

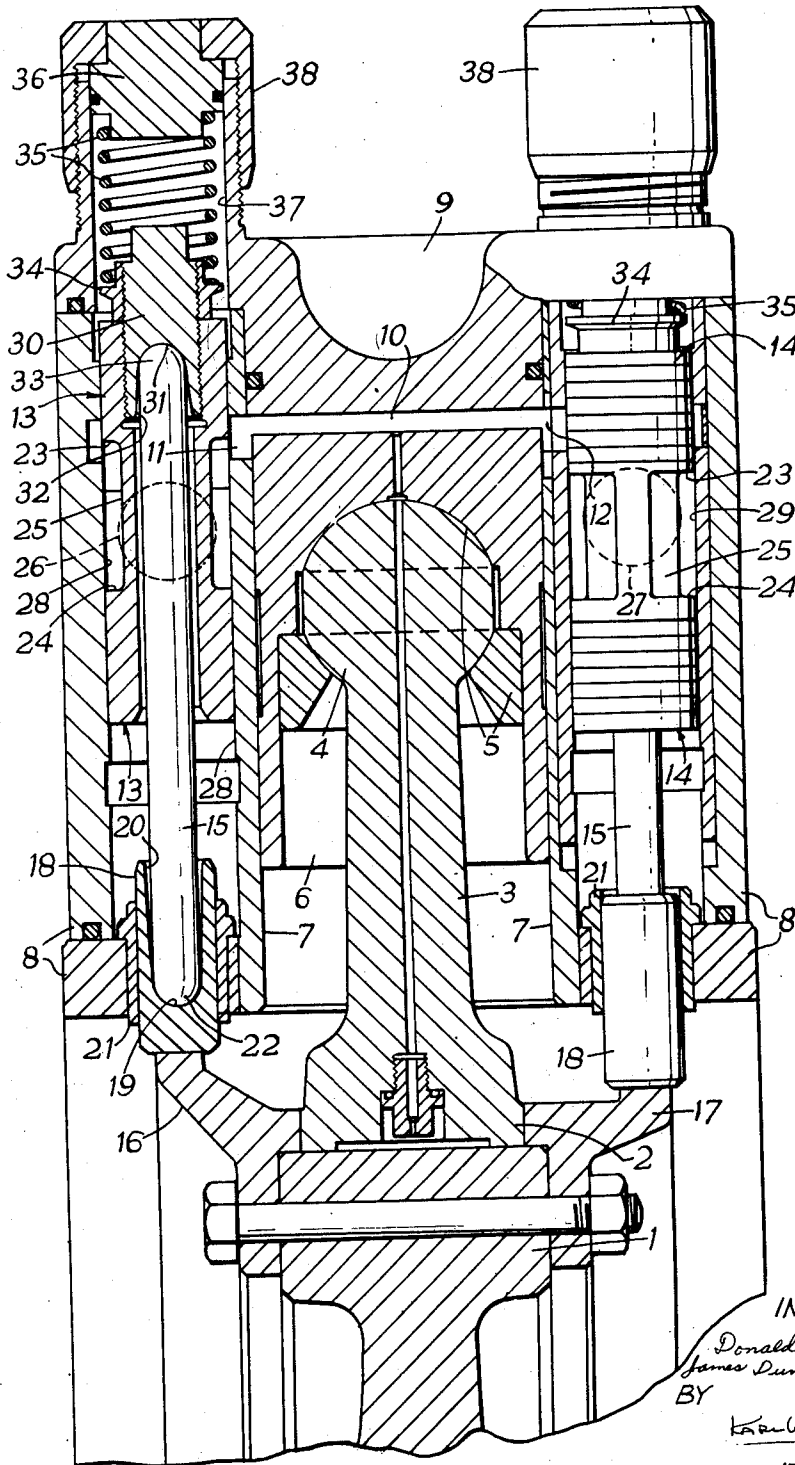
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PISTON VALVE FOR FLUID PRESSURE PUMPS OR MOTORS

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PISTON VALVE FOR FLUID PRESSURE
PUMPS OR MOTORS

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This invention relates to positive displacement fluid pressure pumps or motors and aims at improving their efficiency.

One source of loss of efficiency in known forms of hydraulic piston type pumps and motors having push-rod valve gear is that thermal expansion of the push-rods during working of the pump or motor causes variations in valve timing.

In a positive displacement hydraulic fluid motor or pump according to the present invention, efficiency is improved by means of a push rod operated valve in which the valve member proper is of tubular form. The end of this tube is closed and constitutes the valve head which controls the opening and closing of the port in the cylinder, and the internal cavity terminates at its inner end in a rounded or part-spherical seating. This is engaged by a similarly shaped end on the push rod, the radius of the latter being not greater than that of the seating.

The seating is preferably at approximately the same level as the working edge of the valve head so that thermal expansion of the latter in the axial direction has negligible effect on the timing of the port events.

Advantageously, the tubular valve member has an external land around the head of the valve the under-edge of which constitutes the port control edge, the external land being so dimensioned that, so long as the internal seating is at a level intermediate the limits of the land, any axial expansion of the push-rod is at least partially compensated by axial expansion of the land in the opposite sense.

The cavity in the tubular valve member is conveniently flared outwards towards the skirt so as to prevent metal-to-metal contact between the valve and the push-rod except at the seating, thereby reducing transfer of heat to the push rod.

An improved positive displacement hydraulic motor according to the present invention is illustrated, by way of example, in the accompanying drawing which shows an axial section through a piston and its valve gear.

