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(54) **A hydraulic piston machine**

(57) A hydraulic machine (1) comprising a casing (40) to which a head (10) is fixed, the head (10) being provided with at least a cylindrical seating (20) destined to axially slidably receive a piston (30), in which the cy-

lindrical seating (20) is afforded in a body (21) removably associated to the head (10) and removable in a sliding direction of the piston (30) on an opposite side to the casing (40).

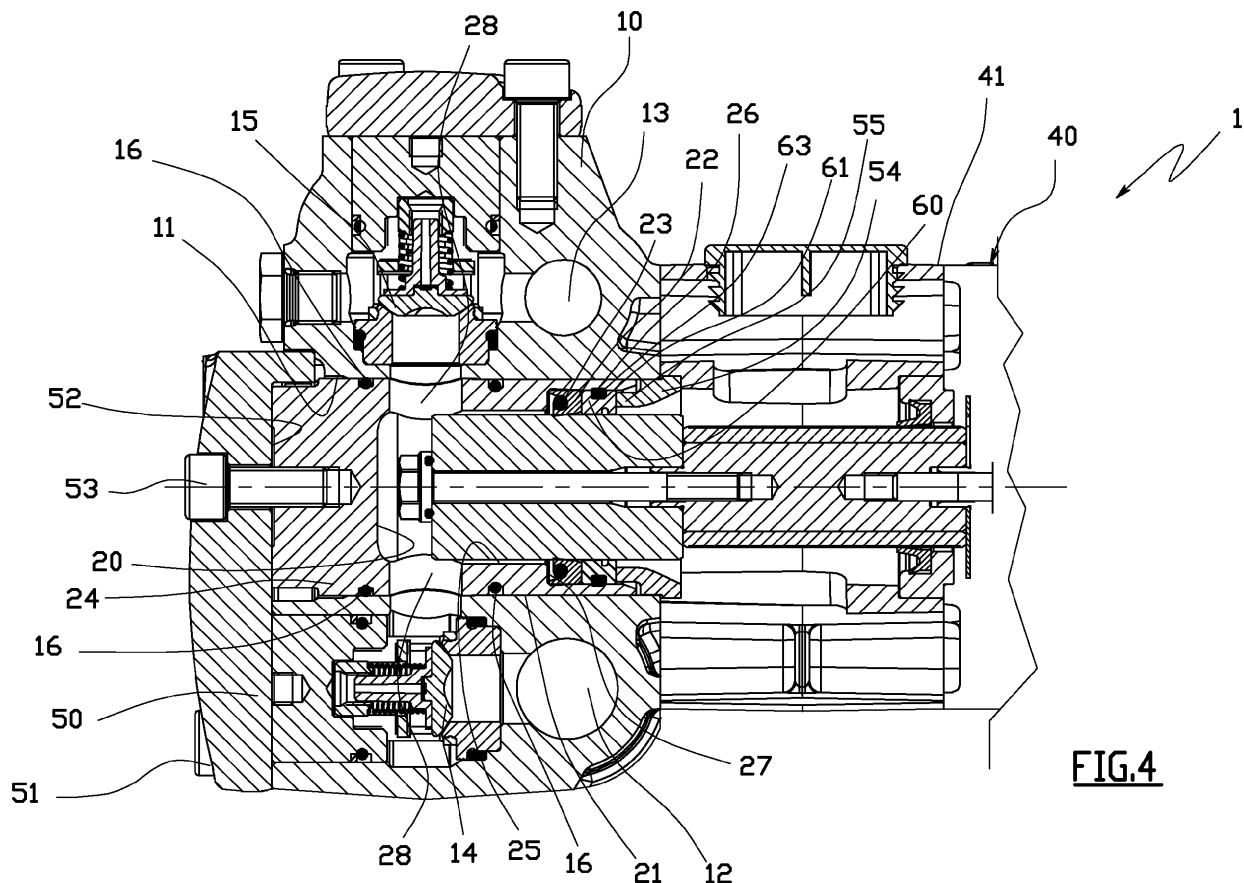


FIG.4

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Description

[0001] The present invention relates to a hydraulic machine with pistons of a type destined to function as a pump or a motor.

[0002] An advantageous application of the present invention is in piston hydraulic machines destined to function as high-pressure pumps, which are used in various industrial applications.

[0003] Among these industrial applications, a particularly important one is the use of pumps in contexts where they are destined to work at high pressures in the mining and/or extraction field, where it is required to pump lubricating liquid to the drills along a bore-hole.

[0004] Apart from facilitating drilling by lubricating the drill tool, the lubricating liquid, generally highly viscous and including bentonite-type compounds, also has the task of consolidating the walls of the bore-hole.

[0005] As is known, a hydraulic piston pump comprises a casing destined to rotatably support a rotating shaft and internally of which is arranged a crank thrust mechanism of the crank-shaft type. The crank is associated to the shaft and the con rod to a piston which projects externally of the casing and is slidably associated thereto.

[0006] The piston is destined to insert internally of a blind cylindrical seating housed in a head which is fixed to the casing, such as to define a variable-volume chamber.

