



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.09.2011 Bulletin 2011/38

(51) Int Cl.:
F04D 1/06 (2006.01) **F04D 13/10 (2006.01)**
F04D 29/08 (2006.01) **F04D 29/62 (2006.01)**

(21) Application number: **11158552.7**

(22) Date of filing: **16.03.2011**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(72) Inventors:
• **Matteazzi, Giuliano**
36040, Brendola (VI) (IT)
• **Zamberlan, Fiorenzo**
36070, Trissino (VI) (IT)

(30) Priority: **18.03.2010 IT VI20100075**

(74) Representative: **Bonini, Ercole**
Studio Bonini Srl
Corso Fogazzaro, 8
36100 Vicenza (IT)

(71) Applicant: **CALPEDA S.p.A.**
I-36050 Montorso Vicentino (VI) (IT)

(54) **Improved tight multi-stage pump**

(57) The invention is a multi-stage pump (1) comprising an external jacket (2) with a suction port (3) and a delivery port (4), provided at one end with a casing cover (5) and at the opposite end with a lantern bracket (6) supporting an electric motor (7) associated with rotary pumping members (8). The casing cover (5) and the lantern bracket (6) are coupled to the ends of the external jacket (2) through fixing means with the interposition of annular gaskets (17). Each gasket is housed in an annular seat (18) defined by a shaped annular area (19) present in the casing cover (5) and the lantern bracket (6) and by a counter-shaped annular area (20) present in the corresponding end of the external jacket (2), opposing each other. The counter-shaped annular area (20) comprises an annular counteracting surface (20a), inclined with respect to the longitudinal axis (Y) defined by the external jacket (2), suited to compress the annular gasket (17) when the casing cover (5) and the lantern bracket (6) are coupled to the external jacket (2) through the tie rods. The external jacket (2) is provided with a plurality of shaped annular portions (28) suited to make the external jacket (2) elastically yielding along the direction defined by its longitudinal axis (Y) and the fixing means comprise a plurality of tie rods (12) each one of which is provided with a first end (12a) constrained to the casing cover (5) and a second end (12b) constrained to the lantern bracket (6).

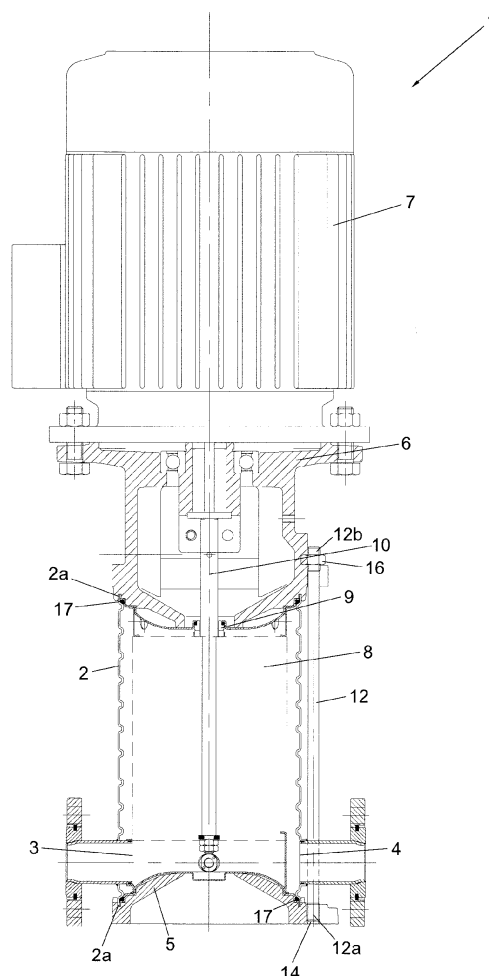


Fig.1

Description

DESCRIPTION

[0001] The invention concerns an improved tight multi-stage pump.

[0002] It is known that pumps frequently have tightness problems in the areas where the parts defining the casing that contains the pumping unit are coupled together.

[0003] Tightness problems occur even in multi-stage pumps, generally in the areas where the casing cover and the lantern bracket that supports the motor are coupled with the external jacket enclosing the pumping unit.

[0004] The known patent documents EP 0 406 787 A2, JP 57 103400 U, US 5 407 323 A and EP 0 566 089 A1 describe embodiments of multi-stage pumps provided with annular gaskets that are housed in annular seats where tightness is obtained thanks to an inclined annular surface that compresses the gasket.

