C. FERROUX.

Rock-Drilling Machine.

No. 167,324. Patented Aug. 31, 1875.

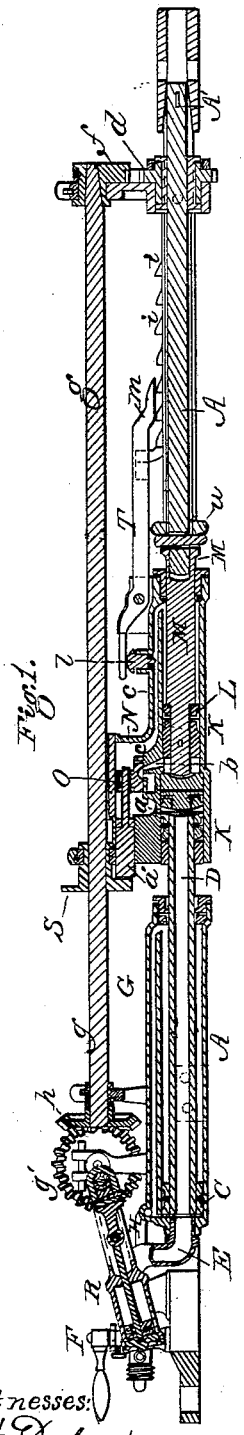

Fig. 1.

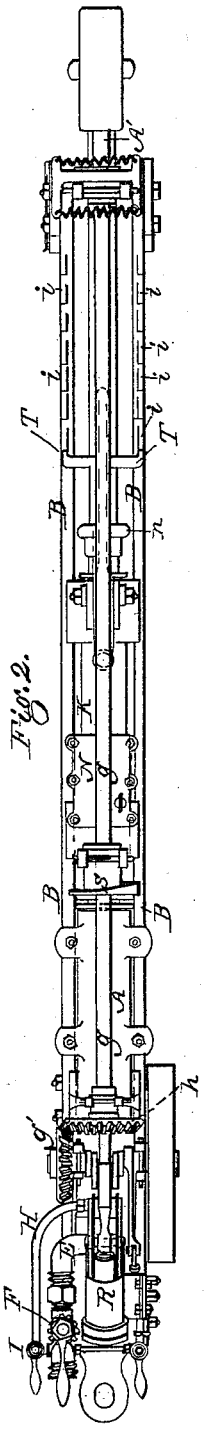

Fig. 2.

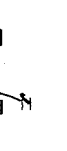

Fig. 6.

Fig. 5.

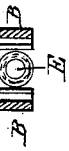

Fig. 4.

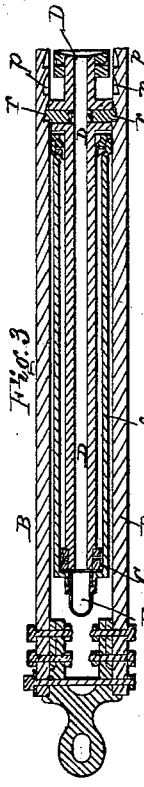

Fig. 3.

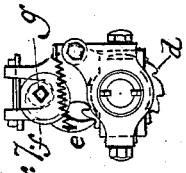

Fig. 7.

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CAMILLE FERROUX, OF GOESCHENEN, SWITZERLAND.

IMPROVEMENT IN ROCK-DRILLING MACHINES.

Specification forming part of Letters Patent No. **167,324**, dated August 31, 1875; application filed August 6, 1874.

To all whom it may concern:

Be it known that I, CAMILLE FERROUX, of Goeschenen, in Switzerland, have invented certain Improvements in Rock-Drilling Machines, of which the following is a specification:

This invention relates to that class of automatic machines, operated by compressed air or steam, in which the cutting-tool is attached to the end of a piston-rod by which the tool is alternately drawn back and thrust forward against the stone.

The invention consists in attaching the drill-operating cylinder and its connections to the end of a hollow piston-rod, by which all the drilling mechanism proper is advanced and withdrawn and the actuating air or steam supplied thereto; in a peculiar construction and arrangement of the two pistons and cylinders; in a peculiar arrangement of valve-operating and drill-rotating devices, and in various details, as hereinafter fully explained.