[0007] An aspiration conduit and a delivery conduit are also housed in the head, which conduits communicate with the cylindrical chamber and are such as to connect, by means of retaining valves, with respective aspirating and delivery manifolds distinct from the head and fixed thereto by means of threaded organs.

[0008] In the blind cylindrical seating destined to slidably house the piston, retaining and guide organs are provided, which substantially snugly insert on the head of the piston.

[0009] During functioning, the fluid is aspirated at low pressure through the aspirating conduit, is compressed by the piston moved by the suitably-motorised shaft, and is sent at high pressure through the delivery conduit. The hydraulic piston machines of known type are not, however, free of drawbacks, among which the fact that each time an inspection has to be made, or an extra maintenance intervention on the cylindrical seating and/or the piston becomes necessary, the hydraulic machine has to be shut down, the delivery and aspiration conduits emptied, the connections with the relative circuit manifolds removed, when these too are at least partially emptied, removing the fastening organs of the whole head from the casing and removing the head itself from the piston. Finally, it is also necessary to inversely repeat the above steps in order to complete the re-mounting of the hydraulic machine once the eventual damaged components have been repaired or replaced.

[0010] These operations are clearly time-consuming, as regards the actual intervention, and physically labori-

ous for the operators involved, especially when they relate to hydraulic machines exhibiting considerable spatial size and heft.

[0011] In particular, in the use of these machines as pumps destined to function at high pressure, the weight of the head alone can be in the order of several tens of kg, and the maintenance operations, apart from occupying a considerable time because of the number of intervention stages, as above mentioned, are decidedly difficult and laborious for the personnel involved. Furthermore, in these hydraulic machines there is a need to regularly replace the seal organs interposed between the cylindrical seating and the piston or the piston itself, due to the usual wear phenomena and therefore the need to prevent any undesired operating fluid leakage in the casing or in any case externally of the head.

[0012] This phenomenon is more greatly accentuated when the hydraulic machine - when used as a high-pressure pump - is destined to aspirate particularly aggressive fluids, for example fluids containing suspensions of particularly tiny particulate, such as in the above-described case of bentonite-based lubricants.

[0013] Further, even in other applications of the machine which are different to the one described herein above, the above-described wear phenomenon on the seal organs can be accentuated by the high temperatures of the operating fluid.

[0014] In any case, there exists the need to perform relatively-frequent interventions in connection with the substitution of the seal organs which, as mentioned above, require long down-times of the hydraulic machine, due to all the above-described intervention stages. Also, the cost of the specialised personnel performing the operations is not negligible.

[0015] An aim of the present invention is to resolve or reduce the above-mentioned drawbacks of the known solutions.

[0016] A further aim of the present invention is to attain the above-cited objectives with a solution that is simple, rational and relatively economical.

[0017] These and other aims besides are attained by the characteristics of the invention reported in independent claim 1. The dependent claims delineate preferred and/or particularly advantageous aspects of the invention.

[0018] The invention provides a hydraulic machine which comprises a casing to which a head is fixed, provided with at least a cylindrical seating destined to house an axially-sliding piston.

[0019] In the invention, the cylindrical seating is afforded in a body which is removably associated to the head and is removable in the sliding direction of the piston on the part opposite the casing.

[0020] This solution enables the inspection and maintenance operations on the cylindrical seating and the internal components thereof to be carried out rapidly.

[0021] Further, the machine of the invention means that the whole head need not be demounted, with the

ensuing above-described problems that operation implies, in order to perform inspections or replacements of components internal of the cylindrical seating.

[0022] In a preferred aspect of the invention the hydraulic machine comprises seal means interposed between the piston and the cylindrical seating.

[0023] The seal means advantageously comprise an annular seal associated to the cylindrical seating such as to insert substantially snugly onto the piston.

[0024] The machine of the invention thus enables rapid and advantageous replacement of the annular seal, which is the component that is most subject to wear in the hydraulic machine, and thus enables conditions of maximum seal and efficiency of the machine to be restored on all occasions.

[0025] In a further aspect of the invention, the machine comprises blocking means for axially blocking the seal means in the cylindrical seating.

[0026] In this way the seal can be extracted contemporaneously with the cylindrical seating and this facilitates the replacement operations of the annular seal.

[0027] In a further aspect of the machine the body of the cylindrical seating is afforded in is substantially beaker-formed.

[0028] This conformation is particularly useful and economical, as the bushing is easily obtainable in a single piece, and is comfortably manoeuvrable. Further, in another aspect, the machine also comprises a guide organ of the piston with respect to the cylindrical seating, internally associated to the cylindrical seating itself and destined to insert snugly on the piston.

[0029] More advantageously, in an embodiment the blocking means and the guide organ coincide.

[0030] This solution enables optimal alignment of the piston with the cylindrical seating to be obtained, while at the same time, by means of a structural simplification, it enables the seal to be removed together with the bushing when it is to be replaced.

[0031] In a further aspect of the invention, the machine comprises at least an aspiration conduit and a delivery conduit realised in the head, the body of the cylindrical seating comprising a pair of through-openings destined to be placed respectively in communication with the aspiration conduit and the delivery conduit.

[0032] In this way, the delivery and aspiration conduit can be compact and housed internally of the head, saving space.

[0033] In a further aspect of the invention, the machine comprises fastening means for axially fixing the body of the cylindrical seating to the head.

