(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 685 650 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number : **95201391.0**

(22) Date of filing : **30.05.95**

(51) Int. Cl.[6] : **F04C 2/14,** F04C 11/00

(30) Priority : **31.05.94 IT MO940077**

(43) Date of publication of application :
06.12.95 Bulletin 95/49

(84) Designated Contracting States :
AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL PT SE

(71) Applicant : **SALAMI S.p.A.**
1006, Via Emilia Ovest
I-41100 Modena (IT)

(72) Inventor : **Salami, Giuseppe**
Via Argiolas, 44
I-41100 Modena (IT)
Inventor : **Leo, Gianfranco**
Via Buon Pastore, 210
I-41100 Modena (IT)

(74) Representative : **Gardi, Giuliano**
Gardipatent
Palazzo Prora
Via Giardini, 605
I-41100 Modena (IT)

(54) External gear hydraulic device.

(57) A gear pump, or motor (1, 1a, 1c, 1d) comprises a hollow body (2) acting as casing closed off axially at one end by a cover (4, 19) and by a flange (3, 20) at the opposite end, the hollow body (2) having a cavity (5) in the form of two opposing lobes in which are coupled rotationally pairs of driving (9, 9a, 15, 15a) and driven (10, 10a) gearwheels that mesh with each other, the said driving gearwheels (9, 9a, 15, 15a) being coupled to driving means ; the casing (2) is fitted with positionable partitioning means (11) that divide the cavity (5) into at least two distinct and independent pumping chambers (13).

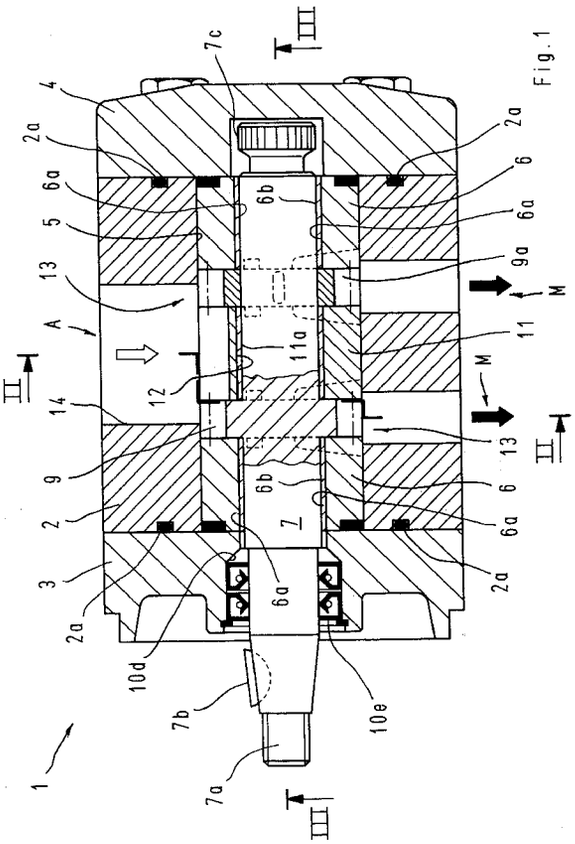


Fig.1

EP 0 685 650 A1

The invention concerns an external gear hydraulic device, i.e. an external volumetric gear pump, or motor, comprising a hollow body acting as casing closed off axially at one end by a cover and by a flange at the opposite end, the hollow body having a seat in the form of two opposing lobes in which are coupled rotationally pairs of gearwheels that mesh with each other.

The prior art comprises gear pumps of the type described above, in which the hollow body is generally obtained by extruding high strength aluminium, or by casting metallic material, for example, special cast iron.

In the pumps of the first type supports are provided for the rotational coupling of the shafts, onto which the gearwheels are keyed, said supports being set into in the two-lobe cavity in which the said gearwheels are positioned: in this way the gearwheels are automatically positioned coaxially in the relative lobe of the cavity in which they are placed.

When two or more independent pumping elements are required, having the same displacements or even displacements that are not the same, they are arranged in series, whereby the driving shaft of the pair of gearwheels of one pumping element is coupled in series, by means of a coupling, with the driving shaft of the next pumping element, and so on: the resulting axial dimension corresponding to the sum of the axial lengths of the bodies of each pumping element, to which have to be added the axial lengths of the couplings, the thickness of a cover and that of a flange.

With pumps of the second type, that is, having bodies obtained from a casting, the supports of the shafts of each pumping element are set into the cover and into the flange, thereby requiring these to be positioned with respect to the body by means of centering pins that entail a high degree of precision during machining and therefore high costs: when a number of pumping elements are required, the body of the pump is split into sections in order to insert, between the shaft of one pumping element and the next, the coupling for transmitting the rotation, this entailing further machining difficulties, considerable costs and sizeable overall dimensions.

Alternatively, at least in the case where only two pumping elements are required that are hydraulically independent of each other, special castings have to be designed that have two distinct pumping chambers.

The excessive dimensions of such apparatus constitutes a severe limit on the application of these pumps, causing considerable problems during installation, for example, for small hydraulic excavators, in which the available space is very limited and in which there is the requirement for a number of independent hydraulic circuits.

Such prior art may be subject to considerable improvements with a view to eliminating the above-mentioned drawbacks.

The technical problem to be solved by the invention is that of simplifying the manufacture of hydraulic devices, such as gear motor or pumps.

According to a particular aspect, the problem consists in achieving, in an extremely simple and economical manner, a number of independent chambers in a single gear motor or pump.

The invention solves the above-mentioned problem by adopting a gear motor or pump comprising a casing having a lobed cavity, said casing being fitted with positionable partitioning means that divide the lobed cavity into at least two distinct and independent chambers.

Each chamber may be provided with an inlet and a respective outlet; this is particularly advantageous when the hydraulic device has to be used as a bidirectional gear motor or pump.

The chambers may also have a common inlet and distinct outlets, which is preferable when the hydraulic device has to be used as uni-directional pump, or as a gear motor flow-divider.

In the latter embodiment, the outlets may be conected toghether and a check valve may be interposed between them, particularly when the device has to be used as an high-low (hi-lo) pump.

In a particularly advantageous embodiment, the said positionable partitioning means consists of at least one divider plate that may be placed axially inside the cavity with two opposing lobes in correspondence with a transverse plane perpendicular to the axis of the said cavity.

One of the advantages of the present invention lies in the reduction in overall dimensions achieved by adopting the said solution when at least two independent pumping or motor elements are required.

Furthermore, another advantage lies in the fact that it is possible, using the same pump, or motor, body of a predetermined length, to obtain a range of different displacements for the chambers in function of the axial position in which the divider plate is set during assembly: this gives significant benefits in terms of the reduction of spare parts kept in stock and greatly simplifies the production cycle; also, the solution as described is suitable for use both with pumps, or motors, having bodies obtained by extrusion and with pumps having bodies obtained from a casting.

In this respect, it is to be noted that the divider plate can advantageously be made of a wearproof low friction material suitable for coupling with the ends of the gearwheels, solution which is impracticable with prior art pumps, in particular those obtained from a casting, in which only one material is used in the manufacture of the body of the pump, and impossible with pumps, or motors, having extruded bodies in which it is not possible to obtain structural elements formed in a plane that is perpendicular to the axis of extru-

sion.

In a particularly advantageous version, the device has a single inlet opening that passes through the body of the pump, divided into two parts by the underlying divider plate, so as to supply a flow to the two pumping chambers separately, said flow being advantageously proportional to the displacement of each chamber.

For this reason the divider plate may be positioned centrally with respect to the said opening, or even offset with respect to it, that is, displaced along the axis of the cavity towards one of the chambers.

This has the particular advantage of obtaining, in an extremely simple manner and automatically with the positioning of the divider plate, an optimal supply to the chamber of each pumping, or motor, element, without having to use complex external inlet manifolds as used in the prior art.

In another advantageous version, the axial length of the divider plate, that is, its dimension in a direction parallel to the axis of the cavity with two opposing lobes, is less than the sum of the axial lengths of the end supports: it being envisaged that the reduction in length may be of the order of approximately 30% or even up to 50%.

This gives rise to the further advantage consisting in the possibility of further reducing the axial extent of the body of the pump or motor (with a given ratio between the displacements of the adjacent chambers).

It is to be noted, in particular, that the reduction in the axial length envisaged for the divider plate enables, taking into account the manner in which the pump, or motor, is operated during its working life, the quantity of materials used in its manufacture to be optimised eliminating onerous waste caused by over designing.

The provision of an additional support for each of the driving and driven shafts at the divider plate enables a synergic effect in the distribution of the loads to be achieved, effect which does not occur in applications in which there are pumps in series connected by couplings, as found in the prior art.

In another advantageous version, the said divider plate has a plane of symmetry parallel to the axis of the cavity with two opposing lobes and is divided into two parts at the said plane.

