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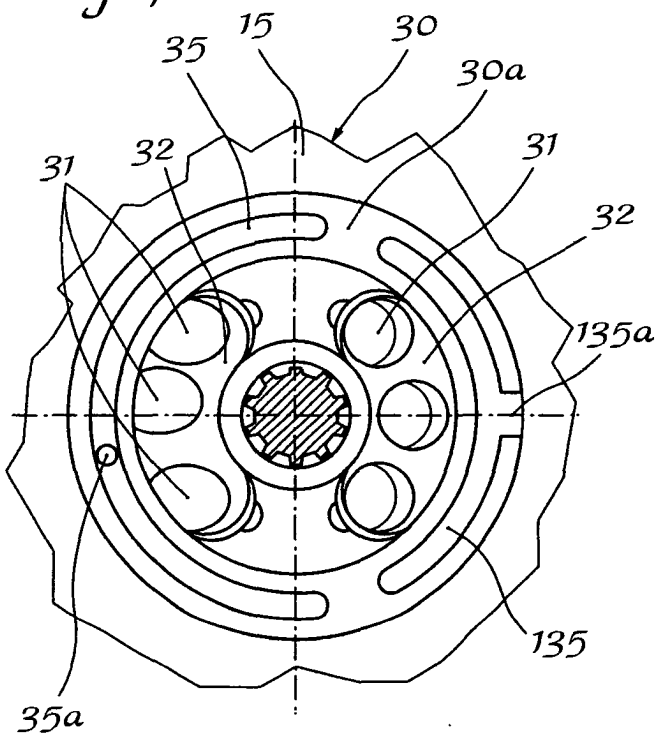
(54) **Rotating disk with asymmetrical balancing eyelets for distributing an actuating fluid to propulsion members of motors**

(57) Rotating disk for distributing a fluid for actuating propulsion members (13) of hydraulic motors (10), which envisages axial through-channels (31) for supplying/discharging the propulsion members (13), the opposite ends of which emerge inside associated inset seats (32, 36) in its opposite front inner surface (30a) and outer surface (30b), the inner surface (30a) being provided with at least one first balancing eyelet (35) and at least one second balancing eyelet (135) connected to respective fluid supply/discharge ducts (35a, 135a), said balancing eyelets (35, 35) being asymmetrical with respect to a diametral axis of the said disk (20).

Fig.4



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Description

[0001] The present invention relates to a rotating disk for distributing the actuating fluid of hydraulic motors.

[0002] It is known in the technical sector of hydraulic motors that operation thereof, both as a motor and as a pump, is based on the thrusting action of radial/axial propulsion members on a cam integral with the drive shaft.

[0003] This thrusting action is achieved by cyclically pressurising/discharging the propulsion members with a time-lag such that the propulsion members being discharged are situated opposite the propulsion members being pressurized and vice versa.

[0004] It is also known that, in order to achieve cyclically said supplying/discharging conditions, rotating fluid distribution units are provided, these consisting essentially of a disk which is provided with through-openings and is axially mounted on the drive shaft with which it rotates; said disk is arranged so that one of its surfaces (referred to below as "inner surface") is in contact with a corresponding surface of the motor casing where the inlet/outlet apertures of the supply/discharge ducts of the radial propulsion members are formed, while the surface of the disk opposite to the above surface (referred to below as "outer surface") is arranged in contact with a second fixed surface in which the apertures of the fluid supply ducts are formed: the through-openings of the said disk are formed so as to supply fluid to some of the propulsion members and discharge the remainder with the required angular time-lag.

[0005] For this purpose, the through-holes in the distribution disk emerge inside inset seats (supply eyelets) on the inner surface of the said disk, which connect several holes and several ducts, producing the required supplying/discharge sequence and the required timing advance.

[0006] Since said distribution disks are inserted between fixed surfaces, between which they must rotate, it is required to ensure a seal in the axial direction between the relative contact surfaces in order to prevent fluid leakages.

[0007] During this cyclical operation, the pressure of the fluid on the said inset sets connecting several holes produces, however, an axial thrust on the inner surface of the disk, which tends to separate the rotating distributor from the fixed frictional surface in which the ducts connecting the propulsion members are formed.

[0008] It is therefore necessary to exert a force on the rotating distributor which opposes and is greater than the force exerted on the inner surface of the said distributor so that the seals between the contact surfaces are ensured.

[0009] This sealing force must be such as to prevail over the thrusting force, but also such that the difference between the two forces is kept as small as possible in order to reduce to a minimum the wear of the parts in frictional contact, said wear causing seizing and producing again loss of contact and therefore a loss of pressure.

