

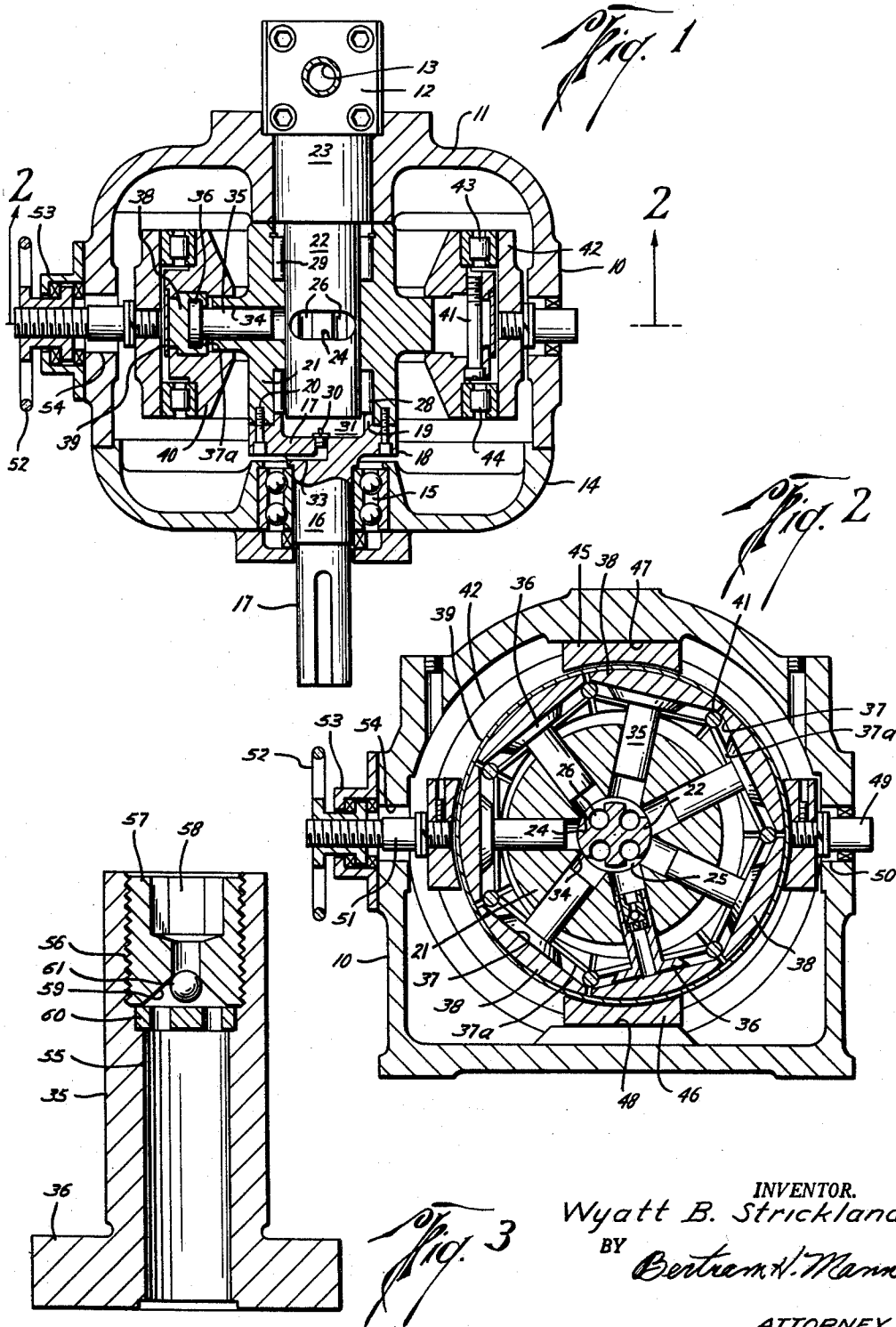
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RADIAL PUMP OR MOTOR

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RADIAL PUMP OR MOTOR

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1 Claim. (Cl. 103—161)

This invention relates to high pressure, high speed rotary, radial-piston hydraulic pumps or motors, and consists particularly in novel piston construction for reducing inertia forces and friction set up during operation of the pump.

Hydraulic machines of this type, as heretofore designed, have been limited in their operating speed and, therefore, capacity principally because of the very great centrifugal forces set up and the resultant high frictional resistance.

Frictional resistance and wear are further increased due to improper lubrication of the pistons and reaction parts. The problem results not only from the great radial and torsional forces transmitted between the pistons, cylinder body, and reaction parts, but also from the tendency to suck lubricant away from the bearing surfaces during the suction strokes of the pistons. An inadequate lubricant seal around the pistons may, also, permit sucking of air into the cylinders, resulting in noisy operation and vibration, frequently leading to premature failure.

