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# (54) A ROTARY POSITIVE DISPLACEMENT PUMP

ROTATIONSVERDRÄNGERPUMPE

POMPE À DÉPLACEMENT POSITIF ROTATIF

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## Description

TECHNICAL FIELD

**[0001]** The present invention relates to rotary positive displacement pump. The invention further relates to a method for assembling a rotary positive displacement pump and to a method for providing maintenance to a positive displacement pump.

BACKGROUND

**[0002]** In the field of rotary positive displacement pumps, there is a continuous demand for further improved reliability and reduced maintenance effort.

**[0003]** For example, rotary positive displacement pumps with front loading seals are known and provides simplified maintenance.

**[0004]** US 2014/065002 A1 discloses a positive displacement pump in form of a circumferential piston pump with a front-loading seal arrangement. The pump includes a gear case with a front end that supports a pump body on a rear side of the pump body. An input torque is translated and divided within the gear case into a pair of counter-rotational torques that are provided to a pair of output shafts on the front end of the gear case. The pump body houses a pair of intermeshed rotors that are received in an internal cavity of the pump body. The internal cavity is defined by the walls of the pump body and the cover. A fluid inlet and a fluid outlet are disposed on respective opposing lateral sidewalls of the pump body. A pair of hubs protrude from the rear wall of the pump body. The pair of hubs each have an axially-extending opening in which one of the pair of output shafts of the gear case is received. The pair of output shafts are keyed such that the rotor received on the output shaft can be rotationally driven by the rotation of the shafts. The rotor is received onto the shaft by telescopically inserting an opening of a central portion of the rotor onto the shaft such that the central portion of the rotor is disposed between the hub and the shaft. The rotors are spun in opposite directions about their respective axes of rotation. Each rotor includes two wings. The rotor includes a disc-shaped portion on the forward axial end of the rotor that links the central portion of the rotors to the wings. In order to axially secure the rotor on the shaft, a fastening element engages both the rotor and the shaft. On the end of the shaft furthest from the gear case, the shaft has a threaded portion and a nut is fastened to the threaded portion so as to secure the rotor on the shaft. The central portion of the rotor has an end surface abutting an axial abutment surface of the output shaft. The central portion of the rotor extends into the hub. The end surface of the central portion and the axial abutment surface of the output shaft are located inside the hub.

**[0005]** US 2015/064041 A1 discloses a similar positive displacement pump as US 2014/065002 A1 where the end surface of the central portion of the rotor has a groove receiving an o-ring. The end surface of the central portion provided with the o-ring abuts the axial abutment surface of the output shaft. The central portion of the rotor extends into the hub. The end surface of the central portion provided with the o-ring and the axial abutment surface of the output shaft are located inside the hub. However, front loading seals may under certain conditions result in reduced long term reliability and pumping efficiency and/or increased manufacturing cost.

**[0006]** There is thus a need for a further improved rotary positive displacement pump in terms of improved reliability, serviceability and pumping efficiency and/or reduced manufacturing cost.

SUMMARY

**[0007]** An object of the present invention is to provide a rotary positive displacement pump, a method for assembling a rotary positive displacement pump and a method for providing maintenance to a positive displacement pump, where the previously mentioned problems are avoided. This object is at least partly achieved by the features of the independent claims.

**[0008]** In particular, according to a first aspect of the present invention, there is provided a rotary positive displacement pump for pumping a fluid product. The pump has a front side and a rear side and comprises a main body providing rotational support to a pair of parallel, axially extending, shafts with gears in constant mesh condition, such that the pair of shafts are arranged to rotate in opposite directions. The pump further comprises a rotor case body connected to a front side of the main body, wherein the rotor case body has a stationary interior pumping cavity defined by an axial rear wall, a circumferential side wall, and a removable front cover, a fluid product inlet opening, a fluid product outlet opening, and a pair of cylindrical rotor case hubs extending from the rear wall, wherein each cylindrical rotor case hub receives internally one of the pair of shafts. The further comprises a pair of rotors, each having at least one rotor wing and a rotor drive element that is mounted torque proof on a rotor seat at an end region of one of the pair of shafts, wherein each of the pair of rotor seats has an axial abutment surface facing in an axial direction towards a front side of the pump and a mounting surface facing radially outwards. The pump further comprises a pair of fasteners, preferably threaded fasteners, each being engaged with a mating section, preferably a threaded section, at the end region of one of the pair of shafts, and each exerting an axial clamping force on one of the rotor drive elements against the axial abutment surface of one of the rotor seats, wherein the axial abutment surface of each rotor seat is located axially outside, towards a front side, of the associated hub.

**[0009]** Moreover, according to a second aspect of the present invention, there is provided a method for assembling a rotary positive displacement pump for pumping a fluid product, the pump having a front side and a rear side. The method comprises providing a main body giving rotational support to a pair of parallel, axially extending, shafts with gears in constant mesh condition, such that the pair of shafts are arranged to rotate in opposite directions. The method further comprises providing a rotor case body having: a stationary interior pumping cavity defined by an axial rear wall, a circumferential side wall, and a removable front cover; a fluid product inlet opening; a fluid product outlet opening; and a pair of cylindrical rotor case hubs extending from the rear wall, wherein the rotor case body is located on a front side of the main body, and wherein each cylindrical rotor case hub receives internally one of the pair of shafts. The method additionally comprises providing a pair of rotors, each having at least one rotor wing and a rotor drive element. Moreover, the method comprises mounting each rotor drive element torque proof on a rotor seat at an end region of one of the pair of shafts, wherein each rotor seat has an axial abutment surface facing in an axial direction towards a front side of the pump and mounting surface facing radially outwards, and mounting a fastener, preferably a threaded fastener, on an end region of each of the pair of shafts. Finally, the method comprises tightening the fasteners for exerting an axial clamping force on each rotor drive element against the axial abutment surface of one of the rotor seats, wherein the axial abutment surface of each rotor seat is located axially outside, towards a front side, of the associated hub, and mounting the removable front cover on the rotor case body.

**[0010]** In addition, according to a third aspect of the present invention, there is provided a method for assembling a rotary positive displacement pump as described before, the method further comprises mounting a first part of a first pair of seal assemblies, such as mechanical face-seal assemblies, in a front seal seat of each cylindrical rotor case hub, and mounting a second part of the first pair of seal assemblies, such as mechanical face-seal assemblies, in a rotor seal seat of each rotor drive element.

**[0011]** In addition, according to a fourth aspect of the present disclosure, there is provided a method for providing maintenance to a sealing arrangement of a rotary positive displacement pump. The pump has a front side and a rear side and two parallel axially extending shafts, wherein each shaft is carrying a rotor having at least one rotor wing and a rotor drive element. The pump further has an interior pumping cavity including a pair of cylindrical rotor case hubs extending towards the front side from a rear wall of the interior pumping cavity, wherein each shaft has a rotor seat with an axial abutment surface facing in an axial direction towards a front side of the pump. The method comprises: removing a removable front cover of the pump, removing at least one of the pair of rotors from the associated shaft for enabling access to a sealing arrangement configured for preventing leakage along a gap between the associated shaft and the associated cylindrical rotor case hub, servicing the sealing arrangement, mounting the at least one removed rotor on the associated shaft and abutting the rotor drive element against the axial abutment surface of an associated rotor seat, wherein the axial abutment surface of each rotor seat is located axially outside, towards a front side, of the associated hub, and mounting the removable front cover on the pump.

**[0012]** The rotary positive displacement pump and associated method of assembly described above not only enables reduced maintenance effort by means of the front loading seals, due to the design wherein the axial abutment surface of each rotor seat is located axially outside, towards a front side, of the associated hub, the rotary positive displacement pump and associated method of assembly described above additionally enable increased dimension of the first and second shafts without negative effect on pumping volume or exterior pump dimensions.

**[0013]** In particular, increased dimension of the first and second shaft, i.e. increased diameter, has positive effects in many ways. For example, the increased dimension results in increased shaft stiffness. As a result, the shafts, rotors and/or rotor case body may be manufactured in less exotic materials without sacrificing operating reliability or risk for material fatigue. For example, conventional stainless steel, such as duplex stainless steel, may be used to a larger degree. In addition, thanks to the stiffer first and second shafts, the clearance between the rotor wings and the radial and axial walls of the stationary pumping cavity may be reduced, thereby resulting in reduced pump slippage and increased pumping efficiency.

**[0014]** Further advantages are achieved by implementing one or several of the features of the dependent claims.

**[0015]** In some example embodiments, a mounting portion of each rotor drive element is radially non-overlapping the associated cylindrical rotor case hub. Thereby, space for increased shaft diameter may be accomplished.

**[0016]** In some example embodiments, a mounting portion of each rotor drive element includes an axial abutment surface facing in an axial direction towards a rear side of the pump and a mounting surface facing radially inwards, and the axial abutment surface of each mounting portion is located axially outside, towards a front side, of the associated hub. Thereby, space for increased shaft diameter may be accomplished.

**[0017]** In some example embodiments, the mounting portion of each rotor drive element does not extend radially outside of an inner diameter of the associated cylindrical rotor case hub.

**[0018]** In some example embodiments, the torque proof connection between each of the rotor drive elements and the associated shaft is a splined or keyed connection. Thereby, a robust and reliable torque connection is accomplished.

**[0019]** In some example embodiments, each rotor drive element comprises an annular projection extending towards the rear side of the pump, wherein the annular projection comprises the axial abutment surface, and wherein each annular projection is arranged on a portion of the associated shaft.

**[0020]** In some example embodiments, the pump further comprises a first pair of seal assemblies, such as mechanical face-seal assemblies, each having a first part and a second part with sealing surfaces pressed against each other, and each arranged to prevent fluid product from escaping the stationary pumping cavity and flowing along one of the shafts towards the rear side of the rotor case body. Thereby, a leakage-proof pump is accomplished.

**[0021]** In some example embodiments, each cylindrical rotor case hub has a front seal seat facing towards the front side of the pump, wherein the front seal seat is located at a front region of each rotor case hub, and wherein each front seal seat has the first part of one of the first pair of seal assemblies mounted therein. Thereby, front-loading of the seal is enabled.

**[0022]** In some example embodiments, the first part of each first pair of seal assemblies faces, as seen in the radial direction, a circumferential outer surface of a portion of the associated shaft. Thereby, a compact pump design with large diameter shafts is accomplished.

**[0023]** In some example embodiments, each rotor drive element has a rotor seal seat facing towards the rear side of the pump, wherein each rotor seal seat has the second part of one of the first pair of seal assemblies mounted therein. Thereby, the seals are easily accessible from the front side of the pump.

**[0024]** In some example embodiments, the rotary positive displacement pump is configured for front-loading of the first pair of seal assemblies. Thereby, improved serviceability is accomplished.

**[0025]** In some example embodiments, an exterior diameter of each shaft in an axial region of the front seal seat of each cylindrical rotor case hub is larger than an exterior diameter of each shaft in an axial region of, and in contact with, the mounting portion of each rotor drive element. Thereby, large diameter shafts are accomplished over a wider range.

**[0026]** In some example embodiments, the pump further comprises a second pair of seal assemblies, such as mechanical face-seal assemblies, each having a first part and a second part with sealing surfaces pressed against each other, and each arranged to prevent fluid product from flowing along the shaft towards the rear side of the rotor case body. Thereby, the sealing performance is further improved.

**[0027]** In some example embodiments, the method further comprising an intermediate step, performed before mounting the rotor drive elements to the shafts, of mounting a first part of a first pair of seal assemblies, such as mechanical face-seal assemblies, in a front seal seat of each cylindrical rotor case hub, and mounting a second part of the first pair of seal assemblies, such as mechanical face-seal assemblies, in a rotor seal seat of each rotor drive element.

**[0028]** The pump according to the invention can be arranged for pumping a variety of different product fluids, in particular product fluids commonly known in dairy, food, beverage, pharma and personal care markets.

**[0029]** In some example embodiments, the rotary positive displacement pump is a circumferential piston pump or a lobe pump. Preferably, the rotary positive displacement pump is a circumferential piston pump.

**[0030]** Further features and advantages of the invention will become apparent when studying the appended claims and the following description. The skilled person in the art realizes that different features of the present disclosure may be combined to create embodiments other than those explicitly described hereinabove and below, without departing from the scope of the present invention as defined by the appended claims.

## BRIEF DESCRIPTION OF DRAWINGS

**[0031]** The disclosure will be described in detail in the following, with reference to the attached drawings, in which

| | |
|---|---|
| Fig. 1 | shows schematically a side of a pump according to the invention, |
| Fig. 2 | shows schematically a front view of the pump according to the invention, |
| Fig. 3 | shows schematically a 3D view of an example embodiment of the rotor case hub, |
| Fig. 4 | shows schematically a 3D view of an example embodiment of a rotor, |
| Fig. 5 | shows schematically the functionality of the pump, |
| Fig. 6 | shows schematically a cross-section of a front portion of an example embodiment of the pump, |
| Fig. 7 | shows schematically a close-in view of a portion of figure 6, |
| Fig. 8 | shows schematically an alternative embodiment of the sealing arrangement, |
| Fig. 9 | shows schematically still an alternative embodiment of the sealing arrangement, |
| Fig. 10, 11 | show the basic steps of two example embodiments of the methods for assembling a pump according to the invention, and |
| Fig. 12 | show the basic steps of an example embodiments of a method for providing maintenance of a sealing arrangement of a pump according to the invention. |

## DESCRIPTION OF EXAMPLE EMBODIMENTS

**[0032]** Various aspects of the invention, will hereinafter be described in conjunction with the appended drawings to illustrate and not to limit the invention, wherein like designations denote like elements, and variations of the described aspects are not restricted to the specifically shown embodiments, but are applicable on other variations of the disclosure.