This gives rise to the further advantage of making the divider plate particularly easy to manufacture, in that each one of the two parts into which the divider plate is divided can be obtained by axial-symmetric machining from a semifinished piece obtained by forming, for example by casting, or forged, or even swarf machined from bars using normal machine tools.

In another advantageous version, the divider plate has a first recess, positioned on the side corresponding to the inlet, thereby making the pumping, or motor, chambers axially intercommunicating so as to improve the filling of them.

On its side facing the outlet, the divider plate may have a second recess, analogous to said first recess, but coupling with a plugging element of the same shape protruding from the surface defining the cavity and extending inwards in a position corresponding to the join between the lobes, so as to prevent the pumping chambers from being interconnected on the outlet side.

Moreover, the divider plate can be symmetrical with respect to a plane that is perpendicular to the axis of the cavity with two opposing lobes of the body of the pump.

This affords the further advantage of rapidity of assembly, essential requirement in order to easily automate the manufacturing cycle of such pumps.

Some embodiments of the invention are illustrated, purely by way of example, in the ten tables of drawings attached in which:

Figure 1 is a longitudinal section of an uni-directional gear pump having an extruded body, in a first embodiment with two pumping chambers having substantially the same displacement separated by an intermediate divider plate;

Figure 2 is a section taken along line II-II of Figure 1;

Figure 3 is a section taken along III-III of Figure 2, but showing an embodiment having pumping chambers with different displacements;

Figure 4 is a longitudinal section as in Figure 1, but relative to an embodiment with a double ring gear in order to reduce noise levels;

Figure 5 is a longitudinal section as in Figure 1, but relating to an embodiment having a cast body;

Figure 6 is a partial and enlarged top view of Figure 2, in an embodiment with divider plate centred with respect to the inlet opening;

Figure 7 is a view as in Figure 6, but in an embodiment with divider plate off centre;

Figure 8 is a plan view of a divider plate separating two adjacent pumping chambers, in an embodiment comprising two separate symmetrical parts placed side by side, for example, obtained from a bar;

Figure 9 is a view from the right of Figure 8;

Figure 10 is a view as in Figure 8, but in an embodiment with a single-piece divider plate, for example obtained by casting;

Figure 11 is a view from the right of Figure 10;

Figure 12 is a longitudinal section of a bi-directional gear motor, or pump, having an extruded body, in a further embodiment with two chambers having substantially the same displacement separated by an intermediate divider plate;

Figure 13 is a section taken along line XIII-XIII;

Figure 14 is a view of a divider plate insertable in an intermediate position into the cavity of the

gear motor or pump shown in Figure 12;

Figure 15 is a longitudinal section of an high-low (hi-lo) pump provided with a postionable divider plate;

Figure 16 is a longitudinal section of a bi-directional gear motor flow divider having two chambers obtained by means of a positionable divider plate;

Figure 17 is a front view of a divider plate positionable into a lobed cavity of a gear motor flow divider of Figure 16.

The hydraulic device may include a gear pump 1 having a body 2, for example, obtained by extrusion, to which are fitted axially a cover 3 and, at the opposite end, a flange 4 for coupling it to driving means not shown. The body 2 has a through opening 5, or cavity, preferably having the shape of two opposing symmetrical lobes, for the insertion into them with wet seal of two pairs of end supports 6 of a driving shaft 7 and of a driven shaft 8 (Figure 2), coupled to each other by means of pairs of driving gearwheels 9, 9a, that is, keyed onto the driving shaft 7, meshing with a corresponding pair of driven gearwheels 10, 10a mounted on the driven shaft 8.

The supports 6 are equipped with bushes 6b for the rotary coupling in them of the shafts 7, 8, said bushes being fitted into corresponding axial holes 6a of the supports 6.

The cover 3 and the flange 4 are locked onto the body 2, by means of ties 10c; frontal peripheral seals 2a being positioned between the body 2, the cover 3 and the flange 4 respectively. The flange 4 is provided with a through hole 10d for the shaft 7, equipped with rotary sealing elements 10e on the shaft itself. In the vicinity of an intermediate section of each shaft 7, 8 there is a divider plate 11 having a pair of through holes 12 for the rotary coupling in them of the shafts 7, 8 with bushes 11 a positioned between them.

The divider plate 11 defines, inside the opening 5 of the body 2 having the shape of two opposing lobes, two distinct pumping chambers 13 delimited axially between the said divider plate and the supports 6; said lobes serving as seat for the gearwheels 9, 10, 9a, 10a. It has to be noted that the ends of the gearwheels 9, 9a, 10, 10a have a sliding contact with the divider plate 11 on one side and the end supports 6 on the other side: this making it possible to obtain a range of displacements with predetermined proportions between the pumping chambers 3 by using gearwheels having suitable axial dimensions as shown in Figure 3.

The divider plate 11, manufactured separately from the body 2, can be inserted, during assembly, in an appropriate axial position within the opening 5, so as to define chambers 13 that are the same as each other or different from each other, using one single pump body 2: the positioning and fixing in place is preferably achieved by interference-fit assembly, advantageously by heating the body 2 and cooling the divider plate 11.

In the case of aluminium pumps the body can be heated to approximately +250°C and the divider plate can be cooled to approximately -20°C; the temperature levels being equivalent to those suitable in the case of cast iron pumps.

The device used for inserting the divider plate in a predetermined axial position inside the body 2 can comprise an assembly manipulator.

It is to be noted that the inlet opening A for the fluid to be pumped, generally oil, consists of a through opening 14 set into the body 2 in a position corresponding to that of the divider plate 11 so as to supply both the pumping chambers 13 in appropriate proportions: the plan view shape of the opening 14 can be circular or rectangular, elongated and radiused at the ends, or mixed (see Figures 6, 7), or other suitable shape.

The inlet opening A, 14 can also have a constant oil flow section, or even variable, in particular increasing towards the pumping chambers 13 that it supplies; in this embodiment, the side walls of the opening 14 can have stretches 14a advantageously diverging towards the inside in order to facilitate the complete filling of the pumping chambers, particularly when they extend a long way axially, as in the embodiments shown in Figures 4, 5. Furthermore, such a configuration of the opening 14 makes an optimal filling of the pumping chambers 13 possible even when the divider plate 11, for example, for reasons of strength, extends a long way axially.

The divider plate can be placed in a position corresponding to the axis of symmetry of the opening 14, as in Figure 6, or in an off centre position as in Figure 7: in the first case the position of the opening has to be determined in function of the ratio between the displacements of the pumping chambers 13, whereas in the second case the positioning is essentially independent of the position of the divider plate 11.

Figures 1, 3, 4 also show how the driving shaft 7 can be provided with coupling means, at the opposite end to the end coupled to the driving means, for example, by means of shank 7a and key 7b, preferably for driving the drive shaft of another pump coupled in series with pump 1: the said driving means possibly consisting of a splined portion 7c.

Figure 4 shows an embodiment of a pump in which each pumping chamber 13 is occupied by a pair of gearwheels 15 meshing with each other, each having two ring gears 15a between which a spacer ring 16 is placed. Each ring gear 15a is angularly offset with respect to the other ring gear 15a inserted in the same chamber 13, by an angle corresponding to a fraction of the pitch, preferably 1/2 the pitch between the teeth of each gearwheel: this in order to reduce the noise level of the pump.

Each chamber 13, furthermore, is made commu-

nicating with the hydraulic circuit downstream by means of a relative outlet M, consisting of a through opening 17 set into the body 2.

Figure 5 shows an embodiment in which the body 18, analogously hollow, is obtained from a casting and coupled to a cover 19 and a flange 20.

In this embodiment the supports 6 are an integral part of the said cover and said flange and are each equipped with a pair of bushes 6a.

The ends of the gearwheels 9, 9a and similarly 10, 10a have a sliding contact, as regards the internal ends, directly on the divider plate 11 and, as regards the external ends, on the respective cover 19 and flange 20 with anti-friction plates 21 positioned between them, that is, manufactured using a material having a low coefficient of friction: it is to be noted that making the divider plate separately from the body makes it possible to save on production costs as anti-friction plates between the ends of the gearwheels 9, 9a, 10, 10a and the divider plate 11 are not required because the divider plate is preferably made from a wearproof material with a low coefficient of friction.

Figures 8 to 10 show two possible embodiments of the divider plate 11: it is to be noted that the external surface of the divider plate has to have two opposing lobes 22 so that they may marry with the internal surface of the axial opening 5 with a stable coupling of the forms on assembly.

On the inlet side A, the divider plate has a first recess 23, in order to improve the filling of the pumping chambers 13.

On the same side, the divider plate has a pair of grooves 23a, interconnecting through holes 12, that are intended to avoid the possibility of cavitation.

