W. A. SMITH.

ROCK DRILL.

APPLICATION FILED AUG. 13, 1920.

1,414,224.

Patented Apr. 25, 1922.

2 SHEETS—SHEET 1.

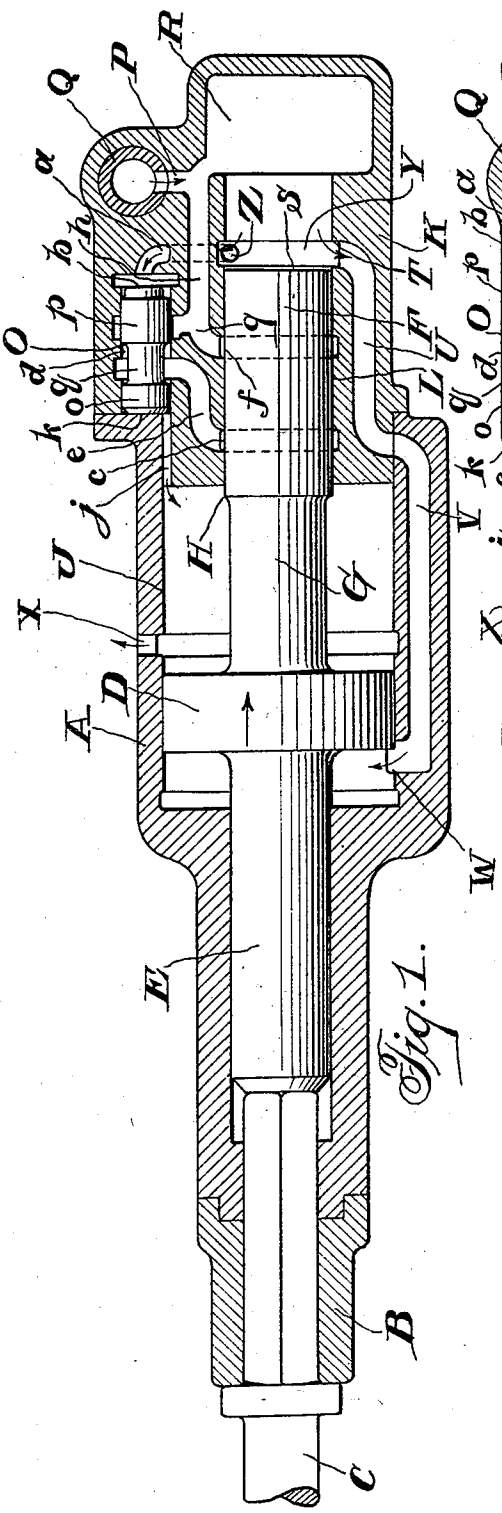


Fig. 1.

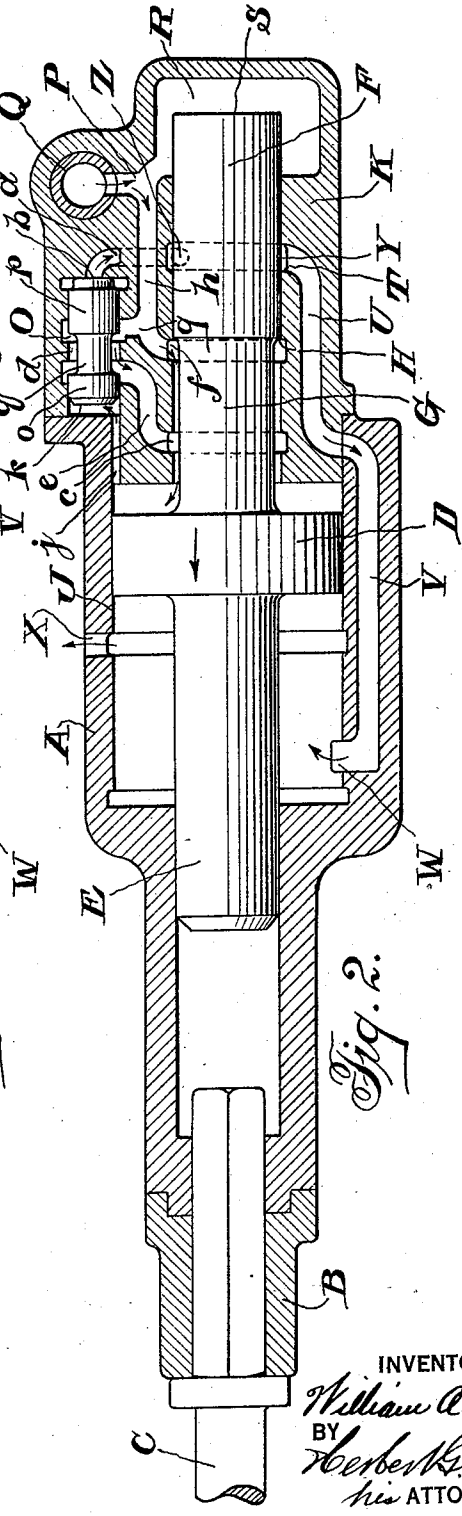


Fig. 2.