**[0033]** Figure 1 schematically shows a side view of a first example embodiment of the rotary positive displacement pump 1 for pumping a fluid product according to the invention.

**[0034]** The pump 1 has a main body 2 including rotational support 3 to first and second parallel shafts 4, 5, which extend in an axial direction 10. The rotational support 3 may for example be provided in form of a set of annular rolling bearings, each of which surrounds a shaft and is fastened to the main body 2. The first axially extending shaft 4 carries a first gear 6 and the second axially extending shaft 5 carries a second gear 7. The first and second gears 6, 7, i.e. gear wheels, are arranged in constant mesh condition, meaning that they are in constant gear engagement with each other. Moreover, since the first and second gears 6, 7 are in directing engagement with each other they rotate in opposite directions.

**[0035]** The main body 2 has an axial direction 10, a first lateral direction 11 that is perpendicular to the axial direction 10, and a second lateral direction 12 that is perpendicular to both the axial direction 10 and the first lateral direction 11. The main body further has a front side 13 and a rear side 14, as seen in the axial direction 10. An end portion 9 of one of the first and second shafts 4, 5, such as for example the first shaft 4, may extend out through a wall of the main body 2 in the rear side of the main body 2 for rotational connection with a rotational torque source, such as for example a motor, for powering the pump 1.

**[0036]** The main body 2 may be made of metal, such as for example cast iron, steel or aluminium alloy, and the first and second shafts 4, 5 may be made of steel.

**[0037]** The main body 2 may additionally include a support structure 8 for enabling attachment of the main body to an exterior support surface, for example by means of threaded bolts or other type of fasteners. The main body may be made in one piece or composed of multiple subparts.

**[0038]** In the example embodiment of the pump illustrated in figure 1, the pump 1 further comprises a rotor case body 15 connected to the main body 2 at the front side 13 of the main body 2. The rotor case body 15, which for example is made of stainless steel, may be removably fastened to the front side 13 of the main body 2 via a suitably fastening arrangement. For example, the rotor case body 15 may be clamped against the front side 13 of the main body 2 by means of a plurality of threaded bolts or nuts 16 or similar threaded members. Alternatively, the rotor case body 15 may be permanently attached to the front side 13 of the main body 2, of integrally formed within the main body 2.

**[0039]** The assembled pump 1 including the main body 2 and the rotor case body 15 has a front side 17 and a rear side 18, and the pump 1 of figure 1 is shown from a front side in figure 2. As can be seen in figure 2, the plurality of threaded bolts or nuts 16 used for clamping the rotor case body 15 may extending through the entire rotor case body 15 and by visible from the front side 17 of the pump 1.

**[0040]** In the example embodiment of figures 1 and 2, the rotor case body 15 comprises an axial rear wall 20, a circumferential side wall 21 and an axial front wall 22, which jointly defines a closed stationary interior pumping cavity.

**[0041]** Since the rotor case body 15 includes first and second rotors 23, 24 located within the interior pumping cavity, the rotor case body 15 is openable for enabling access to the interior pumping cavity. In the example embodiment of figure 1 and 2, this access is made possible by making the rotor case body 15 in two parts: a rotor case rear housing 25 including the axial rear wall 20 and circumferential side wall 21 of the rotor case body 15, and a front cover 26 including the axial front wall 22 of the rotor case body 15, wherein the removable front cover 26 is removably fastened to the rotor case rear housing 25 by suitable attachment arrangement.

**[0042]** A schematic 3D view of an example embodiment of a rotor case rear housing 25 according to the disclosure is provided in figure 3, as seen partly from a front side of the rotor case rear housing 25.

**[0043]** The removable front cover 26 may be clamped against the rotor case rear housing 25 by means of the same plurality of threaded bolts or nuts 16 that are used for clamping the rotor case body 15 against the front side 13 of the main body 2. Alternatively, separate attachment arrangements may be provided for attaching the front cover 26 to the rotor case rear housing 25.

**[0044]** In the example embodiment of figures 1-3, the rotor case body 15 further includes a fluid product inlet opening 30 for enabling a fluid product to enter, e.g. being sucked into, the interior pumping cavity, and a fluid product outlet opening 31 for enabling the fluid product to exit, e.g. being pumped out of, the interior pumping cavity.

**[0045]** As mention above, the rotor case body 15 furthermore includes the first and second rotors that are configured for generating the pumping functionality of the pump. The first rotor 23 is rotationally fastened to a front end of the first shaft 4 and the second rotor 24 is rotationally fastened to a front end of the second shaft 5. Consequently, the first and second rotors 23, 24 are configured to rotate in mutually opposite directions, as illustrated by solid arrows in figure 5.

**[0046]** The first and second rotors 23, 24, which may have substantially identical design, are schematically illustrated in figure 1 and 2, and a 3D view of a rotor, as seen partly from a rear side, is provided in figure 4. Each of the first and second rotors 23, 24 has at least one, and preferably a plurality of, rotor wings 32 and a rotor drive element 33 that is configured to be mounted torque proof on a rotor seat of an associated shaft 4, 5. In particular, the rotor seat is located at a front end region of each shaft 4, 5.

**[0047]** The rotor drive element 33 of each rotor 23, 24 may be substantially disc-shaped or sleeve-shaped and including a central hole or recess 44 for mounting on the associated shaft 4, 5. The hole or recess 44 may be defined by a cylindrical mounting surface 48 having splines 45, or by a non-circular mounting surface for enabling torque proof mounting of the rotor on the rotor seat of the associated shaft 4, 5. The rotor drive element 33 of each rotor 23, 24 may additionally include an annular rotor seal seat 46 facing towards the rear side 18 of the pump 1 and configured for housing a seal. The annular rotor seal seat 46 may for example be implemented in form of a groove machined or otherwise manufactured in a rearwards facing surface of the rotor drive element 33 of each rotor 23, 24.

**[0048]** With reference to figure 5, in this example embodiment of the pump 1, during operation of the pump 2, the rotors are configured to rotate in opposite directions with the same rotational speed. The rotors are configured to define a pumping volume within a space 35 restricted by the neighbouring rotor wings of the same rotor and the walls 20, 21, 22 of the interior pumping cavity. Moreover, during rotation of the rotors 23, 24, the fluid product is configured to be conveyed from the fluid product inlet opening 30, along an outer side of each rotor 23, 24 and to the fluid product outlet opening 32, illustrated by the dashed arrows in figure 5.

**[0049]** In particular, when the rotor wings (pistons) rotate around the circumference of the pumping cavity, this continuously generates a partial vacuum at the product inlet opening as the rotors unmesh, causing product fluid to enter the pump. The fluid is transported around the pumping cavity by the rotor wings, and is displaced as the rotor wings re-mesh, generating pressure at the discharge port. Direction of flow is reversible.

**[0050]** The specific form and number of rotor wings 32 may vary considerably and the specific rotor twin-wing design illustrated in figures 2, 4 and 5 is merely one example embodiment of rotor wings, and the pump may thus have rotors 23, 24 with other types of rotor wing designs according to the disclosure.

**[0051]** With reference to figure 3, the rotor case body 15 comprises a first cylindrical rotor case hub 36 extending from the rear wall 20, and second cylindrical rotor case hub 37 extending from the rear wall 20. The first and second hubs 36, 37 are essentially hollow cylindrical sleeves that are open towards both axial sides thereof. Moreover, an axial direction of each cylindrical hubs is aligned with the axial direction of the pump 1.

**[0052]** The first rotor case hub 36 is configured to receive the first shaft 4, and the second rotor case hub 37 is configured to receive the second shaft 5. In other words, in an assembled state, the first rotor case hub 36 is aligned with the first shaft 4, and the second rotor case hub 37 is aligned with the second shaft 5. The first and second hubs 36, 37 are thus displaced from each other in the first lateral direction 11.

**[0053]** Prior to assembly of the main body 2 with the rotor case body 15, the front ends of the first and second shafts 4, 5 protrude forwards beyond the front surface 13 of the main body. Subsequently, upon assembly of the main body 2 with the rotor case body 15, said front ends of the first and second shafts 4, 5 are inserted from a rear side into the first and seconds hubs, respectively, and a rear side of the rotor case body 15 comes into contact with the front surface 13 of the main body 2. In this state, the front ends of the first and second shafts 4, 5 extend through the complete axial length of the first and seconds hubs 36, 37, as schematically shown in figure 6.

**[0054]** More in detail, figure 6 shows a cross-sectional side view of a front portion of an example embodiment of the pump 1 in an assembled state including a front portion of the main body 2, the rotor case body 15 composed of the rotor case rear housing 25 and the front cover 26, threaded fasteners 16 for clamping the rotor case body 15 against the front surface 13 of the main body 2, and first and second rotors 23, 24 being mounted torque proof on the rotor seats 34 of the first and second shafts 4, 5, respectively.

**[0055]** Figure 6 also shows a space 35 that is restricted by the neighbouring rotor wings of the same rotor, the axial rear wall 20, the circumferential side wall 21, the axial front wall 22, and the first rotor case hub 36. Clearly, although not showed in figure 6, also the second rotor 24 defines spaces 35 between neighbouring rotor wings 32 of the same rotor 24.

**[0056]** In addition, figure 6 also shows that each of the first and second rotors 23, 24 are secured to the rotor seats 34 of the associated shaft 4, 5 by means of a fastener 38, preferably a threaded fastener, that is engaged with a mating section 39, preferably a mating threaded section, at an end region of the associated shaft 4, 5. Specifically, each of said fastener 38 is configured to exert an axial clamping force on a centre portion of the associated rotor 23, 24 for clamping the rotor 23, 24 against an axial abutment surface of the rotor seat of the shaft 4, 5.

**[0057]** Figure 6 further shows that each of the first and second rotor case hubs 36, 37 is provided with a annular sealing arrangement 40 for preventing fluid product located within the space 35 from leaking out along the first and second shafts 4, 5 towards the rear side of the rotor case body.

**[0058]** Each annular sealing arrangement 40 may for example be implemented in form of a seal assembly having two main sealing parts. A first annular sealing part is associated with the rotor case hub and a second annular sealing part is associated with the rotor. Preferably, the seal assembly is a mechanical face-seal assembly. Then, the first and second sealing parts are held in sealing contact against each other in the axial direction while allowing relative rotation. One or both of the first and/or second annular sealing parts may have square-shaped, L-shaped, I-shaped or P-shaped cross-sectional shape, or any other shape, as seen in a plane extending through a centre of the annular sealing arrangement 40 and aligned with the axial direction 10.

**[0059]** In general, mechanical face seal technology involves having one seal ring remaining stationary as a shaft with a corresponding mating seal ring rotates. Thus, a dynamic seal is established between the contact faces of the seal ring and mating seal ring. However, the sealing arrangement 40 may be implemented using other types of seals. For example, an elastic seal, such as an o-ring or lip seal, may be associated with the rotor case or rotor case hub thereof and a sleeve may be associated with the rotor. Optionally, the elastic seal may be mounted on a housing associated with the rotor case hub.

**[0060]** Figure 7 schematically shows an enlargement of the area 41 marked with dashed rectangle in figure 6 for better illustrating the details of the seat 34 of the first shaft 4, the first rotor 23, the sealing arrangement 40 and the first rotor case hub 36, according to an example embodiment of the pump. The dashed-dotted line 60 lines refers to a rotational centre axis of the first shaft 4. The same design applies also to the second rotor 24, the second shaft 5 and the second rotor case hub 37. However, the specific design of the sealing arrangement illustrated and described with reference to figure 6 and 7 merely represent example embodiments of the sealing arrangement and other configurations and implementations of the sealing arrangement are possible within the scope of the invention as defined by the present claims.

**[0061]** The rotor seat 34 of the first shaft 4 has an axial abutment surface 42 facing in an axial direction 10 towards a front side 17 of the pump 1 and a mounting surface 43 facing radially outwards, i.e. in a direction perpendicular to the axial direction 10. In the assembled state of the pump 1, a mounting portion 47 of each rotor drive element 33 is located in the rotor seat 34 of one of the first and second shafts 4, 5. The mounting portion 47 of each rotor drive element 33 is indicated by a dashed circle in figure 6.

**[0062]** The mounting surface 43 of the rotor seat 34 may be provided with splines, a key-connection, a non-cylindrical surface, or the like for rotational engagement with corresponding splines 45 or the like provided on an interior mounting surface 48 of the rotor drive element 33.

**[0063]** A threaded fastener 38, such as a nut, may be engaged with a mating threaded section 39, such as a threaded pin-shaped section, at the end region 49 of the shaft 4 and configured for axially pressing the rotor drive element 33 against the axial abutment surface 42 of the rotor seat 34. This may also be achieved by means of a screw or bolt, possibly accompanied by a disc (similar to a washer), screwed into a threaded axial hole at the end region 49 of the shaft 4.

**[0064]** The first annular sealing part 51 is located in a front seal seat 53 of the first hub 36, and the second annular sealing part 52 is located in the annular rotor seal seat 46 of the rotor drive element 33, which annular rotor seal set 46 is facing towards the rear side 18 of the pump 1. Moreover, a rearward facing sealing surface 54 of the second annular sealing part 52 is axially pressed against a corresponding forward facing sealing surface 55 of the first annular sealing part 51 via a suitable axial pressing arrangement, such as some type of spring or resilient element, in a conventional manner.

**[0065]** As a result, product fluid that has flowed from the interior pumping cavity and having entered a gap 57 between the first rotor case hub 36 and the rotor drive element 33 is prevented from flowing further, and in particular prevented from entering a gap 56 between the interior surface of first rotor case hub 36 and an exterior surface of the first shaft 4, because this could otherwise result in leakage of the product fluid out from the interior pumping cavity.

