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VALVE MECHANISM FOR ROCK DRILLS

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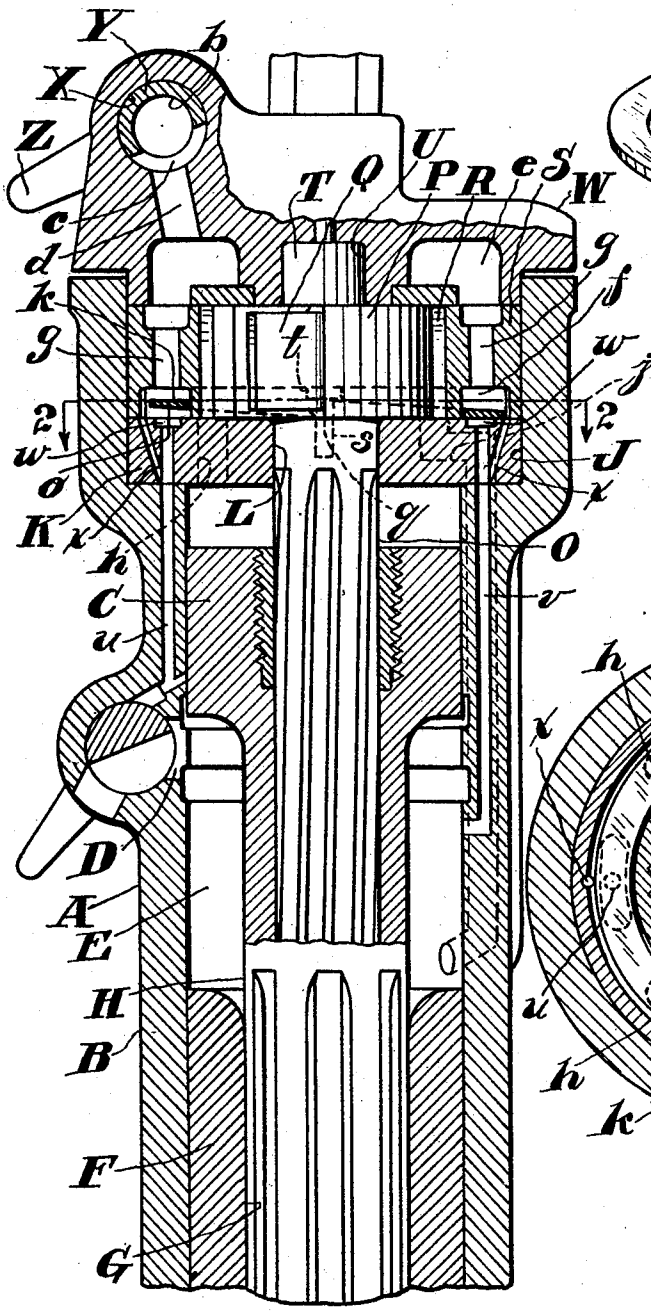


FIG.-1.

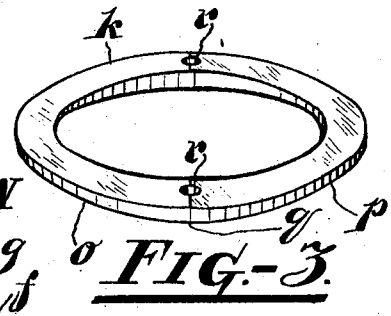


FIG.-3.

