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(54) **Gerotor pump**

(57) A gerotor pump (10) having a pump body (11) closed by a cover (12). The pump body (11) has a cavity ((CV)) for housing:

- an outer rotor having an outer surface ((SUP1), SUP4)) which slides on the surface of the cavity ((CV)), and an inner surface ((SUP3), (SUP5)) with lobes ((LB1), (LB4)) projecting inwards of the outer rotor; and

- an inner rotor (14, 16) which is fitted to a drive shaft (18) having an axis ((AX)) of rotation, and has lobes ((LB2), (LB3)) which mesh with the lobes ((LB1), (LB4)) of the outer rotor (13, 17). The inner rotor is divided into at least two lobed portions (14, 16) by cutting the inner rotor along a plane ((ψ)) substantially perpendicular to the axis ((AX)) of rotation.

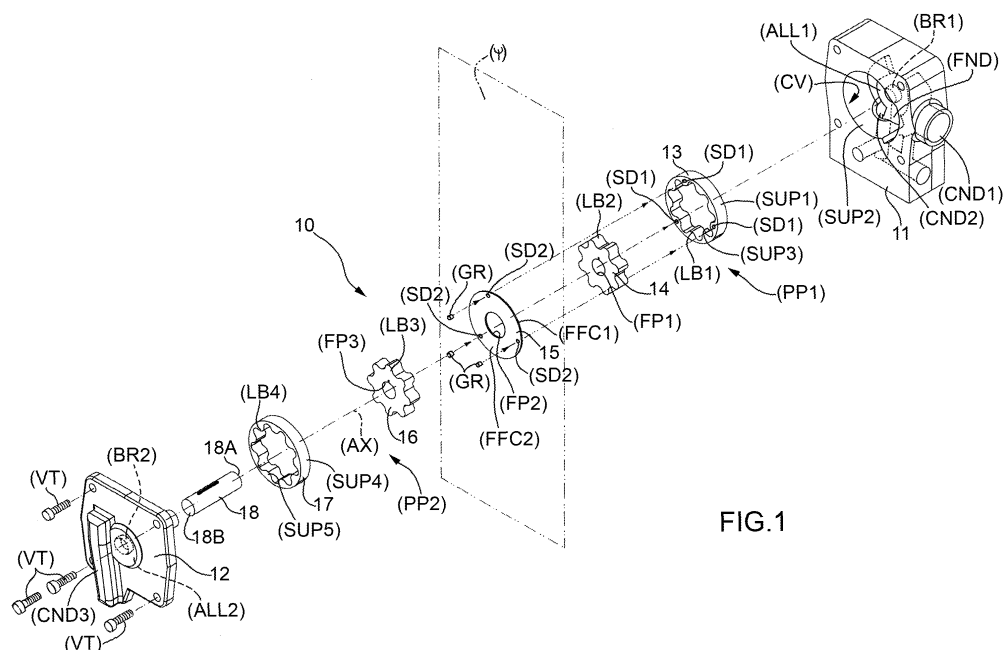


FIG. 1

Description

[0001] The present invention relates to a gerotor oil pump. More specifically, the present invention relates to a gerotor pump (generated pump rotor) comprising an inner rotor with a given number of lobes; and an outer rotor (normally with one more lobe than the inner rotor). The inner rotor is eccentric with respect to the outer rotor, and the inner rotor lobes mesh with the outer rotor lobes to cyclically form a number of compression chambers between the lobes, in which the fluid is compressed and fed to a delivery conduit.

[0002] Gerotor pumps are used in a wide range of applications, such as automotive oil pumps.

[0003] Gerotor pumps are also widely used in farm tractor hydraulic circuits.

[0004] The present invention may therefore be used to particular advantage, though not exclusively, in the manufacture of farm tractors, to which the following description refers purely by way of example.

[0005] Known gerotor pumps normally comprise a pump body closed by a cover.

[0006] The pump body in turn comprises a cavity for housing:

- an outer rotor having an outer surface which slides on the cavity surface, and an inner surface with lobes projecting inwards of the outer rotor; and
- an inner rotor fitted to a drive shaft and with lobes which mesh with the lobes on the outer rotor.

[0007] Up to a certain thickness of the rotors, no serious vibration of the pump is noticeable.

[0008] To increase pump flow, however, the thickness of the rotors must necessarily be increased, thus resulting, in the case of very thick rotors, in a considerable increase in vibration and therefore in the noise level of the pump.

