



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
11.12.2019 Bulletin 2019/50

(51) Int Cl.:
F04B 1/04 (2006.01) **F04B 53/04** (2006.01)
F04B 53/16 (2006.01) **F04B 53/18** (2006.01)
F04B 39/12 (2006.01)

(21) Application number: **19174328.5**

(22) Date of filing: **14.05.2019**

(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
Designated Validation States:
KH MA MD TN

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(30) Priority: **08.06.2018 IT 201800006145**

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(54) **VOLUMETRIC PISTON PUMP**

(57) A volumetric piston pump (10) that comprises:
- a casing (20) equipped with a cylinder (21) defining a compression chamber (22) communicating with an intake conduit (23,25) and a delivery conduit (24,27);
- a reciprocating piston (30) slidable inside the cylinder (21) and delimiting the compression chamber (22);
- a first gasket (60) fixed to the casing (20) inside the cylinder (21) and coaxially inserted on the reciprocating piston (30);
- a second gasket (61) fixed to the casing (20) inside the

cylinder (21) and coaxially inserted on the reciprocating piston (30) in distal position from the compression chamber (22) with respect to the first gasket (60);
- a collection chamber (65) interposed and axially delimited between the first gasket (60) and the second gasket (61);
- a recirculation conduit (70) that connects the collection chamber (65) with the intake conduit (23,25); and
- a lubrication conduit (80) that connects the delivery conduit (24,27) with the collection chamber (65).

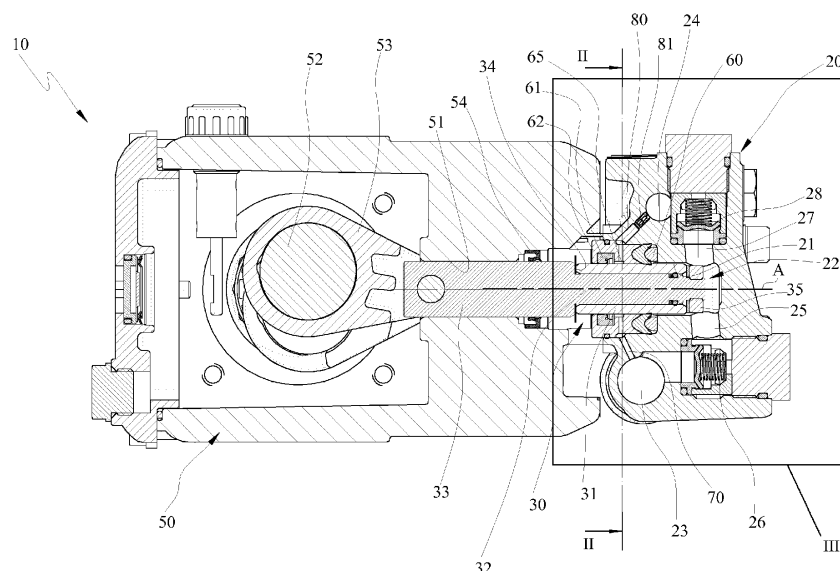


FIG.1

Description

TECHNICAL FIELD

[0001] The present invention concerns the field of volumetric piston pumps that can be installed on pressure washers or on other machines for distributing and/or dispensing pressurised fluids (typically water), for example used in high-pressure industrial washing.

PRIOR ART

[0002] As known, volumetric piston pumps generally comprise an intake conduit adapted for being connected to a tank of the fluid to be pumped, a delivery conduit adapted for being connected to a fluid dispensing device (for example to a rod or a dispensing gun) equipped with an end nozzle, and an adjustment valve, hydraulically interposed between the delivery conduit and the dispensing device, which is adapted for adjusting the maximum dispensing pressure of the fluid.

[0003] Moreover, volumetric piston pumps generally comprise a pump body, defining one or more cylinders, and a head, fixed to the pump body and adapted for closing an end of each cylinder. Inside every cylinder a reciprocating piston is slidably received, said piston being adapted for defining, together with the corresponding cylinder and the head, a respective compression chamber having variable volume. The pistons are kinematically connected to a drive shaft (using eccentrics) through a respective rod-crank linkage, which is adapted for transforming the rotary movement of the actuation shaft, imparted by an actuation motor, into a reciprocating linear movement of the piston. Each compression chamber is connected to the intake conduit through a respective one-way intake valve and to the delivery manifold through a respective one-way delivery valve.

[0004] The high pressure of the fluid delivered by the end nozzle is ensured by the sealing system of the fluid on the pistons and by the materials used to ensure the suitable lifetime of the sealing system.

[0005] A known efficient sealing system is the so-called "double gasket sealing system", which consists, for every piston, of a high-pressure gasket of more rigid material (for example rubber and cloth) and of a low-pressure gasket of softer material (rubber).

[0006] The double gasket sealing system is particularly efficient since the high-pressure gasket, due to the high pulsating loads, tends, by wearing, to allow leaks to come out that are held by a low-pressure gasket that prevents them from being directed towards the rod-crank linkage, but are collected in a chamber interposed between the high-pressure gasket and the low-pressure gasket from which they are reintroduced into the intake conduit through a suitable channel.

[0007] The high-pressure gasket, during the operation of the pump, is immersed in the fluid and is lubricated and cooled by it in an optimal manner, reducing the fric-

tion that generates the wearing thereof.

[0008] The low-pressure gasket, on the other hand, due to the position thereof, cannot be easily lubricated, since the chamber interposed between the high-pressure gasket and the low-pressure gasket is constantly emptied due to the depression existing in the intake conduit (especially since in the priming step, operating without lubrication, it will tend to overheat and wear the sealing lip in contact with the piston) and, also in the case in which the pump is supercharged, it is found that there can be air pockets in the upper part of the chamber interposed between the high-pressure gasket and the low-pressure gasket, said air pockets being difficult to evacuate due to the lack of escape paths, such air is, however, harmful and causes the erosion of the surface of the pistons or of the head in particular in the compression chambers of the liquid.

[0009] The pistons, moreover, in order to withstand the loads and the wear generated by the high pressures, are generally made of sintered ceramic or other very hard materials, which are difficult to work and thus expensive.