On the outlet side M, a second recess 26 can be provided, corresponding to the first recess 23 and positioned opposite it: inside the cavity 5 a plugging element 27 is positioned between the said second recess and the said cavity 5, to prevent the pumping chambers 13 from being intercommunicating on the outlet side. The plugging element 27 may be integral with the body of the hydraulic device 1, and may consist of an internally projecting appendix of the lobed cavity 5.

On the side where the second recess 26 is provided, the divider plate is advantageously provided with two pairs of opposing grooves 24, each being "V" shaped, that allow the oil to exit more gradually from the chamber defined by the meshing teeth in a position corresponding to that of the chamber with the highest pressure so as to reduce noise levels.

The divider plate is symmetrical with respect to a first plane parallel to the axes of the holes 12, and therefore to the lobed cavity 5: it can therefore be divided into two parts along a first plane of symmetry S, as in the embodiment of Figure 8, positioned with respect to each other by a locating pin on assembly, or it can be made from a single piece, as in the embodiment shown inFigure 10.

Furthermore, as shown in Figure 9, 11, the divider plate is advantageously symmetrical also in a third plane of symmetry perpendicular to the axis of hole 12.

It is to be noted that the supports 6 and the plates 21 are such as to compensate the axial thrust acting on the ends of the gearwheels 9, 9a, 10, 10a, 1 5a of shafts 7, 8.

According to a further embodiment, not shown, both the driving shaft 7 and the driven shaft 8 may be rotatably coupled to one of the support 6 and to the divider plate 11, thereby the further support 6 serving only as an axial balancing plate.

As shown in Figure 12, the hydraulic device may include a bi-directional gear motor, or pump, 1a; in the drawings, inlets A are associated to oultets M when the gearwheels 9, 9a are driven in a clockwise direction, while inlets A1 are associated to outlets M1 when the gearwheels 9, 9a are driven in counter-clockwise direction.

Each chamber 13 is provided with an inlet A, A1, 14b and a respective outlet M, M1, provided for in the body 2 of the motor, or pump, 1a.

In order to obtain separation between the chambers 13, the divider plate 11b must have an external outline peripherally coupled to the internal outline of the cavity 5; this is preferably achieved by providing a divider plate 11 b which is also symmetrical with respect to a second plane of symmetry passing through the axis of the holes 12. In particular, said divider plate 11b has a pair of opposed second recesses 26 engageable with corresponding appendixes 27 of the cavity 5.

Each second recess 26 is provided with a respective V-shaped groove 24.

As shown in Figure 15, a hydraulic hi-lo pump 1c has outlets joined together by a connecting channel 30 provided with a check valve 31, a pilot line 32 piloting a sequence valve 33; said sequence velve 33 being inserted into a by-pass line 34 of one chamber 13.

A gear motor flow divider 1d, as shown in Figure 16, is provided with a divider plate 11c, having a first recess 23 and a second recess 26, both having a V-shaped groove 24: the gear motor flow divider 1d has a pair of opposing covers 4, both ends of shafts 7d being provided with coupling means 7c.

In practice the materials, dimensions and details of execution may be different from, but technically equivalent to, those described without departing from the juridical domain of the present invention.

Claims

1. External gear hydraulic device (1, 1a, 1c, 1d), comprising a hollow body (2) acting as casing

closed off axially by closing means (3, 4; 19, 20), the hollow body (2) having a cavity (5) in which pairs of gearwheels (9, 9a,10, 10a, 15, 15a) are coupled rotationally, said pairs of gearwheels (9, 9a,10, 10a, 15, 15a) meshing with each other, characterised in that the casing (2) is fitted with positionable partitioning means (11, 11b, 11c) that divide the cavity (5) into at least two distinct and independent chambers (13).

2. Hydraulic device according to claim 1, wherein each chamber (13) is provided with an independent outlet opening (M, M1, 17) and with an inlet opening (A, 14, 14a) communicating with a corresponding inlet opening (A, 14, 14a) of a further chamber (13).

3. Hydraulic device according to claim 1, wherein each chamber (13) is provided with an independent outlet (M, M1, 14b, 17) opening and an independent inlet (A, A1, 14, 14b, 17) opening.

4. Hydraulic device according to any preceding claim, wherein said positionable partitioning means consist of at least one divider plate (11, 11b, 11c) that may be placed axially inside the cavity (5) in correspondence with a transverse plane perpendicular to the axis of the said cavity (5): said divider plate (11, 11b, 11c) having a pair of through holes (12) for the rotary coupling in them of respective shafts (7, 8) onto which said gearwheels (9, 9a, 10, 10a, 15, 15a) are provided for.

5. Hydraulic device according to claim 2, wherein a single inlet opening (14) is provided for passing through the body (2) of the pump, said opening being divided into two sections by the underlying divider plate (11).

6. Hydraulic device according to any preceding claim, wherein the inlet opening (14a) has side walls that define a flow section increasing towards the chambers (13).

7. Hydraulic device according to claim 5, wherein the position of the divider plate (11) with respect to the said chambers (13) is such that the flow of the liquid entering to each chamber (13) is proportional to its displacement.

8. Hydraulic device according to any preceding claim, wherein the linear dimension of the divider plate (11) in a direction parallel to the axis of the cavity (5), is less than the sum of the corresponding axial dimensions of the end supports (6, 6a): the reduction in length being of the order of approximately 30% or even up to 50%.

9. Hydraulic device according to any preceding claim, wherein the divider plate (11, 11c) has a first recess (23), positioned on the side corresponding to the inlet opening (14, 14a), that makes the chambers (13) intercommunicating.

10. Hydraulic device according to any preceding claim, wherein the divider plate (11) has, on the side facing the outlet openings (17), a contour that marries with the internal surface of the cavity (5) in order to prevent the chambers (13) from being intercommunicating.

11. Hydraulic device according to any preceding claim, wherein the divider plate (11) has a second recess (26) designed to form a seal with a plugging element (27) protruding from the cavity (5) in a position corresponding to the join between the lobes.

12. Hydraulic device according to any preceding claim, wherein the divider plate (11) has two pairs of grooves (23a), bilateral and opposite each other, extending between the through holes (12).

13. Hydraulic device according to any preceding claim, wherein the divider plate (11, 11b, 11c) has, on the side of the outlet opening (17), two pairs of bilateral opposing grooves (24) that are "V" shaped.

14. Hydraulic device according to any preceding claim, wherein the divider plate (11, 11b, 11c) has a first plane of symmetry (S) parallel to the axis of the cavity (5).

15. Hydraulic device according to any preceding claim, wherein the divider plate (11b) has a second plane of symmetry passing through the axis of holes (12).

16. Hydraulic device according to any preceding claim, wherein the divider plate (11, 11b, 11c) is symmetrical with respect to a third plane of symmetry perpendicular to the axis of hole (12).

17. Hydraulic device according to any preceding claim, wherein the divider plate (11, 11b, 11c) is obtained by forming wearproof material with a low coefficient of friction.

18. Hydraulic device according to any preceding claim, wherein each gearwheels (10, 10a, 15, 15a) have two ring gears (10a, 15a) between which a spacer ring (16) is positioned, said ring gears having teeth angularly offset with respect to each other.

