United States Patent [19]

Lucien

[11] **3,728,943**

[45] **Apr. 24, 1973**

[54] **HYDRAULIC PUMPS OR MOTORS OF THE ROTATING BARREL TYPE**

[75] Inventor: **Rene Lucien,** Haute de Seine, France

[73] Assignee: **Messier,** Paris, France

[22] Filed: **June 9, 1971**

[21] Appl. No.: **151,436**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 780,699, Dec. 3, 1968, Pat. No. 3,631,764.

[52] **U.S. Cl.** **91/506**

[51] **Int. Cl.** **F01b 13/04**

[58] **Field of Search** 91/504, 506; 308/175

[56] **References Cited**

UNITED STATES PATENTS

501,375	7/1893	Simonds	308/175
1,232,750	7/1917	Amess	308/175
2,667,862	2/1954	Muller	91/506
3,396,670	8/1968	Baits	91/505

Primary Examiner—William L. Freeh

Attorney—Waters, Roditi, Schwartz & Nissen

[57] **ABSTRACT**

A hydraulic pump or motor comprises a rotary barrel carrying reciprocating pistons attached to an adjustable inclined actuating plate. The actuating plate is supported in cradles and is subjected to side thrust from shearing forces applied by the pistons to the plate. At least one side bearing is attached to the actuating plate for contact with an adjacent cradle under the action of the side thrust.