[0010] A known volumetric piston pump having the technical features recited in the preamble of claim 1 is disclosed in document EP2728190. A purpose of the present invention is to overcome the aforementioned drawbacks of the prior art, in a simple, rational and low-cost solution.

[0011] Such purposes are achieved by the characteristics of the invention given in the independent claim. The dependent claims outline preferred and/or particularly advantageous aspects of the invention.

SUMMARY OF THE INVENTION

[0012] The invention, particularly, provides a volumetric piston pump that comprises:

- a casing (or head) equipped with a cylinder and defining a compression chamber communicating with an intake conduit and a delivery conduit;
- a reciprocating piston slidable inside the cylinder and delimiting the compression chamber;
- a first gasket fixed to the casing inside the cylinder and coaxially inserted on the piston;
- a second gasket fixed to the casing inside the cylinder and coaxially inserted on the piston in distal position from the compression chamber with respect to the first gasket;
- a collection chamber interposed and axially delimited between the first gasket and the second gasket;
- a recirculation conduit that connects the collection chamber with the intake conduit, for example upstream of a one-way intake valve arranged in the intake conduit; and
- a lubrication conduit that connects the delivery conduit, for example downstream of a one-way delivery valve arranged in the delivery conduit, with the collection chamber.

[0013] Thanks to such a solution, the flow of fluid that from the lubrication conduit enters naturally into the collection chamber makes it possible to improve the lubrication and the cooling of the second (low-pressure) gasket, reducing the wearing thereof and, therefore, increasing the lifetime thereof (thus making it possible to decrease the maintenance interventions to restore the second gasket itself).

[0014] At the same time, the flow of fluid that from the lubrication conduit enters naturally into the collection chamber makes it possible to wash possible residual air bubbles or pockets that would otherwise accumulate in the collection chamber, thus making it possible to reduce the phenomenon of cavitation that degrades the surface of the piston, compromising the seal between the first and second gasket and the same piston. Therefore, such a solution makes it possible to decrease the maintenance interventions on expensive parts like the pistons.

[0015] According to an aspect of the invention, the volumetric pump can comprise a nozzle, for example a nebulizing nozzle or in any case one with a calibrated section, which is arranged in the lubrication conduit (to intercept the flow of fluid that crosses it).

[0016] Thanks to such a solution, the pressure of the fluid inside the collection chamber can be limited with respect to the high delivery pressure of the fluid itself and, at the same time, the efficiency of lubrication and cooling of the second (low-pressure) gasket and of evacuation of the air pockets present in the collection chamber can be increased without excessively affecting the loss of flow rate of fluid to be dispensed.

[0017] Preferably, the lubrication conduit can be made in the casing.

[0018] Thanks to this, the lubrication conduit is particularly compact and functional. According to an aspect of the invention, the casing can comprise a plurality of cylinders, each equipped with a respective collection chamber, in which a respective reciprocating piston is received.

[0019] In such an aspect a first embodiment of the volumetric pump can provide for a lubrication conduit for every collection chamber of each cylinder.

[0020] Therefore, the volumetric pump comprises as many lubrication conduits as there are collection chambers, i.e. as there are cylinders, allowing the efficient lubrication and cooling of each second (low-pressure) gasket and the efficient evacuation of air pockets from the respective collection chambers.

[0021] In such an aspect, a second and alternative embodiment of the volumetric pump can provide for a single lubrication conduit that connects the delivery conduit with a single collection chamber of the plurality of collection chambers; in this case the collection chamber connected to the lubrication conduit can then be connected to the other collection chambers, i.e. placed in fluid communication with them, through a respective service channel.

[0022] Thanks to such a solution, it is possible to optimise the production costs of the volumetric pump while

at the same time allowing the efficient lubrication and cooling of each second (low-pressure) gasket and the efficient evacuation of the air pockets from the respective collection chambers.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] Further characteristics and advantages of the invention will become clearer from the following description provided as a non-limiting example, with the help of the figures illustrated in the attached tables.

Figure 1 is a section view of a first embodiment of a volumetric piston pump carried out according to a plane containing the axis of a piston.

Figure 2 is a section view along the section line II-II of figure 1.

Figure 3 is an enlargement of the detail III of figure 1.

Figure 4 is a section view of a second embodiment of a volumetric piston pump carried out according to a plane containing the axis of a piston (central).

Figure 5 is a section view along the section line V-V of figure 4.

Figure 6 is an enlargement of the detail VI of figure 4.

BEST EMBODIMENT OF THE INVENTION

[0024] With particular reference to such figures, reference numeral 10 globally indicates a volumetric piston pump, which can be installed on a pressure washer or on another machine or system for distributing or dispensing pressurised fluids (typically water), for example for industrial washing.

[0025] The volumetric pump 10 comprises an outer casing, commonly called head 20 defining a cylinder 21 with which a reciprocating piston 30 is associated so as to be able to slide in the axial direction.

[0026] The reciprocating piston 30, together with the corresponding cylinder 21 and the head 20, defines a respective compression chamber 22 having variable volume.

[0027] The volumetric pump 10, in the example, comprises a plurality (in the example 3 in number) of (identical) cylinders 21, for example parallel and equidistant, with each of which a respective reciprocating piston 30 is associated so as to be able to slide in the axial direction, defining a respective compression chamber 22.

[0028] The volumetric pump 10 comprises an intake manifold 23 and a delivery manifold 24, both of which can be made in the head 20.

[0029] Each compression chamber 22 can be connected to the intake manifold 23 through a respective intake pipe 25, for example through a respective intake valve 26.

[0030] The intake manifold 23 opens outside of the head 20 through an inlet opening (not illustrated) and, together with each intake pipe 25 defines (the end segment distal from the compression chamber 22 of) an intake conduit of the volumetric pump 10.

[0031] Moreover, each compression chamber 22 can be connected to the delivery manifold 24 through a respective delivery pipe 27, for example through a respective delivery valve 28.

[0032] The delivery manifold 24 opens outside of the head 20 through an outlet opening (not illustrated) and, together with each delivery pipe 27 defines (the end segment distal from the compression chamber 22 of) a delivery conduit of the volumetric pump 10.

[0033] The intake valves 26 and the delivery valves 28 can be automatic one-way valves and are *per se* conventional.

