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(54) **ROTARY PUMP**

ROTATIONSPUMPE

POMPE ROTATIVE

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(56) References cited:
WO-A1-2014/086338 DE-A1- 102005 020 232
US-A- 1 526 356 US-A- 1 685 815
US-A- 3 113 527

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Description

TECHNICAL FIELD

[0001] This invention belongs to the field of pumps comprising a rotor contained in a chamber which is rotated by a shaft powered externally.

STATE OF THE ART

[0002] Rotary pumps usually comprise a chamber and a rotor housed inside the chamber. The chamber is usually divided into a cover, lateral walls and a base. The rotor is usually moved by a shaft, which is in turn powered by a mechanic or electric motor.

[0003] The performance of the pump is adversely affected by the fluid leakages below and above the rotor, through the potential gaps which are present between the base and the rotor, and between the rotor and the cover. It is therefore very important to minimize these potential gaps in the design stage.

[0004] For vertical pumps, it is desired that the rotor rests on the chamber base, so that the surfaces are parallel and in contact. If these elements are positioned this way, there is not a gap under the rotor, and the position of the chamber cover may be better adjusted, thus reducing the gap over the rotor. For horizontal pumps, it is desired that the rotor remains also parallel as much as possible to the chamber base and cover; thus reducing the gaps under and over the rotor.

[0005] This shaft may be connected to the rotor either directly or by means of an intermediate element, usually called "driver". The connection between the rotor and the shaft is usually designed to minimize or avoid the relative angular movement between both components, in order to efficiently transmit the rotation.

[0006] Different alternatives have been developed to achieve this aim. First ones provide a rigid coupling between the shaft and the rotor, either by crimping, gluing or any other manufacturing process which rigidly attaches the rotor to the shaft. Second ones provide a joint where a small angular gap is accepted. Although first ones avoid angular gap, this construction also avoids the ability of the assembly shaft-rotor to adapt to the tolerances in the rest of the elements being part of the pump, and this may lead to bigger final gaps.

[0007] Regarding the second ones, the rotor would be allowed to slightly move with respect to the shaft (or driver). Even in this case, the shape of the shaft (or the driver) and/or the rotor internal cavity where the shaft (or the driver) is coupled would not ensure the correct positioning of the rotor on the base, since a small angular tolerance is kept.

[0008] Document US3113527A describes coupling means for a solid connection between a driven member and a driving member of pneumatic and hydraulic tools. Document US1526356 discloses a gear type pump with a driving spindle that has some angular play relative to

the axis of the pump wheel. Document DE 1 02005020232A1 discloses a pump having a rotor with radially sliding vanes and a drive shaft which are keyed together for torque transmission by meshing teeth.

DESCRIPTION OF THE INVENTION

[0009] The invention provides a solution for this problem by means of a pump according to claim 1. Preferred embodiments of the invention are defined in dependent claims.

[0010] In a first inventive aspect, the invention provides a rotary pump comprising

a pump chamber with a chamber base;
a rotor housed in the pump chamber and comprising a bottom base resting on the chamber base, the rotor comprising a rotor housing and configured to rotate around a rotation axis Z orthogonal to the chamber base;
a driving element intended to be housed in the rotor housing, the driving element having an external surface comprising
a contact portion comprising a spherical zone symmetrical to Z axis and
at least one lateral driving protrusion fixed to and extending from the spherical zone along a first direction orthogonal to Z axis, the at least one lateral driving protrusion being intended to transmit a rotary movement to the rotor around the rotational axis Z, wherein the at least one lateral driving protrusion has the shape of a hemisphere or of a spherical segment, and

wherein the rotor housing comprises

a central recess having a diameter for accommodating the contact portion and
at least one lateral cavity intended to house the at least one lateral driving protrusion,
such that the contact portion and the central recess are slidably engageable to each other for compensating angular misalignments between an axis orthogonal to the bottom base of the rotor and the Z axis, when the bottom base of the rotor is resting on the chamber base
and the at least one lateral cavity is configured to allow a relative angular movement, around any direction orthogonal to Z axis, between the at least one lateral driving protrusion and the at least one lateral cavity required by the sliding between the central recess and the contact portion, to keep the bottom base of the rotor resting on the chamber base but movable around Z axis by the pushing of the at least one lateral driving protrusion against the lateral cavity.

[0011] In the present invention an spherical zone

means the lateral surface of an spherical segment or part of the lateral surface of an sphere.

[0012] The chamber base may be a separated part or integrated with the rest of the pump chamber.

[0013] The relation between the contact portion and the central recess allows the rotor to move freely enough over the driver (for any angular movement of the driver) so that the bottom base of the rotor rests on the chamber base (face to face in contact) while keeping a tiny angular clearance to minimize the relative rotational movement between both parts and taking also into account the potential lack of perpendicularity between the rotor housing walls and the rotor base and/or between the shaft axis and the chamber base.

[0014] The configuration of the lateral cavity is designed to allow an angular movement (around a direction orthogonal to Z axis) of the at least one protrusion inside the lateral cavity, when the rotor moves over the driver, without colliding with the walls of the lateral cavity. Furthermore, in spite of the angular deviation of the protrusion inside the lateral cavity, when the protrusion rotates around Z axis (moved by an output shaft of a motor), the protrusion is able to transmit a rotational movement to the rotor such that the rotor rotates around the rotational axis Z.

[0015] In an embodiment the rotor housing has a cross section in a plane orthogonal to axis Z comprising two arc shaped walls defining part of a circumference to configure the central recess and two opposite vertical walls, extending from the central recess, in the first direction orthogonal to Z axis and a traverse end wall, in a second direction orthogonal to Z axis, to configure the at least one lateral cavity. The traverse end wall can be orthogonal to the opposite vertical walls. The traverse end wall can be arc shaped.

[0016] In some embodiments the rotor housing comprises two lateral cavities arranged opposed to each other along a direction orthogonal to Z axis. Each of the lateral cavities being delimited by two opposite vertical walls extending in the first direction orthogonal to Z axis and a traverse end wall (orthogonal to the opposite vertical walls or arc shaped). In these embodiments the driving element can comprise two lateral driving protrusions each one of them intended to be housed in one of the lateral cavities.

[0017] The rotor housing can be a through hole or a blind hole. In some embodiments the height of the central recess is the same as the height of the lateral cavities while in alternative embodiments the height of the central recess is greater than the height of the lateral cavities, the height being measured along Z direction from the bottom base of the rotor.

[0018] In an embodiment the cross section of the spherical zone of the contact portion has a diameter D substantially equal (equal or slightly smaller) to the diameter of the circumference defined by the arc shaped walls of the central recess of the rotor housing. The diameters are substantially the same because the rotor

housing and the driving element are intended to couple together and slide one over the other.

[0019] The central recess can be cylindrical shaped.

[0020] In some embodiments a height H of the at least one lateral cavity, measured along Z direction from the bottom base of the rotor, is greater than $(h + e/2)$, being h a distance in Z direction between the bottom base of the rotor and a plane parallel to the bottom base and passing through the centre of the at least one lateral driving protrusion and being e a height of the lateral driving protrusion measured in Z direction.

[0021] In a preferred embodiment the height H of the at least one lateral cavity, measured along Z direction from the bottom base of the rotor, is greater or equal than $((l - e/2) \sin A + e/2 + h)$, being l the length of the lateral driving protrusion, and being A the angular misalignment of the driving element and/or rotor around an X axis orthogonal to a plane comprising the Z axis and the first direction. A are the degrees of the angular misalignment from an horizontal position of the rotor where the bottom base of the rotor is parallel to the chamber base. The length l of the lateral driving protrusion is a length from Z axis to the edge of the protrusion, measured along the symmetry axis Y of the protuberance.

[0022] In some embodiments a longitudinal length L of the at least one lateral cavity along the first direction orthogonal to Z axis is greater than l, being l the length of the lateral driving protrusion. The length L is measured from Z axis along the first direction orthogonal to Z.

[0023] In a preferred embodiment (for example when the at least one lateral driving protrusion is spherical shaped tangent to the protrusion connecting element) the longitudinal length L of the at least one lateral cavity along the first direction orthogonal to Z axis is greater or equal than $((l - e/2) \cos A + e/2)$, being e the height of the lateral driving protrusion measured in Z direction and being A the angular misalignment of the driving element and/or rotor around an X axis orthogonal to a plane comprising the Z axis and the first direction.

[0024] In another embodiment (for example when the at least one lateral driving protrusion is cylindrical shaped) the longitudinal length L of the at least one lateral cavity, measured from the Z axis along the first direction orthogonal to Z axis, is greater or equal than $(l \cos A + e/2 \sin A)$, being l the length of the lateral driving protrusion and being A the angular misalignment of the driving element and/or rotor around an X axis orthogonal to a plane comprising the Z axis and the first direction. The length l of the lateral driving protrusion is the length from Z axis to the edge of the protrusion, measured along the symmetry axis Y of the protuberance. The length e is the height of the lateral driving protrusion measured in the Z direction in a plane comprising Z and X axis.