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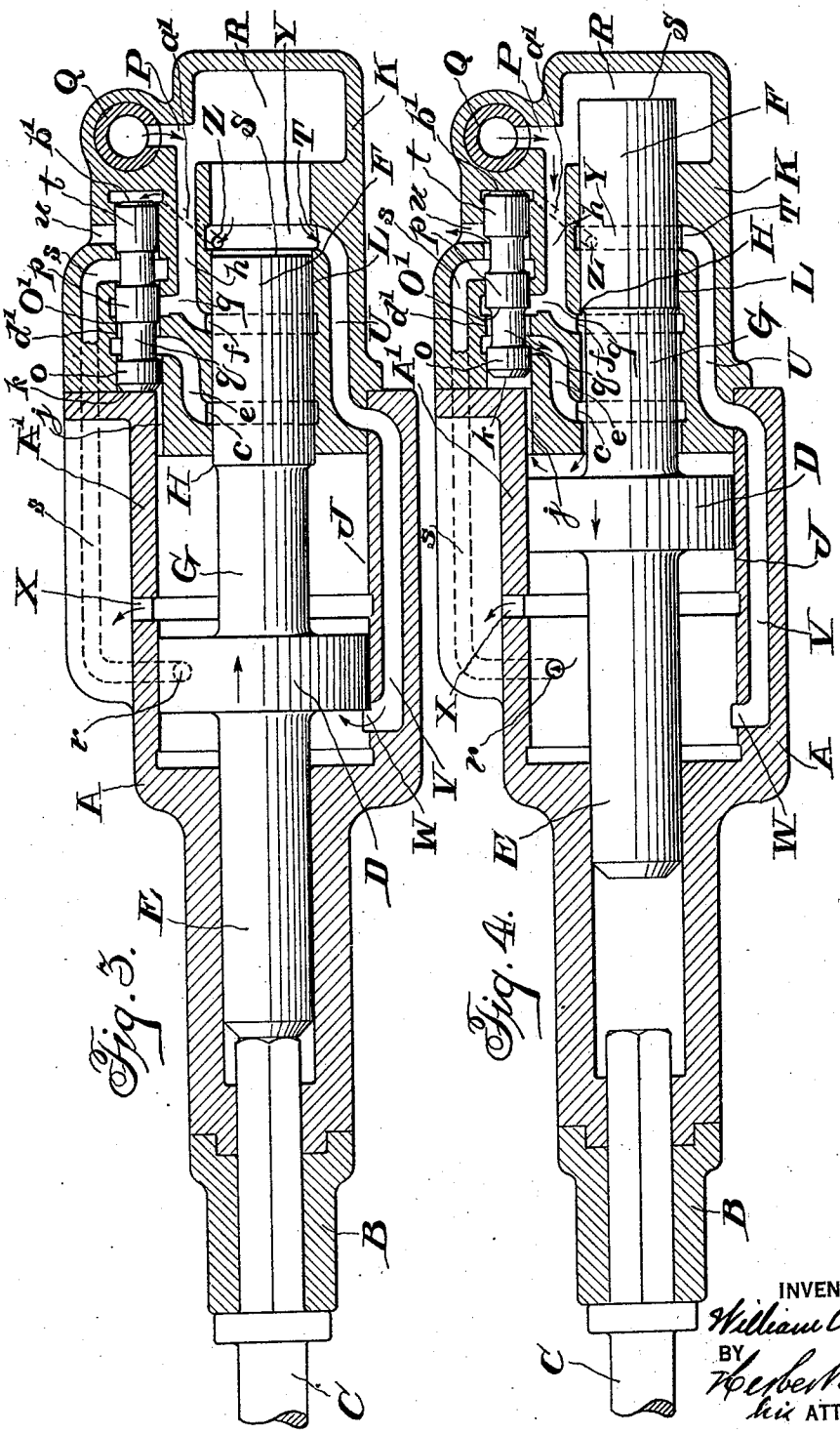


Fig. 3.

Fig. 4.

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UNITED STATES PATENT OFFICE.

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

ROCK DRILL.