[0034] The inlet opening of the intake conduit (i.e. of the intake manifold 23) can be connected to a tank containing the fluid to be pumped, whereas the outlet opening of the delivery conduit (i.e. of the delivery manifold 24) can be connected to a dispensing device, for example to a dispensing gun or rod, which can be equipped with suitable valve members adapted for selectively opening and closing the dispensing of the fluid following a manual actuation. Each reciprocating piston 30 comprises a cylindrical jacket 31, typically made of ceramic material, which is coaxially slotted onto a support stem 32, typically made of metallic material like steel.

[0035] The support stem 32 is coaxially formed in a single body with a rear cylindrical trunk 33 of increased diameter, from which it is separated by a shoulder 34.

[0036] The cylindrical jacket 31 is axially locked between the shoulder 34 and a lock nut 35 screwed to the free end of the support stem 32.

[0037] The rear trunk 33 is localized outside of the head 20 and is arranged inside a case 50 fixed to the head 20 itself, for example slidably slotted inside a cylindrical guide seat 51 formed in the case 50.

[0038] The case 50 houses a crankshaft 52 and a connecting rod 53, which is articulated both to the rear trunk 33 and to the crankshaft 52, so as to make a thrusting crank gear (of the rod-crank type) adapted for transforming the rotary motion of the crankshaft 52 into a reciprocating movement of the reciprocating piston 30 along the direction defined by its own longitudinal axis A. The rotation of the crankshaft 52 is actuated by a motor (not illustrated) arranged outside of the case 50.

[0039] A lip annular gasket 54 is coaxially interposed between the rear trunk 33 and the cylindrical guide seat 51, fixedly connected to the latter, so as to hold the lubricant oil for the joints of the connecting rod 53 with the crankshaft 52 and the rear trunk 33 inside the case 50.

[0040] The sealing of each compression chamber 22 is entrusted to respective two annular gaskets that are fixed to the head 20, for example inside the cylinder 21 and that are coaxially slotted onto the cylindrical jacket 31 of the reciprocating piston 30.

[0041] In particular, each compression chamber 22 is delimited by a first annular gasket 60, called high-pressure gasket, which is directly subjected to the pressure of the compression chamber 22 and is coaxially inserted in a suitable annular seat formed in the respective cylin-

der 21, and a second annular gasket 61, called low-pressure gasket, which is also coaxially inserted in a suitable annular seat formed in the respective cylinder 21 and is arranged a greater distance from the top of the reciprocating piston 30 with respect to the first gasket 60.

[0042] The first gasket 60 has the purpose of holding the fluid to be pumped inside the compression chamber 22, whereas a purpose of the second gasket 61 is that of holding the fluid losses that can sometimes get past the first gasket 60, preventing them from being able to leak into the case 50 and, at the same time allowing the recovery thereof (as will be described more clearly hereinafter).

[0043] In the illustrated example, the first gasket 60 is a gasket of more rigid material (for example a bi-component material made from rubber and cloth) with respect to the material that constitutes the second gasket 61 (for example a single-component material made of only rubber).

[0044] In greater detail, in each cylinder 21 an enlarged receiving seat is defined, formed in the head and distal from the top of the respective reciprocating piston 30, which is coaxial to the cylinder 21 itself and defines the opening thereof through which the reciprocating piston 30 penetrates into the compression chamber 22.

[0045] The first gasket 60 is housed inside the receiving seat and is axially locked between a support ring 62, for example fixed by interference inside the receiving seat itself, and a shoulder that separates the receiving seat from the compression chamber 22.

[0046] The support ring 62 also has an inner radial opening in which the second gasket 61 is received, so that it can project radially towards the cylindrical jacket 31 of the reciprocating piston 30.

[0047] Between the first gasket 60 and the second gasket 61, moreover, the support ring 62 has a plurality of radial grooves of full extension, i.e. passing from one side to the other thereof, which, for example, are connected with the radial opening in which the second gasket 61 is received through a radial constriction.

[0048] A further annular gasket, in this case a sealing O-ring, can be coaxially interposed between the support ring 62 and the receiving seat, for example at or close to the end thereof distal from the top of the reciprocating piston 30. Axially along the cylinder 21 (and around the cylindrical jacket 31 of the reciprocating piston 30) between the first gasket 60 and the second gasket 61 a gap is defined that defines a collection chamber 65, for example substantially of annular or toroidal shape, which is intended to receive the losses of fluid that can sometimes get past the first gasket 60.

[0049] In the example, the collection chamber 65 is defined by the radial grooves and by the radial construction of the support ring 62 (and by the cylindrical jacket 31 of the reciprocating piston 30).

[0050] This collection chamber 65 is separated from the compression chamber 22 through the first gasket 60; it is separated from the external environment through the

aforementioned further annular gasket and it is separated from the internal environment of the case 50 through the second gasket 61.

[0051] The volumetric pump 10 also comprises a recirculation conduit 70 which places the collection chamber 65 in fluid communication with the intake conduit, in particular in the example the intake manifold 23, upstream of the intake valve 26 in the crossing direction of the fluid from the inlet opening to the compression chamber 22.

[0052] In particular, it is possible to provide for a recirculation conduit 70 for each compression chamber 22, in this case each collection chamber 65 is connected to the intake conduit, in particular to the intake manifold 23, through a respective recirculation conduit 70.

[0053] Each recirculation conduit 70 is for example made in the head 20, for example by milling, and has a first end that opens into the collection chamber 65 and an opposite second end that opens into the intake conduit, i.e. into the intake manifold 23.

[0054] Thanks to the recirculation conduit 70, the fluid that from the compression chamber 22 leaks through the first gasket 60, is collected in the collection chamber 65 and from here it can be recovered at the intake of the volumetric pump 10, i.e. reintroduced into the intake manifold 23, through the recirculation conduit 70.

[0055] Particularly, the volumetric pump 10 comprises a lubrication conduit 80 which places the delivery conduit, in particular in the example the delivery manifold 24, preferably downstream of the delivery valve 28 in the crossing direction of the fluid from the compression chamber 22 to the outlet opening, in fluid communication with the collection chamber 65.

[0056] The lubrication conduit 80 is made in the head 20, for example by milling, and has a first end that opens into the collection chamber 65 and an opposite second end that opens into the delivery conduit, i.e. into the delivery manifold 24.