Consequently, an object of the present invention is to provide a pump of the radial piston type which is capable of higher speed operation and, therefore, greater volumetric capacity than previous pumps.

Another object is to provide for improved lubrication, particularly, of the pistons and reaction ring parts in this type of pump or motor.

Another object is to provide a rotary, radial piston type of pump or motor having substantially less piston mass and, accordingly, less inertia forces than previous devices of this type.

Another object is to simplify and cheapen a radial pump or motor of this type by reducing the inertia forces set up during operation and, therefore, the necessary ruggedness of reacting parts and bearings.

Another object is to provide a rotary pump of the radial piston type having increased efficiency.

Another object is to provide a pump of this type with means to reduce the tendency of gas and air bubbles to form in the cylinders, and resultant noisy operation and vibration.

These objects and other more detailed objects hereafter appearing are attained by the novel structure illustrated in the accompanying drawing in which

FIG. 1 is a horizontal central section through the device;

FIG. 2 is a vertical transverse section taken substantially on the corresponding section line of FIG. 1; and

FIG. 3 is an enlarged detail showing one of the novel pistons disassembled.

According to the present invention, the radially reciprocating pistons are hollowed longitudinally therethrough so that the operating liquid extends in solid columns from the spindle valve to the reaction ring for lubricating the reaction bearing surfaces and transmitting substantial portions of working forces independently of the pistons. Thus the mass of the pistons is substantially reduced. Within the pistons are provided outwardly opening check valves which open during the pressure strokes of the pistons and close during their suction strokes to isolate bodies of liquid under pressure about the reacting surfaces of the pistons and reactance ring structure.

The pump is mounted in a stationary, main casing 10, of generally cylindrical contour, having an integral end wall 11 upon which is mounted an attachment block 12

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for hydraulic fittings, one being shown at 13. A cap 14 closes the other end of the casing and is provided with a ball bearing 15 which receives journal 16 on drive shaft 17 extending through the cap. At the inner end of the drive shaft is a flange 18 having a central cup 19 and bolted, as at 20, to the cylinder body 21. Concentric with shaft 17 and extending through the body from fitting block 12 is the valve spindle 22, having an enlarged extremity 23 press fitted in casing end wall 11 and provided with diametrically opposite operating ports 24 and 25. Longitudinal passages 26 and 27 extend from block 12 through the valve spindle and communicate with ports 24 and 25.

The central, cylindrical part of the cylinder body is received upon and maintained at operating clearance with respect to spindle valve 22 by means of needle bearings 28 and 29 which accurately maintain the concentricity of the cylinder body and valve. Cup portion 19 on the drive shaft maintains bearings 28 in position. A fitting 30 in the end of the drive shaft mounts a spring pressed relief valve which holds liquid in space 31 at sufficient pressure to properly lubricate bearings 28. Excess pressure is delivered to the casing through a passage 33.

Radiating from the spindle valve in a plane normal thereto and cutting the axes of ports 24 and 25 are cylinders 34 which, during rotation of the cylinder body, sequentially communicate, respectively, with ports 24 and 25 for alternately pressuring and discharging the cylinders. Working in each cylinder is a piston 35 having a T-head 36. The flat outer surfaces of all of the heads 36 slidably engage inwardly facing, chordal bearing surfaces 37 on the sectors 38 forming part of the reaction ring structure. Snugly received about and positioning sectors 38 is a ring 39, the ring and sectors being clamped between circular side pieces 40 secured together by bolts 41. Sectors 38 also have ribs 37a located radially inwardly of and paralleling surfaces 37. These ribs underlie piston heads 36 so as to enforce outward movement thereof during the suction cycle.

The reaction structure is rotatably carried within an adjusting ring 42 by means of roller bearings 43 and 44 lodged within corner cutouts provided therefor in the side pieces. Adjusting ring 42 has diametrically spaced pads 45 and 46 which slidably engage milled bearing surfaces 47 and 48 within casing 10 for guiding the reaction ring structure in linear movements transversely of the casing. A pin 49, between pads 45 and 46, projects laterally from the adjusting structure through a packed opening 50 in the casing wall. A bolt 51 projects from ring 42 oppositely of pin 49 and its threaded extremity receives an adjusting wheel 52 sealingly received in a packing box 53 secured to the casing wall about opening 54 therein. Turning of wheel 52 shifts the reaction ring structure to vary its eccentricity relative to the cylinder body and, consequently, the piston stroke.

The pistons have hollowed interiors extending longitudinally therethrough, as best shown in FIG. 3, each including an outer portion 55 and an enlarged, internally threaded inner portion 56 receiving a valve seat member 57 having a polygonal wrench receiving opening 58 at its inner end and a tapered outer end opening 59. A spider 60 lodged across the tapered end of the valve seat member retains a check ball 61 in position relative to its tapered valve seat.