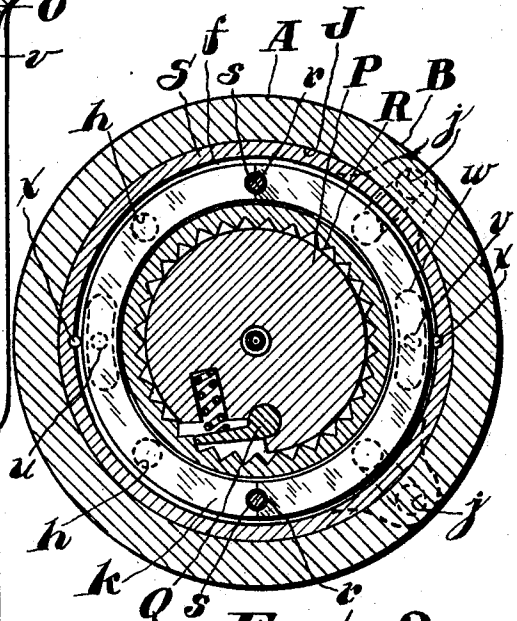


FIG.-2.

INVENTOR.
William A. Smith Jr.
BY Chester A. Adee
HIS ATTORNEY.

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UNITED STATES PATENT OFFICE

WILLIAM A. SMITH, JR., OF PHILLIPSBURG, NEW JERSEY, ASSIGNOR TO INGERSOLL-RAND COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY

VALVE MECHANISM FOR ROCK DRILLS

Application filed September 8, 1928. Serial No. 304,640.

This invention relates to fluid actuated rock drills, but more particularly to an improved valve mechanism used for distributing the pressure fluid to the cylinder of the drill.

The objects of the invention are to accelerate the action of the valve and to assure a positive seating of the valve in its limiting positions.

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

In the drawings accompanying the specification and in which similar reference characters refer to similar parts,

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

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

Figure 3 is a perspective view of one form of valve in connection with which the invention may be used.

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

A closure is provided for the front end of the piston chamber E in the form of a front cylinder washer F having a bore G to slidably receive an extension H of the piston C.

In the rearward end of the cylinder B is formed an enlarged bore J to receive, among other elements, a back cylinder washer K which forms a closure for the rearward end of the piston chamber E. The back cylinder washer K may be held in the bore J in any suitable manner and has an aperture L through which extends a rifle bar O having the usual head P which is seated on the front cylinder washer K and carries spring pressed pawls Q adapted for engagement with teeth R of a rotation ratchet S. The rifle bar O interlocks slidably with the piston C in a well known manner and has a rearward projection T which extends into a bore U of a back head W for centralizing the rifle bar O.

In the form of construction illustrated the rotation ratchet S is seated on the back cylinder washer K and in turn forms a seat for the back head W. The back head W in this instance is provided with a throttle valve chamber X in which is disposed a throttle valve Y having a lever Z whereby said throttle valve may be manipulated. The throttle valve Y is of the rotary type and has a central chamber *b* into which pressure fluid from a suitable source of supply may be constantly admitted. In the wall of the throttle valve Y is a port *c* which, in the open position of the throttle valve, registers with a passage *d* leading to an annular supply reservoir *e* in the forward or innermost end of the back head W.

In addition to the functions described the rotation ratchet S and the back cylinder washer K also serve as a valve chest. The rotation ratchet S is accordingly provided with an annular groove to form a valve chamber *f* which is closed at its front end by the back cylinder washer K.

The admission of pressure fluid into the valve chamber *f* is effected through supply passages *g* in the rotation ratchet and leading from the supply reservoir *e* to the valve chamber *f*.

Leading from the valve chamber *f* through the back cylinder washer K to the rearward end of the piston chamber E is a rearward inlet passage *h* through which pressure fluid is conveyed to the rearward end of the piston chamber for impelling the piston C in a forwardly direction. The back cylinder washer K is further provided with a front inlet passage *j* which leads from the valve chamber *f* through the back cylinder washer K and the cylinder B to the front end of the piston chamber E for conveying pressure fluid thereto to actuate the piston C in a rearwardly direction.