[0057] For example, the first end of the lubrication conduit 80 that opens into the collection chamber 65 is substantially diametrically opposite to the first end of the recirculation conduit that opens into the same collection chamber 65.

[0058] In the example, the lubrication conduit 80 has an axial segment, for example proximal to the second end, which has an internal threading.

[0059] Preferably, the volumetric pump 10 comprises a nozzle 81, for example a nebulizing nozzle, which is arranged inside the lubrication conduit 80, for example screwed to the internal threading thereof.

[0060] The nozzle 81 comprises an axially passing inner channel, for example having a calibrated minimum diameter, for example of 0.1 mm, which allows the nebulization of the fluid that crosses it.

[0061] In the example, the inner channel has a minimum diameter at the axial end of the nozzle 81 itself proximal to the second end of the lubrication conduit 80 (the inner channel also has sections with increasing di-

ameter up to the opposite axial end thereof).

[0062] This does not rule out the possibility that the lubrication conduit 80 can itself constitute a nozzle (nebulizer) or have a (minimum) inner diameter such as to allow the nebulization of the fluid that crosses it.

[0063] Thanks to the lubrication conduit 80, a minimal part of the (high-pressure) fluid that is sent from the compression chamber 22 to the delivery conduit, preferably to the delivery manifold 24, can be tapped through the lubrication conduit 80 and, thus, through the nozzle 81, and be sent - thus nebulized - in the collection chamber 65.

[0064] The pressurised nebulized fluid that, through the lubrication conduit 80 is introduced into the collection chamber 65, actually fills the collection chamber 65 and, therefore, promotes the cooling and the lubrication of the second gasket 61 (i.e. the low-pressure gasket).

[0065] At the same time, the pressurised nebulized fluid that is introduced through the lubrication conduit 80 into the collection chamber 65 exerts a thrust that pushes possible accumulations of residual air that would otherwise accumulate in the collection chamber 65 itself and that would cause cavitation and, therefore, the deterioration of the cylindrical jacket 31 of the reciprocating piston 30 jeopardising the seal of the first gasket 60 and of the second gasket 61 themselves outside of the collection chamber 65, through the recirculation conduit 70.

[0066] In a first embodiment shown in figures 1-3, the volumetric pump 10 comprises a plurality of lubrication conduits 80, in particular a lubrication conduit 80 (with respective nozzle 81) for each compression chamber 22 (and each collection chamber 65).

[0067] In this case, therefore, each collection chamber 65 is connected to the delivery conduit, in particular to the delivery manifold 24, through a respective lubrication conduit 80 possibly equipped with a respective nozzle 81.

[0068] In a second and alternative embodiment shown in figures 4-6, the volumetric pump 10 has a single lubrication conduit 80, preferably with a respective nozzle 81, said single lubrication conduit 80 connecting the delivery conduit, i.e. the delivery manifold 24, with a single collection chamber 65, for example a central collection chamber 65 of the volumetric pump 10.

[0069] In such an embodiment, it is possible to provide that the collection chamber 65 that is connected to the lubrication conduit 80, as described above, is connected to the other collection chambers 65 through a respective service channel 90, for example radial.

[0070] Each service channel can be a through hole or a milling (enlarged) that connects a collection chamber 65 (peripheral) with the collection chamber 65 (central) into which (the first end of) the lubrication conduit 80 opens.

[0071] In the example shown, relative to such a second embodiment of the volumetric pump 10, the volumetric pump itself has a single lubrication conduit 80, but a plurality of recirculation conduits 70 (one for each collection chamber 65).

[0072] However, this does not rule out the possibility that in such a second embodiment it is possible to provide for the volumetric pump 10 to also be able to have a single recirculation conduit 70 that connects the intake conduit, i.e. the intake manifold 23, with a single collection chamber 65, for example the central collection chamber 65 of the volumetric pump 10 or a different collection chamber 65 (for example peripheral).

[0073] Again alternatively, in such a second embodiment it is possible to provide that the volumetric pump 10 has a plurality of recirculation conduits 70, one for each collection chamber 65 (peripheral) into which the lubrication conduit 80 does not open.

[0074] In practice, it has been observed that, thanks to the pressure gradient existing between the delivery conduit, i.e. the delivery manifold 24, and the intake conduit, i.e. the intake manifold 23, each collection chamber 65 is always hit by a flow of fluid (calibrated and nebulized through the nozzle 81, i.e. the minimum passage section thereof) that, entering from the lubrication conduit 80, crosses it in the circumferential direction to then come out from the recirculation conduit 70.

[0075] Such a flow of fluid (nebulized and continuous), as stated above, always contains a certain amount of fluid coming from the intake of the pump 10, which is held inside the gap also thanks to the second gasket 61, and promotes the cooling and the lubrication of the second gasket 61 (i.e. the low-pressure gasket) and, at the same time, allows the collection chamber to be washed of possible accumulations or residual air pockets that would otherwise accumulate in the collection chamber 65 itself.

[0076] The invention thus conceived can undergo numerous modifications and variants all of which are encompassed by the inventive concept.

[0077] Moreover, all of the details can be replaced by other technically equivalent elements.

[0078] In practice, the materials used, as well as the contingent shapes and sizes, can be whatever according to the requirements without for this reason departing from the scope of protection of the following claims.

Claims

1. A volumetric piston pump (10) comprising:

- a casing (20) equipped with a cylinder (21) defining a compression chamber (22) communicating with an intake conduit (23,25) and a delivery conduit (24,27);
- a reciprocating piston (30) slidable within the cylinder (21) and delimiting the compression chamber (22);
- a first gasket (60) attached to the casing (20) within the cylinder (21) and coaxially inserted on the reciprocating piston (30);
- a second gasket (61) attached to the casing (20) within the cylinder (21) and coaxially insert-

ed on the reciprocating piston (30) in the distal position from the compression chamber (22) with respect to the first gasket (60);

- a collection chamber (65) interposed and axially delimited between the first gasket (60) and the second gasket (61);

- a recirculation conduit (70) which connects the collection chamber (65) with the intake conduit (23,25);

characterized in that the volumetric piston pump (10) comprises:

- a lubrication conduit (80) which connects the delivery conduit (24,27) with the collection chamber (65).

