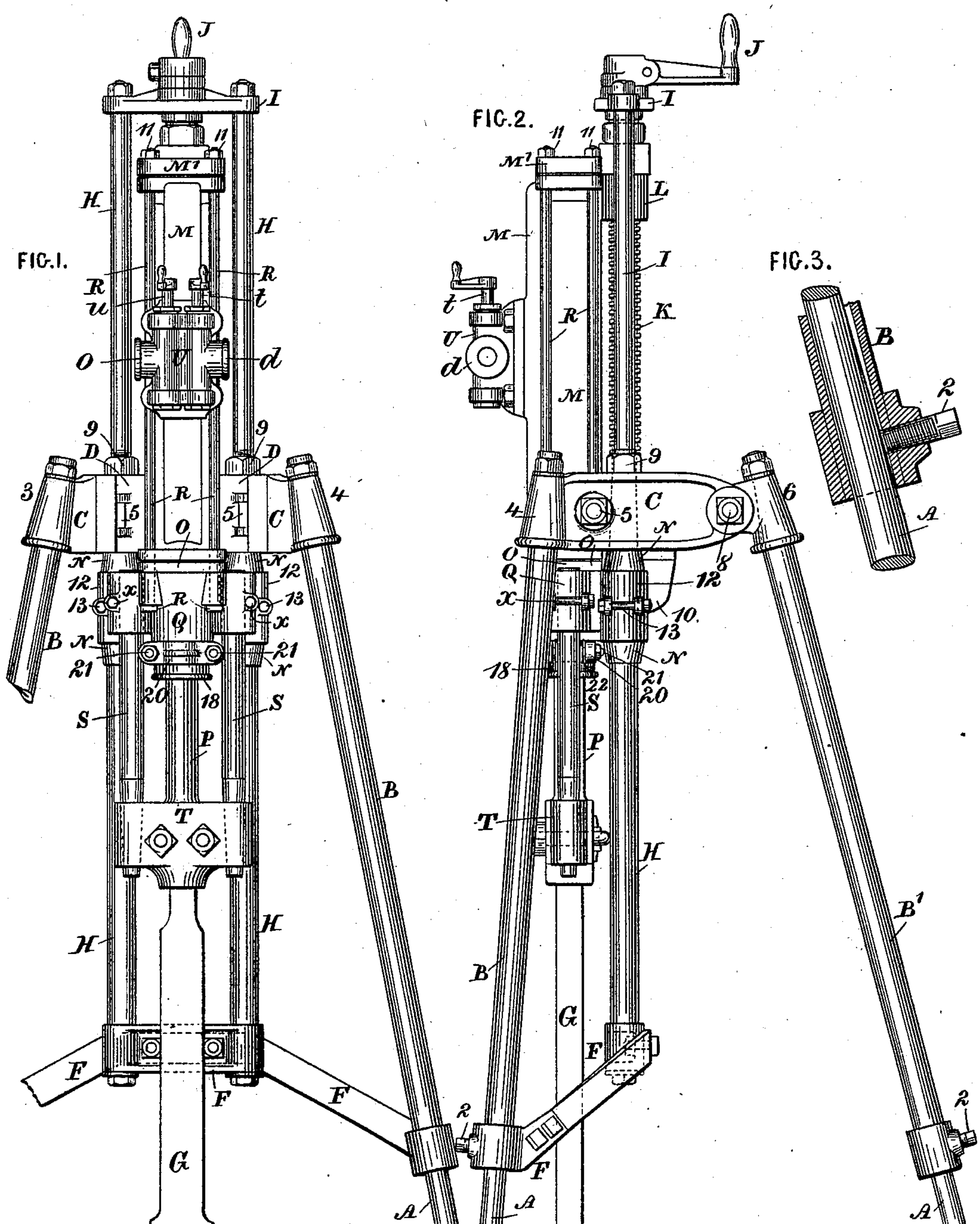
(No Model.) 2 Sheets—Sheet 1.

G. M. GITHENS.

MACHINE FOR DRILLING ROCK.

No. 539,475. Patented May 21, 1895.