**[0066]** The location of the sealing arrangement 40 between the rotor 23, 24 and a front region of the associated rotor case hub 36, 37 also enables simplified maintenance because the sealing arrangement 40 is more accessible for maintenance thereof. In particular, access to the sealing arrangement 40 is accomplished by merely removing the removable front cover 26 and thereafter removing the first and/or second rotor 23, 24. Thereafter, the sealing arrangement 40 is fully accessible for cleaning, replacement or maintenance, or the like, all without the need for removing the entire rotor case body 15 from the main body 2. This is also referred to as front loading seals, or front loading sealing arrangement.

**[0067]** Furthermore, the rotary positive displacement pump 1 according to the invention, besides enabling reduced maintenance effort by means of the front loading seals, additionally enables improved reliability, improved pumping efficiency, improved cleanability and hygiene without disassembly, also called Clean In Place (CIP), and/or reduced manufacturing cost by means of increased dimension of the first and second shafts 4, 5, all without negative effect on pumping volume or exterior pump dimensions.

**[0068]** This is accomplished by a rotary positive displacement pump 1 for pumping a fluid product according to figures 1 - 7 of the present disclosure, wherein the pump 1 comprises a main body 2 that provides rotational support to a pair of oppositely rotating, parallel, axially extending, shafts 4, 5 with gears 6, 7 that are in constant mesh condition. The pump 1 further includes a rotor case body 15 connected to a front side 13 of the main body 2. The rotor case body 15 comprises a stationary interior pumping cavity defined by an axial rear wall 20, a circumferential side wall 21 and a removable front cover 26. The rotor case body 15 further comprises a fluid product inlet opening 30, a fluid product outlet opening 31 and a pair of cylindrical rotor case hubs 36, 37 extending from the rear wall 20, wherein each cylindrical rotor case hub 36, 37 receives internally one of the pair of shafts 4, 5.

**[0069]** The rotary positive displacement pump 1 further includes a pair of rotors 23, 24, each having at least one rotor wing 32, preferably a plurality of rotor wings 32, and a rotor drive element 33 that is mounted torque proof on a rotor seat 34 at an end region 49 of one of the pair of shafts 4, 5. The torque proof connection between each of the rotor drive elements 33 and the associated shaft 4, 5 may be a splined or keyed connection. Alternatively, the first and second shaft 4, 5 may have a non-cylindrical shape at said end region 49, such as triangular-shaped, square-shaped, polygon-shaped, oval-shaped, or the like, for enabling the desired torque proof connection between the rotor drive element 33 and the shaft 4, 5.

**[0070]** Moreover, each of the pair of rotor seats 34 has an axial abutment surface 42 facing in an axial direction 10 towards a front side 17 of the pump 1 and a mounting surface 43 facing radially outwards.

**[0071]** Furthermore, the pump 1 comprises a pair of fasteners 38, such as threaded fasteners 38, each being engaged with a mating section 39, such as a mating threaded section 39, at the end region 49 of one of the pair of shafts 4, 5, and each exerting an axial clamping force on one of the rotor drive elements 33 against the axial abutment surface 42 of one of the rotor seats 34, and the axial abutment surface 42 of each rotor seat 34 is located axially outside, towards a front side 17, of the associated hub 36, 37.

**[0072]** A length of the gap 57 between the axial abutment surface 42 of each rotor seat 34 and an axial end surface 66 of the associated hub 36, 37, in the axial direction 10, may for example be about 0.05 - 5 mm or more, or within a range of about 0.05 - 50 mm, specifically 0.1 -25 mm, more specifically 0.1 -10 mm, or even more specifically 0.1 - 5 mm, or yet more specifically 0.1 - 1 mm.

**[0073]** Consequently, since the axial abutment surface 42 of each rotor seat 34 is located axially outside, towards a front side 17, of the associated hub 36, 37, the first and second shafts 4, 5 may have a relatively large diameter 63 over a wider range 73, and in particular further towards the front side 17 of the pump 1, thereby enabling increased shaft stiffness without negative effect on pumping volume or exterior pump dimensions.

**[0074]** As mentioned above, increased shaft diameter 63 enables manufacturing of the shafts 4, 5 in less exotic materials without sacrificing operating reliability or risk for material fatigue. Moreover, stiffer shafts 4, 5 generally enables pump design with reduced clearance between the rotor wings 32 and the radial and axial walls 20, 21, 22 of the stationary pumping cavity because stiffer or larger diameter shafts typically result in reduced shaft deflection. Reduced rotor wing clearance may be directly linked with reduced pump slippage and thus increased pumping efficiency. Stiffer shafts 4, 5 also reduces the risk for undesired interference between the first and second rotors 23, 24 during pumping operation.

**[0075]** The rotary positive displacement pump 1 according to the invention thus not only enables reduced maintenance effort by means of the front loading seals, the rotary positive displacement pump 1 additionally enables increased dimension of the first and second shafts 4, 5, all without negative effect on pumping volume or exterior pump dimensions.

**[0076]** As a result of having the axial abutment surface 42 of each rotor seat 34 being located axially outside, towards a front side 17, of the associated hub 36, 37, a mounting portion 47 of each rotor drive element 33 is radially non-overlapping the associated cylindrical rotor case hub 36, 37.

**[0077]** The term "mounting portion" herein refers to the portion of the rotor drive element 33 that is radially limited on the inside by the interior mounting surface 48 of the hole or recess 44 of the rotor drive element 33 and on the outside by the annular rotor seal seat 46. Hence, the mounting portion 47 of each rotor drive element 33 does certainly not extend radially outside of an inner diameter 62 of the associated cylindrical rotor case hub 36, 37. By having a mounting portion 47 of each rotor drive element 33 radially non-overlapping the associated cylindrical rotor case hub 36, 37, larger diameter shafts 4, 5 may be used over a wider range within the rotor case body 15, as seen in the axial direction 10.

**[0078]** The mounting portion 47 of each rotor drive element 33 includes an axial abutment surface 61 facing in an axial direction 10 towards a rear side 18 of the pump 1 and a mounting surface 48 facing radially inwards. The axial abutment surface 61 of each mounting portion is located axially outside, towards a front side 17, of the associated hub 36, 37, in particular axially outside of the axial end surface 66 of the associated hub 36, 37. Thereby, larger diameter shafts 4, 5 may be used over a wider range within the rotor case body 15, as seen in the axial direction 10.

**[0079]** In figure 7, a large diameter portion 73 of the first shaft 4 is indicated and extends forwards until the axial abutment surface 42 of the rotor seat 34, and a smaller diameter portion 74 of the first shaft is indicated and extends from the axial abutment surface 42 of the rotor seat 34 to a front end of the first shaft 4.

**[0080]** Consequently, an exterior diameter 63 of each shaft 4, 5 in an axial region of the front seal seat 53 of each cylindrical rotor case hub 36, 37, is larger than an exterior diameter 64 of each shaft 4, 5 in an axial region of, and in contact with, the mounting portion 47 of each rotor drive element 33.

**[0081]** The mounting portion 47 of each rotor drive element 33 comprises an annular projection 65 extending towards the rear side 18 of the pump 1, wherein the annular projection 65 comprises the axial abutment surface 61 of the rotor drive element 33, and wherein the annular projection 65 of each rotor drive element 33 is arranged on a portion of the associated shaft 4, 5, namely on the mounting surface 43 of the rotor seat 34.

**[0082]** With reference to figures 6 and 7, the pump 1 may comprise a sealing arrangement 40 in form of a first pair of seal assemblies, such as mechanical face-seal assemblies, i.e. one seal assembly associated with the first rotor case hub 36 and one seal assembly associated with the second rotor case hub 37.

**[0083]** As mentioned above, each seal assembly may include a first part 51 and a second part 52 with sealing surfaces 54, 55 pressed against each other, and each seal assembly may be arranged to prevent fluid product from escaping the stationary pumping cavity and flowing along one of the shafts 4, 5 towards the rear side of the rotor case body 15.

**[0084]** Each cylindrical rotor case hub 36, 37 has a front seal seat 53 facing towards the front side 17 of the pump 1. The front seal seat 53 is located at a front region of each rotor case hub 36, 37, and each front seal seat 53 has the first part 51 of one of the first pair of seal assemblies mounted therein.

**[0085]** More in detail, the front seal seat 53 may correspond to a recess having at least an axial support surface 67 facing towards a front side 17 of the pump 1 for providing an axial support to the first sealing part 51. In addition, the recess of the front seal seat 53 may include a radial support surface 68 facing towards the associated shaft 4, 5, for providing radial support to the first sealing part 51.

**[0086]** As a result of the location of the front seal seat 53 adjacent the axial end surface 66 of the associated hub 36, 37, the first sealing part 51 of each first pair of assemblies faces, as seen in the radial direction, a circumferential outer surface 71 of a portion of the associated shaft 4, 5.

**[0087]** In particular, the first sealing part 51 of each first pair of seal assemblies may even face, as seen in the radial direction, a circumferential outer surface 71 of the large diameter portion 73 of the associated shaft 4, 5.

**[0088]** Each rotor drive element 33 has a rotor seal seat 46 facing towards the rear side 18 of the pump 1, and each rotor seal seat 46 has the second part 52 of one of the first pair of seal assemblies mounted therein.

**[0089]** The rotor seal seat 46, which may be implemented in form of a groove or recess in a rearwards facing surface of the rotor drive element 33 of each rotor 23, 24, may include an axial support surface 69 facing towards a rear side 18 of the pump 1 for providing axial support to the second sealing part 52. In addition, the groove or recess of the rotor seal seat 46 may include at least one radial support surface 70 facing radially inwards and/or outwards for providing radial support to the second sealing part 52.

**[0090]** A further embodiment of the sealing arrangement 40 is schematically illustrated in figure 8, wherein some more details of an example implementation are included. For example, the sealing arrangement 40 may include a first elastic sealing ring 75 sandwiched between a rear side of the first sealing part 51 and the axial support surface 67 and/or radial support surface 68 of the front seal seat 53 for improved sealing performance and providing more flexibility in terms of positioning and tolerances of the first sealing part 51. Moreover, the first sealing part 51 may be rotationally fixed relative the first rotor case hub 36 for preventing any relative rotation between the first sealing part 51 and first rotor case hub 36. For example, the rotational connection may be accomplished with a pin 76 or the like connected to the first rotor case hub 36 and configured to interact with the first sealing part 51 for preventing any relative rotation of the first sealing part 51 and first rotor case hub 36.

**[0091]** The sealing arrangement 40 may also include a second elastic sealing ring 77 sandwiched between the second sealing part 52 and the rotor seal seat 46 for improved sealing performance and providing more flexibility in terms of positioning and tolerances of the first sealing part 51. One of the first and second sealing parts 51, 52, for example the second sealing part 52 as illustrated in figure 8, may additionally be axially preloaded with an axial spring 78.

**[0092]** Similar to above, also the second sealing part 52 may be rotationally fixed relative the rotor 23, 24 for preventing any relative rotation between the second sealing part 52 and the rotor 23, 24, for example by means of a pin 79 or the like rotationally connected to the rotor 23, 24 and configured to interact with the second sealing part 51 for preventing any relative rotation.

**[0093]** Still a further embodiment of the sealing arrangement 40 is schematically illustrated in figure 9, wherein the sealing arrangement 40 further comprises a second pair of seal assemblies, such as mechanical face-seal assemblies. Hence, each rotor case hub 36, 37 is provided with two internal seal assemblies, a first seal assembly 80 located adjacent the front end of the rotor case hub 36, 37, and a second seal assembly 81 arranged further towards the rear side 18 of the pump 1. The first seal assembly in figure 9 may have the same configuration as described with reference to figure 8.

**[0094]** Each second seal assembly 81 of the second pair of seal assemblies, such as mechanical face-seal assemblies, includes a first sealing part 82 having a first sealing surface 84, and a second sealing part 83 having a second sealing surface 85 pressed against each other, and each second seal assembly 81 is arranged to prevent fluid product from flowing along the shaft towards the rear side of the rotor case body 15.

**[0095]** The second seal assembly 81 may include a first elastic sealing ring 86 sandwiched between a rear side of the first sealing part 82 and an axial support surface 87 of the shaft 4 for improved sealing performance and providing more flexibility in terms of positioning and tolerances of the first sealing part 82. Moreover, the first sealing part 82 may be rotationally fixed relative the shaft 4 for preventing any relative rotation between the first sealing part 82 and first shaft 4. For example, the rotational connection may be accomplished with a pin 88 or the like connected to the first shaft 4 and configured to interact with the first sealing part 82 for preventing any relative rotation there between.

**[0096]** The second seal assembly 81 may also include a second elastic sealing ring 89 sandwiched between the second sealing part 83 and the first rotor case hub 36 for improved sealing performance and providing more flexibility in terms of positioning and tolerances of the second sealing part 83. One of the first and second sealing parts 82, 83, for example the second sealing part 83 as illustrated in figure 9, may additionally be axially preloaded with an axial spring 90.

**[0097]** Similar to above, also the second sealing part 83 may be rotationally fixed relative the first rotor case hub 36 for preventing any relative rotation there between, for example by means of a pin 91 or the like connected to the first rotor case hub 36.

**[0098]** However, the second pair of seal assemblies may be implemented using other types of seals. For example, an elastic seal, such as an o-ring or lip seal, may be associated with the rotor case or rotor case hub thereof and a sleeve may be associated with the shaft. Optionally, the elastic seal may be mounted on a housing associated with the rotor case or rotor case hub thereof.