In operation, as a pump, hydraulic pressure lines are connected to the proper fittings in block 12 in a manner to connect the valve ports, respectively, to the pressure and suction sides of the hydraulic system and wheel 52 is properly adjusted to determine the piston stroke. Power is supplied to drive shaft 17, causing rotation of cylinder body block 21 and the reactance ring structure 38, 39 and

40. If the reactance ring structure is in an operative position eccentric of the cylinder block, the pistons will be caused to reciprocate within their cylinders and heads 36 will oscillate between chordal bearing surfaces 37 and 37a on the reactance structure, thus pressuring the hydraulic system. Normally, the space between the cylinder body and the reactance ring structure will be maintained full of operating liquid due to centrifugal force and leakage past the pistons. During the outward or suction strokes of the pistons, check balls 61 will be held tightly on their seats so as to isolate the bodies of hydraulic liquid within the hollowed interiors of the pistons, thus trapping this body of liquid in position to insure continued lubrication of the reactor bearing surfaces and preventing the sucking of lubricant away from the cylinder walls. This is particularly important since transmission of pump torque through the pistons causes the application of substantial lateral forces between the pistons and cylinder walls. This trapped body of liquid also tends to prevent the formation of gaseous bubbles in the cylinders, during the suction strokes which would result in shocks and noisy operation. A further advantage of the check equipped, hollowed interiors of the pistons is that when the stroke is reversed from the suction to the pressure cycle a body of solid liquid is immediately available for transmitting pump forces from the reactance structure to the liquid in pressure passages 26.

After the cylinder body travels 180° during the suction strokes of certain of its pistons, the directions of these pistons will be reversed and their associated cylinders connected to pressure port 24. At this time, check balls 61 will leave their seats so that a continuous column of liquid will exist between each associated reaction bearing surface 37 and the pressure passages, thus transmitting substantial portions of the pumping pressure directly from the reactance ring to the pressure port.

The hollowed construction of the pistons serves to substantially reduce the mass thereof so that centrifugal forces during high speed operation of the machine are substantially reduced. Accordingly, the pump may be operated at higher speeds than where the pistons are of solid construction. Furthermore, since substantial portions of the pumping forces from the reactance ring structure are transmitted independently of the pistons, the pistons themselves need be only rugged enough to carry the remainder of such forces. Consequently, the pistons may be made of substantially lighter construction and, in fact, constitute merely the shells of cylinders.

As previously explained, the check valves 61 serve an important function during the suction stroke in that they prevent the application of pump suction to the reactor bearing surfaces which would tend to withdraw lubricant

therefrom and to introduce air or gaseous bubbles into the cylinders.

Thus, the novel hydraulic machine, particularly when used as a high pressure hydraulic pump, is able to operate at higher velocity than previous pumps of this type, so that greater volumes may be pumped without loss of pressure. Furthermore, the pump operates more efficiently, particularly during the suction stroke thereof and with less danger of the introduction of gaseous bubbles into the cylinders. By the use of the present invention, a pump of usual proportions for service in a high pressure hydraulic system, may be designed to pump over 100 gallons per minute at 3,000 p.s.i. The necessary high speed and reduced frictional resistance are made possible by the novel, partially counterbalanced piston construction.

The invention may be modified in various respects as will occur to those skilled in the art and the exclusive use of all modifications as come within the scope of the appended claim is contemplated.

In the claim:

In a rotary, radial piston pump or motor, a rotatable cylinder body having an internal pressure chamber and at least one cylinder radiating therefrom, a reaction ring received eccentrically about said body, a piston working in said cylinder and having bearing means at its outer and slidably engaging said ring, there being a chamber extending longitudinally through said piston from end to end thereof and occupying a major portion of the volume of said piston so as to substantially reduce the weight thereof, a valve seat located intermediately in said piston chamber and communicating with said cylinder and said chamber, and an outwardly opening check valve on said seat for providing direct fluid communication between said pressure chamber and said ring to transmit a substantial portion of the working fluid force directly to said ring during the pressure stroke of said piston and to lubricate said bearing means while cutting off said communication during the suction stroke to trap a body of fluid between said valve and said ring and prevent the sucking of air and lubricant inwardly across said bearing means.

References Cited in the file of this patent

UNITED STATES PATENTS

1,152,729	Hele-Shaw	Sept. 5, 1915
2,250,512	Vickers	July 29, 1941
2,429,011	Wylie	Oct. 14, 1947
2,518,578	Tomlinson	Aug. 15, 1950
2,687,615	Morrow	Aug. 31, 1954

FOREIGN PATENTS

745,216	France	May 8, 1933
764,698	Great Britain	Jan. 2, 1957