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PRESSURE FLUID MACHINE

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Fig.1

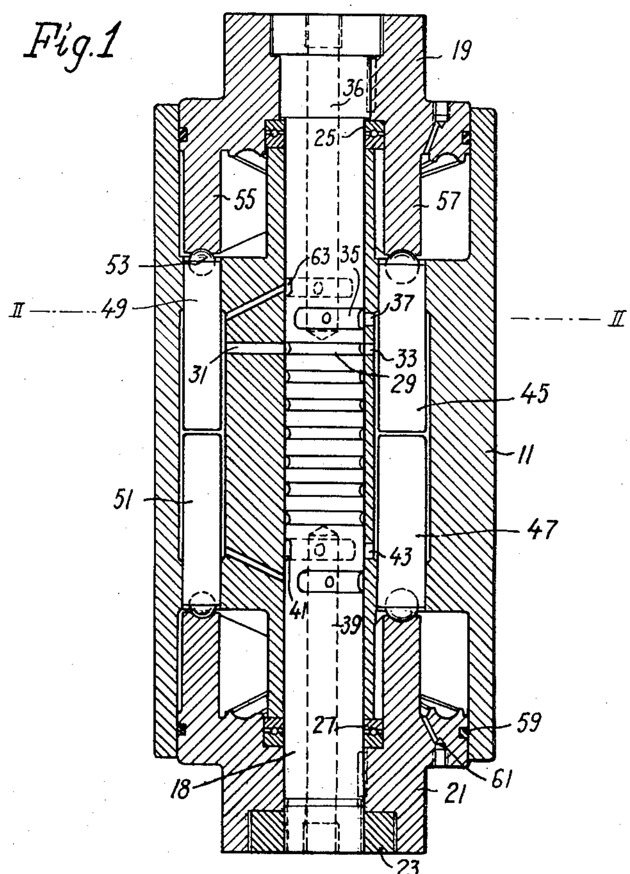
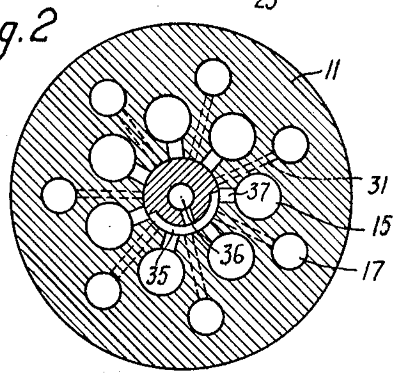


Fig.2



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PRESSURE FLUID MACHINE

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The present invention concerns pressure fluid machines such as motors or pumps, of the kind comprising a plurality of cylinders with reciprocating pistons parallel to the driving or driven shaft and cooperating with the same in such a manner that the reciprocating motion of the pistons is converted into a rotary motion of the shaft, or vice versa.

In known devices of said kind the working phases of the pistons are mutually time-displaced in such a manner that at a given moment the piston pressure is high in the cylinders located on one side of the shaft and low on the other side. This brings with it the disadvantage that the shaft is subjected to an eccentric strain striving to bend the shaft.

The object of the invention is to eliminate said strain on the shaft by balancing the forces acting thereupon.

The invention will be described further, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is an axial section; and

FIG. 2 is a corresponding transverse section.

A cylindrical block 11, has a number of parallel, through bores; these comprise a central bore 13, seven cylinders 15 located on an inner circle and seven cylinders 17 located on an outer circle. The cylinders of the inner circle are situated equally distant from the axis of the block and the central bore, are evenly distributed and are of the same cross-sectional area. The same applies to the cylinders of the outer circle. Each cylinder of the outer circle lies midway between the two closest cylinders of the inner circle and diametrically opposite to a cylinder of the inner circle. The cylinders of the outer circle are of a smaller cross-sectional area than the cylinders of the inner circle, and the ratio of the areas is inversely proportional to the distance of the cylinders from the central axis of the block.

