

[54] RADIAL-PISTON MULTIPLE-ACTION HYDRAULIC MOTOR

[72] Inventor: **Anatoly Yakovlevich Rogov**, Moskovskoi obl., pos. VUGI, 24, kv. 26, Ljubertsy, U.S.S.R.

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Related U.S. Application Data

[63] Continuation of Ser. No. 738,357, June 19, 1968, abandoned.

[52] U.S. Cl. **91/482, 91/492, 91/498**

[51] Int. Cl. **F01b 1/06, F01b 13/06**

[58] Field of Search. **91/204, 205, 482, 492, 498, 103/161**

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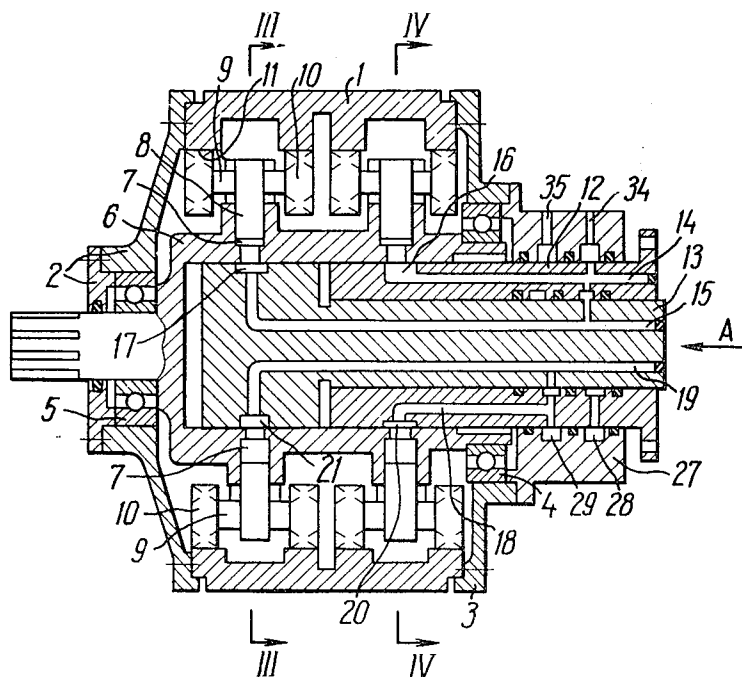
Primary Examiner—Paul E. Maslousky

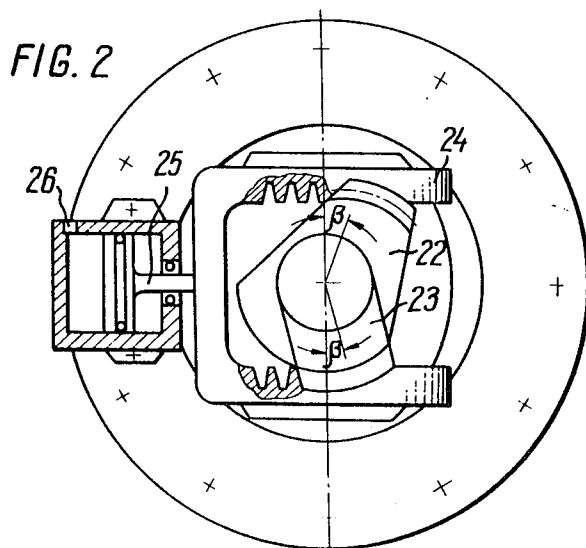
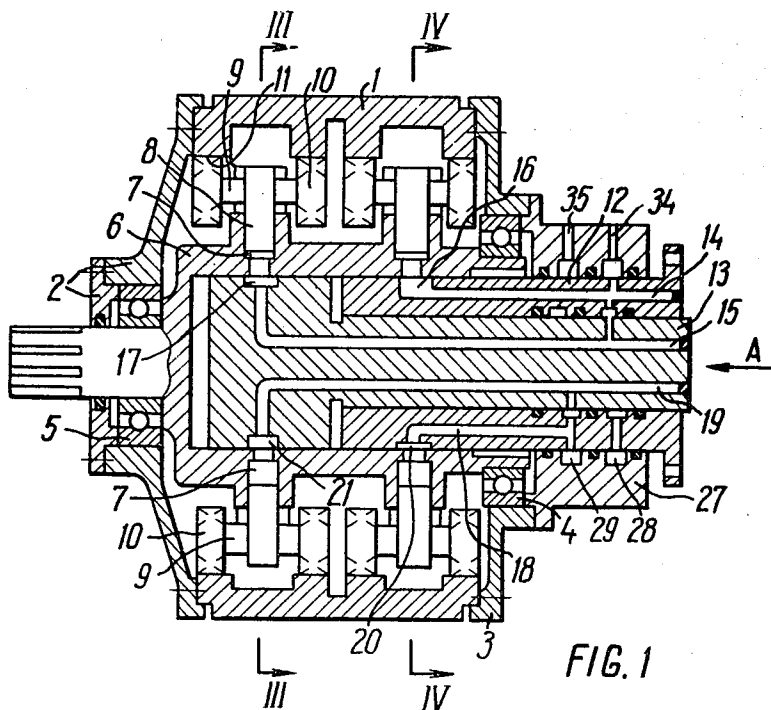
Attorney—Waters, Roditi, Schwartz & Nissen

