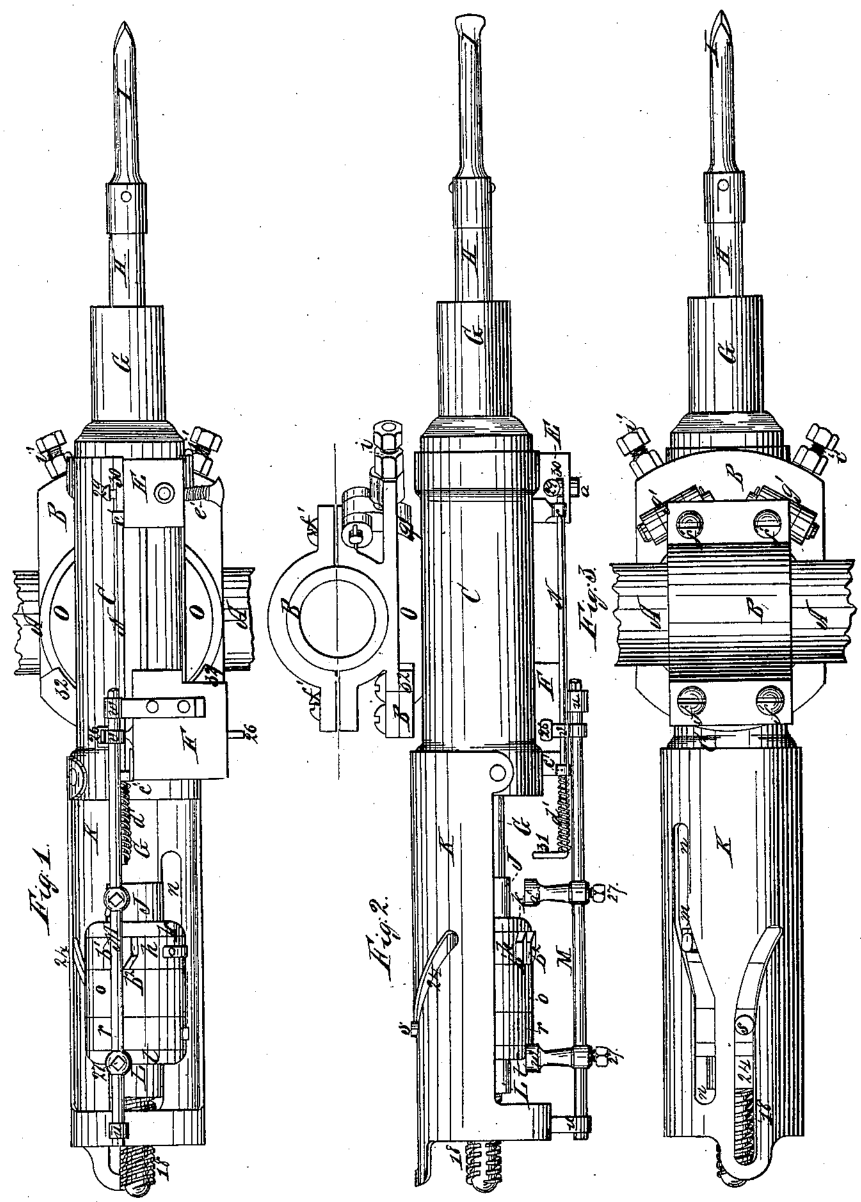
4 Sheets-Sheet 1.

Brooks, Gates & Burleigh,

Steam Rock-Drill.

No. 52,960. Patented Mar. 6, 1866.



