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(54) **Pendulum pump, in particular to feed oil under pressure to a final device**

Pendelpumpe, insbesondere zum Zuführen von Drucköl zu einer endgültigen Vorrichtung

Pompe pendulaire, en particulier pour l'alimentation d'huile sous pression vers un dispositif final

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Description

[0001] The present invention relates to a pendulum pump, such as the one disclosed in WO 2009/014661 A1, in particular to feed oil under pressure to a final device.

[0002] In order to feed oil under pressure to a final device, for example to an internal combustion engine, it is known to provide a pendulum pump of the type comprising an outer rotor mounted to rotate around a first rotation axis; an inner rotor mounted inside the outer rotor to rotate around a second rotation axis which is parallel to the first rotation axis; and a plurality of dragging pendulums interposed between the outer rotor and the inner rotor.

[0003] The dragging pendulums are generally rotationally coupled to the outer rotor and slidingly engage respective guide recesses obtained on the inner rotor.

[0004] Each guide recess is separated from each adjacent guide recess by means of a respective partition wall radially extending outward with respect to the rotation axis of the inner rotor.

[0005] The inner rotor is keyed onto a motorized drive shaft, which sets the inner rotor in rotation to allow the dragging pendulums to rotate the outer rotor.

[0006] Each dragging pendulum defines a first variable-volume chamber together with the inner rotor, the outer rotor, and each adjacent dragging pendulum, and further defines a second variable-volume chamber together with the corresponding guide recess.

[0007] The chambers are axially limited by two lateral sides which are parallel to each other, each of which extends perpendicular to the rotation axes of the two rotors, and has two cavities, which extend around the second rotation axis according to respective angles smaller than 180°, face towards the chambers, and are hydraulically separated from each other in a fluid-tight manner.

[0008] A first cavity of each lateral side is hydraulically connected to a corresponding first cavity of the other lateral side and to an oil intake in the pendulum pump, while the second cavity of each lateral side is hydraulically connected to a corresponding second cavity of the other lateral side and to an oil delivery for the mentioned final device.

[0009] The two first cavities are configured so as to hydraulically connect a part of the mentioned first and second chambers together and to the intake, during the rotation of the rotors around the respective rotation axes, while the two second cavities are configured so as to hydraulically connect the remaining first and second chambers together and to the delivery, during the rotation of the rotors around the respective rotation axes.

[0010] Since the two rotors are mounted so as to be eccentric, each chamber has a volume varying between a maximum volume at the first cavities and thus at the intake, and a minimum volume at the second cavities and thus at the delivery.

[0011] Known pendulum pumps of the above-described type have certain drawbacks mainly originating

from the guide recesses having respective radial symmetry planes which contain the rotation axis of the inner rotor. Accordingly, the minimum tangential thickness of each partition wall and the structural strength of the inner rotor are relatively small.

[0012] It is the object of the present invention to provide a pendulum pump, in particular to feed oil under pressure to a final device, which is free from the above-described drawbacks and is simple and cost-effective to be implemented.

[0013] According to the present invention, a pendulum pump, in particular to feed oil under pressure to a final device, is provided as claimed in the appended claims.

[0014] The present invention will now be described with reference to the accompanying drawings, which show a nonlimiting embodiment thereof, in which:

figure 1 is a diagrammatic front view, with parts in section and parts removed for clarity, of a preferred embodiment of the pendulum pump of the present invention;

figure 2 is a diagrammatic front view of a first detail of the pendulum pump in figure 1;

figure 3 is a diagrammatic front view of a second detail of the pendulum pump in figure 1; and

figure 4 is a diagrammatic front view of a third detail of the pendulum pump in figure 1.

[0015] With reference to the accompanying drawings, numeral 1 indicates, as a whole, a pendulum pump adapted to take oil from a storage tank (not shown) and to feed oil under pressure to a final device (not shown), for example an internal combustion engine.

[0016] The pendulum pump 1 comprises a pump body 2, which is cup-shaped, is limited by a substantially flat end face 3, and defines a cavity 4, which opens outward at face 3, and is limited by a bottom wall 5 which is substantially parallel to the face 3 itself.

[0017] Cavity 4 is closed by a plate 6 which is limited by a substantially flat face 7 arranged in contact with face 3.

