Oct. 7, 1930. W. A. SMITH, JR 1,777,775

VALVE MECHANISM FOR ROCK DRILLS

Filed Nov. 22, 1928

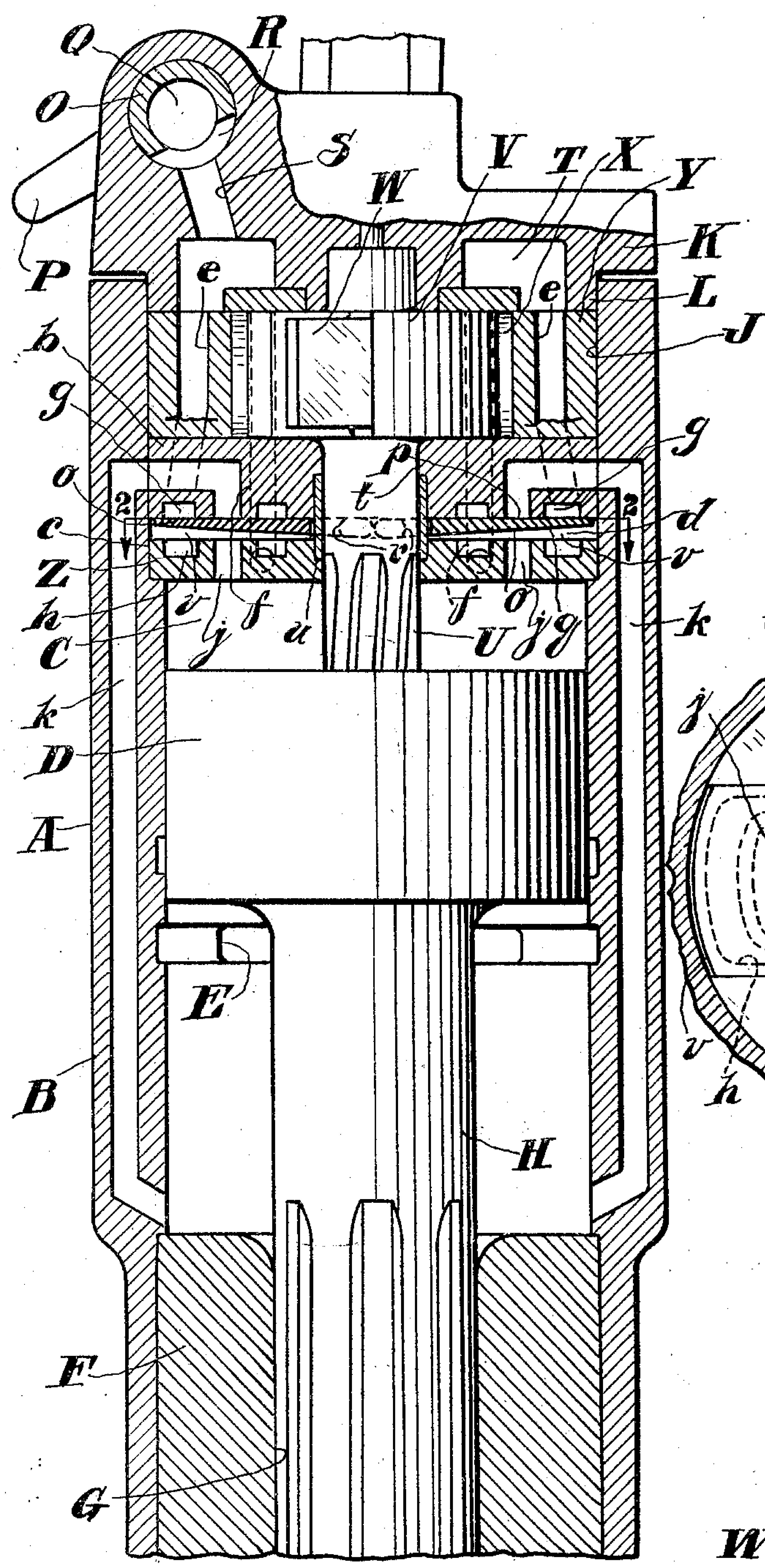

FIG.-1.

