(No Model.) 2 Sheets—Sheet 1.

R. UREN.

OPERATING THE PISTONS OF ROCK DRILLS.

No. 303,344. Patented Aug. 12, 1884.

Fig. 1

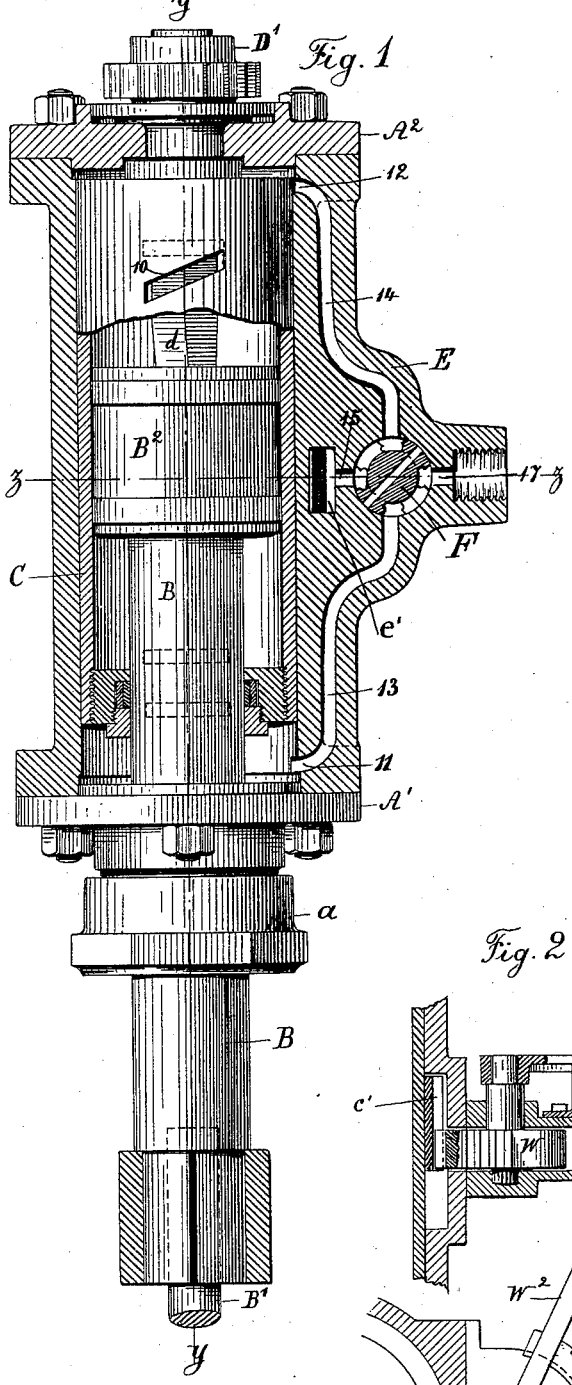


Fig. 2

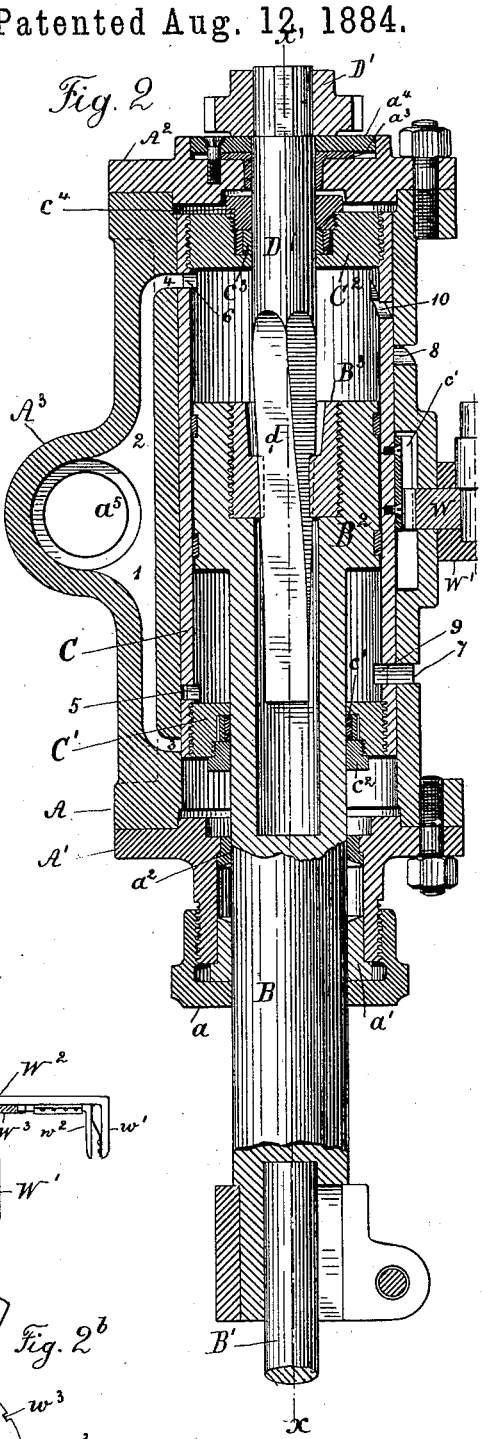
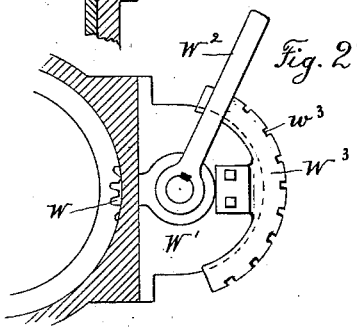