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4 Sheets, Sheet 2

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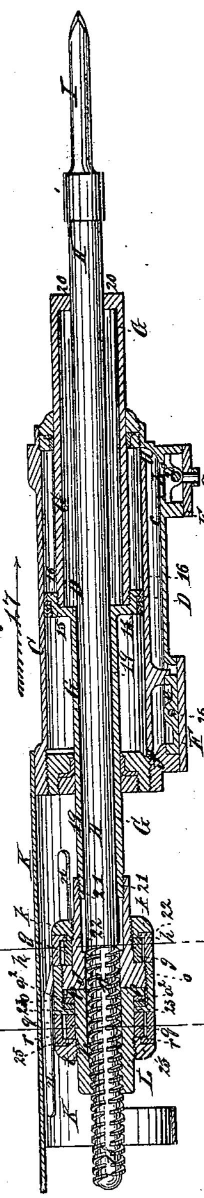

Fig. 4.

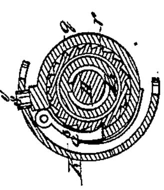

Fig. 6.

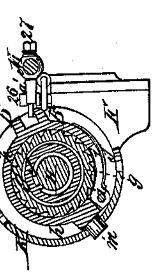

Fig. 5.

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4 Sheets-Sheet 3.

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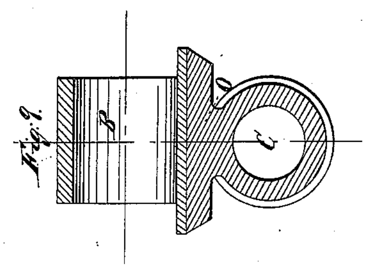

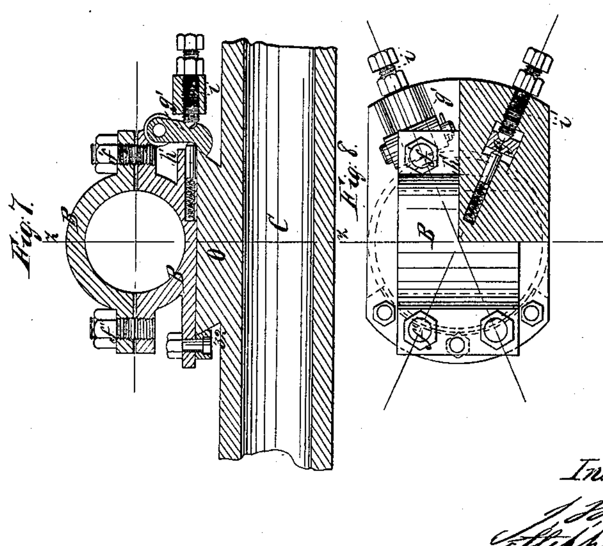

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4 Sheets-Sheet 4-

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Fig. 10.

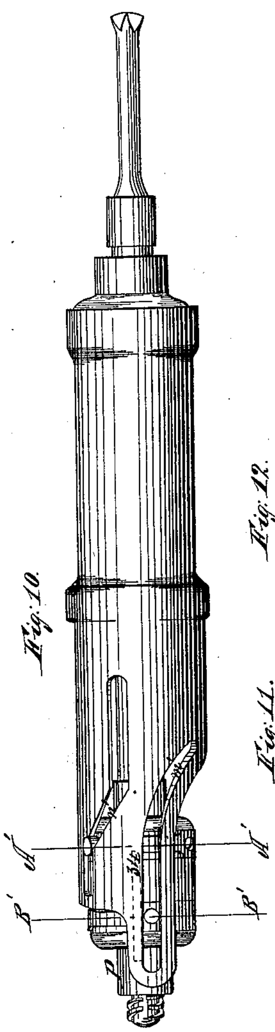
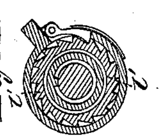


Fig. 12.

Fig. 11.



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UNITED STATES PATENT OFFICE.

JOHN W. BROOKS, OF MILTON, STEPHEN F. GATES, OF BOSTON, AND CHARLES BURLEIGH, OF FITCHBURG, MASSACHUSETTS.

IMPROVED ROCK-DRILL.

Specification forming part of Letters Patent No. 52,960, dated March 6, 1866.