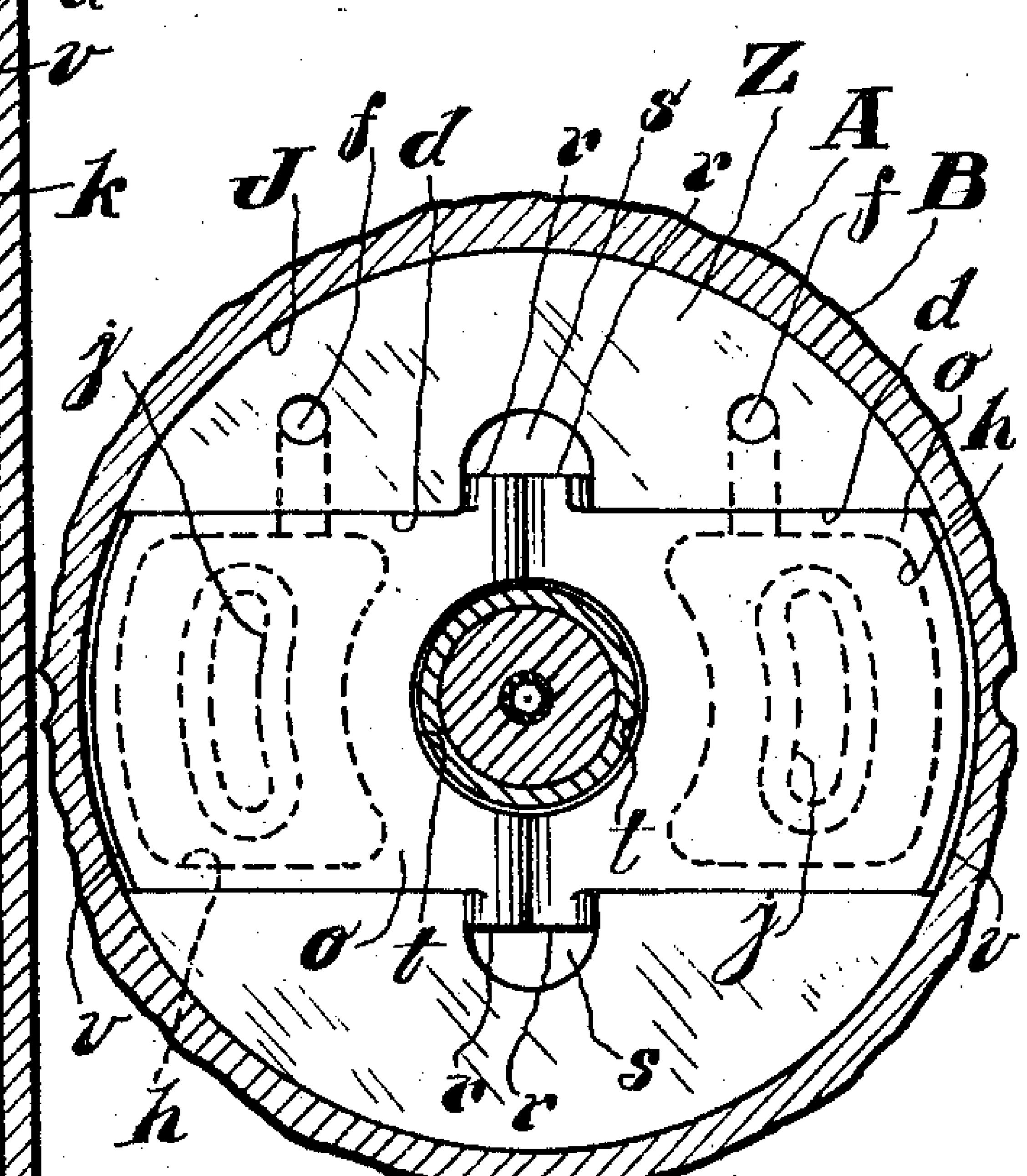

FIG.-2.

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Patented Oct. 7, 1930 1,777,775

UNITED STATES PATENT OFFICE

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VALVE MECHANISM FOR ROCK DRILLS

Application filed November 22, 1928. Serial No. 321,134.

This invention relates to fluid actuated rock drills, but more particularly to a valve mechanism whereby the distribution of pressure fluid to the cylinder is effected.

One object of the invention is to insure an immediate and abundant supply of pressure fluid to the ends of the cylinder for actuating the piston and another object is to maintain the valve firmly in its limiting positions during the admission of pressure fluid into the cylinder.

Other objects will be in part obvious and in part pointed out hereinafter.

In the drawings illustrating a practical application of the invention and in which similar reference characters refer to similar parts,

Figure 1 is a sectional elevation of a portion of the rock drill having the invention applied thereto, and

Figure 2 is a transverse view taken through Figure 1 on the line 2—2 looking in the direction indicated by the arrows.

Referring to the drawings, A designates generally a rock drill comprising a cylinder B having a piston chamber C in which is disposed a reciprocatory hammer piston D. The cylinder B has in this instance a free exhaust port E which is controlled by the piston D.