Fig. 2ª

Fig. 2ᵇ



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(No Model.) 2 Sheets—Sheet 2.

R. UREN.

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Fig. 3

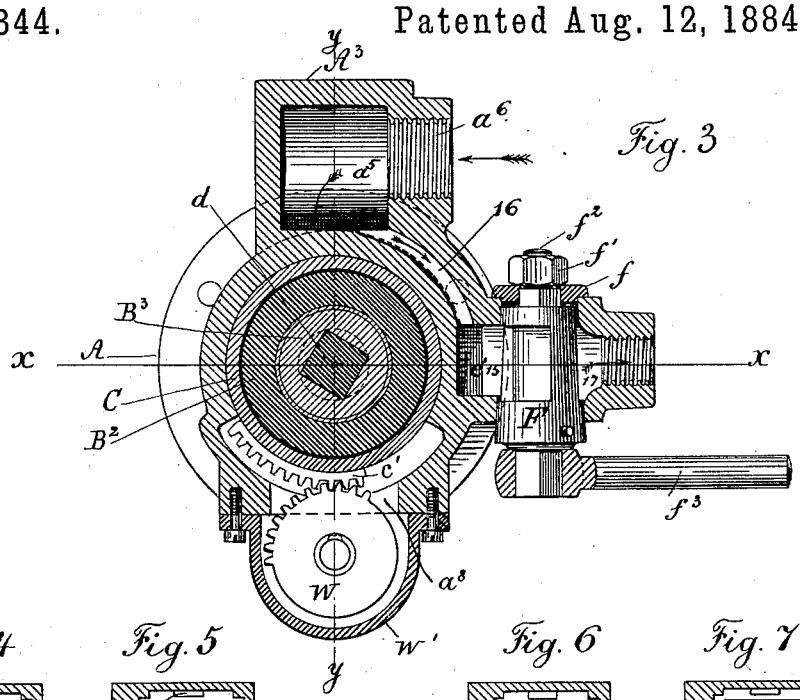


Fig. 4

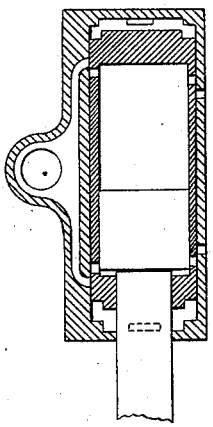


Fig. 5

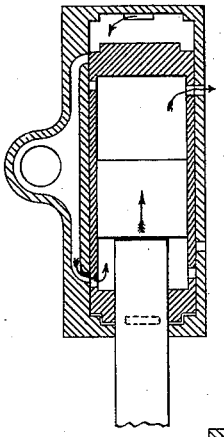


Fig. 6

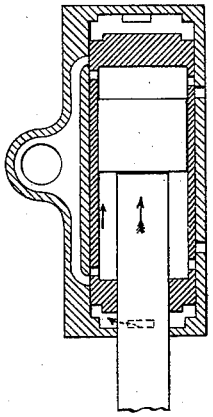


Fig. 7

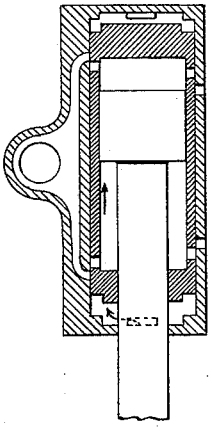
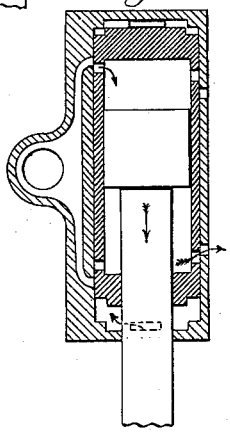


Fig. 8



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UNITED STATES PATENT OFFICE.

RICHARD UREN, OF HOUGHTON, MICHIGAN.

OPERATING THE PISTONS OF ROCK-DRILLS.

SPECIFICATION forming part of Letters Patent No. 303,344, dated August 12, 1884.

Application filed October 12, 1883. (No model.)

To all whom it may concern:

Be it known that I, RICHARD UREN, a citizen of the United States, residing at Houghton, in the county of Houghton and State of Michigan, have invented certain new and useful Improvements in Mechanism for Operating the Pistons of Rock-Drills and other Engines, of which I do declare the following to be a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

My present invention has for its objects, first, to provide improved valve mechanism, whereby the reciprocating movement of pistons, and particularly the pistons of rock-drills, steam-hammers, and similar machines, may be controlled automatically and in such manner as to give, when the piston is employed to operate a tool-carrier, a more effective blow with less danger of disarrangement or breakage of parts; and, second, to provide improved means whereby short strokes of the piston may be delivered when desired. These several objects of invention are accomplished by the mechanism hereinafter described, illustrated in the accompanying drawings, and particularly defined as to its novel features in the claims at the end of the specification.

As my invention is particularly well suited to the operation of rock-drills of that type wherein the motive power employed is compressed air or steam, I have in the accompanying drawings shown the improvements as applied to such a machine; but it will be readily seen, and I wish the scope of my invention to be distinctly so understood, that these improvements are applicable as well to steam-hammers and to a great variety of machines.

Figure 1 is a view partly in section and partly in elevation on line *x x*, Fig. 3. Fig. 2 is a view partly in section and partly in elenation on line *y y* of Fig. 3. Figs. 2^a and 2^b are detail views of the mechanism for turning the valve-cylinder. Fig. 3 is a view in transverse section on line *z z* of Fig. 1. Figs. 4, 5, 6, 7, and 8 are conventional views in vertical section to illustrate the various positions of the piston in making its upward and downward strokes.