[0034] In this way the cylindrical seating is stably fixed to the head when the machine is normally in use, as if it were a single piece there-with, while it can be demounted, as above-mentioned, when necessary.

[0035] Finally, in an aspect of the invention the machine comprises a plurality of pistons and a respective plurality of the cylindrical seatings.

[0036] The above-mentioned fixing means for axially

fastening the body of the cylindrical seating to the head advantageously comprise at least a closing cover of the head that is solidly associated to the head by means of first removable connecting means, and solidly associated to the body of each cylindrical seating by means of second removable connecting means.

[0037] In this way all the cylindrical seatings or only a part of them can be contemporaneously removed, simply by removing the cover of the head; in this way the machine provides a high degree of ease for carrying out the maintenance and equipping operations.

[0038] Further characteristics and advantages of the invention will emerge more clearly from the following description, made by way of non-limiting example with the aid of the accompanying figures of the drawings, in which:

figure 1 is a frontal view of a high-pressure piston pump according to the present invention;

figure 2 is section II-II of figure 1;

figure 3 is section III-III of a detail of figure 1;

figure 4 is a longitudinal section of a detail of a high-pressure piston pump in an alternative embodiment of the invention.

[0039] With particular reference to the figures, 1 denotes in its entirety a hydraulic piston pump, in the example a high-pressure pump, usable for pressurising an operating fluid to more than 100 bar.

[0040] The pump 1 comprises a head 10, defining the body of the pump, which is provided with at least a cylindrical seating 20 destined to slidingly house a piston 30.

[0041] The head 10 is solidly associated to a casing 40 by means of interposing a holed spacer 41.

[0042] The head 10 is fixed to the casing 40 by means of interposing the spacer 41, by means of fastening screws 42.

[0043] The cylindrical seating 20, in particular, is afforded in a body 21 which is removably associated to the head 10 and can be removed therefrom in the sliding direction 30 of the piston, on the opposite side with respect to the casing 40.

[0044] The pump 1 further comprises seal means interposed between the piston 30 and the cylindrical seating 20; the seal means advantageously comprise an annular seal 22, for example made of at least a yielding material.

[0045] The annular seal 22 is in particular provided with a reinforcing core 23, for example made of metal or another material.

[0046] The annular seal 22 is associated to the cylindrical seating such as to insert substantially snugly on the head 31 of the piston 30 in order substantially to realise a seal for the operating fluid during the sliding of the piston 30 along the cylindrical seating 20.

[0047] As can be seen in figure 3, the body 21 of the cylindrical seating it is made in is substantially beaker-formed.

[0048] The body 21 in which the cylindrical seating 20 is realised is generally defined as a bushing, and it will be thus-termed in the following; the piston 30 is slidably associated internally of the bushing 21.

[0049] The bushing 21 is inserted snugly in a through-seating 11, also cylindrical, which is realised in the head 10.

[0050] The bushing 21, the piston 30 and the through-seating 11 are substantially coaxial.

[0051] In particular, the bushing 21 exhibits an external diameter which is slightly smaller than the internal diameter of the through-seating 11, such as to be inserted internally thereof with a small degree of play.

[0052] The pump 1 advantageously comprises fastening means 50, 54 for axially fixing the bushing 21 to the head 10.

[0053] The fastening means 50, 54 comprise at least a closing cover 50 of the head 10 solidly associated to the head on the opposite side with respect to the casing 40.

[0054] In particular, the cover 50 is fixed to the head 10 first removable connecting means 51, i.e. connecting means that can be removed when so required, for example in order to remove and newly mount the cover 50 itself; these first removable connecting means 51 are for example fastening screws.

[0055] The cover 50 exhibits at least a flat zone 52 destined to function as an abutment and rest for the bottom 24 of the bushing 21, such as to axially block the bushing 21 in the direction of the demounting of the head 10 on an opposite side with respect to the casing 40.

[0056] In a preferred embodiment, the cover 50 is solidly associated to the bottom 24 of the bushing 21, by means of second removable connecting means 53, which for example are fastening screws, bayonet-couplings or the like.

[0057] The pump 1 comprises blocking means destined to axially block the annular seal 22 to the cylindrical seating 20.

[0058] Further, the pump 1 comprises a guide organ of the piston 30 with respect to the cylindrical seating 20, which is internally associated to the jacket 25 of the bushing 21. The guide organ is destined to snugly insert on the head 31 of the piston 30 such as to guide the sliding of the piston 30 in the cylindrical seating 20; in particular, in the illustrated embodiment the guide organ enables the piston 30 to slide in the sliding direction while staying substantially coaxial to the bushing 21.

[0059] In a preferred embodiment shown in figures 1 to 3, the guide organ comprises an annular element 60 the internal surface of which is substantially rectified and is such as substantially to snugly insert on the head 31 of the piston 30, while the blocking means comprise a Seeger ring 62 destined to insert in an annular seating 26 afforded in the jacket 25 of the bushing 21 and to axially block the annular element 60.

[0060] In a further embodiment, illustrated in figure 4, the blocking means and the guide organ coincide and

comprise an annular element 60, the internal surface of which is substantially rectified and is such as substantially to insert snugly on the head 31 of the piston 30.

