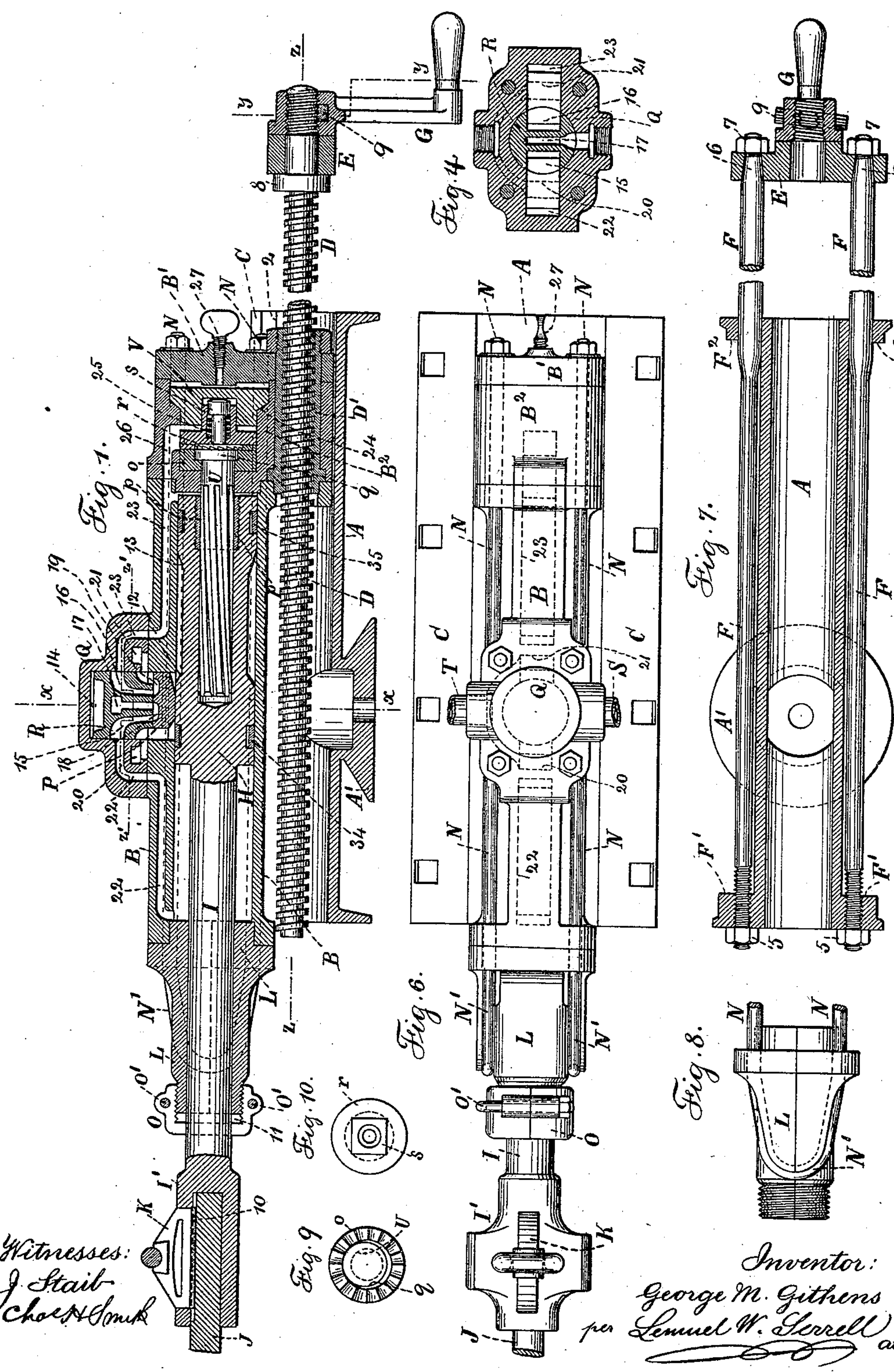
(No Model.) 2 Sheets—Sheet 1.

G. M. GITHENS.

ROCK DRILL.

No. 457,348. Patented Aug. 11, 1891.

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(No Model.)

2 Sheets—Sheet 2.

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Fig. 5.