The cylinder B is provided at its front end with a suitable closure in the form of a front cylinder washer F having a bore G through which extends slidably a stem or nose H of the piston D for delivering blows against a working implement, such as a drill steel (not shown).

In the rearward end of the cylinder B is an enlarged bore J which is closed at its outer end by a back head K having an annular flange L which extends into the bore J for centralizing the back head K with respect to the cylinder B.

The back head K forms a housing for a throttle valve O whereby the admission of pressure fluid into the drill may be controlled. The throttle valve O is shown as being of the rotary type and accordingly has a lever P whereby it may be manipulated. In this instance the throttle valve O is provided with a central chamber Q into which the pressure fluid from a suitable source of supply may be introduced and in the side of the throttle valve is a port R adapted to register with a passage S in the back head leading to a supply reservoir T also in the back head.

In order to obtain a step by step rotary movement of the drill steel, the drill is provided with a suitable rotation mechanism comprising a rifle bar U which may be interlocked slidably with the piston D in a well known manner. The rifle bar U has the head V which carries spring pressed pawls W adapted for engagement with teeth X of a rotation ratchet Y disposed in the rearward end of the bore J and acting in this instance as a seat for the back head K.

In accordance with the present invention a valve chest Z is disposed in the inner end of the bore J adjacent the rearward end of the piston chamber C for which it forms a closure. The valve chest Z comprises a pair of plates *b* and *c*, the plate *b* being interposed between the plate *c* and the rotation ratchet Y which is seated on the plate *b*.

In one side of the plate *b* is formed a valve chamber *d* which communicates at its ends with the supply reservoir T through front and rear supply passages *e* and *f*. The supply passages *f* lead to the forward end of the valve chamber *d* and to the opposite sides thereof and the passages *e* lead to the opposite sides of the rearward end of the valve chamber *d*. In the construction shown endless grooves *g* are formed in the plate *b* and said grooves communicate with the supply passages *e* to assure a constant supply of pressure fluid in the rearward side of the valve chamber *d*. Similarly grooves *h* are formed in the plate *c* and the supply passages *f* open into the grooves *h* to also assure a constant supply of pressure fluid in the front end of the valve chamber *d*.

Pressure fluid for actuating the piston D in a forwardly direction is admitted into the rear end of the piston chamber C through rearward inlet passages *j* formed in the plate *c* and leading from the opposite ends of the valve chamber *d*. The admission of pressure fluid to the front end of the piston chamber C is effected through front inlet passages *k* also leading from the opposite ends of the valve chamber *d* and from the rearward side thereof through the plate *b* and through the cylinder B to the front end of the piston chamber C. The passages *j* and *k* are preferably so arranged that their inlet openings lie substantially in the same longitudinal plane. This is also the preferred arrangement of adjacent grooves *g* and *h* which, as will be observed, encircle or surround the inlet openings of the passages *j* and *k*.

The distribution of pressure fluid to the piston chamber C is effected in this instance by a pair of oscillatory plate valves *o* disposed in the valve chamber *d* in such manner that their free ends oscillate between the passages *j* and *k* which they control. The valves *o* have rearward and forward pressure areas *p* and *q* which converge toward the outer free ends of the valves.

As a preferred arrangement the valves are disposed end to end and carry at their inner or adjacent ends lateral trunnions *r* which extend into notches or pockets *s* in the plate *c* to serve as pivots for the valves *o* and for holding the valves *o* against endwise movement in the valve chamber *d*.

When adapted for use in rock drills employing rifle bars as in the present instance and where it may be desirable to dispose the valves in the same transverse plane, said valves may be provided with suitable recesses *t* which combine to form a cylindrical aperture for the reception of the rifle bar and, as in the present instance, a bushing *u* which encircles the rifle bar and extends into the plates *b* and *c* for preventing leakage of pressure fluid from the valve chamber along the rifle bar into the piston chamber C.

The ends of the valves *o* carrying the trunnions *r* are preferably of a thickness substantially equal to the depth of the valve chamber *d* in order to divide the said valve chamber *d* into two pressure chambers *v* from each one of which lead a pair of inlet passages *j* and *k*. By dividing the valve chamber *d* into separate pressure chambers, each valve may act independently of the other and without being influenced by any variation in pressure which may exist in opposite ends of the valve chamber *d*.

The operation of the device is as follows: By rotating the throttle valve O to the open position illustrated, pressure fluid will flow through the passage S into the supply reservoir T, thence into the supply passages *e* and *f* to the rearward and front sides of the valve chamber *d*.