[57] ABSTRACT

A radial-piston, multiple-action hydraulic motor comprises a casing in which a rotor with an even number of rows of radially arranged pistons is rotatable, the casing having guides with profiles containing noncontrolled and controlled sections. The pistons of one half of the rows interact first with the noncontrolled sections then with the controlled sections and the pistons of the second half of the rows interact first with the controlled sections and then with the non-controlled sections of the profiles. A journal-type distributor is installed in the rotor and has at least two coaxial journals with channels for distributing working fluid and controlling the displacement volume of the hydraulic motor by turning synchronously in opposite directions relative to their axis, the distributing channels of each journal communicating hydraulically with one half of the rows of the pistons.

3 Claims, 6 Drawing Figures





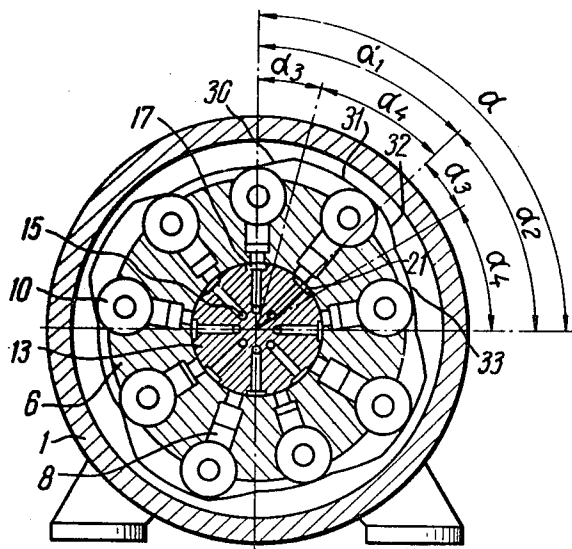


FIG. 3

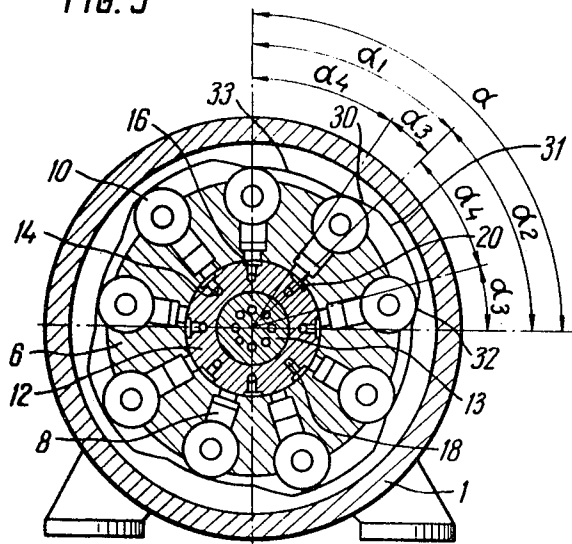


FIG. 4

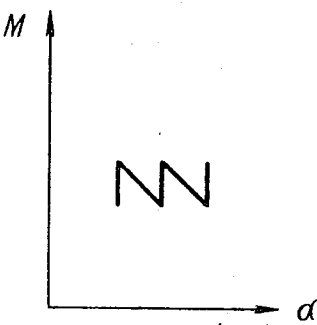


FIG. 5

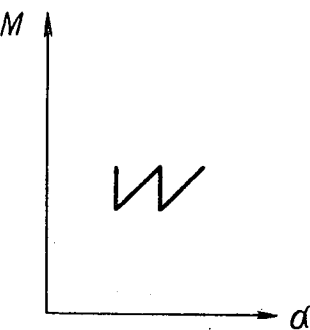


FIG. 6

RADIAL-PISTON MULTIPLE-ACTION HYDRAULIC MOTOR

This application is a continuation of application, Ser. No. 738,357, filed June 19, 1968, now abandoned, and relates to radial-piston hydraulic motors.