[0009] The present invention is designed to eliminate these drawbacks by cutting the inner rotor (and possibly also the outer rotor) into at least two portions along a plane perpendicular to its axis of rotation.

[0010] This provides for a surprisingly drastic reduction in the noise level of the pump.

[0011] Further improvements have been achieved by offsetting the resulting two inner rotors by a given angle.

[0012] The rotors may be more than two in number, and may be of the same or different thicknesses.

[0013] According to the present invention, there is provided a gerotor oil pump as claimed in Claim 1 or in any one of the Claims depending directly or indirectly on Claim 1.

[0014] A number of preferred, non-limiting embodiments of the present invention will be described by way of example with reference to the accompanying drawings, in which:

ment of a gerotor pump in accordance with the present invention;

Figure 2 shows a pump body forming part of the Figure 1 pump;

Figure 3 shows a cover of the Figure 1 pump;

Figure 4 shows a negative (i.e. "solid" for "hollow") view of the Figure 1 pump;

Figure 5 shows an exploded view of parts of a second embodiment of a gerotor pump in accordance with the present invention.

[0015] Number 10 in Figure 1 indicates as a whole a gerotor pump in accordance with the present invention.

[0016] Gerotor pump 10 comprises a pump body 11 and a cover 12 which "pack" together a number of parts described below.

[0017] Said parts comprise a first outer rotor 13; a first inner rotor 14; an annular partition disk 15; a second inner rotor 16; a second outer rotor 17; and a drive shaft 18 rotated by a motor (not shown) and having a longitudinal axis (AX) which is also the axis of rotation of drive shaft 18.

[0018] Pump body 11 (which is later closed by cover 12) has a cavity (CV) for housing :

- first outer rotor 13, which has an outer surface (SUP1) that slides on the inner surface (SUP2) of cavity (CV); first outer rotor 13 also has an inner surface (SUP3) with a first number of lobes (LB1) projecting inwards of first outer rotor 13;
- first inner rotor 14, which is fitted to drive shaft 18 of axis (AX) by means of a central through hole (FP1); first inner rotor 14 also has a second number of (outwardly-projecting) lobes (LB2) which, in use, mesh with lobes (LB1) of first outer rotor 13;
- annular partition disk 15, which has a central through hole (FP2) also fitted through, in use, with drive shaft 18; partition disk 15 is fixed to first outer rotor 13 by pins (GR), each of which is inserted inside a respective seat (SD1) formed in a front face of first outer rotor 13, and inside a respective seat (SD2) formed in partition disk 15; it should be noted that assembly of partition disk 15 to first outer rotor 13 is made possible by partition disk 15 being larger in diameter than first inner rotor 14, that pins (GR) are three in number and spaced 120° apart in the example shown, and that, without departing from the scope of the present invention, partition disk 15 may be fixed to second outer rotor 17 as opposed to first outer rotor 13;
- second inner rotor 16 fitted to drive shaft 18 of axis (AX) by means of a central through hole (FP3), and having a third number of outer lobes (LB3); and
- second outer rotor 17, which has an outer surface (SUP4) that slides on the inner surface (SUP2) of cavity (CV); second outer rotor 17 also has an inner surface (SUP5) with a fourth number of lobes (LB4) projecting inwards of second outer rotor 17; and

Figure 1 shows an exploded view of a first embodi-

lobes (LB3) of second inner rotor 16 mesh, in use, with lobes (LB4) of second outer rotor 17.

[0019] It should be pointed out that, whereas the two inner rotors 14, 16 are fitted to drive shaft 18, both disk 15 and the two outer rotors 13, 17 are mounted idly on drive shaft 18. The outside diameters of disk 15 and the two outer rotors 13, 17 are substantially equal to the diameter of cavity (CV) of pump body 11.

[0020] One aspect of the present invention therefore lies in cutting an inner rotor and an outer rotor each into two parts along a plane (ψ) substantially perpendicular to the axis (AX) of drive shaft 18 (Figure 1).

[0021] It should also be pointed out that the system would work equally well with two inner rotors and only one outer rotor, and even without the partition disk.

[0022] The two inner rotors 14, 16 can be mounted offset with respect to each other by an angle (not shown) formed between a lobe (LB2) of a first lobed portion (14) and a lobe (LB3) of a second lobed portion (16).