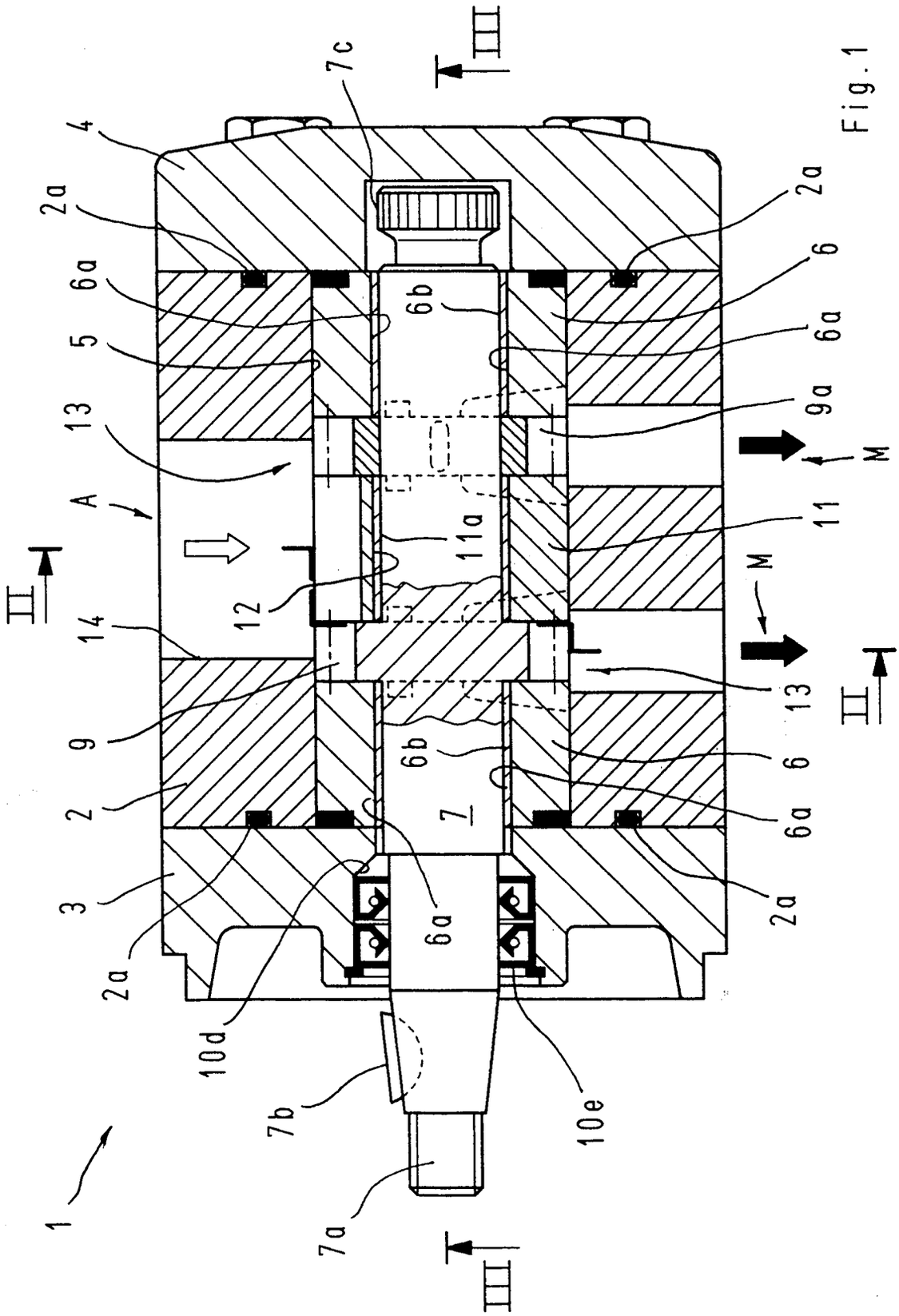

III
7c
4
2a
6a
5
13
A
II
14
9
2
3
2a
10d
7b
7a
1
6b
7
6a
2a
6
6a
9a
M
11
11a
12
M
II
13
6
6b
6a
2a
III