To all whom it may concern:

Be it known that we, JOHN W. BROOKS, of Milton, in the county of Norfolk, STEPHEN F. GATES, of Boston, in the county of Suffolk, and CHARLES BURLEIGH, of Fitchburg, in the county of Worcester, all in the State of Massachusetts, have invented certain Improvements in Machinery for Drilling Rocks, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, making part of this specification, in which—

Figure 1 is an elevation of one side of our improved machine for drilling rocks. Fig. 2 is a plan of the same. Fig. 3 is an elevation of the side of the machine opposite to that represented in Fig. 1. Fig. 4 is a horizontal longitudinal section through the same. Fig. 5 is a transverse section through the machine on the line *x x* of Fig. 4. Fig. 6 is a transverse section through the machine on the line *y y* of Fig. 4. Fig. 7 is a section through the clamp and a portion of the cylinder. Fig. 8 is an elevation of the clamp, a portion being shown in section. Fig. 9 is a section through the cylinder and clamp on the line *z z* of Fig. 7. Figs. 10, 11, and 12 represent a modification of our invention.

To enable others skilled in the art to understand and use our invention, we will proceed to describe the manner in which we have carried it out.

In the said drawings, A represents a post or standard, to which is secured, by means of a clamp, B, the cylinder C and parts connected therewith.

Within this cylinder C works the hollow piston D, which is driven by means of compressed air led from air-compressors driven by any suitable motive power. The compressed air enters the valve-chest E at *a* and passes through the port *b* into the passage *c* and thence through the opening *d* into the cylinder in front of the piston, forcing it back to the opposite end of the cylinder. The valve *e* in the chest F is now moved by mechanism to be described particularly hereinafter, so as to allow the compressed air to enter the cylinder at *f*, and the surface area of this side 15 of the piston D, on which the air acts, being much greater than that of the opposite side, 16, the piston is driven forward in the direction of the arrow 17, Fig. 4, against the resistance of the air on the side 16. This difference in the area of the piston D is effected by making the hollow piston-rod G of greater diameter on one side than the other, as seen in Fig. 4. On the piston arriving at the end of its stroke in this direction the valve *e* is again moved, closing the inlet-port and opening the exhaust-port, when the pressure of the air on the side 16 of the piston D drives it back, and the operation continues as before.

By thus causing the air to press constantly against one side of the piston and making the surface area on which the air acts greater on one side of the piston than the other, an exhaust-port is required at one end of the cylinder only, thus simplifying the construction of the machine.

When the drill is intended to be worked vertically upward we prefer to make the area of the side 15 of the piston greater in proportion to that of the side 16 than where the drill is to be worked horizontally. This difference of area, however, may be made to suit the requirements of the case.

The piston D and piston-rod G are packed in the ordinary manner, and are made hollow for the reception of the drill-spindle H, which slides snugly therein, and has cut on its rear end a screw-thread, 18, the portion 19 and front end, 20, of the piston-rod G serving as guides for the drill-spindle, to the forward end of which is secured the drill I.

The manner in which the drill is turned after each blow and fed forward will now be described.

J is a hub or head, which is screwed to the rear end of the hollow piston-rod G at 21, and to this hub is permanently secured a ring, *g*, entirely around which are cut ratchet-teeth, as seen in Fig. 5, and over this ratchet is fitted a band, *h*, carrying a pawl, *i*, which is pressed inward by means of a spring, *j*. The drill-spindle H slides through the hub J, a spline being made in the drill-spindle and a feather in the hollow piston-rod G or hub J, as seen in Fig. 5, by which the spindle is prevented from turning independently of the hub or piston-rod, while it is free to slide through it.

