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VALVE FOR ROCK DRILLS

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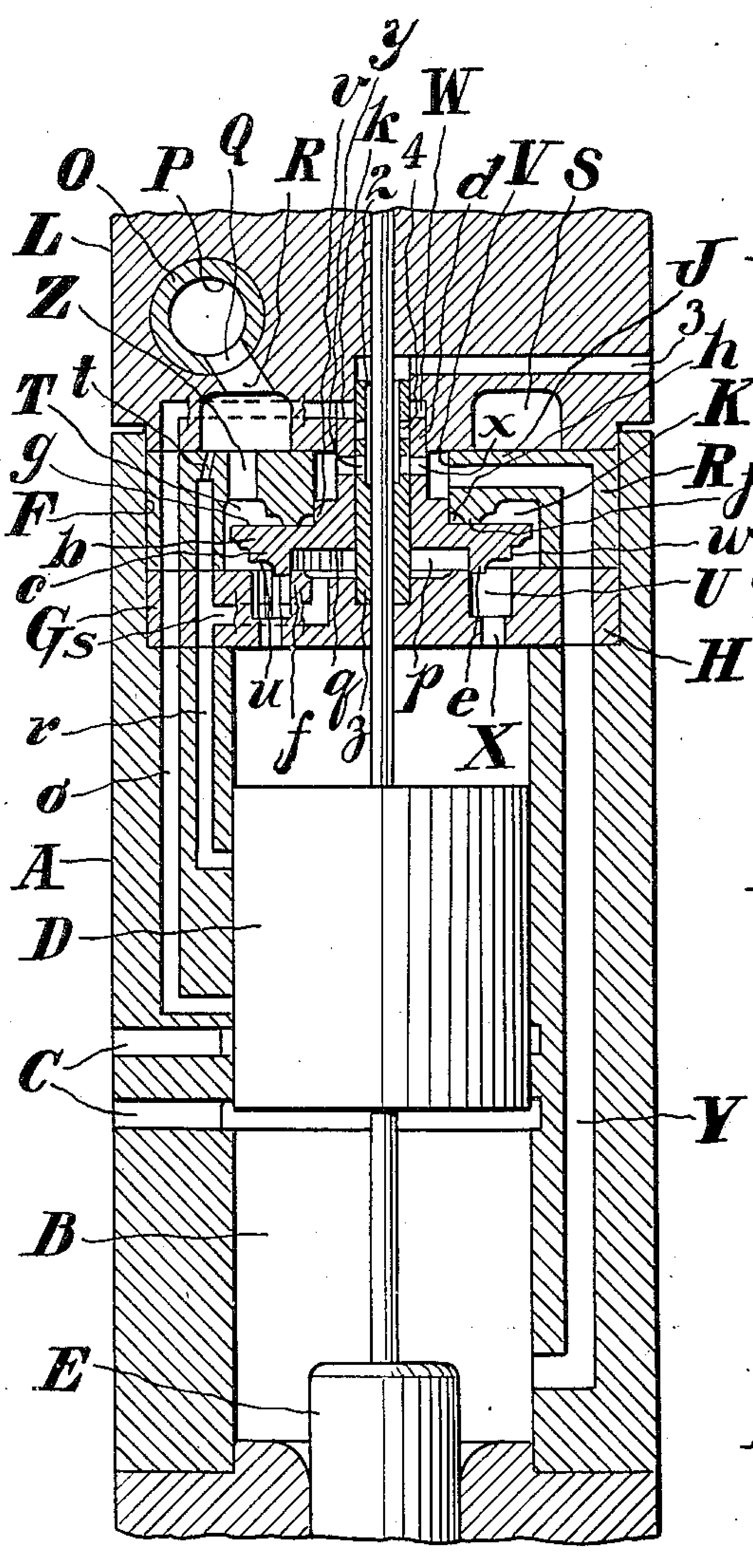

FIG-1.