[0023] In one particular case, the offset angle may be such that at least one lobe (LB2) of inner rotor 14 corresponds to a gap between two adjacent lobes (LB3) of inner rotor 16.

[0024] Offsetting inner rotors 14 and 16 is advantageously assisted using a drive shaft 18 with longitudinal grooves (not shown in Figure 1) which mate with like grooves (not shown) in the walls of respective central through holes (FP1), (FP3) of inner rotors 14, 16.

[0025] If a partition disk 15 is provided, when pump 10 is fully assembled, parts 13, 14, 15, 16, 17 are packed together between the end (FND) of cavity (CV) of pump body 11 and cover 12, which is tightened onto pump body 11 by four screws (VT); and parts 13, 14, 15, 16, 17 are all fitted through with drive shaft 18, the ends 18A, 18B of which are supported by bearings (BR1), (BR2) housed respectively inside a seat (ALL1) in the end (FND) of cavity (CV), and a seat (ALL2) inside cover 12.

[0026] When all the parts are assembled between pump body 11 and cover 12, partition disk 15 forms a first pumping chamber (PP1) and a second pumping chamber (PP2).

[0027] More specifically, first pumping chamber (PP1) is defined at one end by end (FND) of cavity (CV), and at the other end by a first face (FFC1) of partition disk 15, and houses first outer rotor 13, first inner rotor 14, and a first portion of drive shaft 18.

[0028] Second pumping chamber (PP2) is defined at one end by the end of cover 12, and at the other end by a second face (FFC2) of partition disk 15, and houses second inner rotor 16, second outer rotor 17, and a second portion of drive shaft 18.

[0029] The two pumping chambers (PP1), (PP2) are isolated hydraulically, as stated, by partition disk 15.

[0030] As shown in Figures 1, 2, 3 and 4, whereas a common intake conduit (CND1) is provided for both pumping chambers (PP1), (PP2), two delivery conduits (CND2) and (CND3) are provided, one for each pumping

chamber (PP1), (PP2).

[0031] More specifically, intake conduit (CND1) branches off into a first portion (PZ1) (Figure 4) on the pump body 11 side, and a second portion (PZ2) on the cover 12 side.

[0032] In other words, a first delivery conduit (CND2) is formed in pump body 11, and a second delivery conduit (CND3) in cover 12.

[0033] As shown in Figure 4, the delivery conduits (CND2), (CND3) may be connected by an inner channel (TB) connected to a further inner return channel (CND4) which may be parallel-connected to a relief valve (VVM).

[0034] An intermediate conduit (CND5) connects inner return channel (CND4) hydraulically to intake conduit (CND1).

[0035] As is known, when delivery exceeds a given pressure, relief valve (VVM) opens, and oil flows along intermediate conduit (CND5) back into intake conduit (CND1).

[0036] In the second embodiment in Figure 5, partition disk 15 is replaced by a contoured disk 150, again located between the two pumping chambers (PP1), (PP2).

[0037] In the Figure 5 embodiment, contoured disk 150 has a first intake opening 152 and a second delivery opening 151 hydraulically connecting the two pumping chambers (PP1), (PP2).

[0038] Contoured disk 150 also has a through hole (FP4) fitted through, in use, with drive shaft 18.

[0039] In other embodiments, not shown, of the present invention, the two faces (FFC3) and (FFC4) of contoured disk 150 may have grooves and/or slits and/or dead cavities by which to produce preferential paths and/or variations in speed and pressure in the oil flow inside the two pumping chambers (PP1), (PP2).

[0040] Each end point (P1), (P2) of second opening 152 of contoured disk 150 has a projection (EL1), (EL2).

[0041] The two projections (EL1), (EL2) are fixed to the wall of cavity (CV) (Figure 1) in pump body 11 (Figure 1).

[0042] In the second embodiment in Figure 5, contoured disk 150 must obviously be fixed to the wall of cavity (CV) to prevent the contoured disk from rotating, and to ensure correct positioning of first intake opening 152 and second delivery opening 151.

[0043] The main advantage of the gerotor pump according to the present invention is that of providing a pump with extremely thick lobed rotors (and therefore high flow) while at the same time reducing vibration and the noise level of the pump.

[0044] In fact, as stated, the present invention was conceived precisely to eliminate these drawbacks, by cutting the inner rotor (and possibly also the outer rotor) into at least two portions along a plane perpendicular to the axis of rotation of the inner rotor.

[0045] So doing has proved to bring about a surprisingly drastic reduction in the noise level of the pump.

