May 30, 1933. A. S. UHLER ET AL 1,911,978

ROCK DRILL

Filed Sept. 22, 1931

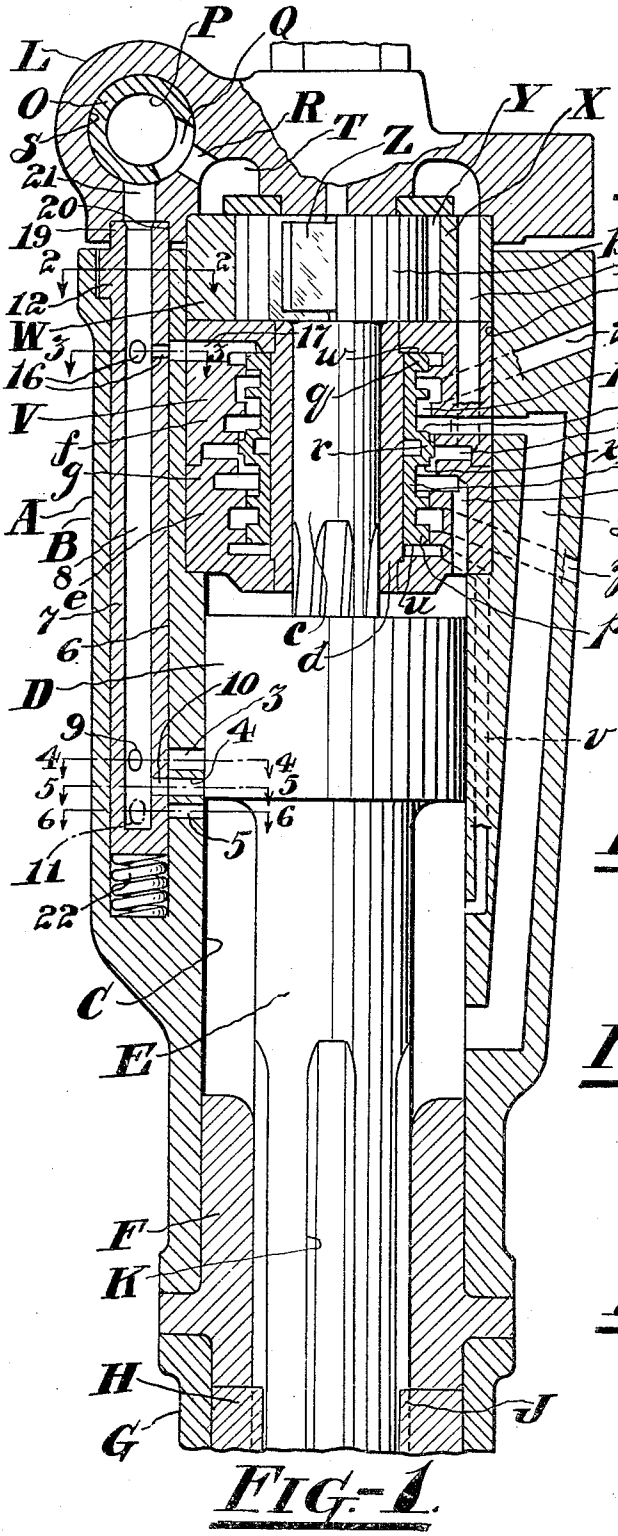


FIG.-1.

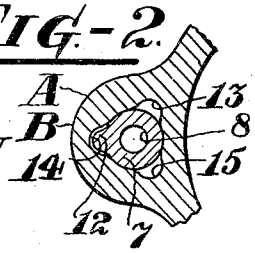


FIG.-2.



FIG.-3.

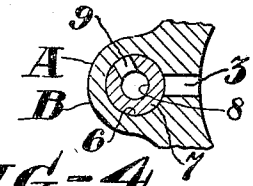


FIG.-4.

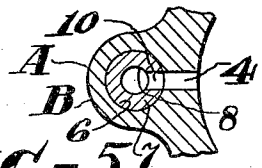


FIG.-5.

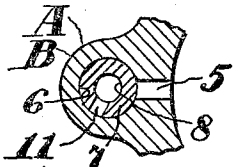


FIG.-6.