2. The volumetric piston pump (10) according to claim 1, which comprises a nozzle (81) located in the lubrication conduit (80).

3. The volumetric piston pump (10) according to claim 1, wherein the lubrication conduit (80) is implemented in the casing (20).

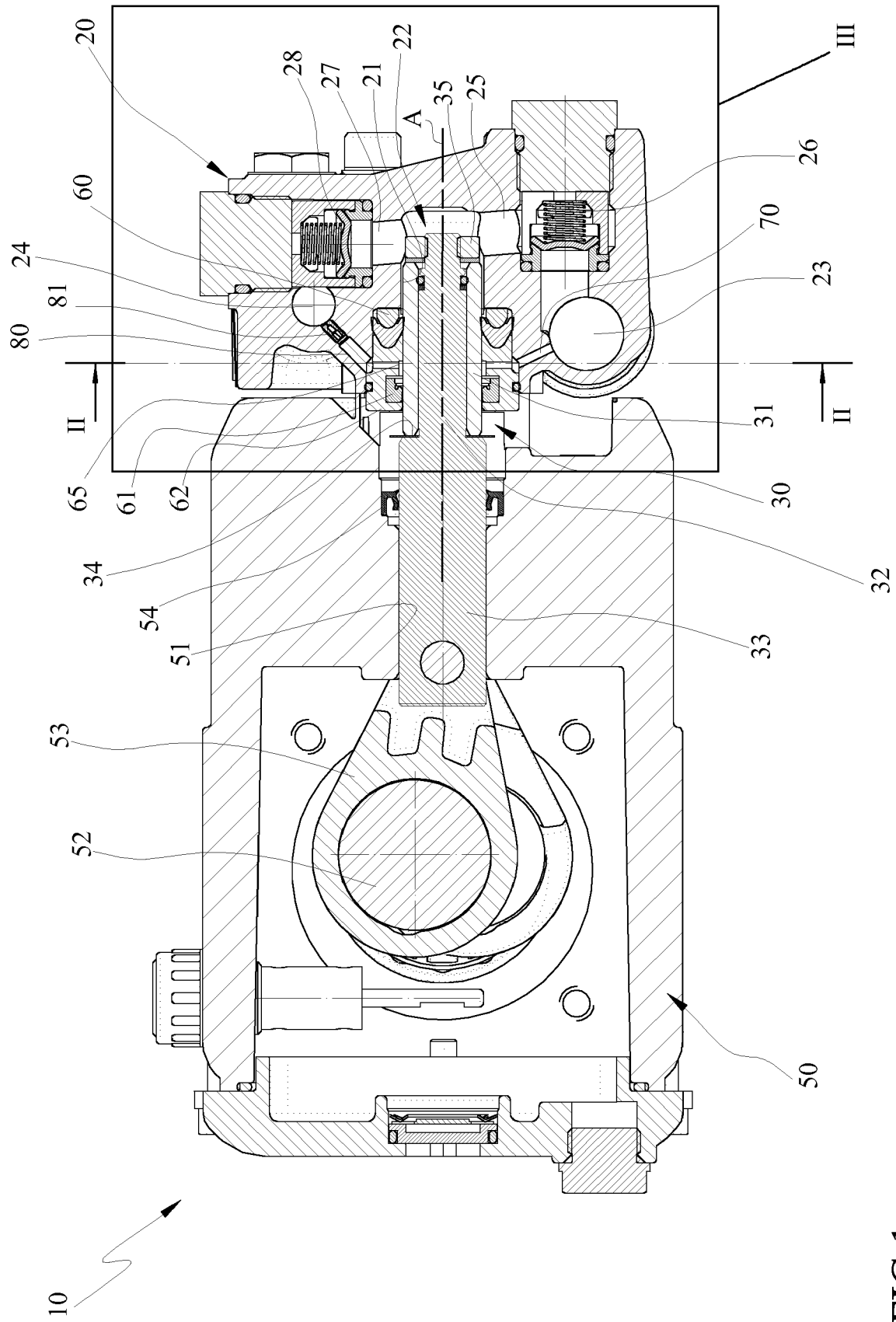
4. The volumetric piston pump (10) according to claim 1, wherein the casing (20) comprises a plurality of cylinders (21), within which a respective reciprocating piston (30) is housed, as well as a corresponding plurality of collection chambers (65).

5. The volumetric piston pump (10) according to claim 4, which comprises a lubrication conduit (80) for every collection chamber (65) of each cylinder (21).

6. The volumetric piston pump (10) according to claim 4, which comprises a single lubrication conduit (80) connecting the delivery conduit (24,27) to a single collection chamber (65) of the plurality of chambers (65), the collection chamber (65) connected to the lubrication conduit (80) being connected to the other collection chambers (65) via a corresponding service channel (90).

7. The volumetric piston pump (10) according to claim 1, wherein in the intake conduit (23,25) a one-way intake valve (26) is installed.

8. The volumetric piston pump (10) according to claim 1, wherein in the delivery conduit (24,27) a one-way delivery valve (28) is installed.