In the drawings, A designates the main casing of the drill, to which are bolted the top and bottom end plates, A′ and A^2, of usual construction. Through the threaded cap *a* of the end plate A′, and through suitable packing-sleeves, *a′* a^2, passes the tool stock or carrier B, within which the tool B′ is held. Upon the upper end of the tool-carrier B is formed the piston B^2, of a size adapted to work within the valve-cylinder C, which fits air-tight, and yet in a manner free to slide within the outer casing, A, and has attached by screws to its side the segmental rack-bar *c*, which works within a cut-away space, *c′*, in the part A^4 of the casing. In the side of the casing, at a point opposite the segmental rack-bar, is formed a slot, a^8, through which projects the segmental gear-wheel W, suitably journaled in the casting W′, bolted to the casing, as seen in Fig. 3. The teeth of the gear-wheel W are in mesh with those of the rack-bar *c′*, and this wheel serves not only to prevent the lateral movement of the valve-cylinder as it slides up and down, but serves also to slightly turn the cylinder, when desired, for a purpose to be presently stated. The axle of the wheel W is extended through the casting W′, and has a reduced end, over which fits the key W^2, having the downwardly-projecting arm *w′*, carrying the spring-bolt w^2, adapted to fit in the notches w^3 of the segmental catch-bar W^3, which is bolted to the top of the casting W, as shown in detail, Figs. 2^a and 2^b. This key W^2 not only enables the valve-cylinder to be turned, but, by its coaction with the spring-bolt w^2 and segmental catch-bar W^3, also guards against any accidental displacement of the valve-cylinder when once set to a desired position. The valve-cylinder C has closed ends C′ and C^2, and through the lower end, C′, and its packing-ring *c′* and exteriorly-threaded sleeve c^2 passes the tool-carrier B. The upper portion of the tool-carrier and the piston B^2 are bored out, as shown in Fig. 2, and into the threaded end of the piston is fitted the nut B^3, having a four-sided hole throughout of a shape corresponding with the twisted portion *d* of the turning-bar D, over which the nut slides freely as the piston B^2 rises and falls in operating the drill. The turning-bar D, which may be of usual construction, passes through the upper end, C^2, of the cylinder-valve and through the packing-ring c^3 and the exteriorly-thread-