[0018] The pendulum pump 1 further comprises an inner rotor 8, which is accommodated inside cavity 4, and is keyed onto a drive shaft 9 rotationally engaged through the pump body 2 and plate 6 to rotate around its own longitudinal axis 10 which is substantially perpendicular to the faces 3 and 7.

[0019] The pendulum pump 1 further has an outer rotor 11 mounted so as to be eccentric with respect to the inner rotor 8 so as to rotate around its own longitudinal axis 12 which is parallel to, and separate from, the mentioned axis 10.

[0020] The rotation motion of shaft 9 and, therefore, of the inner rotor 8 around axis 10 is transmitted to the outer rotor 11 by means of a plurality of dragging pendulums 13, which are distributed around axis 12, are interposed between the inner rotor 8 and the outer rotor 11, and have a dimension, measured parallel to the axes 10 and

12, which is substantially equal to a dimension of the inner rotor 8 and of the outer rotor 11, which is also measured parallel to the axes 10 and 12.

[0021] Each pendulum 13 has a first free end rotationally fitted to the outer rotor 11 to oscillate around a fulcrum axis 14 parallel to axis 12, and also has a second free end rotationally coupled in an axially sliding manner to a guide recess 15 obtained in the inner rotor 8.

[0022] Each recess 15 is laterally limited by two flat sides 15a which are parallel to each other, and is separated from each adjacent recess 15 by means of an intermediate wall 15b.

[0023] The two sides 15a are parallel to the axes 10, 12 and are connected to each other by a bottom wall 15c of recess 15. In this case, wall 15c is flat and perpendicular to the sides 15a themselves.

[0024] The recesses 15 are distributed around axis 10 and have respective symmetry planes P, which extend parallel to axis 10, and are tangent to a circumference C which is concentric with respect to axis 10 and common to all the planes P.

[0025] Each plane P is parallel to the sides 15a and perpendicular to the wall 15c of the corresponding recess 15.

[0026] The distance between the sides 15a of each recess 15 and the dimensions of the corresponding pendulum 13 are such that pendulum 13 is always in contact with both the sides 15a and therefore is coupled to the recess 15 itself in a substantially fluid-tight manner.

[0027] Each pendulum 13 thus defines a first variable-volume chamber 16 together with the inner rotor 8, the outer rotor 11, and each adjacent pendulum 13, and defines a second variable-volume chamber 17 together with the corresponding recess 15.

[0028] The coupling between each pendulum 13 and the corresponding recess 15 allows the pumping effect of the corresponding chamber 17 to be utilized, ensures a uniform dragging of the outer rotor 11, and allows noises, vibrations and impacts to be avoided.

[0029] The chambers 16, 17 are axially limited by the bottom wall 5 of the pump body 2 and by the face 7 of plate 6.

[0030] Wall 5 and face 7 each have two respective cavities 18, 19, which extend around axis 10 according to respective angles smaller than 180°, face towards the chambers 16, 17, and are hydraulically separated from each other in a fluid-tight manner.

[0031] The two cavities 18 of wall 5 and of face 7, respectively, are hydraulically connected to each other by means of the chambers 16, 17, and are also hydraulically connected to a duct 20 for taking the oil in the pendulum pump 1.

[0032] The two cavities 19 of wall 5 and of face 7, respectively, are hydraulically connected to each other by means of the chambers 16, 17, and are also hydraulically connected to a duct 21 for delivering the oil to the mentioned final device.

[0033] The two cavities 18 are configured so as to hy-

draulically connect a part of the chambers 16, 17 together and to duct 20, when the inner rotor 8 and the outer rotor 11 rotate around the respective axes 10, 12, while the two cavities 19 are configured so as to hydraulically connect the remaining chambers 16, 17 together and to duct 21, when the inner rotor 8 and the outer rotor 11 rotate around the respective axes 10, 12.

[0034] Since the inner rotor 8 and the outer rotor 10 are mounted so as to be eccentric, each chamber 16, 17 has a volume varying between a maximum volume at the first cavities 18 and thus at duct 20, and a minimum volume at the cavities 19 and thus at duct 21.