[0046] Further improvements have been achieved by offsetting the two inner rotors by a given angle.

Claims

1. A gerotor pump (10) comprising a pump body (11) closed by a cover (12); said pump body (11) having a cavity ((CV)) for housing:
 - an outer rotor having an outer surface ((SUP1), SUP4)) which slides on the surface of said cavity ((CV)), and an inner surface ((SUP3), (SUP5)) with lobes ((LB1), (LB4)) projecting inwards of the outer rotor; and
 - an inner rotor which is fitted to a drive shaft (18) having an axis ((AX)) of rotation, and has lobes ((LB2), (LB3)) which mesh with the lobes ((LB1), (LB4)) of the outer rotor;
 and the gerotor pump (10) being **characterized in that** said inner rotor is divided into at least two lobed portions (14, 16) by cutting said inner rotor along a plane ((ψ)) substantially perpendicular to said axis ((AX)).
2. A gerotor pump (10) as claimed in Claim 1, **characterized in that** the outer rotor is also divided into at least two lobed portions (13, 17) by cutting said outer rotor along said plane ((ψ)).
3. A gerotor pump (10) as claimed in either one of the foregoing Claims, **characterized in that** said at least two lobed portions (14, 16) are mounted offset with respect to each other by an offset angle formed between a lobe ((LB2)) of a first lobed portion (14) and a lobe ((LB3)) of a second lobed portion (16).
4. A gerotor pump (10) as claimed in Claim 3, **characterized in that** the offset angle is such that at least one lobe ((LB3)) of said second lobed portion (16) corresponds to a gap between two adjacent lobes ((LB2)) of said first lobed portion (14).
5. A gerotor pump (10) as claimed in Claim 3 or 4, **characterized in that** said at least two lobed portions (14, 16) are mounted on a grooved drive shaft (18), and each have like grooves formed in a respective central through hole ((FP1), (FP3)) formed in each first (14) and second (16) lobed portion.
6. A gerotor pump (10) as claimed in any one of the foregoing Claims, **characterized in that** a partition disk (15) is located between the two lobed portions (14, 16) to separate a first pumping chamber ((PP1)) and a second pumping chamber ((PP2)); said partition disk (15) having a central through hole ((FP2)) through which said drive shaft (18) is fitted.
7. A gerotor pump (10) as claimed in Claim 6, **characterized in that** the first pumping chamber ((PP1)) is defined at one end by the end ((FND)) of the cavity ((CV)), and at the other end by a first face ((FFC1)) of the partition disk (15); the first pumping chamber ((PP1)) housing at least one lobed portion (14) and a first portion of the drive shaft (18).
8. A gerotor pump (10) as claimed in Claim 6 or 7, **characterized in that** the second pumping chamber ((PP2)) is defined at one end by the end of the cover (12), and at the other end by a second face ((FFC2)) of the partition disk (15); the second pumping chamber ((PP2)) housing at least one lobed portion (16) and a second portion of the drive shaft (18).
9. A gerotor pump (10) as claimed in Claim 6, **characterized in that** said partition disk (15) is fixed to a lobed portion (13, 17) of the outer rotor by fastening means ((GR), (SD1), (SD2)).
10. A gerotor pump (10) as claimed in Claim 9, **characterized in that** said fastening means ((GR), (SD1), (SD2)) comprise at least one pin ((GR)) which engages at least one seat ((SD1)) formed in a face of a lobed portion (13, 17) of the outer rotor, and a seat ((SD2)) formed in the partition disk (15).
11. A gerotor pump (10) as claimed in Claim 8, **characterized in that** each pumping chamber ((PP1), (PP2)) has at least one intake conduit ((CND1) and at least one delivery conduit ((CND2), (CND3)).
12. A gerotor pump (10) as claimed in any one of Claims 1 to 5, **characterized in that** a contoured disk (150) is located between the two lobed portions (14, 16) to separate a first pumping chamber ((PP1)) and a second pumping chamber ((PP2)).
13. A gerotor pump (10) as claimed in Claim 12, **characterized in that** the contoured disk (150) has openings (151, 152) and/or grooves and/or slits and/or dead cavities.
14. A gerotor pump (10) as claimed in Claim 13, **characterized in that** said contoured disk (150) has fastening means ((EL1), (EL2)) for assembly to the cavity ((CV)) in the pump body (11).