12 Claims, 6 Drawing Figures

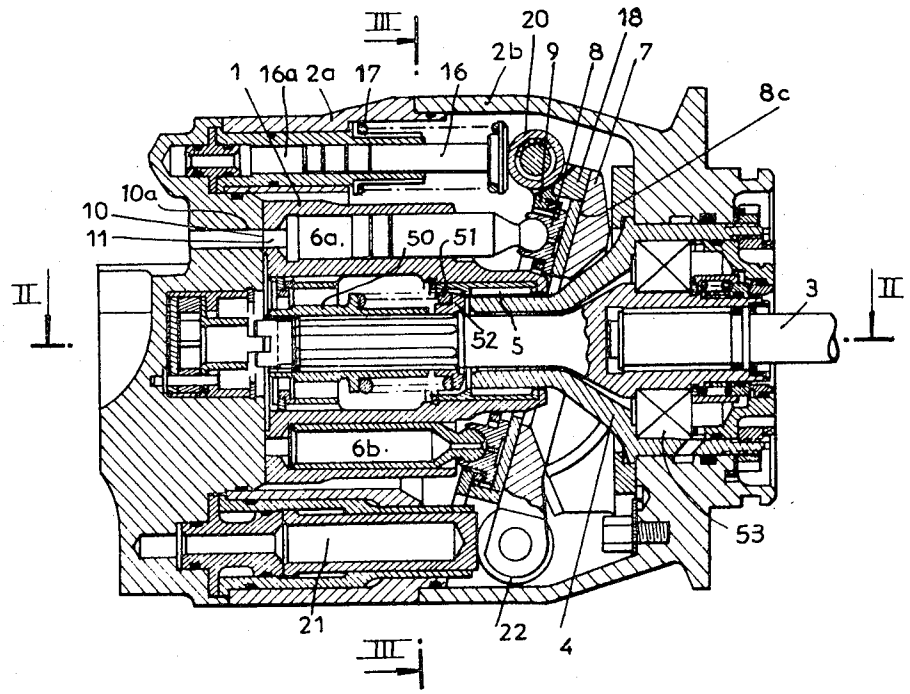


Fig-1

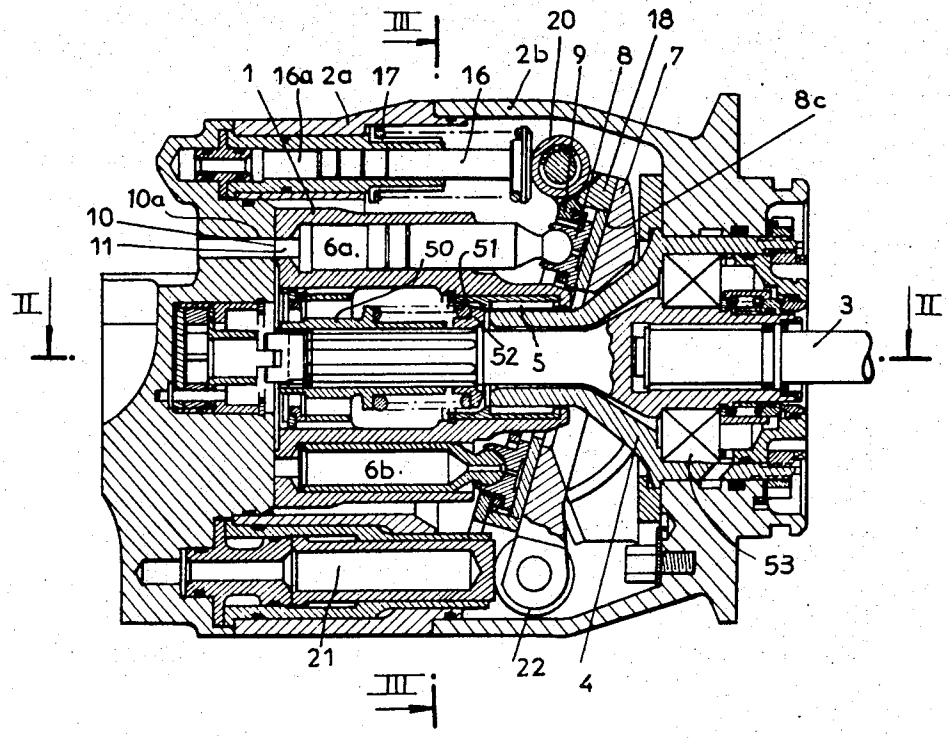

III
20
18
1
16a
2a
17
16
2b
9
8
7
8c
10a
10
11
6a.
50
51
II
II
3
52
5
6b.
53
21
22
4
III