[0035] As shown above, it is worth noting that the maximum volume of the chambers 16, 17 and thus the displacement of the pendulum pump 1 depend on the eccentricity between the axes 10, 12, and that the eccentricity between the axes 10, 12 is selectively controlled by means of an adjusting device 22.

[0036] Device 22 comprises a crank 23, which is substantially cylindrical in shape, is mounted inside cavity 4 and is rotationally engaged by the outer rotor 11.

[0037] Crank 23 is hinged to the pump body 2 to oscillate, with respect to the pump body 2 and under the thrust of a known actuating device (not shown), around a fulcrum axis 24 which is parallel to the axes 10 and 12.

[0038] According to a variant (not shown), the pendulums 13 are rotationally fitted to the inner rotor 8, the recesses 15 are obtained in the outer rotor 11, and the planes P are tangent to a circumference C which is concentric with respect to axis 12.

[0039] Since the planes P are not radial and are tangent to circumference C, the dimensions of the inner rotor 8 being equal, the pendulum pump 1 allows:

- an increased number of recesses 15 and thus of pendulums 13 to be used, with a subsequent reduction of the pressure pulsation; or
- the number of recesses 15 and thus of pendulums 13 to be kept constant, with a subsequent increase of the thickness of walls 15b and thus of the structural strength of the inner rotor 8.

Claims

1. A pendulum pump, in particular to feed oil under pressure to a final device, comprising an outer rotor (11) mounted to rotate around a first rotation axis (12); an inner rotor (8) mounted inside the outer rotor (11) to rotate around a second rotation axis (10) which is parallel to the first rotation axis (12); and a plurality of dragging pendulums (13), which are interposed between the two rotors (8, 11), are rotationally coupled to one of the rotors (8, 11), and are slidingly coupled to respective guide recesses (15) obtained on the other rotor (8, 11); each guide recess (15) being limited by two lateral sides (15a), which are parallel to each other and to the rotation axes

(12, 10), and are connected together by a bottom wall (15c) of the guide recess (15) itself; and **characterized in that** each guide recess (15) has a symmetry plane (P) which is parallel to the corresponding lateral sides (15a), and is tangent to a circumference (C) which is concentric with respect to the rotation axis (10, 12) of the rotor (8, 11) having the guide recesses (15).

2. A pendulum pump according to claim 1, wherein the symmetry planes (P) of all the guide recesses (15) are tangent to the same circumference (C). 10
3. A pendulum pump according to claim 1 or 2, wherein each symmetry plane (P) is perpendicular to the bottom wall (15c) of the corresponding recess (15). 15
4. A pendulum pump according to any one of the preceding claims, wherein the lateral sides (15a) and the bottom wall (15c) of each recess (15) are flat. 20
5. A pendulum pump according to any one of the preceding claims, wherein the dragging pendulums (13) are rotationally fitted to the outer rotor (11) and the guide recesses (15) are obtained on the inner rotor (8). 25
6. A pendulum pump according to claim 5, wherein the circumference (C) is concentric with respect to the second rotation axis (10). 30
7. A pendulum pump according to any one of the preceding claims and further comprising a drive shaft (9), which is engaged through the inner rotor (8) in an angularly fixed manner, in order to move the inner rotor (8) around the second rotation axis (10). 35
8. A pendulum pump according to any one of the preceding claims, wherein said first and second rotation axes (10, 12) are parallel and eccentric to each other. 40
9. A pendulum pump according to any one of the preceding claims, wherein each dragging pendulum (13) and the corresponding recess (15) are sized so that the dragging pendulum (13) is always in contact with the lateral sides (15a) of the recess (15) itself. 45
10. A pendulum pump according to any one of the preceding claims, wherein each dragging pendulum (13) is coupled to the corresponding recess (15) in a substantially fluid-tight manner, and thus defines a first variable-volume chamber (16) together with the two rotors (8, 11) and with each adjacent dragging pendulum (13), and defines a second variable-volume chamber (17) together with the corresponding guide recess (15); said first and second variable-volume chambers (16, 17) connecting, during the rotation of the two rotors (8, 11) around the rotation

axes (10, 12) thereof, to at least one intake (20) and to at least one delivery (21) of the pendulum pump.