[0061] An annular seating 61, destined to receive an o-ring 63, is afforded on the external surface of the annular element 60.

[0062] A respective annular seating 26 is further afforded on the jacket 25 of the bushing 21, which annular seating 26 is destined to house the o-ring 63 such that the o-ring prevents reciprocal sliding, in the axial sliding direction, of the annular element 60 and the bushing 21 itself during removal of the bushing 21 from the head 10.

[0063] In particular, in both embodiments shown in the figures, the bushing 21 exhibits, at the open end thereof, a broadening of the section forming a step 27 which slides along the whole diameter thereof.

[0064] The step 27 is such as to restingly receive the annular seal 22.

[0065] The annular element 60 is such as to define a further abutment for the annular seal 22 on the opposite side of the step 27, such that the seal is axially blocked with respect to the bushing 21.

[0066] The fastening means 50, 54 further comprise a lock ring 54 solidly associable, for example by friction, to the head 10 on the casing 40 side, such as to exhibit an abutment surface for the bushing 21.

[0067] The lock ring 54 is such as to axially block the bushing 21 in the removal direction of the head 10 on the same side as the casing 40.

[0068] Further the locking ring 54 exhibits an annular flap 55 destined to insert with play internally of the broadening of the bushing 21; the frontal surface of the annular flap 55 rests on the annular element 60, such as to reinforce the axial blocking action thereof in use conditions of the pump itself.

[0069] The pump 1 further comprises at least an aspiration conduit 12 and a delivery conduit 13, which are directly realised in the head 10. These conduits are such as to be opened and closed respectively by an aspiration valve 14 and a delivery valve 15 which are housed internally of the head 10.

[0070] The aspiration and delivery valves 14 and 15 are of the retaining type, as known to the technical expert in the sector, and will not be further described in detail.

[0071] The bushing 21 comprises a pair of through-holes 28, which are realised on the jacket 25 of the bushing 21, in particular in a zone interposed between the step 27 and the bottom 24, which openings are destined, respectively, to be placed in communication with the aspiration conduit 12 and the delivery conduit 13.

[0072] The two openings 28 are in mutual communication via the compression chamber which is delimited, internally of the bushing 21, by the bottom 24 of the bushing 21, by the top of the piston 30 and, laterally by the jacket 25 of the bushing 21, as well as by the active lip of the annular seal 22 which projects from the bushing 21 and goes to contact the head 31 of the piston 30.

[0073] Further seals 16 are present externally of the

bushing 21, at the openings 28, which further seals 16 are destined to be interposed between the head 10 and the bushing 21, such as to guarantee flow, without leaks and losses, of the operating fluid from the aspiration conduit 12 to the delivery conduit 13. With particular reference to figures 1-3, the pump 1 comprises three pistons and respectively three cylindrical seatings 20 as described herein above, each of which is in communication, via the respective openings 28, with the aspiration conduit 12 and the delivery conduit 13 realised in the head 10.

[0074] In the preferred embodiments shown in the figures, in particular, the closing cover 50 of the head 10 is singly associated to the bottom 24 of each of the bushings 21 by means of respective second removable connecting means 53, independent of one another.

[0075] Further, each piston 30 is activated in alternating translating motion by a thrust crank mechanism formed by a con rod 32 rotatably associated to the piston and pivoted on a crank 33 constituted by a crankshaft 34.

[0076] The crank shaft 34 is rotatably supported by the casing 40 and is appropriately motorised, as known to an expert in the field.

[0077] Further, the casing 40 is substantially a closed box-shaped body which is sealedly closed, from which an end of the crank shaft 34 and the head of the pistons 30 project, which piston head 30 is destined to insert in the respective bushing 21 associated to the head 10.

[0078] The spacer 41 is such as to envelop the intermediate portion between the casing 40 and the head 10.

[0079] The present invention functions as follows.

[0080] In ideal use conditions, the operating fluid is transferred by means of the motion of the piston 30 from the aspiration conduit 12 to the delivery conduit 13, without loss or leaks, passing through the compression chamber.

[0081] Should the annular seal 22 lose efficiency, for example due to phenomena connected with wear, hardening-up or other reasons, leaks of the operating fluid will be noticed, which pass beyond the annular seal 22 with fluid loss from the open end of the bushing 21. In this case the operating fluid can be seen to drip at the holed spacer 41, and the problem is easy to diagnose.

[0082] To replace the annular seal 22, it is sufficient to stop the pump 1; unscrew the screws constituting the first removable connecting means 51 and fastening the cover 50 to the head 10; extract the cover itself, such that the bushings 21, which remain fixed to the cover 50 by means of the second removable connecting means 53, are removed along the sliding direction of the cylindrical piston-seating, enabling the head 10 to be left fixed to the casing 40, and with it all the connectors of the operating fluid circulating circuit connected thereto.

[0083] Further, it is possible for only the necessary bushings 21 to be removed; in order not to remove some it is sufficient to remove the screws only of the second removable connecting means 53 from the bushings 21 which are to be left in the cylindrical seating 20.

[0084] During the removing of the bushing 21 from the

piston 30, the annular element 60 retains the annular seal 22, which therefore remains associated to the bushing and is removed there-with.