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UNITED STATES PATENT OFFICE

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ROCK DRILL

Application filed September 22, 1931. Serial No. 564,284.

This invention relates to fluid actuated rock drills, and more particularly to rock drills of this type wherein the pressure fluid for actuating the valve is conveyed thereto by a passage or passages controlled by the piston so that, in consequence, the valve and the piston move in nicely timed relation with respect to each other.

One object of the invention is to vary the relative movements of the valve and the piston.

Another object is to vary the force of the blow of the piston so that either a light blow or a heavy blow may be delivered to the working implement which the piston is intended to actuate.

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

In the drawing accompanying this specification and forming a part thereof and in which similar reference characters refer to similar parts,

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

Figures 2, 3, 4, 5 and 6 are transverse views taken through Figure 1 on the lines 2—2, 3—3, 4—4, 5—5 and 6—6 respectively, and looking in the directions indicated by the arrows.

Referring more particularly to the drawing, A designates in general a rock drill comprising a cylinder B having a piston chamber C therein to accommodate a reciprocatory hammer piston D. The piston D is shown provided with the usual forward extension or stem E which is guided by a front cylinder washer F which serves as a closure for the front end of the piston chamber C and also to centralize a front head G with respect to the cylinder B.

Within the front head G may be arranged the usual chuck mechanism, only a portion of which is shown and designated by H, and having ribs J therein to engage flutes K in the stem E for maintaining the piston and the chuck mechanism H against relative rotary movement.

The front head G may be clamped to the cylinder B in any well known manner as may be also a back head L which is arranged at the rear end of the cylinder B. The back head L, among other functions, serves as a housing for a throttle valve O shown as having a central chamber P which may be in constant communication with a source of pressure fluid supply. The throttle valve O is preferably of the rotary type and has a port Q in its wall to register with a passage R in the back head L and opening at one end into the chamber S wherein the valve O lies and with its other end into a supply reservoir T in the inner or front end of the back head L.

In the rear end of the cylinder B is a bore U of somewhat larger diameter than the piston chamber C and disposed therein is valve mechanism designated in general by V and rotation mechanism designated in general by W.

The rotation mechanism may be of a well known type comprising a ratchet ring X disposed in the extreme rear end of the bore U and serving in this instance as a seat for the back head L. On the inner surface of the ratchet ring X are the usual introverted teeth Y to act as abutments for pawls Z carried by a head *b* of a rifle bar *c*.

The rifle bar *c* extends in the present instance through the valve mechanism V to interlockingly engage the piston D in a well known manner. A bearing is provided for that portion of the rifle bar *c* which lies within the valve mechanism by a bushing *d* which is suitably supported by the valve mechanism V and serves an additional function of preventing unauthorized passage of pressure fluid from the valve mechanism along the rifle bar into the piston chamber C.

The specific type of valve mechanism selected to illustrate the invention and its operation comprises a valve chest *e* which consists in this instance of a pair of plugs or plates *f* and *g*. The plate *g* is arranged on the bottom of the bore U adjacent the rear end of the piston chamber C for which it serves as a closure, and the plate *f* is seated on the rear end of the plate *g* and acts as a seat for the ratchet ring X and the head *b* of the rifle bar *c*.

The plates *f* and *g* may be held in the correct assembled position with respect to each other and adjacent elements in any suitable and convenient manner to assure fixed registration of the ports and passages therein with such ports and passages of adjacent elements wherewith they are intended to communicate.

In the plates *f* and *g* is a valve chamber *h* for which the bushing *d* forms an inner bounding surface. The bushing *d* may, moreover, serve as a bearing surface for a distributing valve *j* disposed in the valve chamber *h* to effect the distribution of pressure fluid to the piston chamber C. Such pressure fluid is conveyed to an intermediate portion of the valve chamber *h* by a supply passage *k* extending through the ratchet ring X and the plate *f* and opening into an annular groove *o* in the plate *f* and which groove communicates at its inner extremity with the valve chamber *h*.