Fig. 1

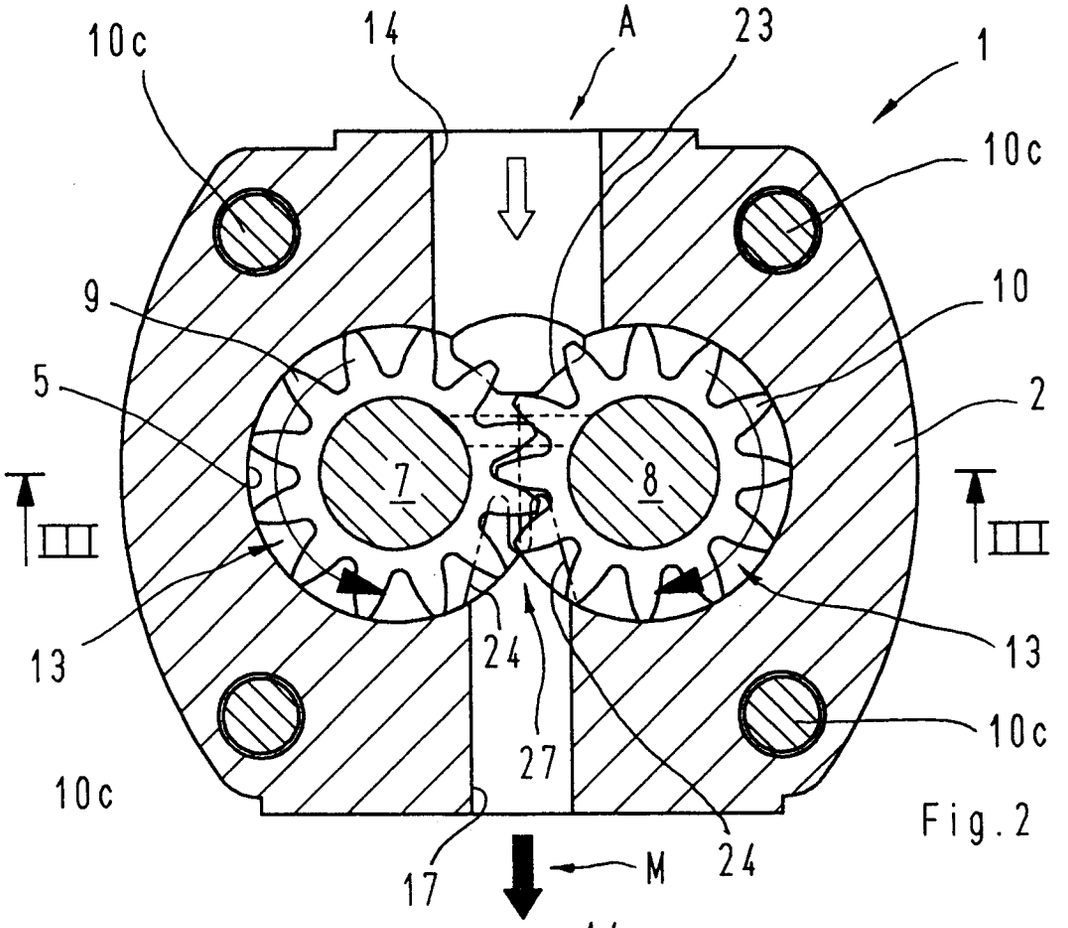


Fig.2

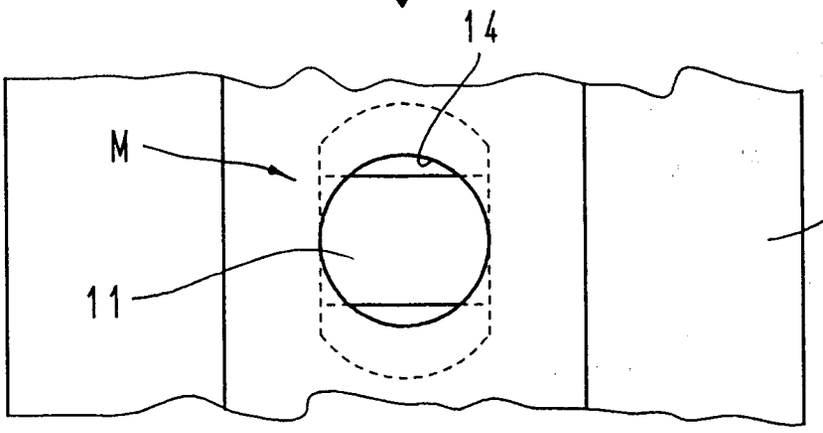


Fig.6

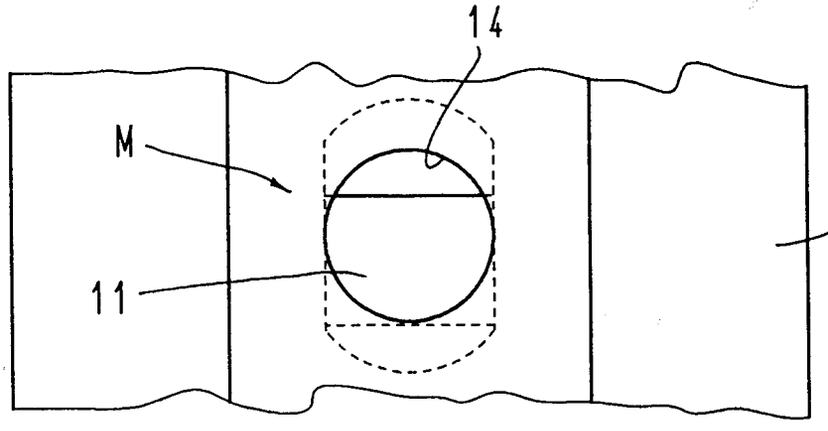


Fig.7

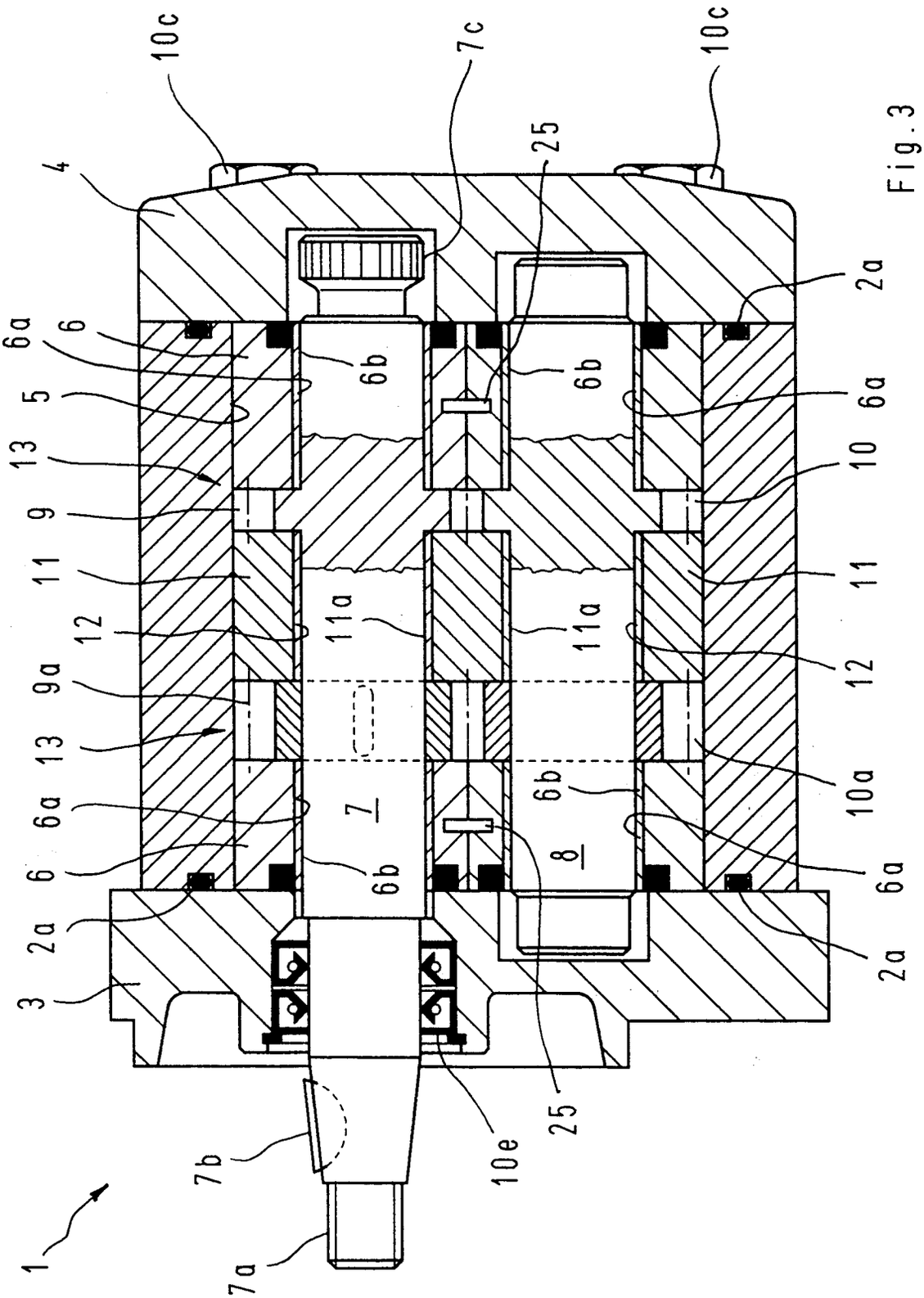

10c
7c
10c
25
4
2a
6a
6
6b
6b
5
6a
13
10
9
11
11a
11a
11
12
9a
12
13
10a
6a
7
6b
8
6
6b
6a
2a
2a
3
25
10e
7b
1
7a