[0085] For the replacing of the seal, it is sufficient to remove the annular element, position a new annular seal 22 in the place of the worn one, reposition the annular element 60, re-insert the bushing 21 such that it keys to the relative piston 30 and, finally, newly fasten the cover 50 to the head 10, with considerable time and labour saving in the performing of the maintenance operations.

[0086] Obviously a technical expert in the field might make numerous modifications of a technical-application nature to the invention, without its forsaking the ambit of the invention as claimed herein below.

Claims

1. A hydraulic machine (1) comprising a casing (40) to which a head (10) is fixed, the head (10) being provided with at least a cylindrical seating (20) destined to axially slidably receive a piston (30), **characterised in that** the cylindrical seating (20) is afforded in a body (21) removably associated to the head (10) and removable in a sliding direction of the piston (30) on an opposite side to the casing (40).
2. The machine (1) of claim 1, **characterised in that** it comprises seal means (22) interposed between the piston (30) and the cylindrical seating (20).
3. The machine (1) of claim 2, **characterised in that** the seal means comprise an annular seal (22) associated to the cylindrical seating (20) in such a way as to insert substantially snugly on the piston (30).
4. The machine (1) of claim 2, **characterised in that** it comprises blocking means (60) destined to axially block the seal means (22) to the cylindrical seating (20).
5. The machine (1) of claim 1, **characterised in that** the body (21) in which the cylindrical seating (20) is afforded is substantially beaker-shaped.
6. The machine (1) of claim 1, **characterised in that** it comprises at least a guide organ (60) of the piston (30) with respect to the cylindrical seating (20), internally associated to the cylindrical seating and destined to snugly insert on the piston (30).
7. The machine (1) of claim 4 and 6, **characterised in that** the blocking means and the guide organ coincide.
8. The machine of claim 1, **characterised in that** it comprises at least an aspiration conduit (12) and a delivery conduit (13) realised in the head (10), the

body (21) of the cylindrical seating (20) comprising a pair of through-openings (28) destined to be placed respectively in communication with the aspiration conduit (12) and the delivery conduit (13).

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9. The machine (1) of claim 1, **characterised in that** it comprises fastening means (50, 54) for axially fixing the body (21) of the cylindrical seating (20) to the head (10).

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10. The machine (1) of claim 1, **characterised in that** it comprises a plurality of pistons (30) and a respective plurality of the cylindrical seatings (20).

11. The machine (1) of claim 9, **characterised in that** the fastening means (50, 54) comprise at least a closing cover (50) of the head (10) solidly associated to the head (10) by means of first removable connecting means (51), and solidly associated to the body (21) of each cylindrical seating (20) by means of second removable connecting means (53).

