J. B. JOHNSON.
Rock-Drill.

No. 213,663. **Patented Mar. 25, 1879.**

Fig: 1.

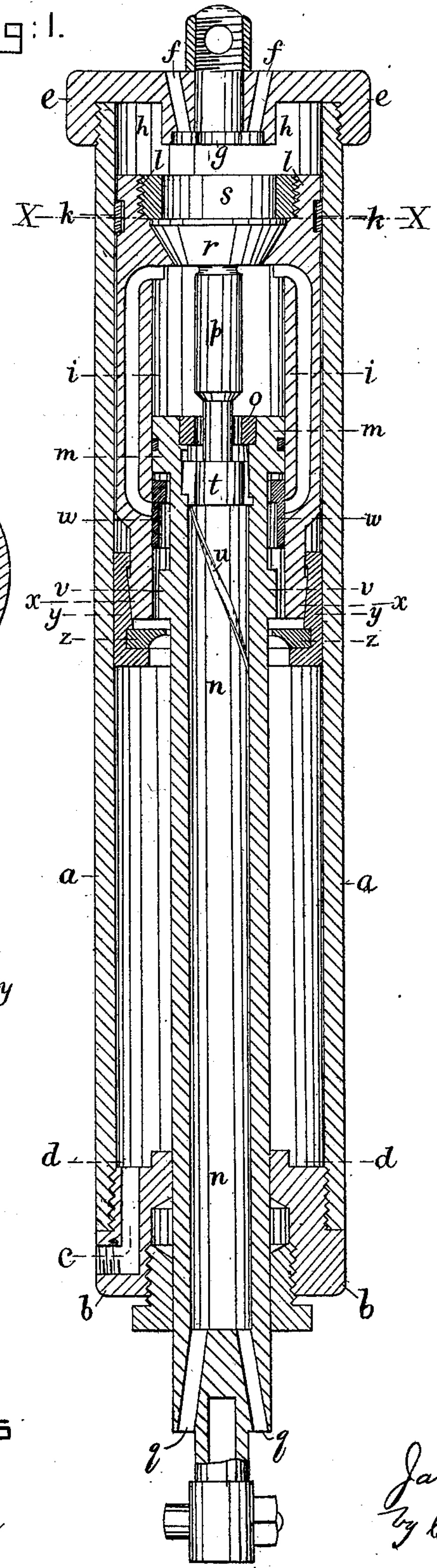


Fig: 5

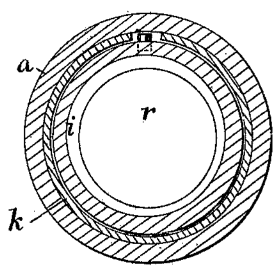


Fig: 2.

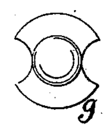


Fig: 4.

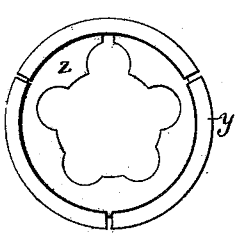


Fig: 3

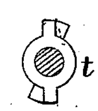
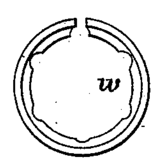


Fig: 6.



Witnesses
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James B. Johnson,
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UNITED STATES PATENT OFFICE.

JAMES B. JOHNSON, OF BOSTON, MASS., ASSIGNOR TO THE JOHNSON ROCK DRILL MANUFACTURING COMPANY, OF SAME PLACE.

IMPROVEMENT IN ROCK-DRILLS.

Specification forming part of Letters Patent No. **213,663**, dated March 25, 1879; application filed February 3, 1879.

To all whom it may concern:

Be it known that I, JAMES B. JOHNSON, of Boston, county of Suffolk, and State of Massachusetts, have invented an Improvement in Rock-Drills, of which the following description, in connection with the accompanying drawings, is a specification.

My invention relates to a rock-drill in which the working-cylinder travels in an outer steam-tight casing, provided at its lower end with a head having a stuffing-box, through which the piston-rod travels, and an induction-port, and at its upper end with a head having a valve opening to the exterior. The working-cylinder is fed along automatically in the outer casing without screw-gearing for accomplishing said feeding, and at the end of its travel automatically closes the induction-port, thus coming to rest without shock to any part of the machine. The working-cylinder is forced upward and the drill withdrawn from the hole in the rock by a single action of the steam which works the drill, the motion of the cylinder being cushioned and brought to rest without shock to the upper head of the casing.

The working-cylinder is provided at its upper end with an exhaust-pin, friction-disk, and head, provided with a spiral projection, working in a corresponding groove inside the hollow piston-rod, all for the purpose of rotating the drill. At its lower end the working-cylinder is provided with a conical or tapering prolongation, fitting in a sectional clamp, which is caused to press firmly against or to be partially released from the external casing, as occasion requires, the sectional clamp being provided with an internal elastic ring, which also presses it against the outer casing when not so held by the conical projection on the cylinder. These parts form the automatic feed mechanism.