1,414,224. Specification of Letters Patent. Patented Apr. 25, 1922.

Application filed August 13, 1920. Serial No. 403,351.

To all whom it may concern:

Be it known that I, WILLIAM A. SMITH, a citizen of the United States, and a resident of Phillipsburg, county of Warren, State of New Jersey, have invented certain new and useful Improvements in Rock Drills, of which the following is a specification.

This invention relates to fluid pressure operated drills of the hammer type, but more particularly to a rock drill of such type having a differential piston provided with a main head and forwardly and rearwardly extending shanks or extensions, with a constant pressure chamber exerting constant pressure upon the rear end of the rearwardly extending shank.

In a drill of this class the fluid pressure is distributed to the front and rear ends of the main cylinder bore in front of and behind the main piston head in any suitable manner, and in the present instance this distribution is controlled partly by the rearwardly extending piston shank and partly by an automatic valve so that the machine may be termed a semi-valveless rock drill.

The primary object of the invention is to produce late admission of the actuating fluid or live air pressure against the rear surface of the main head on the rearward stroke, in order to afford as long back travel for the piston as possible, and produce a late cut-off on the forward stroke. By producing as long admission of air as possible against the rear pressure surface of the main piston head, I am enabled to take advantage of the full power of the piston hammer.

The invention is illustrated in the accompanying drawings which show two preferred forms of the machine.

Figures 1 and 2 are diagrammatic longitudinal sectional elevations of a rock drill embodying the invention, showing the piston hammer in two different positions, and

Figures 3 and 4 are similar views of a modification showing the piston hammer in two different positions.

Referring to the drawings, A represents the cylinder of a rock drill having the chuck B through which the drill steel C is inserted in the usual manner in position to receive the impact blows of the reciprocating piston hammer, which comprises the main piston head D having the forwardly extending reduced shank E and the rearwardly extending shank F provided with the reduced neck G forming the shoulder H with the shank portion F of full diameter.

The main piston head D reciprocates within the larger bore J of the cylinder and the cylinder is provided with a back cylinder portion or back head K having a bore L of smaller diameter to receive the piston shank F. The cylinder A and the back head K are provided with a suitable arrangement of ports and passages partly controlled by the piston and partly controlled by a valve O for distributing fluid pressure to the different portions of the cylinder for actuating the piston.

Actuating fluid as air under pressure is admitted at the inlet port P and controlled by the usual throttle valve Q. The chamber R at the rear of the back head K is under constant pressure as shown so that pressure is constantly exerted on the pressure surface S of the rearwardly extending piston shank. The actuating fluid passes from the constant pressure chamber R through the port T and the passage U in the back head K registering with the passage V in the cylinder A out through the port W to the forward end of the main cylinder bore J in front of the main piston head D and the cylinder is provided with the exhaust port X. The passages U and V also form an exhaust passage on the forward stroke of the piston because the passage U communicates by means of the annular groove Y with the port Z opening from the passage *a* leading to the rear pressure surface *b* of the valve O. This pressure surface *b* is obviously subject to a fluctuating pressure in the operation of the valve.

The supply of fluid pressure to the rear end of the main cylinder bore J behind the main piston head D is controlled partly by the shoulder H of the piston shank F and partly by the valve O, and the manner in which this control is effected forms one of the principal features of this invention. As shown a forward admission port *c* opens into the smaller bore L of the cylinder casing and communicates with the valve chamber *d* of the valve O by means of the forward passage *e*. Another rearward admission port *f* communicates with the valve chamber *d* by means of the rearward passage *g* and also communicates with the con-

stant pressure R by means of the passage *h*. A port *j* in the back head K between the main cylinder bore J and the forward end of the valve chamber *d* subjects the forward pressure surface *k* of the valve O to a fluctuating pressure in the operation of the machine.

The valve O may be of any suitable form but is conveniently provided with a front head *o* and a rear head *p* connected by the reduced neck *q* and the function of this valve is to control communication between the forward admission passage *e* and the rearward admission passage *g* in order to produce a late admission of fluid pressure against the rear pressure surface of the main head D on the rearward stroke and prolong the admission. The piston thus has a long back travel, longer than customary in rock drills of this type and has a later cut-off on the forward stroke.

In the operation of the machine, let it be assumed that the piston is at the forward end of its stroke and is about to start on the back stroke as indicated in Figure 1. The cylinder is shown exhausting through the exhaust port X and pressure is also exhausted from the front of the valve O through the port *j*. The live pressure on the rear surface *b* of the valve O has caused the valve to throw over or move to its forward position as indicated in Figure 1, closing communication between the forward and rearward admission passages *e* and *g*.