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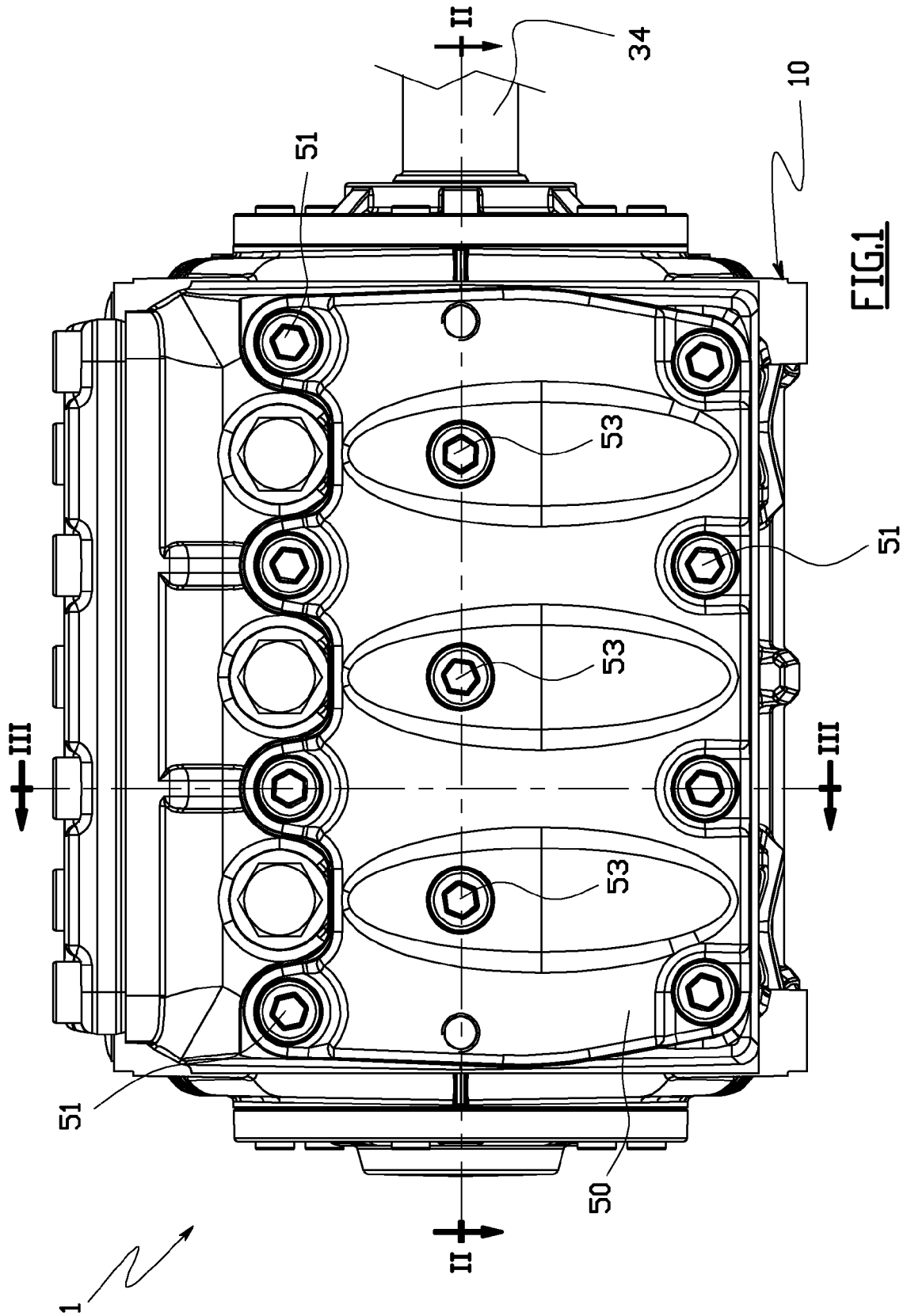
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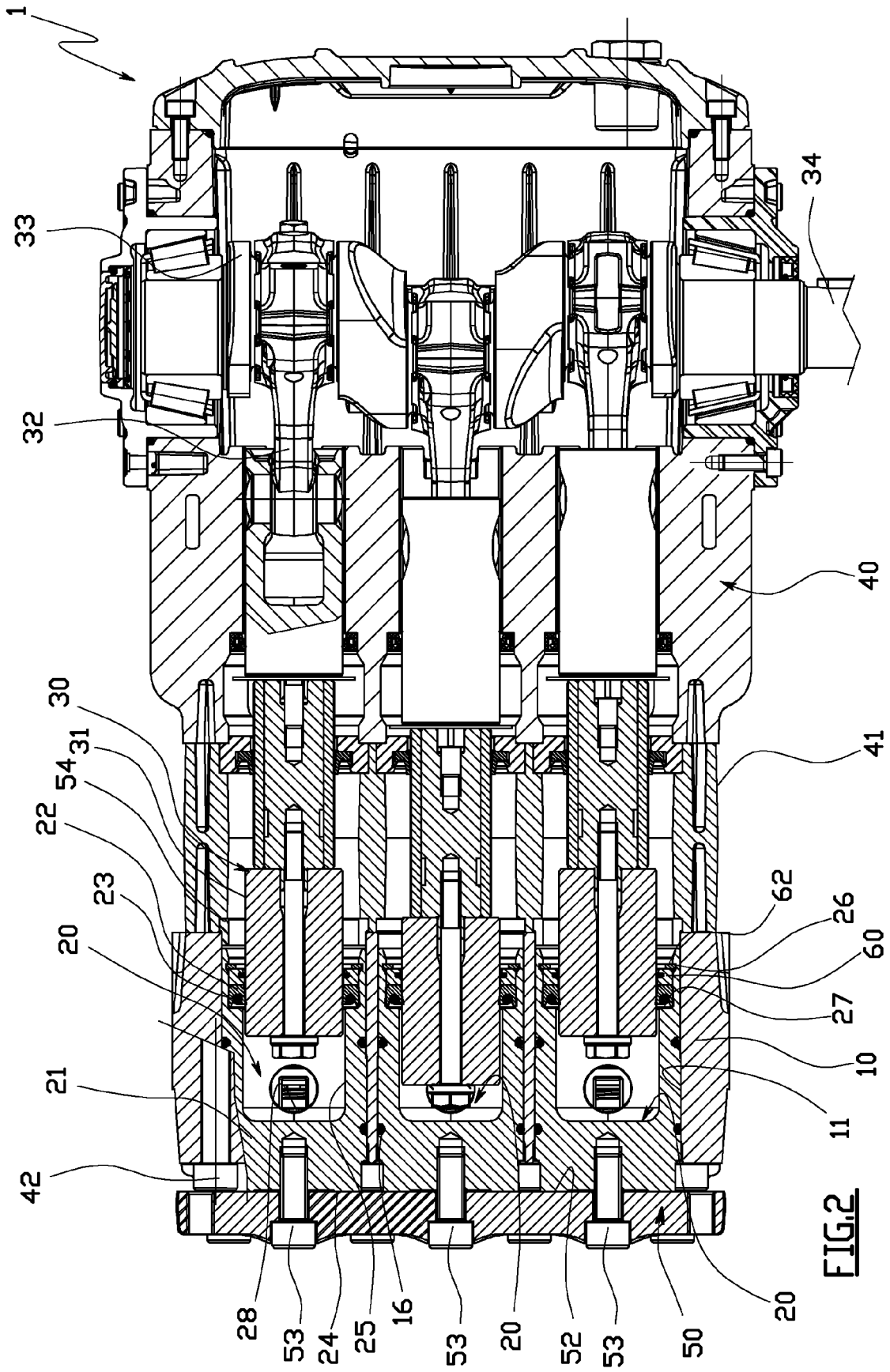
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