[0010] In order to solve this problem solutions are known where the outer surface of the rotating distributor is provided with inset seats connecting the through-holes, so as to be under pressure.

[0011] In addition to this axial thrust requirement it is however also necessary that said thrust should have a balanced centre of gravity, i.e. such that the resultant of all the axial force components is coaxial with the axis of rotation of the drive shaft.

[0012] For this purpose, in the art it is also known to form so-called balancing eyelets, which are situated radially outside the supply eyelets and which extend in such a way that, when filled with the fluid, they are able to balance the forces resulting from the pressure of the supply eyelets. These known balancing eyelets are formed symmetrically with respect to a diametral axis of the distribution disk, which results in the need also for the formation of a zero-pressure annular drainage zone formed along the entire circumferential edge of the distributor. Alternatively, it is possible to connect the entire outer zone of the distributor to the drainage area by displacing the pressurized zone into another position.

[0013] Consequently, in order to produce the rotating distributor, it is required to perform high-precision machining operations with additional machining of the part on the machine-tool, resulting in high production costs and a possible high reject rate owing to the small machining tolerance imposed by the operating specifications of the rotating distributor.

[0014] Examples of the prior art in relation to the preamble of Claim 1 are described in US 4,181,067 and/or EP 0,651,159.

[0015] The technical problem which is posed, therefore, is that of providing a rotating device for distributing the fluid for actuating the propulsion members of hydraulic motors, which is provided with means for balancing the axial thrusts exerted on the said distributor; whereby said balancing means must be such as to cause a reduction in and simplification of the mechanical machining of the rotating distributor, a reduction in the radial dimensions thereof and a longer working life of the distributor so as to limit the motor maintenance operations and therefore the downtime during use of said motor.

[0016] In connection with this problem it is also required that these balancing means should be functional both at the low and high operating pressures of the motor and for both directions of rotation of the distributor and should have small dimensions, be easy and inexpensive to produce and assemble and be able to be installed easily also on existing motors using normal standardized means.

[0017] These results are achieved according to the present invention by a rotating disk for distributing a fluid for actuating propulsion members of hydraulic motors, which envisages axial through-channels for supplying/discharging the propulsion members, the opposite ends of which emerge inside associated inset seats in the opposite front inner surface and outer surface thereof, the

inner surface being provided with at least one first and at least one second balancing eyelet connected to respective fluid supply/discharge ducts, said balancing eyelets being asymmetrical with respect to a diametral axis of the said disk.

[0018] The present invention relates furthermore to a distribution unit according to the characteristic features of Claim 5 and a hydraulic motor with distribution unit according to the characteristic features of Claim 6.

[0019] Further details may be obtained from the following description of a non-limiting example of embodiment of the subject of the present invention provided with reference to the accompanying drawings in which:

Fig. 1 shows a cross-section along the plane indicated by I-I in Fig. 2 of an oil- hydraulic motor provided with a rotating distributor according to the present invention;

Figure 2 shows a cross-section along the plane indicated by II-II in Fig. 1;

Figure 3 shows a cross-section, on a larger scale, of the detail relating to the rotating distributor of the fluid for actuating the propulsion members;

Figure 4 shows a cross-section along the plane indicated by IV-IV in Fig. 3.

[0020] As shown in Fig. 1 and assuming solely for greater clarity of the description and without a limiting meaning a pair of reference axes in a longitudinal direction X-X and radial transverse direction Y-Y, respectively, as well as a front part corresponding to the drive shaft part and a rear part opposite the first part, a motor 10 of the oil-hydraulic type is composed essentially of a casing 11 which is closed by covers 12 and houses internally radial cylinders 13 which exert their thrusting force on an eccentric shaft 14 supported by the casing 11 of the motor by means of associated bearings 11b. Each of the cylinders 13 communicates with a rotating distribution unit 20 (Fig. 2) able to open/close the ducts for supplying/discharging the said cylinders so that the latter are cyclically compressed/discharged.

[0021] Said rotating distribution unit 20 (Fig. 3) consists of a disk 30 mounted on an extension 14a of the shaft 14 together with which it rotates integrally.

[0022] The disk 30 is passed through in the axial direction by holes 31 which are suitably arranged along a predefined circumference concentric with the drive shaft 14 so as to be cyclically aligned with the apertures of the ducts 13c for supplying/discharging the cylinders 13.

[0023] In the example described the disk 30 is arranged between two auxiliary parts which are arranged axially on opposite sides of the said disk and consist of:

- of a first fixed plate 40 arranged between the disk 30 and the fixed motor casing 11 (referred to below as "inner side" of the distributor) in turn provided with through-holes 41 coaxial with the duct apertures;
- a second plate 50 which is situated between the disk 30 and the container 21 (referred to below as the "outer side" of the distributor) and constrained to the latter by means of a rotation lock pin 51.