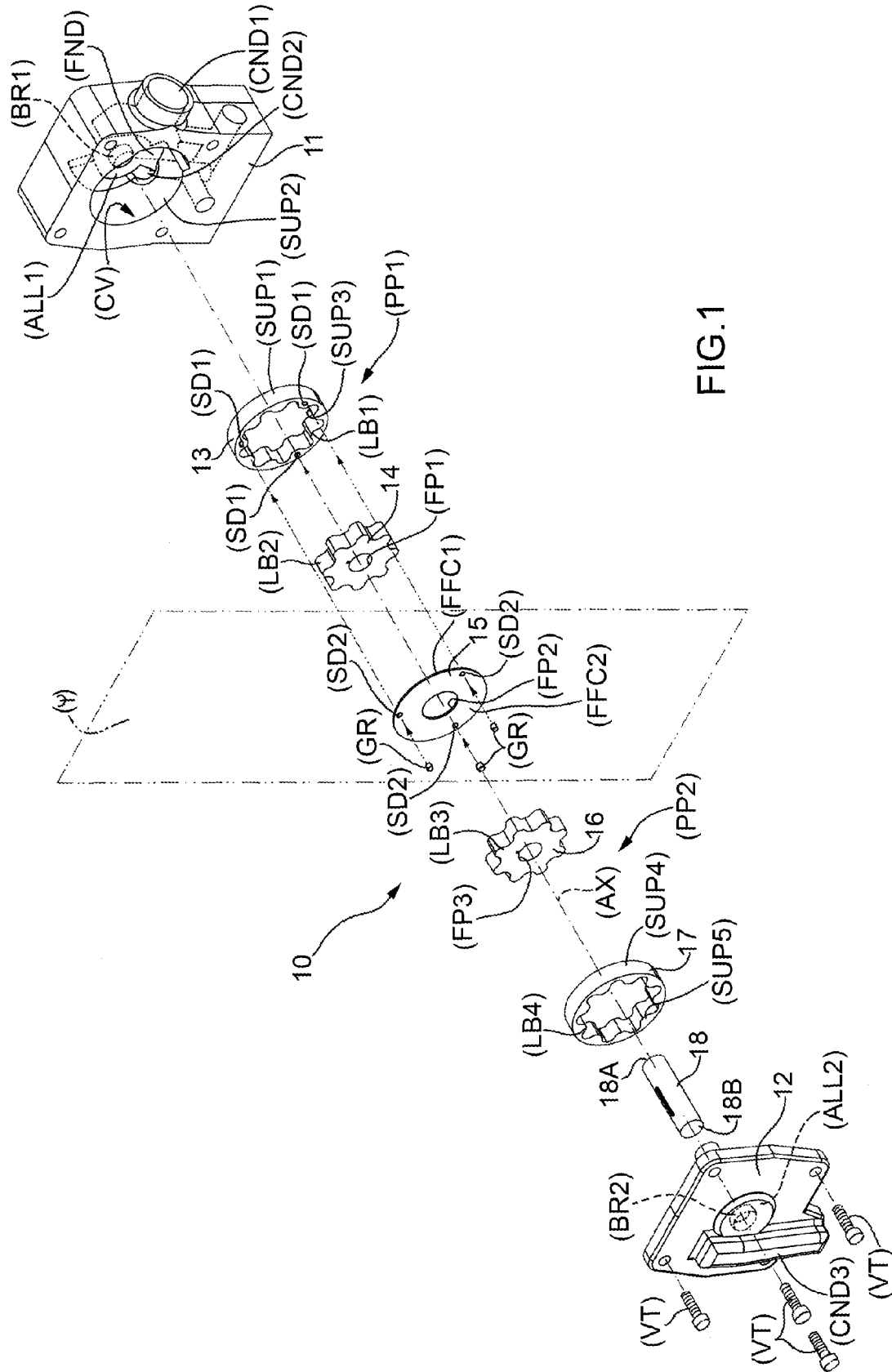
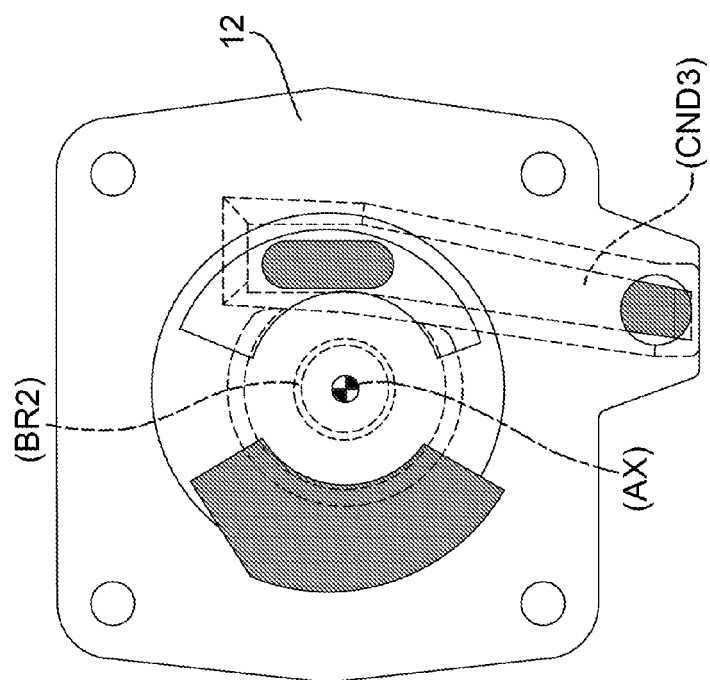