**[0099]** The pump shown in the drawings is a circumferential piston pump.

**[0100]** The disclosure also relates to a method of assembling a rotary positive displacement pump for pumping a fluid product as described above. With reference to figure 10, the method comprises a first step S1 of providing a main body 2 giving rotational support 3 to a pair of parallel, axially extending, shafts 4, 5 with gears 6, 7 in constant mesh condition, such that the pair of shafts 4, 5 are arranged to rotate in opposite directions. The method further comprises a second step S2 of providing a rotor case body having a stationary interior pumping cavity defined by an axial rear wall, a circumferential side wall, and a removable front cover, a fluid product inlet opening, a fluid product outlet opening, and a pair of cylindrical rotor case hubs extending from the rear wall, wherein the rotor case body 15 is located on a front side 13 of the main body 2, and wherein each cylindrical rotor case hub 36, 37 receives internally one of the pair of shafts 4, 5. In addition, the method comprises a third step S3 of providing a pair of rotors, each having at least one rotor wing, preferably a plurality of rotor wings, and a rotor drive element. Moreover, the method comprises a fourth step S4 of mounting each rotor drive element torque proof on a rotor seat at an end region of one of the pair of shafts, wherein each rotor seat has an axial abutment surface facing in an axial direction towards a front side of the pump and mounting surface facing radially outwards. Finally, the method comprises a fifth step S5 of mounting a fastener 38, such as a threaded fastener 38, on an end region of each of the pair of shafts 4, 5, a sixth step S6 of tightening the pair of fasteners for exerting an axial clamping force on each rotor drive element against the axial abutment surface of one of the rotor seats, wherein the axial abutment surface of each rotor seat is located axially outside, towards a front side, of the associated hub, and a seventh step S7 of mounting the removable front cover on the rotor case body.

**[0101]** Clearly, the consecutive order of at least some of the steps may change without in significant change of effect, such as for example in particular the first, second and third steps.

**[0102]** In addition to above, the method may further comprise an intermediate step, performed before mounting the rotor drive elements to the shafts, of mounting a first part of a first pair of seal assemblies, such as mechanical face-seal assemblies, in a front seal seat of each cylindrical rotor case hub, and mounting a second part of the first pair of seal assemblies, such as mechanical face-seal assemblies, in a rotor seal seat of each rotor drive element.

**[0103]** Here again the consecutive order of at least some of the steps may change without a significant change of effect. For example, the step of mounting the second part 52 of the first pair of seal assemblies in the rotor seal seat of each rotor drive element 33 may be performed any time after having provided the rotor.

**[0104]** The disclosure also relates to another method of assembling a rotary positive displacement pump, such as a circumferential piston pump or rotary lobe pump, for pumping a fluid product as described above. With reference to figure 11, the method comprises a first step R1 of providing a pump having two parallel axially extending shafts, an interior pumping cavity and a pair of cylindrical rotor case hubs extending towards the front side from a rear wall of the interior pumping cavity. The method further comprises a second step R2 providing a pair of rotors, each having at least one wing, preferably a plurality of wings, connected to a central rotor drive element, and a third step R3 of mounting a first part of a first pair of seal assemblies, such as mechanical face-seal assemblies, in a front seal seat of each cylindrical rotor case hub, and mounting a second part of the first pair of seal assemblies, such as mechanical face-seal assemblies, in a rotor seal seat of each rotor drive element. The wing(s) may in case of a lobe pump be denoted lobe(s). The method additionally comprises a fourth step R4 of mounting one of the pair of rotors on each shaft, wherein each shaft has a rotor seat with an axial abutment surface facing in an axial direction towards a front side of the pump. Finally, the method comprises a fifth step R5 of abutting each rotor drive element against the axial abutment surface of an associated rotor seat, wherein the axial abutment surface of each rotor seat is located axially outside, towards a front side, of the associated hub, and a sixth step R6 mounting a removable front cover on the pump.

**[0105]** In addition to above, the disclosure also relates to a method of providing maintenance to a sealing arrangement 40 of a rotary positive displacement pump 1 as described above. With reference to figures 1 - 7, the rotary positive displacement pump 1 has a front side 17 and a rear side 18, two parallel axially extending shafts 4, 5 each carrying a rotor 23, 24 having at least one rotor wing 32, preferably a plurality of rotor wings 32, and a rotor drive element 33. The rotary displacement pump 2 further has an interior pumping cavity including a pair of cylindrical rotor case hubs 36, 37 extending towards the front side 17 from a rear wall of the interior pumping cavity, wherein each shaft 4, 5 has a rotor seat 34 with an axial abutment surface 42 facing in an axial direction towards a front side 17 of the pump 1. With reference to figure 12, the method comprises a first step T1 of removing a removable front cover 26 of the pump 1, and a second step T2 of removing at least one of the pair of rotors 23, 24 from the associated shaft 4, 5 for enabling access to a sealing arrangement 40 configured for preventing leakage along a gap 56 between the associated shaft 4, 5 and the associated cylindrical rotor case hub 36, 37. The method comprises a third step T3 of servicing the sealing arrangement 40, and a subsequent fourth step T4 mounting the at least one removed rotor 23, 24 on the associated shaft 4, 5 and abutting the rotor drive element 33 against the axial abutment surface of an associated rotor seat 34, wherein the axial abutment surface of each rotor seat 34 is located axially outside, towards a front side 17, of the associated hub 36, 37. Finally, the method comprises a fifth step T5 of mounting the removable front cover 26 on the pump 1.

**[0106]** Clearly, the method of providing maintenance to a sealing arrangement 40 of the rotary positive displacement pump 1 may include steps of removing both the first and second rotors 23, 24 from the associated shafts 4, 5, servicing of the sealing arrangements 40 associated with both the first and second rotors 23, 24, and subsequent remounting of both the first and second previously removed rotors 23, 24 on the associated first and second shafts 4, 5 while abutting each rotor drive element 33 against the axial abutment surface of the associated rotor seat 34, wherein the axial abutment surface of each rotor seat 34 is located axially outside, towards a front side 17, of the associated hub 36, 37. Many additional alternative sequences for performing the maintenance steps of the pump are possible, such as removing the first rotor, servicing its sealing arrangement and mounting of the first rotor, and subsequently performing the corresponding steps of the second rotor and its sealing arrangement 40, or still other sequences resulting from other mixing of the steps/actions of the method.

**[0107]** The term "enabling access to a sealing arrangement 40" herein refers to the fact that a sealing arrangement 40 is arranged in a front region of each of the cylindrical rotor case hub 36, 37 and thereby is easily accessible by service personnel from a front side of the pump 1 upon removal of the first and second rotors 23, 24, thereby eliminating the need to dismount the rotor case body 15 or rotor case rear housing 25, such that simplified servicing and maintenance of the pump is accomplished.

**[0108]** Furthermore, the term "servicing" of the sealing arrangement 40 herein refers to actions such as inspection, measurement, cleaning and/or replacement of the sealing arrangement 40 and/or associated seal seats, such as the front seal seat 56 and/or rotor seal seat 46. For example, the step T3 of servicing the sealing arrangement 40 may include removing a second part 52 of a seal assembly, such as a mechanical face-seal assembly, of the sealing arrangement 40 from a rotor seal seat 46 of the at least one removed rotor 23, 24, removing a first part 51 of the seal assembly, such as the mechanical face-seal assembly, from a front seal seat 53 of the associated cylindrical rotor case hub 36, 37, mounting a new second part 52 of a new seal assembly, such as a new mechanical face-seal assembly, in the rotor seal seat 46 of the at least one removed rotor 23, 24, mounting a new first part 51 of the new seal assembly, such as the new mechanical face-seal assembly, in the front seal seat 53 of the associated cylindrical rotor case hub 36, 37.

**[0109]** It will be appreciated that the above description is merely exemplary in nature and is not intended to limit the present disclosure, its application or uses. While specific examples have been described in the specification and illustrated in the drawings, it will be understood by those of ordinary skill in the art that various changes may be made without departing from the scope of the present invention as defined in the claims. Furthermore, modifications may be made to adapt a particular situation or material to the teachings of the present invention without departing from the scope as defined in the claims.

**[0110]** Therefore, it is intended that the present invention not be limited to the particular examples illustrated by the drawings and described in the specification as the best mode presently contemplated for carrying out the teachings of the present invention but that the scope of the present invention will include any embodiments falling within the scope of the appended claims. Reference signs mentioned in the claims should not be seen as limiting the extent of the matter protected by the claims, and their sole function is to make claims easier to understand.

## Claims

**1.** A rotary positive displacement pump (1) for pumping a fluid product, the pump (1) having a front side (17) and a rear side (18) and comprising:

a main body (2) providing rotational support to a pair of parallel, axially extending, shafts (4, 5) with gears (6, 7) in constant mesh condition, such that the pair of shafts (4, 5) are arranged to rotate in opposite directions,

a rotor case body (15) connected to a front side (13) of the main body (2) and having:

- a stationary interior pumping cavity defined by an axial rear wall (20), a circumferential side wall (21), and a removable front cover (26),
- a fluid product inlet opening (30),
- a fluid product outlet opening (31), and
- a pair of cylindrical rotor case hubs (36, 37) extending from the rear wall (20), wherein each cylindrical rotor case hub (36, 37) receives internally one of the pair of shafts (4, 5),

a pair of rotors (23, 24), each having at least one rotor wing (32) and a rotor drive element (33) that is mounted torque proof on a rotor seat (34) at an end region of one of the pair of shafts (4, 5), wherein each of the pair of rotor seats (34) has an axial abutment surface (42) facing in an axial direction (10) towards a front side (17) of the pump (1) and a mounting surface (43) facing radially outwards,

wherein the pump (1) further comprises a pair of fasteners (38), each being engaged with a mating section (39) at the end region of one of the pair of shafts (4, 5), and each exerting an axial clamping force on one of the rotor drive elements (33) against the axial abutment surface (42) of one of the rotor seats (34), and

**characterized in that** the axial abutment surface (42) of each rotor seat (34) is located axially outside, towards a front side (17), of the associated hub (36, 37).

**2.** The rotary positive displacement pump (1) according to claim 1, wherein a mounting portion (47) of each rotor drive element (33) is radially non-overlapping the associated cylindrical rotor case hub (36, 37).

**3.** The rotary positive displacement pump (1) according to claim 1 or claim 2, wherein a mounting portion (47) of each rotor drive element (33) includes an axial abutment surface (61) facing in an axial direction towards a rear side (18) of the pump (1) and a mounting surface (48) facing radially inwards, and wherein the axial abutment surface (61) of each mounting portion is located axially outside, towards a front side (17), of the associated hub (36, 37).

**4.** The rotary positive displacement pump (1) according to any of the preceding claims 2-3, wherein the mounting portion (47) of each rotor drive element (33) does not extend radially outside of an inner diameter of the associated cylindrical rotor case hub (36, 37).

**5.** The rotary positive displacement pump (1) according to any of the preceding claims 3 - 4, wherein each rotor drive element (33) comprises an annular projection (65) extending towards the rear side (18) of the pump (1), wherein the annular projection (65) comprises the axial abutment surface (61), and wherein each annular projection (65) is arranged on a portion of the associated shaft (4, 5).

**6.** The rotary positive displacement pump (1) according to any of the preceding claims, further comprising a first pair of seal assemblies, each having a first part (51) and a second part (52) with sealing surfaces (54, 55) pressed against each other, and each arranged to prevent fluid product from escaping the stationary pumping cavity and flowing along one of the shafts (4, 5) towards the rear side of the rotor case body (15).

**7.** The rotary positive displacement pump (1) according to claim 6, wherein each cylindrical rotor case hub (36, 37) has a front seal seat (53) facing towards the front side (17) of the pump (1), wherein the front seal seat (53) is located at a front region of each rotor case hub (36, 37), and wherein each front seal seat (53) has the first part (51) of one of the first pair of seal assemblies mounted therein.

**8.** The rotary positive displacement pump (1) according to any of the preceding claims 6-7, wherein the first part (51) of each first pair of seal assemblies faces, as seen in the radial direction, a circumferential outer surface (71) of a portion of the associated shaft (4, 5).

**9.** The rotary positive displacement pump (1) according to any of the preceding claims 6-8, wherein each rotor drive element (33) has a rotor seal seat (46) facing towards the rear side (18) of the pump (1), wherein each rotor seal seat (46) has the second part (52) of one of the first pair of seal assemblies mounted therein.

**10.** The rotary positive displacement pump (1) according to any of the preceding claims 6-9, wherein the rotary positive displacement pump (1) is configured for front-loading of the first pair of seal assemblies.

**11.** The rotary positive displacement pump (1) according to any of the preceding claims 7 - 10, wherein an exterior diameter (63) of each shaft (4, 5) in an axial region of the front seal seat (53) of each cylindrical rotor case hub (36, 37), is larger than an exterior diameter (64) of each shaft (4, 5) in an axial region of, and in contact with, a mounting portion (47) of each rotor drive element (33).

**12.** The rotary positive displacement pump (1) according to any of the preceding claims 6 - 11, further comprising a second pair of seal assemblies, each having a first part (82) and a second part (83) with sealing surfaces pressed against each other, and each arranged to prevent fluid product from flowing along the shaft towards the rear side of the rotor case body (15).