[0024] Inset seats 32 are formed on the inner surface 30a of the disk 30 (Figs. 4,5) and have, emerging inside them, each hole 31 of the disk 30; these seats 32 are suitably shaped so as to contain within their perimeter several holes 31 and produce the correct advance timing for the supplying/discharging of the cylinders 10.

[0025] The following are also formed on the front surface 30a of the distributor 30:

- a first seat 35 axially connected, via a hole 35a, to a corresponding seat 36 in the rear surface 30b of the disk 20, and
- a second seat 135 connected by means of a radial opening 135a to an annular chamber 25 of the cover 20 which is supplied by the ducts supplying/discharging the propulsion members 13. These seats 35,135 extend in the manner of an arc of a circle having its centre on the axis of rotation of the shaft 14 and angular amplitude such as to produce an asymmetrical profile with respect to a diametral axis of the disk 30.

[0026] As a result of this asymmetrical profile it is possible to compensate for the imbalances generated by the thrusts which are created as a result of leakages of the pressurized fluid from the seats 35, 135, helping ensure an axial thrust and counter-thrust which keep the distributor statically balanced in any angular position thereof.

[0027] It is therefore clear how with the device according to the invention it is possible to achieve improved balancing of the rotating fluid-distribution disk with considerable simplification of the machining operations which are required for manufacture thereof.

[0028] In addition, tests have shown that there is an increase in the working life of the rotating disk which wears more slowly since the contact surfaces under pressure have been reduced.

[0029] Although described in connection with certain constructional forms and certain preferred examples of embodiment of the invention, it is understood that the scope of protection of the present patent is defined solely by the following claims.

Claims

1. Rotating disk for distributing a fluid for actuating propulsion members (13) of hydraulic motors (10), which envisages axial through-channels (31) for supplying/discharging the propulsion members (13), the opposite ends of which emerge in associated inset seats (32,36) in the opposite front inner surface (30a) and outer surface (30b) thereof, the inner sur-

face (30a) being provided with at least one first balancing eyelet (35) and at least one second balancing eyelet (135) which are connected to respective ducts (35a,135a) for supplying/discharging the fluid, **characterized in that** said balancing eyelets (35,135) are asymmetrical with respect to a diametral axis of the disk (20) itself.

2. Disk according to Claim 1, **characterized in that** said balancing eyelets (35,135) extend in the manner of an arc of a circle having its centre on the axis of rotation of the shaft (14) of the motor (10).

3. Device according to Claim 1, **characterized in that** the duct (35a) connecting the first balancing eyelet is axial and passes through the disk (20).

4. Device according to Claim 3, **characterized in that** said duct (135a) connecting the second balancing eyelet (135) is radial.

5. Unit for distributing the fluid for actuating propulsion members (13) of hydraulic motors (10), **characterized in that** it comprises a rotating disk (30) according to Claim 1.

6. Hydraulic motor, **characterized in that** it comprises a unit (20) for distributing the fluid for actuating propulsion members according to Claim 5.