[0005] During operation, at the level of the tight areas, the external jacket dilates due both to the internal pressure and to the heated liquid.

[0006] Due to this dilation, the contact with the gaskets is reduced and consequently a tightness loss takes place, which progressively increases over time and with the use of the pump.

[0007] The present invention aims to eliminate or at least mitigate this recognized drawback.

[0008] In particular, it is an object of the invention to improve, compared to the prior art, the conditions in which the gaskets provide tightness, especially in multi-stage pumps, at the level of the coupling area of the casing cover and the lantern bracket at the ends of the external jacket.

[0009] It is another object of the invention to guarantee that the gaskets are subjected to a compression force that remains substantially constant when the pump temperature and operating pressure change.

[0010] It is a further object of the invention to increase the rigidity of the mechanical coupling of the casing cover and the lantern bracket with the external jacket at the height of the area where there are the gaskets.

[0011] The objects described above are achieved by a multi-stage pump having the characteristics illustrated in the main claim.

[0012] Other details of the pump that is the subject of the invention are described in the dependent claims.

[0013] Advantageously, in the multi-stage pump of the invention the tightness of the coupling of the casing cover and the lantern bracket with the external jacket is obtained with no need to make costly modifications to the pump design.

[0014] Still advantageously, the higher degree of tightness is obtained using the same gaskets used in the prior art, improving their stability and their operating conditions.

[0015] The objects and advantages described above will be highlighted in greater detail in the description of a

preferred embodiment of the invention that is supplied here below as an indicative, non-limiting example, with reference to the enclosed drawings, wherein:

- Figure 1 shows a partial, longitudinal cross-sectional view of the pump that is the subject of the invention;
- Figure 2 shows an enlarged detail of Figure 1;
- Figure 3 shows an enlarged detail of Figure 2;
- Figure 4 shows an enlarged detail of Figure 3;
- Figure 5 shows a further enlarged detail of Figure 2;
- Figure 6 shows an enlarged detail of Figure 5.

[0016] The multi-stage pump that is the subject of the invention is shown in Figure 1, where it is indicated as a whole by 1.

[0017] It can be observed that it comprises a substantially cylindrical external jacket 2 with mainly longitudinal development, in which it is possible to identify a suction port 3 and a delivery port 4 arranged in proximity to one end of the external jacket to which a casing cover 5 is applied.

[0018] At the opposite end there is a lantern bracket 6 that supports an electric motor 7 of an assembly of rotary and statoric members indicated as a whole by 8, arranged inside the external jacket 2.

[0019] Regarding the rotary and statoric member assembly 8 that is hatched in the figure, it may be of any type.

[0020] Special gaskets 9 ensure tightness between the shaft 10 that connects the electric motor 7 to the pumping unit 8 and the lantern bracket 6, at the level of the passage hole 11 from the shaft 10 into the lantern bracket 6.

[0021] The casing cover 5 and the lantern bracket 6 are mechanically and removably coupled with the corresponding ends 2a of the external jacket 2 through fixing means.

[0022] Tightness in the coupling areas is guaranteed by interposing annular gaskets 17 that are preferably but not necessarily constituted by elastomer rings commonly available on the market and known as O rings.

[0023] Each one of said gaskets 17, as shown in greater detail in Figures from 4 to 6, is housed in an annular seat 18 that is defined by a shaped annular area 19 present in the casing cover 5 and the lantern bracket 6, and by a counter-shaped annular area 20 present in the corresponding end of the external jacket 2, opposing each other.

[0024] It can be observed that the counter-shaped annular area 20 comprises an annular counteracting surface 20a, inclined with respect to the longitudinal axis Y defined by the external jacket 2 and suited to compress the annular gasket 17 when the casing cover 5 and the lantern bracket 6 are coupled to the external jacket 2.

[0025] It can be observed, in particular, that the shaped annular area 19 present in the casing cover 5 belongs to a laminate element 21 that covers the surface of the casing cover 5 directed towards the inside of the external jacket 2 when the casing cover 5 is coupled to the external

jacket 2.

[0026] Analogously, it can be observed that the shaped annular area 19 present in the lantern bracket 6 belongs to a laminate element 22 that covers the surface of the lantern bracket 6 directed towards the inside of the external jacket 2 when the lantern bracket 6 is coupled to said external jacket 2.