Disposed in the valve chamber *f* is a valve *k* in the form of an oscillatory ring plate having converging seating surfaces *o* and *p* which form at the point of convergence an apex or fulcrum *q* whereon the valve *k* is adapted to rock from one limiting position to another for controlling the admission of

pressure fluid from the valve chamber *f* into the inlet passages *h* and *j*. The valve *k* may be held with its fulcrum *q* on the back cylinder washer K which forms a seat for the valve in any suitable manner. For the purpose of illustrating one mode of holding the valve said valve is provided on opposite sides with holes *r* which lie in the same plane as the fulcrum *q* to receive pins *s* seated in the back cylinder washer K. The pins *s* may be provided with heads *t* to overlie the valve and serve to hold the valve against being lifted bodily by the pressures acting thereagainst for rocking it on the fulcrum *q*.

In valves of the type to which the present invention pertains it is customary to depend both upon compression flowing through the inlet passages and to the suction created by the pressure fluid flowing over the raised end of the valve to oscillate the valve from one limiting position to the other. Although this mode of controlling the action of the valve has generally been highly satisfactory it has been found however, that under certain conditions of operation an erratic action of the piston takes place, for instance, when the working implement against which the piston is adapted to strike changes its position with respect to its holder such as a chuck (not shown) so that it becomes necessary for the piston to travel a greater distance to impact against the working implement, the piston may impact against the end closures of the piston chamber with the result that these parts become damaged or broken.

In order to avoid an occurrence of the kind referred to the drill A is provided with a pair of kicker passages *u* and *v*. The kicker passage *u* in this instance leads from the valve chamber *f* to a point in the piston chamber E rearwardly of the exhaust port D and the kicker passage *v* leads from the valve chamber *f* to a point in the piston chamber E forwardly of the exhaust port D. Preferably, cavities *w* are formed in the back cylinder washer to act as inlet openings for the kicker passages *u* and *v*, and said cavities may be of considerably greater cross sectional area than the kicker passages *u* and *v* so that considerable areas of the seating surfaces *o* and *p* of the valve may be exposed to the pressures which obtain in the kicker passages.

Adjacent the cavities *w* and in the back cylinder washer K are leak passages *x* which open at the rearward ends into the valve chamber *f* at points outside of the range of movement of the valve. The leak passages *x* are angularly disposed with respect to the kicker passages *u* and *v* into which they open so that pressure fluid flowing through said leak passages into the kicker passages and during such times that said kicker passages are in communication with the exhaust port D will create a sub-atmospheric pressure in the portions of the kicker passages adjacent the valve chamber *f* and therefore also beneath the seating surfaces *o* and *p* of the valve.

Arranged in the manner described the leak passages *x* will constantly convey pressure fluid into the kicker passages *u* and *v*. Therefore, when the piston C covers the kicker passages *u* and *v* the pressure fluid leaking through the leak passages *x* will be entrapped in the kicker passages *u* and *v* and will act against the seated ends of the valve *k* to assist in rocking said valve about its fulcrum *q*.

The operation of the device is as follows: With the throttle valve Y in the open position illustrated, pressure fluid may flow through the passage *d* into the supply reservoir *e*, thence through the supply passages *g* into the valve chamber *f*. With the valve *k* in the position illustrated pressure fluid will flow over the raised or left hand end of the valve through the inlet passage *h* into the rearward end of the piston chamber E to impel the piston C forwardly in the direction of the working implement. As the piston C moves forwardly the exhaust port D will be covered thereby and the air compressed in the front end of the piston chamber E will flow through the inlet passage *j* to act against the opposite or seated end of the valve *k*.

During the admission of pressure fluid into the rearward end of the piston chamber, pressure fluid will of course also be present in the kicker passage *u* and when the piston C overruns the exhaust port D such pressure fluid in the kicker passage *u* will escape to the atmosphere through the exhaust port D along with the pressure fluid utilized for actuating the piston C forwardly.

When the piston C covers the kicker passage *v* and immediately prior to the time the piston delivers its blow to the working implement the pressure fluid flowing through the leak passage *x* into the kicker passage *v* will create a pressure in said kicker passage equal to line pressure to act against the seated end of the valve *k*. Such pressure fluid together with the compression flowing through the inlet passage *j* will act against the valve and when a drop in pressure occurs in the rearward end of the piston chamber E due to the exhaust of fluid therefrom the pressures in the inlet passage *j* and the kicker passage *v* will rock the valve *k* to its other limiting position. This shifting of the valve may occur immediately prior or at about the time of delivery of the blow of the hammer piston against the working implement.