**13.** Method for assembling a rotary positive displacement pump (1) for pumping a fluid product, the pump (1) having a front side (17) and a rear side (18), wherein the method comprises:

providing a main body (2) giving rotational support to a pair of parallel, axially extending, shafts (4, 5) with gears (6, 7) in constant mesh condition, such that the pair of shafts (4, 5) are arranged to rotate in opposite directions, providing a rotor case body (15) having:

- a stationary interior pumping cavity defined by an axial rear wall (20), a circumferential side wall (21), and a removable front cover (26),
- a fluid product inlet opening (30),
- a fluid product outlet opening (31), and
- a pair of cylindrical rotor case hubs (36, 37) extending from the rear wall, wherein the rotor case body (15) is located on a front side (13) of the main body (2), and wherein each cylindrical rotor case hub (36, 37) receives internally one of the pair of shafts (4, 5),

providing a pair of rotors (23, 24), each having at least one rotor wing (32) and a rotor drive element (33),
mounting each rotor drive element (33) torque proof on a rotor seat (34) at an end region of one of the pair of shafts (4, 5), wherein each rotor seat (34) has an axial abutment surface (42) facing in an axial direction towards a front side (17) of the pump (1) and a mounting surface (43) facing radially outwards,
mounting a fastener (38) on an end region of each of the pair of shafts (4, 5),
tightening the pair of fasteners (38) for exerting an axial clamping force on each rotor drive element (33) against the axial abutment surface (42) of one of the rotor seats (34), wherein the axial abutment surface (42) of each rotor seat (34) is located axially outside, towards a front side (17), of the associated hub (36, 37), and
mounting the removable front cover (26) on the rotor case body (15).

**14.** Method according to claim 13, further comprising an intermediate step, performed before mounting the rotor drive elements (33) to the shafts (4, 5), of mounting a first part (51) of a first pair of seal assemblies in a front seal seat (53) of each cylindrical rotor case hub (36, 37), and mounting a second part (52) of the first pair of seal assemblies in a rotor seal seat (46) of each rotor drive element (33).

**15.** Method for providing maintenance to a sealing arrangement (40) of a rotary positive displacement pump (1) having a front side (17) and a rear side (18), two parallel axially extending shafts (4, 5) each carrying a rotor (23, 24) having at least one rotor wing (32) and a rotor drive element (33), and an interior pumping cavity including a pair of cylindrical rotor case hubs (36, 37) extending towards the front side (17) from a rear wall of the interior pumping cavity, wherein each shaft (4, 5) has a rotor seat (34) with an axial abutment surface (42) facing in an axial direction (10) towards a front side (17) of the pump (1), the method comprises:

removing a removable front cover (26) of the pump (1),
removing at least one of the pair of rotors (23, 24) from the associated shaft (4, 5) for enabling access to a sealing arrangement (40) configured for preventing leakage along a gap (56) between the associated shaft (4, 5) and the associated cylindrical rotor case hub (36, 37),
servicing the sealing arrangement (40),
mounting the at least one removed rotor (23, 24) on the associated shaft (4, 5) and abutting the rotor drive element (33) against the axial abutment surface (42) of an associated rotor seat (34), wherein the axial abutment surface (42) of each rotor seat (34) is located axially outside, towards a front side (17), of the associated hub (36, 37), and
mounting the removable front cover (26) on the pump (1).

**Patentansprüche**

**1.** Rotationsverdrängungspumpe (1) zum Pumpen eines Fluidprodukts, wobei die Pumpe (1) eine Vorderseite (17) und eine Rückseite (18) aufweist und Folgendes umfasst:

einen Hauptkörper (2), der eine Rotationsstütze für ein Paar von parallelen, sich in Axialrichtung erstreckenden, Wellen (4, 5) mit Zahnrädern (6, 7) in konstantem Eingriffszustand bereitstellt, so dass das Paar von Wellen (4, 5) dafür angeordnet sind, sich in entgegengesetzten Richtungen zu drehen,
einen Rotorgehäusekörper (15), der mit einer Vorderseite (13) des Hauptkörpers (2) verbunden ist und Folgendes aufweist:

- einen unbeweglichen inneren Pumphohlraum, der durch eine axiale Rückwand (20), eine umlaufende Seitenwand (21) und eine abnehmbare vordere Abdeckung (26) definiert wird,
- eine Fluidprodukt-Einlassöffnung (30),
- eine Fluidprodukt-Auslassöffnung (31) und
- ein Paar von zylindrischen Rotorgehäusenaben (36, 37), die sich von der Rückwand (20) aus erstrecken, wobei jede zylindrische Rotorgehäusenabe (36, 37) innen eine von dem Paar von Wellen (4, 5) aufnimmt,

ein Paar von Rotoren (23, 24), die jeweils min-

destens einen Rotorflügel (32) und ein Rotorantriebselement (33), das drehfest an einem Rotorsitz (34) an einem Endbereich von einer von dem Paar von Wellen (4, 5) angebracht ist, aufweisen,
wobei jeder von dem Paar von Rotorsitzen (34) eine axiale Widerlagerfläche (42), die in einer axialen Richtung (10) hin zu einer Vorderseite (17) der Pumpe (1) zeigt, und eine Anbringungsfläche (43), die in Radialrichtung nach außen zeigt, aufweist,
wobei die Pumpe (1) ferner ein Paar von Befestigungselementen (38) umfasst, die jeweils mit einer Passsektion (39) an dem Endbereich einer von dem Paar von Wellen (4, 5) in Eingriff gebracht sind und jeweils eine axiale Klemmkraft auf eines der Rotorantriebselemente (33) gegen die axiale Widerlagerfläche (42) eines der Rotorsitze (34) ausüben, und
**dadurch gekennzeichnet, dass** die axiale Widerlagerfläche (42) jedes Rotorsitzes (34) in Axialrichtung außerhalb, hin zu einer Vorderseite (17), der zugeordneten Nabe (36, 37) angeordnet ist.

**2.** Rotationsverdrängungspumpe (1) nach Anspruch 1, wobei ein Anbringungsabschnitt (47) jedes Rotorantriebselements (33) die zugeordnete zylindrische Rotorgehäusenabe (36, 37) nicht in Radialrichtung überlappt.

**3.** Rotationsverdrängungspumpe (1) nach Anspruch 1 oder Anspruch 2, wobei ein Anbringungsabschnitt (47) jedes Rotorantriebselements (33) eine axiale Widerlagerfläche (61), die in einer axialen Richtung hin zu einer Rückseite (18) der Pumpe (1) zeigt, und eine Anbringungsfläche (48), die in Radialrichtung nach innen zeigt, einschließt und wobei die axiale Widerlagerfläche (61) jedes Anbringungsabschnitts in Axialrichtung außerhalb, hin zu einer Vorderseite (17), der zugeordneten Nabe (36, 37) angeordnet ist.

**4.** Rotationsverdrängungspumpe (1) nach einem der vorhergehenden Ansprüche 2 bis 3, wobei sich der Anbringungsabschnitt (47) jedes Rotorantriebselements (33) nicht in Radialrichtung außerhalb eines Innendurchmessers der zugeordneten zylindrischen Rotorgehäusenabe (36, 37) erstreckt.

**5.** Rotationsverdrängungspumpe (1) nach einem der vorhergehenden Ansprüche 3 bis 4, wobei jedes Rotorantriebselement (33) einen ringförmigen Vorsprung (65) umfasst, der sich hin zu der Rückseite (18) der Pumpe (1) erstreckt, wobei der ringförmige Vorsprung (65) die axiale Widerlagerfläche (61) umfasst und wobei jeder ringförmige Vorsprung (65) an einem Abschnitt der zugeordneten Welle (4, 5) angeordnet ist.

**6.** Rotationsverdrängungspumpe (1) nach einem der vorhergehenden Ansprüche, die ferner ein erstes Paar von Dichtungsbaugruppen umfasst, die jeweils einen ersten Teil (51) und einen zweiten Teil (52) mit Dichtungsflächen (54, 55) aufweisen, die gegeneinander gepresst werden, und jeweils dafür angeordnet sind, zu verhindern, dass Fluidprodukt aus dem unbeweglichen Pumphohlraum entweicht und entlang einer der Wellen (4, 5) hin zu der Rückseite des Rotorgehäusekörpers (15) strömt.

**7.** Rotationsverdrängungspumpe (1) nach Anspruch 6, wobei jede zylindrische Rotorgehäusenabe (36, 37) einen vorderen Dichtungssitz (53) aufweist, der hin zu der Vorderseite (17) der Pumpe (1) zeigt, wobei der vordere Dichtungssitz (53) an einem vorderen Bereich jeder Rotorgehäusenabe (36, 37) angeordnet ist und wobei jeder vordere Dichtungssitz (53) den ersten Teil (51) einer von dem ersten Paar von Dichtungsbaugruppen aufweist, der in demselben angebracht ist.

**8.** Rotationsverdrängungspumpe (1) nach einem der vorhergehenden Ansprüche 6 bis 7, wobei der erste Teil (51) jedes ersten Paars von Dichtungsbaugruppen, gesehen in der Radialrichtung, zu einer umlaufenden Außenfläche (71) eines Abschnitts der zugeordneten Welle (4, 5) zeigt.

**9.** Rotationsverdrängungspumpe (1) nach einem der vorhergehenden Ansprüche 6 bis 8, wobei jedes Rotorantriebselement (33) einen Rotordichtungssitz (46) aufweist, der hin zu der Rückseite (18) der Pumpe (1) zeigt, wobei jeder Rotordichtungssitz (46) den zweiten Teil (52) einer von dem ersten Paar von Dichtungsbaugruppen aufweist, der in demselben angebracht ist.

**10.** Rotationsverdrängungspumpe (1) nach einem der vorhergehenden Ansprüche 6 bis 9, wobei die Rotationsverdrängungspumpe (1) zum Laden des ersten Paars von Dichtungsbaugruppen von vorn konfiguriert ist.

**11.** Rotationsverdrängungspumpe (1) nach einem der vorhergehenden Ansprüche 7 bis 10, wobei ein Außendurchmesser (63) jeder Welle (4, 5) in einem axialen Bereich des vorderen Dichtungssitzes (53) jeder zylindrischen Rotorgehäusenabe (36, 37) größer ist als ein Außendurchmesser (64) jeder Welle (4, 5) in einem axialen Bereich eines Anbringungsabschnitts (47) jedes Rotorantriebselements (33) und in Kontakt mit demselben.

**12.** Rotationsverdrängungspumpe (1) nach einem der vorhergehenden Ansprüche 6 bis 11, die ferner ein zweites Paar von Dichtungsbaugruppen umfasst, die jeweils einen ersten Teil (82) und einen zweiten

Teil (83) mit Dichtungsflächen aufweisen, die gegeneinander gepresst werden, und jeweils dafür angeordnet sind, zu verhindern, dass Fluidprodukt entlang der Welle hin zu der Rückseite des Rotorgehäusekörpers (15) strömt.

**13.** Verfahren zum Zusammenbauen einer Rotationsverdrängungspumpe (1) zum Pumpen eines Fluidprodukts, wobei die Pumpe (1) eine Vorderseite (17) und eine Rückseite (18) aufweist, wobei das Verfahren Folgendes umfasst:

Bereitstellen eines Hauptkörpers (2), der einem Paar von parallelen, sich in Axialrichtung erstreckenden, Wellen (4, 5) mit Zahnrädern (6, 7) in konstantem Eingriffszustand eine Rotationsstütze gibt, so dass das Paar von Wellen (4, 5) dafür angeordnet sind, sich in entgegengesetzten Richtungen zu drehen,
Bereitstellen eines Rotorgehäusekörpers (15), der Folgendes aufweist:

- einen unbeweglichen inneren Pumphohlraum, der durch eine axiale Rückwand (20), eine umlaufende Seitenwand (21) und eine abnehmbare vordere Abdeckung (26) definiert wird,
- eine Fluidprodukt-Einlassöffnung (30),
- eine Fluidprodukt-Auslassöffnung (31) und
- ein Paar von zylindrischen Rotorgehäusenaben (36, 37), die sich von der Rückwand aus erstrecken, wobei der Rotorgehäusekörper (15) auf einer Vorderseite (13) des Hauptkörpers (2) befindlich ist und wobei jede zylindrische Rotorgehäusenabe (36, 37) innen eine von dem Paar von Wellen (4, 5) aufnimmt,

Bereitstellen eines Paars von Rotoren (23, 24), die jeweils mindestens einen Rotorflügel (32) und ein Rotorantriebselement (33) aufweisen,
Anbringen jedes Rotorantriebselements (33) drehfest an einem Rotorsitz (34) an einem Endbereich von einer von dem Paar von Wellen (4, 5), wobei jeder Rotorsitz (34) eine axiale Widerlagerfläche (42), die in einer axialen Richtung hin zu einer Vorderseite (17) der Pumpe (1) zeigt, und eine Anbringungsfläche (43), die in Radialrichtung nach außen zeigt, aufweist,
Anbringen eines Befestigungselements (38) an dem Endbereich jeder von dem Paar von Wellen (4, 5),
Anziehen des Paars von Befestigungselementen (38) zum Ausüben einer axialen Klemmkraft auf jedes Rotorantriebselement (33) gegen die axiale Widerlagerfläche (42) eines der Rotorsitze (34), wobei die axiale Widerlagerfläche (42) jedes Rotorsitzes (34) in Axialrichtung außerhalb, hin zu einer Vorderseite (17), der zugeordneten Nabe (36, 37) befindlich ist, und
Anbringen der abnehmbaren vorderen Abdeckung (26) an dem Rotorgehäusekörper (15).

**14.** Verfahren nach Anspruch 13, das ferner einen Zwischenschritt, der vor dem Anbringen der Rotorantriebselemente (33) an den Wellen (4, 5) durchgeführt wird, des Anbringens eines ersten Teils (51) eines ersten Paars von Dichtungsbaugruppen in einem vorderen Dichtungssitz (53) jeder zylindrischen Rotorgehäusenabe (36, 37) und des Anbringens eines zweiten Teils (52) des ersten Paars von Dichtungsbaugruppen in einem Rotordichtungssitz (46) jedes Rotorantriebselements (33) umfasst.