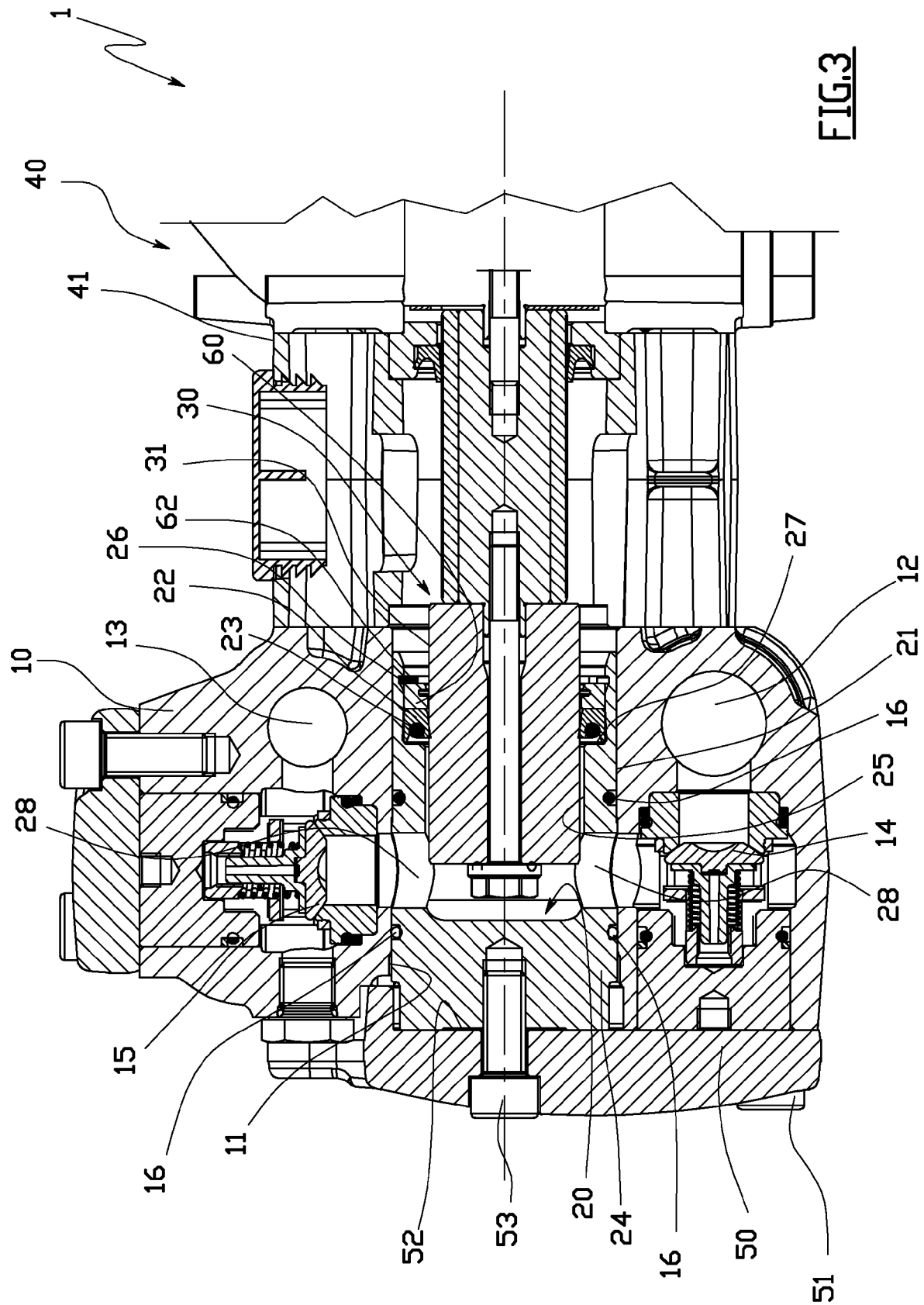
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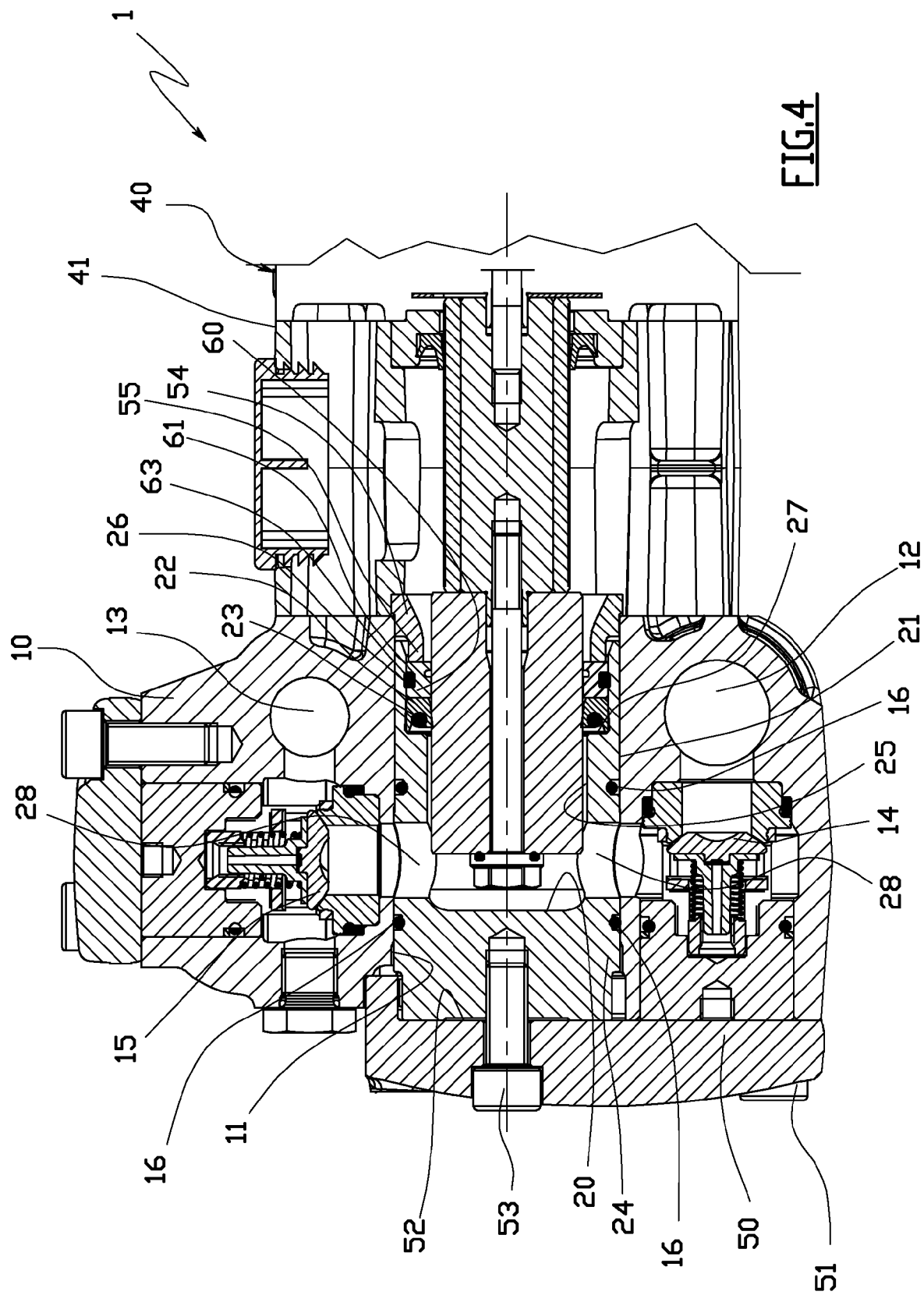
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EUROPEAN SEARCH REPORT