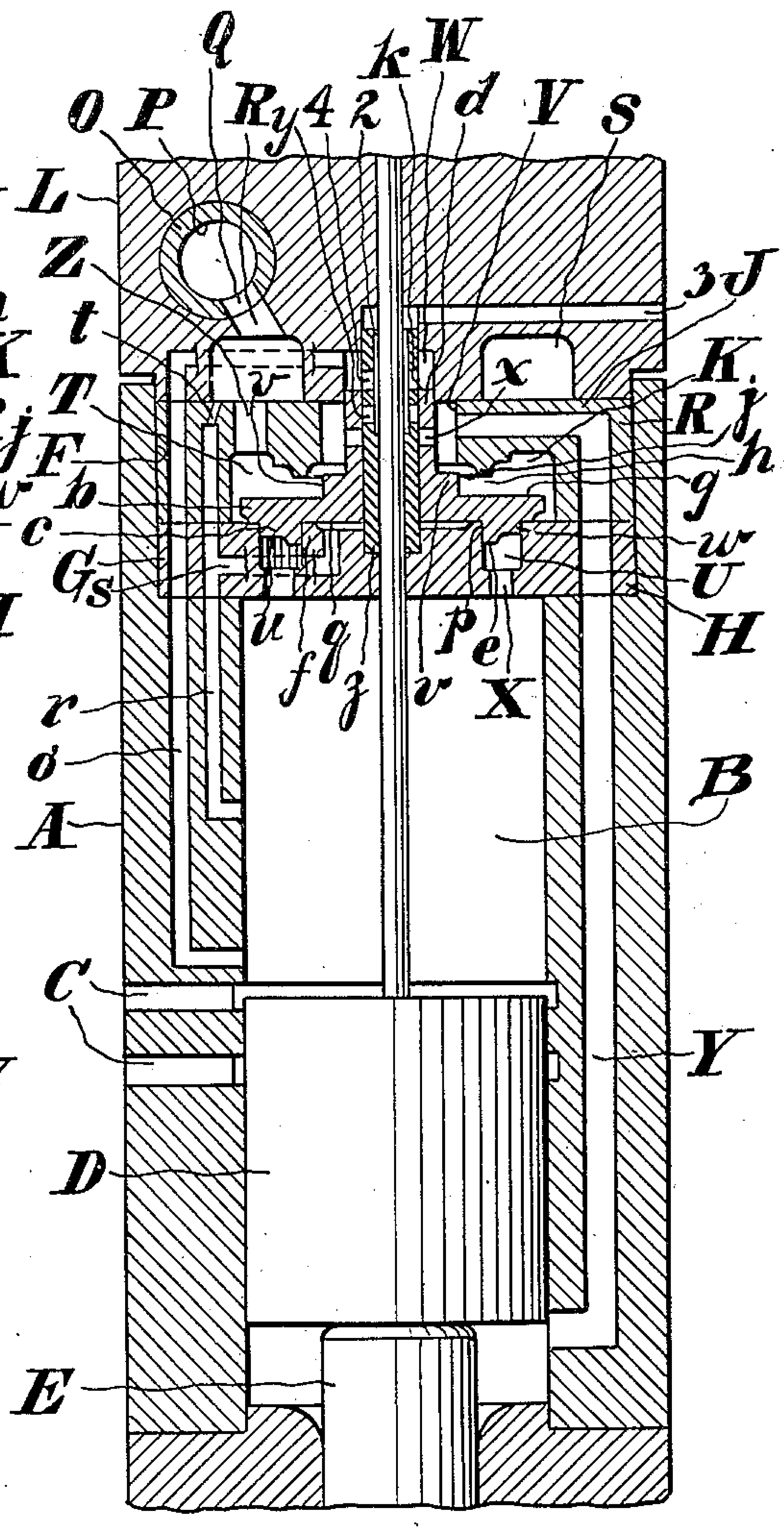

FIG-2.

INVENTOR.
William A. Smith Jr.
BY [signature]
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 FOR ROCK DRILLS

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This invention relates to rock drills, but more particularly to a distributing valve for fluid actuated rock drills of the hammer type.

The objects of the invention are to assure a rapid and positive action of the valve, to reduce the pressure fluid consumption of the drill to which the valve may be applied to a minimum, and to assure a powerful blow of the piston against the working implement.