[0025] The at least one protrusion of the driver, combined with dimensions L and H of the vertical walls of at least one lateral cavity of the housing of the rotor, allow free adjustment of the rotor into the shaft so that the vertical position of the rotor is determined by the pump base

instead (and potentially by gravity, too). At the same time, the vertical opposite walls of the rotor cavity tightly limit the angular rotation.

[0026] In some particular embodiments, the driving element comprises two protrusions.

[0027] In an embodiment, the protrusions are arranged opposed to each other along the first direction orthogonal to Z axis, so that the protrusions protrude in a perpendicular direction from the rotation axis. Two protrusions which are opposed to each other improve the adjustment between the rotor and the driving element. The symmetry in the position of these protrusions minimizes the angular gap and provides a more uniform stresses pattern.

[0028] In another embodiment the two protrusions are arranged in a plane perpendicular to Z axis at an angle smaller than 180 °.

[0029] In some embodiments the two protrusions are arranged in different planes perpendicular to axis Z.

[0030] When the at least one protrusion (or protrusions) has the shape of part of a second spherical zone, the protrusion can be an spherical segment or part of an sphere. The protrusion can be oval shaped or ovoidal. The protrusion can have any special shape providing it transmits the rotary movement to the rotor and allows the free movement required and described in the present document

[0031] In some embodiments the part of a sphere surface allows the protrusion have one tangency point against a surface where the protrusion leans on.

[0032] In some particular embodiments, the second spherical zone has a diameter which is smaller than the diameter of the first spherical zone.

[0033] In some embodiments the driving element comprises an intermediate portion extending between the contact portion and the second spherical zone.

[0034] In some particular embodiments, the driving element is a shaft. In other particular embodiments, the driving element is a driver which is connected to a shaft.

[0035] In both cases, the driving element is intended to transmit a rotary movement from an external motor to the pump rotor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0036] To complete the description and in order to provide for a better understanding of the invention, a set of drawings is provided. Said drawings form an integral part of the description and illustrate an embodiment of the invention, which should not be interpreted as restricting the scope of the invention, but just as an example of how the invention can be carried out. The drawings comprise the following figures:

Figure 1 shows a perspective view of a rotary pump according to the invention, showing the chamber base, lateral wall, rotor with vanes, a rotor housing and a driving element housed in the rotor housing.

Figure 2 shows a perspective view in section of a rotary pump according to the invention, showing for clarity only the driving element and the rotor.

Figures 3A and 3B show a perspective view in section and an elevation view of one configuration for the rotor housing.

Figures 4A and 4B show a perspective view in section and an elevation view of another configuration for the rotor housing.

Figures 5A, 5B and 5C show different configurations of the driving element of the invention. Figure 5D shows a configuration of the driving element where the lateral driving protrusions are cylindrically shaped.

Figures 6A, 6B and 6C show different views of the driving element in angular deviation in relation to Z axis, Y axis and X axis, when the protrusions are spherical shaped.

Figures 7A, 7B and 7C show different views of the driving element in angular deviation in relation to Z axis, Y axis and X axis, when the protrusions are cylindrical shaped.

Figures 8A and 8B are schematic representations of the housing of the rotor and a driver to show the dimensional relation of both elements.

DETAILED DESCRIPTION OF THE INVENTION

[0037] Figure 1 shows a perspective view of a rotary pump 1 according to the invention.

[0038] This rotary pump 1 comprises

a pump chamber 2 with a chamber base 21;
a rotor 3 housed in the pump chamber 2 and comprising a rotor housing 31;
a driving element 4 being intended to transmit a rotary movement to the rotor 3 and which is housed in the rotor housing 31.

[0039] The rotor 3 rests on the chamber base 21, so that both surfaces are parallel and the gap between the rotor and the cover of the pump chamber is minimized. This rotor 3 is configured to rotate around a rotational axis Z orthogonal to the chamber base 21.

[0040] In this embodiment the rotor 3 is directly laid on the driving element 4 which is in turn connected to a shaft (or is a part of the shaft), which transmits a rotational movement to the rotor.

[0041] Figure 2 shows a perspective view in section to show the driving element 4 inside the rotor housing 31. In this figure the rotor housing 31 is a through hole. This figure shows a detail of the joint between the driving el-

ement 4 and the rotor housing 31, in a rotary pump 1 according to the invention.

[0042] The driving element 4 comprises an external surface 40 which is intended to contact the rotor housing 31 in such a way that the rotor housing 31 can move over an external surface 40 of the driving element 4. In the embodiment shown in figure 2 this external surface 40 comprises a contact portion 41 which has the shape of part of a first sphere comprising an spherical zone. The external surface 40 also comprises two lateral (hemispherical) driving protrusions 42 which extend from the first sphere in a perpendicular direction from the rotation axis Z. These lateral driving protrusions 42 are arranged opposed to each other along a Y direction orthogonal to the rotational Z axis.

[0043] Figures 3A and 3B show a perspective view and an elevation view of a detail of a configuration of the rotor housing 31 of the rotary pump of figure 1.

[0044] The rotor housing 31 comprises a central recess 32. This recess has substantially the same diameter as the first spherical zone of the contact portion 41, since the central recess 32 and the contact portion 41 are intended to couple. This rotor housing 31 further comprises two lateral cavities 33, each cavity 33 being intended to house one of the hemispherical lateral driving protrusions 42.

[0045] The rotor housing 31 has a cross section in a plane orthogonal to axis Z comprising two arc shapes walls 321 defining part of a circumference to configure the central recess 32 and each of the lateral cavities 33 is defined between two vertical opposite walls 331 extending in a direction (Y) orthogonal to Z axis and a traverse end wall 332. In this embodiment the rotor housing 31 has a constant cross section as shown in figure 3B. This rotor housing 31 can house a driving element 4 as shown in figures 5A and 5B.

[0046] Figures 4A and 4B show perspective view and an elevation view of a detail of another configuration of the rotor housing 31 of the rotary pump of figure 1. This rotor housing 31 can house a driving element 4 as shown in figures 5D.

[0047] Figures 5A, 5B, 5C and 5D show different configurations for the driving element 4.

[0048] Figure 5A, shows a driving element 4 comprising two driving protrusions 42 arranged opposed to each other along a direction orthogonal to axis Z, so that the protrusions protrude in a perpendicular direction from the rotation axis Z. The driving protrusions 42 are spherical shaped. The diameter of the spherical driving protrusion 42 is smaller than the diameter of first spherical zone of the contact portion 41.

[0049] Figure 5B, shows a driving element 4 comprising two driving protrusions 42 arranged in different planes perpendicular to axis Z. The driving protrusions 42 are spherical shaped. The diameter of the spherical driving protrusions 42 is smaller than the diameter of first spherical zone of the contact portion 41.

[0050] Figure 5C, shows a driving element 4 compris-

ing two driving protrusions 42 arranged in a plane perpendicular to Z axis at an angle of 90°. The driving protrusions 42 are spherical shaped. The diameter of the spherical driving protrusion 42 is smaller than the diameter of first spherical zone of the contact portion 41.

[0051] Figure 5D, shows a driving element 4, which is not part of the present invention, comprising two driving protrusions 42 arranged opposed to each other along a direction orthogonal to axis Z, so that the protrusions protrude in a perpendicular direction from the rotation axis. The driving protrusions 42 are cylindrical shaped.

[0052] Figures 6A, 6B and 6C show different views of the driving element 4 in angular deviation when the protrusions are spherical shaped and the central recess 32 as shown in figures 3A and 3B. Figure 6A corresponds to a side view in a plane orthogonal to Z axis when the driving element 4 rotates around Z axis. Figure 6B corresponds to a side view in a plane orthogonal to Y axis when the driver 4 has an angular deviation in this plane. Figure 6C corresponds to a side view in a plane orthogonal to X axis when the driver 4 has an angular deviation in this plane.

[0053] Figures 7A, 7B and 7C show different views of the driving element 4, which are not part of the present invention, in angular deviation when the protrusions are cylindrical shaped and the central recess 32 as shown in figures 4A and 4B. Figure 7A corresponds to a side view in a plane orthogonal to Z axis when the driving element 4 rotates around Z axis. Figure 7B corresponds to a side view in a plane orthogonal to Y axis when the driver 4 has an angular deviation in this plane. Figure 7C corresponds to a side view in a plane orthogonal to X axis when the driver 4 has an angular deviation in this plane.

[0054] Figures 8A and 8B are schematic representations of the housing of the rotor and a driver to show the dimensional relation of both elements, and specially the dimension L, l, H, h, e and A used in the formulas of the invention. Figure 8A represents a driving element (4) and rotor (3) with no misalignment and figure 8B shows an angular misalignment A between the driving element (4) and the rotor (3).

[0055] In this text, the term "comprises" and its derivations such as "comprising", etc. should not be understood in an excluding sense, that is, these terms should not be interpreted as excluding the possibility that what is described and defined may include further elements, steps, etc.

[0056] The invention is obviously not limited to the specific embodiments described herein, but also encompasses any variations that may be considered by any person skilled in the art for example, as regards the choice of materials, dimensions, components, configuration, etc., within the general scope of the invention as defined in the claims.