Known in the art is a multiple-action hydraulic motor with radial pistons interacting on one side with guides, accommodated in the casing thereof, the profiles of each of said guides having noncontrolled and controlled sections and on the other side with a journal-type working fluid distributor installed so that it can be turned for controlling the displacement volume of the hydraulic motor.

A disadvantage of the known hydraulic motor is that it cannot ensure complete uniformity of the torque and speed of rotation, in the course of control.

An object of the present invention resides in eliminating the aforesaid disadvantage.

Another object of the invention resides in providing a hydraulic motor ensuring a complete uniformity of the torque and speed of rotation in the course of controlling its displacement volume.

This object is achieved by providing a radial-piston multiple-action hydraulic motor with an even number of piston rows, said pistons interacting on one side with the guides accommodated in the casing, the profiles of each of said guides having noncontrolled and controlled sections and on the other side with a journal-type working fluid distributor installed so that it can be turned for controlling the displacement volume of the hydraulic motor. According to the invention, the journal-type fluid distributor consists of at least two coaxial journals turning, synchronously during volume control operation, in opposite directions about a common axis. The distributing channels of each journal communicate hydraulically with one half of the piston rows. The guides are made in such a manner that the half of the piston rows interact first with the noncontrolled sections of the profile, then with the controlled sections. Conversely, the other half of the piston rows interact first with the controlled sections and then with the noncontrolled sections of the profile.

Synchronous turning of the journals is ensured by toothed quadrants secured to the journals and meshing with counterposed racks performing a reciprocating motion.

Given below is a detailed description of an embodiment of this invention with reference to the accompanying drawings in which:

FIG. 1 is a sectional view of the radial-piston hydraulic motor according to the invention;

FIG. 2 is a view along arrow A in FIG. 1, the structure visible in FIG. 2 not being shown in FIG. 1;

FIG. 3 is a section taken along the line III—III of FIG. 1;

FIG. 4 is a section taken along the line IV—IV of FIG. 1;

FIG. 5 shows a torque diagram for one half of the piston rows; and

FIG. 6 is a torque diagram for the other half of the piston rows.

Installed in the hydraulic motor casing 1 (FIG. 1) which is closed at the ends with covers 2 and 3 is a rotor 6 rotating in bearings 4 and 5.

The rotor 6 has an even number of rows of cylinders 7. The cylinders 7 with pistons 8 are installed in each row radially. The pistons 8 are connected to pivots 9 carrying rollers 10. Said rollers interact with guides 11 accommodated in the casing 1.

Located in an axial recess of the rotor 6 is a journal-type working fluid distributor consisting of two coaxial journals 12 and 13. Each journal is in hydraulic communication with one half of the piston rows. For this purpose the journals 12 and 13 have, respectively, channels 14 and 15 and ports 16 and 17 through which the working fluid flows under the pistons 8 after which it is forced out through channels 18 and 19 and ports 20 and 21 into the return line.

Synchronous turning of the distributor journals 12 and 13 is ensured by toothed quadrants 22 (FIG. 2) and 23, installed on each journal and meshing with counter-opposed racks 24

which are connected to the piston 25 of a hydraulic cylinder 26; when in the initial position, the quadrants 22 and 23 are located at 180° from each other and the angle of turning β of said quadrants from the initial position in this case is equal to zero.

The working fluid is fed into, and discharged from the hydraulic motor through a header 27 (FIG. 1) which has circular channels 28 and 29 communicating, respectively, with the channels 14, 15 and 18, 19 of the journals 12 and 13.

The guides 11 have a periodically repeated profile which governs the nature of movement and the number of piston cycles per revolution of the rotor.

Within each cycle, corresponding to the rotor angle of $\alpha = 2\pi/x$ (where x is a number of cycles per revolution) (FIGS 3,4), the roller 10 rolls over four sections 30,31,32,33 of the profile of the guide 11.

While the rollers 10 move over the sections 30 and 31, high-pressure fluid enters under the pistons 8 connected to said rollers and the rotor turns through angle α_1 .

As the rollers 10 move over the sections 32 and 33, the pistons 8 slide towards the center of the rotor 6, forcing the fluid out into the return line and the rotor turns through angle α_2 . The sections 30 and 32 are noncontrolled ones and the profile of each of said sections is a parabolic curve; as the rollers move over this curve the rotor turns through angle α_3 ; the sections 31 and 33 are controlled sections where the supply of the working fluid is controlled; the profile of each of these sections follows an Archimedes spiral; while the rollers 10 roll over this curve, the rotor turns through angle α_4 .