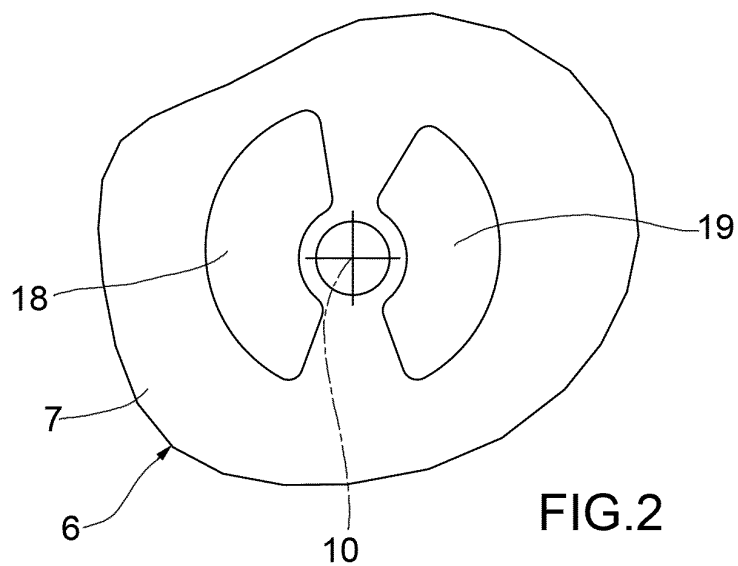
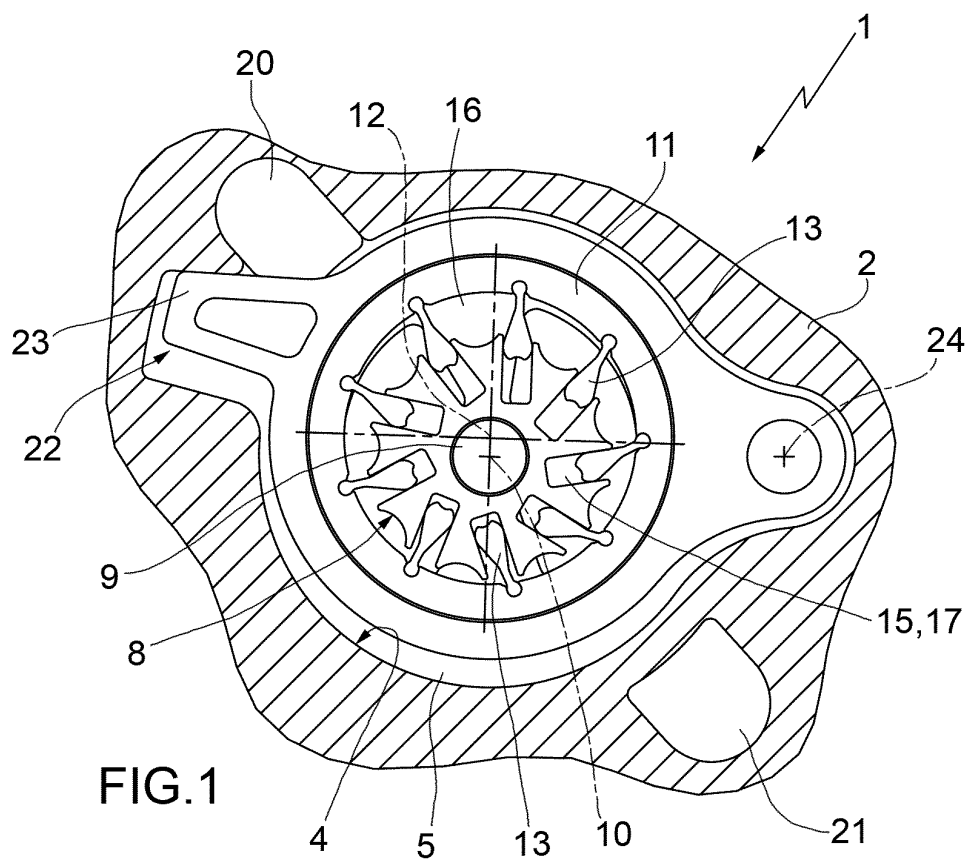
5 Patentansprüche