Claims

1. Rotary pump (1) comprising:

a pump chamber (2) with a chamber base (21);
a rotor (3) housed in the pump chamber (2) and comprising a bottom base resting on the chamber base (21), the rotor (3) comprising a rotor housing (31) and configured to rotate around a rotational axis Z orthogonal to the chamber base (21);
a driving element (4) intended to be housed in the rotor housing (31), the driving element (4) having an external surface (40) comprising:

a contact portion (41) comprising an spherical zone symmetrical to Z axis; and
at least one lateral driving protrusion (42) fixed to and extending from the spherical zone along a first direction (Y) orthogonal to Z axis, the at least one lateral driving protrusion (42) being intended to transmit a rotary movement to the rotor (3) around the rotational axis Z,

and wherein the rotor housing (31) comprises:

a central recess (32) having a diameter for accommodating the contact portion (41); and
at least one lateral cavity (33) intended to house the at least one lateral driving protrusion (42), such that the contact portion (41) and the central recess (32) are slidably engageable to each other for compensating angular misalignments between an axis orthogonal to the bottom base of the rotor (3) and the Z axis, when the bottom base of the rotor (3) is resting on the chamber base (21)
and the at least one lateral cavity (33) is configured to allow a relative angular movement, around any direction orthogonal to Z axis, between the at least one lateral driving protrusion (42) and the at least one lateral cavity (33) required by the sliding between the central recess (32) and the contact portion (41), to keep the bottom base of the rotor (3) resting on the chamber base (21) but movable around Z axis by the pushing of the at least one lateral driving protrusion (42) against the lateral cavity (33)

characterized in that the at least one lateral driving protrusion (42) has the shape of a hemisphere or of a spherical segment.

2. Rotary pump (1) according to claim 1, wherein the rotor housing has a cross section in a plane orthogonal to axis Z comprising two arc shaped walls (321) defining part of a circumference to configure the central recess (32) and two opposite vertical walls (331)

extending, from the central recess, in the first direction (Y) orthogonal to Z axis and a traverse end wall (332) in a second direction (X) orthogonal to Z axis, to configure the at least one lateral cavity (33).

3. Rotary pump (1) according to claim 2 wherein a cross section of the spherical zone of the contact portion (41) has a diameter D substantially equal to the diameter of the circumference defined by the arc shaped walls (321) of the rotor housing

4. Rotary pump according to any of previous claims, wherein a height H of the at least one lateral cavity (33), measured along Z direction from the bottom base of the rotor (3) is greater than $(h + e/2)$, being h a distance in Z direction between the bottom base of the rotor (3) and a plane parallel to the bottom base and passing through the centre of the at least one lateral driving protrusion (42) and being 'e' a height of the lateral driving protrusion (42) measured in Z direction.

5. Rotary pump according to claim 4, wherein the height H along Z direction of the at least one lateral cavity (33) is greater or equal than $((l - e/2) \sin A + e/2 + h)$, being 'l' the length of the lateral driving protrusion (42), and being 'A' the angular misalignment of the driving element (4) and/or rotor (3) around an X axis orthogonal to a plane comprising the Z axis and the first direction (Y).

6. Rotary pump according to any of previous claims, wherein a longitudinal length 'L' of the at least one lateral cavity (33) along the first direction (Y) orthogonal to Z axis is greater than 'l', being 'l' the length of the lateral driving protrusion (42).

7. Rotary pump according to claim 6, wherein the longitudinal length 'L' of the at least one lateral cavity (33) along the first direction (Y) orthogonal to Z axis is greater or equal than $(l \cos A + e/2 \sin A)$, being 'e' the height of the lateral driving protrusion (42) measured in Z direction and being 'A' the angular misalignment of the driving element (4) and/or rotor (3) around an X axis orthogonal to a plane comprising the Z axis and the first direction.

8. Rotary pump according to claim 6, wherein the longitudinal length 'L' of the at least one lateral cavity (33) along the first direction (Y) orthogonal to Z axis is greater or equal than $((l - e/2) \cos A + e/2)$, being 'e' the height of the lateral driving protrusion (42) measured in Z direction and being 'A' the angular misalignment the driving element (4) and/or rotor (3) around an X axis orthogonal to a plane comprising the Z axis and the first direction.

9. Rotary pump according to any of previous claims

wherein the driving element (4) comprises two lateral driving protrusions (42).

10. Rotary pump according to claim 9 wherein the two lateral driving protrusions (42) are arranged opposed to each other along the first direction (Y) orthogonal to axis Z, so that the lateral driving protrusions (42) protrude in a perpendicular direction from the rotational axis Z.
11. Rotary pump according to claim 9 wherein the two lateral driving protrusions (42) are arranged in a plane perpendicular to Z axis at an angle smaller than 180 °.
12. Rotary pump according to any of claims 9, 10 or 11 wherein the two lateral driving protrusions (42) are arranged in different planes perpendicular to axis Z.
13. Rotary pump (1) according to any of the preceding claims, wherein the driving element (4) is a shaft.
14. Rotary pump (1) according to any one of the preceding claims, wherein the driving element (4) comprises an intermediate portion extending between the contact portion (41) and its hemispheric or spheric segment shaped end portion.

Patentansprüche

1. Rotationspumpe (1), umfassend:

eine Pumpenkammer (2) mit einer Kammerbasis (21);
einen Rotor (3), der in der Pumpenkammer (2) aufgenommen ist und eine untere Basis umfasst, die auf der Kammerbasis (21) aufliegt, wobei der Rotor (3) ein Rotorgehäuse (31) umfasst und dazu ausgebildet ist, sich um eine Drehachse z orthogonal zur Kammerbasis (21) zu drehen;
ein Antriebselement (4), das in dem Rotorgehäuse (31) aufgenommen werden soll, wobei das Antriebselement (4) eine Außenfläche (40) aufweist, die Folgendes umfasst:

einen Kontaktabschnitt (41), der einen kugelförmigen Bereich symmetrisch zur z-Achse umfasst, und
mindestens einen lateralen Antriebsvorsprung (42), der an dem kugelförmigen Bereich fixiert ist und sich entlang einer ersten Richtung (y) orthogonal zur z-Achse von diesem erstreckt, wobei der mindestens eine laterale Antriebsvorsprung (42) eine Drehbewegung des Rotors (3) um die Drehachse z übertragen soll,

und wobei das Rotorgehäuse (31) Folgendes umfasst:

eine mittlere Aussparung (32) mit einem Durchmesser zur Aufnahme des Kontaktabschnitts (41); und
mindestens einen lateralen Hohlraum (33), der den mindestens einen lateralen Antriebsvorsprung (42) aufnehmen soll, so dass der Kontaktabschnitt (41) und die mittlere Aussparung (32) verschiebbar miteinander in Eingriff gebracht werden können, um Winkelversätze zwischen einer Achse orthogonal zur unteren Basis des Rotors (3) und der z-Achse bei Auflage der unteren Basis des Rotors (3) auf der Kammerbasis (21) auszugleichen, und der mindestens eine laterale Hohlraum (33) dazu ausgebildet ist, eine relative Winkelbewegung um eine beliebige Richtung orthogonal zur z-Achse zwischen dem mindestens einen lateralen Antriebsvorsprung (42) und dem mindestens einen lateralen Hohlraum (33), die durch das Gleiten zwischen der mittleren Aussparung (32) und dem Kontaktabschnitt (41) erforderlich ist, zu gestatten, um die untere Basis des Rotors (3) in Auflage auf der Kammerbasis (21), aber beweglich um die z-Achse durch Drücken des mindestens einen lateralen Antriebsvorsprungs (42) gegen den lateralen Hohlraum (33) zu halten,
dadurch gekennzeichnet, dass der mindestens eine laterale Antriebsvorsprung (42) die Form eines halbkugelförmigen oder eines kugelförmigen Segments aufweist.

2. Rotationspumpe (1) nach Anspruch 1, wobei das Rotorgehäuse einen Querschnitt in einer Ebene orthogonal zur Achse z aufweist, mit zwei bogenförmigen Wänden (321), die Teil eines Umfangs definieren, um die mittlere Aussparung (32) auszubilden, und zwei gegenüberliegenden vertikalen Wänden (331), die sich von der mittleren Aussparung in der ersten Richtung (y) orthogonal zur z-Achse erstrecken, und einer Querendwand (332) in einer zweiten Richtung (x) orthogonal zur z-Achse zum Ausbilden des mindestens einen lateralen Hohlraums (33).
3. Rotationspumpe (1) nach Anspruch 2, wobei ein Querschnitt des kugelförmigen Bereichs des Kontaktabschnitts (41) einen Durchmesser D aufweist, der im Wesentlichen gleich dem Durchmesser des Umfangs ist, der durch die bogenförmigen Wände (321) des Rotorgehäuses definiert wird.
4. Rotationspumpe nach einem der vorhergehenden Ansprüche, wobei eine Höhe H des mindestens ei-

nen lateralen Hohlraums (33), gemessen entlang der z-Richtung von der unteren Basis des Rotors (3), größer ist als $(h + e/2)$, wobei h ein Abstand in der z-Richtung zwischen der unteren Basis des Rotors (3) und einer Ebene parallel zu der unteren Basis, die durch die Mitte des mindestens einen lateralen Antriebsvorsprungs (42) verläuft, ist und 'e' eine Höhe des lateralen Antriebsvorsprungs (42), gemessen in der z-Richtung, ist.