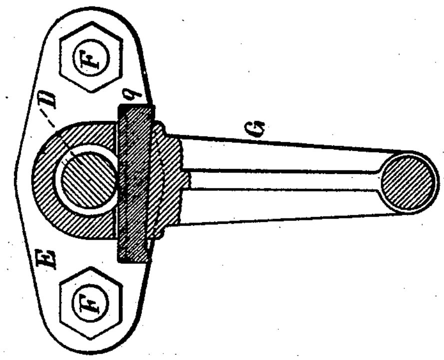



Fig. 3.

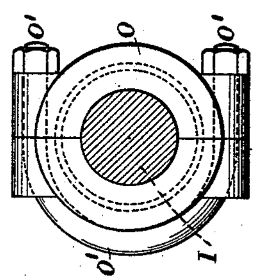
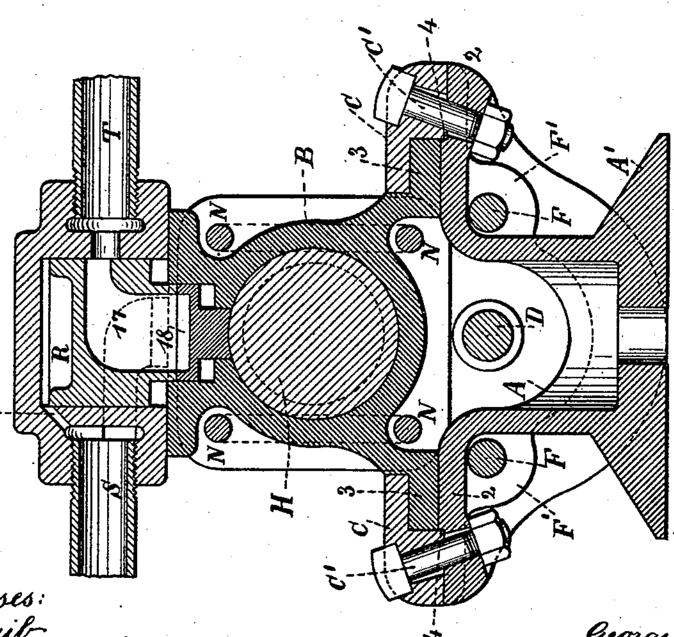



Fig. 2.

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# UNITED STATES PATENT OFFICE.

GEORGE M. GITHENS, OF BROOKLYN, NEW YORK.

## ROCK-DRILL.

SPECIFICATION forming part of Letters Patent No. 457,348, dated August 11, 1891.

Application filed March 13, 1891. Serial No. 384,860. (No model.)

*To all whom it may concern:*

Be it known that I, GEORGE M. GITHENS, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented an Improvement in Rock-Drills, of which the following is a specification.

Rock-drills that are actuated by steam or compressed air are subject to strain and rapid concussion that tend to loosen the respective parts, and unless such looseness can be compensated from time to time there is a hammering action that rapidly destroys such parts.

The object of the present invention is to provide for easily tightening the respective parts, separating the parts in case of wear or injury, and for rapidly repairing such parts, and for preventing concussion in the valve or any of the parts of the machine, and for placing the entire apparatus under the control of the attendant, and adapting the apparatus to the various circumstances of use.

In the drawings, Figure 1 is a longitudinal section of the cylinder and parts connected therewith. Fig. 2 is a cross-section at the line *x x*. Fig. 3 is a detached view of the piston-rod gland. Fig. 4 is a horizontal section at *z' z'* of the steam-ports, and Fig. 5 is a cross-section at the line *y y* of Fig. 1. Fig. 6 is a plan view of the machine without the feed-screw and connected parts. Fig. 7 is a longitudinal section at the line *z z* of Fig. 1, the feed-screw and its nut being removed. Fig. 8 is a detached view of the cylinder-head. Fig. 9 shows the annular ratchet and head of the rotator. Fig. 10 represents the back of the opposite ratchet-disk. Figs. 2, 3, 4, and 5 are on a larger scale than the other figures.

