(No Model.)

L. B. STONE.

STEAM ROCK DRILL.

No. 248,896. Patented Nov. 1, 1881.

Fig. 1.

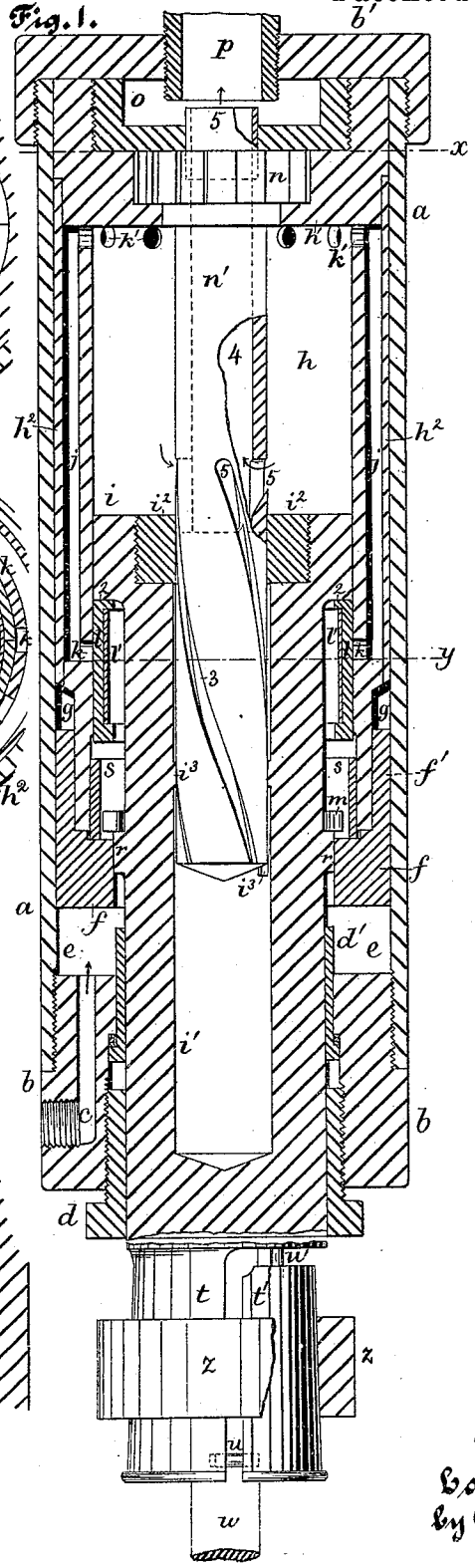


Fig. 2.

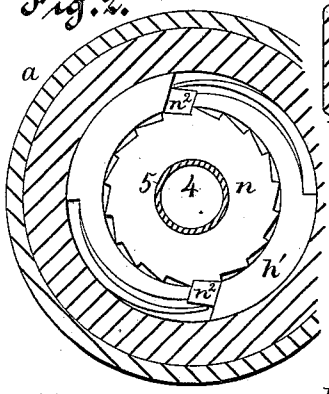


Fig. 3.

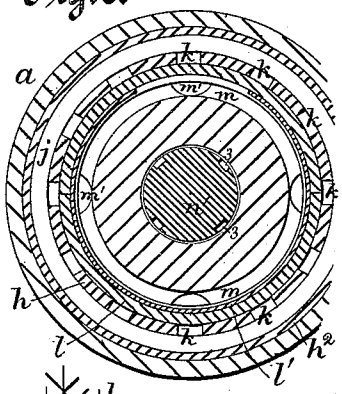


Fig. 4.

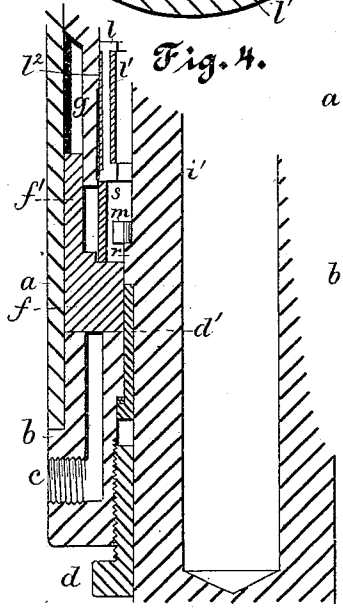
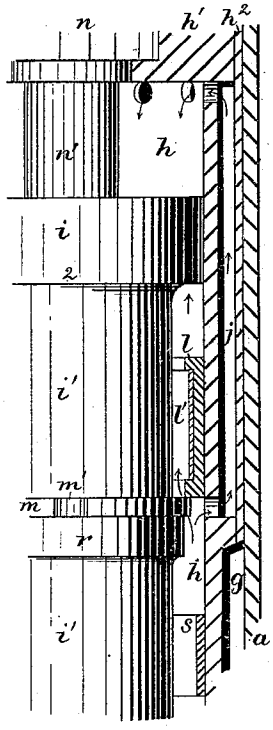