5. Rotationspumpe nach Anspruch 4, wobei die Höhe H entlang der z-Richtung des mindestens einen lateralen Hohlraums (33) größer oder gleich $((l - e/2) \sin A + e/2 + h)$ ist, wobei 'l' die Länge des lateralen Antriebsvorsprungs (42) ist und 'A' der Winkelversatz des Antriebselements (4) und/oder Rotors (3) um eine x-Achse orthogonal zu einer Ebene mit der z-Achse und der ersten Richtung (y) ist.
6. Rotationspumpe nach einem der vorhergehenden Ansprüche, wobei eine longitudinale Länge 'L' des mindestens einen lateralen Hohlraums (33) entlang der ersten Richtung (y) orthogonal zur z-Achse größer 'l' ist, wobei 'l' die Länge des lateralen Antriebsvorsprungs (42) ist.
7. Rotationspumpe nach Anspruch 6, wobei eine longitudinale Länge 'L' des mindestens einen lateralen Hohlraums (33) entlang der ersten Richtung (y) orthogonal zur z-Achse größer oder gleich $(l \cos A + e/2 \sin A)$ ist, wobei 'e' die Höhe des lateralen Antriebsvorsprungs (42), gemessen in z-Richtung, ist und 'A' der Winkelversatz des Antriebselements (4) und/oder Rotors (3) um eine x-Achse orthogonal zu einer Ebene mit der z-Achse und der ersten Richtung ist.
8. Rotationspumpe nach Anspruch 6, wobei die longitudinale Länge 'L' des mindestens einen lateralen Hohlraums (33) entlang der ersten Richtung (y) orthogonal zur z-Achse größer oder gleich $((l - e/2) \cos A + e/2)$ ist, wobei 'e' die Höhe des lateralen Antriebsvorsprungs (42), gemessen in z-Richtung, ist und 'A' der Winkelversatz des Antriebselements (4) und/oder Rotors (3) um eine x-Achse orthogonal zu einer Ebene mit der z-Achse und der ersten Richtung ist.
9. Rotationspumpe nach einem der vorhergehenden Ansprüche, wobei das Antriebselement (4) zwei laterale Antriebsvorsprünge (42) umfasst.
10. Rotationspumpe nach Anspruch 9, wobei die beiden lateralen Antriebsvorsprünge (42) entlang der ersten Richtung (y) orthogonal zur Achse z einander gegenüber angeordnet sind, so dass die lateralen Antriebsvorsprünge (42) in einer senkrechten Richtung von der Drehachse z ragen.

11. Rotationspumpe nach Anspruch 9, wobei die beiden lateralen Antriebsvorsprünge (42) in einer Ebene senkrecht zur z-Achse in einem Winkel kleiner als 180° angeordnet sind.

12. Rotationspumpe nach einem der Ansprüche 9, 10 oder 11, wobei die beiden lateralen Antriebsvorsprünge (42) in verschiedenen Ebenen senkrecht zur Achse z angeordnet sind.

13. Rotationspumpe (1) nach einem der vorhergehenden Ansprüche, wobei das Antriebselement (4) eine Welle ist.

14. Rotationspumpe (1) nach einem der vorhergehenden Ansprüche, wobei das Antriebselement (4) einen Zwischenabschnitt umfasst, der sich zwischen dem Kontaktabschnitt (41) und seinem als halbkugelförmiges oder kugelförmiges Segment geformten Endteil erstreckt.

Revendications

1. Pompe rotative (1) comprenant :

une chambre de pompe (2) avec une base de chambre (21) ;

un rotor (3) logé dans la chambre de pompe (2) et comprenant une base inférieure s'appuyant sur la base de chambre (21), le rotor (3) comprenant un boîtier de rotor (31) et configuré pour tourner autour d'un axe de rotation Z orthogonal à la base de chambre (21) ;

un élément d'entraînement (4) prévu pour être logé dans le boîtier de rotor (31), l'élément d'entraînement (4) ayant une surface externe (40) comprenant :

une partie de contact (41) comprenant une zone sphérique symétrique à l'axe Z ; et

au moins une saillie d'entraînement latérale (42) fixée sur et s'étendant à partir de la zone sphérique le long d'une première direction (Y) orthogonale à l'axe Z, la au moins une saillie d'entraînement latérale (42) étant prévue pour transmettre un mouvement de rotation au rotor (3) autour de l'axe de rotation Z,

et dans laquelle le boîtier de rotor (31) comprend :

un évidement central (32) ayant un diamètre pour loger la partie de contact (41) ; et

au moins une cavité latérale (33) prévue pour loger la au moins une saillie d'entraînement latérale (42),

de sorte que la partie de contact (41) et l'évidement central (32) peuvent se mettre en prise de manière coulissante entre eux pour compenser les défauts d'alignement angulaires entre un axe orthogonal à la base inférieure du rotor (3) et l'axe Z, lorsque la base inférieure du rotor (3) s'appuie sur la base de chambre (21),

et la au moins une cavité latérale (33) est configurée pour permettre un mouvement angulaire relatif, autour de n'importe quelle direction orthogonale à l'axe Z, entre la au moins une saillie d'entraînement latérale (42) et la au moins une cavité latérale (33) requise par le coulisement entre l'évidement central (32) et la partie de contact (41), pour maintenir la base inférieure du rotor (3) s'appuyant sur la base de chambre (21), mais mobile autour de l'axe Z par la poussée de la au moins une saillie d'entraînement latérale (42) contre la cavité latérale (33),

caractérisée en ce que la au moins une saillie d'entraînement latérale (42) a la forme d'une hémisphère ou d'un segment sphérique.

2. Pompe rotative (1) selon la revendication 1, dans laquelle le boîtier de rotor a une section transversale dans un plan orthogonal à l'axe Z comprenant deux parois en forme d'arc (321) définissant une partie d'une circonférence afin de configurer l'évidement central (32) et deux parois verticales (331) opposées s'étendant, à partir de l'évidement central, dans la première direction (Y) orthogonale à l'axe Z et une paroi d'extrémité transversale (332) dans une seconde direction (X) orthogonale à l'axe Z, afin de configurer la au moins une cavité latérale (33).

3. Pompe rotative (1) selon la revendication 2, dans laquelle une section transversale de la zone sphérique de la partie de contact (41) a un diamètre D sensiblement égal au diamètre de la circonférence définie par les parois en forme d'arc (321) du boîtier de rotor.

4. Pompe rotative selon l'une quelconque des revendications précédentes, dans laquelle une hauteur H de la au moins une cavité latérale (33), mesurée le long de la direction Z à partir de la base inférieure du rotor (3) est supérieure à $(h + e/2)$, h étant une distance dans la direction Z entre la base inférieure du rotor (3) et un plan parallèle à la base inférieure et passant par le centre de la au moins une saillie d'entraînement latérale (42) et « e » étant une hauteur de la saillie d'entraînement latérale (42) mesu-

rée dans la direction Z.

5. Pompe rotative selon la revendication 4, dans laquelle la hauteur H le long de la direction Z de la au moins une cavité latérale (33) est supérieure ou égale à $((1 - e/2) \sin A + e/2 + h)$, « 1 » étant la longueur de la saillie d'entraînement latérale (42), et « A » étant le défaut d'alignement angulaire de l'élément d'entraînement (4) et/ou du rotor (3) autour d'un axe X orthogonal à un plan comprenant l'axe Z et la première direction (Y).
6. Pompe rotative selon l'une quelconque des revendications précédentes, dans laquelle une longueur longitudinale « L » de la au moins une cavité latérale (33) le long de la première direction (Y) orthogonale à l'axe Z est supérieure à « 1 », « 1 » étant la longueur de la saillie d'entraînement latérale (42).
7. Pompe rotative selon la revendication 6, dans laquelle la longueur longitudinale « L » de la au moins une cavité latérale (33) le long de la première direction (Y) orthogonale à l'axe Z est supérieure ou égale à $(1 \cos A + e/2 \sin A)$, « e » étant la hauteur de la saillie d'entraînement latérale (42) mesurée dans la direction Z et « A » étant le défaut d'alignement angulaire de l'élément d'entraînement (4) et/ou du rotor (3) autour d'un axe X orthogonal à un plan comprenant l'axe Z et la première direction.
8. Pompe rotative selon la revendication 6, dans laquelle la longueur longitudinale « L » de la au moins une cavité latérale (33) le long de la première direction (Y) orthogonale à l'axe Z est supérieure ou égale à $((1 - e/2) \cos A + e/2)$, « e » étant la hauteur de la saillie d'entraînement latérale (42) mesurée dans la direction Z et « A » étant le défaut d'alignement angulaire de l'élément d'entraînement (4) et/ou du rotor (3) autour d'un axe X orthogonal à un plan comprenant l'axe Z et la première direction.
9. Pompe rotative selon l'une quelconque des revendications précédentes, dans laquelle l'élément d'entraînement (4) comprend deux saillies d'entraînement latérales (42).
10. Pompe rotative selon la revendication 9, dans laquelle les deux saillies d'entraînement latérales (42) sont agencées à l'opposé l'une de l'autre le long de la première direction (Y) orthogonale à l'axe Z, de sorte que les saillies d'entraînement latérales (42) font saillie dans une direction perpendiculaire à partir de l'axe de rotation Z.
11. Pompe rotative selon la revendication 9, dans laquelle les deux saillies d'entraînement latérales (42) sont agencées dans un plan perpendiculaire à l'axe Z à un angle inférieur à 180°.