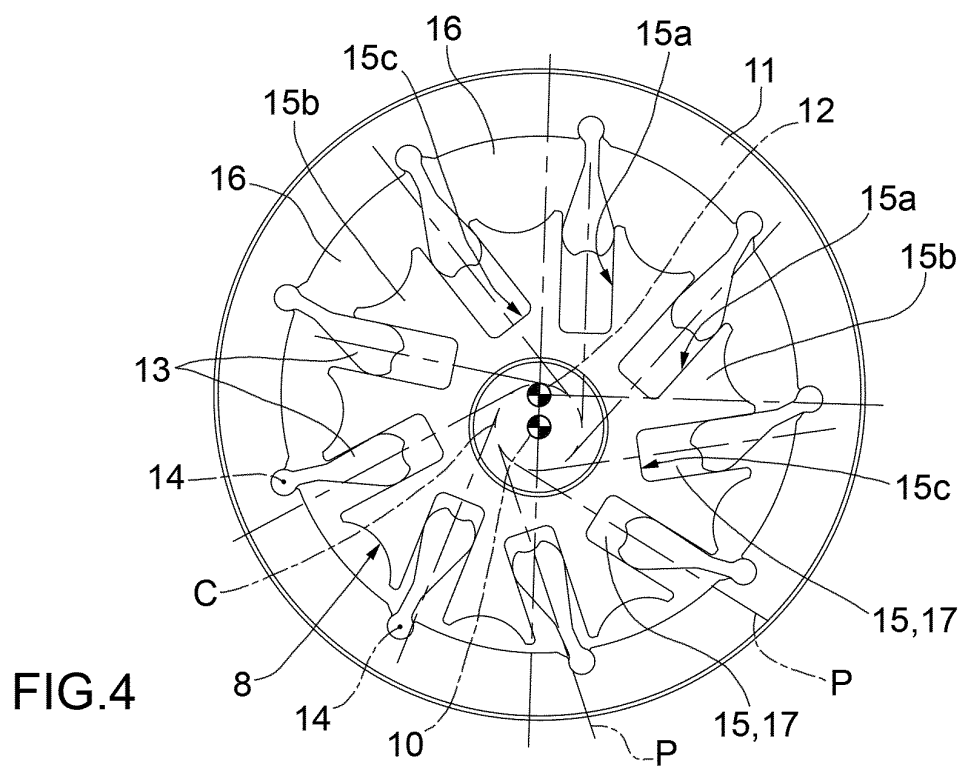
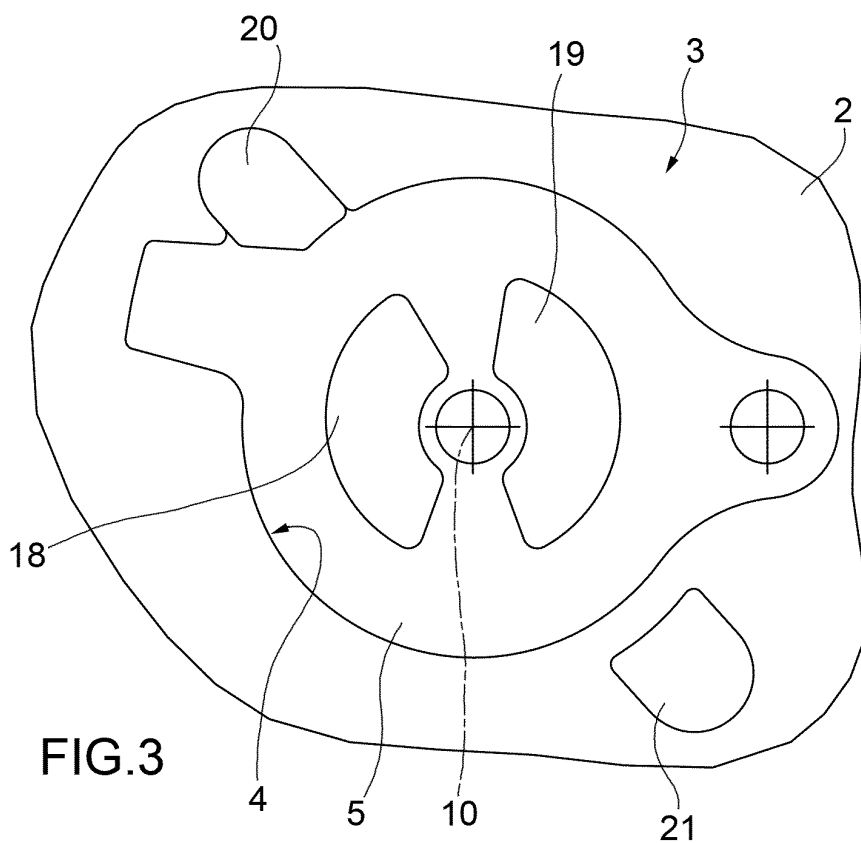
1. Pendelpumpe, insbesondere zum Zuführen von Drucköl zu einer Endvorrichtung, die aufweist: einen Außenrotor (11), der montiert ist, so dass er sich um eine erste Drehachse (12) dreht; einen Innenrotor (8), der innerhalb des Außenrotors (11) montiert ist, so dass er sich um eine zweite Drehachse (10) dreht, die parallel zu der ersten Drehachse (12) ist; und mehrere Zugpendel (13), die zwischen den zwei Rotoren (8, 11) eingefügt sind, drehbar mit einem der Rotoren (8, 11) gekoppelt sind und gleitend mit jeweiligen Führungsaussparungen (15) gekoppelt sind, die auf dem anderen Rotor (8, 11) erhalten werden; wobei jede Führungsaussparung (15) durch zwei seitliche Seiten (15a) begrenzt wird, die parallel zueinander und zu den Drehachsen (12, 110) sind und durch eine Bodenwand (15c) der Führungsaussparung (15) selbst miteinander verbunden sind; und **dadurch gekennzeichnet, dass** jede Aussparung (15) eine Symmetrieebene (P) hat, die parallel zu den entsprechenden seitlichen Seiten (15a) und an einen Umfang (C) tangential ist, der in Bezug auf die Drehachse (10, 12) des Rotors (8, 11) mit den Führungsaussparungen (15) konzentrisch ist.
2. Pendelpumpe nach Anspruch 1, wobei die Symmetrieebenen (P) aller der Führungsaussparungen (15) an den gleichen Umfang (C) tangential sind.
3. Pendelpumpe nach Anspruch 1 oder 2, wobei jede Symmetrieebene (P) senkrecht zu der Bodenwand (15c) der entsprechenden Aussparung (15) ist.
4. Pendelpumpe nach einem der vorhergehenden Ansprüche, wobei die seitlichen Seiten (15a) und die Bodenwand (15c) jeder Aussparung (15) flach sind.
5. Pendelpumpe nach einem der vorhergehenden Ansprüche, wobei die Zugpendel (13) drehbar an den Außenrotor (11) montiert sind und die Führungsaussparungen (12) auf dem Innenrotor (8) erhalten werden.
6. Pendelpumpe nach Anspruch 5, wobei der Umfang (C) in Bezug auf die zweite Drehachse (10) konzentrisch ist.
7. Pendelpumpe nach einem der vorhergehenden Ansprüche, der ferner eine Antriebswelle (9) aufweist, die durch den Innenrotor (8) in einer winkelig festen Weise in Eingriff ist, um den Innenrotor (8) um die zweite Drehachse (10) herum zu bewegen.