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

In the drawings illustrating the invention and in which similar reference characters refer to similar parts,

Figure 1 is a sectional elevation of so much of a rock drill as will serve to illustrate the invention and showing the valve in position to admit pressure fluid into the rear end of the cylinder for actuating the piston forwardly, and

Figure 2 is a similar view showing the valve in its other limiting position.

Referrng more particularly to the drawings, A designates a cylinder of a rock drill having a piston chamber B which is provided with a free exhaust port or ports C. Within the piston chamber B is a hammer piston D which controls the exhaust ports C and is adapted to deliver blows of impact to a working implement, only the shank E of which is shown extending into the front end of the piston chamber B.

In the rearward end of the cylinder A is an enlarged bore F to receive a valve chest designated generally by G and comprising a pair of plates H and J which are suitably bored to form a valve chamber K. The plate H in this instance is disposed adjacent the rear end of the piston chamber B to form a closure therefor, and on the plate J is seated a back head L which acts as a closure for the rearward end of the cylinder A.

The back head L also serves as a casing for a throttle valve O having a chamber P which may be in constant communication with a source of pressure fluid supply through a suitable conduit (not shown). In the wall of the throttle valve O is a port Q to register with a passage R in the back head and which passage R leads to a supply reservoir S in the front end of the back head.

In accordance with the present invention the valve chamber K is formed in the plates H and J and in the back head L. The valve chamber K comprises an enlarged portion T which is located in the plate J and at the forward end of the enlarged portion is an annular groove U which opens with its rearward end into the enlarged portion T and is formed in the plate H.

In the plate J and rearwardly of the enlarged portion T wherewith it is arranged coaxially is a reduced bore V forming a part of the valve chamber K, and rearwardly of said bore V and in the back head L is a circular recess W which communicates at its front end with the bore V and forms the portion of minimum diameter of the valve chamber K.

Within the plate H are rear inlet passages X which connect the rear end of the piston chamber B with the annular groove U for conveying pressure fluid to the rear end of the piston chamber to actuate the piston D forwardly.

The pressure fluid utilized for returning the piston D is conveyed to the front end of the piston chamber B by an inlet passage Y which leads from the front end of the piston chamber to the bore V of the valve chamber, and a supply passage Z in the plate J affords constant communication between the supply reservoir S and the enlarged portion T of the valve chamber K.

Disposed within the valve chamber K is a distributing valve *b* having a flange *c* which lies within the enlarged portion T of the valve chamber but is of somewhat smaller diameter than said portion T to enable the pressure fluid to flow around the edge of the flange to the rear inlet passages X. The flange *c* has a rearwardly extending stem *d* which extends slidably into the recess W for guiding the valve.

The valve *b* is further provided with means at its front end to assist in guiding the valve during its reciprocations in the valve chamber. To this end an annular flange *e* is formed at the front end of the flange *c* to slidably engage the periphery of a boss *f* in the plate H and which boss forms the inner bounding surface of the annular groove U.

The rearward end of the flange *b* constitutes a pressure surface *g*, against an outer annular portion of which pressure fluid constantly acts tending to throw the valve forwardly. An inner annular portion *h* of the pressure surface *g* is intermittently exposed to pressure fluid to assist in holding the valve in its foremost limiting position. This inner annular portion *h* is determined by a ring *j* on the plate J which forms an abutment for the flange *c* to limit the rearward travel of the valve *b*.

In order to assist the pressure fluid acting against the pressure surface *g* to actuate the valve *b* forwardly the stem *d* of the valve is provided at its rear end with an actuating surface *k* which is adapted to be intermittently exposed to pressure fluid. Such pressure fluid is conveyed into the rear end of the recess W by a kicker passage *o* which opens with its inlet end into the piston chamber B at a point rearwardly of the exhaust ports C and is controlled by the piston D.

