zweiten und dritten Ausgleichsgewicht (35, 36) an Stellen, die über die Länge der Achse der Antriebswelle (15) bewirkt werden, ein größengleiches und bezüglich der Umlaufrichtung entgegengesetztes Moment erzeugt wird.

23. Strömungsmaschine nach Anspruch 16, dadurch gekennzeichnet, daß sie als Kompressor ausgebildet ist, in welchem die Strömungsmittel-taschen bei ihrer Bewegung zum Mittelpunkt der Schneckenkörper ihr Volumen vermindern und das Strömungsmittel verdichten.

24. Strömungsmaschine nach Anspruch 1, dadurch gekennzeichnet, daß das Kupplungsstück (33) ein erstes Ausgleichsgewicht (331) trägt, welches verglichen mit der Zentrifugalkraft durch die Umlaufbewegung der umlaufenden Bauteile (30, 34, 33) eine geringfügig kleinere Zentrifugalkraft erzeugt, so daß insgesamt gesehen eine kleine Zentrifugalkraft verbleibt, die den umlaufenden Schneckenkörper (30) gegen den stationären Schneckenkörper (28) drückt, um zwischen diesen Schneckenkörpern die Abdichtung zu verbessern, daß die Antriebswelle (15) mit einem zweiten Ausgleichsgewicht (35) versehen ist, welches eine Zentrifugalkraft erzeugt, die in gleicher Richtung wirkt wie die Zentrifugalkraft des ersten Ausgleichsgewichtes (331) und daß an der Antriebswelle (15) ein drittes Ausgleichsgewicht (36) vorgesehen ist, dessen Zentrifugalkraft geringfügig kleiner ist als die vom zweiten Ausgleichsgewicht (35) verursachte Zentrifugalkraft, so daß das von den Zentrifugalkräften von zweitem und drittem Ausgleichsgewicht (35, 36) erzeugte Moment nahezu vollständig das von der Zentrifugalkraft der umlaufenden Bauteile (30, 34, 33) und der Zentrifugalkraft des ersten Ausgleichsgewichtes (331) erzeugte Moment aufhebt.

25. Strömungsmaschine nach irgendeinem der vorangegangenen Ansprüche, dadurch gekennzeichnet, daß der Schneckenkörperansatz (303) als Nabe ausgebildet ist, in welche das Kupplungsstück (33) in Art einer Buchse eingreift.

Revendications

1. Appareil de transfer de fluides du type à spirale comportant un carter (10) ayant un orifice d'entrée de fluides (26) et un orifice de sortie de fluides, un élément en spirale (28) fixe installé de manière fixe dans ledit carter (10) et ayant des premiers moyens formant plaque d'extrémité (281) à partir desquels s'étendent des premiers moyens formant un enroulement (282), un élément orbital en spirale (30) ayant des seconds moyens formant plaque d'extrémité (301) à partir desquels s'étendent des seconds moyens formant un enroulement (302), lesdits premiers et seconds moyens formant enroulement (282, 302) s'emboîtant avec un décalage angulaire pour réaliser une pluralité de lignes de contact pour définir au moins une paire de poches de fluides étanches, un arbre d'entraînement (15) supporté à rotation par ledit carter (10), un doigt d'entraînement (154) disposé de manière excentrée par

rapport à l'axe de l'arbre d'entraînement (15) situé à une extrémité intérieure dudit arbre d'entraînement et reliée audit élément orbital en spirale (30) pour transmettre le mouvement orbital, et des moyens anti-rotatifs (39) pour empêcher la rotation dudit élément orbital en spirale (30) au cours du mouvement orbital dudit élément orbital en spirale, ce, grâce à quoi, les poches de fluides changent de volume sous l'effet du mouvement orbital dudit élément orbital en spirale (301), caractérisé en ce que lesdits seconds moyens formant plaque d'extrémité (301) dudit élément orbital en spirale (30) a une saillie (303) placée sur un côté opposé à une surface latérale à partir de laquelle s'étendent les seconds moyens formant un enroulement (302), un élément de liaison (33) est fonctionnellement relié à ladite saillie (303), ledit élément de liaison (33) possède un trou excentré (332) placé de manière excentrée par rapport au centre dudit élément de liaison, ledit doigt d'entraînement (154) est inséré dans ce trou excentré (332) et est raccordé en rotation audit élément de liaison (33), un centre de ce doigt d'entraînement (154) est situé sur un côté opposé à un centre dudit arbre d'entraînement (15) par rapport à une ligne droite qui passe par le centre dudit élément de liaison (33) et est perpendiculaire à une ligne de raccordement passant par le centre dudit arbre (15) et le centre dudit élément de liaison (33), ledit centre du doigt d'entraînement (154) est situé aussi au-delà de la ligne droite qui passe par le centre dudit arbre (15) et le centre dudit élément de liaison (33) dans le sens de rotation dudit arbre d'entraînement, et cet élément de liaison (33) possède une première masse d'équilibrage (331) pour créer une force centrifuge qui égale ou qui est légèrement inférieure à la force centrifuge qui prend naissance à partir du mouvement orbital des pièces orbital (30, 34, 33), ce grâce à quoi la force de contact entre lesdits premiers et seconds moyens formant un enroulement (282, 302) est générée par le seul moment créé par les positions relatives dudit arbre d'entraînement (15), dudit doigt d'entraînement (154) et dudit élément de liaison (33).