**15.** Verfahren zum Bereitstellen von Wartung für eine Abdichtungsanordnung (40) einer Rotationsverdrängungspumpe (1) mit einer Vorderseite (17) und einer Rückseite (18), zwei parallelen sich in Axialrichtung erstreckenden Wellen (4, 5), die jeweils einen Rotor (23, 24) tragen, der mindestens einen Rotorflügel (32) und ein Rotorantriebselement (33) aufweist, und einem inneren Pumphohlraum, der ein Paar von zylindrischen Rotorgehäusenaben (36, 37) einschließt, die sich von einer Rückwand des inneren Pumphohlraums aus hin zu der Vorderseite (17) erstrecken, wobei jede Welle (4, 5) einen Rotorsitz (34) mit einer axialen Widerlagerfläche (42) aufweist, die in einer axialen Richtung (10) hin zu einer Vorderseite (17) der Pumpe (1) zeigt, wobei das Verfahren Folgendes umfasst:

Entfernen einer abnehmbaren vorderen Abdeckung (26) der Pumpe (1),
Entfernen mindestens eines von dem Paar von Rotoren (23, 24) von der zugeordneten Welle (4, 5) zum Ermöglichen des Zugangs zu einer Abdichtungsanordnung (40), die zum Verhindern einer Leckage entlang eines Spalts (56) zwischen der zugeordneten Welle (4, 5) und der zugeordneten zylindrischen Rotorgehäusenabe (36, 37) konfiguriert ist,
Warten der Abdichtungsanordnung (40),
Anbringen des mindestens einen entfernten Rotors (23, 24) an der zugeordneten Welle (4, 5) und Anstoßen des Rotorantriebselements (33) gegen die axiale Widerlagerfläche (42) eines zugeordneten Rotorsitzes (34), wobei die axiale Widerlagerfläche (42) jedes Rotorsitzes (34) in Axialrichtung außerhalb, hin zu einer Vorderseite (17), der zugeordneten Nabe (36, 37) befindlich ist, und
Anbringen der abnehmbaren vorderen Abdeckung (26) an der Pumpe (1).

## Revendications

**1.** Pompe volumétrique rotative (1) permettant de pomper un produit fluide, la pompe (1) présentant un côté avant (17) et un côté arrière (18) et comprenant :

un corps principal (2) fournissant un support en rotation à une paire d'arbres (4, 5) parallèles s'étendant de manière axiale, avec des engrenages (6, 7) en condition d'engrènement constante, de sorte que la paire d'arbres (4, 5) sont agencés de façon à tourner dans des directions opposées,
un corps de boîtier de rotor (15) connecté à un côté avant (13) du corps principal (2) et présentant :

- une cavité de pompage intérieure fixe définie par une paroi arrière axiale (20), une paroi latérale circonférentielle (21) et un capot avant amovible (26),
- une ouverture d'entrée d'un produit fluide (30),
- une ouverture de sortie d'un produit fluide (31), et
- une paire de moyeux de boîtier de rotor cylindriques (36, 37) s'étendant depuis la paroi arrière (20), dans lequel chaque moyeu de boîtier de rotor cylindrique (36, 37) reçoit intérieurement l'un de la paire d'arbres (4, 5),

une paire de rotors (23, 24) présentant chacun au moins une aile de rotor (32) et un élément d'entraînement de rotor (33) qui est monté fixe en rotation sur un logement de rotor (34) au niveau d'une zone d'extrémité d'un de la paire d'arbres (4, 5),
dans laquelle chaque logement de la paire de logements de rotor (34) présente une surface de butée axiale (42) orientée vers une direction axiale (10) vers un côté avant (17) de la pompe (1) et une surface de montage (43) orientée radialement vers l'extérieur,
dans laquelle la pompe (1) comprend en outre une paire de fixations (38), chacune étant mise en prise avec une section d'emboîtement (39) au niveau de la région d'extrémité de l'une de la paire d'arbres (4, 5), et chacune exerçant une force de serrage axiale sur un des éléments d'entraînement de rotor (33) contre la surface de butée axiale (42) d'un des logements de rotor (34), et
**caractérisée en ce que** la surface de butée axiale (42) de chaque logement de rotor (34) est située de manière axiale à l'extérieur, vers un côté avant (17), du moyeu associé (36, 37).

**2.** Pompe volumétrique rotative (1) selon la revendication 1, dans laquelle une partie de montage (47) de chaque élément d'entraînement de rotor (33) ne chevauche pas radialement le moyeu de boîtier de rotor cylindrique associé (36, 37).

**3.** Pompe volumétrique rotative (1) selon la revendication 1 ou la revendication 2, dans laquelle une partie de montage (47) de chaque élément d'entraînement de rotor (33) inclut une surface de butée axiale (61) orientée vers une direction axiale vers un côté arrière (18) de la pompe (1) et une surface de montage (48) orientée radialement vers l'intérieur, et dans laquelle la surface de butée axiale (61) de chaque partie de montage est située de manière axiale vers l'extérieur, vers un côté avant (17), du moyeu associé (36, 37).

**4.** Pompe volumétrique rotative (1) selon l'une quelconque des revendications 2 à 3 précédentes, dans laquelle la partie de montage (47) de chaque élément d'entraînement de rotor (33) ne s'étend pas radialement vers l'extérieur d'un diamètre intérieur du moyeu de boîtier de rotor cylindrique associé (36, 37).

**5.** Pompe volumétrique rotative (1) selon l'une quelconque des revendications 3 à 4 précédentes, dans laquelle chaque élément d'entraînement de rotor (33) comprend une projection annulaire (65) s'étendant vers le côté arrière (18) de la pompe (1), dans laquelle la projection annulaire (65) comprend la surface de butée axiale (61) et dans laquelle chaque projection annulaire (65) est agencée sur une partie de l'arbre associé (4, 5).

**6.** Pompe volumétrique rotative (1) selon l'une quelconque des revendications précédentes, comprenant en outre une première paire d'ensembles de joint, chacun présentant une première partie (51) et une seconde partie (52) avec des surfaces d'étanchéité (54, 55) comprimées l'une contre l'autre, et chacun étant agencé pour empêcher qu'un produit fluide ne s'échappe de la cavité de pompage fixe et ne s'écoule le long de l'un des arbres (4, 5) vers le côté arrière du corps de boîtier de rotor (15).

**7.** Pompe volumétrique rotative (1) selon la revendication 6, dans laquelle chaque moyeu de boîtier de rotor cylindrique (36, 37) présente un logement de joint avant (53) orienté vers le côté avant (17) de la pompe (1), dans laquelle le logement de joint avant (53) est situé au niveau d'une région avant de chaque moyeu de boîtier de rotor (36, 37), et dans laquelle chaque logement de joint avant (53) présente la première partie (51) d'un ensemble de la première paire d'ensembles de joint montée en son sein.

**8.** Pompe volumétrique rotative (1) selon l'une quelconque des revendications 6 à 7 précédentes, dans laquelle la première partie (51) de chaque première paire d'ensembles de joint fait face, vu dans la direction radiale, à une surface extérieure circonférentielle (71) d'une partie de l'arbre associé (4, 5).

**9.** Pompe volumétrique rotative (1) selon l'une quelconque des revendications 6 à 8 précédentes, dans laquelle chaque élément d'entraînement de rotor (33) présente un logement de joint de rotor (46) orienté vers le côté arrière (18) de la pompe (1), dans laquelle chaque logement de joint de rotor (46) présente la seconde partie (52) d'un de la première paire d'ensembles de joint, montée en son sein.

**10.** Pompe volumétrique rotative (1) selon l'une quelconque des revendications 6 à 9 précédentes, dans laquelle la pompe volumétrique rotative (1) est configurée pour un chargement frontal de la première paire d'ensembles de joint.

**11.** Pompe volumétrique rotative (1) selon l'une quelconque des revendications 7 à 10 précédentes, dans laquelle un diamètre extérieur (63) de chaque arbre (4, 5) dans une région axiale du logement de joint avant (53) de chaque moyeu de boîtier de rotor cylindrique (36, 37) est supérieur à un diamètre extérieur (64) de chaque arbre (4, 5) dans une région axiale de, et en contact avec, une partie de montage (47) de chaque élément d'entraînement de rotor (33).

**12.** Pompe volumétrique rotative (1) selon l'une quelconque des revendications 6 à 11 précédentes, comprenant en outre une seconde paire d'ensembles de joints, chacun présentant une première partie (82) et une seconde partie (83) avec des surfaces d'étanchéité comprimées l'une contre l'autre, et chacun étant agencé pour empêcher qu'un produit fluide ne s'écoule le long de l'arbre vers le côté arrière du corps de boîtier de rotor (15).

**13.** Procédé permettant d'assembler une pompe volumétrique rotative (1) pour le pompage d'un produit fluide, la pompe (1) présentant un côté avant (17) et un côté arrière (18), dans lequel le procédé comprend :

la fourniture d'un corps principal (2) donnant un support en rotation à une paire d'arbres (4, 5) parallèles s'étendant de manière axiale, avec des engrenages (6, 7) en condition d'engrènement constante, de sorte que la paire d'arbres (4, 5) sont agencés de façon à tourner dans des directions opposées,
la fourniture d'un corps de boîtier de rotor (15) présentant :

- une cavité de pompage intérieure fixe définie par une paroi arrière axiale (20), une paroi latérale circonférentielle (21) et un capot avant amovible (26),
- une ouverture d'entrée d'un produit fluide (30),
- une ouverture de sortie d'un produit fluide (31), et
- une paire de moyeux de boîtier de rotor cylindriques (36, 37) s'étendant depuis la paroi arrière, dans lequel le corps de boîtier de rotor (15) est situé sur un côté avant (13) du corps principal (2), et dans lequel chaque moyeu de boîtier de rotor cylindrique (36, 37) reçoit intérieurement l'un de la paire d'arbres (4, 5),

la fourniture d'une paire de rotors (23, 24) présentant chacun au moins une aile de rotor (32) et un élément d'entraînement de rotor (33),
le montage de chaque élément d'entraînement de rotor (33) fixe en rotation sur un logement de rotor (34) au niveau d'une zone d'extrémité d'un de la paire d'arbres (4, 5), dans lequel chaque logement de rotor (34) présente une surface de butée axiale (42) faisant face à une direction axiale vers un côté avant (17) de la pompe (1) et une surface de montage (43) orientée radialement vers l'extérieur,
le montage d'une fixation (38) sur une région d'extrémité de chacun de la paire d'arbres (4, 5),
le serrage de la paire de fixations (38) pour exercer une force de serrage axiale sur chaque élément d'entraînement de rotor (33) contre la surface de butée axiale (42) d'un des logements de rotor (34), dans lequel la surface de butée axiale (42) de chaque logement de rotor (34) est située de manière axiale à l'extérieur, vers un côté avant (17), du moyeu associé (36, 37), et
le montage du capot avant amovible (26) sur le corps de boîtier de rotor (15).

**14.** Procédé selon la revendication 13, comprenant en outre une étape intermédiaire, réalisée avant de monter les éléments d'entraînement de rotor (33) sur les arbres (4, 5), consistant à monter une première partie (51) d'une première paire d'ensembles de joint dans un logement de joint avant (53) de chaque moyeu de boîtier de rotor cylindrique (36, 37), et à monter une seconde partie (52) de la première paire d'ensembles de joint dans un logement de joint de rotor (46) de chaque élément d'entraînement de rotor (33).

**15.** Procédé de fourniture d'une maintenance d'un système d'étanchéité (40) d'une pompe volumétrique rotative (1) dotée d'un côté avant (17) et d'un côté arrière (18), de deux arbres s'étendant de manière axiale parallèles (4, 5) portant chacun un rotor (23, 24) présentant au moins une ailette de rotor (32) et un élément d'entraînement de rotor (33), et d'une cavité de pompage intérieure incluant une paire de moyeux de boîtier de rotor cylindriques (36, 37) s'étendant vers le côté avant (17) depuis une paroi arrière de la cavité de pompage intérieure, dans lequel chaque arbre (4, 5) présente un logement de rotor (34) avec une surface de butée axiale (42) orientée dans une direction axiale (10) vers un côté avant (17) de la pompe (1), dans lequel le procédé comprend :

le retrait d'un capot avant amovible (26) de la pompe (1),
le retrait d'au moins l'un de la paire de rotors (23, 24) de l'arbre associé (4, 5) pour permettre l'accès à un système d'étanchéité (40) configuré pour empêcher toute fuite le long d'un écart (56) entre l'arbre associé (4, 5) et le moyeu de boîtier de rotor cylindrique associé (36, 37),
l'entretien du système d'étanchéité (40),
le montage de l'au moins un rotor retiré (23, 24) sur l'arbre associé (4, 5) et la mise en butée de l'élément d'entraînement du rotor (33) contre la surface de butée axiale (42) d'un logement de rotor associé (34), dans lequel la surface de butée axiale (42) de chaque logement de rotor (34) est située de manière axiale à l'extérieur, vers un côté avant (17), du moyeu associé (36, 37), et
le montage du capot avant amovible (26) sur la pompe (1).