The motor shaft carries a main eccentric 1 on whose periphery bear the slippers 2 of the piston rods 3. Each piston rod has a part-spherical "little end" bearing 4 which works in a complementary little end seating assembly 5 in the piston 6. The latter reciprocates in a cylinder 7 in a cylinder block 8 having a detachable head 9 which defines, with the piston 6, a compression space 10. Inlet and exhaust ports 11, 12 respectively open into this space at each side, and each port is controlled by a respective piston valve 13, 14 operated by a push rod 15, of less external diameter than the internal diameter of the tubular valve, from a corresponding inlet or exhaust cam 16, 17 bolted to the eccentric 1.

The push rod 15 of each valve transmits the required valve motion from its cam 16 or 17 through a tappet 18 in the form of a deep cup having a rounded or part-spherical seating 19 and side wall 20 which is upwardly and outwardly flared. As shown, this side wall 20 is coned, the cone angle being a few degrees. Each tappet slides in a bush 21 pressed into a socket in the cylinder block 8.

The bottom end of the push rod 15 is complementarily rounded or of hemispherical shape at 22, the radius of the

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surface being not greater—and preferably slightly less—than that of the seating 19, so as to ensure self-alignment of the rod 15 and also to provide a minimum of bearing surface area for the transmission of heat from the tappet 18 to the rod.

The piston valve 13 (or 14) is of generally tubular form having spaced upper and lower external lands 23, 24. The reduced diameter stem portion 25 between the lands registers with an inlet passage 26 or an outlet passage 27, as the case may be. The lands 23, 24 form pressure fluid seals with the wall of a respective valve bore 28 or 29, the upper land 23 serving also to open and close the inlet or exhaust port 11, 12. The length of the stem 25 between lands is such as to ensure that the passage 26 or 27 is never cut off during the valve stroke.

The head of the valve 13 or 14 is constituted by an inverted thimble 30 having a rounded or part-spherical internal seating 31 with a flared or coned side wall 32. The seating 31 receives a complementarily rounded or hemispherical end 33 at the top of the push rod 15, this end being of a radius not greater than—and preferably less than—that of the seating 31.

The thimble 30 is threaded into the top end of the bore through the tubular valve 13 or 14 and is locked in its position of adjustment by means of a flanged nut 34 which also forms the lower abutment for a helical compression valve spring 35. The upper abutment for the spring 35 is provided by a shouldered plug 36 which is slidable in an upper extension 37 of the respective valve bore 28 or 29 and bears against an internal shoulder on a cap 38 threaded on the external wall of the extension bore 37.

When the motor is working, the valves 13 and 14 are continuously reciprocated through their push rods 15 and tappets 18, by the respective inlet and exhaust cams 16, 17. During operation of the motor, the temperature of the working parts rises, and in hitherto known constructions of motor the expansion of the push rods and valves has been such as to vary the valve timing, with consequent loss of efficiency. In the construction of motor according to the present invention, this disadvantage is minimised or eliminated for the following reasons.

First, the radial clearance between the internal wall of the tubular valve 13, 14 and the push rod 15 substantially insulates the latter from heat generated in the valve wall.

Secondly, the small area of contact between the hemispherical ends 22, 33 of the push rod 15 and the co-acting seatings 19, 31 of the tappet 18 and thimble 30, respectively, substantially eliminates the conduction of heat from these components to the push rod 15.

Thirdly, the valve timing is primarily affected by a change in the axial distance between the crown of the rounded seating 31 and the lower edge of the land 23, and since this distance can be made very short, thermal expansion of the valve can be effectively neglected. In any case, any expansion of the push rod 15 which may occur will raise the crown of the rounded seating 31 and will tend to compensate for thermal expansion of the head end of the valve. This compensating action takes place because of the positioning of seating 31 within the valve 13, 14, at the end of the axial cavity, wherein push rod 15 extends through valve 13, 14 past the lower edge of land 23 which is the working edge of the valve. Therefore expansion, due to temperature changes, of rod 15 relative to the driving cam 16, 17 or tappet 18 is in a direction to raise valve 13, 14. Since the larger mass of valve 13, 14 is in a position below the contact area of seating 31 the major expansion of valve 13, 14 is in a downward direction, opposed to the expansion of push rod 15. Thus, compensating actions of expansion of push rod 15 and valve 13, 14 maintain accuracy in valve timing in the present invention.

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What we claim is:

1. A valve mechanism for a positive displacement hydraulic machine comprising a valve body having a valve bore, a generally tubular valve member reciprocable in said bore and having a head end and a skirt portion, an external port control land around said head end terminating adjacent the skirt portion in a working edge controlling a port in said valve bore, a rounded seating within the valve member at the end of an axial cavity therein extending through the skirt portion and past the position of said working edge and terminating in the head portion, a push rod extending with radial clearance through said cavity and having a rounded end engaging with said seating, and driving means operatively engaging said rod whereby expansion in the direction of movement of said valve member and said rod due to temperature changes is relative to the position of said driving means.

2. A valve mechanism for a positive displacement hydraulic machine comprising a valve body having a valve bore, a generally tubular valve member reciprocable in said bore and having a head end and a skirt portion, an external port control land around said head end terminating adjacent the skirt portion in a working edge con-

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trolling a port in said valve bore, a rounded seating within the valve member at the end of an axial cavity therein extending through the skirt portion and terminating beyond and adjacent to the position of said working edge, a tappet reciprocable co-axially with said valve member, a rounded seating in said tappet co-axially opposed to the rounded seating in the valve member, a push rod extending with radial clearance through said axial cavity in the valve member and having rounded ends engaging with said rounded seatings in the valve member and tappet, and driving means operatively engaging said tappet whereby expansion in the direction of movement of said valve member and said rod due to temperature changes is relative to the position of said driving means.

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