Within the forward end of the valve *b* and formed by the annular flange *e* is a chamber *p*, the end wall of which chamber constitutes an actuating surface *q* of larger area than the actuating surface *k*. This actuating surface *q* is intermittently exposed to pressure fluid for throwing the valve rearwardly. The pressure fluid utilized for this purpose is conveyed to the chamber *p* by a trip passage *r* which leads from the rearward end of the piston chamber B to the supply reservoir S and has a branch *s* which affords constant communication between the trip passage *r* and the chamber *p*. Preferably the communication between the trip passage *r* and the supply passage S is effected through a restricted passage *t* in the plate J.

On the forward end of the annular flange *e* is a pressure surface *u* which is adapted to be intermittently exposed to compression from the rear end of the piston chamber B to assist in throwing the valve *b* rearwardly.

Means are provided to assure an early cut off of the pressure fluid to the ends of the piston chamber, that is, to effect a cut off of the pressure fluid at the instant the piston D starts to uncover the exhaust ports C. To this end the valve *b* is provided with a shoulder *v* which is adapted to extend slidably into the bore V to cut off the flow of pressure fluid from the enlarged portion T to the inlet passage Y shortly before the flange *c* of the valve seats against the ring *j*. Similarly, on the annular flange *e* is a shoulder *w* which cooperates with the outer periphery of the annular groove U to cut off the admission of pressure fluid into said annular groove shortly before the valve *b* reaches its foremost limiting position.

To the end that the piston D may deliver a powerful blow against the working implement unhampered by compression in the front end of the piston chamber B the stem *d* of the valve is provided with a port or ports *x* which are in constant communication with the bore V and therefore with the inlet passage Y. The ports *x* are adapted to register with ports *y* in a plug *z* which extends through the valve *b* and is seated with its rear end in the back head L and with its forward end in the plate H. The plug *z* is provided with a passage 2 wherewith the ports *y* communicate and said passage opens with its rearward end into an exhaust passage 3 in the back head L and leading to the atmosphere.

In order to provide an outlet for the pressure fluid admitted to the actuating surface *k* after the valve *b* has been moved forwardly the plug *z* is provided with the port or ports 4 which are controlled by the rear end of the stem *d* of the valve. The ports 4 are located rearwardly of the port *y* and also open into the passage 2 in the plug *z*.

The operation of the device is as follows: With the valve in its rearmost position as illustrated in Figure 1, pressure fluid will flow from the enlarged portion T of the valve chamber around the edge of the flange *c* into and through the annular groove U and the inlet passages X into the rear end of the piston chamber to drive the piston D forwardly.

It will be observed that while the piston D is in the rearmost position it will cover the trip passage *r* or that pressure fluid flowing thereinto will enter the chamber *p* through the branch *s* and will act against the actuating surface *q* to maintain the valve in the position stated.

As the piston D proceeds forwardly and shortly prior to the uncovering of the exhaust ports C thereby, the said piston will uncover the kicker passage *o* to admit pressure fluid into the rearward end of the recess W to act against the actuating surface *k*. The pressure fluid thus admitted to the actuating surface *k* together with that acting against the pressure surface *g* combine with the force of the suction created by the pressure fluid on the edge of the flange *c* to throw the valve *b* forwardly at the instant the piston D starts to uncover the exhaust port C, thus preventing an escape of pressure fluid directly from the source of supply through the piston chamber to the atmosphere.

With the drop in pressure in the rearward end of the piston chamber the pressure within the chamber *p* will of course also be reduced so that the opposing pressures may readily actuate the valve *b* forwardly. As the valve b approaches its foremost position the rear end of the stem d will uncover the ports 4 so that the pressure fluid acting against the actuating surface k may escape through the said ports 4 into the passage 2 and thence through the passage 3 to the atmosphere.

After the valve has been shifted to the new position described, pressure fluid will flow over the pressure surface g into the bore V and thence through the inlet passage Y to the front end of the piston chamber to actuate the piston rearwardly. When the piston reaches a position to form a closure for the trip passage r pressure fluid leaking thereinto will flow into the chamber p and will act against the actuating surface q tending to throw the valve rearwardly.