2. Appareil selon la revendication 1, dans lequel ledit élément de liaison (33) peut se balancer autour du centre du doigt d'entraînement (154) selon un arc, ce grâce à quoi le rayon du mouvement orbital peut varier selon les besoins.

3. Appareil selon la revendication 2 dans lequel ledit arbre d'entraînement (15) et l'élément de liaison (33) possèdent des moyens de limitation de l'angle de balancement (155, 333) pour réduire l'angle de balancement dudit élément de liaison.

4. Appareil selon la revendication 3 dans lequel ces moyens de limitation de l'angle de balancement sont constitués par une saillie (155) s'étendant à partir d'un desdits éléments de liaison (33) et ladite extrémité intérieure dudit arbre d'entraînement (15) et un orifice de réception (333) ménagé dans l'autre desdits éléments de liaison (33) et ladite extrémité intérieure dudit



20

arbre d'entraînement (15) pour recevoir ladite saillie.

5. Appareil selon la revendication 1 dans lequel le centre de gravité desdites pièces orbitales (30, 34, 33) est déporté axialement par rapport au centre de gravité de ladite première masse d'équilibrage (331).

6. Appareil selon la revendication 1 ou 5, dans lequel ladite première masse d'équilibrage (331) engendre une force centrifuge qui annule la force centrifuge qui prend naissance à partir du mouvement orbital des pièces orbitales (30, 34, 33), ledit arbre d'entraînement (15) possède une seconde masse d'équilibrage (35) qui engendre une force centrifuge qui s'exerce dans le même sens que la force centrifuge de ladite première masse d'équilibrage (331) et possède une troisième masse d'équilibrage (36) pour ainsi annuler le moment créé par le couple de la force centrifuge desdites pièces orbitales (30, 34, 33) et la force centrifuge de ladite première masse d'équilibrage (331) par un moment créé par le couple de la force centrifuge desdites seconde et troisième masses d'équilibrage (35, 36).

7. Appareil selon la revendication 6 dans lequel la force centrifuge de ladite troisième masse d'équilibrage (36) est de sens opposé à la force centrifuge de ladite seconde masse d'équilibrage (35) et d'égale amplitude.

8. Appareil selon la revendication 6, dans lequel ladite seconde masse d'équilibrage (35) est adjacente à une partie d'extrémité intérieure dudit arbre d'entraînement (15) et ladite troisième masse d'équilibrage (36) est adjacente à une partie d'extrémité extérieure dudit arbre d'entraînement (15).

9. Appareil selon la revendication 8, dans lequel ladite seconde masse d'équilibrage (35) est fixée à une surface d'extrémité antérieure d'une partie de disque (151).

10. Appareil selon la revendication 6 dans lequel ladite troisième masse d'équilibrage (36) est fixée à une plaque d'arrêt (38) qui comprend une partie d'un embrayage magnétique (19, 20, 21) de couplage dudit arbre d'entraînement (15) à une source d'énergie.

11. Appareil selon la revendication 9, dans lequel ladite troisième masse d'équilibrage (36) est fixée à une plaque d'arrêt (38) qui comprend une partie d'un embrayage magnétique (19, 20, 21) de couplage dudit arbre d'entraînement (15) à une source d'énergie.

12. Appareil selon la revendication 10 dans lequel ladite troisième masse d'équilibrage (36) fait corps avec ladite plaque d'arrêt (38).

13. Appareil selon la revendication 1 comportant un roulement à aiguilles (34) disposé dans un espace creux situé entre ladite saillie (303) et ledit élément de liaison (33).

14. Appareil selon la revendication 1, comportant un roulement (32) disposé dans un espace creux situé entre ledit doigt d'entraînement (154) et ledit trou excentré (332).

15. Appareil selon la revendication 1, dans lequel ledit appareil de transfert de fluides est un

compresseur au moyen duquel, quand ladite poche de fluides se déplace vers le centre des deux moyens formant des enroulements (282, 302), son volume se réduit pour comprimer le fluide qui s'y trouve.