The ratchet-band *h* is kept in place by means of a nut, *k*, which is screwed over the hub J, its flange 22 pressing against the ratchet *g* and preventing the nut from binding against the band h. From this band h projects a pin, m, which works in a slot, n, Figs. 1, 3, and 4, in a curved shell or casing, K, attached to the cylinder C by means of screws. This slot n has two straight portions and one inclined portion, and as soon as the pin m passes into the inclined portion of the slot n on the forward stroke of the drill the ratchet-band h is turned, causing the pawl i to turn the ratchet g, and with it the hollow piston-rod G, drill-spindle, and drill, as required, while on the backward stroke of the drill the band h is turned in the opposite direction sufficiently far to cause the pawl i to fall into the next succeeding tooth of the ratchet g, the drill being thus prevented from striking twice in the same place.

L is a nut, in the interior of which is cut a screw-thread for the screw 18 on the end of the drill-spindle to work in. The front face of this nut rests against the face of the hub J, to which it is secured by means of the union-coupling o, which is provided with a flange, 23, between which and the flange P of the nut L are introduced rings of green hide a^2, or other suitable elastic substance, for the purpose of relieving the hollow piston and parts connected therewith from the shock caused by the blow of the drill, thus preventing them from being injured and increasing the durability of the machine. To the nut L is permanently secured a ring, g, which is provided with ratchet-teeth, as seen in Fig. 6, and over this ratchet is fitted a band, r, which carries a pawl, a^3, Fig. 6, and has projecting from it a pin, s, which works in a slot, 24, in the curved shell or casing K. The ratchet-band r is held in place by means of a nut, t, which is screwed over the nut L, as seen in Fig. 4, its flange 25 resting against the ratchet q, so as to prevent its binding on the band r. A portion of the slot 24 is curved, and as the pin s travels through the curved portion on the backward stroke of the drill the ratchet-band r is turned, carrying with it the nut L, which thus feeds forward the drill-spindle H and drill I, as required, the spindle being prevented from turning with the nut L by the spline and feather before described. By thus placing the feed-screw on the central drill-spindle itself, instead of on one side of it, as heretofore, the ratchets and the working parts connected therewith are all brought compactly around the spindle, and the jerking and lateral strain and consequent liability of breakage heretofore experienced is avoided.

The manner in which the feed is regulated to accord with the character of the rock in which the drill is operating will now be described. The machine being in place, the drill-spindle is turned in the nut L, so that when the drill strikes the rock the pin s will be nearly in the center of the curved portion of the slot 24, in which position the ratchet-band r is not turned quite far enough to cause its pawl to fall into the next tooth of the ratchet q. If, now, the character of the rock is so hard that the drill will not penetrate far enough to allow the pin s to travel in the slot 24 sufficiently far to cause the band r to be turned until its pawl takes into the next tooth of the ratchet, there will be no feed until the drill has penetrated the rock to a sufficient distance to allow of this taking place, while on the contrary, if the rock be so soft that the drill will penetrate until the pin s travels nearly to the forward end of the curved portion of the slot 24, the band r will be turned so far as to cause its pawl to fall into every second notch of the ratchet, thus enabling us to obtain a rapid feed when the rock is soft. With rock of ordinary nature, however, the drill will penetrate so as to cause the pawl to take one tooth only in the ratchet q at each forward stroke of the drill. We are thus enabled to obtain an irregular automatic feed which will adapt itself with a great degree of nicety to the exact character of the rock on which the drill is operating, and to the cut of the drill itself, which are of great importance in this class of machinery.

We will now proceed to describe the manner in which the valve e is operated as the piston moves back and forth with the drill.

M is a rock-shaft supported in bearings u on the casing K and valve-chest F. To this shaft is secured a short arm, v, which is jointed to the stem 26 of the valve e. w a' are tappet-arms secured to the rock-shaft M by means of set-screws 27, by means of which their position may be adjusted as required, and these tappet-arms are raised and lowered to operate the valve e at the required times by means of the dogs b' b^2 on the ratchet-band h. The position of the tappet-arm a' on the rock-shaft is so adjusted that the dog b^2 will strike and raise it so as to close the inlet-port and open the exhaust-port in the valve-chest F just previous to the pawl of the ratchet-band r taking a new tooth for the feed, thus insuring the working of the valve e, whether the drill be fed forward or not. The position of the tappet-arms w a' may also be adjusted on the shaft M so as to operate the valve e at any required point and cause the air in a measure to cushion the piston D at the end of each stroke.