The stock or bed A is provided with a conical base A', to which is connected any suitable clamping device for the legs, tripod, or other support usual in rock-drills, and upon this bed A are flanges 2, upon which rest the flanges 3 of the cylinder B. This cylinder is movable endwise upon the stock or bed by a screw hereinafter described, as usual in rock-drills, and I find it very important to prevent looseness of the flanges 3 in their connection to the bed A. Heretofore these flanges 3 have been held by the guide-bars C, bolted to the flanges 2; but such bolts have passed perpendicularly through the flanges 2. The wear, however, comes almost entirely upon the outer edges of the flanges 3, and it is necessary to be able to set up the guide-bars C without clamping the flanges 3 rigidly, because such flanges 3 must be free to move between the bars C and the flanges 2. To provide for these difficulties I make use of diagonally-placed bolts C', the holes for which are slightly larger than the bolts, and these bolts pass through the guide-bars C and through the flanges 2, and they are placed in the positions shown in Fig. 2. Hence in screwing up the nuts of the diagonal bolts the guide-bars C are pressed toward the outer edges of the flanges 3, and if the flanges 3 become worn, so as to move loosely between the guide-bars C and the flanges 2, it is only necessary to file away the edges 4 upon the flanges 2 sufficiently to allow the guide-bars to be set up closely against the outer edges of the flanges 3, thereby compensating for wear and at the same time preventing the flanges 3 being clamped in such a manner as to interfere with their free end movement under the action of the screw D. The screw D passes through the nut D' within a projection upon the cylinder B. This nut and screw may be of any desired character—such, for instance, as that shown in my patent, No. 362,617, granted May 10, 1887. The screw D passes through the cross-head E, which is sustained by the rods F, as usual in rock-drilling machines. I however have found that these rods are liable to become bent or broken, and they frequently need to be removed and straightened and sometimes mended.

One feature of my present invention relates to the manner in which these rods are fitted in place to facilitate straightening. It is preferable to make the portions of these rods F that extend beyond the stock A of larger diameter than the portions that pass between the lugs $F^2$ and the lugs F' on said stock A, and the holes in the lugs $F^2$ are sufficiently large for the rods F to pass through them, but fit tightly, and the ends of the rods F that pass through the lugs F' are screw-threaded for some distance, so that such rods F may be screwed through said lugs to any desired point and receive upon their ends the lock-nuts 5, so that by this means the tapering portions 6 of the rods F may be brought into proper position for the reception of the cross-head E, such tapering portions 6 of the rods F passing through tapering holes in the cross-head E, and the nuts 7 on these ends of the rods F holding the cross-heads E firmly, and the parts are not liable to shake loose under the concussion of the rock-drill. By this construction it is more easy to remove and straighten the rods F, if bent, and if the rods are broken they can be pieced and mended without requiring the usual accuracy in measurements, because the rods can be screwed through the lugs F′ more or less.

In rock-drilling machines it is usual to rotate the feed-screw D by means of a crank G, and there is a collar 8 upon this feed-screw which sets against one side of the cross-head E, and in order to separate the parts for repairs this crank G must be removable from the screw. A convenient way for removing this crank is to unscrew the same from the screw-threaded end of the feed-screw D; but to prevent such crank from turning on this screw or becoming loose has been a serious difficulty, and the devices that have been employed for tightening the crank upon this screw have been liable to be misplaced or lost. I make use of a key 9, introduced through a mortise in the hub of the crank, and the mortise is not cut parallel with the face of the crank I, but it is cut at an inclination corresponding to the angle of the screw-thread at the end of the feed-screw, and the key 9 is grooved upon its face that is next to the screw, the grooves corresponding in size and pitch to the screw-threads, and the key is made with a head, and the parts are constructed so that the key can be put through the mortise before the crank is screwed upon the end of the feed-screw, and when this has been done the key cannot fall out, but it is capable of a slight motion endwise in either direction. Hence after the crank has been screwed upon the end of the feed-screw until the hub of the crank sets closely against the cross-head E the crank is firmly affixed, so that it will not turn upon the screw, by simply driving up the key 9, which clamps the crank-arm to the screw of the feed-screw without injuring the screw-thread, and should there be any looseness at the cross-head between the collar 8 and the hub of the crank G the key 9 can be loosened by a blow on the end, the crank turned upon the feed-screw to take up the looseness, and then the key 9 driven endwise into its place to clamp the parts, and this can be done with facility, and only requires an ordinary hammer, and if the parts have to be separated this can be done by simply loosening the key 9. A nut may be provided at the small end of the key to draw the same up tightly.