8. Pendelpumpe nach einem der vorhergehenden Ansprüche, wobei die ersten und zweiten Drehachsen (10, 12) parallel und exzentrisch zueinander sind.
9. Pendelpumpe nach einem der vorhergehenden Ansprüche, wobei jedes Zugpendel (13) und die entsprechende Aussparung (15) derart dimensioniert ist, dass das Zugpendel (13) immer in Kontakt mit den seitlichen Seiten (15a) der Aussparung (15) selbst ist.
10. Pendelpumpe nach einem der vorhergehenden Ansprüche, wobei jedes Zugpendel (13) in einer im Wesentlichen fluiddichten Weise mit der entsprechenden Aussparung (15) gekoppelt ist und somit zusammen mit den zwei Rotoren (8, 11) und mit jedem benachbarten Zugpendel (13) eine erste Kammer (16) mit veränderlichem Volumen definiert und zusammen mit der entsprechenden Führungsaussparung (15) eine zweite Kammer (17) mit veränderlichem Volumen definiert; wobei die ersten und zweiten Kammern (16, 17) mit veränderlichem Volumen während der Drehung der zwei Rotoren (8, 11) um ihre Drehachsen (10, 12) mit wenigstens einem Einlass (20) und mit wenigstens einer Abgabe (21) der Pendelpumpe verbinden.