Fig-2

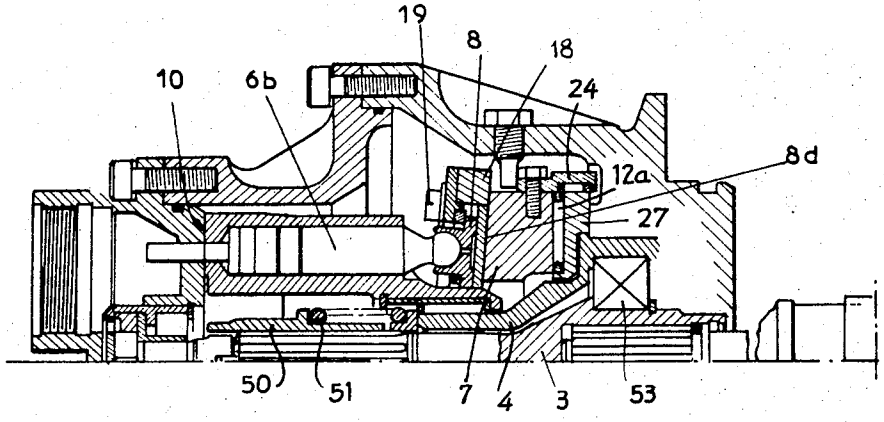

19
8
18
10
6b
24
8d
12a
27
50
51
7
4
3
53

Fig-1

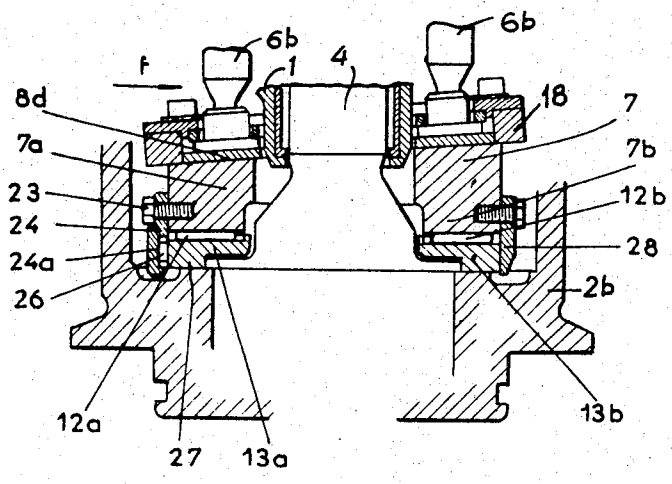

6b
6b
f
1
4
8d
18
7
7a
7b
23
12b
24
28
24a
26
2b
13b
12a
27
13a

Fig-3

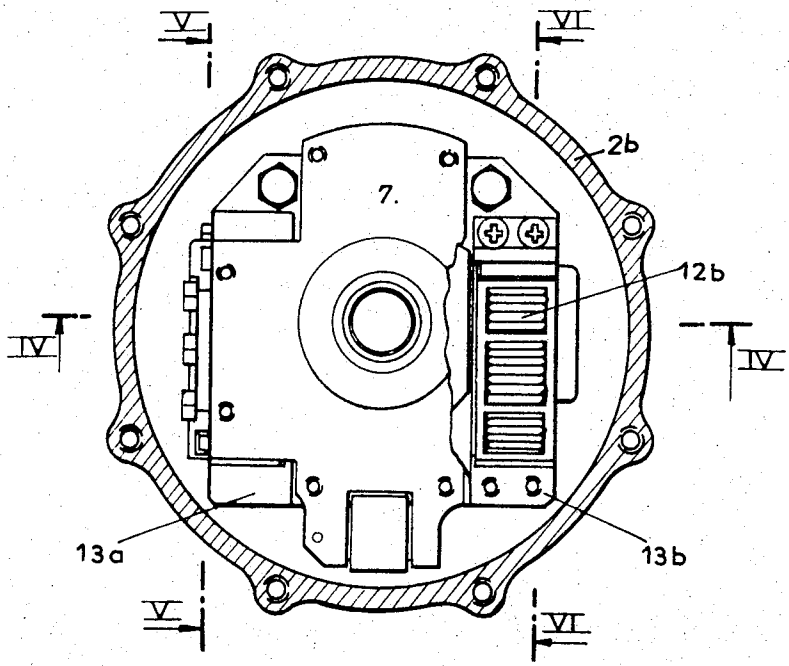

V
VI
2b
7.
12b
IV
IV
13a
13b
V
VI

Fig-6

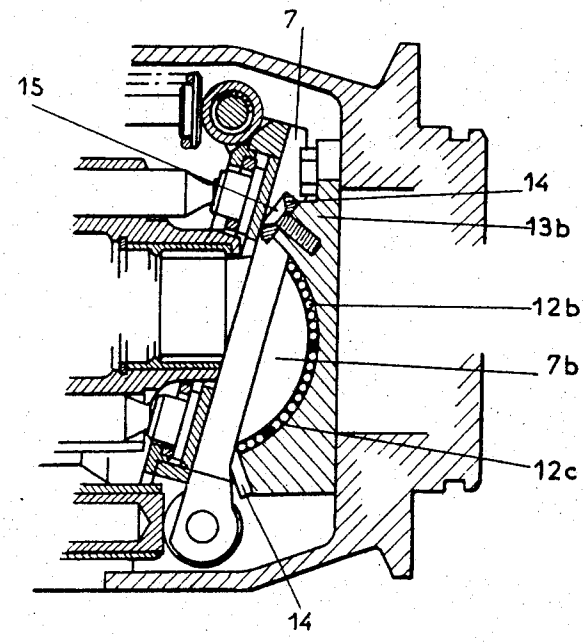
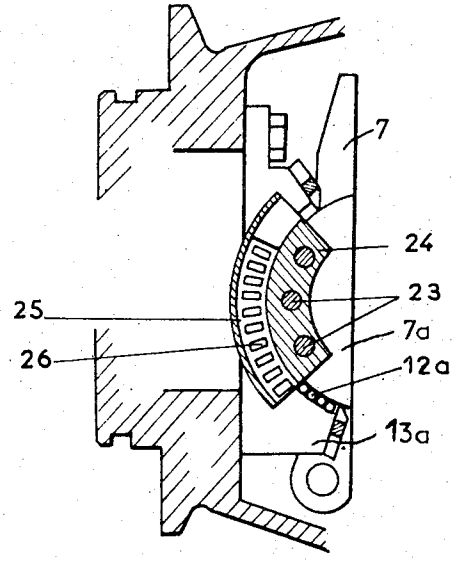


Fig-5



HYDRAULIC PUMPS OR MOTORS OF THE ROTATING BARREL TYPE

CROSS RELATED APPLICATION

This is a continuation-in-part application of my earlier application Ser. No. 780,699 filed Dec. 3, 1968 and now issued as U.S. Pat. No. 3,631,764, and claiming priority of my corresponding French application filed Dec. 4, 1967.