The valve *j* which is of the sleeve type is provided with heads *p* and *q* at its front and rear ends respectively and with an intermediate flange *r* which is preferably of slightly larger diameter than the heads *p* and *q* and is adapted to move across the annular groove *o* to control the flow of pressure fluid from said groove to the opposite sides of the flange *r*. The arrangement is such that when the valve occupies its foremost position pressure fluid will flow over the rear surface of the flange *r* to a front inlet passage *s* which leads to the front end of the piston chamber C. When the valve *j* occupies its rearmost position pressure fluid flows from the groove *o* over the front surface of the flange *r*, thence to a rear inlet passage or passages *t* which lead from the valve chamber *h* to the rear end of the piston chamber C.

The front end of the valve *j* and therefore also of the head p constitutes an actuating surface *u* which is intermittently subjected to pressure fluid for actuating the valve rearwardly. The pressure fluid employed for this purpose is conveyed into the front end of the valve chamber *h* by a kicker passage *v* which opens into the piston chamber C at a point forwardly of its transverse median line.

The rear end of the valve *j* and of the head *q* also serves as an actuating surface *w* against which pressure fluid valved by the pistion D may intermittently act for throwing the valve forwardly. The front and rear surfaces of the flange *r* constitute holding surfaces *x* and *y* respectively against which the pressure fluid flowing thereover may act to maintain the valve in its limiting positions.

Preferably the drill is provided with atmospheric vents or exhaust passages *z* and 2 for exhausting the fluid, utilized for actuating the piston, to the atmosphere. The passages *z* and 2 lead in this instance from the valve chamber *h* to the atmosphere. The passage designated *z* communicates with the valve chamber at a point intermediate the flange *r* and the head *p*, and the passage designated 2 communicates with the valve chamber at a point rearwardly of the flange *r* and forwardly of the head *q*.

In accordance with the practice of the invention means are provided to selectively retard or advance the movement of the valve *j* with respect to the cycle of movement of the piston D and, in consequence thereof, to assure the delivery of either a light or a heavy blow of the piston D against the working implement. To this end the cylinder B is provided with a plurality of openings or ports, in this instance three, designated by 3, 4 and 5 and all of which are arranged rearwardly of the transverse median line of the piston chamber C. The ports 3, 4 and 5 are suitably spaced with respect to each other along the length of the piston chamber C. They open with their outer ends into a bore 6 in the cylinder B and wherein is disposed a plug 7 having a passage 8 therein which opens from the rear end of the plug 7 and extends to a point near the front end of the plug.

In the plug 7 and near the front end of the passage 8 are ports 9, 10 and 11 which are adapted to register with the ports 3, 4 and 5 respectively. The ports 9, 10 and 11 lie in different radial planes with respect to each other so that in one position of the plug 7 the port 9 may register with the port 3, while in another position of the plug communication will be cut off between the ports 9 and 3 and the port 10 may then be in registration with the port 4. In still another position of the plug 7 the ports 9 and 10 may be out of registration from the ports 3 and 4 and the port 11 registers with the port 5.

The means provided for assuring registration between the ports in the plug 7 and the ports in the cylinder B consist of a prominence or lug 12 preferably arranged near the rear end of the plug 7 and adapted to seat in notches 13, 14 and 15 in the rear end of the cylinder B, said notches being in this instance spaced equi-distantly with respect to each other.

The plug 7 is further provided with a plurality of ports 16 which are spaced equidistantly with respect to each other and lie in the same transverse plane. These ports 16 also lie in the same transverse plane as a passage 17 in the plate *f* and which passage opens into the rear end of the valve chamber *h*. Preferably the cylinder B is provided with an atmospheric vent 18 so arranged that when either of the ports 16 is in regis-

try with the passage 17 another port 16 will register with the said vent.

As a preferred means of construction the plug 7 is provided with a projection 19 rearwardly of the lug 12 and fitting snugly into a bore 20 in the front surface of the back head L. In this way a correct seal will be provided to prevent leakage of pressure fluid from the passage 8 to the atmosphere. This arrangement, moreover, enables the passage 8 to be placed in direct communication with a passage 21 in the back head L and opening into the chamber S so that, upon rotating the throttle valve O, the port Q therein may be brought into registry with the passage 21 for admitting pressure fluid directly from the throttle valve into the piston chamber C.