The automatic stop, by which the operation of the machine is arrested in case the drill should suddenly enter a hole or fissure in the rock or encounter a very soft or porous place in the rock will now be described.

N is a rod which slides in bearings c' on the valve-chests E F, and is retained in the position seen in Figs. 1 and 2 by means of a spiral spring, d'. The lower end of the stem of the valve 28, which commands the port b, is provided with a head, between which and the chest E it is surrounded by a spiral spring, e', by which it is drawn down. The upper end of the stem of the valve 28 is provided with a head or button, 29, under which the bent portion 30 of the rod N is drawn by the spiral spring d', as seen in Figs. 1 and 2. The valve 28 is thus retained up against the resistance of the spiral spring e', so as to admit the compressed air to the cylinder as required. In case, however, the drill should strike into a hole or fissure in the rock, or from any other cause penetrate suddenly too far, the dog b^2 will strike against the bent end 31 of the sliding rod N, carrying the bent portion 30 out from under the button 29, when the valve 28 will be carried down by the spring e', closing the inlet-port b andi nstantly cutting off the supply of compressed air from the cylinder, thereby avoiding the danger of concussion and injury to the machinery. On again starting it is simply necessary to set the valve in the position shown in Figs. 1 and 2.

It now remains to describe the manner in which the machine is attached to the clamp B, which, on loosening the screws f', may be turned around on the standard A in a well-known manner.

On one side of the cylinder C is formed a circular disk, O, the edge of which is beveled so as to fit under a curved lip, 32, of a corresponding bevel on the face of the clamp B. The opposite side of the disk O is confined by means of two latches, g', which are pivoted to the clamp B, as seen in Figs. 2, 3, and 7, and are pressed up to the beveled edge of the disk O against the resistance of spring-bolts h', Fig. 7, or other springs by means of set-screws i', thus confining the disk securely to the clamp B. By loosening the screws i', in connection with the screws f' of the clamp B, the disk, and with it the cylinder and drill, may be turned in any direction, either horizontally or vertically, so as to operate in the position required, and by withdrawing the screws i' until the latches g' are forced out by their springs so as to clear the edge of the disk O the machine may be removed from the clamp when desired.

We do not limit ourselves to the number of latches employed, as one or more than two may be used, if desired.

In Figs. 10, 11, and 12 is represented a modification of our invention, in which the ratchets k' l' are made to work in opposite directions instead of in the same direction, as above described, the slots m' n' being so curved or inclined as to produce the required movements of the pawls which operate them, in which case the pawl 33 must be raised out of the teeth of the feeding-ratchet k' by means of an inclined projection, 34, or other device, as seen in Fig. 12, just previous to the drill being turned by its ratchet, so as to prevent the drill from being fed forward more than the required amount, which would be the case (when the ratchets were made to work in opposite directions) if the pawl 33 were not raised out of the teeth of the feeding-ratchet k'. It will thus be seen that by making the ratchets work in opposite directions against each other, as above described, a positive feed is obtained without regard to the friction of the feeding-nut on the screw of the drill-spindle, while when both ratchets are made to work in the same direction, as first described, in case the friction of the feeding-nut on its screw should be sufficient to cause them to stick and turn together, no feed of the drill would be produced. When the pawl 33 is raised out of the teeth of the feeding-ratchet the feeding-nut P can be turned in either direction, so as to advance or withdraw the point of the drill as may be required in setting or adjusting the machine.

Instead of the ratchets being operated by pins running in curved or inclined slots in a shell or casing, K, as described, they may be operated by some other equivalent device without departing from the spirit of our invention.