12. Pompe rotative selon l'une quelconque des revendications 9, 10 ou 11, dans laquelle les deux saillies d'entraînement latérales (42) sont agencées dans différents plans perpendiculaires à l'axe Z. 5
13. Pompe rotative (1) selon l'une quelconque des revendications précédentes, dans laquelle l'élément d'entraînement (4) est un arbre. 10
14. Pompe rotative (1) selon l'une quelconque des revendications précédentes, dans laquelle l'élément d'entraînement (4) comprend une partie intermédiaire s'étendant entre la partie de contact (41) et sa partie d'extrémité en forme de segment hémisphérique ou sphérique. 15

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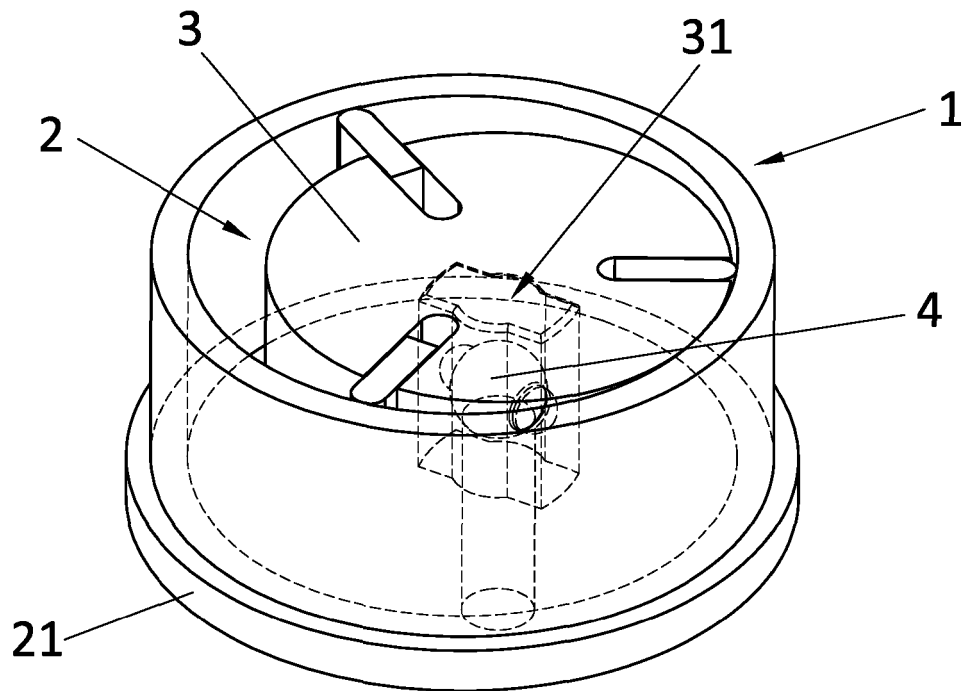