[0027] Finally, each counter-shaped annular area 20, when the pump is assembled, is arranged in front of each corresponding shaped annular area 19 and is obtained in the body of the external jacket 2 at the level of each end 2a.

[0028] It is in the coupling of the casing cover 5 and the lantern bracket 6 to the external jacket 2 that the annular seat 18 is defined, whose cross section, obtained according to a plane passing through the longitudinal axis Y defined by the external jacket 2, substantially has the shape of a right-angled trapezium whose sloping side corresponds to the annular counteracting surface 20a.

[0029] In particular, the annular surface 20a counteracts the gasket 17 when the fixing means tighten the casing cover 5 and the lantern bracket 6 against the ends 2a, 2b of the external jacket 2 with a force that generates:

- an axial component that forces the gasket 17 against the bottom 18a of the annular seat 18 and
- a radial component that tends to expand it making it adhere to the walls 18b of the annular seat 18, that is, against the lateral walls of the shaped annular area 19 and of the counter-shaped annular area 20 that define it.

[0030] The degree of tightness is defined by the degree of tightening of the fixing means.

[0031] According to the invention, the fixing means, as shown in detail in Figures 2 and 3, comprise a plurality of tie rods 12, wherein each tie rod 12 has a first threaded end 12a screwed into a threaded hole 14 present in the casing cover 5 and a second threaded end 12b constrained into a through hole made in the lantern bracket 6 through a nut 16.

[0032] The tightening of the nut 16 against the surface of the lantern bracket 6 tensions the tie rod 12 and ensures the stable connection of the casing cover 5 and the lantern bracket 6 to the ends of the external jacket 2.

[0033] Again according to the invention, the external jacket 2 has a plurality of shaped annular portions 28 suited to make the external jacket 2 elastically yielding along the direction defined by the longitudinal axis Y.

[0034] In particular, the shaped annular portions 28 have their convex side directed towards the inside of the external jacket 2, are arranged according to planes that are parallel to each other and arranged crosswise to the longitudinal axis of the external jacket 2 and serve to make it yield elastically when it is subjected to axial loads.

[0035] Therefore, tightening the tie rods 12 fixes the casing cover 5 and the lantern bracket 6 to the ends 2a of the external jacket 2, so that the latter is forced axially

and thus preloaded simulating the behaviour of a spring.

[0036] During operation, any elongation due to a pressure or temperature increase is absorbed by the elastic recovery due to the preload that has been given to the external jacket on assembly by adjusting the tightening of the tie rods, and this allows the thrust against the gaskets 17 to be kept constant.

[0037] In this way the first object is achieved, that is, the object to improve the tightness of the gasket 17 by increasing adherence against the walls of the annular seat 18 in which it is contained.

[0038] Furthermore, the invention also achieves the object to guarantee that the gaskets are subjected to a substantially constant compression force independently of the pump temperature and operating pressure, by properly adjusting the degree of tightening of the tie rods 12.

[0039] Tightness is improved also by improving the mechanical rigidity of the coupling of the casing cover 5 and the lantern bracket 6 to the external jacket 2.

[0040] In fact, it can be observed in detail in Figures 4 and 6 that the casing cover 5 and the lantern bracket 6 are provided with an annular groove 25 that houses the perimeter edge of the corresponding end 2a of the external jacket 2 when the tie rods 12 mechanically connect the casing cover 5 and the lantern bracket 6 to the external jacket 2.

[0041] In this way, each end 2a of the external jacket 2 remains constrained in the annular groove 25 in which it is housed, substantially eliminating any radial movement of the external jacket that may occur in that area due to heat or pressure.

[0042] This considerably increases the stability of the gaskets and positively affects also their tightness over time.

[0043] According to the preferred embodiment of the invention described herein, the cross section of each one of the shaped annular portions of the external jacket 2 carried out according to a plane passing through the longitudinal axis Y has substantially the shape of an isosceles trapezium.

[0044] It is evident, however, that said shaped portions can have any profile and shape, for example the shape of an arc of a circle or another shape, and their convex side can be directed towards the inside or the outside of the external jacket 2.

[0045] Regarding the suction port 3 and the delivery port 4, it can be observed that at the level of each of them there is a sleeve 30, 40 that is connected directly to the external jacket 2 through a weld bead 31, 41 carried out by means of one of the known automatic or manual welding systems.