Assuming the piston to be in the position illustrated, pressure fluid flowing into the grooves *h* will pass through the rearward inlet passages *j* into the rearward end of the piston chamber C to impel the piston D forwardly against the working implement. After the free exhaust port E is covered by the piston D, the air in the front end of the piston chamber C will be compressed and will flow through the inlet passages *k* to act against the rearward pressure surfaces *p* of the valves *o*.

Inasmuch that the rearward pressure surfaces *p* are exposed to pressure over a smaller area than the pressure surfaces *q*, the valves *o* will remain in the rearward positions until the piston D uncovers the free exhaust port E. The pressure fluid in the rearward end of the piston chamber C will then be exhausted to the atmosphere and as a result the pressure acting against the pressure areas *q* will drop considerably below line pressure. When this drop in pressure in the forward side of the valve chamber *d* takes place, the compression, together with the live pressure fluid acting against the rearward pressure areas *p* will throw the valves forwardly to cut off communication between the grooves *h* and the rearward inlet passages *j*.

After the valves *o* have been thus reversed, pressure fluid will flow from the groove *g* over the rearward pressure areas *p* of the valves into and through the inlet passages *k* to the forward end of the piston chamber C to drive the piston D rearwardly to its initial position.

During the rearward stroke of the piston D, the air compressed in the rearward end of the piston chamber C will flow through the inlet passages *j* to act against the pressure areas *q* of the valves *o*. When the piston D reaches a position in which the free exhaust port E will be uncovered the pressure fluid in the front end of the piston chamber will be exhausted to the atmosphere and the pressure acting against the forward pressure surface *q*, such as the live pressure fluid in the grooves *h* and the compression in the inlet passages *j*, will again reverse the valves, thus completing the cycle of operations.

From the foregoing description it will be observed that the valves *o* will move simultaneously in the same direction and that the valves are not actuated by the force of suction of pressure fluid flowing over any portions of the valves but by positive pressure acting against the pressure areas both for throwing the valves and for holding them in the seated positions. This is a highly advantageous feature in valves of the oscillatory plate type since it assures a steady action thereof. It precludes the possibility of trembling of the valves on their seats and therefore prevents the admission of pressure fluid into the pressure chamber in advance of the piston and as a result a full and heavy blow will be struck against the working implement by the piston. This invention also assures an abundant and immediate supply of pressure fluid to both ends of the piston chamber for actuating the piston since, immediately upon the opening of the valve, pressure fluid will be uniformly distributed over the pressure surface of the piston. This results in an increased piston speed and therefore a greater drilling efficiency.

I claim:

1. In a fluid actuated rock drill, the combination of a cylinder and a piston, an exhaust port in the cylinder controlled by the piston, a valve chest for the cylinder having a valve chamber, inlet passages leading from the opposite sides of one end of the valve chamber to the rearward end of the cylinder, inlet passages leading from the opposite sides of the valve chamber to the front end of the cylinder, a plurality of valves in the valve chamber to control the inlet passages and having opposed pressure areas, and front and rear supply passages leading to the front and rear ends of the valve chamber and constantly conveying pressure fluid into the valve chamber to act against the opposed pressure areas for actuating the valves.

2. In a fluid actuated rock drill, the combination of a cylinder and a piston, an exhaust port in the cylinder controlled by the piston, a valve chest for the cylinder having a valve chamber, inlet passages leading from the opposite sides of one end of the valve chamber to the rearward end of the cylinder, inlet passages leading from the opposite sides of the other end of the valve chamber to the front end of the cylinder, a plurality of oscillatory plate valves in the valve chamber to control the inlet passages, trunnions on the ends of the valves seated in the valve chest to act as pivots for the valves, and rear and front supply passages leading to the rear and front ends of the valve chamber and constantly conveying pressure fluid to opposite sides of the valve chamber to actuate the valves and to supply pressure fluid to the inlet passages leading from the same end of the valve chamber wherewith the supply passages communicate.

3. In a fluid actuated rock drill, the combination of a cylinder and a piston, an exhaust port in the cylinder controlled by the piston, a valve chest for the cylinder having a valve chamber, a rearward and a front inlet passage leading from each side of the valve chamber and from opposite ends thereof, to the cylinder, a pair of oscillatory plate valves in the valve chamber to control the inlet passages and having enlarged adjacent ends to divide the valve chamber into a pair of pressure chambers, trunnions on the enlarged ends of the valves seated in the valve chest to act as pivots for the valves, and front and rear supply passages leading to the front and rear ends of the valve chamber constantly conveying pressure fluid into the pressure chambers to act against opposite sides of the valves for actuating the valves and to supply pressure fluid to the inlet passages leading from the same end of the valve chamber wherewith the supply passages communicate.

In testimony whereof I have signed this specification.

WILLIAM A. SMITH, Jr.