After the valve *k* has been reversed in the manner described pressure fluid will flow over the right hand or raised end of the valve through the inlet passage *j* into the front end of the piston chamber E to return the piston C to its initial position. During the time however, that the piston C occupies its fore-

most limiting position in the piston chamber E the pressure fluid leaking through the leak passage x into the kicker passage u will create a sub-atmospheric pressure in the uppermost end of the kicker passage immediately below the seated surface of the valve k, and this reduced pressure will further tend to cause the valve k to remain firmly seated on the back cylinder washer K.

Upon the admission of pressure fluid into the front end of the piston chamber E the piston C will be actuated rearwardly. After the free exhaust port D has been covered by the piston the air in the rearward end of the piston chamber E will be compressed and such compression will flow through the inlet passage h to act against the seated surface of the valve. After the piston C has travelled a sufficient distance in a rearwardly direction to cover the outlet opening of the kicker passage u the pressure fluid flowing through the leak passage x into the said kicker passage u will result in the building of a pressure equal to line pressure beneath the seated end of the valve. By properly proportioning the leak passages x the point in the cycle of operations at which the maximum pressure in the kicker passages u and v will occur may be suitably timed so that the valve k will be tilted to its other limiting position as the piston C nears the end of its stroke. During the rearward stroke of the piston C the kicker passage v will be uncovered thereby and the pressure fluid flowing through the leak passage x into the kicker passage v will then draw a vacuum beneath the seated end of the valve to assist in maintaining the valve firmly on its seat.

I claim:

1. In a fluid actuated rock drill, the combination of a cylinder and a piston, an exhaust port for the cylinder, a valve chest having a valve chamber, inlet passages leading from the valve chamber to the cylinder, an oscillatory plate valve in the valve chamber for controlling the admission of pressure fluid into the inlet passages, kicker passages leading from the valve chamber to the cylinder and controlled by the piston, and leak passages for constantly conveying pressure fluid from the valve chamber into the kicker passages to actuate the valve when the kicker passages are covered by the piston.

2. In a fluid actuated rock drill, the combination of a cylinder and a piston, an exhaust port for the cylinder, a valve chest having a valve chamber, front and rear inlet passages leading from the valve chamber to the front and back ends of the cylinder, an oscillatory plate valve in the valve chamber for controlling the admission of pressure fluid into the inlet passages, front and rear kicker passages leading from the valve chamber to the front and back ends of the cylinder and having their inlet opening at the same end of the valve chamber as the inlet passages leading to the same ends of the cylinder, and leak passages in the valve chest leading from the valve chamber to the kicker passages and constantly conveying pressure fluid into the kicker passages for tripping the valve when the kicker passages are covered by the piston.

3. In a fluid actuated rock drill, the combination of a cylinder and a piston, an exhaust port for the cylinder, a valve chest having a valve chamber, front and rear inlet passages leading from the valve chamber to the front and back ends of the cylinder, an oscillatory plate valve in the valve chamber for controlling the admission of pressure fluid into the inlet passages, front and rear kicker passages leading from the valve chamber to the front and back ends of the cylinder and having their inlet opening at the same end of the valve chamber as the inlet passages leading to the same ends of the cylinder, and leak passages in the valve chest leading from the valve chamber to the kicker passage constantly conveying pressure fluid into the kicker passages for tripping the valve when the kicker passages are covered by the piston, said leak passages being angularly disposed with respect to the kicker passages to direct pressure fluid toward the outlet openings of the kicker passages, thus causing a sub-atmospheric pressure in the portions of the kicker passages adjacent the valve chamber to prevent fluttering of the valve in its limiting positions.

In testimony whereof I have signed this specification.

WILLIAM A. SMITH, JR.