[0046] The application of said sleeves 30, 40 directly to the external jacket 2 through a welded joint simplifies the construction of the pump and lowers its costs. Obviously, each sleeve 30, 40 can be provided, for example, with a flange 32, 42 suited to house a corresponding counter-flange coupled therewith, not illustrated in the

drawings, in order to connect the pump 1 to external suction and delivery pipes that are not illustrated, either.

[0047] Alternatively the sleeves 30, 40 can be connected to the external pipes via threading or other known joining systems.

[0048] On the basis of the above, it is clear that the multi-stage pump that is the subject of the invention achieves all the set objects.

[0049] In particular, it has been shown that it is possible to guarantee improved gasket tightness over time by combining the following:

- making the external jacket 2 axially elastic by means of the shaped annular portions 28;
- applying the tie rods 12 that make it possible to adjust the axial tightening force.

[0050] Moreover, a further improvement, especially in terms of gasket stability, is obtained by stiffening the mechanical connection of the ends 2a of the external jacket 2 in the coupling with the casing cover 5 and the lantern bracket 6.

[0051] It is evident that in the construction stage the pump of the invention can be subjected to modifications and changes that may consist, for example, in different profiles of the annular seats that house the gaskets and even in the presence of different numbers of the same.

[0052] Furthermore, as already explained, the form of the shaped annular portions obtained on the external jacket and their number can be different from those described and illustrated herein.

[0053] Finally, it will also be possible to modify the way in which each end of the external jacket 2 is mechanically connected to the corresponding casing cover 5 and the corresponding lantern bracket 6 so that it is different from the procedure described and illustrated herein.

[0054] All the variant embodiments described herein and any other, neither described nor illustrated, that should be applied to the pump of the invention, must all be considered protected by the present patent, provided that they fall within the scope of the following claims.

[0055] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the protection of each element identified by way of example by such reference signs.

Claims

1. Multi-stage pump (1) comprising a substantially tubular external jacket (2) with mainly longitudinal development and with at least one suction port (3) and at least one delivery port (4), provided at one end with a casing cover (5) and at the opposite end with a lantern bracket (6) supporting an electric motor (7)

associated with rotary pumping members (8) arranged inside said external jacket (2), said casing cover (5) and said lantern bracket (6) being mechanically and removably coupled to the ends of said external jacket (2) through fixing means with the interposition of annular gaskets (17), each one of which is housed in an annular seat (18) defined by a shaped annular area (19) present in said casing cover (5) and in said lantern bracket (6), and by a counter-shaped annular area (20) present in the corresponding end of said external jacket (2), opposing each other, said counter-shaped annular area (20) comprising an annular counteracting surface (20a), inclined with respect to the longitudinal axis (Y) defined by said external jacket (2), suited to compress said annular gasket (17) when said casing cover (5) and said lantern bracket (6) are coupled to said external jacket (2) through said fixing means, **characterized in that** said external jacket (2) is provided with a plurality of shaped annular portions (28) suited to make said external jacket (2) elastically yielding along the direction defined by its longitudinal axis (Y) and **in that** said fixing means comprise a plurality of tie rods (12), each having a first end (12a) constrained to said casing cover (5) and a second end (12b) constrained to said lantern bracket (6).

2. Multi-stage pump (1) according to claim 1, **characterized in that** said casing cover (5) and said lantern bracket (6) are provided with an annular groove (25) housing the perimeter edge of the corresponding end (2a) of said external jacket (2) when said fixing means mechanically connect said casing cover (5) and said lantern bracket (6) to said external jacket (2).
3. Multi-stage pump (1) according to any of the preceding claims, **characterized in that** said counter-shaped annular area (20) present in each end of said external jacket (2) is obtained in the body of said external jacket (2).
4. Multi-stage pump (1) according to any of the preceding claims, **characterized in that** said shaped annular area (19) present in said casing cover (5) belongs to a laminate element (21) that covers the surface of said casing cover directed towards the inside of said external jacket (2) when said casing cover (5) is coupled to said external jacket (2).
5. Multi-stage pump (1) according to any of the preceding claims, **characterized in that** said shaped annular area (19) present in said lantern bracket (6) belongs to a laminate element (22) that covers the surface of said lantern bracket (6) directed towards the inside of said external jacket (2) when said lantern bracket (6) is coupled to said external jacket (2).