The piston is ready for the rearward stroke by the admission of fluid under pressure to the front end of the cylinder through the passages U and V from the constant pressure chamber R. As the piston travels back, the exhaust port X to the back of the main head D is closed and the admission port T to the forward end of the cylinder and the port Z to the rear end *b* of the valve O are closed, but the shoulder H at the neck of the piston over-runs the forward admission port *c*, without admitting pressure to the rear surface of the main head D, because the forward admission passage *e* is still closed by the valve O.

After the main head D over-runs the cylinder exhaust port X, the exhaust from the forward end of the cylinder is opened, which also opens the rear end *b* of the valve O to exhaust through the passage *a*, port Z, annular groove Y and passages U and V to and through the forward end of the cylinder. The shoulder H on the neck of the piston then over-runs the rearward admission port *f*, which admits pressure past the piston neck G to the rear of the larger bore J of the cylinder, and also through the port *j* to the front end *k* of the valve O, which throws the valve to its rear position indicated in Figure 2, thus opening communication between the forward and rearward admission passages *e* and *g*, and supplying full pressure behind the main head D to drive the piston forward.

Owing to the fact that no pressure is supplied to the rear of the main cylinder head D when the forward admission port *c* is uncovered by the piston shoulder H, the piston has a substantially long rearward stroke, before the forward and rearward admission passages *e* and *g* are placed in communication by the action of the valve O, and on the other hand, the piston is given a late cut-off on the forward stroke, because cut-off does not take place when the rearward admission port *f* is over-run by the piston shoulder H, but is delayed until the forward admission port *c* is over-run by the piston as indicated in Figure 1.

The construction shown in Figures 3 and 4 is substantially the same as shown in Figures 1 and 2 except that an additional anti-compression or reliever port *r* is provided and the forward end of the cylinder communicates by means of the passage *s* with the valve chamber *d'*, to relieve compression after the piston closes the main exhaust port X. The valve O' is provided with an additional auxiliary head *t*, the rear surface *b'* of which is subjected to a fluctuating pressure through the passage *a'*, and the auxiliary head *t* controls an atmospheric port *u* communicating with the valve chamber and the reliever port passage *s*. The anti-compression or reliever port *r* is over-run and closed by the piston before the admission of fluid pressure to the front end of the main cylinder bore J. When the valve O' is thrown to its forward position as shown in Figure 3, communication is cut off between the reliever port *r* and the atmosphere by means of the head *t*.

I claim:

1. In a fluid operated rock drill of the hammer type, the combination of a cylinder and a differential piston subject to constant pressure on one of its forwardly acting pressure surfaces, means controlled by the piston for supplying motive fluid to the rearwardly acting pressure surface of the piston, a forward admission port and an admission port rearward of said forward admission port for supplying motive fluid to the other forwardly acting pressure surface of the piston and a fluid actuated valve for controlling communication between forward and rearward admission passages leading to said forward and rearward admission ports.

2. In a fluid operated rock drill of the hammer type, the combination of a cylinder and a differential piston subject to constant pressure on one of its forwardly acting pressure surfaces, means controlled by the piston for supplying motive fluid to the rearwardly acting pressure surface of the piston, a forward admission port and an admission port

rearward of said forward admission port for supplying motive fluid to the other forwardly acting pressure surface of the piston and a fluid actuated valve subject to fluctuating pressure on opposed operative surfaces, for controlling communication between forward and rearward admission passages leading to said forward and rearward admission ports.

3. In a fluid operated rock drill of the hammer type, the combination of a cylinder and piston, means controlled by the piston for supplying motive fluid to the forward end of the cylinder, and an exhaust port and an anti-compression port for the cylinder, a forward admission port and another admission port rearward of said forward admission port for supplying motive fluid to the rearward end of the cylinder, and a fluid actuated valve for controlling communication between forward and rearward admission passages leading to said forward and rearward admission ports and for controlling communication between said anti-compression port and the atmosphere.

4. In a fluid operated rock drill of the hammer type, the combination of a cylinder and a piston, means controlled by the piston for supplying motive fluid to the forward end of the cylinder, and an exhaust port and an anti-compression port for the cylinder, a forward admission port and another admission port rearward of said forward admission port for supplying motive fluid to the rearward end of the cylinder, and a fluid actuated valve subject to fluctuating pressure on opposed operative surfaces for controlling communication between forward and rearward admission passages leading to said forward and rearward admission port and for controlling communication between said anti-compression port and the atmosphere.

In testimony whereof I have signed this specification.

WILLIAM A. SMITH.