The noncontrolled sections 30 and 32 and controlled sections 31 and 33 are so located on the guides 11 which interact with the rollers 10 connected to the pistons of one half of the rows of the cylinders 7 that the rollers 10 first interact with the noncontrolled sections 30 and 32 (FIG. 3) and then with the controlled sections 31 and 33. The rollers 10 connected to the pistons 8 of the other half of the rows of the cylinders 7 interact first with the controlled sections 31 and 33 (FIG. 4) then with the noncontrolled sections 30 and 32.

The hydraulic motor operates as follows.

The working fluid flows under a high pressure through the circular channel 34 of the header 27 into the channel 14 and port 16 of the journal 12 and into the channel 15 and port 17 of the journal 13 and thence under the pistons 8. The pistons 8 transmit the effort produced by the fluid to the pivot 9 and rollers 10 and the latter interact with the profiled sections of the guides 11. The lateral forces originated during this interaction turn the rotor 6. The pistons 8 perform a working stroke, moving from the lowermost to the uppermost position on the sections 30,31. As the rollers move over to the sections 32,33, the fluid is forced from under the pistons 8 connected to these rollers through the channels 18 and 19 and the ports 20 and 21 of the journals 12 and 13 into the circular channel 35 of the header 27 and thence into the return line.

When the quadrants 22 and 23 connected to the journals 12 and 13 are in the initial position, that is, at 180° to each other and their turning angle β is equal to zero, the displacement volume of the hydraulic motor is a maximum. In this position there are no fluctuations of the motor torque and speed. When the quadrants are offset by an angle less than 180°, the motor torque and speed is regulated due to reduced stroke of the pistons caused by offset timed relation between the supply and outlet channels and the pistons.

As the journals 12 and 13 are turned synchronously through angle $\alpha_1 < \beta > 0$ by the rack 24 and toothed quadrants 22 and 23, the working fluid enters under the pistons 8 and the rotor turns through angle $\alpha_1 - \beta$. This reduces the working stroke performed by the pistons 8 under the force of the high-pressure working fluid and this results in a reduction in the displacement volume of the hydraulic motor.

In such a method of controlling the displacement volume of the hydraulic motor, the changes in the torque M in accordance with the turning angle α of the rotor 6 follow the diagram given in FIG. 5 for one half of the rows of pistons and in

FIG. 6 for the other half of the rows of pistons. These diagrams are piecewise linear functions with the section inclination angle of different direction but of the same magnitude. As the hydraulic motor torque is a result of summation of the moments produced by both halves of the piston rows, the summary torque does not fluctuate which can be proved by superposing the diagrams given in FIGS. 5 and 6.

For reversing the hydraulic motor, it is necessary to change the direction of flow of the working fluid fed under the hydraulic motor pistons. In this case the high-pressure fluid enters under the pistons 8 through the circular channel 35 of the header 27, the channels 18 and 19 and ports 20 and 21 in the journals 12 and 13 and is discharged from under the pistons through the channels 14 and 15 and ports 16 and 17 of said journals into the circular channel 34 of the header 27 and thence into the return line.

The description has disclosed a hydraulic motor with a rotating rotor. However, the hydraulic motor may be made with a rotating casing and a stationary cylinder block.

I claim:

1. A radial-piston multiple-action hydraulic motor comprising: a casing; a rotor with an even number of rows of radially arranged pistons installed in cylinders provided in said casing; guides in said casing each having profiles with noncontrolled and controlled sections, the pistons of one half of the rows in-

teracting first with the noncontrolled sections then with the controlled sections and the pistons of the second half of the rows interacting first with the controlled sections and then with the noncontrolled sections of the profile; a journal-type distributor installed in said rotor and comprising at least two coaxial journals having channels for distributing working fluid to said cylinders, said distributing channels of each journal communicating hydraulically with the cylinders of one half of the rows of said pistons and means coupled to said journals to turn the same synchronously in opposite directions and alter the time of fluid feed into said cylinders relative to the position of said pistons relative to said guides, whereby to control the stroke of said pistons for controlling the displacement volume of the hydraulic motor by turning of the journals synchronously in opposite directions relative to their axis.

2. A motor as claimed in claim 1, wherein said means to turn the journals synchronously comprises toothed quadrants secured to said journals, and counteropposed racks meshing with said journals and reciprocally displaceable to oscillate the racks and the journals to which they are secured.

3. A motor as claimed in claim 1, wherein said noncontrolled sections are of parabolic shape and said controlled sections are of spiral shape.

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