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Aldinger

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[54] **ROTOR CENTERING ARRANGEMENT FOR A HYDRAULIC MACHINE**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **91/484,** 91/498

[51] **Int. Cl.** **F01b 13/06**

[58] **Field of Search** 91/484, 487, 498

[56] **References Cited**

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[57] **ABSTRACT**

The rotor of a radial piston pump, or motor, rotates on a stationary cylindrical control body, and has chamber ports communicating with expanding and contracting working chambers, and opening on the cylindrical inner rotor surface so as to move over high pressure and low pressure control ports on the outer cylindrical control body surface. Pairs of grooves are provided on the control body surface on opposite sides of the control ports to collect leakage fuid, and the pressure in the grooves is equalized by ducts connecting pairs of grooves.

10 Claims, 2 Drawing Figures

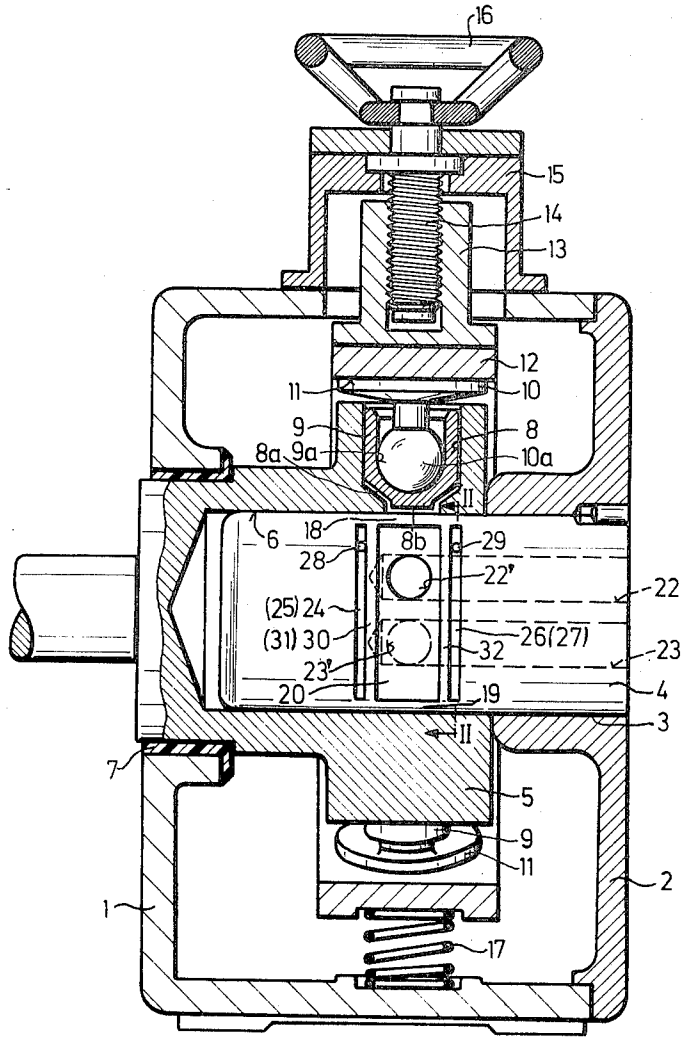


Fig. 1

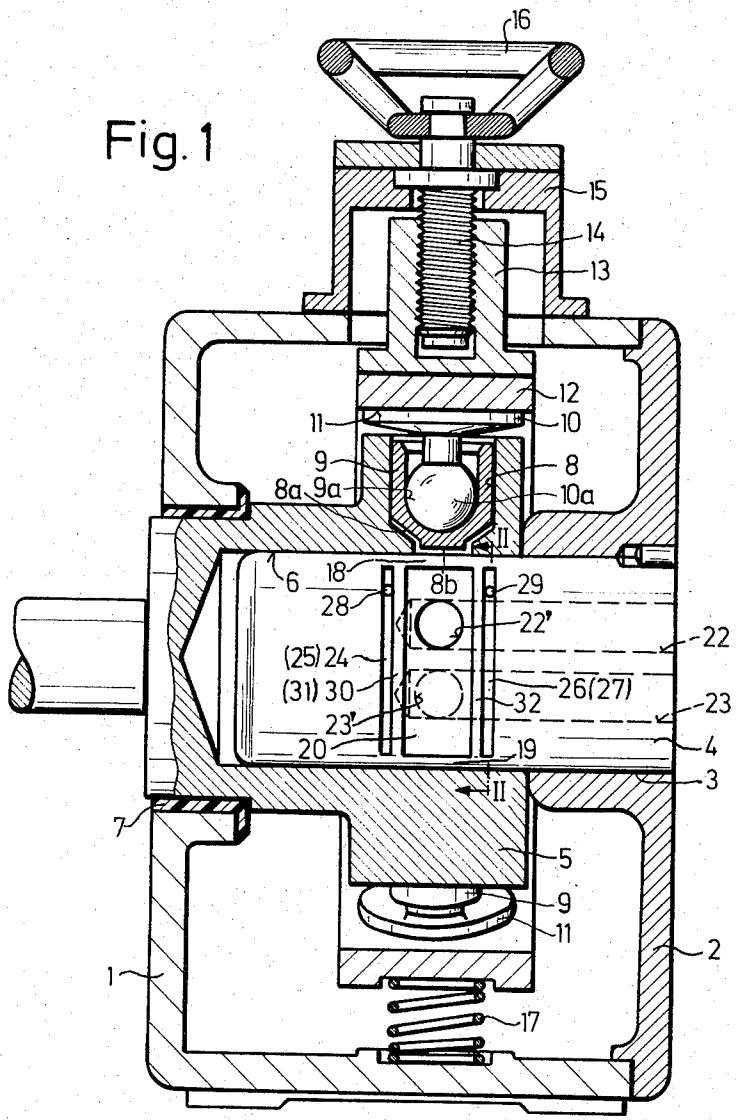
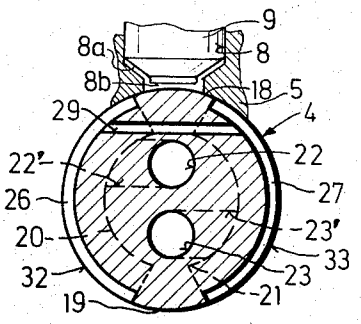

16
15
14
13
12
11
10
9
8
8a
9a
10a
II
6
18
8b
29
28
22'
22
(25) 24
(31) 30
26(27)
32
23
23'
20
19
4
3
II
7
5
9
11
2
1
17

Fig. 2


9
8a
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ROTOR CENTERING ARRANGEMENT FOR A HYDRAULIC MACHINE

BACKGROUND OF THE INVENTION

The present invention relates to a rotor centering arrangement for a radial piston pump or motor with a cylindrical rotor mounted on a journal and having radial cylinder bores in which pistons are reciprocated by means of an eccentric cam ring engaging the outer ends of the pistons. In machines of this type, chamber ports communicating with the working chambers in the cylinders, move over high pressure and low pressure control ports in the journal or control body so that fluid is supplied to the working chambers. The German OS 1,453,629 discloses a radial piston machine in which grooves are provided on the side of a port on the control body which are connected with a diametrically opposite control port by a duct. This results in a pressure area in the region of the grooves laterally of the low pressure control port, while on the opposite side, the pressure area extends only from the high pressure control port over the comparatively narrow sealing portion to the respective groove in which the pressure is reduced to low pressure. The pressure area compensates on the rotor the pressures acting in the region of the control ports, while hydrodynamic pressure areas form between the ends of the control ports so that the forces acting on the rotor in this region are equalized.