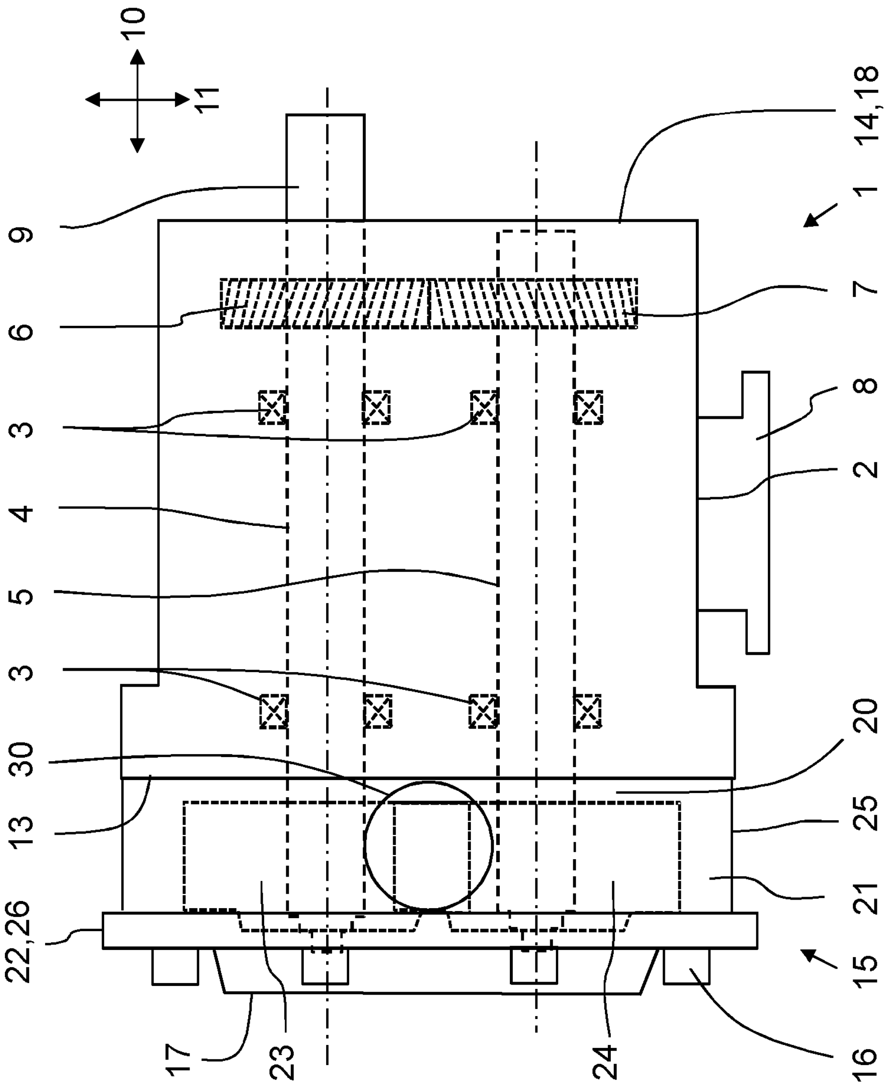
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FIG.1

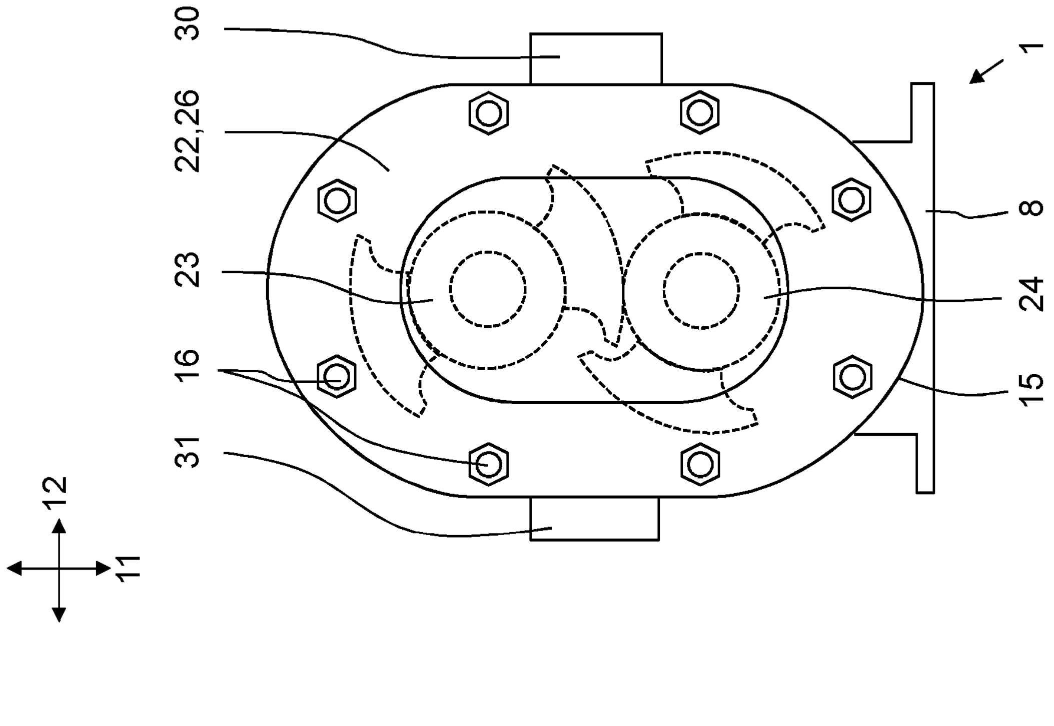
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FIG.2

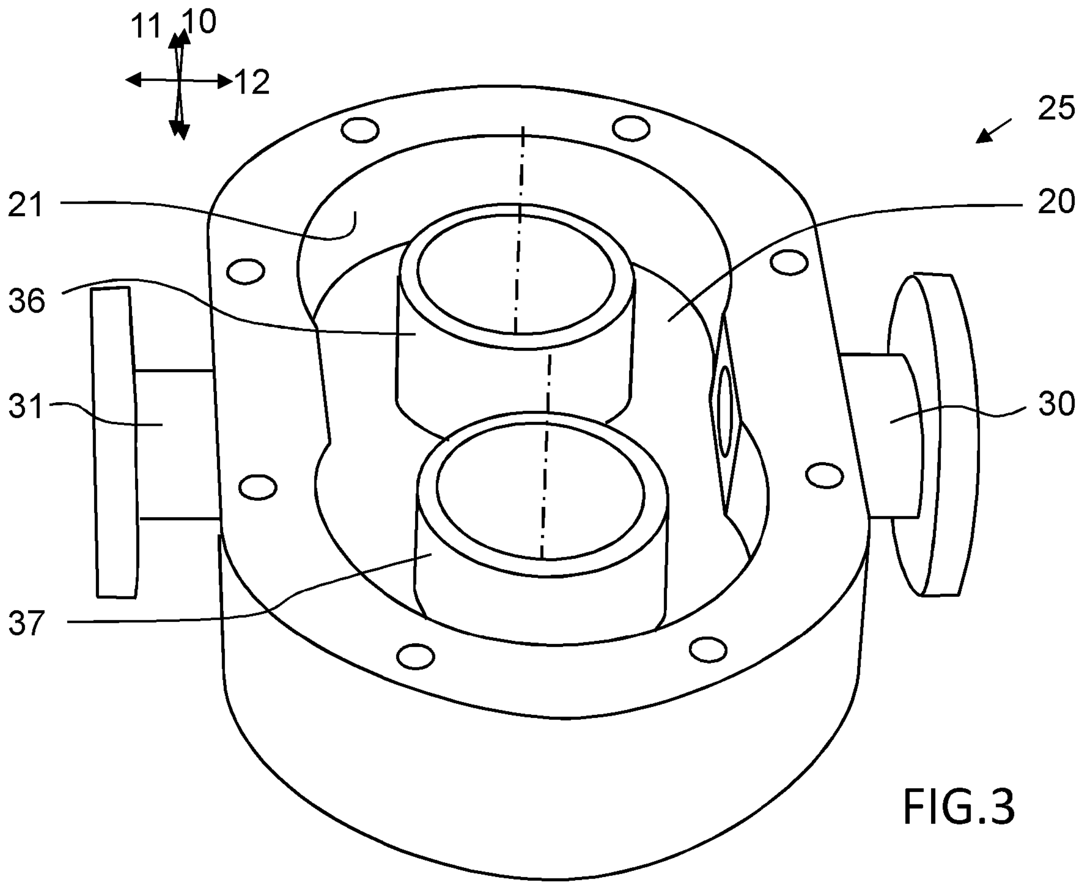


FIG.3

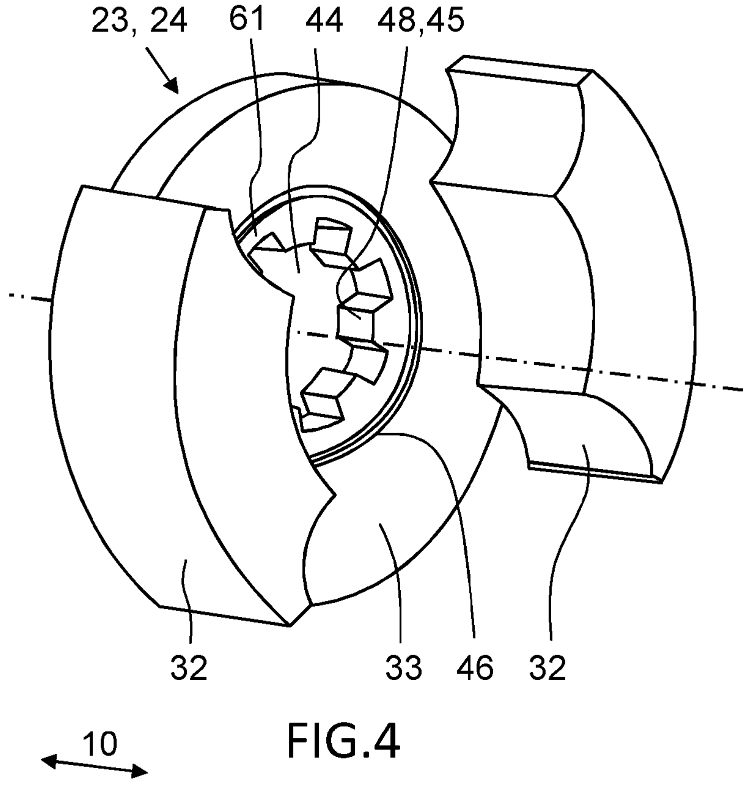


FIG.4

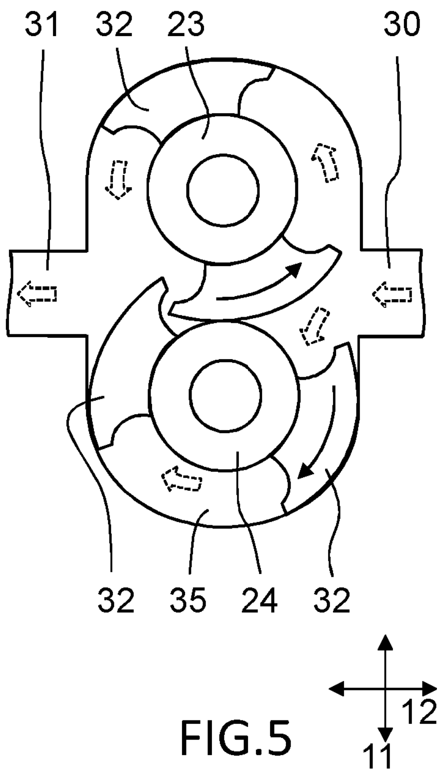


FIG.5

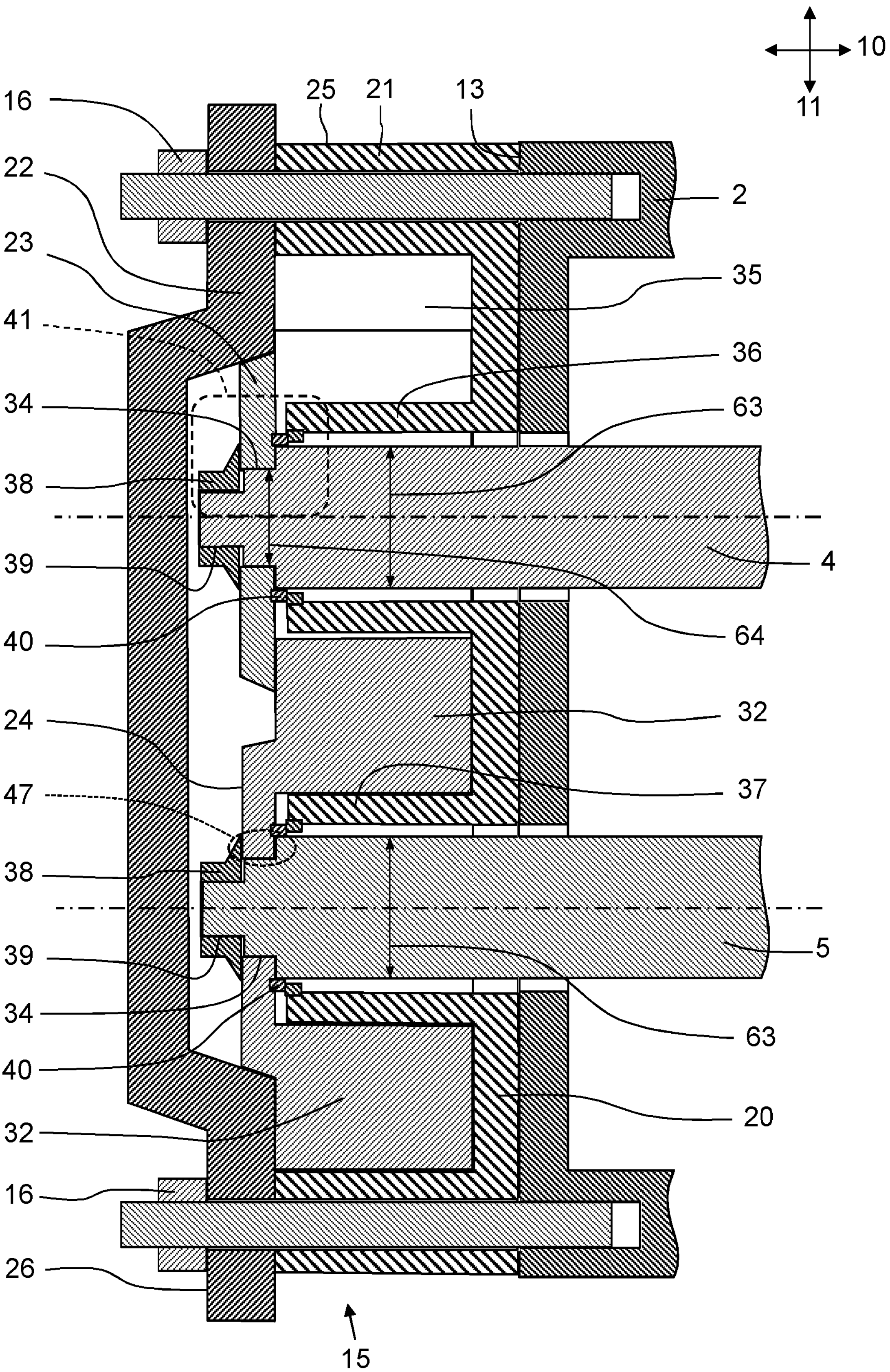
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FIG.6