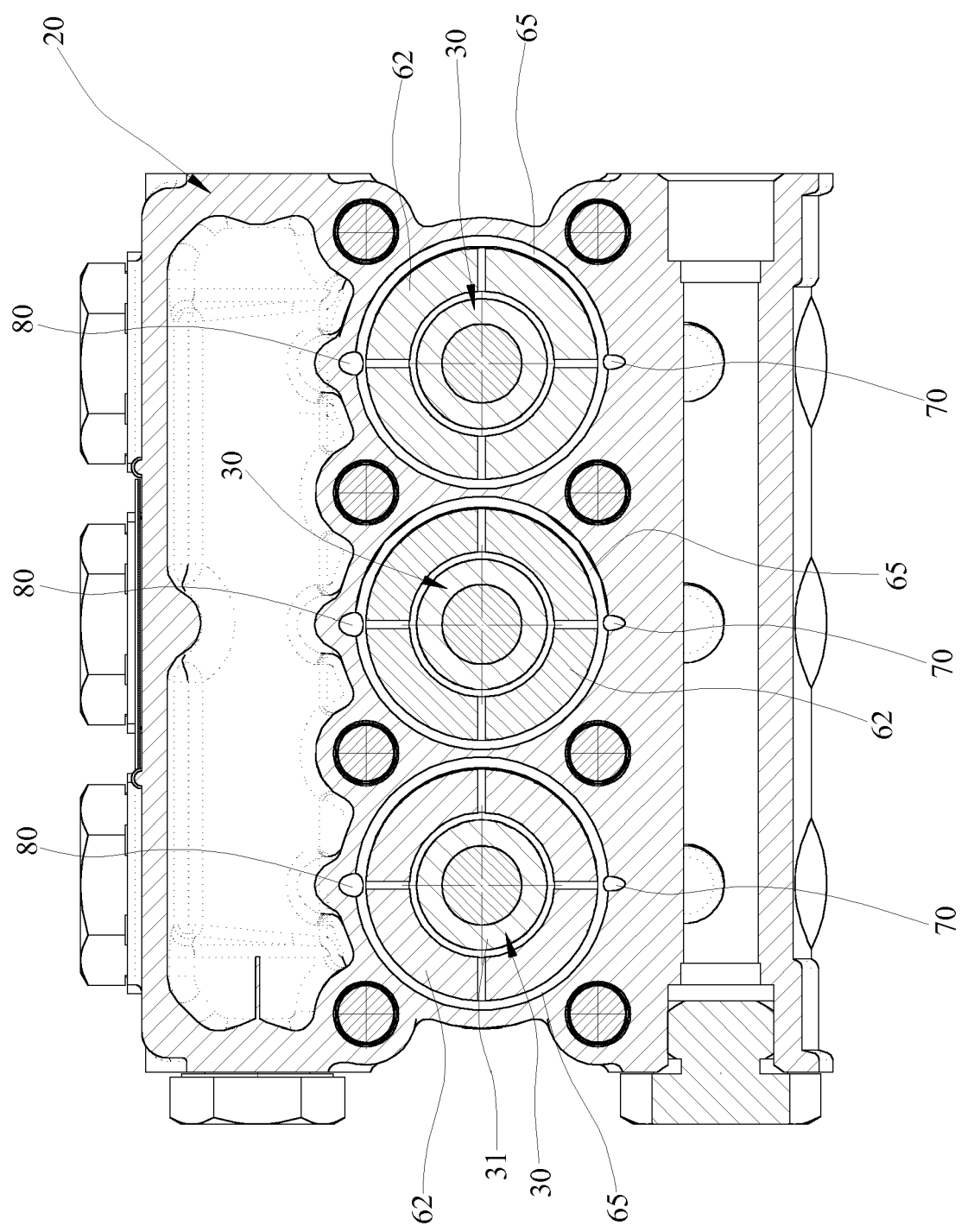


FIG.2