6. Multi-stage pump (1) according to any of the preceding claims, **characterized in that** the cross section of said annular seat (18) made according to a plane passing through the longitudinal axis (Y) defined by said external jacket (2) has substantially the shape of a right-angled trapezium. 5
7. Multi-stage pump (1) according to any of the preceding claims, **characterized in that** each one of said suction port (3) and delivery port (4) is provided with a sleeve (30, 40) directly connected to said external jacket (2) through at least one weld bead (31, 41). 10
8. Multi-stage pump (1) according to any of the preceding claims, **characterized in that** the cross section of each one of said shaped annular portions (28) made according to a plane passing through the longitudinal axis (Y) defined by said external jacket (2) has the shape of a trapezium with the convex side facing towards the inside of said external jacket (2). 15 20
9. Multi-stage pump (1) according to any of the preceding claims, **characterized in that** in each one of said tie rods (12) said first end (12a) is threaded and constrained into a threaded hole (14) present in said casing cover (5) and said second end (12b) is threaded and constrained into a through hole made in said lantern bracket (6) through a nut (16). 25

30

35

40

45

50

55

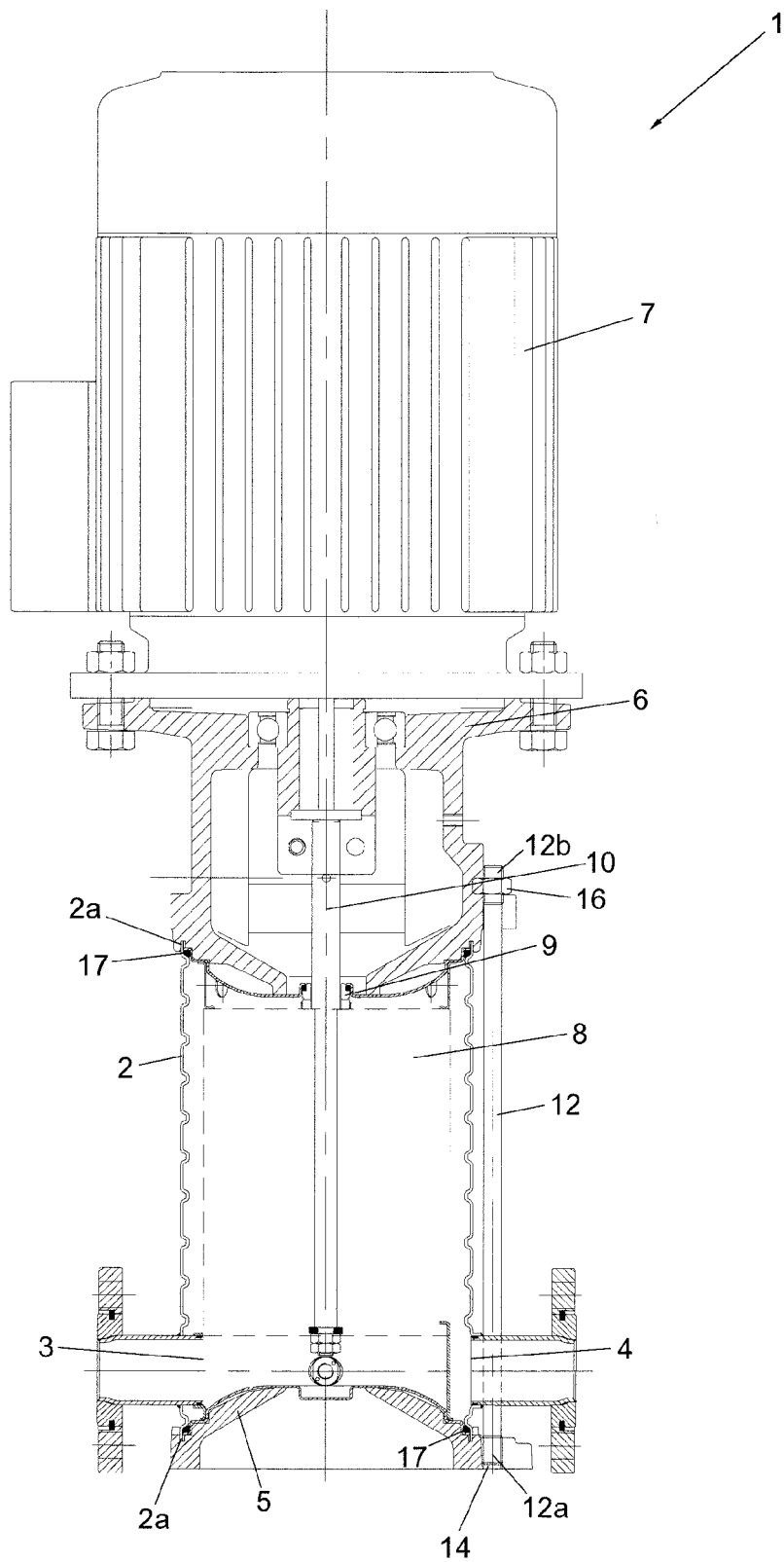


Fig.1

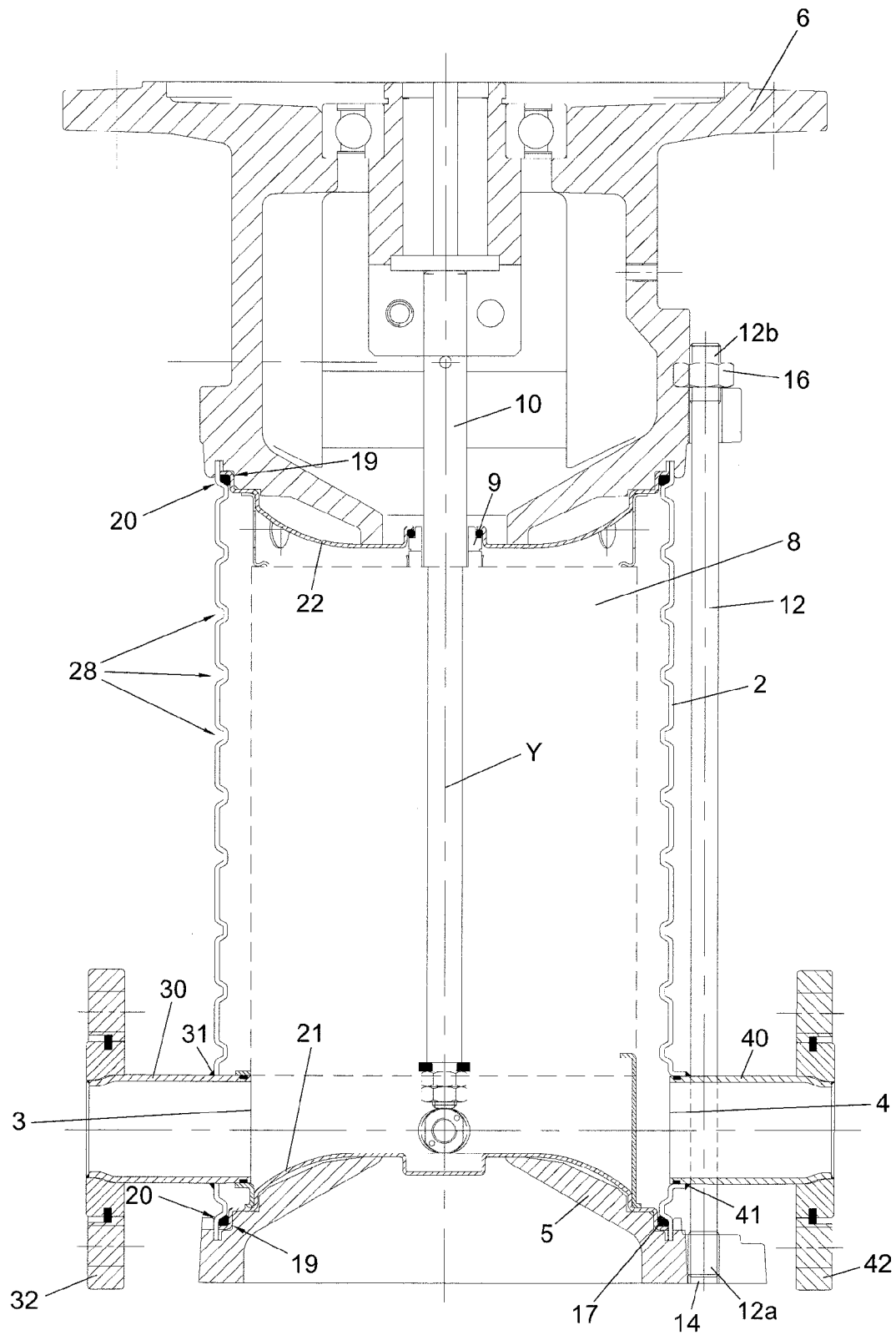
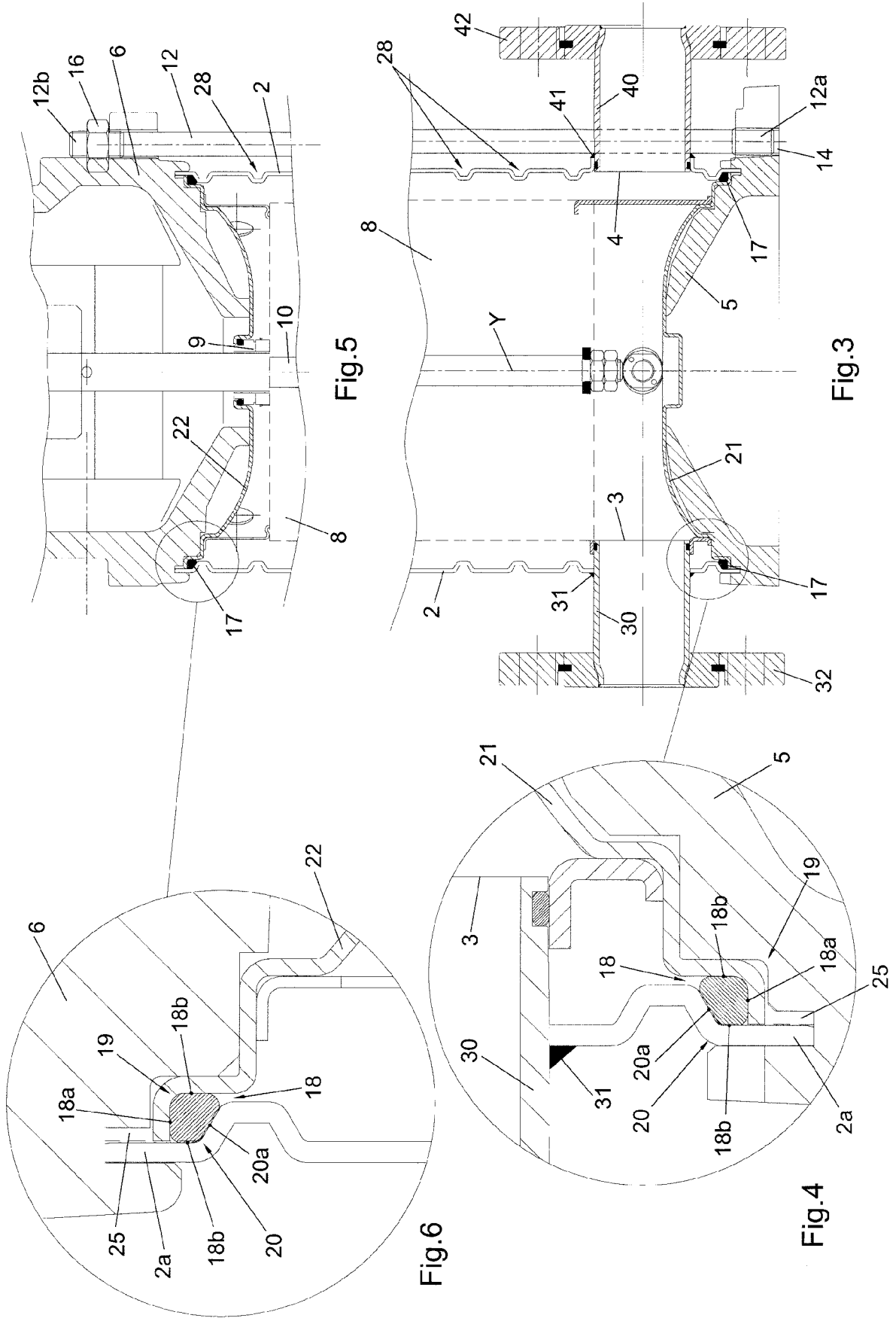


Fig.2



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 0406787 A2 [0004]
- JP 57103400 U [0004]
- US 5407323 A [0004]
- EP 0566089 A1 [0004]