The block 11 is journalled on a shaft 18 having the same diameter as the central bore 13.

End pieces 19, 21 are keyed to the shaft ends extending beyond the block. One end piece 19 abuts against a shoulder on the shaft 18, and by means of a nut 23 screwed onto the shaft end the other end piece 21 is pressed towards the first-mentioned end piece, said end pieces embracing between themselves the block 11 and the interposed ball bearings 25, 27 from both directions.

At the centre part of the shaft 18 seven annular grooves 29 are turned out of its surface. Each of said grooves is located opposite to a radial bore 31 opening out into a cylinder 17 of the outer circle, and also opposite a radial bore 33 opening out into a cylinder 15 of the inner circle, said last-mentioned cylinder being located diametrically opposite to the first-mentioned cylinder. In this manner the cylinders are connected to each other in pairs, and said connection is always open independently of the angular position taken by the block relatively to the shaft. Outwardly of said annular grooves a groove 35 extending approximately over 180 degrees of the periphery is cut out of the surface of the shaft. By means of a passageway 36 in the shaft formed by a radial bore and an axial bore, said groove communicates with a pressure fluid supply conduit, not shown, connected to the end face of the shaft. In a transverse plane through the groove 35, holes 37 are bored between the central bore and all cylinders of the inner

circle. Therefore, when pressure fluids is supplied through the passageway 36, the fluid flows through the three holes 37 temporarily situated opposite to the groove 35 into the cylinders 15 on one block half, and from them it also flows through the above-described individual connections into the three outer cylinders 17 of the opposite block half. In the other end of the shaft there is a corresponding passageway 39 connected to a drain conduit not shown and communicating with a half-circular groove 41 in the surface of the shaft.

Opposite to the groove 41 there is bored a hole 43 between each one of the inner cylinders and the central bore. The groove 41 extends over the half of the periphery of the shaft located opposite to the groove 35, and as a result of this three inner cylinders other than the above-mentioned ones and the outer cylinders permanently connected thereto are connected to the drain conduit. The remaining pair of cylinders is either shut off from connection with the inlet and the outlet or is about to change its connection.

Arranged in each of the cylinders are two pistons 45, 47 and 49, 51, respectively, which are forced outwards in opposite directions when pressure fluid is supplied to the cylinders. In order to admit pressure fluid from the various bores to the opposite end faces of the pistons the cylinders are widened at their centre parts, or grooves are cut out of their sides. The outer end of each one of the pistons bears with the interposition of a ball 53 against a race formed on the end piece 19 or 21; this race is concentric with the shaft and lies in an inclined plane forming an acute angle to the same. Each end piece 19, 21 is formed with two concentric, obliquely cut, sleeve-shaped flanges 55, 57, one lying opposite to the outer circle pistons and the other opposite to the inner circle pistons. The end faces of these flanges, which preferably are hollowed-out to form ball races, are inclined in different directions relatively to a plane perpendicular to the shaft, the lowest point of the inner flange 57 being located close to the highest point of the outer flange 55, and vice versa.

The end pieces 19, 21 partly project into the ends of the block 11, the flanges 55, 57 forming the ball races being protected. A sealing ring 59 is inserted in the joint between the rotary block and the stationary end piece. An outlet 61 for pressure fluid which may leak past the pistons, is arranged in the end piece.

In accordance with the above description, in operation the inner cylinders of one block half and the outer cylinders of the other block half are put under pressure, the pistons of these cylinders being forced outward towards their respective races on the end pieces. The pressure then exerted thereupon is evenly distributed around the periphery, due to the fact that the outer pistons which have the longer leverage, are made with a correspondingly smaller cross-sectional area upon which the pressure fluid can act. Consequently, the shaft 18 will not be subjected to any bending stresses but merely to extension. The block rotates due to the pressure of the pistons transmitted by the balls to the inclined races on the stationary end pieces. The motion is maintained by new holes 37 being successively brought opposite to the groove 35. During each revolution each piston will be connected to the pressure fluid supply passage 36 for somewhat less than 180 degrees, will then be closed for a slight angle and will then be connected to the outlet passage 39 for somewhat less than 180 degrees.