The pressure areas produced by the connection of the grooves with the control ports, are detrimental and undesired for radial piston machines of the type in which an equilibrium of forces already exists due to a corresponding dimensioning of the chamber ports and of the width of the sealing surfaces of the control body.

SUMMARY OF THE INVENTION

It is an object of the present invention to construct the control body or journal of a radial piston machine of the above-described type in such a manner that the equilibrium of the forces acting on the rotor is not disturbed, while optimal guidance and lubrication of the rotor during rotation is obtained.

Another object of the invention is to provide grooves around the control body in which the same pressure prevails so that the rotor is supported on the control body in a centered position.

With these objects in view, the present invention provides two pressure grooves on opposite sides of each control port, and a connecting duct connecting the pairs of grooves located on the same side of the control port.

The arrangement of the invention has the advantage that the pressure fluid leaking through the clearance or gap between the outer cylindrical surface of the control body and the inner cylindrical surface of the rotor, is uniformly distributed so that the pressure areas which develop, are symmetrical. In addition to the improved centering of the rotor on the control body, the lubrication between the engaging surfaces is improved.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a longitudinal sectional view illustrating a radial piston machine provided with the improvement of the present invention; and

FIG. 2 is a cross-sectional view taken on line II-II in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A radial piston machine has a housing **1** which is closed by housing cover **2**. A hollow rotor **5** has an inner blind bore forming an inner rotor surface **6** in sliding engagement with an outer cylindrical surface **3** of a control body or journal **4**. One end of the rotor **5** is also mounted in a bearing **7** secured to the housing **1**.