Fig. 5.



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STEAM ROCK-DRILL.

SPECIFICATION forming part of Letters Patent No. 248,896, dated November 1, 1881.

Application filed August 1, 1881. (No model.)

To all whom it may concern:

Be it known that I, LAWSON B. STONE, of Marblehead, Essex county, State of Massachusetts, have invented an Improvement in Steam Rock-Drills, of which the following description, in connection with the accompanying drawings, is a specification.

My invention relates to rock-drills; and it consists in certain improvements whereby the construction of the parts is made simpler, more durable, and less expensive, and the operation is more perfect, there being no dead-points.

In the following description the term "downstroke" will mean the stroke toward the rock, and "upstroke" away from the rock, and the words "upper" and "under" will be used as if the drill were acting upon the rock vertically beneath it, although it is to be understood that the drill can be set to bore in any desired direction.

The working-cylinder is contained in an outer casing, into which the actuating-fluid is admitted near its lower end when it first acts upon the under surface of the piston to produce its upward stroke, and the said cylinder is provided with ports connecting the space above and below the piston, and controlled by a cut-off valve that is properly actuated by the piston and projections upon the piston-rod to open the said ports when the piston and drill has nearly finished its upward stroke, thus permitting the fluid to act also upon the upper surface of the piston, which is of larger area than the under surface, so that the piston is forced down by the pressure due to the difference in these areas, and when near the end of its downstroke carries the cut-off valve to close the ports, and thus remove the live-fluid pressure from the upper side of the piston to permit it to make its next upstroke. A pin that passes through the piston and a portion of the piston-rod is arranged to cause the latter to rotate as usual in making its stroke, and acts as an exhaust-valve for the space within the cylinder above the piston, it permitting the escape of the actuating-fluid from the said space when the drill has completed its downstroke. These elements are found in the drill patented to J. B. Johnson, No. 213,663, March 25, 1879, upon which the present invention is intended as an improvement. In the present invention the working-cylinder is fixed in the outer casing, and fed therewith to advance the drill into the rock by feeding mechanism of any usual and suitable construction. The piston-rod passes out through a stuffing-box in the lower head of the case, through which steam is admitted by a suitable inlet-passage, an annular recess being formed above the lower head of the case, between the sides of the said case and the gland of the stuffing-box surrounding the piston-rod.

An annular block, which is herein denominated a "cushion" or "auxiliary" piston, since under some circumstances it acts as a piston to move the piston-rod, is longitudinally movable within the case in and out from the said annular recess above the inlet-port, in which it has a working fit. An annular shoulder upon the piston-rod fits within this auxiliary head when the rod is at the end of its downstroke, and if the drill be in a vertical position the auxiliary piston will drop into the annular recess, and with the piston-rod and its said shoulder will fill the entire outer casing, so that when steam is admitted it will act upon the under surface of the said auxiliary piston and shoulder to raise them and the piston-rod making the beginning of the upstroke.

An annular lug at the upper end of the shoulder on the piston-rod is engaged by the upper end of the auxiliary piston, causing the said rod to move positively therewith until the said auxiliary piston is stopped by engaging with the lower end of the cylinder, when the steam acting upon the annular shoulder causes the piston-rod to continue its upstroke until the shoulder has passed from within the auxiliary piston, leaving the space previously occupied by it free for the passage of the actuating-fluid to reach the under side of the piston proper, causing it to finish its upstroke, during which the annular lug on the piston-rod, which may be called the "valve-actuating lug," engages the cut-off valve and moves it above the lower openings of the connecting-ports of the cylinder, permitting the fluid to pass through the ports and act upon the upper surface of the piston.