Within the cylinder B is a piston H, with a piston-rod I and a tool-holding stock I′. These parts are preferably made of one piece of metal, and the stock has a central cavity or recess for the tool or drill J, and I make use of an elastic key K, similar to that shown in my patent, No. 426,640, granted April 29, 1890.

In consequence of the piston, the piston-rod, and the stock being made in one piece, the cylinder-head has to be made in two parts. I have represented the cylinder-head L as divided longitudinally and provided with a central opening for the piston-rod and with an annular flange passing into the end of the cylinder, and I make use of the double bolts N for simultaneously securing the cylinder-heads B′ and L and pressing the two parts of the cylinder-head L tightly together. These double bolts N are bent U-shaped at N′, and are received into inclined and round-ended grooves in the surfaces of the cylinder-head L, the division between the two parts of the cylinder-head being at right angles to the plane of each double bolt, so that the U-shaped portions of these double bolts tend to press the parts of the divided cylinder-head L together. These double bolts are well adapted to resist concussion in cases where the piston strikes against the cylinder-head, because there are not any nuts or screws on such bolts near the head L, and such bolts, being U-shaped, are slightly elastic. The cylinder portion of the divided cylinder-head L beyond the bolts N is screw-threaded upon its exterior surface to receive the gland or cap O, which also is made in two parts that are held together by the U-shaped bolt O′, and the interior of this gland or cap is fitted to screw upon the screw-threaded portion of the divided head L, and there is a packing at 11, surrounding the piston-rod and between the end of the head L and the gland or cap O. The parts are so constructed that this cap O will screw upon the head L and compress the packing 11 properly, and by tightening up the nuts of the U-bolt O′ the cap O will be held firmly in its position, so that it cannot shake loose by the vibrations of the rock-drill, and there is sufficient spring or elasticity in the U-shaped bolt O′ to prevent the nuts thereof becoming loose; but whenever the packing 11 needs to be set up it can be easily accomplished by loosening one of the nuts on the bolt O′.

In rock-drills the valve has been moved by a direct action from the piston, as shown in the patent, No. 362,617, heretofore granted to me. In my present invention the valve is controlled by the joint action of the pressure of the steam, air, or actuating-fluid and the movements of the piston, and it is rendered very reliable and efficient in its operation by the features of construction next described. The piston H is reduced in its diameter in the center part thereof, and there are inclines 12 and 13 at the end portions of the reduction, and such inclines act upon the valve P, and this valve is in a recess in the cylinder B adjacent to the steam-chest Q, and within the steam-chest is a movable valve seat or carrier R, that can move freely toward or from the piston to keep the under surface of the valve P in contact with the surface of the piston. To effect this object steam or fluid under pressure is to be admitted by the pipe S, and there is a smaller hole 14, Fig. 2, to admit the pressure to act on the outer or upper face of the valve-carrier R and tend to force the valve-carrier and valve toward the piston, and in this valve-carrier are ports 15 and 16 for the steam and a port 17 for the exhaust, and there is an exhaust-pipe at T adjacent to the lateral opening of the exhaust-port 17. The face of the valve P is against the valve-seat of the carrier R, and this valve P is preferably a double **D** slide-valve having ports 18 and 19, and in the steam-chest and communicating with the pipe S are the ports 20 and 21, which ports open inwardly into the space occupied by the valve and valve-carrier, and it will be observed that the valve is shorter than the valve-carrier, so that such valve may receive an end motion in either direction from the inclines 12 and 13. There are ports 22 23 leading from the steam-chest to the respective ends of the cylinder B, and the ports 15 16 are wide enough to be always open to these ports 22 23 when the carrier R is moved up or down. The operation of these parts is that as the piston rises and the drill is withdrawn the incline 12 comes against the valve P and moves the same upon the valve-seat to bring the port 19 in position for steam to pass from the inlet-port 21 through the ports 19, 16, and 23 to drive the piston and drill in the opposite direction at the same time the port 18 opens the exhaust from the port 22 at the other end of the cylinder by the ports 15 and 18 and exhaust-port 17, and as the drill is projected the incline 13 of the piston strikes the valve P and moves the same to the reverse position, shutting off the supply of steam above the piston and opening the exhaust for the same through 23, 16, 19, to 17, and at the same time admitting steam from 20 through 18, 15, and 22 to the lower end of the piston to drive the piston in the opposite direction and withdraw the drill. It will be observed that during these operations the full pressure of the steam is acting between the steam-chest and the top of the carrier R by the steam that passes through the hole 14, and there will always be a minus pressure upon the opposite side of the valve-carrier and valve, because one side or the other will be open to the exhaust or to the less pressure that there is in the cylinder, in consequence of the rapid movement of the piston in first one direction and then the other, and it is usual to apply packing-rings 34 35 around the piston toward the ends thereof, so that any steam that may be in the recess around the piston cannot escape in either direction.