The rotor **5** has substantially radial cylindrical bores **8** in which pistons **9** are mounted for inward and outward reciprocating movement, forming in cylinders **8**, expanding and contracting working chambers **8***a* opening in circumferentially spaced chamber ports **8***b* on the inner surface **6** of rotor **5**.

The pistons **9** have slide shoes **10** at the outer ends which have balls **10***a* forming a joint with seats **9***a* in pistons **9**. The slide shoes **10** slide on the inner endless surface **11** of an eccentric actuator cam ring **12** whose eccentricity can be adjusted by screwing a spindle **14** into a nut **13** secured to the outside of the cam ring **12**. A hand wheel **16** is used for turning spindle **14**, which is held immovable in axial direction by a bearing provided in a bracket **15** on housing **1**. As is known to those skilled in the art, the adjustment of the eccentricity of cam ring **12** results in different strokes of the pistons **9, 11** in the cylinders **8** so that the working chambers **8***a* expand and contract for receiving or discharging fluid through the chamber ports **8***b* which are arranged circumferentially spaced on the inner surface **6**. The downward movement of the cam ring **12** by the operation of the hand wheel **16**, is opposed by spring **17** abutting cam ring **12** and housing **1**.

As best seen in FIG. **2**, the control body **4** has two diametrically opposed high pressure and low pressure control ports **20, 21**, each of which is connected in the control body **4** by transverse passages **22', 23'** with axially extending high pressure and low pressure conduits **22** and **23**, see also FIG. **1**. On opposite sides of the two circumferentially extending partcircular control ports **20** and **21**, pairs **24, 25** and **26, 27** of narrow partcircular diametrically arranged grooves **24** to **27** are formed in the outer cylindrical surface of the control body **4**. The pair of grooves **24, 25** is located on one side of the control ports **20, 21**, and a pair of grooves **26, 27** is located on the other side of control ports **20, 21**, the grooves being axially spaced from the control ports between the same, as best seen in FIG. **1**. The grooves **24, 25** of one pair, and the grooves **26, 27** of the other pair, are respectively connected by straight ducts **28** and **29** which open near the ends of the respective grooves connected thereby. The ends of the grooves of the same pair are spaced from each other, and the ends of the control ports **20** and **21** are also spaced from each other, the ends of the control ports **20, 21** being axially aligned with the respective ends of

the associated grooves, for example 26, 27, as shown in FIG. 2.

Between the control ports 20 and the associated grooves 24 and 26, narrow circumferential surface strips 30, 32 of the control body surface 3 remain, as shown in FIG. 1, while the grooves 25, 27 are separated by corresponding surface strips 33, 32 from the other control port 21. Surface strips 30 and 33 cooperate with the inner surface 6 of the rotor to seal the grooves from the control ports.

During rotation of rotor 5, the slide shoes slide on the inner surface 11 of the eccentric cam ring 12 and force the pistons 9 to reciprocate so that fluid is sucked from the control port 20, for example, and discharged into the control port 21. The length of the stroke of pistons 9, 10 by which the volume of the working chambers 8a is increased and reduced, can be adjusted by displacing the actuating cam ring 12 by operation of hand wheel 16.

Through the clearance between the surface 3 of the control body 4 and the surface 6 of the rotor 5, fluid flows from control ports 20, 21 and enters the grooves 24 and 27 on both sides of the control ports 20, 21. The transverse ducts 28, 29 have the effect that between the grooves 24, 25 or 26, 27, respectively, the pressure is equalized. Consequently, the pressure areas in this region have substantially the same size and supporting ability so that the inner surface 6 of the rotor is centered in relation to the outer surface 3 of the control body 4 without undesired hydrostatic forces being developed in the region of the control ports 20, 21 which may disturb the equilibrium at the rotor 5 obtained by constructive measures. While the grooves 24 to 27 center the rotor, the equilibrium obtained by properly dimensioning the chamber ports 8b communicating with the working chambers 8a is not disturbed, and when optimal guidance and lubrication of the rotor 5 is obtained.