The cylinder is provided at its upper extremity with a projecting ring, fitting in a depression in the upper head of the casing, to trap steam or air and cushion the upward movement of the cylinder.

In the description I shall speak of steam as the motive power; but compressed air or any convenient fluid-pressure may be used.

The feed-clamp is also provided with a ring, fitting in a depression in the lower head, which partially closes the induction-port and stops the machine without shock when the working-cylinder reaches the bottom of the casing.

Figure 1 is a longitudinal section, showing my improved rock-drill, the exhaust-pin and attached parts being shown in elevation. Fig. 2 is a detached plan view of the valve in the upper head of the external casing. Fig. 3 is a detached plan view of the spiral head. Fig. 4 is a plan of feed-clamp and feed-spring. Fig. 5 is a horizontal section on line *x x* of Fig. 1. Fig. 6 is a detached view of the elastic cut-off ring, looking upward.

The outer casing, *a*, which is made steam-tight, is provided at its lower end with a head, *b*, having a stuffing-box, through which the piston-rod works, and an induction-passage, *c*. The head *b* has an annular recess or groove, *d*, at its upper end, for the purpose hereinafter described. At the upper end of the casing *a* is a head, *e*, provided with passages *f* from the inside to the outside of the casing, and a valve, *g*, which may be of any construction suitable for quickly opening and closing the passages *f*. The head *e* is also provided at its inner side with an annular recess, *h*, for the purpose to be described.

An internal cylinder, *i*, is fitted loosely within the casing *a*, so as to travel freely in the same, and so as to allow steam to pass from the induction-port *c* through the casing *a* to the space in the casing above the cylinder *i*. The cylinder is kept from rotating in the casing by an elastic friction-ring, *k*, which is cut at one point, and does not greatly impede the passage of the steam upward through the space between the cylinder *i* and casing *a*, the ring itself being kept from rotating on the cylinder *i* by a pin, as shown in Fig. 5.

At the top of the cylinder *i* is a projecting ring, *l*, into which is screwed a union, *s*, the two parts *l* and *s* forming a single annular projection, which fits accurately the annular recess *h* in the upper head of the casing, said recess thus acting as a dash-pot, cushioning the cylinder at the end of its upward movement in the casing.

Within the cylinder *i* is the piston *m*, provided with the hollow piston-rod *n*, which passes out through the stuffing-box in the lower head, *b*, of the casing *a*.

The piston-rod *n* has at its upper extremity a bushing, *o*, bored to fit accurately upon the exhaust-pin *p*, which thus acts as a valve, closing the passage of the exhaust-steam down through the piston-rod and out at holes *q*, as described in Patent No. 186,735.

The exhaust-pin has at its upper end a taper friction-plug, *r*, which fits a tapering seat in the top of the cylinder *i*, and is held in place by the union *s*.

At the lower end of the exhaust-pin *p* is a spiral head, *t*, (shown also detached in Fig. 3,) the spiral projection of which engages in grooves *u* in the piston-rod.

An annular projection, *v*, on the piston-rod operates the elastic cut-off ring *w* and the feed mechanism at the bottom of the cylinder. This ring *w*, which acts as a valve, is counterbored, so as to permit the projection *v* to pass nearly to the top of the ring before operating the same; and the internal bore of said ring is cut away in places, to permit the steam to pass freely between it and the piston-rod, as fully shown in Fig. 6. The ring *w* opens and closes the ports which lead from the space below to that above the piston, as clearly shown in Fig. 1, being moved down to close the same by the under surface of the piston *m*. This ring, cut at one point, presses by its own elasticity against the cylinder *i* with sufficient force to keep it from moving until struck by the piston *m* or projection *v*.

At the lower end of the cylinder *i* is a conical prolongation, *x*, which fits in a corresponding tapering portion of the feed-clamp *y*. (Shown more fully in Fig. 4.)

The feed-clamp has a shoulder at its upper part, and the prolongation *x* has a corresponding shoulder, to prevent the feed-clamp from becoming detached entirely from the cylinder, said clamp being made in sections, to permit of its being more readily put in place, and to allow it to expand against the casing *a*.

In a recess at the bottom of the feed-clamp *y* is placed an elastic ring, *z*, which is cut away inside, as shown in Fig. 4, so as to allow the steam to pass freely between it and the piston-rod, the internal projections being left, however, to be struck by the projection *v* on the piston-rod.

The ring *z* serves to hold the feed-clamp *y* with moderate friction against the casing *a*, so that the conical prolongation *x* of the cylinder may wedge it more firmly against the casing, thus stopping the downward motion of the cylinder until the feed-clamp is released from the conical prolongation *x* by the striking of projection *v* on the ring *z*.