In the operation of rock-drills it is well known that where the rock is hard the drill rebounds and the rock-drill can be driven with a rapid movement; but where the rock is soft there is but little rebound and the drill runs with a much slower movement. It is of course advantageous to strike the rock that is hard with a heavy blow and the soft rock with a lighter blow.

In rock-drilling machines heretofore made the fluid under pressure is admitted in such a manner that with a rapid movement there is but a light blow. By the present arrangement the apparatus is automatic for giving a heavy blow with a rapid movement. This is effected in consequence of the inclination 13 upon the piston moving the valve in proportion to the speed. When the piston is moving slowly, the friction of incline 13 against the valve moves the latter rapidly to admit the steam for raising the piston and drill and thus lessening the force of the blow; but when the piston is moving with rapidity the incline 13 does not overcome the inertia of the valve to move the same with it at as early a portion of the stroke. Thereby the fluid under pressure is allowed to act for a longer time in giving a full blow by the drill and the valve is shifted at a later point in the stroke of the piston to admit the fluid for raising the piston. This feature is of importance in the efficient operation of the rock-drill.

In rock-drills it is usual to partially rotate the piston and the drill between one blow and the next. Difficulty has heretofore been experienced in applying a rotative device that was reliable in its action and at the same time allowing the rotative device to turn under abnormal conditions—such, for instance, as the end of the drill striking into a seam. The devices next described effect these objects and overcome these difficulties. The intermediate cylinder end $B^2$ is fitted into the end of the cylinder B between the same and the head B′ and it is held by the double bolts N, as aforesaid, and there is within this cylinder end $B^2$ a disk *o*, through the center of which and through a hole in the cylinder end passes the rotator U, formed as a plug within the piston H and provided with longitudinal inclined grooves for receiving similar ribs in the nut *p*, which is screwed firmly into the interior of the piston H. Hence when the piston is moving over this rotator it will be turned by the rotator when such rotator is held stationary; but when the rotator is allowed to revolve or turn the piston will move back and forth without being rotated.