Operation: The drill being pointed in the desired direction and secured in place by means of the clamp B with its latches g', and the piston D being at the forward end of the cylinder, the compressed air is admitted into the chest E through the pipe a, whence it passes into the cylinder in front of the piston, carrying it back in a direction contrary to the arrow 17, Fig. 4, the pin s, with the ratchet-band r, at the same time being turned as it travels in the curved portion of the slot 24, so as to turn the ratchet-band r and operate the feeding-ratchet q to produce the feed of the drill, as before explained. As the piston continues to travel in this direction the pin m enters the inclined portion of the slot n, turning the ratchet-band h so as to cause the pawl i to take a new tooth in the ratchet g. The pins m and s now travel in the straight portions of the slots n and 24 until the dog b' strikes the inclined edge of the tappet-arm w on the rock-shaft M, which, through the connection explained, opens the inlet-port and closes the exhaust-port in the valve-chest F, thus admitting the compressed air through the passage f into the cylinder behind the piston, causing it to travel in the direction of the arrow 17, Fig. 4, toward the front end of the cylinder against the resistance of the air on its front face, 16, carrying with it the drill, as required.

As soon as the pin m reaches the inclined portion of the slot n the ratchet-band h is turned so as to operate the ratchet g and turn the drill as required, to prevent its striking twice in the same place. The pin s now enters the curved portion of the slot 24, turning the ratchet-band r and causing the pawl to fall into the next succeeding tooth of the feeding-ratchet q, provided the nature of the rock is such as to permit the drill to penetrate sufficiently far to allow the pin s to advance to such a point in the curved portion of its slot that this will take place. If, however, as before explained, the character of the rock is such that the drill will penetrate until the pin s arrives nearly to the end of the slot 24, then the ratchet-band r will be carried round so far as to cause its pawl to take two teeth in the feeding-ratchet q, and thereby increase the feed as required. Just previous to the pawl

a^3 falling into the next tooth of the feeding-ratchet q the dog b^2 strikes the inclined edge of the tappet-arm a' on the rock-shaft M and moves the valve e so as to close the inlet-port and open the exhaust-port in the chest F, when the pressure of the compressed air on the front side, 16, of the piston D will carry it back in a direction contrary to the arrow 17, and the operation continues as before.

In the above description we have spoken of compressed air only as a motive power, but it is evident that steam may be employed equally as well, if preferred.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. The drill-spindle H, with its central feed-screw, 18, in combination with a hollow piston, D, and piston-rod G, operating substantially as set forth.

2. The ratchets g and q, operated by suitable mechanism in the same or opposite directions, in combination with the drill-spindle H, for the purpose of rotating the drill and feeding it forward, substantially as described.

3. The nut L, with its ratchet q, operated by suitable mechanism, in combination with the drill-spindle H, for the purpose of feeding it forward, substantially as set forth.

4. Increasing the amount of rotation of the ratchet q as the piston advances by means of the slot 24 and pin s on the ratchet-band r, or equivalent device, so as to produce the variable feed of the drill required by rocks of different consistency, substantially as set forth.

5. Introducing an elastic material, a^2, between the nut L, or part attached to the drill-spindle H, and the hub J, or part connected with the hollow piston-rod G, substantially as and for the purpose set forth.

6. The union-coupling o, for the purpose of connecting the feed-nut L with the hub J of the hollow piston-rod, substantially as described.

7. The rock-shaft M, with its adjustable tappet-arms w and a', moved by the dogs b' b^2, or equivalent device, for the purpose of operating the valve e and regulating the movements of the piston and drill, substantially as set forth.

8. The application to machinery for drilling rocks of an automatic stop so arranged that when the piston is driven beyond the desired point in the cylinder the compressed air or other motive power will be shut off and the blow checked.

9. The clamp B, having one or more latches, g', in combination with the beveled disk O, operating substantially as described.

10. The drill-spindle H, with its feed-screw cut thereon, substantially as described.

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