The exhaust pin or valve is made tubular or provided with a longitudinal passage communicating with an exhaust-chamber below the

upper head of the casing, from which the exhaust-steam may be led in any desired direction, and is provided with ports leading into the cylinder and properly located to be uncovered by the piston when it has completed its downstroke, during which the under side of the piston has acted upon the cut-off valve to close the connecting-ports before the said exhaust-ports are open, so that a passage will not be afforded for the inlet-port through the said connecting and exhaust ports into the said exhaust-chamber to permit the steam to blow through without operating the drill.

Should the drill in its downstroke fail to meet with the rock or other obstructions, the piston will travel with its momentum until the annular shoulder upon the rod enters the auxiliary piston, it being meanwhile cushioning upon the actuating-fluid, which always acts upon its lower surface, and should it go far enough the annular lug above the said shoulder will engage the auxiliary piston and carry it into the annular recess at the lower end of the case, where it will be brought to rest by the cushioning action of the fluid upon its large area without shock to the lower head of the case.

A stop-ring is interposed between the cut-off valve and the upper surface of the auxiliary piston, which, in case of such excessive stroke or overshot of the drill, will prevent the said cut-off valve from passing beyond and uncovering the connecting-ports before the shoulder has entered the auxiliary piston and closed the casing to prevent the fluid from reaching the cylinder at all; and in the upstroke the said stop-ring and auxiliary piston will cause the valve to close the said ports before the said shoulder leaves the auxiliary piston.

Instead of making the usual large connecting-ports in the cylinder by coring, the external diameter of the cast cylinder is made considerably smaller than the internal diameter of the casing, and a thin tube, preferably of steel, fitting in the said casing, is placed over the cylinder, forming the outside thereof, an annular space thus being left between the said tube and cast portion of the cylinder to form a continuous passage for the actuating-fluid, into which a sufficient number of small port-openings are made in the proper position near either end of the cylinder, such openings forming less obstruction to the movement of the cut-off valve than the larger port-openings shown in the former patent referred to. The valve is made to fit between the cylinder so closely as to remain held by its friction in any position until positively moved therefrom, and consists of a main portion cut longitudinally and chambered upon its inside to receive an elastic tube set with a tendency to spring outward and press the main portion against the inside of the cylinder, it also covering the saw-cuts in the main portion, which receives the positive blows of the piston and actuating-lug upon the piston-rod.

Figure 1 is a longitudinal section of the drill constructed in accordance with this invention, the piston being at the end of its downstroke; Fig. 2, a transverse section on line *x*, Fig. 1; Fig. 3, a transverse section on line *y*, Fig. 1; Fig. 4, a partial section, showing the relative position of the ports when the piston is in its lowest position as before the actuating-fluid is admitted; and Fig. 5, a similar partial section, showing the piston near the end of its upstroke, at the point where the fluid is first admitted to produce the downstroke.

The outer casing, *a*, consists of a tube or cylinder made smooth outside and inside, and provided at its lower end with a head, *b*, containing the main inlet-port *c*, and provided with a stuffing-box, *d*, the upper gland or bushing, *d'*, of which extends through the head *b* in the casing *a*, thus forming an annular recess, *e*, just above the said head. The auxiliary piston or cushion *f* is made to fit within the said recess *e*, as shown in Fig. 4, and to move longitudinally in the casing *a* as a cylinder under the pressure of the fluid entering the port *c*, the said auxiliary piston having an upward projection, *f'*, which enters a recess, *g*, between the casing *a* and the lower end of the working-cylinder *h*, the upper end, *h'*, of which is turned to fit the casing *a*, while the portion traversed by the piston *i* is made of considerably smaller external diameter than the said casing, and receives a tube, h^2, fitting tightly upon the ends of the said cylinder and of sufficiently large bore to leave a space, *j*, entirely surrounding the main portion of the cylinder to form a connecting port or passage between its upper and lower ends, a series of small port-openings, *k k'*, being made from the inside of the cylinder, at either end thereof, into the said passage *j*. The lower port-openings, *k*, are controlled by a valve, *l*, actuated by the under surface, 2, of the piston *i* in its downward movement to close the said openings *k*, and by the valve-actuating lug *m* upon the piston-rod *i'* in the upward movement thereof to uncover the said port-openings and permit the fluid to pass through the passage *j* and act upon the upper surface of the piston *i*, as shown by the arrows, Fig. 5.