Difficulty has heretofore been experienced in connecting the rotator U with the disk or ring *o*, because in the rapid movement any key or screw is liable to be broken or become loose. I therefore provide upon the end of the rotator U an eccentric flange *q*, passing into an eccentric recess in the disk or ring *o*. Hence by fitting these parts and driving the rotator through the ring *o* and forcing the eccentric flange into its eccentric recess the rotator and the ring are firmly connected and will move together. Upon the face of the ring $o$ are ratchet-teeth, and there is an annular ratchet $r$, the teeth of which fit the teeth in the ring $o$, and this annular ratchet $r$ has a polygonal stem $s$, passing into the friction-valve V, that fits loosely into the end portion of the intermediate cylinder $B^2$, the surface 24 being conical, similar to a valve; but the cylindrical portions of this valve V fit the interior of the intermediate cylinder $B^2$ loosely, and there is a steam-space between the head B′ and the back face of this valve V, and upon the inner face of the head B′ is a projection which nearly reaches the flat end of the friction-valve V, and there is a spring of suitable character, as at 25, that tends to press the annular ratchet-faces together, and there is a steam-port 26, which is an extension of the port 23 within the cylinder end $B^2$, that admits steam into the space occupied by the ring, ratchets, and friction-valve V, and it is to be understood that the annular ratchets engage each other when the parts are rotated in one direction and they slide over each other by the yielding of the spring 25 when the parts are rotated in the other direction, and the operation of these parts is as follows: When steam passes through the port 23 to drive the piston H and project the drill, it also passes by the port 26 and presses against the inner face of the friction-valve V, separating the conical surfaces 24 and passing into the recess between the friction-valve V and the head B′, and at this time the friction-valve V is free to turn. Hence it will be turned by the piston H, passing along the inclined grooves of the rotator U and turning the same, the ring $o$, the annular ratchets, and the friction-valve V; but the moment the valve P is changed in its position and the exhaust takes place through the port 23 the steam between the head B′ and the friction-valve V causes the conical surfaces 24 to come together and produce a sufficient friction to hold the valve V and the annular ratchets, the ring $o$, and the rotator U. Hence as the piston H rises, drawing back the drill, it receives a partial rotation, and as soon as the steam is again admitted by the ports 23 and 26 the friction-valve V is relieved of the friction upon the conical surfaces 24, and it is free to be turned by the rotator as the drill is again projected, and should the drill strike into a seam, or any abnormal condition arise liable to injure any of the parts, the friction between the conical surfaces 24 will be overcome and the valve V and rotator can be turned without risk of injury. I provide a hole through the head B′ and a screw plug or cock 27, by the opening of which the pressure can be relieved between the friction-valve V and the head B′. Hence this friction-valve V will be free to rotate and the rotary movement of the piston and drill will be stopped.

The annular ratchet-teeth are inclined in the direction represented, in order that the rotator may not revolve the piston as the drill is projected. This is of importance, because when the drill is retracted the cushioning of the air or steam and the admission of fresh fluid under pressure will exert a force sufficient to raise the friction-valve and pass in between the same and the cylinder-head, and when the piston commences to move in the opposite direction to project the drill the pressure may be sufficiently lessened in the cylinder to cause the friction-valve V to hold upon its seat during this time, and the annular ratchets do not hold the rotator to the friction-valve, but pass by each other, and upon the return motion the annular ratchets will engage each other and hold the rotator, and the friction-valve will also be fully operative to hold the ratchets.

It will be evident that the yielding annular ratchet is the equivalent of a spring-pawl for holding the adjacent teeth in one direction and passing over such teeth in the other direction.

I claim as my invention—

1. The combination, with the cylinder and the stock or bed in a rock-drilling machine, of the cross-head, the longitudinal rods, to which the cross-head is attached, such longitudinal rods passing through openings at one end of the stock or bed and screwing into lugs at the other end of such stock, and lock-nuts and the feed-screw passing through the cross-head, substantially as set forth.

2. The combination, with the stock or bed in a rock-drill, of the rods F, passing through openings at one end of such bed and screwing through lugs at the other end of such bed and lock-nuts, a cross-head with openings receiving the conical ends of the rods, and nuts for securing the cross-head in position, and a feed-screw passing through the cross-head and provided with a crank, substantially as set forth.

3. The combination, with the cross-head and feed-screw having a collar or shoulder in a rock-drill, of a crank screwed upon the end of the feed-screw, and a cross-key passing through a mortise in the hub of the crank and acting against the screw-threads, substantially as set forth.

4. The combination, with the feed-screw having a collar or shoulder and a cross-head, through which the feed-screw passes, of a crank screwed upon the end of the feed-screw and having a mortise through the hub at an inclination corresponding to the inclination of the screw-thread, and a key within the mortise having parallel grooves corresponding to the threads of the screw for tightening the crank upon the screw, substantially as set forth.

5. The combination, with the cylinder, piston, and piston-rod in a rock-drill, of a divided head to the cylinder having a central opening for the piston-rod, and double bolts with U-shaped connections holding the two parts of the cylinder-head together and pass-

ing longitudinally of the cylinder for securing the heads to the same, substantially as set forth.

6. The combination, with the cylinder, piston, piston-rod, and stock in a rock-drill, of a divided head to the cylinder surrounding the piston-rod, a two-part gland screwing upon the divided head, and a U-bolt for holding the two parts of the divided gland together, substantially as set forth.