BRIEF SUMMARY OF THE INVENTION

The present invention relates to improvements in hydraulic pumps or motors of the rotating barrel type. Pumps or motors of the type under consideration are known and comprise a body unit in which a barrel held in place by one or two bearings undergoes rotation. The barrel is provided with cylindrical bores spaced circumferentially and at equal distances from the axis of rotation, and pistons provided with shoes slide in the cylinders. At one end, the barrel has openings leading to the cylinders, said openings being connected to other openings in a fixed plate or "face" integral with the body for distributing a liquid in the cylinders. The pistons and their shoes are reciprocally moved by the alternating action of an operating plate of adjustable inclination which pushes them to the bottom of their respective cylinders, the return of the pistons being obtained by springs or by a perforated plate mechanically connected to the actuating plate.

The plate which receives the thrust of the pistons can generally pivot on two bearings which can be either complete cylinders provided with balls, rollers or needles, or parts of a cylinder whose elements — convex and concave parts or cradles — slide one or the other in the course of the angular movement of the plate.

It is also well-known to give to the plate an initial inclination which exists even when the machine is not supplying or receiving energy. This inclination is provided in order to reduce the pressure pulsations in the case of a pump.

The present invention relates to a novel arrangement of bearings supporting the variable inclination plate and more particularly the manner in which traverse stresses are resisted.

According to the invention, the bearing of the piston actuating plate comprises, besides the complementary cylindrical parts rotating one on the other, at least on lateral bearing integral with the outside face of one of the convex cylindrical parts of the piston actuating plate and able to co-operate with the lateral surface of the adjacent cradle, when the piston actuating plate is subjected to transverse stresses tending to bring the lateral bearing and the said cradle together.

According to one particular embodiment of the invention, the lateral being is constituted as a plate, in the form of a sector, whose inner radial portion is secured to one side of the piston actuating plate and whose outer radial portion serves as a housing for bearing elements, such as balls or needles adapted to roll between the bearing plate and the side face of the adjacent cradle.

According to a feature of the invention, a safety flange is attached to the piston actuating plate, at the side opposite to that which carries the bearing, said flange preventing all axial sliding of the piston actuating plate under the action of stresses in the opposite direction.

The invention will now be described referring to the accompanying drawings given only by way of example and not in any sense limitative and in which:

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an axial cross-section view of the pump;

FIG. 2 is a half-sectional view taken along line II—II in FIG. 1;

FIG. 3 is a cross-sectional view taken along line III—III in FIG. 1, the moving parts being partially removed;

FIG. 4 is a cross-sectional view taken along line IV—IV in FIG. 3;

FIG. 5 is a cross-sectional view taken along line V—V in FIG. 3; and

FIG. 6 is a cross-sectional view taken along line VI—VI in FIG. 3.

DETAILED DESCRIPTION

The pump shown in FIGS. 1 and 2 is a pump which is self-regulating by variation of the cylinder capacity per revolution, as a function of the delivery pressure. This pump will not be described in detail for it is of a type well-known per se and is described in my U.S. Pat. No. 3,545,338 and my earlier parent application.

Briefly, the pump comprises a barrel **1** housed in a body composed of units **2***a*, **2***b* and driven in rotation by a shaft **3** through the intermediary of a sleeve **50** having internal and external splines. A fixed hollow support **4**, is attached to body unit **2***b* and the barrel is supported on support **4** through the intermediary of needle bearing **5**. The barrel **1** contains cylinder **6***a* in which slide pistons **6***b* connected to a piston actuating plate **7** by shoes **8**, themselves supported by a device **9**. The casing of the pump has a fixed face **10** provided with suction and delivery openings **10***a* which are successively placed in communication with openings **11** in the bottom of each of the cylinders **6***a*, to produce reciprocation of the pistons in the cylinders. The bearing **5** is of small diameter and arranged at the point of application along the axis of rotation of barrel **1** of the resultant of the shearing forces applied to the pistons so as to absorb the shearing forces. The bearing **5** rests on a slightly domed portion of support **4**. Barrel **1** is permitted to make slight angular movements with respect to said support and thus with respect to the axis of rotation of shaft **3**. When starting up or in the absence of delivery pressure, the barrel **1** is applied against the face **10** by a spring **51** which is supported against the shaft **3**, through the intermediary of a ring **52** and its other extremity on a radial web of the sleeve **50**. The force of this spring is taken up by a bearing **53**.