ed sleeve c^4, and also through the top end plate, A^2, the packing-sleeve a^3, and plate a^4 of the casing. To the top of the turning-bar is keyed a ratchet-wheel, D′, which may be turned by any of the well-known forms of mechanism for operating the turning-bar and imparting the necessary rotation to the drill.

Upon the side of the casing A is formed the enlargement A^3, constituting the air or steam chest a^5, to which compressed air or steam will be admitted by a suitable pipe connected to the threaded opening a^6 of the chest. From this air-chest a^5 extend the air-delivery channels 1 and 2, formed in the wall of the casing, and terminating in the upper and lower delivery-ports, 3 and 4. These delivery-ports open into the casing at a distance from the top and bottom end plates, A′ and A^2, respectively, equal to the distance at which the delivery-ports 5 and 6 in the valve-cylinder are placed from the extreme ends of said cylinder, so that when the valve-cylinder is in its lowest position the ports 3 and 5 shall coincide, and in its highest position the ports 4 and 6 shall coincide, as will presently more fully appear in the description of the operation of the machine. In the casing A, and preferably at about the position shown, are formed the upper and lower eduction or escape ports, 7 and 8; and the corresponding eduction or escape ports, 9 and 10, of the valve-cylinder are so placed relatively thereto that when the upper delivery or induction ports, 4 and 6, are coincident the lower eduction or escape ports, 9 and 7, will coincide, the lower delivery-ports, 3 and 5, and upper escape-ports, 8 and 10, being closed, and vice versa. The upper escape-ports, 8 and 10, of the casing and valve-cylinder are obliquely inclined in reverse direction, as shown, so that when desirable, as will presently appear, the point at which the air or steam is allowed to escape from the valve-cylinder can be varied by turning the valve-cylinder by means of the segmental rack-bar and gear-wheel, thus causing the escape-ports to coincide at a higher or lower point.

In the walls of the casing A, and at points near the end plates, A′ and A^2, are formed the ports 11 and 12. When the piston is making full strokes, the spaces between the upper and lower ends of the cylinder-valve and the top and bottom of the casing are in communication with each other through the ports 11 and 12, the channels 13 and 14, formed in the walls of the casing, and the channel i in the hand-valve F, so that the cylinder can move freely up, and will not be cushioned by confined air until it has closed the ports 11 or 12. The channels 1 3 and 14 open into the cock or valve-space e, formed in the enlargement E upon the side of the casing. With the valve-space e also connects the chamber e' by port 15, the main air or steam chest a^5 by the channel 16 in the wall of the casing, and the discharge-port 17, which connects with a suitable escape-pipe attached to the threaded part e^2 of enlargement E. Through the valve-seat e passes the valve or cock F, which is held in place by means of the washer f and nut f', fitting over the threaded end f^2, and is operated by means of the hand-lever f^3, keyed thereto.

It will be readily understood by those skilled in the art that, instead of a hand-lever to control the operation of the cock F, this may be accomplished automatically when my improved valve mechanism is to be applied as a "cut off" to a variety of engines by connecting the cock by a rod to a suitable working part of the engine in the usual manner.

The operation of the drill when delivering full strokes will first be defined, as in this operation is required only such features of the improved mechanism as constitute the first part of my invention.