Instead of the passages formed by the bores 31, 33 and the annular grooves 29, or in addition thereto, there may be provided direct connections between the outer cylinders and the pressure fluid supply passage 36. In this case, diametrically opposite to the groove 35 but displaced in the axial direction relatively thereto there is a similar half-circular groove **63** which communicates with the passage **36** through a radial bore, and arranged in the block at the level of said last-mentioned groove are seven radial bores leading to the outer cylinders. Similar direct connections may be arranged between the outer cylinders and the outlet passage **39**.

The hydraulic motor described above may be used as a hydraulic winch, the wire of which is wound directly upon the block, or as a driving roller, a conveyer belt resting upon the block or being put partly around the same. The motor may also be built-in as a hub for a wheel or other rotary member. The direction of rotation may be reversed by changing, by means of a four-way valve, the connection between the conduits attached to the ends of the shaft and the pressure side of a pump and its tank, and the speed can be adjusted by means of a choke valve in the pressure conduit.

In the device described above the direction of energy transfer can be reversed, so that it works instead as a pump. In that case, however, particular measures must be taken in order to ensure that the pistons are always kept engaging their races, e.g. by inserting helical coils between the two pistons of the same cylinder. When the block is turned from the outside, then the pressure of the passing liquid will rise. The invention can be applied also to other kinds of driving or motion transforming devices which are of the same general design as the motor described above.

Of course, the embodiment described above can be modified as to its details within the scope of the invention set forth in the following claim. As an example it may be mentioned that the number of cylinders can be greater or smaller than as shown, but is preferably an odd number.

I claim:

A balanced shaft rotary fluid pressure motor comprising: a cylinder block having a central bore therethrough and mounted for rotation about a shaft extending through said bore: sealing means between said shaft and said block; said block having a plurality of cylinder bores therein arranged to form an inner and outer series of bores concentric with the axis of said central bore; each of said cylinder bores having opposed pistons freely mounted therein in longitudinally spaced relationship; means providing end pieces secured to said shaft and closing off the ends of said block, each of said end pieces having two concentric sleeves projecting into concentric end bores of the block, each inner sleeve defining at its

end an obliquely set cam surface cooperating with the ends of the pistons of the inner cylinders, each of the outer sleeves defining at its end an obliquely set cam surface cooperating with the ends of the pistons of the outer cylinders, said obliquely set cam surfaces being inclined in opposite directions relative to a plane perpendicular to the axis of said shaft, the crest of one of the cam surfaces corresponding with the root of the other corresponding surface; bearing means interposed between adjacent sleeve ends and corresponding piston ends to reduce friction therebetween; said shaft having an axial inlet passage in communication with a first semi-circular groove in the outer periphery of said shaft, a plurality of axially spaced annular grooves corresponding to the number of pairs of inlet and outlet cylinders in said block along said shaft, an axial outlet passage in communication with a second semi-circular groove in the outer periphery of said shaft, said second groove radially spaced approximately 180° from said first semi-circular groove; said block having fluid inlet passages communicating with one series of bores in the plane of said first semi-circular groove, passageways providing communication between one inner cylinder and the diametrically opposed outer cylinder in the plane of each of said annular grooves, and fluid outlet passages communicating with said other series of bores in the plane of said second semi-circular groove, each of said inner cylindrical bores and its associated passageway being of a proportionate larger size than the size of the diametrically opposed outer cylinder bore and its associated passageway, whereby fluid pressure directed to said shaft from each of said inner cylinders and its associated piston is equal to the fluid pressure directed to said shaft from the diagonally opposed outer cylinder and its associated piston, the cooperative force imparted by the opposed pistons in each of said cylinder bores thereby cancelling the moments of the force.

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