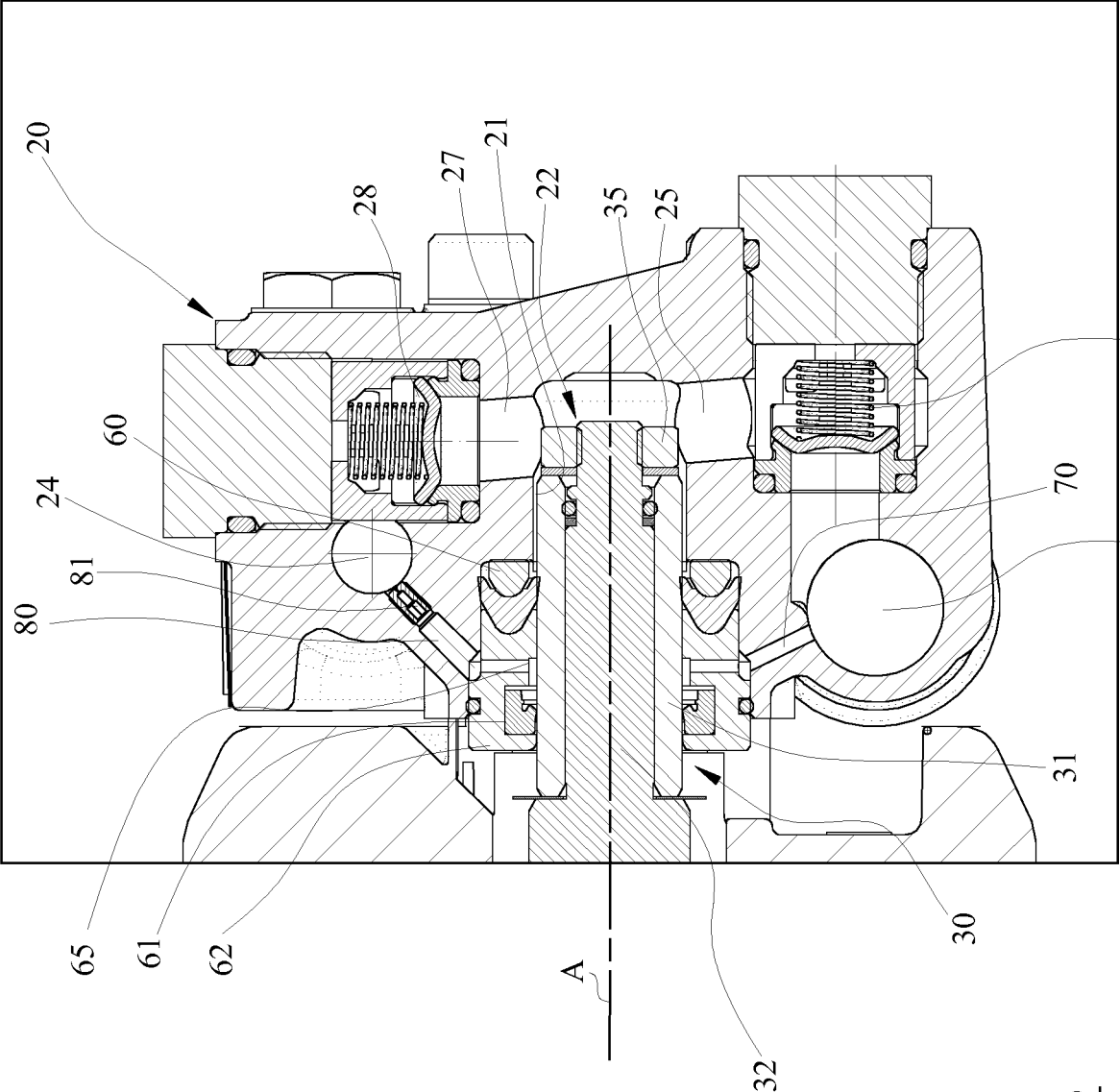
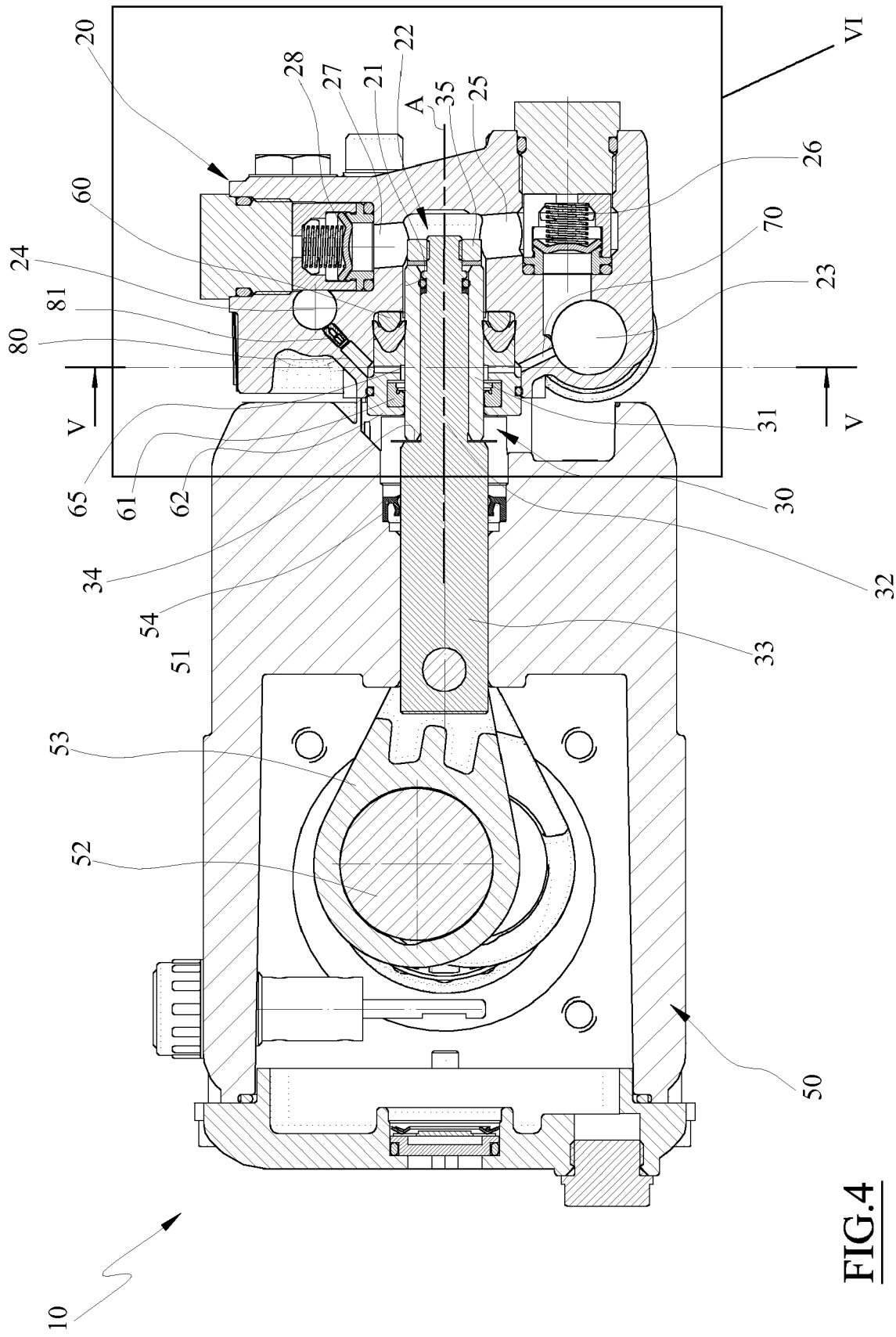