Two convex cylindrical parts **7***a* and **7***b* are formed on the rear face of the piston actuating plate and are applied via needle bearings **12***a* and **12***b* against two parts of a concave cylindrical surface or cradles **13***a* and **13***b* concentric with the convex cylindrical parts **7***a* and **7***b*.

Wedges **14** are fixed on the cradles **13***a* and **13***b* by means of screws **15** and serve as stops for the needles of bearings **12***a* and **12***b*. The needles in the bearings are arranged in rows **12***c* which have a developed length smaller than that of the concave parts **13***a* and **13***b*, the difference being such that the needles of the bearings **12***a* and **12***b* can roll without sliding on the parts **7***a* and **7***b* on the one hand, and **13***a* and **13***b* on the other, as soon as the needles at the end of a row have come to stop against one of the wedges **14**.

Of course, the needle bearings may be omitted, and in this case the contact surfaces of the plate and support are made of a low friction material so as to form journal bearings. It is also possible to provide a considerable surface area for the needle bearings **12***a* and **12***b* and for the concave cylindrical parts **13***a* and **13***b* against which the plate **7** rotates, with a view to reducing the surface pressures to which these parts are subjected.

It will be noted in FIG. **2** that the piston actuating plate **7** maintains an inclination even when the machine is not supplying or receiving energy. More specifically, the surface **8***c* of the plate **8** in the main cross-section (FIG. **1**) can pivot in the plane of the drawing until it becomes perpendicular to the axis of the barrel **1**, while the surface **8***d* of the plate **8** in a plane at right angles to the above (FIG. **2**), maintains an initial inclination as seen in FIG. **2**. This inclination is provided to reduce the pressure pulsations in the case of a pump.

During operation, the piston actuating plate **7** is applied against support **4** by the force of pressure prevailing in the cylinders. When the delivery pressure is zero, a piston **16**, slidable in a cylinder **16***a* in the body of the pump, is displaced by aspring **17** (or any other known means) in the direction of a ring **18** fixed on the piston actuating plate **7** by screws **19**. The piston **16** acts on plate **7** through the intermediary of a roller **20**. The piston **16** may also be subjected to the delivery pressure of the pump, so as to apply a compensating force on the piston actuating plate **7** which tends to incline the plate.

As is well-known with this type of pump, the maximum inclination of the piston actuating plate **7** is assured, when starting up, by the action of a spring, and as soon as the delivery pressure is established, by the action of the pressure forces. When the pressure reaches a value known as the regulation pressure it displaces a slide-valve (not shown) which then activates a piston **21** in order to regulate the inclination of the piston actuating plate **7**, through the intermediary of a roller **22**.

According to the invention, the cradle **13***a* of the actuating plate **7** is also provided with a side bearing fixed by means of screws **23** at the outside end of one of the convex cylindrical parts **7***a* or **7***b*. As FIGS. **4** and **5** show, this side bearing is made up of a plate **24**, in the form of a sector, and having a circular groove **24***a* in which is fitted a needle-race **25**. In each segment of race **25** there is placed a needle **26** which rolls in the groove **24***a* of the plate **24** and against the lateral face **27** of the cradle **13***a*. The pressure of the axial needles on only one side of the cradle is sufficient when the main transverse stress is applied in the direction of the arrow F in FIG. **4** as a result of the initial inclination of surface **8***d* of plate **8**. If there were stresses in both directions side bearings would be provided at each end of the cradle.

In the case where there is only one side bearing, a safety flange **28** is fixed at the other end of plate **7**. This safety flange serves to prevent all axial sliding of the plate under a stress in a direction opposite to the arrow F.

In the embodiment of FIG. **4**, the plate **24** and the flange **28** are secured to the plate **7** by means of screws, but it is obvious that attachment may be made by any other means or the plate and flange may be machined integrally with the plate **7**.