The operation of the drill is as follows: The parts being in position shown, steam, being admitted at *c*, fills the casing *a*, and passes above the cylinder and presses down on the upper end of the cylinder *i*. This pressure is balanced, except when, as in Fig. 1, the bushing *o* is moved from the exhaust-pin, when the area of the bore of the cylinder is pressed upward only by the atmosphere, which alone acts on the under surface of the taper friction-plug *r*. Downward motion of the cylinder is resisted by the feed-clamp, which holds more tightly as the downward force is increased.

The steam, passing upward into the cylinder *i*, acts on the lower annular surface of the piston *m*, raising it, steam at the same time exhausting from above the piston out through the piston-rod at *q*.

The taper piston-plug *r*, being pressed downward by the steam and upward only by the atmosphere, is held firmly in its seat, and, by means of the spiral head *t* and grooves *u*, rotates the drill during its upward motion.

When the exhaust-pin enters the bushing at the top of the piston-rod the exhaust is cut off and compression begins, continuing until the projection *v*, having passed into the counterbore of the valve *w*, raises the valve and opens the ports, allowing live steam to act above the piston, driving it downward by the pressure on the difference between the upper and under effective areas of the piston *m*.

The valve *w* leaves the ports open until just as the piston in its downstroke is leaving the exhaust-pin *p*, when said piston operates the ring, closing the ports, thus giving a dead blow on the rock.

In the downstroke of the piston the under surface of the taper plug *r* is acted on by the live steam, thus easing its pressure on its seat and allowing it to rotate with the piston.

At the end of the downstroke the projection *v* strikes on the ring *z*, releasing the feed-clamp *y* from the conical prolongation *x* of the cylinder, thus allowing the cylinder to be moved forward by the steam-pressure above it.

When the drill-point meets no obstruction (as when it is approaching the rock before beginning its work) the projection *v* remains in contact with ring *z*, preventing the clamp *y* from engaging with the part *x* until, after passing down some distance, the steam acting upward on the piston *m*, stops it and allows the clamp *y* to catch.

The inner cylinder, *i*, is thus fed forward by long strokes until, when the drill meets the rock, the projection *v* merely starts the feed-clamp *y*, the cylinder *i* then being fed forward only as fast as the rock is cut.

When the cylinder reaches the bottom of the casing *a* the under part of the feed-clamp *y*, which is turned to fit the annular recess *d* in the lower head, *b*, of the casing *a*, enters said recess *d* and gradually stops the entrance of the steam, thus bringing the drill to rest without shock to the lower head, *b*, of the casing.

To withdraw the drill from the hole, the valve *g* in the upper head, *e*, of the casing *a* is opened, thus removing the downward pressure on the cylinder *i* and allowing it to be raised by the pressure of the steam below.

At the end of the upward movement of the cylinder *i* exhaust steam or air is trapped in the recess *h*, preventing shock to the head *e*.

When, in drilling, the hole becomes filled with sludge or grout, the valve *g* is opened and the drill withdrawn from the hole. Then, the valve *g* being closed, the drill feeds forward with long steps, thus churning out the drill-hole.

I claim—

1. In a rock-drill, the combination, with an outer casing, smooth internally, of an inner cylinder, provided with a feed-clamp, said cylinder sliding freely from end to end of the outer casing under the action of the motive fluid-pressure, substantially as described.

2. The combination, with the outer casing and inner cylinder, free to travel in the same, of a valve in the upper head of the casing, as and for the purpose described.

3. In a rock-drill, the combination, with the inner cylinder and outer casing, of a projecting ring at the top of the inner cylinder, adapted to enter a recess in the head of the outer casing, as and for the purpose described.

4. The combination, with the working-cylinder, piston, and hollow piston-rod, provided with a spiral groove, of an exhaust-pin, taper friction-plug, and spiral head, substantially as described.

5. The combination, with the inner cylinder and outer casing, of a conical projection on the inner cylinder, and a feed-clamp fitting the same, and the elastic ring, having internal projections, and the projection on the piston-rod, to operate substantially as described.

6. In a rock-drill, the combination of the casing, internal cylinder, and a feed-clamp, having a projecting ring, with the lower head of the casing, having a recess corresponding to said projecting ring and induction-port, substantially as described, for the purpose set forth.

7. In a working-cylinder provided with ports connecting the space above and below the piston, an elastic ring to open and close the said ports, said ring being operated by the piston and projection on the piston-rod, substantially as described.

8. In a rock-drill, the combination, with the working-cylinder, of an elastic ring to open and close the port, applied within the cylinder and counterbored at its lower end, to operate substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JAMES B. JOHNSON.

Witnesses:

G. W. GREGORY,

N. E. WHITNEY.