As the piston proceeds rearwardly it will uncover the exhaust port C so that the pressure fluid may exhaust from the front end of the piston chamber to the atmosphere and in consequence there will be a drop in pressure rearwardly of the flange c. At the same time the air in the rear end of the piston chamber B will be compressed by the piston and will act against the pressure surface u. Such compression, together with the pressure fluid acting against the actuating surface q, will then return the valve b to its initial position.

I claim:

1. In a fluid actuated rock drill, the combination of a cylinder and a piston therein, an exhaust port for the cylinder controlled by the piston, a valve chest having a valve chamber, inlet passages leading from the valve chamber to the cylinder, a distributing valve in the valve chamber comprising a flange over which pressure fluid flows to one inlet passage, a pressure surface on the flange constantly exposed to pressure fluid tending to throw the valve in one direction, an actuating surface on the valve intermittently exposed to pressure fluid to assist the pressure fluid acting against the pressure surface in throwing the valve, an opposed actuating surface on the valve intermittently exposed to pressure fluid for throwing the valve in the opposite direction, passages controlled by the piston for delivering pressure fluid to the actuating surfaces, and means on the valve to effect an early cut off of pressure fluid to the cylinder.

2. In a fluid actuated rock drill, the combination of a cylinder and a piston therein, an exhaust port for the cylinder controlled by the piston, a valve chest having a valve chamber, inlet passages leading from the valve chamber to the cylinder, a distributing valve in the valve chamber comprising a flange over which pressure fluid flows to one inlet passage, a pressure surface on the rear end of the flange constantly exposed to pressure fluid tending to throw the valve forward, an actuating surface on the valve intermittently exposed to pressure fluid to assist in throwing the valve forward, an opposed actuating surface on the front end of the valve intermittently exposed to pressure fluid for throwing the valve rearward, passages controlled by the piston for delivering pressure fluid to the actuating surfaces, and shoulders of the valve cooperating with the valve chamber to cut off the admission of pressure fluid to the cylinder.

3. In a fluid actuated rock drill, the combination of a cylinder and a piston therein, an exhaust port for the cylinder controlled by the piston, a valve chest having a valve chamber, rear and front inlet passages leading from the valve chamber to the cylinder, a distributing valve in the valve chamber comprising a flange over which pressure fluid flows to the rear inlet passage, a pressure surface on the rear end of the flange constantly exposed to pressure fluid tending to throw the valve forward, a rearwardly extending stem on the valve having an actuating surface against which pressure fluid intermittently acts to assist in throwing the valve forward, an actuating surface on the front end of the valve against which pressure fluid intermittently acts for throwing the valve rearward, passages controlled by the piston for delivering pressure fluid to the actuating surfaces, shoulders on the valve cooperating with the valve chamber to cut off the admission of pressure fluid to the cylinder at the instant of uncovering of the exhaust port by the piston, and ports and passages controlled by the valve for relieving compression from the front end of the cylinder.

4. In a fluid actuated rock drill, the combination of a cylinder and a piston therein, an exhaust port for the cylinder controlled by the piston, a valve chest having a valve chamber, front and rear inlet passages leading from the valve chamber to the cylinder, a valve in the valve chamber comprising a flange over which pressure fluid flows to the rear inlet passage, a pressure surface on the rear end of the flange constantly exposed to pressure fluid tending to throw the valve forward, an actuating surface on the rear end of the valve intermittently exposed to pressure fluid to assist in throwing the valve forward, a kicker passage leading from the cylinder to the valve chamber to deliver pressure fluid to the actuating surface and controlled by the piston, an actuating surface on the front end of the valve, a trip passage affording communication between the cylinder and a source of pressure supply and having a branch for delivering pressure fluid to the second said actuating surface, a pressure surface on the front end of the flange intermittently exposed to compression to assist in throwing the valve rearward, shoulders on the opposite ends of the flange

cooperating with the valve chamber to cut off the flow of pressure fluid to the cylinder at the instant of uncovering of the exhaust port by the piston, and ports and passages controlled by the valve for relieving compression from the front end of the cylinder.

In testimony whereof I have signed this specification.

WILLIAM A. SMITH, Jr.