Fig.3

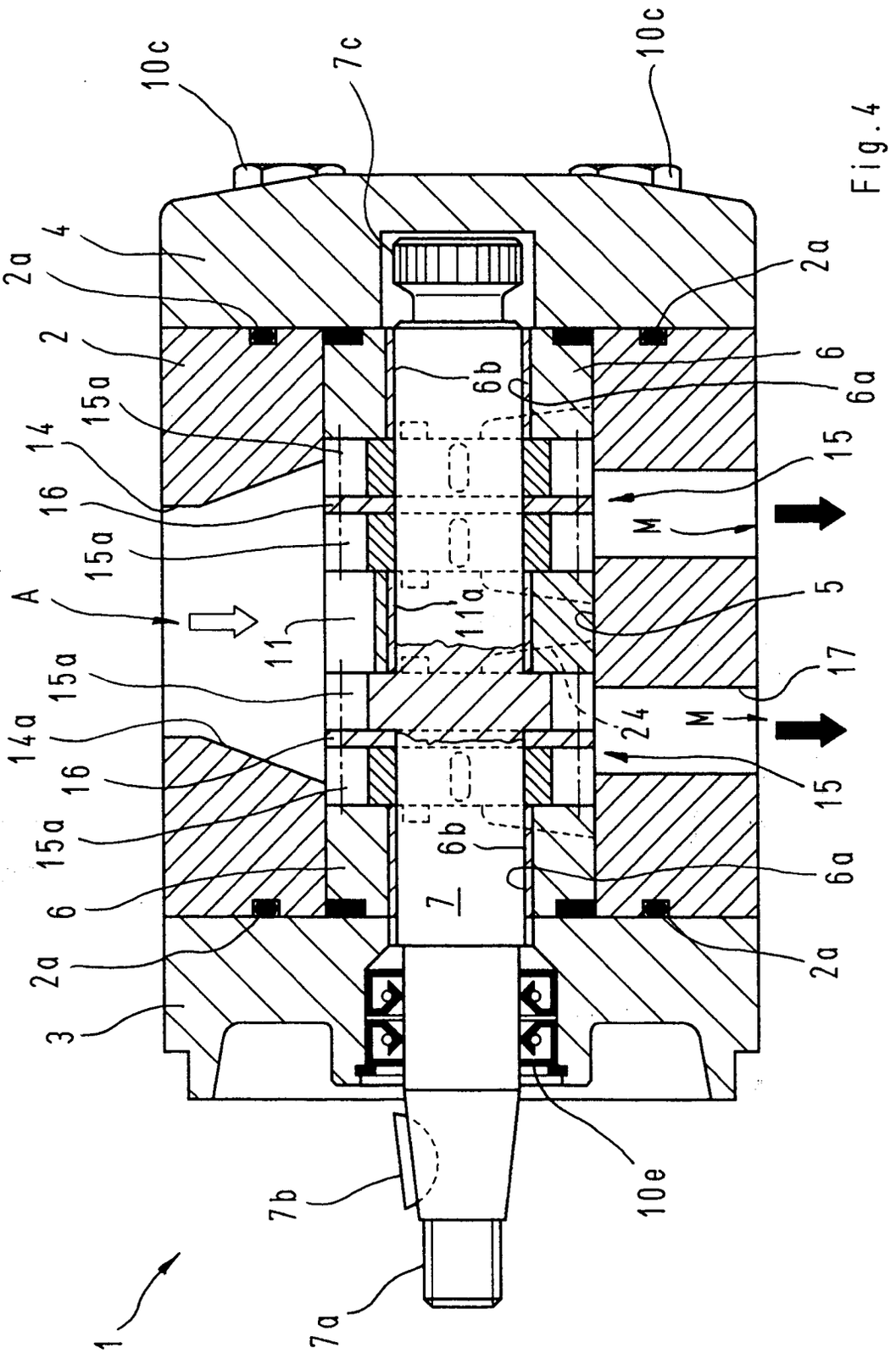

10c
7c
10c
4
2a
2
6b
6
6a
15a
14
16
15
M
A
11
11a
5
17
24
14a
7
7b
7a
10e
1
3

Fig.4

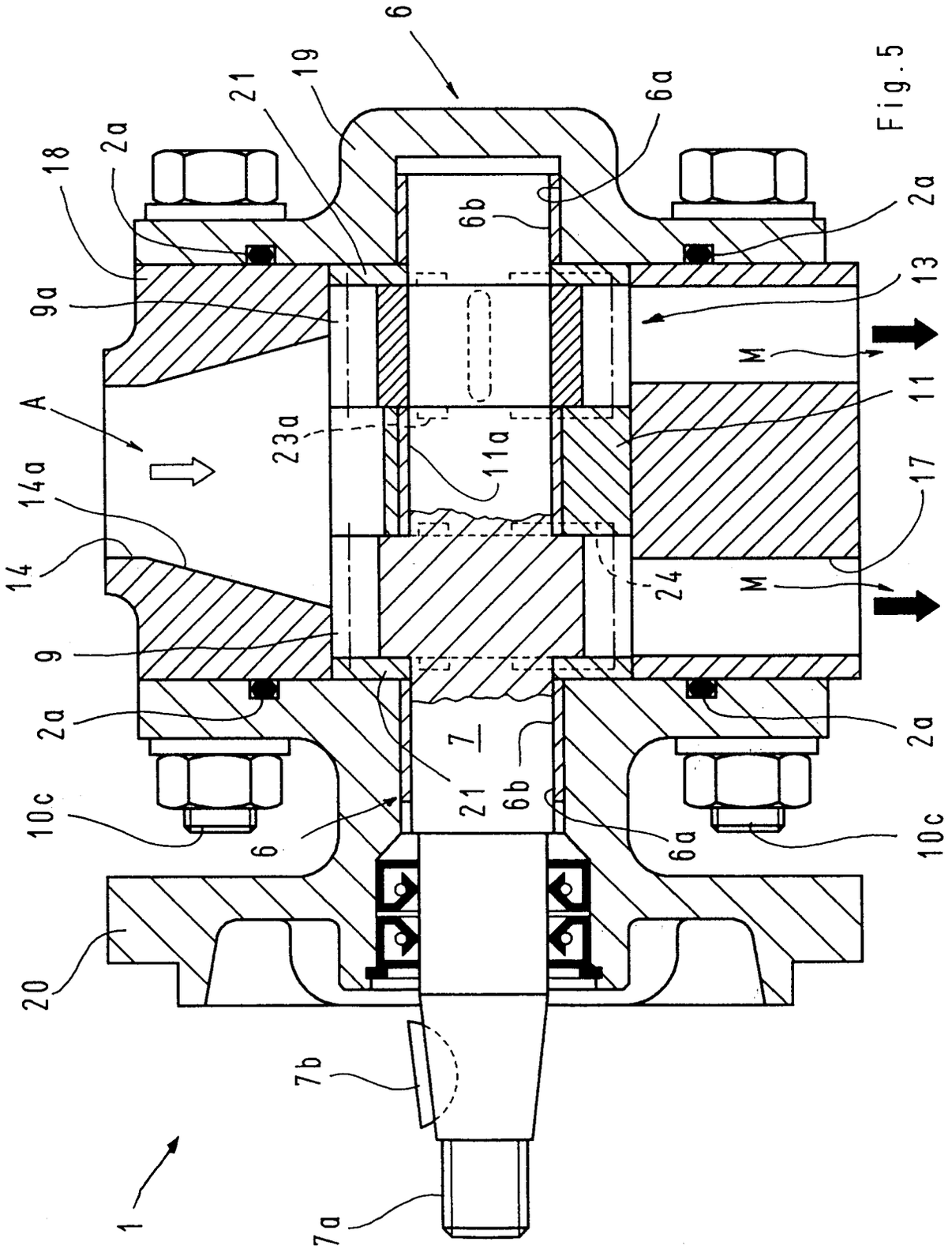

6
19
21
6a
2a
18
6b
2a
9a
13
M
A
23a
11a
11
17
14a
14
24
M
9
2a
2a
7
21
6b
10c
6
6a
10c
20
7b
1
7a