Figure 1 is a longitudinal vertical section of my machine through its center. Fig. 2 is a top plan view of the machine. Fig. 3 is a horizontal central section through the rear cylinder and the frame; Fig. 4, a transverse vertical section on the line *x x*; Fig. 5, a transverse vertical section on the line *z z*; Fig. 6, a front end view of the machine.

A represents a long cylinder, with closed ends, secured firmly between two long parallel bars, B, which form the frame of the machine and give support to all the other parts. In this cylinder there is mounted a sliding piston, C, provided with a hollow piston-rod, D, which extends out through a stuffing-box at the front end of the cylinder, and has the drill carrying and operating mechanism attached to its front end, as hereinafter described. To the rear end of the cylinder there is connected a pipe, E, having a cock, F, through which air or steam is admitted behind the piston, to force it and its hollow rod forward. The hole or opening in the piston-rod is continued through the piston, so that a portion of the steam or air entering behind the piston will pass forward and escape through the rod, for a purpose hereinafter explained. Lengthwise, on top of the cylinder A, there is formed a passage, G, opening at one end into the front of the cylinder, and connected at the other end with a steam or air pipe, H, having a cock, I, as shown in Figs. 1 and 2. Air or steam is admitted through pipe E, and tends constantly to force the piston C and piston-rod D forward when the machine is in operation. When the piston has completed its forward movement, the pipe E is closed, to shut off the pressure behind the piston, and then air or steam admitted through the pipe H and passage G, in front of the piston, so as to force the same backward. It is best to close the pipe H when the piston is moving forward, but it is not necessary to do so, for the reason that the rear area of the piston is greater than the front, in consequence of which the piston will move back when both inlets are open. Forward of the cylinder A, there is a second cylinder, K, connected rigidly to the front end of the hollow piston-rod D, and arranged to slide freely between the guide-bars B, which give it support, as shown in Figs. 1, 2, and 5. In the cylinder K there is mounted a piston, L, having a solid piston-rod, M, which extends out through a stuffing-box and has the tool carrier or rod A′ secured to its end, as shown in Figs. 1 and 2. On the outside of the cylinder K there is a valve chest or chamber, N, from which there are three passages, *a*, *b*, and *c*, the first communicating with the hollow piston-rod C, the second leading into the rear end of the cylinder K, behind the piston L, and the third leading into the front end of the cylinder in front of piston L, as clearly shown in Fig. 1.

In the chest N there is a slide-valve, O, the stem of which extends out through the side of the chest, and is operated in a manner hereinafter described. The air or steam passing forward through the hollow piston-rod C finds its way through the passage *a* into the chest N, whence it is admitted by the valve O, first behind, and then in front of, the piston L, which is thus caused to move back and forth and give the required striking-motion to the tool on its piston-rod. It will now be seen that the front cylinder and piston impart the striking or picking motion to the tool independently of the rear cylinder A and its piston, which serve merely to slide the front cylinder and the drill forward as the latter en-

ters the rock, and to draw them back to commence anew.

In order to give the required rotary motion to the tool the tool-rod or carrier A′ is provided with a spline, and passes through a ratchet-wheel, *d*, which is turned by a pawl, *e*, which latter is mounted on and operated by an eccentric, *f*, Figs. 1 and 7. The eccentric is mounted on the front end of a shaft, *g*, which extends the entire length of the machine above the cylinders. This shaft will be rotated by an engine of any suitable form, mounted on the rear end of the frame, a common reciprocating engine, R, being used in the present instance, and provided with a bevel-wheel, *g′*, gearing into a corresponding wheel, *h*, on the rear end of the shaft. The shaft *g* also carries a sliding cam-wheel, S, which acts upon the stem *a′* of the valve O, and pushes it inward at the proper times, the outward movement being caused by the pressure of the air or steam in the chest. The cam-wheel is mounted in a yoke on the valve-chest, so that as the cylinder K slides back and forth the cam is moved along on the shaft, and kept in proper position relative to the valve-stem. The advance of the forward cylinder and the cutting-tool, and the length of stroke of the latter, are controlled by a forked arm, T, which is pivoted to the top of the cylinder K, and arranged to engage at its front end in teeth *i* formed in the side bars B. The end of the arm is held down in contact with the teeth by means of a small piston, *l*, which is mounted in the top of the cylinder K under the rear end of the arm T, and in rear of its pivot. The pressure of the gas or steam within the cylinder forces the piston upward, and causes it to act against the arm. The arm is provided at the forward end with an incline, *m*, and the piston-rod M provided with an enlargement, *n*, which, when the piston makes its greatest stroke, strikes the incline *m*, and thereby raises the arm T clear of the teeth *i*, leaving the cylinder K free to advance. In order to prevent the hollow piston-rod D from being driven back by the percussion of the front piston L, teeth *p* are formed in the side bars B, and two small pistons, *r*, mounted in the sides of the hollow piston-rod, as shown in Figs. 3 and 6, so that the pressure of the air or steam will force the pistons out and cause them to engage with the teeth. As shown in Fig. 6, a spiral spring, *s*, is arranged to draw the pistons back from the teeth when they are relieved from the internal pressure.