In order to maintain the rear end of the plug 7 tightly seated against the bottom of the bore 20 a spring 22 is disposed in the front end of the bore 6 to exert a pressure against the plug 7.

The operation of the device is as follows: With the valve *j* and the piston D in the positions illustrated in Figure 1 pressure fluid flowing from the supply reservoir T into the annular groove *o* flows over the holding surface *x* of the flange *r*, thence through the inlet passage *t* into the rear end of the piston chamber C to drive the piston D forwardly on its working stroke. As the piston proceeds in the forwardly direction it will uncover a port, either 3, 4 or 5, depending upon which of these ports is in registry with a port in the plug 7. In Figure 1 the port 4 is thus shown as being in registry with the port 10 in the plug.

Upon uncovering, therefore, of port 4 by the piston a portion of the pressure acting against the piston will flow through the said ports 4 and 10, thence through the passage 8 to a port 16 and the passage 17 into the rear end of the valve chamber to throw the valve *j* forwardly.

Prior to this actuation of the valve, however, the valve is held in its rearmost limiting position by the pressure fluid flowing over the holding surface *x*. A further unbalancing effect of the valve will also be assured by the fact that the front end of the valve chamber *h* and wherein the actuating surface *u* lies will then be open to the atmosphere through the kicker passage *v*, the front end of the piston chamber, the inlet passage *s*, the portion of the valve chamber *h* rearwardly of the flange *r*, and through the exhaust passage 2.

After the valve *j* has been thrown to the new position the inlet passage *t* will be placed in communication with the exhaust passage *z*. Pressure fluid may then exhaust from the rear end of the piston chamber, as well as that remaining in the passages leading from the rear end of the piston chamber to the rear end of the valve chamber, it being of course understood that upon the admission of pressure fluid into the rear end of the valve chamber when actuating the valve forwardly, a portion of such pressure fluid may immediately be exhausted to the atmosphere through a port 16 and the vent 18.

With the valve *j* in the forward position pressure fluid flows from the annular groove *o* over the rear holding surface *y* of the flange *r* and upon which it acts to maintain the valve immovable. Such pressure fluid then flows through the front inlet passage *s* into the front end of the piston chamber C to return the piston D to its initial position.

The described cycle of operations may be repeated indefinitely or as long as the nature of the work is such as to require a piston blow of the force which may be obtained with the setting of the plug 7 in the position described. If, however, rock of different hardness characteristics is encountered, as for instance rock of extreme hardness and for the drilling of which it is desirable that a blow of great force be delivered to the working implement, the plug 7 may be changed to a new position so that the lug 12 will lie in the notch 15.

By changing the position of the plug 7 the port 11 will be brought into registry with the port 5 and in this position of the plug the ports 3 and 4 will then be covered by the wall of the plug 7. In the new position of the plug the admission of pressure fluid from the piston chamber C to the rear end of the valve chamber will then occur at a later period during the forward stroke of the piston than would be the case were either the port 4 and 3 in communication with the rear end of the valve chamber. The forward actuation of the valve *j* is thereby delayed and, in consequence, the pressure fluid in the rear end of the piston chamber will then operate against the rear end of the piston for a somewhat longer period of time, with the result that a heavy blow of the piston will be delivered against the working implement.

If, on the other hand, the rock being drilled is of a comparatively soft nature the plug 7 may be shifted to another position wherein the lug 12 will lie in the notch 13 so that the port 9 will be brought into registry with the port 3 and the ports 4 and 5 will then of course be blanked off by the wall of the plug 7. As will be apparent, with the ports 9 and 3 in registry pressure fluid will be admitted into the rear end of the valve chamber *h* at a comparatively early period during the forward stroke of the piston D and the valve *j* will be thrown somewhat earlier during the forward movement of the piston than would be the case were

pressure fluid admitted through either of the ports 4 or 5 for actuating the valve.

The force of the flow of the piston against the working implement will, of course, be also somewhat reduced for the reason that the pressure fluid used for actuating the piston D forwardly is exhausted from the piston chamber at a slightly earlier period in the cycle of operation than it would were the actuation of the valve delayed. The actions of the valve and the piston D will then be considerably accelerated over what they would be were the admission of pressure fluid to the rear end of the valve chamber delayed as by admitting valve actuating pressure through the ports 4 or 5.