FIG. 1

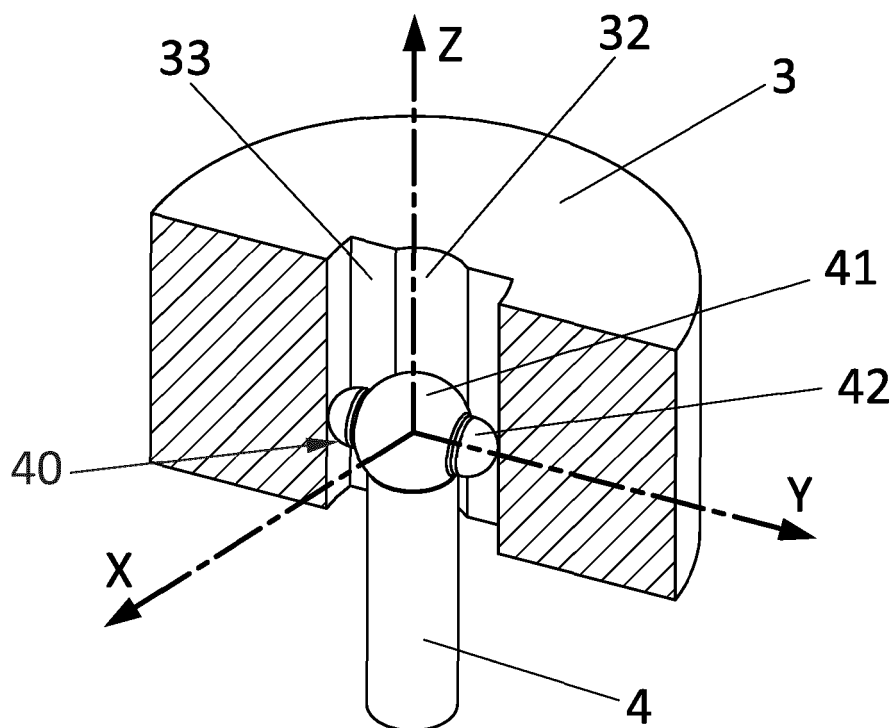


FIG. 2

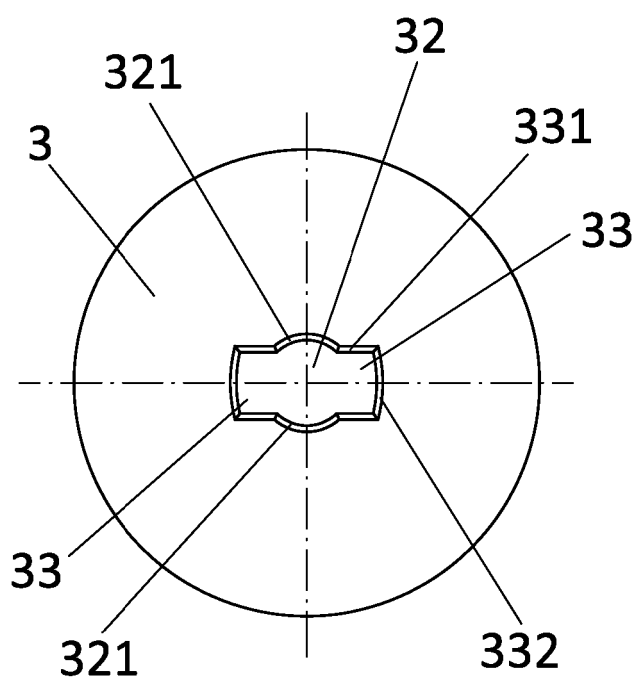


FIG. 3A

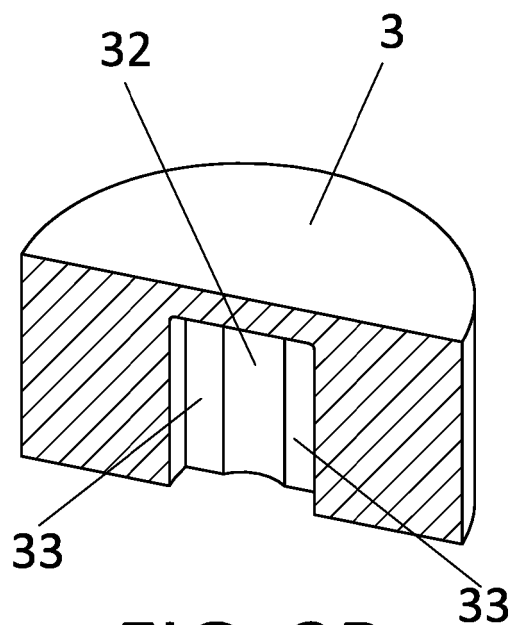


FIG. 3B

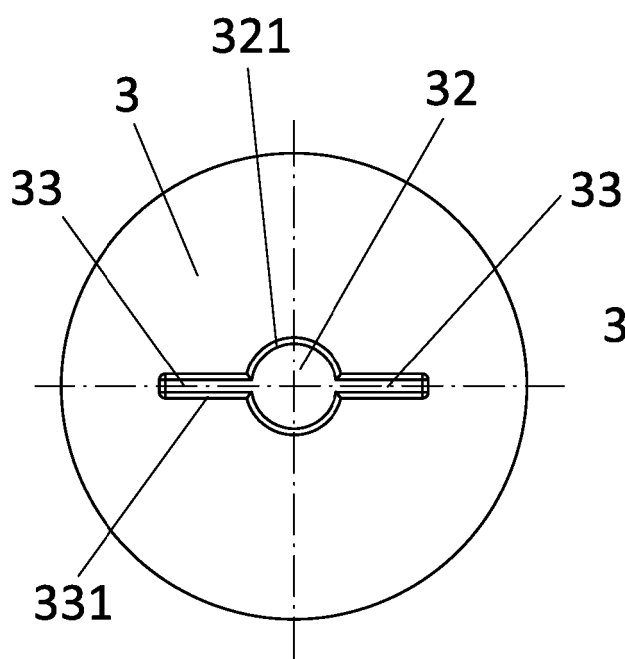


FIG. 4A

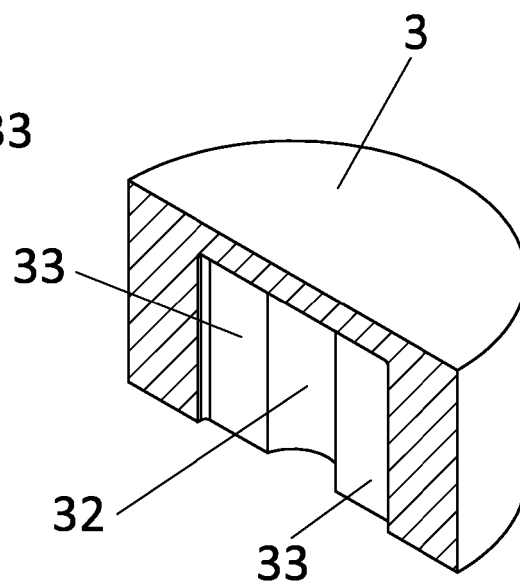
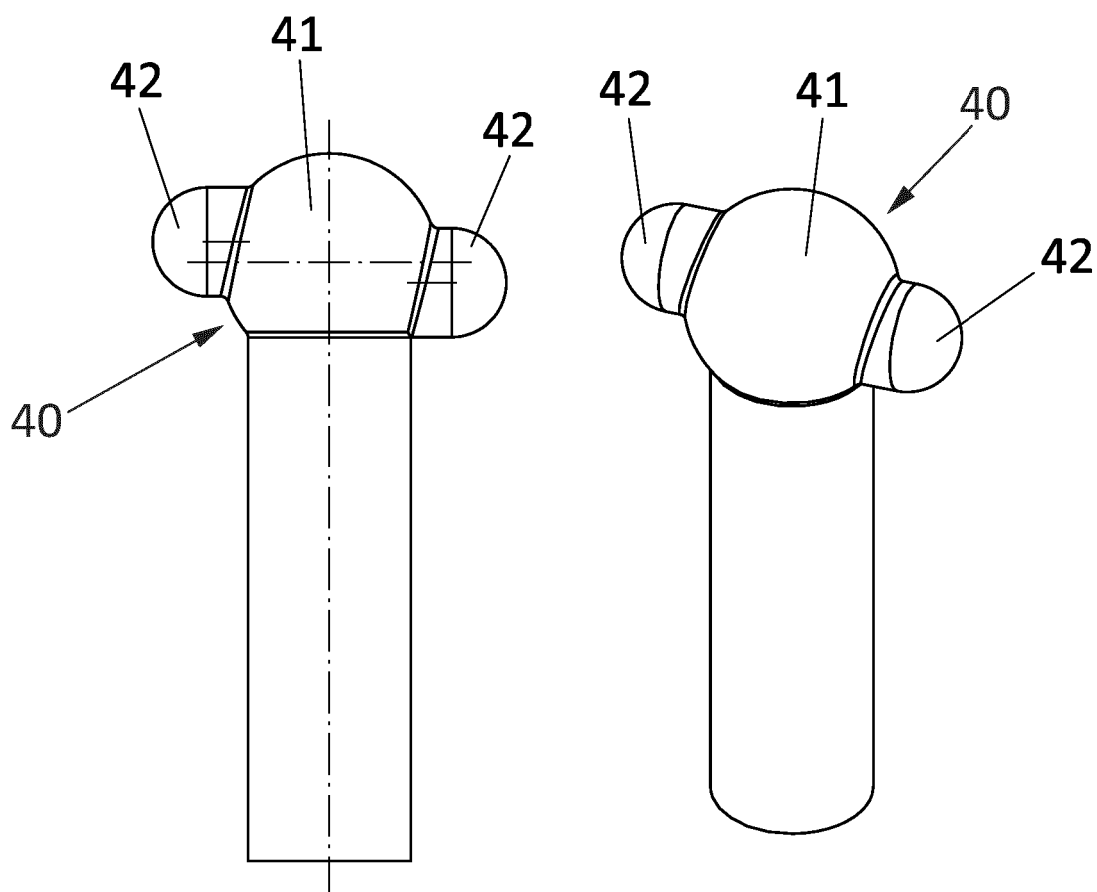
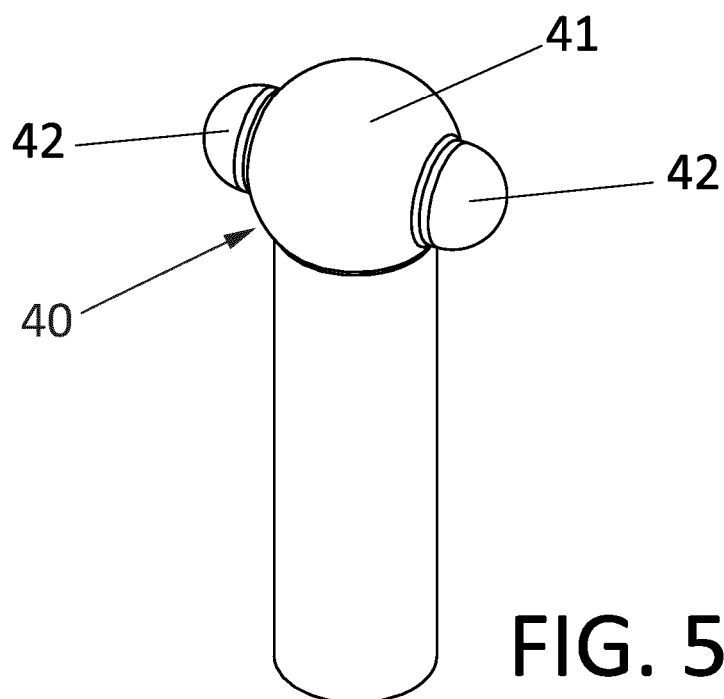