From the above description it becomes apparent that the disclosed embodiment comprises a rotor 5 having circumferentially spaced working chambers 8*a* for a fluid and an inner surface 6 having a set of chamber ports 8*b* communicating with the working chambers 8*a*, respectively, and moving during rotation of rotor 5 along a circular path; and a stationary control body having an outer surface 3 in sliding contact with the inner control surface for supporting the rotor 5, and having in the outer surface 3 a pair of diametrically disposed part-circular control ports 20, 21 located in the path of the chamber ports 8 and being supplied with high pressure and low pressure fluid through conduits 22, 23, 22', 23' opening in the control ports 20, 21.

The control body 4 has first and second pairs 24, 25 and 26, 27 of diametrically disposed part-circular grooves, the first and second pairs of grooves 24, 25 and 26, 27 being located at opposite sides of the control ports 20, 21 spaced a small axial distance from the same so that leakage from the control ports 20, 21 flowing through the clearance between the outer and inner surfaces 3, 6, fills the first and second pairs of grooves 24 to 27. In accordance with the invention, the control body 4 has first and second ducts 28, 29 located on opposite sides of the pair of control ports 20, 21 and connecting the grooves of the first and second pairs of grooves 24, 25 and 26, 27, respectively, whereby uniform pressure prevails in the first and second pairs of grooves 24, 25 and 26, 27 and between the outer and inner surfaces 3, 6.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of rotor centering arrangements for hydraulic machines differing from the type described above.

While the invention has been illustrated and described as embodied in two pairs of grooves located on opposite sides of a pair of control ports being connected by a duct to obtain uniform pressure in the clearance between a rotor and a control body forming a journal for the rotor, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

I claim:

1. A rotor centering arrangement for a hydraulic machine, comprising, in combination, a rotor having a set of circumferentially spaced working chambers for a fluid, and an inner circumferential surface having a set of chamber ports communicating with respective ones of said working chambers and moving during rotation along a circular path; and a stationary control body having an outer circumferential surface in sliding contact with said inner circumferential surface of said rotor, and being provided in said outer circumferential surface with a pair of diametrically oppositely disposed part-circular control ports located along said path, said control body having high and low pressure conduits opening into respective ones of said control ports, so that during rotation of said rotor low pressure and high pressure fluid alternately enter said working chambers, said control body having first and second pairs of diametrically oppositely disposed part-circular grooves, said first and second pairs of grooves being located on opposite axial sides of said control ports spaced axially from the latter so that leakage fluid from said control ports flowing through the radial clearance between said outer and inner circumferential surfaces fills said first and second pairs of grooves, said control body being further formed with a first duct and a second duct both penetrating through the material of said control body and each having two open ends, the open ends of said first duct communicating with respective ones of said first pair of grooves, and the open ends of said second duct communicating with respective ones of said second pair of grooves, whereby to equalize the pressure in the first pair of grooves and whereby to equalize the pressure in the second pair of grooves, each of said ducts intermediate the two open ends thereof being in its entirety located radially inwardly of said outer circumferential surface of said control body completely enclosed by the material of said control body.--

2. Arrangement as claimed in claim 1, wherein said control ports having circumferentially spaced ends sep-

arated by portions of said outer surface; and wherein said grooves of said first and second pairs of grooves have circumferentially ends spaced by portions of said outer surface.

3. Arrangement as claimed in claim 2, wherein said ends of said grooves of said first and second pairs of grooves are axially aligned with said ends of said control ports, respectively.

4. Arrangement as claimed in claim 1, wherein said first and second ducts are straight; and wherein said first duct connects ends of the grooves of said first pair of grooves, and said second duct connects ends of the grooves of said second pair of grooves.

5. Arrangement as claimed in claim 4, wherein the ends of said grooves of said first and second pairs of grooves are axially aligned with the ends of said control ports, respectively.

6. Arrangement as claimed in claim 5, wherein said high pressure conduit and low pressure conduit have axially extending portions located in a plane passing between the circumferentially spaced ends of said grooves and control ports, and transverse portions connecting said axially extending portions with said control ports, respectively; and wherein said straight ducts cross said plane at right angles.

7. Arrangement as claimed in claim 1, wherein said control ports have a greater radial depth than said grooves.

8. Arrangement as claimed in claim 1, wherein said control ports have a substantially greater axial width than said grooves, respectively.

9. Arrangement as claimed in claim 1, wherein said control ports have a greater radial depth than said grooves; and said control ports have a substantially greater axial width than said grooves, respectively.

10. Arrangement as claimed in claim 1, comprising a set of pistons mounted in said working chambers for substantially radial movement; and an actuating cam ring surrounding said rotor and having an endless inner surface eccentric to said rotor engaged by the outer ends of said pistons for reciprocating said pistons in said working chambers.

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