16. Appareil selon l'une quelconque des revendications précédentes, dans lequel ledit carter (10) possède une partie de fourreau (16), ledit arbre d'entraînement (15) est supporté pour son mouvement de rotation par ladite partie de fourreau (16) dudit carter (10); ledit arbre d'entraînement (15) possède une partie de disque (15) disposée à son extrémité intérieure, ledit doigt d'entraînement (154) s'étend à partir de ladite partie de disque (151), des moyens d'embrayage (19, 20, 21) sont couplés à l'extrémité opposée dudit arbre d'entraînement (15) pour relier sélectivement ledit arbre d'entraînement à une source d'énergie, et ledit élément de liaison (33) a une surface circonferentielle généralement cylindrique supportée à rotation dans ladite saillie (303) par des moyens formant roulement (34).

17. Appareil selon la revendication 16 comportant une seconde masse d'équilibrage (35) couplée audit arbre d'entraînement (15) adjacente à ladite partie de disque (151) et ayant sa masse située de manière à créer une force centrifuge de même sens que la force centrifuge de ladite première masse d'équilibrage (331), et une troisième masse d'équilibrage (36) couplée audit arbre d'entraînement (15) adjacent à son extrémité opposée et ayant une masse située de manière à créer une force centrifuge d'égale amplitude et de sens opposé à la force centrifuge de ladite seconde masse d'équilibrage (35).

18. Appareil selon la revendication 17 dans lequel ladite seconde masse d'équilibrage (35) est fixée à une surface de ladite partie de disque (151) opposée à la surface à partir de laquelle s'étend le doigt d'entraînement (154), et ladite troisième masse d'équilibrage (36) étant fixée à l'extrémité distale dudit arbre d'entraînement (15) et disposée à l'extérieur de ladite partie de fourreau (16).

19. Appareil selon la revendication 17 dans lequel ladite troisième masse d'équilibrage (36) est fixée à une plaque d'arrêt (38) des moyens d'embrayage décalés (19, 20, 21).

20. Appareil selon la revendication 16, dans lequel ladite saillie (303) fait corps avec ladite seconde plaque d'extrémité (301) de l'élément orbital en spirale (30), et lesdits moyens formant roulement (34) comprennent un roulement à aiguilles.

21. Appareil selon la revendication 16, 17 ou 18, dans lequel le centre de gravité de ladite première masse d'équilibrage (331) est déporté le long de l'axe dudit arbre d'entraînement (15) depuis le centre de gravité desdites pièces orbitales (30, 34, 33).

22. Appareil selon la revendication 20, dans lequel un moment dirigé dans un premier sens de rotation est créé par les forces centrifuges, décalées axialement, de la première masse orbitale d'équilibrage (331) et les pièces orbitales



(30, 34, 33), et un moment égal en amplitude et de sens de rotation opposé est créé par les forces centrifuges décalées axialement créées par le mouvement orbital desdites seconde et troisième masses d'équilibrage (35, 36) en des points espacés le long de l'axe dudit arbre d'entraînement (15).

23. Appareil selon la revendication 16, dans lequel ledit appareil comprend un compresseur de fluides au moyen duquel, quand ladite poche de fluides se déplace vers le centre des deux moyens formant des enroulements, son volume se réduit pour comprimer le fluide qui s'y trouve.

24. Appareil selon la revendication 1, dans lequel ledit élément de liaison (33) possède une première masse d'équilibrage (331) qui crée une force centrifuge qui est légèrement moindre que la force centrifuge qui prend naissance par le mouvement orbital des pièces orbitales (30, 34, 33), ce qui aboutit à un petit réseau de forces centrifuges qui pousse l'élément orbital en spirale

(30) contre l'élément en spirale fixe (28) pour améliorer l'étanchéité entre eux, et ledit arbre (15) possède une seconde masse d'équilibrage (35) pour provoquer une force centrifuge qui agit dans le même sens que la force centrifuge de ladite première masse d'équilibrage (331) et possède une troisième masse d'équilibrage (36), la force centrifuge créée par la seconde masse d'équilibrage (35) étant légèrement plus grande que la force centrifuge créée par la troisième masse d'équilibrage (36), ce, grâce à quoi, le moment créé par les forces centrifuges des seconde et troisième masses d'équilibrage (35, 36) annulent presque complètement le moment créé par la force centrifuge des pièces orbitales (30, 34, 33) et la force centrifuge de ladite première masse d'équilibrage (331).

25. Appareil selon l'une quelconque des revendications précédentes, dans lequel la saillie (303) est un bossage et ledit élément de liaison (33) est un coussinet disposé dans ledit bossage.

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* C L M S *