The main portion of the valve *l* is divided by two or more longitudinal saw-cuts, as indicated in Fig. 3, (the plane of section of Fig. 1 passing through them as indicated by the omission of the diagonal hatchings,) in order to permit it to expand to press against the inner walls of the cylinder *h*, so that it will remain wherever left therein until positively moved by the under face, 2, of the piston *i*, or by the actuating-lug *m*, and the inside of the said valve is counterbored or chambered to receive the spring-ring *l*, properly set to force the said portions of the valve outward against the cylinder, it also serving to cover the saw-cuts, as shown in Fig. 3. The main portion *l* is of suitable metal to withstand the blows of the piston *i* and lug *m*, it being somewhat malleable, so that it will upset and thus keep the saw-cuts closed. When necessary it may receive

a covering upon its outer surface of proper material to work well upon the inner surface of the cylinder *h*, such a covering being shown at l^2, Fig. 4.

The lug *m* is provided with ports *m'*, to permit the passage of the steam between the piston-rod *i* and the valve *l* when the said lug and valve are in contact, as shown in Fig. 5.

The head *h'* of the cylinder *h* is chambered to receive the ratchet-head *n* of a pin, *n'*, extending down into the cylinder *h*, and passing with a piston fit through a bushing, i^2, in the piston *i*. The lower end of the said pin is provided with spiral channels 3, engaging wings i^3 in the piston-rod *i'* to cause the said rod to rotate in making its upstroke, the ratchet *n* and pin *n'* being then prevented from rotating by the pawls n^2, Fig. 2, in the usual manner. The said pin *n'* is bored axially at its upper end, or provided with a longitudinal exhaust-passage, 4, into which exhaust-openings 5 lead from the upper ends of the channels 3, the said openings, when uncovered by the bushing i^2 at the end of the downstroke of the piston, permitting the fluid to escape from the cylinder *h*, as shown by the arrow, Fig. 1, the port-openings *k* being closed by the valve *l* before the said openings 5 are uncovered. The ratchet *n*, connected pin *n'*, and pawls n^2 and their springs are held in place in the head *h'* of the cylinder by a follower, *o*, which forms an exhaust-chamber, into which the exhausting-fluid is conducted from the passage 4 by a short union or nipple, 5. The exhaust may be led from the said exhaust-chamber through any suitable passage, as by the tube *p*, herein shown as passing through the head *b'* of the casing *a*.

An annular shoulder, *r*, upon the piston-rod *i'* below the valve-actuating lug *m* enters the auxiliary piston *f* if the drill in its downstroke fails to meet the rock or makes abnormally long strokes, owing to the failure of the entire machine to be fed forward as fast as the rock is cut, and if the abnormal downward movement or overshot is sufficiently great, the lug *m* will engage the said piston *f*, causing it to move with the rod *i'* in the casing *a* as a cylinder until the movement is arrested by the fluid in the recess *e*.

A stop-ring, *s*, in the lower end of the cylinder *h* prevents the valve *l* from being thrown below the openings *k* before the shoulder *r* enters the piston *f*, and thus prevents the passage of fluid to the said port-openings, and when the drill is started after having stopped in its lowest position, (shown in Fig. 4,) with the piston *f* in the recess *e*, the stop-ring *s*, in conjunction with the said piston *f*, moves the valve *l* sufficiently to close the openings *k* in the beginning of the upstroke.

The gland *d'* of the stuffing-box *d* is made adjustable, as by means of washers in the head *b* above it, so as to govern the amount of opening for the actuating-fluid between it and the auxiliary piston *f*, when in the position shown in Fig. 1.

The piston-rod *i'* carries at its lower end the drill-holding chuck, (shown in Fig. 1 in the extreme upward position.) It consists of a tapering portion, *t*, continuous with the rod, and a corresponding tapering block, *t'*, detached from the portion *t*, but retained in place thereon by the dowel-pins *u u'*. The said portions *t t'* are provided with a socket to receive the drill-bit *w*, upon which they are tightly wedged by the tapering ring *z*, which acts by its momentum to tighten the hold of the clamp at every blow of the drill.

By the employment of the dowel-pins *u u'* the movable block *t'* will be held in place when the ring *z* is knocked upward to release the drill instead of dropping out, as occurs in the ordinary chuck, which is made without the said pins; but by an extreme upward movement of the ring *z* the block *t'* may be removed, as is desirable when, owing to the situation of the machine, it is necessary to remove the drill-bit laterally from the chuck.