FIG. 4B



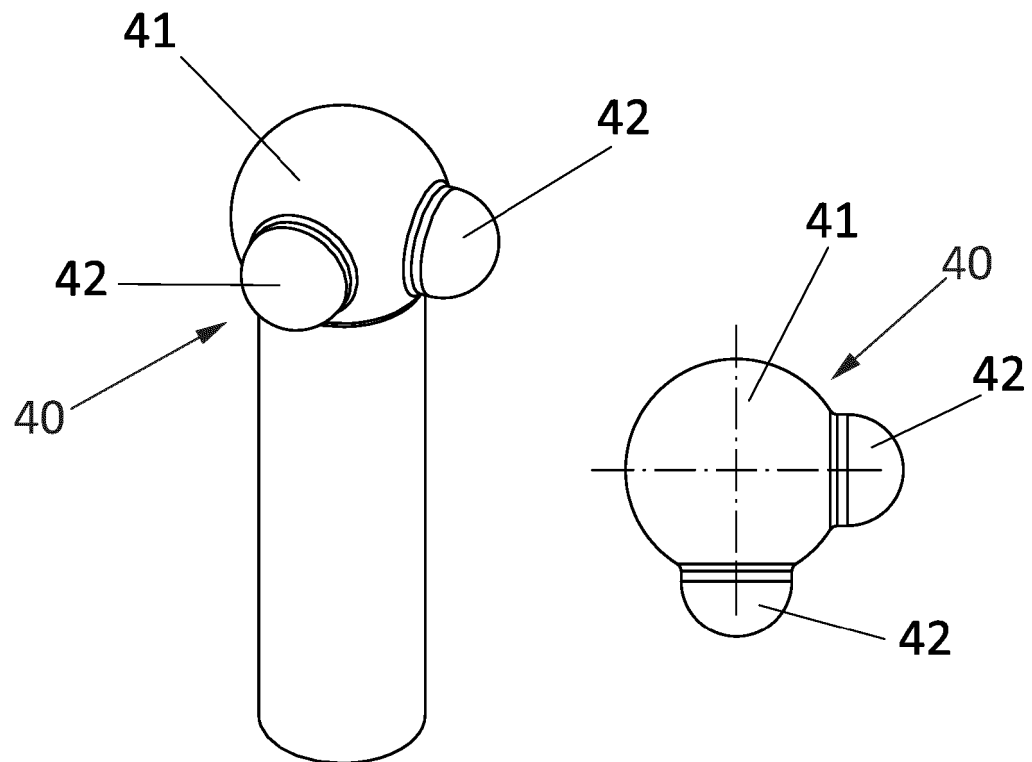


FIG. 5C

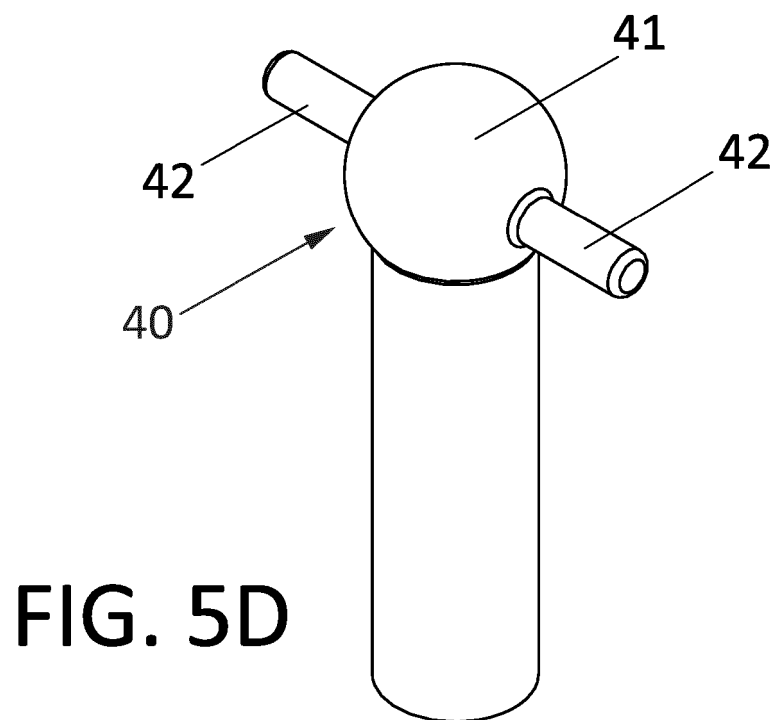


FIG. 5D

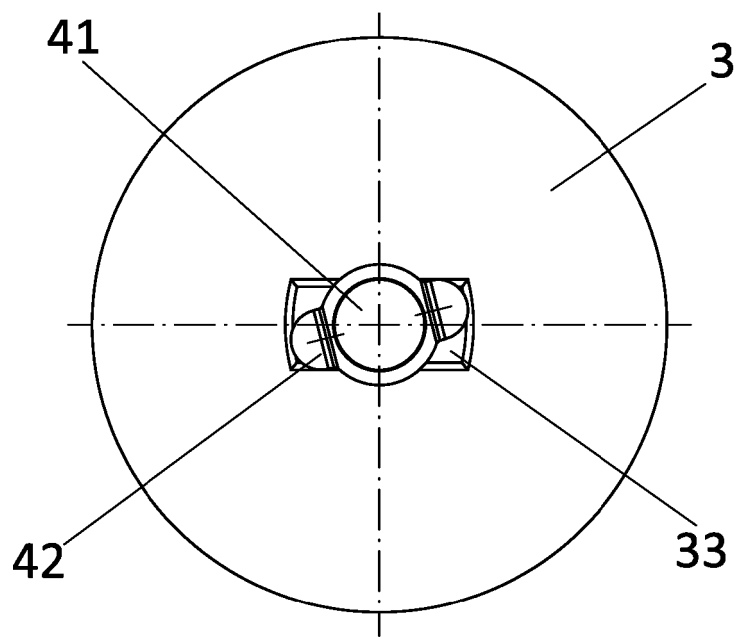


FIG. 6A

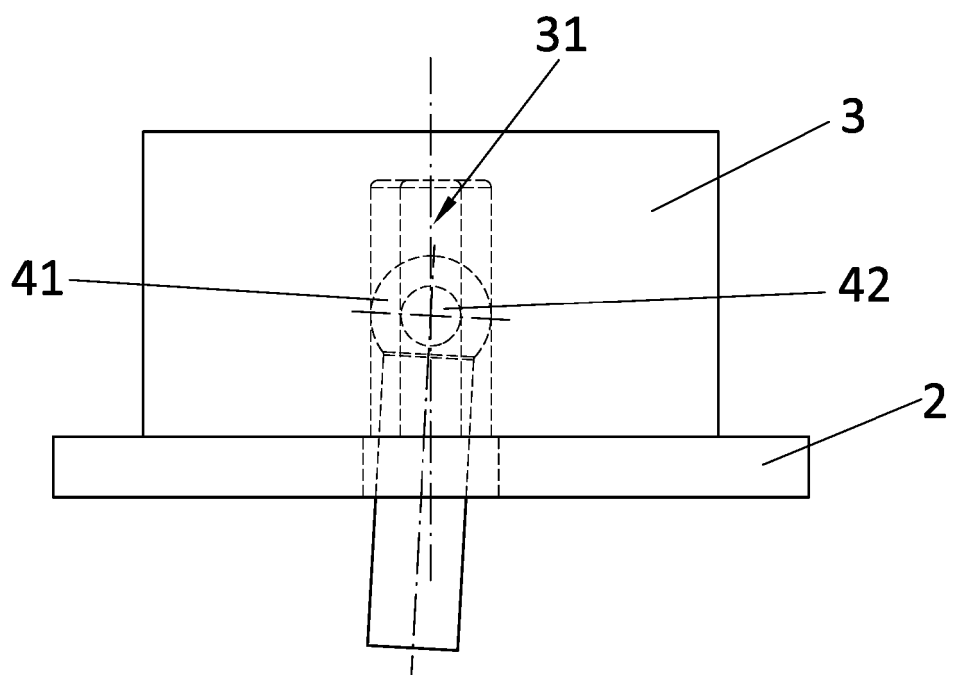


FIG. 6B

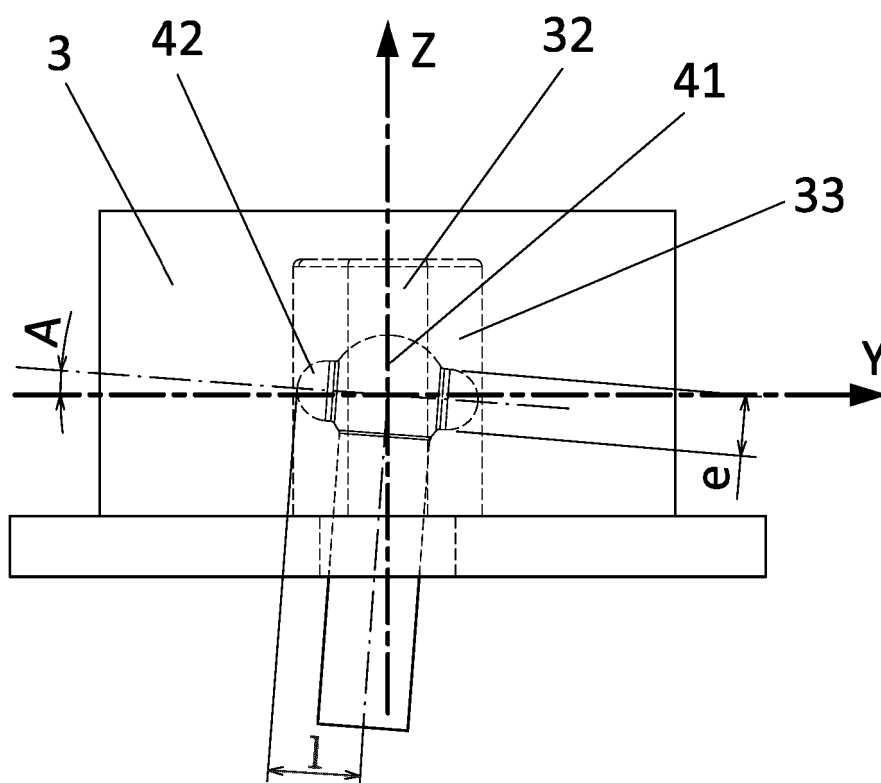


FIG. 6C

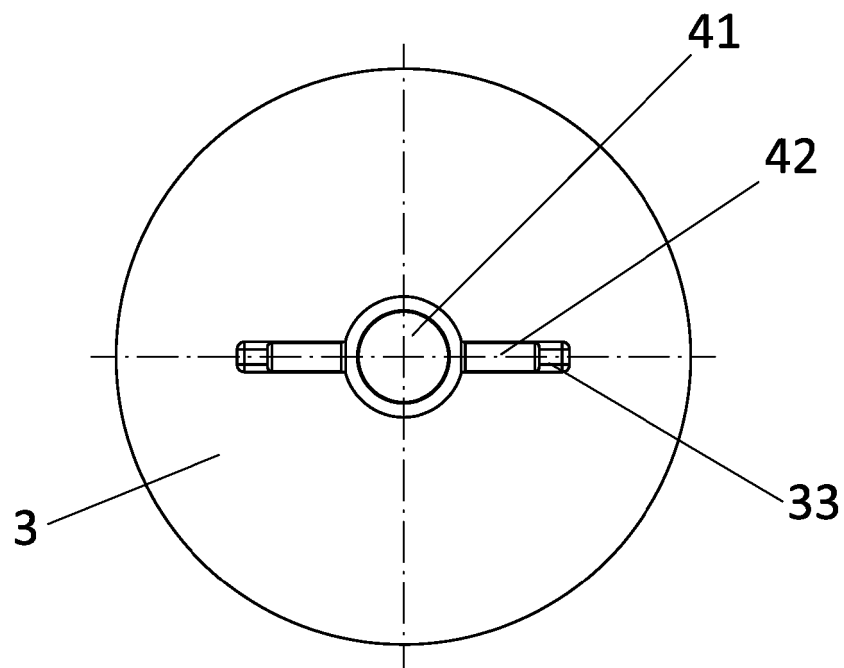


FIG. 7A