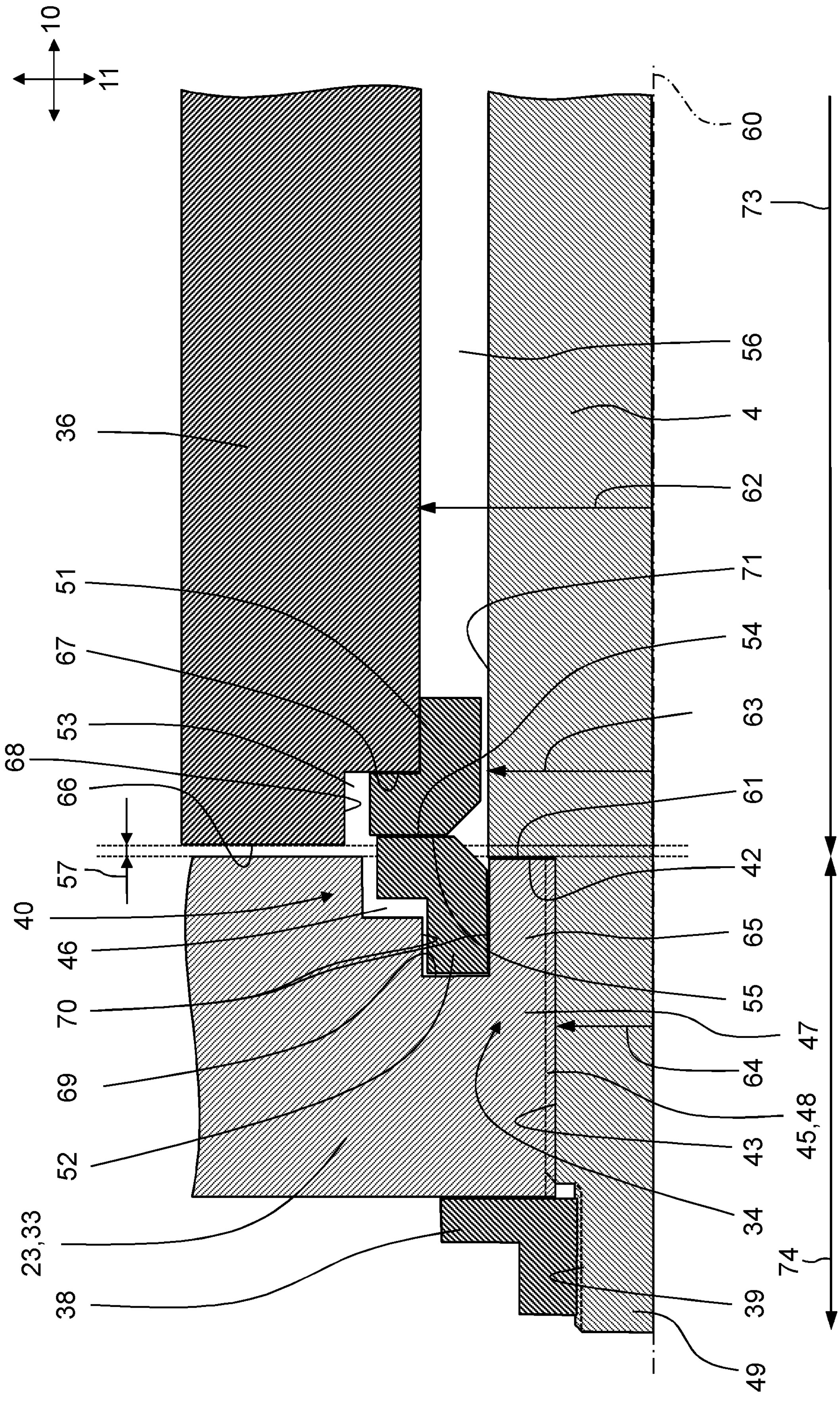
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FIG.7

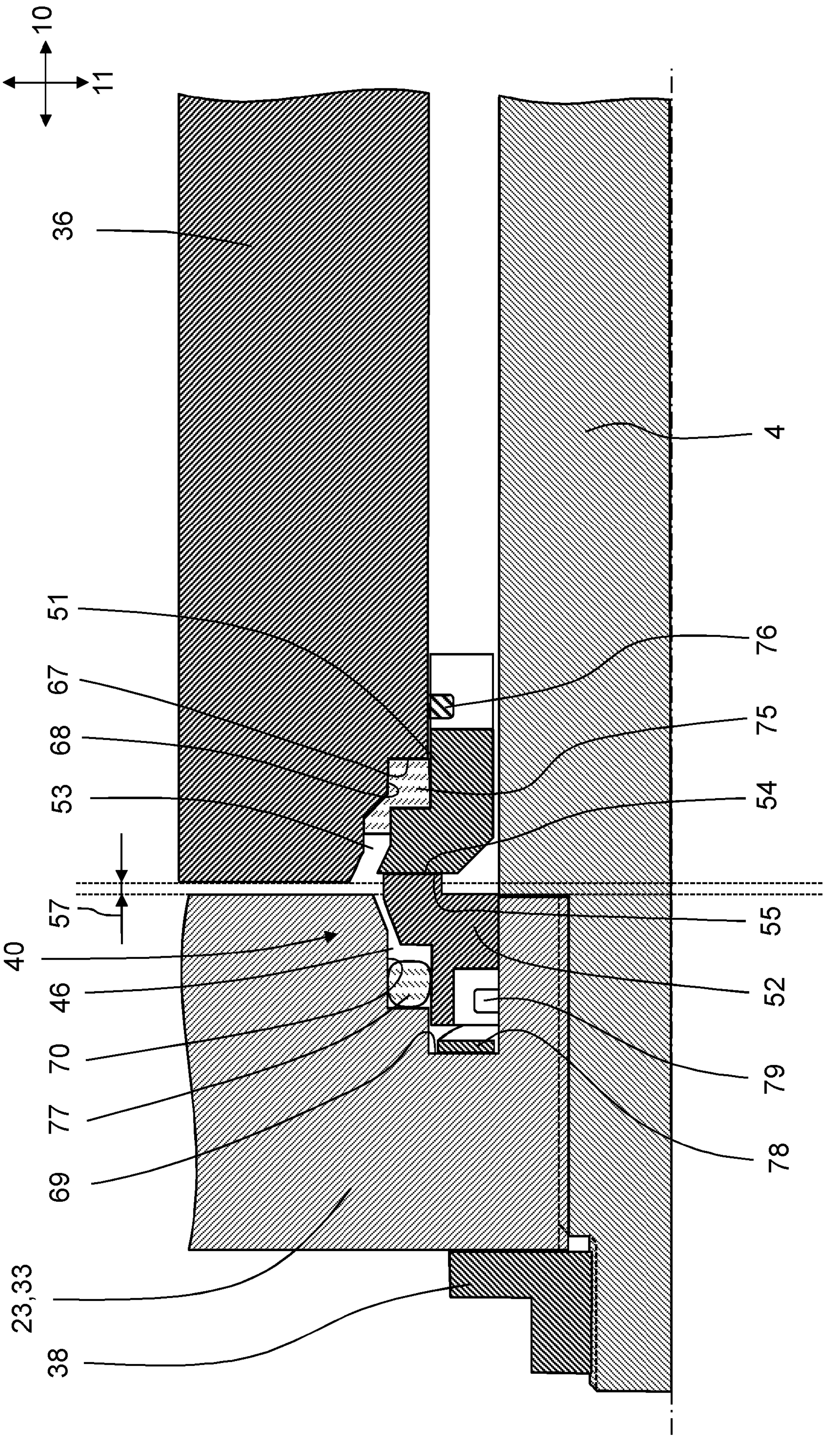


FIG.8

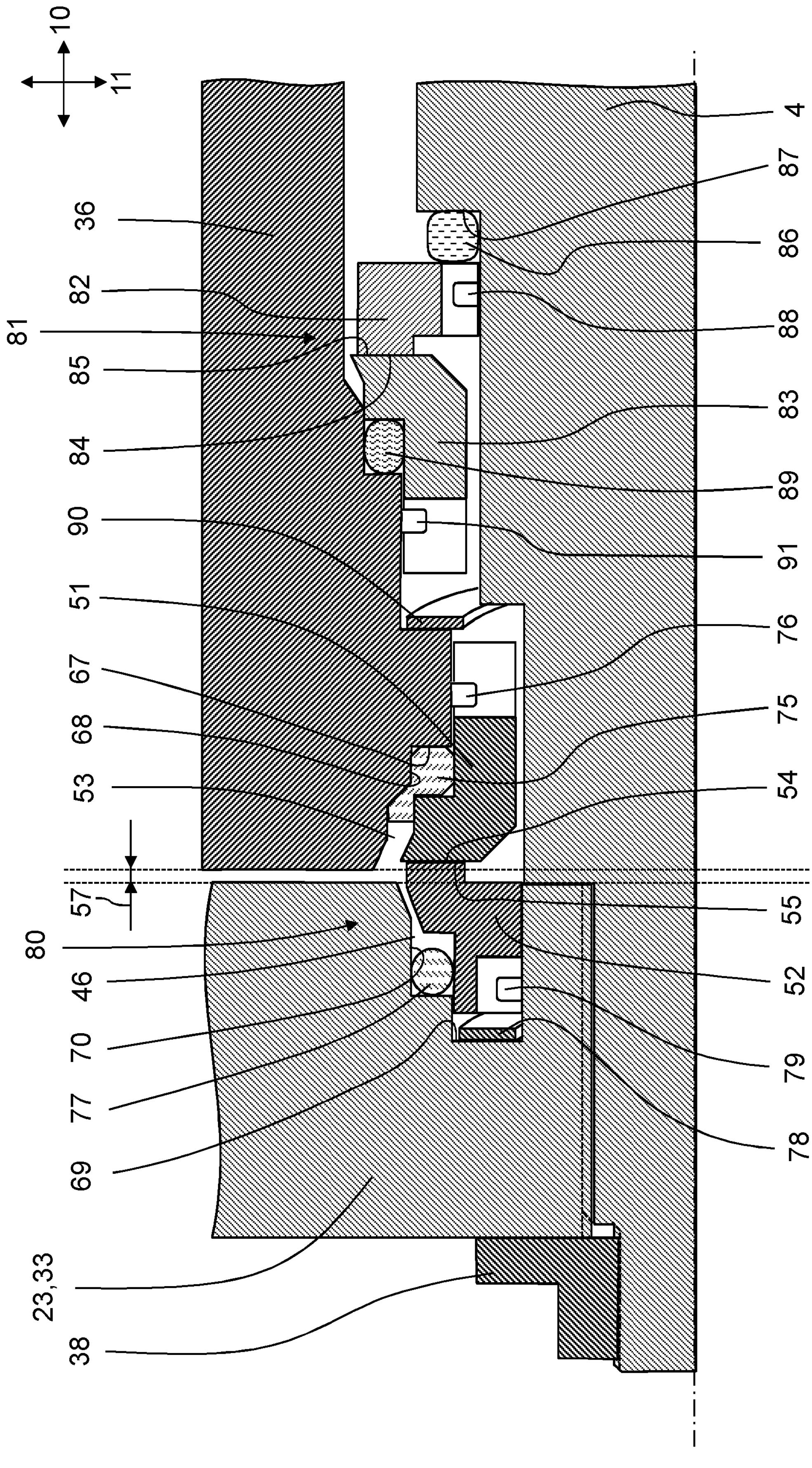
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FIG.9

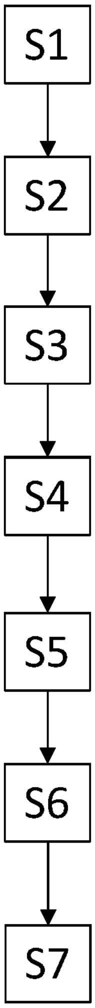


FIG.10

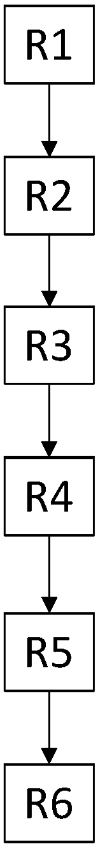


FIG.11

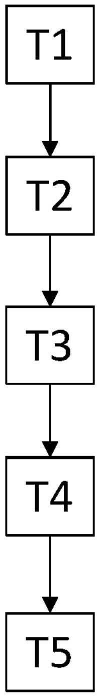


FIG.12

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


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- US 2015064041 A1 **[0005]**