Application Number
EP 11 18 2392

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 213 482 A (ALFRED TEVES GMBH [DE]) 25 May 1993 (1993-05-25) * page 3, line 14 - page 5, line 5 * * figure 2 *	1-11	INV. F03C1/04 F03C1/06 F04B1/04 F04B1/12
X	US 6 305 265 B1 (BECHTEL BWXT IDAHO LLC [US]) 23 October 2001 (2001-10-23) * column 1, line 62 - column 2, line 16 * * column 3, line 38 - column 4, line 22 * * column 7, line 34 - line 42 * * figures 1,2 *	1-10	F04B1/14 F04B1/20 F04B53/16
X	DE 103 22 603 A1 (ROBERT BOSCH GMBH [DE]) 9 December 2004 (2004-12-09) * paragraph [0044] - paragraph [0049] * * paragraph [0055] * * paragraph [0061] - paragraph [0062]; figures 2,7,12 *	1-5,8-10	
X	US 5 232 273 A (ROBERT BOSCH GMBH [DE]) 3 August 1993 (1993-08-03) * column 2, line 13 - column 3, line 48 * * figure 1 *	1-5,8-10	TECHNICAL FIELDS SEARCHED (IPC)
X	DE 10 2006 006555 A1 (SIEMENS AG [DE]) 16 August 2007 (2007-08-16) * paragraph [0031] - paragraph [0036] * * paragraph [0040] * * figures 1,3 *	1	F03C F04B
A		2-11	
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 8 November 2011	Examiner Gnächtel, Frank
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			

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EPO FORM 1503 03.82 (P04.001)

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

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08-11-2011

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5213482 A	25-05-1993	DE 4027794 A1	05-03-1992
		FR 2666381 A1	06-03-1992
		GB 2248277 A	01-04-1992
		JP 4246282 A	02-09-1992
		US 5213482 A	25-05-1993

US 6305265 B1	23-10-2001	NONE	

DE 10322603 A1	09-12-2004	NONE	

US 5232273 A	03-08-1993	DE 4107979 A1	17-09-1992
		GB 2253882 A	23-09-1992
		JP 3367684 B2	14-01-2003
		JP 5087043 A	06-04-1993
		US 5232273 A	03-08-1993

DE 102006006555 A1	16-08-2007	DE 102006006555 A1	16-08-2007
		EP 1987249 A1	05-11-2008
		WO 2007093244 A1	23-08-2007