Fig.5

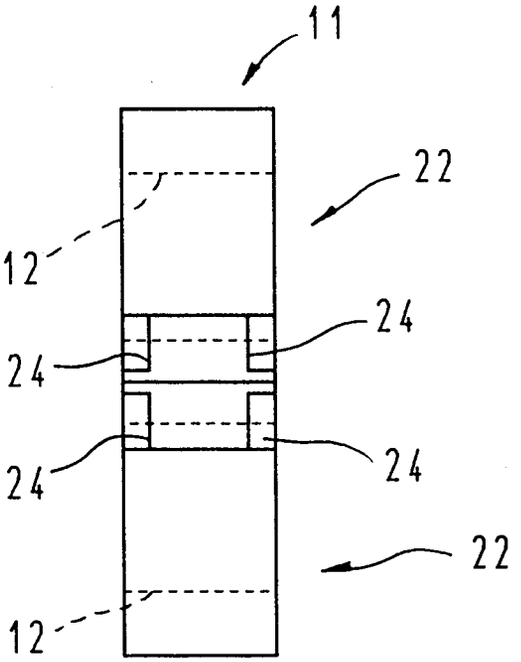


Fig.9

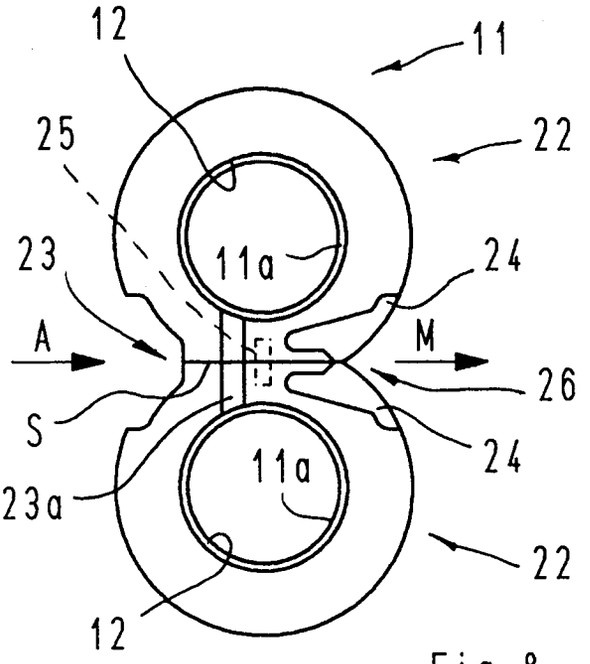


Fig.8

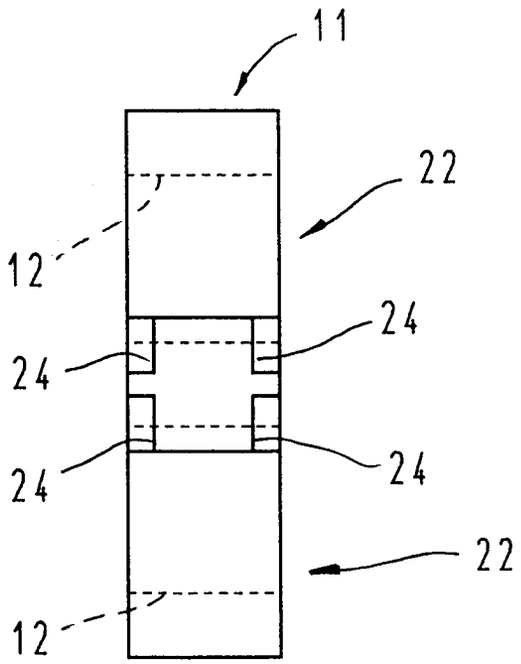


Fig.11

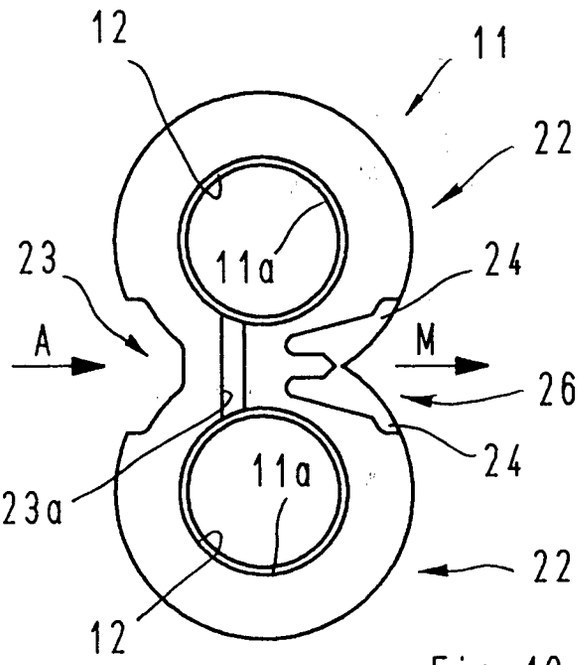


Fig.10

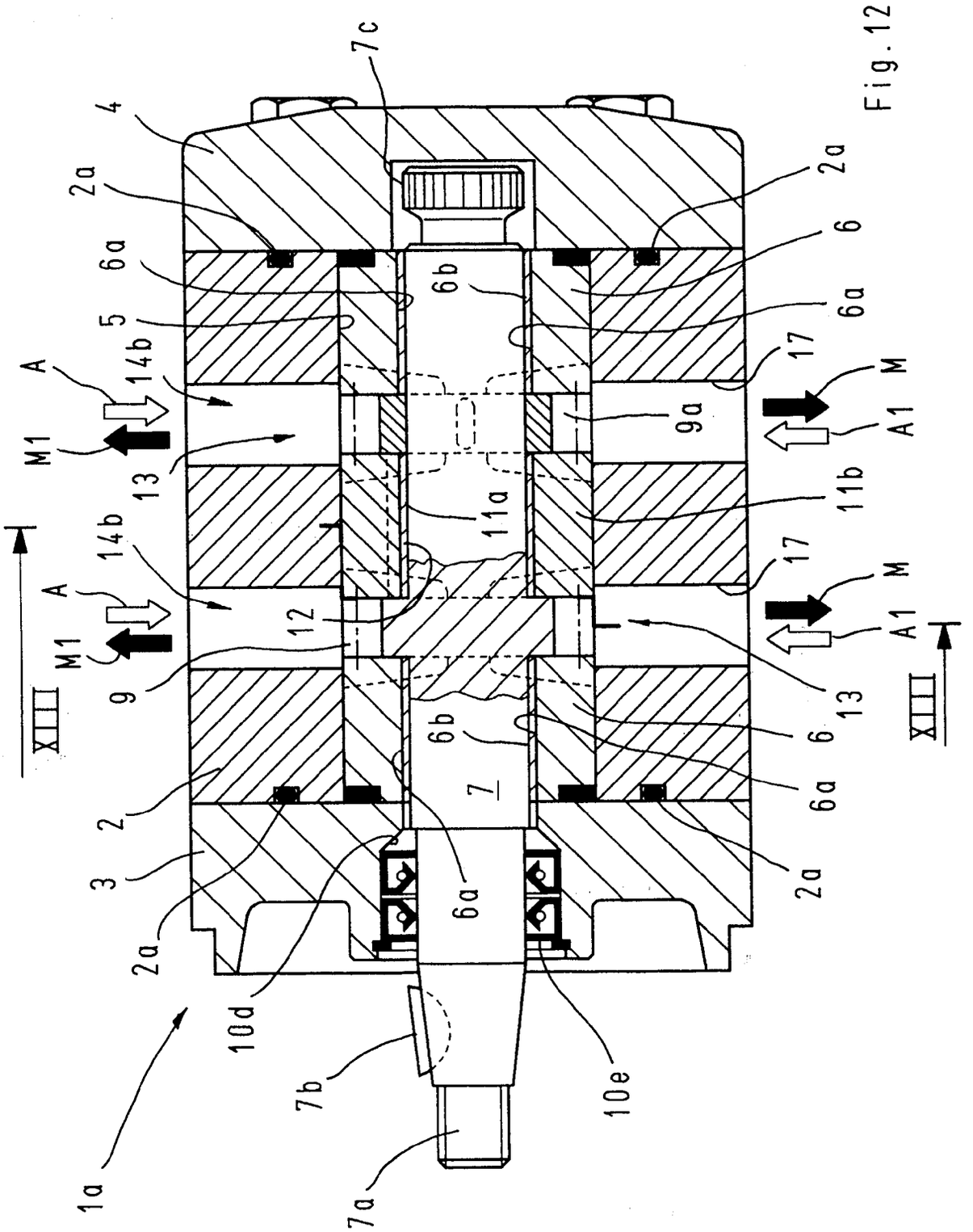

7c
4
2a
6a
5
14b
A
M1
13
9
12
14b
A
M1
XIII
2
3
2a
1a
10d
7b
7a
6b
7
6a
10e
2a
6
6a
17
M
A1
9a
11a
11b
17
M
A1
13
6b
6
6a
2a
XIII