7. The combination, with the cylinder, piston, and piston-rod, and stock in a rock-drill, of a divided head surrounding the piston-rod and closing one end of the cylinder, a two-part gland screwed upon the divided head, double bolts passing longitudinally of the cylinder and U-shaped for clamping the divided head, and nuts for screwing the heads of the cylinder in position, substantially as set forth.

8. The combination, with the stock or bed in a rock-drill, of a cylinder having flanges, guide-bars resting upon said flanges, and diagonal bolts for securing the guide-bars in position and allowing for their adjustment, substantially as set forth.

9. The combination, with the cylinder and piston in a rock-drill, of a valve-chest, a valve-carrier movable toward and from the piston and within the valve-chest and having a valve-seat, and a valve between the carrier and the piston acted upon by the piston, there being ports in the carrier and passages in the valve, substantially as set forth.

10. The combination, with the piston and cylinder in a rock-drill, of a valve-chest, a valve-carrier within the chest, there being an opening for the fluid under pressure to act upon the carrier to move it toward the piston, a valve seated upon the valve-carrier and moved by the piston, there being ports in the carrier and passages in the valve for the admission and exhaust of the fluid under pressure, substantially as set forth.

11. The combination, with the cylinder and valve-chest in a rock-drill, of a piston having a reduced portion and inclines, a valve sliding within a valve-chest under the action of the inclines on the piston and provided with steam-ports, and a valve-carrier within the valve-chest adapted to yield to the valve as the latter is acted upon by the piston, substantially as set forth.

12. The combination, with the piston and cylinder in a rock-drill, of a valve-chest having inlet-ports at opposite sides, a valve-carrier having inlet and exhaust ports, a valve having its seat upon the carrier and acted upon by the piston, there being in the valve-chest an opening to admit fluid under pressure to act upon the valve-carrier and force it toward the piston, substantially as set forth.

13. The combination, with the piston and rotator in a rock-drill, of a ring through which the rotator passes, and an eccentric flange upon the rotator occupying an eccentric recess in the ring, substantially as set forth.

14. The combination, with the piston and rotator in a rock-drill, of annular ratchets connected with the rotator, and a friction-valve against which the fluid under pressure acts for relieving the friction-valve to allow it to rotate when the piston is moving in one direction and for holding the rotator and causing the piston to turn when moving in the other direction, substantially as set forth.

15. The combination, with the cylinder and piston in a rock-drill, of a rotator, a friction-valve and annular ratchet between the friction-valve and the rotator, there being a port for the admission of fluid under pressure to act upon the friction-valve, substantially as set forth.

16. The combination, with the piston and rotator in a rock-drill, of a friction-valve, a head at the end of the cylinder inclosing the friction-valve, there being a space into which the fluid under pressure passes to act upon such friction-valve and hold the same and the rotator when the fluid-pressure is relieved on the other side of such friction-valve, substantially as set forth.

17. The combination, with the cylinder and the piston in a rock-drill, of the cylinder-head and intermediate cylinder-extension, a friction-valve within such extension having conical surfaces, a rotator, annular ratchets, and a spring between the rotator and the valve, and a plug or cock, by the opening of which the pressure is relieved and the friction-valve is allowed to rotate, substantially as set forth.

18. The combination, with a cylinder, piston, and piston-rod in a rock-drill, of a head to the cylinder having a central opening for the piston-rod, and double bolts with U-shaped connections passing over projections on the cylinder-head and running longitudinally of the cylinder for securing the heads to the cylinder, substantially as set forth.

19. The combination, with the valve, valve-chest, and cylinder in a rock-drill, of a piston having an incline to give to the valve a lifting and longitudinal motion for automatically regulating the force of the blow according to the speed of movement, substantially as set forth.

20. The combination, with the piston and a rotator in a rock-drill, of a ring through which the rotator passes, ratchet-teeth upon the ring, a friction-valve, and an annular ratchet connected therewith, substantially as set forth.

21. The combination, with the piston and a rotator in a rock-drill, of a ring and annular ratchet and a friction-valve acted upon by the pressure to hold the same in place while rotating the drill, substantially as set forth.

Signed by me this 2d day of March, 1891.

GEO. M. GITHENS.

Witnesses:
GEO. T. PINCKNEY,
WILLIAM G. MOTT.