The fluid, when entering with the ports in the position shown in Fig. 4, first acts upon the auxiliary piston *f*, and by the lug *m* and ring *s* raises the piston-rod *i'* and valve *k* until the said auxiliary piston is positively stopped by the lower end of the cylinder, as shown in Fig. 1, the valve *l* then closing the openings *k*, after which the piston-rod *i*, with its momentum and the fluid-pressure on the shoulder *r*, will continue its upward movement until the said shoulder has passed out of the piston *f*, when the fluid will pass therewith and act on the under surface, 2, of the piston *i*, causing it to complete its upstroke, during which the projections *m* will have engaged the valve *l* and moved it above the openings *k*, as shown in Fig. 5, to permit the fluid to pass through the passage *j* and act on the upper surface of the piston *i*, first checking its upward movement and then causing it to make its downstroke. The valve *l* remains held by its friction above the ports *k* until engaged by the under surface, 2, of the piston *i* a short space in its stroke before the exhaust-openings 5 are uncovered, the stroke being finished to uncover the said openings by the expansion of the fluid above the piston; and for most effective operation the drill should meet the rock as soon as the said exhaust-openings 5 are uncovered.

It will readily be seen that if a sufficient downstroke is permitted to uncover the said exhaust-openings 5 the drill will operate positively and continuously, it starting from any position in which it may have been stopped or placed, and operating without dead-points or any opportunity for the steam to blow through ineffectually.

In its normal and most effective operation the piston in its upstroke will nearly reach the top of the cylinder *h*, it being carried by its momentum above the position shown in Fig. 5, and the machine should be fed fast enough to cause the downstroke to be terminated somewhat above the position shown in Fig. 1 just before the shoulder *r* enters the auxiliary piston *f*.

I claim—

1. The outer casing and its head provided with an inlet-port, combined with the piston-rod passing through the said head, and the auxiliary piston working in the said casing, and adapted to engage the said piston-rod and act as a piston therefor during a certain portion of its stroke, substantially as and for the purpose described.

2. The casing with its head containing the inlet-port, and provided with a stuffing-box arranged to form an annular recess above the said head, combined with the auxiliary piston fitted to the said recess, and the piston-rod provided with a shoulder fitted to the said piston and operating in conjunction therewith in the said casing as a cylinder, substantially as described.

3. The casing provided with an inlet-port near its lower end, and the working-cylinder provided with a connecting port or passage from the space below to that above the piston, combined with the piston and the exhaust pin or valve fitted therein, the said pin being provided with a longitudinal exhaust-passage leading through the cylinder-head, substantially as described.

4. The herein-described valve, consisting of a main tubular portion divided longitudinally and counterbored or chambered internally, combined with a spring-ring located in the said chamber, to press the said parts outward against the containing-cylinder, and adapted to cover the lines of division of the main portion of the valve, substantially as described.

5. The herein-described working-cylinder, it consisting of a main cast portion properly bored internally, and a tubular jacket surrounding it and inclosing a space upon the outside of the main bored portion, which is provided with series of small port-openings passing from its interior into the said space, substantially as and for the purpose described.

6. In a rock-drill, the combination, with the reciprocating piston-rod, of the chuck consisting of a half-round tapering portion continuous with the said rod, and a corresponding half-round tapering movable block, and an internally-tapering ring adapted by its longitudinal movement to wedge the said portions together upon the drill-bit, combined with dowel-pins to hold the said fixed and movable portions together and prevent the latter from dropping when loosened to release the drill-bit, substantially as described.

7. The outer casing and working-cylinder therein, provided with a port and a frictionally-held valve to control it, and a piston and a piston-rod to actuate the said valve, combined with the auxiliary piston for the said piston-rod working in the said casing, and the stop-ring interposed between the said valve and auxiliary piston, and co-operating with the latter to control the valve, substantially as and for the purpose described.

8. In a rock-drill, the cylinder consisting of an inner and outer tube, having an annular space inclosed between them, and provided with series of port-openings near either end thereof, connecting the said space with the interior of the cylinder, combined with a valve to control one of the said series of openings, and the piston, piston-rod, and valve-actuating lug thereon, arranged and to operate substantially as and for the purpose described.

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

LAWSON B. STONE.

Witnesses:
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