The operation of the machine is as follows: Air is first admitted through the passage G to the front of the piston C, which, being forced back with its hollow piston-rod, draws back the front cylinder K and the drill-rod A′ until the end of arm T engages in the rearmost teeth *i*, and prevents the cylinder K from sliding forward, as shown in Figs. 1 and 2. The machine is then run forward until the tool comes in contact with the rock, while the piston L is near the back end of its cylinder K. The engine R is then set in motion to rotate the drill and the valve-operating cam S. Air or steam being admitted through the pipe E into the rear end of the cylinder A, tends constantly to push the piston C, the hollow piston-rod D, and the front cylinder K forward, and also, at the same time, passes through the hollow piston-rod D into the valve-chest N, from which it is admitted into the cylinder K, first in front and then in rear of the piston L, which, being thus driven to and fro in the cylinder, imparts a reciprocating motion to the cutting-tool, drawing the tool back and then driving it forward against the rock. Meanwhile, it will be remembered, the front cylinder is held from moving forward by the arm T engaging with the teeth *i*.

When the tool commences operation it comes in almost immediate contact with the rock, so that its movement and that of the piston L are very short; but as the tool enters the rock the movement of the piston increases until finally it moves the entire length of the cylinder K, when, of course, the drill can enter no farther.

When, however, the piston attains its full stroke the enlargement *n* on the end of its rod rides under the incline *m* of arm T, and raises the latter clear of the teeth *i*, thus releasing the cylinder K, which is immediately pushed forward by the piston C and hollow rod D until the arm T comes in contact with the next pair of teeth *i*. This advance of the cylinder K permits the drill to advance until it again makes a full stroke, when the arm T is again raised, and the cylinder advances as before. These advances of the drill-operating cylinder continue until it reaches the front end of the frame, when it is drawn back, and operations commence anew.

While, as stated, the drill-operating cylinder is ordinarily advanced from tooth to tooth, it will be noticed that the stroke of the tool is not limited to that extent. By feeding the machine forward at the proper speed the drill-piston may be allowed to move nearly the length of cylinder K at all times.

It is obvious that instead of using the piston *l* to depress the front end of the arm T a spring may be employed.

Having thus described my invention, what I claim is—

1. The rock-drilling machine, consisting of the parallel bars B, the fixed cylinder A secured between the rear ends of the bars, and provided with the piston and piston-rod D, and the sliding cylinder K supported by the bars, and attached to the piston-rod D, and containing the piston L and drill-carrying rod M, all arranged and operating as shown and described.

2. In a rock-drilling machine, the combination of a sliding cylinder, K, provided with the drill-operating piston, and urged constantly forward by means of a cylinder and piston behind it, and a dog, T, attached to the sliding cylinder, engaging in a fixed rack, to prevent

the advance of said cylinder, and arranged to be released by the piston when the latter is at full stroke, as shown and described, whereby the drilling-cylinder is advanced by the direct and instantaneous action of the rear piston in regular steps or stages, and automatically.

3. In combination with the stationary cylinder A, piston C, and sliding cylinder K, the hollow piston-rod D, serving both to communicate motion to the cylinder K and to conduct air or steam thereto.

4. In combination with the cylinder K and the arm T pivoted thereon, the piston *l*, arranged and operating as shown and described.

5. In combination with the hollow piston-rod D, and the bars B having the teeth *p*, the small pistons *r* mounted in the rod D, and engaging in the teeth, as shown.

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