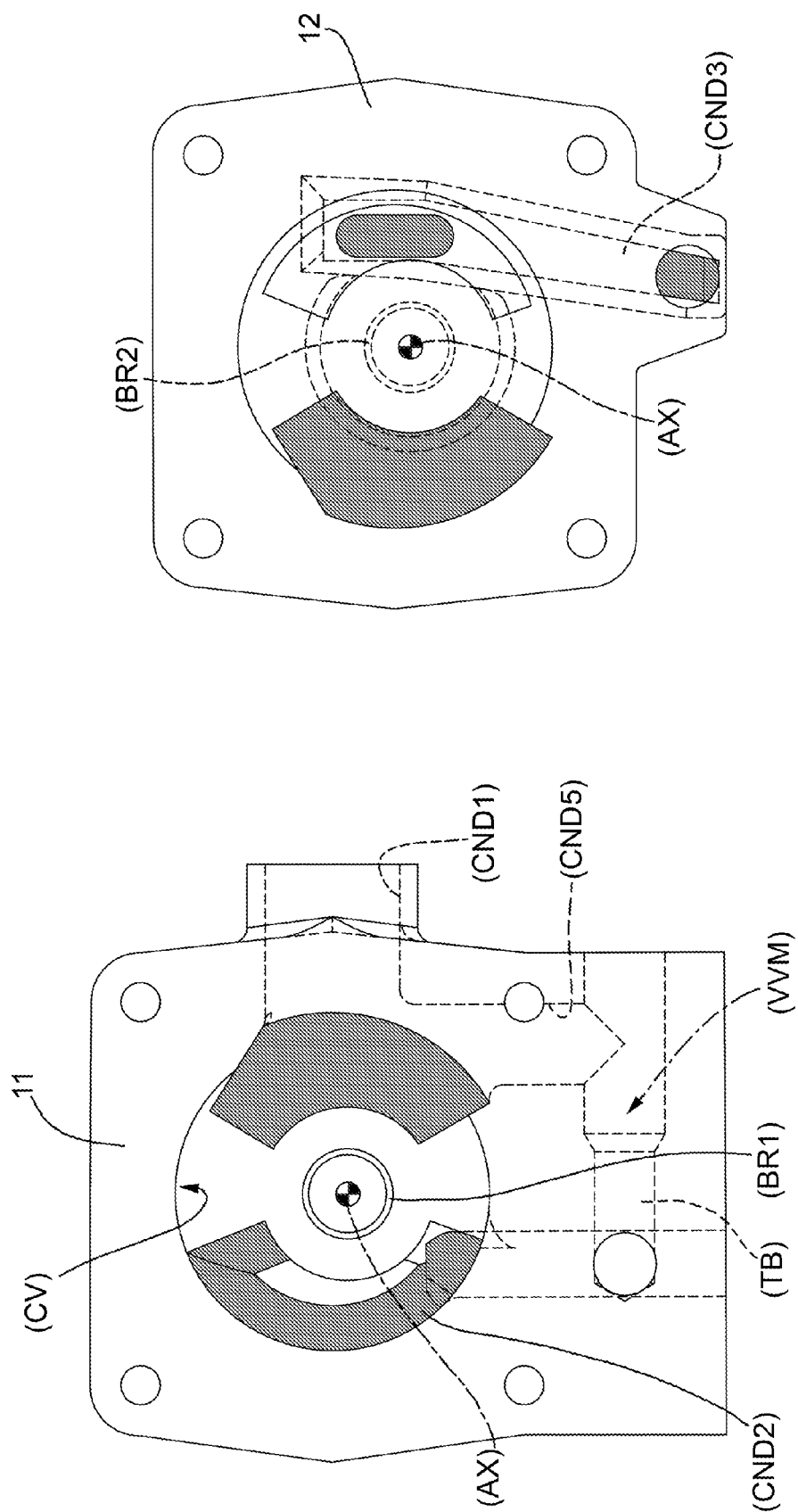