Assuming the various parts to be in the position shown in Fig. 2 of the drawings, the upper delivery-ports, 4 and 6, and the lower escape-ports, 7 and 9, of the casing and valve-cylinder being coincident, and the ports 3 and 5 and 8 and 10 being closed, compressed air is admitted to the air-chest a^5, and passes thence by the channel 2, and through the delivery-ports 4 and 6 to the interior of the valve-cylinder above the tool-carrier piston. The piston B^2 is now forced downward until in its descent it closes the port 9 of the valve-cylinder, when a thin air-cushion is formed between the piston and the lower end, C′, of the valve-cylinder, which prevents the striking of the piston against the cylinder end with too sudden violence. The momentum acquired by the piston in its downward course causes the valve-cylinder to move with the piston during the remainder of its stroke, and until the end C′ of this cylinder strikes the end plate A′ of the casing. This shifting of the position of the valve-cylinder by the piston throws the upper delivery-ports, 4 and 6, and the lower escape-ports, 7 and 9, out of alignment, and at the end of the stroke causes the lower delivery-ports, 3 and 5, and the upper escape-ports, 8 and 10, of the casing and valve-cylinder to coincide. Compressed air will now pass from the air-chest a^5 through the channel 1 and ports 3 and 5 into the valve-cylinder beneath the piston, and will thus force the piston to rise until it nears the end C^2 of the valve-cylinder, (a thin air-cushion between the two, as on the downward stroke,) when the cylinder will be forced by the momentum of the piston to the position shown in Fig. 2 of the drawings, when the downward stroke will begin, as heretofore described. If from any cause the piston is arrested in its descent before it has so far completed its stroke as to shift the valve-cylinder to cause a reverse movement of the piston, this movement can be effected by operating the hand-valve, as will hereinafter more fully appear. When the drill is boring into an overhead wall, the force of the downward stroke will be much increased by reason of the weight of the piston, the drill-stock, and the drill, and

it is to avoid the violent striking of the piston against the end of the valve-cylinder in such cases that I have formed the discharge-ports 8 and 10 obliquely inclined, as shown, as by turning the valve-cylinder by means of the gear-wheel W the ports 8 and 10 may be caused to coincide at a greater distance from the end C^2 of the valve-cylinder, and the air-cushion formed between the piston and the end C^2 will hence be increased, and will better resist the force of the descending piston.

The turning-bar and its mode of operation, being substantially as in well-known forms of rock-drills, will be readily understood by those skilled in the art, and need not be described here.

In beginning the drilling operation, especially upon irregular surfaces or in oblique direction, a source of frequent injury to the machine is the glancing of the drill-point from the rock before the hole is fairly started, as when this occurs the drill-stock and drill are most liable to be bent. By my present invention provision is made whereby at the beginning of the drilling operation a succession of very short blows may be given to the drill until the hole in the rock is of sufficient depth to avoid all danger of the drill glancing from the rock, after which the piston will be worked with full strokes.

The operation of this part of my invention is as follows, assuming the parts to be in the relative position shown in Fig. 1 of the drawings and the operator having by the hand-lever f^3 turned the cock F, as shown. When the cock F is thus turned, compressed air will pass from the air-chest a^5 by channel 16, Fig. 3, through space e', valve-chamber e, channel 14, and port 12 to the upper part of the interior of the casing A, at a point immediately below the end plate A^2 and above the end of the valve-cylinder. At the same time compressed air will also pass from air-chest a^5 through channel 2 and delivery-ports 4 and 6 to the interior of the valve-cylinder above the piston; but since the area of the inner side of the end of the valve-cylinder is less than that of the outside of such end by the thickness of the cylinder-wall, it must follow that the pressure of the air upon the outside of the cylinder end will exceed that upon its inside, and the cylinder will therefore be forced to descend. This downward movement of the valve-cylinder closes the ports 4 and 6 of the cylinder-casing before sufficient air has passed through these ports to depress the piston to any considerable extent, so that the downward stroke of the piston is but little longer than the distance through which the valve-cylinder moves. As the cylinder moves down, the air escapes from the space beneath the same by the port 11, channel 13, and escape-port 17 until the end of the stroke, when the parts are in the position seen in Fig. 5. The operator will now turn the hand-lever f^3 a quarter-revolution until the arms of the cock F assumes the position shown in dotted lines, Fig. 1. When the cock F is thus placed, compressed air will pass from the air-chest a^5, by channel 16, space e', valve-space e, channel 13, and port 11, to the exterior of the casing A at a point below the valve-cylinder and adjoining the lower end plate, A′, and at the same instant air will pass from the air-chest by channel 1 and delivery-ports 3 and 5 to the interior of the valve-cylinder below the piston. As the pressure exerted by the air on the outside of the valve-cylinder end is greater than that exerted on its inner side, by reason of the greater pressure-area in the former case, the valve-cylinder will at once move upward, carrying with it the piston until the end of the cylinder strikes the upper end plate of the casing, when the parts will again assume the position shown in Fig. 1, after which the operator will reverse the cock to effect the downward stroke, as in the first instance. During the upward movement of the valve-cylinder the port 12 and channel 14 allow the escape of air from above the cylinder to the escape-port 17.