Revendications

1. Pompe à balancier, en particulier pour fournir de l'huile sous pression à un dispositif final, comprenant un rotor extérieur (11) monté pour tourner autour d'un premier axe de rotation (12) ; un rotor intérieur (8) monté dans le rotor extérieur (11) pour tourner autour d'un second axe de rotation (10) qui est parallèle au premier axe de rotation (12) ; et une pluralité de balanciers traînants (13) qui sont interposés entre les deux rotors (8, 11), sont couplés en rotation à l'un des rotors (8, 11) et sont couplés en coulissement aux évidements de guidage respectifs (15) obtenus sur l'autre rotor (8, 11) ; chaque évidement de guidage (15) étant limité par deux côtés latéraux (15a) qui sont parallèles l'un à l'autre et aux axes de rotation (12, 10), et sont reliés ensemble par une paroi inférieure (15c) de l'évidement de guidage (15) lui-même ; et **caractérisée en ce que** chaque évidement de guidage (15) a un plan de symétrie (P) qui est parallèle aux côtés latéraux correspondants (15a), et est tangent à une circonférence (C) qui est concentrique par rapport à l'axe de rotation (10, 12) du rotor (8, 11) présentant les évidements de guidage (15).
2. Pompe à balancier selon la revendication 1, dans laquelle les plans de symétrie (P) de tous les évidements de guidage (15) sont tangents à la même circonférence (C).
3. Pompe à balancier selon la revendication 1 ou 2, dans laquelle chaque plan de symétrie (P) est perpendiculaire à la paroi inférieure (15c) de l'évidement correspondant (15).
4. Pompe à balancier selon l'une quelconque des revendications précédentes, dans laquelle les côtés latéraux (15a) et la paroi inférieure (15c) de chaque évidement (15) sont plats.
5. Pompe à balancier selon l'une quelconque des revendications précédentes, dans laquelle les balanciers traînants (13) sont insérés en rotation sur le rotor extérieur (11) et les évidements de guidage (15) sont obtenus sur le rotor intérieur (8).
6. Pompe à balancier selon la revendication 5, dans laquelle la circonférence (C) est concentrique par rapport au second axe de rotation (10).
7. Pompe à balancier selon l'une quelconque des revendications précédentes, et comprenant en outre un arbre d'entraînement (9) qui est engagé par le rotor intérieur (8) de manière fixe angulairement afin de déplacer le rotor intérieur (8) autour du second axe de rotation (10).
8. Pompe à balancier selon l'une quelconque des revendications précédentes, dans laquelle lesdits premier et second axes de rotation (10, 12) sont parallèles et excentriques l'un par rapport à l'autre.
9. Pompe à balancier selon l'une quelconque des revendications précédentes, dans laquelle chaque balancier traînant (13) et l'évidement correspondant (15) sont dimensionnés de sorte que le balancier traînant (13) soit toujours en contact avec les côtés latéraux (15a) de l'évidement (15) lui-même.
10. Pompe à balancier selon l'une quelconque des revendications précédentes, dans laquelle chaque balancier traînant (13) est couplé à l'évidement (15) correspondant de manière sensiblement étanche au fluide et définit ainsi une première chambre à volume variable (16) conjointement avec les deux rotors (8, 11) et avec chaque balancier traînant (13) adjacent, et définit une seconde chambre à volume variable (17) conjointement avec l'évidement de guidage (15) correspondant ; lesdites première et seconde chambres à volume variable (16, 17) étant reliées, pendant la rotation des deux rotors (8, 11) autour des axes de rotation (10, 12) de ceux-ci, à au moins une admission (20) et à au moins une sortie (21) de la pompe à balancier.





REFERENCES CITED IN THE DESCRIPTION

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