FIG.3



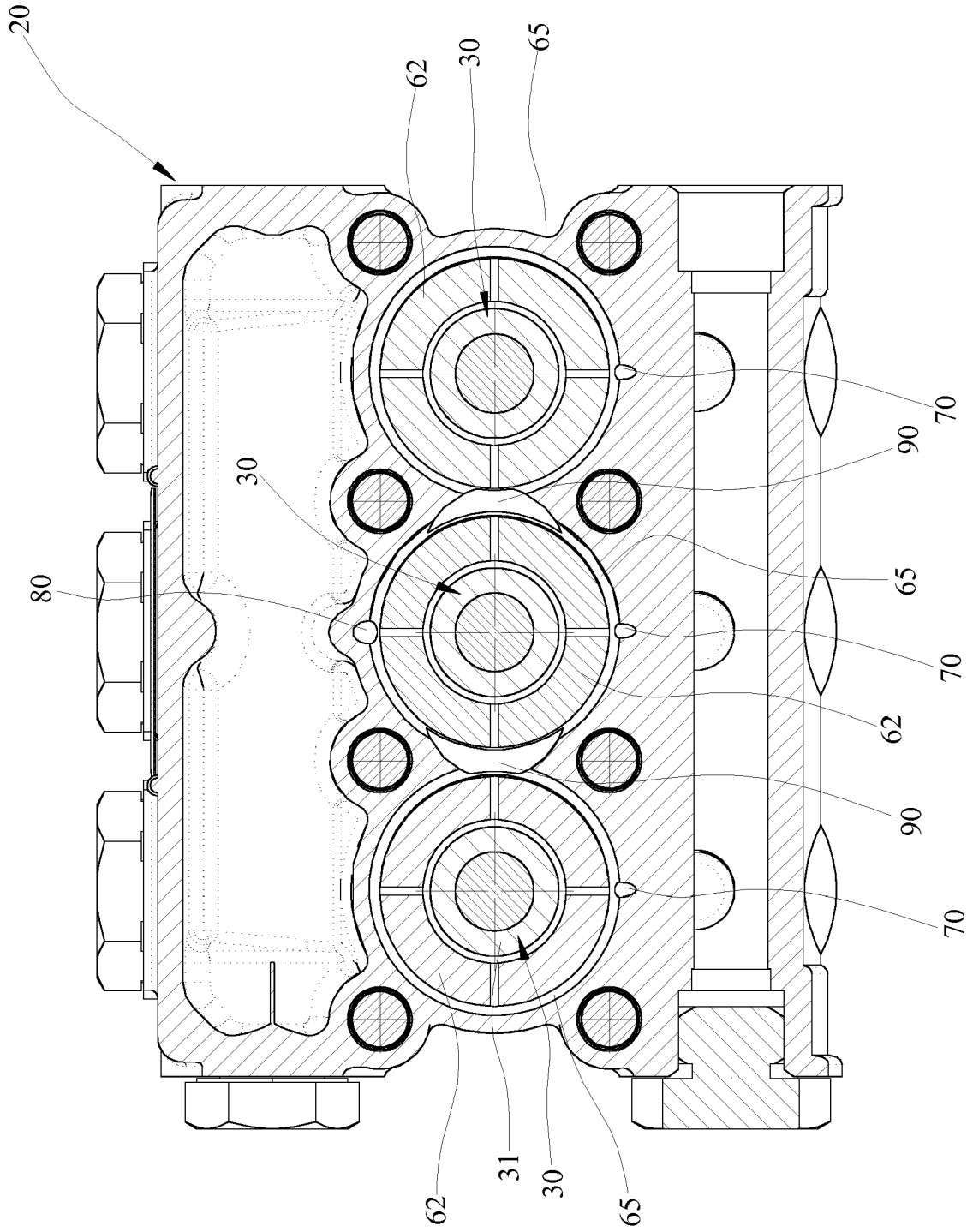


FIG. 5

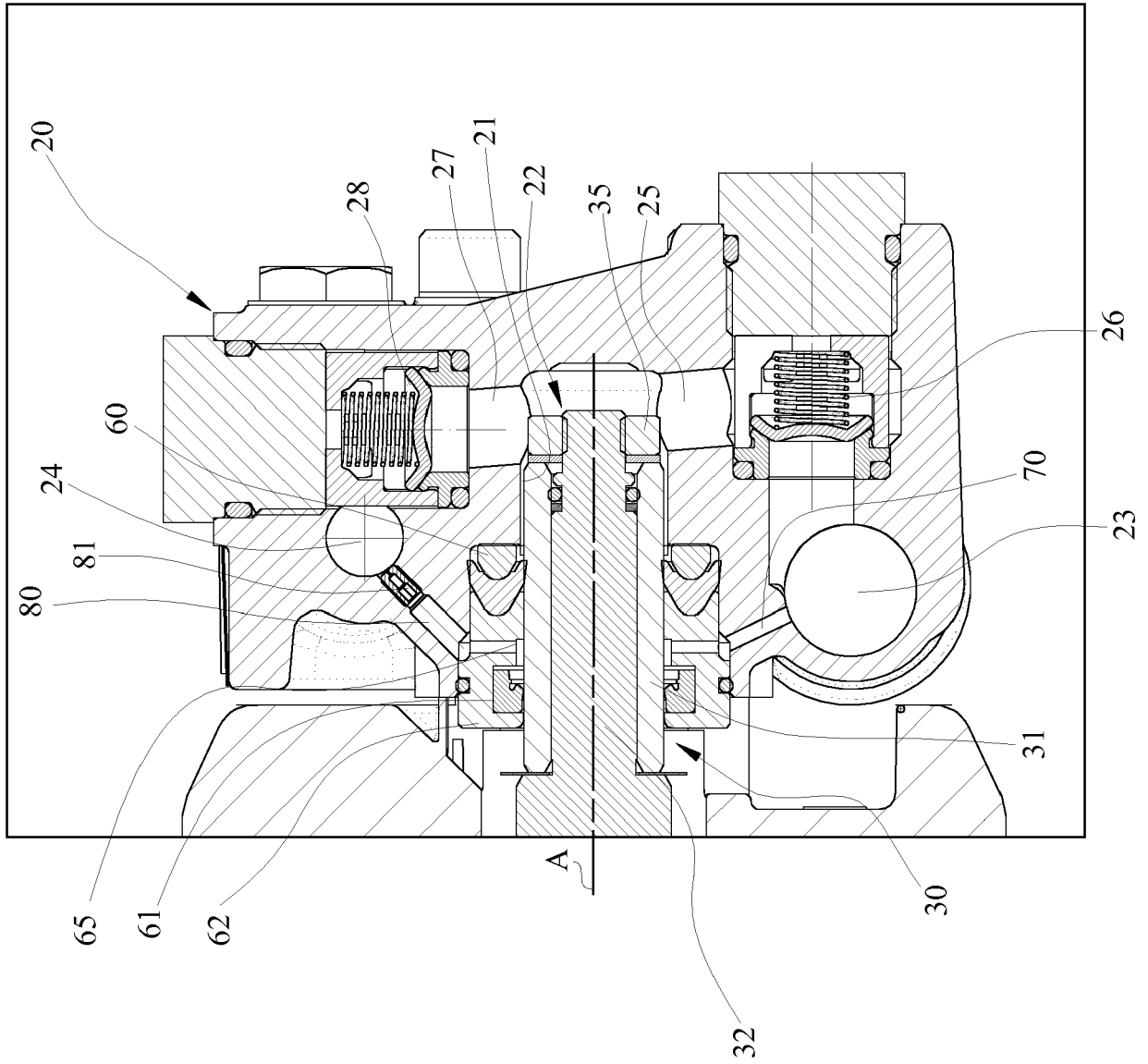


FIG. 6



EUROPEAN SEARCH REPORT

 Application Number
 EP 19 17 4328

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 2 728 190 A1 (INTERPUMP ENGINEERING SRL [IT]) 7 May 2014 (2014-05-07) * paragraphs [0037] - [0043], [0055]; figure 1 *	1-8	INV. F04B1/04 F04B53/04 F04B53/16 F04B53/18
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 1 October 2019	Examiner Homan, Peter
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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