FIG. 1



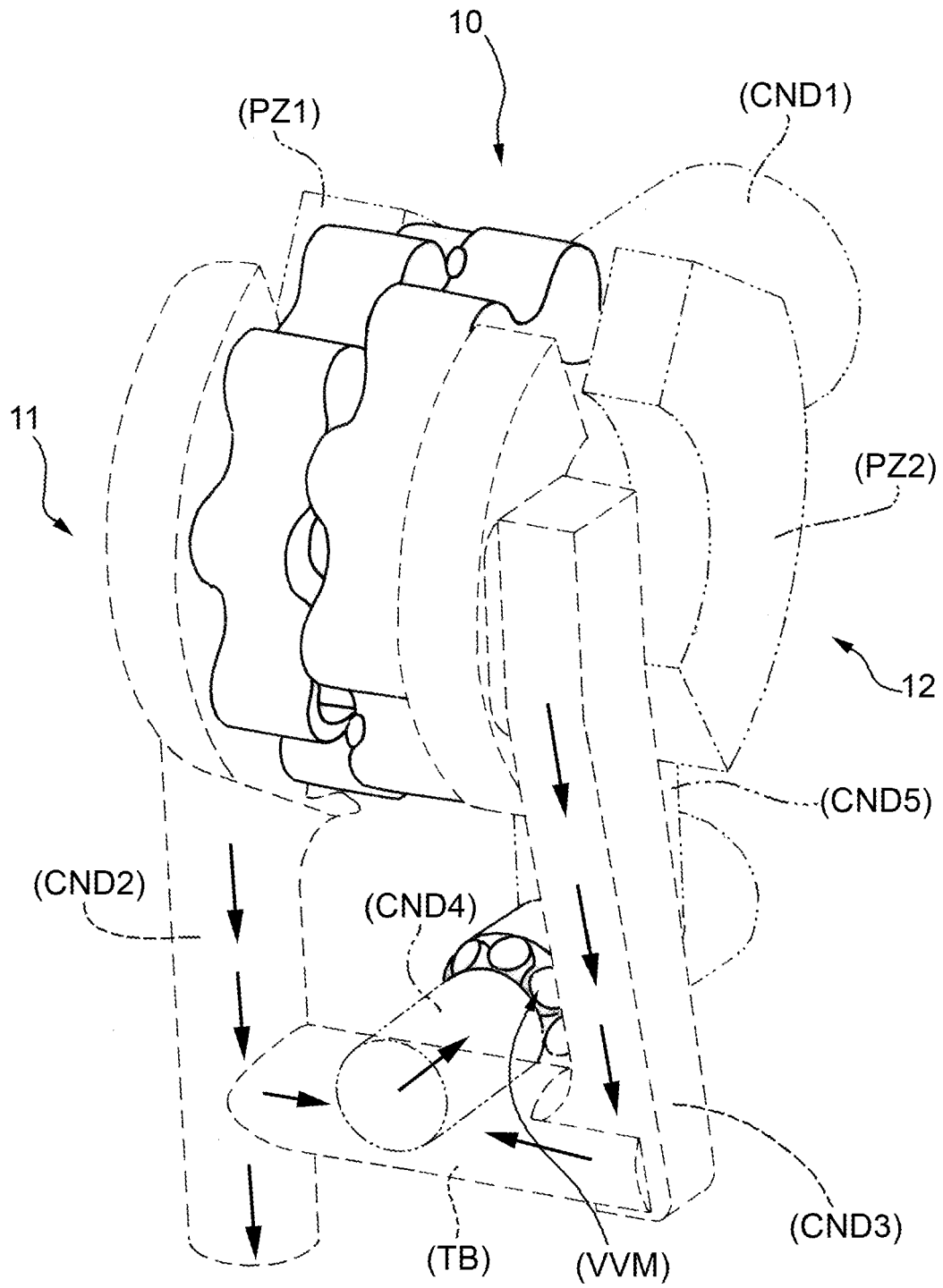


FIG.4

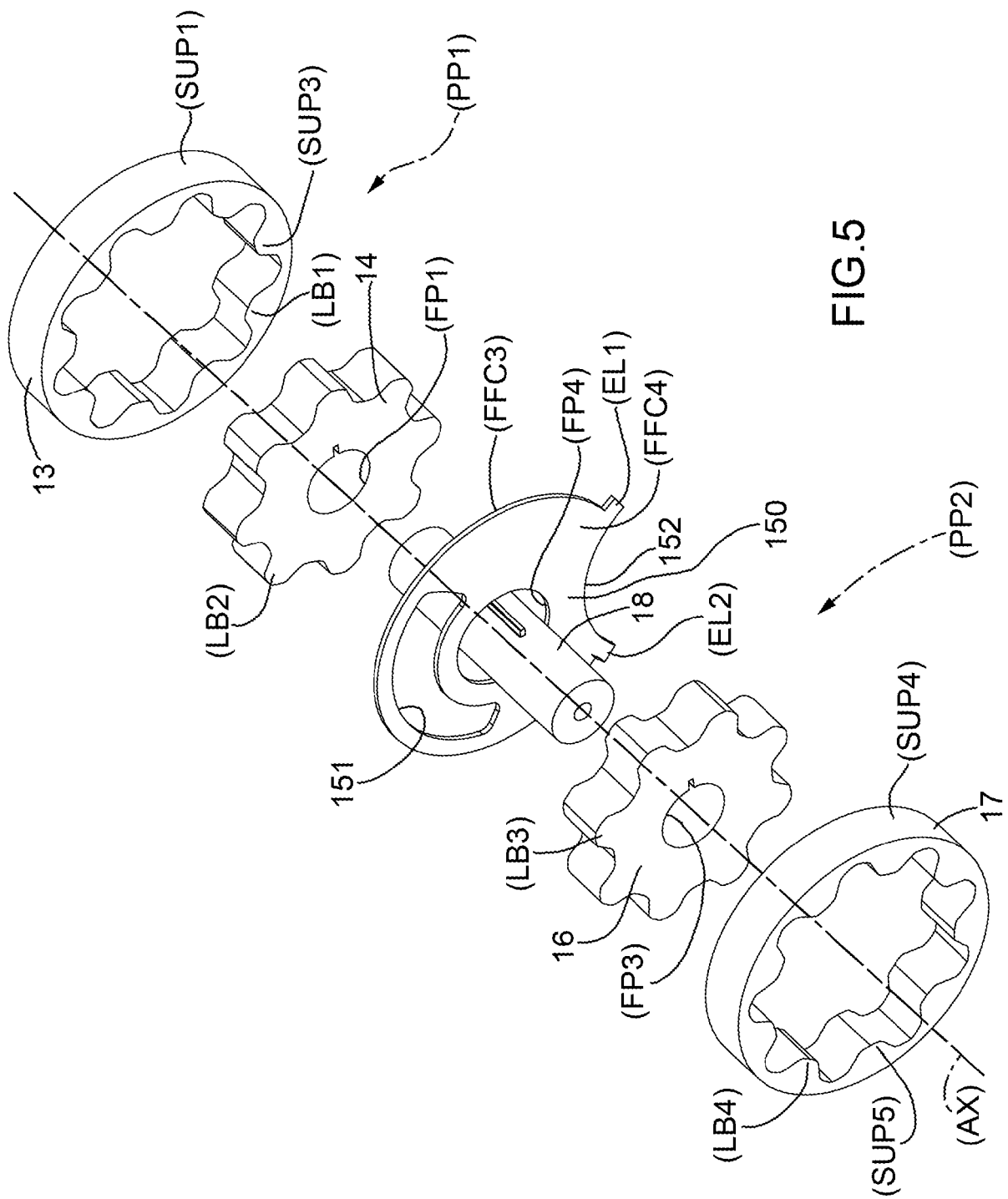


FIG. 5.



EUROPEAN SEARCH REPORT

Application Number
EP 09 17 4909

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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 5 March 2010	Examiner Descoubes, Pierre
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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**ANNEX TO THE EUROPEAN SEARCH REPORT
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