From the foregoing it will be seen that the piston-strokes, when the hand-valve F is quickly operated, are very short, and it will also be seen that since the piston is held in position within the valve-cylinder by means of the air above and below it acts in delivering its stroke against an air-cushion, which is broken by the coincidence of the ports of the cylinder and casing when the stroke is completed.

It will readily appear that the operator can vary the length of the piston-strokes at pleasure by turning the cock F as soon as the valve-cylinder reaches the end of its stroke, or by allowing more or less air to enter the valve-cylinder to further move the piston before the cock is turned.

Those skilled in the art will readily understand that without substantial change my improved construction of valve mechanism may be applied to a great variety of engines; and I do not wish to be understood as restricting the scope of my invention to rock-drills, although, as will be apparent from the foregoing description, it is admirably adapted thereto. In this connection it may be stated that in addition to the advantage attained from the compactness of parts when the valve mechanism is arranged within the drill a further important advantage of this arrangement is that the compressed air within the casing effectually prevents dust from getting therein and injuring the working parts.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination, with a reciprocating main piston, of a movable valve-cylinder within which said main piston may work, and an outer casing within which said cylinder may slide, said casing and cylinder being provid-

ed with delivery and escape ports for steam or compressed air, substantially as described.

2. The combination, with the drill or tool carrier and the main piston, of the movable valve-cylinder and the outer casing, said cylinder and casing being provided with delivery and escape ports, and being arranged relatively to each other, substantially as described.

3. The combination, with the piston, of a valve-cylinder having closed ends, and an outer casing having steam or compressed-air ports above and below said cylinder, whereby a short stroke of the piston may be secured, substantially as described.

4. The combination, with a piston, of a valve-cylinder within which said piston may work, and an outer casing within which said cylinder may slide, said casing and cylinder being provided with delivery and escape ports for admitting steam or compressed air for directly operating the piston when full strokes are to be made, and said casing being provided with supplemental ports for admitting steam or compressed air above and below the valve-cylinder when short strokes are to be made, substantially as described.

5. The combination, with the drill or tool carrier and the piston, of a valve-cylinder within which said piston may work, and an outer casing within which said cylinder may slide, said casing and cylinder being provided with delivery and escape ports for admitting steam for directly operating said piston when full strokes are to be made, and said casing being provided with supplemental ports for admitting steam or compressed air above and below the valve-cylinder when short strokes are to be made, substantially as described.

6. The combination, with the piston and the casing and the valve-cylinder arranged to slide therein, said valve-cylinder and casing being provided with delivery and escape ports and channels, situated substantially as shown, of the cock F and suitable means for operating said cock, substantially as described.

7. The combination, with the piston, of a valve cylinder and casing having delivery and escape ports adapted to be brought into coincidence, and mechanism adapted to vary with respect to the piston-stroke the point at which the escape-ports of the cylinder and casing shall coincide, substantially as set forth.

8. The combination, with the piston, of a valve cylinder and casing having obliquely-inclined escape-ports, and means for turning said valve-cylinder, substantially as described.

9. The combination, with the piston, of a valve-cylinder within which said piston works, and a casing within which said valve-cylinder slides, said valve cylinder and casing being provided with delivery and escape ports adapted to be brought coincident, and the interior of said casing being connected from end to end by channels, and a perforated valve or cock, substantially as described.

10. The combination, with the piston, of the cylinder within which said piston moves, having its discharge-ports located at a slight distance above the end of the cylinder, and adapted to be closed by the piston before the end of the stroke, thereby forming an air-cushion to break the force of the piston, substantially as described.

In testimony whereof I have hereunto set my hand this 5th day of October, A. D. 1883.

RICHARD UREN.

Witnesses:
THOMAS WILLIAM EDWARDS,
JAMES H. PEIRCE.