What is claim is:

1. In a hydraulic pump or motor having a fixed cylindrical casing provided with a bottom having a slide-face with first and second orifices formed therein; a barrel supported in said casing for rotation about an axis, said barrel having cylinders with slidable pistons therein; means for placing said cylinders alternately into communication with said first and second orifices of said slide-face; means for reciprocally moving said pistons in said cylinders and producing forces on said pistons having components acting as shearing forces applied to said barrel; a rotatable shaft; means connecting said barrel to said shaft for rotation therewith; a support coaxial with said shaft and rigidly secured to said casing; and a bearing inside said barrel between said support and said barrel, said bearing being of small diameter and arranged at the point of application along the axis of said barrel of the resultant of the shearing forces applied to said pistons, so as to absorb said shearing forces, said means for reciprocally moving said pistons comprising a piston actuating plate to which said pistons are coupled and means permitting the regulation of the inclination of said plate with respect to the geometric axis of said shaft, said piston actuating plate comprising two convex cylindrical portions having a common axis and the same diameter, and arranged symmetrically with respect to the geometric axis of said shaft, two support elements for said cylindrical portions forming a recess having a shape complementary to that of said convex portions, said elements being rigidly fixed to said support to permit said piston actuating plate to thus pivot with respect to said support, an improvement wherein said piston actuating plate comprises at least one lateral bearing secured to one of the convex cylindrical portions of the piston actuating plate at one of the side faces thereof and facing an adjacent of said support elements to engage the same, when the piston actuating plate is subjected to transverse stresses urging the lateral bearing and said adjacent support element together.

2. An improvement according to claim **1** in which said lateral bearing comprises a plate in the form of a sector having an inner radial portion fixed to said piston actuating plate and an outer radial portion with bearing elements therein capable of rolling on said plate of the bearing and on the adjacent support element.

3. An improvement according to claim **1** wherein said piston actuating plate has a surface for the support of said pistons which is inclined in a plane perpendicular to the plane of regulation of the inclination of said plate whereby to produce transverse stresses from the shearing forces which urge the bearing and its adjacent support element together.

4. An improvement according to claim **1** comprising a safety flange at the extremity of the piston actuating plate opposite that which carries said lateral bearing, said safety flange abutting the other of the support elements to prevent axial sliding of the piston actuating plate in the opposite direction.

5. An improvement according to claim **3**, comprising screw means attaching the sector plate and the safety flange to the piston actuating plate.

6. An improvement according to claim **3**, in which the side plate and the safety flange are integral with the piston actuating plate.

7. A lateral bearing means for a hydraulic pump or motor having a rotatable barrel with reciprocably slidable pistons therein connected to an angularly adjustable circular actuating plate provided with two convex cylindrical portions having a common axis and the same diameter and pivotably supported in two stationary support elements, first bearing means between the cylindrical portions and the stationary support elements, said lateral bearing means comprising at least one lateral bearing member secured to one of the convex cylindrical portions at one of the side faces thereof and extending radially outwardly of the periphery of the stationary support elements to form a bearing surface thereat, whereby when the piston actuating plate is subjected to transverse streases the lateral bearing member transmits the stress to the adjacent stationary support element, said lateral bearing member comprising a plate in the form of a sector having an inner radial portion fixed to said actuating plate and an outer radial portion terminating at the adjacent stationary support element.

8. A lateral bearing means according to claim 7 comprising bearing elements between said plate and the stationary support element.

9. A lateral bearing means according to claim 7 comprising a safety flange at the extremity of the actuating plate opposite that which carries said lateral bearing member, said safety flange abutting the other of the support elements to prevent axial sliding of the actuating plate in the opposite direction.

10. A lateral bearing means according to claim 9, comprising screw means attaching the sector plate and the safety flange to the piston actuating plate.

11. A lateral bearing means according to claim 9, in which the side plate and the safety flange are integral with the piston actuating plate.

12. A lateral bearing means according to claim 7 wherein said actuating plate has a surface for the support of the pistons which is inclined to a plane perpendicular to the plane of regulation of the inclination of said plate whereby to produce transverse stresses from the forces applied by the pistons to the barrel which stresses urge the lateral bearing member and its adjacent support element together.

* * * * *