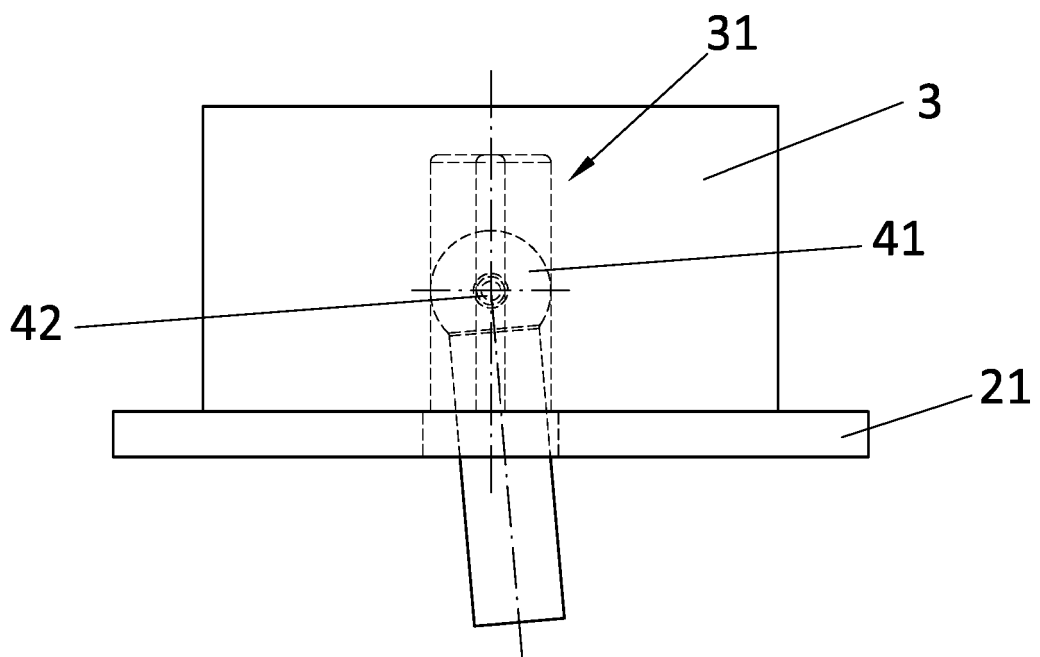


FIG. 7B

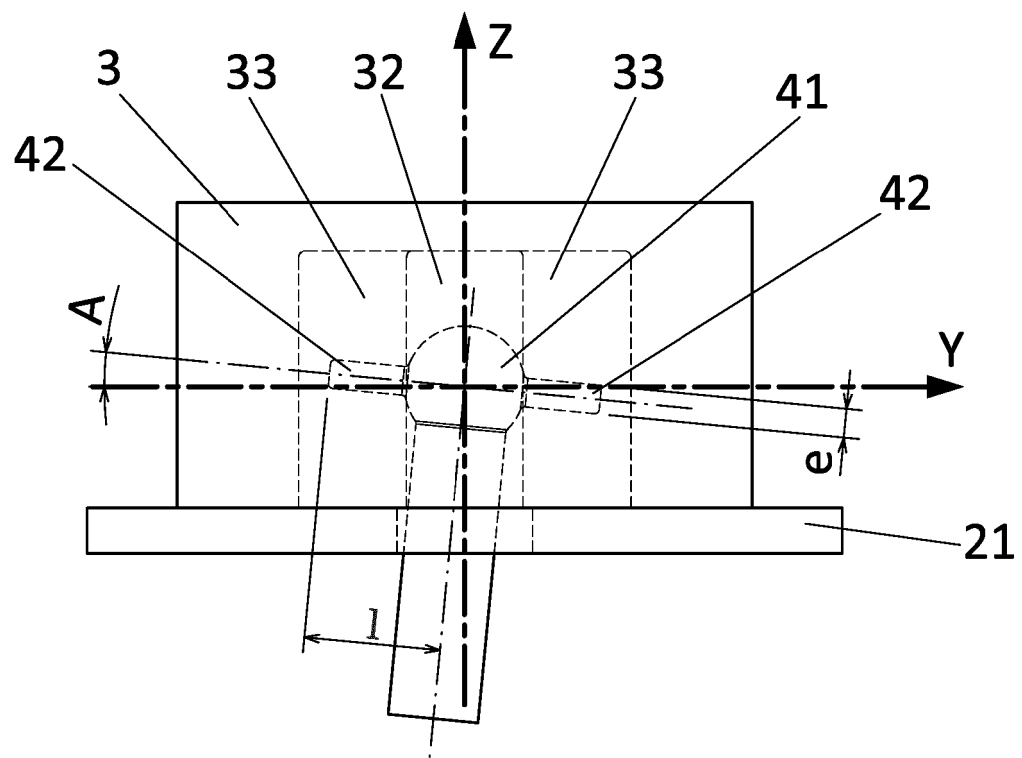


FIG. 7C

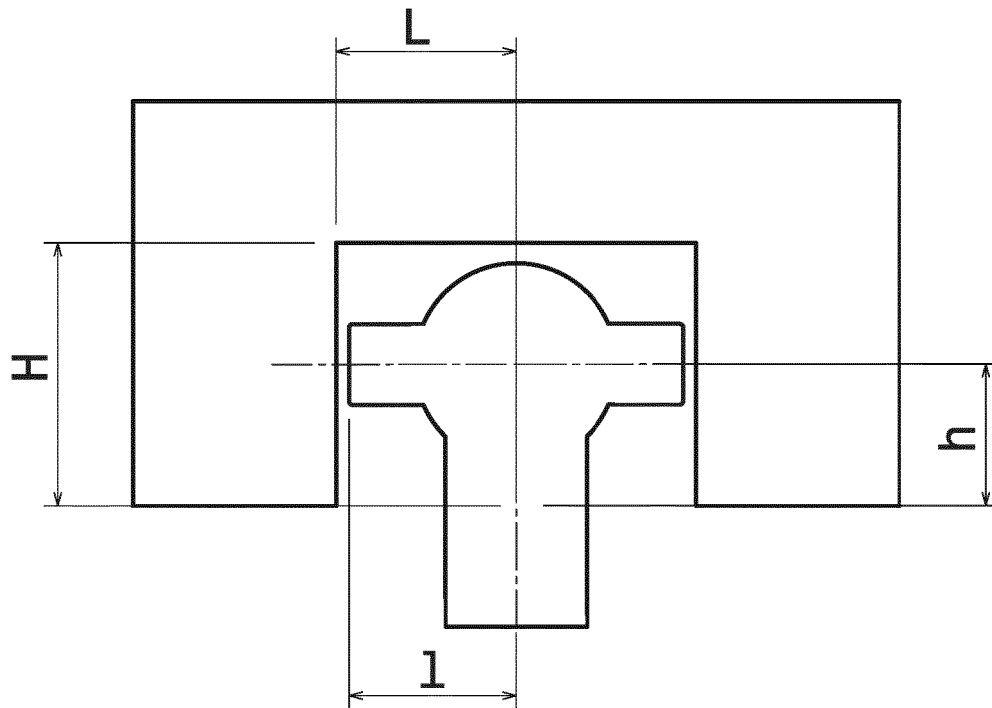


FIG. 8A

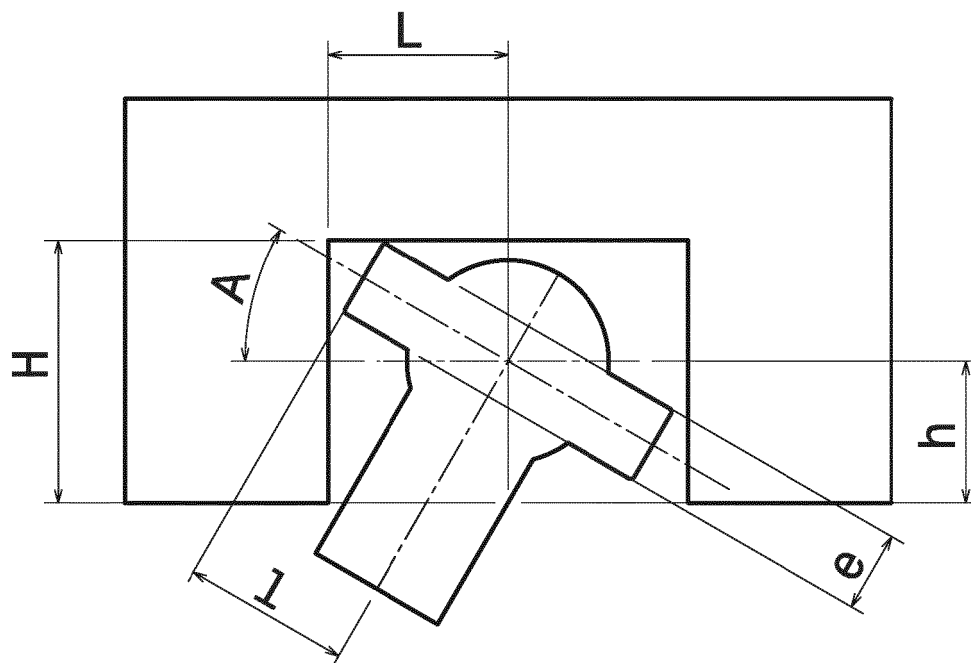


FIG. 8B

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 3113527 A [0008]
- US 1526356 A [0008]
- DE 102005020232 A1 [0008]