Fig.12

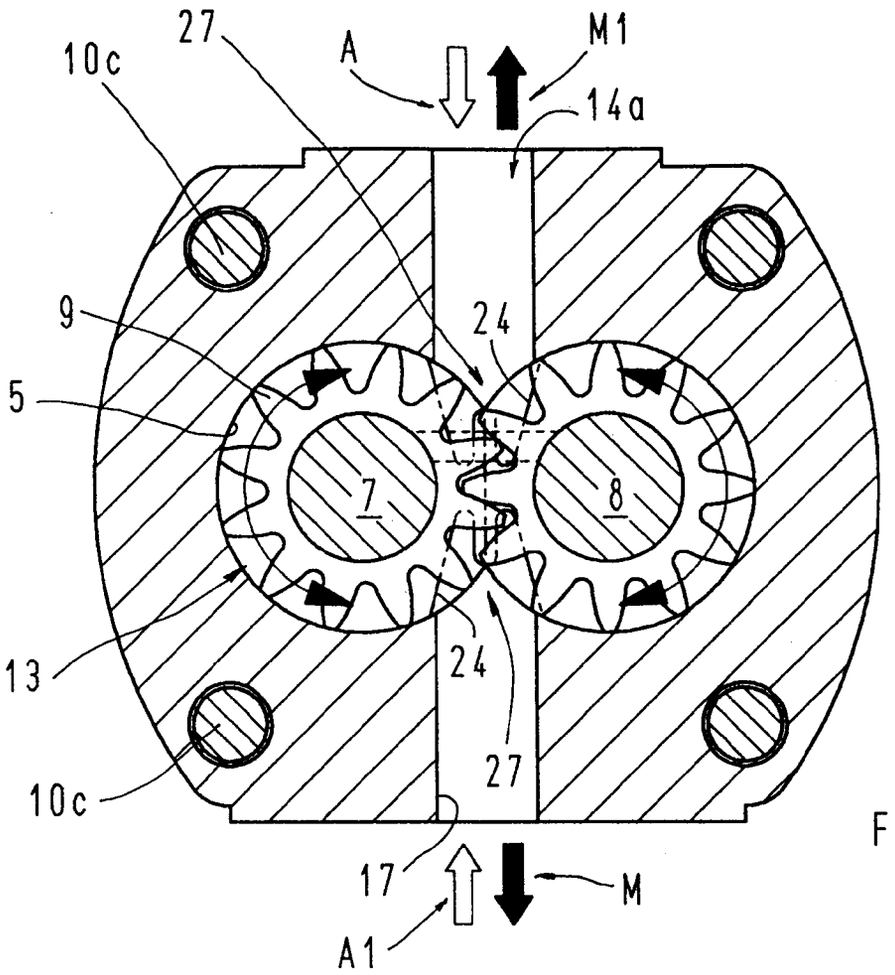


Fig.13

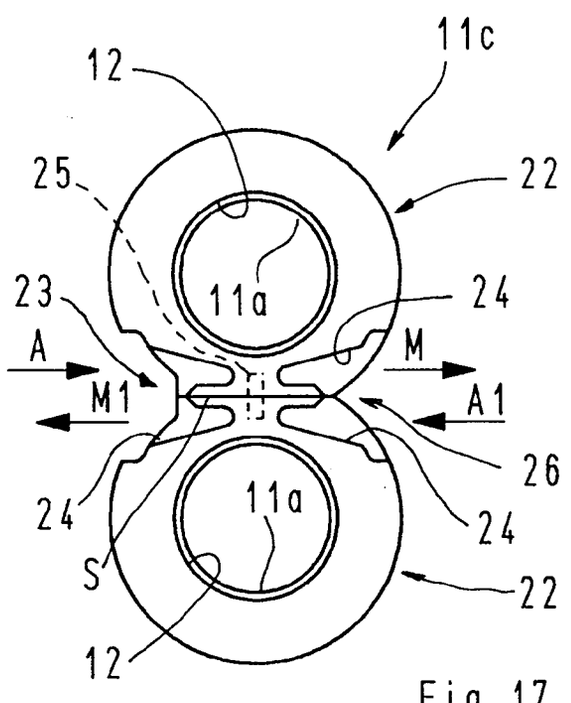


Fig.17

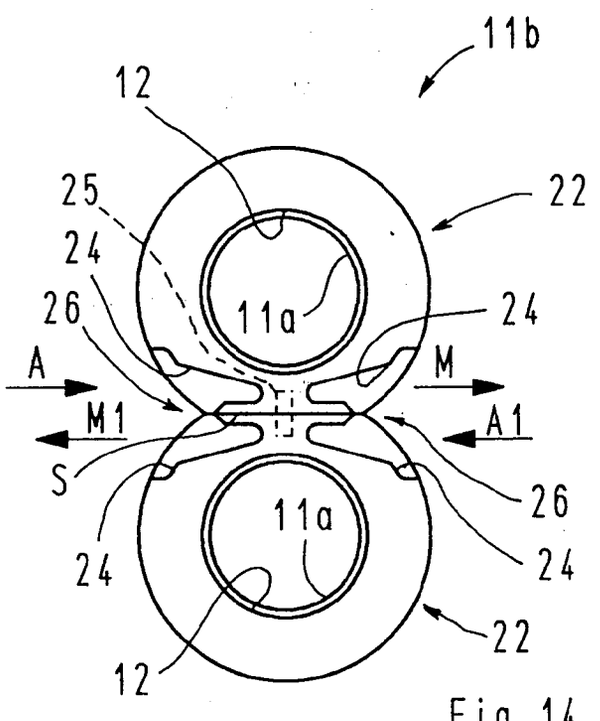


Fig.14

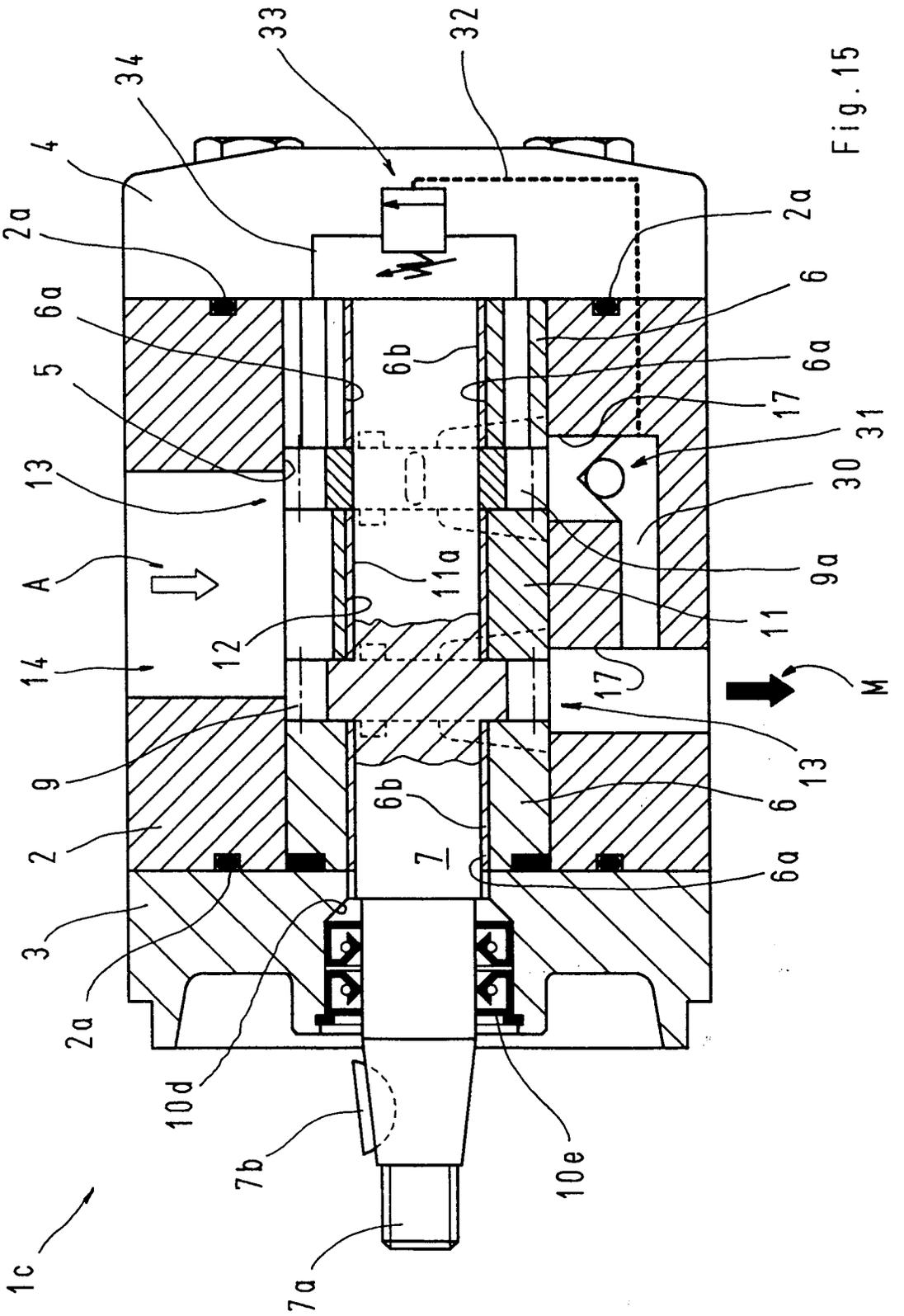

33
32
34
4
2a
2a
6a
6
6b
6a
5
17
31
13
30
A
11a
9a
14
12
11
17
M
9
13
6b
6
2
7
6a
3
2a
10d
7b
10e
1c
7a

Fig.15

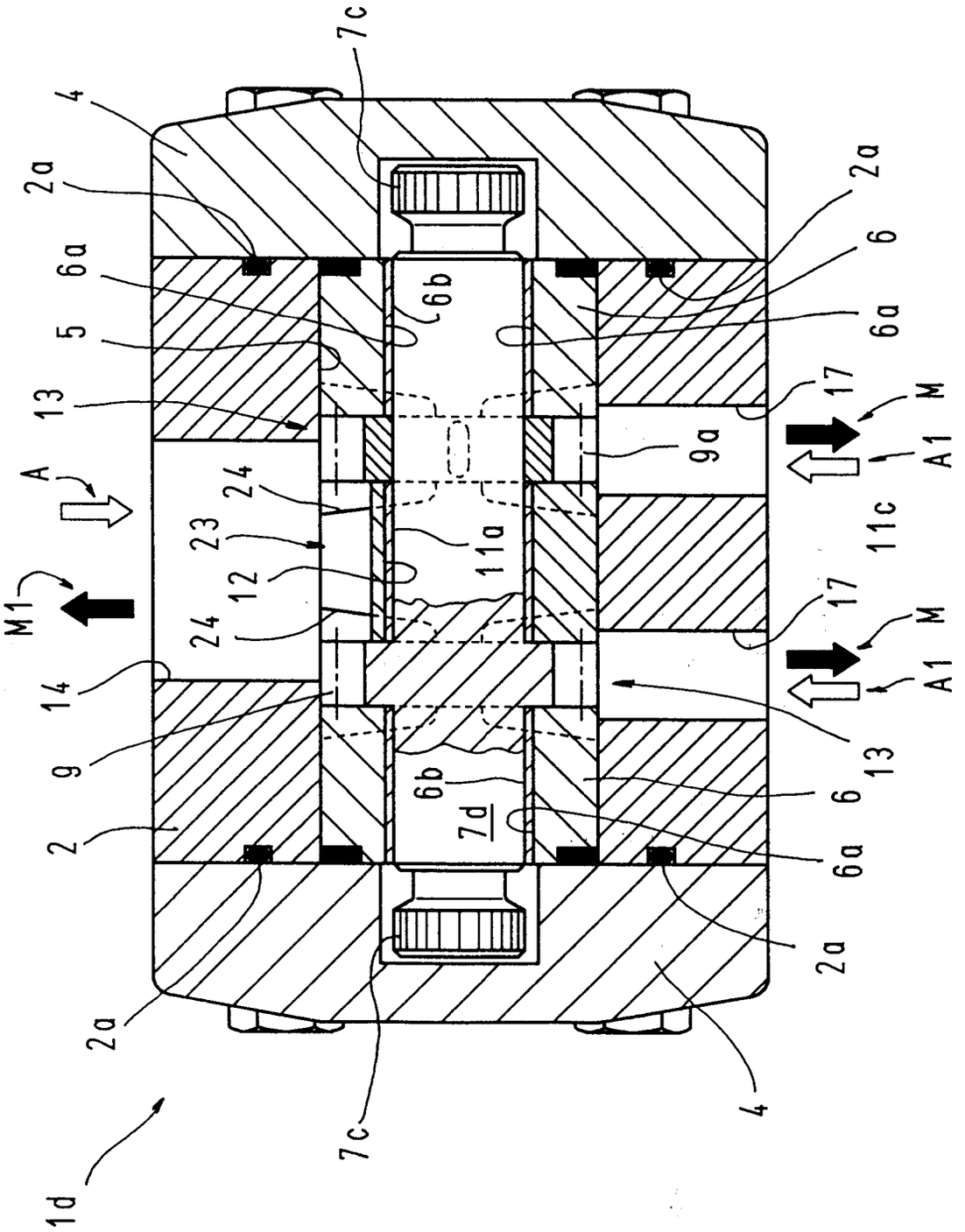


Fig.16

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 20 1391

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X Y	EP-A-0 004 119 (KORSE) * the whole document * ---	1,4,6-8 2,5	F04C2/14 F04C11/00
Y	FR-A-919 498 (PESCO PRODUCTS) * the whole document * ---	2,5	
P,X	DE-A-42 42 217 (ROBERT BOSCH GMBH) * the whole document * ---	1,4	
X	FR-A-2 231 865 (VEB) * the whole document * ---	1	
X	US-A-3 025 796 (MILLER) * the whole document * ---	1	
X	EP-A-0 117 720 (GENERAL ENGINEERING RADCLIFFE LTD.) * the whole document * ---	1	
A	GB-A-2 057 572 (WHITE) * the whole document * ---	1,3	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	EP-A-0 151 798 (ROBERT BOSCH GMBH) * the whole document * -----	9	F04C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	4 September 1995	Dimitroulas, P

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

EPO FORM 1503 03.82 (P04C01)