Although means have been disclosed for varying the period of admission of valve actuating pressure to only the rear end of the valve chamber it is to be understood that the admission of pressure fluid to the front end of the valve chamber for actuating the valve rearwardly may be similarly controlled in cases where it may be desirable to short stroke the piston during its rearward travel.

As may be observed, in order to change the position of the plug 7 to place any of its ports 9, 10 and 11 in registry with the ports in the cylinder it is necessary to partly or entirely remove the back head L in order to gain access to the plug 7 for the shifting thereof since, in the arrangement shown, it becomes necessary to partly withdraw the plug 7 from the bore 6 to remove the lug 12 from or to insert it into one of the notches 13, 14 or 15.

By thus arranging the parts the possibility of having the plug 7 incorrectly placed by an inexperienced attendent will be eliminated. It is, however, readily conceivable that the plug 7 may be so constructed as to permit of its shifting from one position to another without requiring the partial dismantling of any portion or portions of the rock drill embodying the invention.

Whenever it is desired to direct an uninterrupted flow of pressure fluid into the drill hole for the purpose of removing the cuttings therefrom the throttle valve O may be rotated to place the port Q therein into registry with the passage 21. Pressure fluid will then be admitted into the passage 8. A portion of such pressure fluid flows into the rear end of the valve chamber to act against the actuating surface *w* and throw the valve forwardly. Pressure fluid thereafter flows from the annular groove *o* into the valve chamber *h* rearwardly of the flange *r* and, acting against the holding surface *y*, will hold the valve *j* forwardly. The pressure fluid will then flow through the inlet passage *s* into the front end of the piston chamber, thence through the flutes K into and through the drill steel in a well known manner.

During the blowing of the drill hole the rear end of the piston chamber will be in communication with the atmosphere through the inlet passage *t*, the portion of the valve chamber *h* forwardly of the flange *r*, and the exhaust passage *z*. The pressure fluid in the front end of the piston chamber will then move the piston D rearwardly to draw the rear ends of the flutes K into the piston chamber. After the drill hole has been thoroughly cleansed the throttle valve O may again be returned to its initial position and the drill may again operate in its normal manner.

We claim:

1. In a fluid actuated rock drill, the combination of a cylinder having a piston chamber and a piston in the piston chamber, a valve chest having a valve chamber, inlet passages for conveying pressure fluid from the valve chamber to the piston chamber, a valve in the valve chamber to control the inlet passages and having an actuating area, a plurality of ports in the cylinder communicating with the piston chamber and being spaced along the length thereof, a plug having a passage in communication with the actuating area, a plurality of ports radiating from the passage and being angularly disposed with respect to each other, said plug being shiftable to effect selective registration of the ports in the plug with the ports in the cylinder to supply pressure fluid to the actuating area for actuating the valve during the normal operation of the rock drill, means for supplying pressure directly from a source into the passage in the plug to hold the automatic valve immovable and cause said valve to supply pressure fluid to only one end of the piston chamber, and interlocking portions on the cylinder and the plug for retaining the plug in placed position.

2. In a fluid actuated rock drill, the combination of a cylinder having a piston chamber and a piston in the piston chamber, a valve chest having a valve chamber, an automatic valve in the valve chamber, passages controlled by the valve for distributing pressure fluid to the piston chamber, an actuating area on the valve, a plurality of ports in the cylinder communicating with the piston chamber and being spaced along the length thereof, a plug having a passage in communication with the actuating area, a plurality of ports radiating from the passage and being angularly disposed with respect to each other, said plug being shiftable to effect selective registration of the ports in the plug with the ports in the cylinder, notches in the cylinder, a lug on the plug adapted to seat in the notches for retaining the plug in placed position, and a

throttle valve to supply pressure fluid to the passage in all positions of the plug to hold the automatic valve immovable and to simultaneously supply pressure fluid through the valve chamber to only one end of the piston chamber.

In testimony whereof we have signed this specification.

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