Fig.1

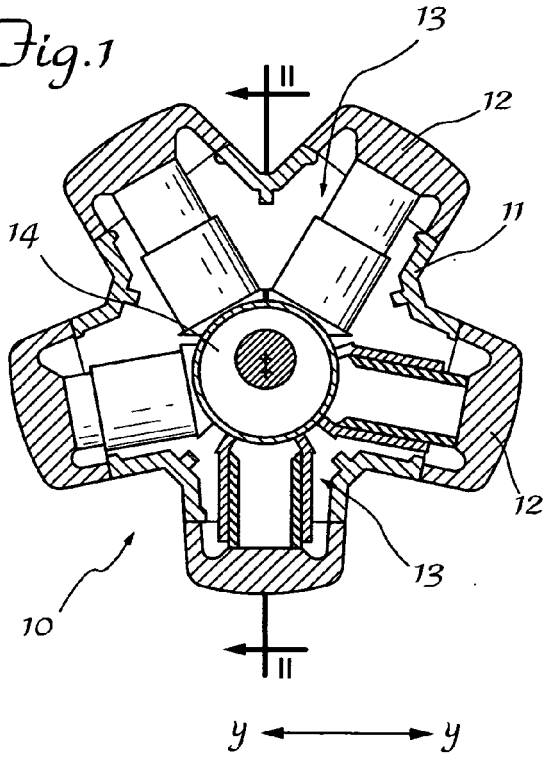


Fig.2

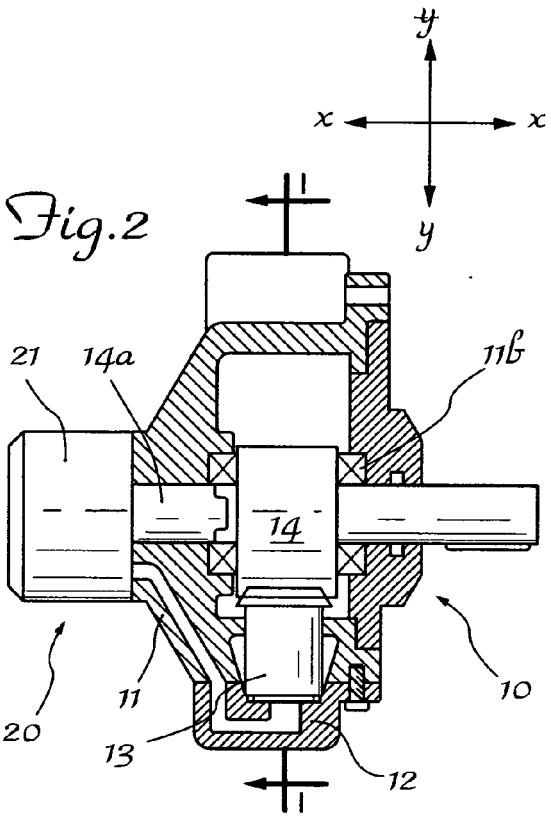


Fig.4

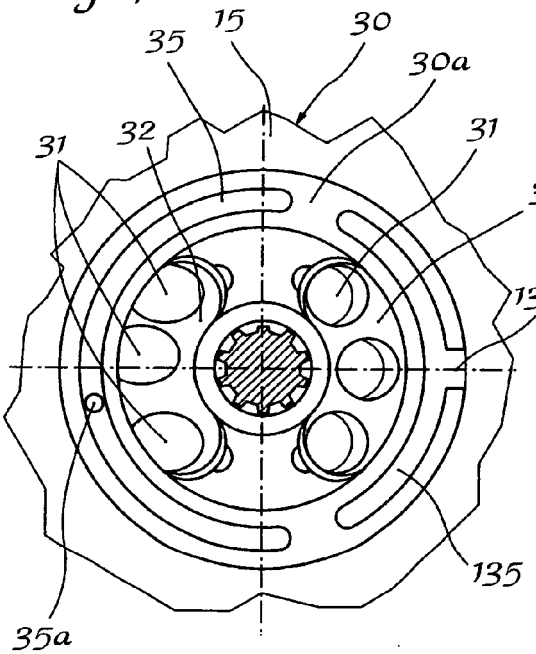
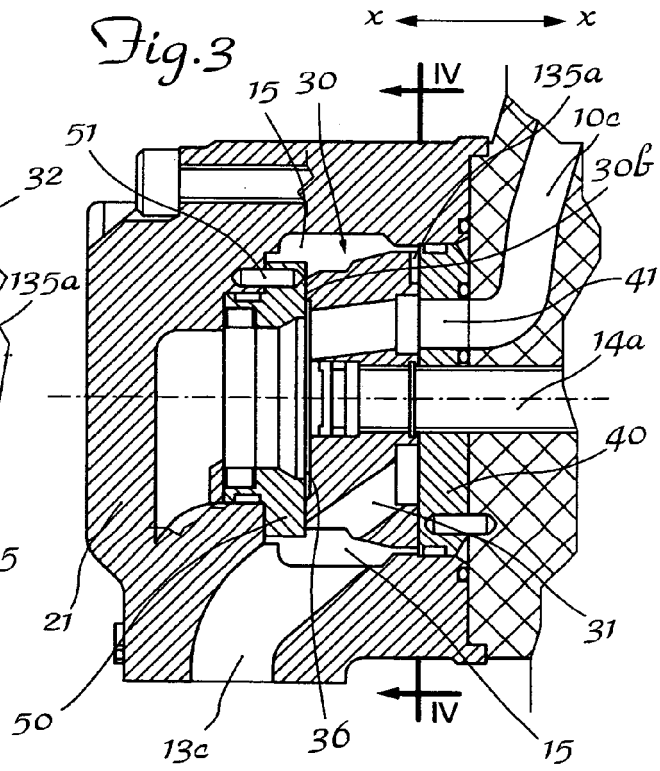


Fig.3



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EUROPEAN SEARCH REPORT

Application Number
EP 10 07 5075

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

F03C
F04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	20 April 2010	Kolby, Lars

CATEGORY OF CITED DOCUMENTS

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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