Witnesses
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per Lemuel W. Serrell
Atty

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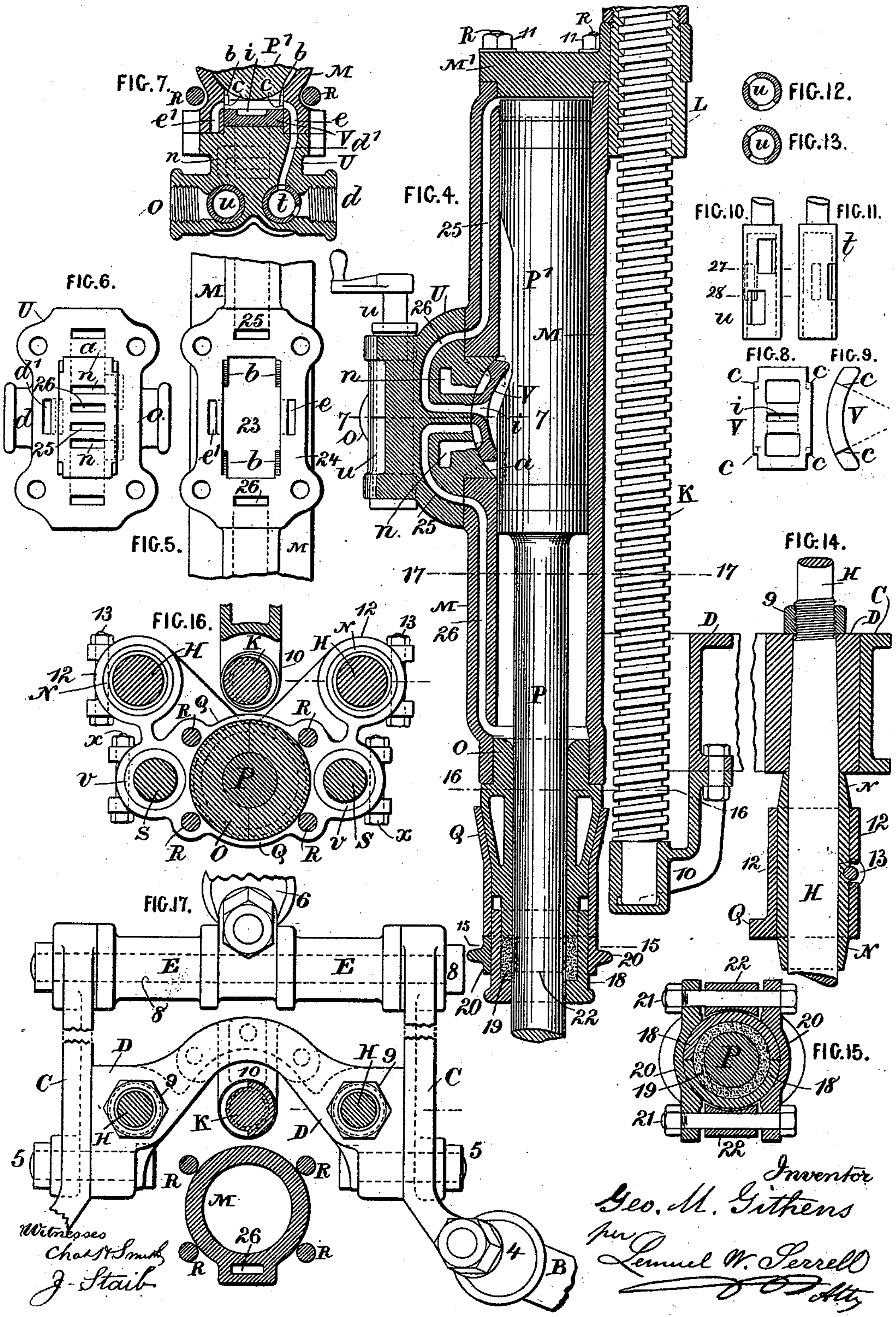

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UNITED STATES PATENT OFFICE.

GEORGE M. GITHENS, OF BROOKLYN, NEW YORK.

MACHINE FOR DRILLING ROCK.

SPECIFICATION forming part of Letters Patent No. 539,475, dated May 21, 1895.

Application filed January 10, 1895. Serial No. 534,421. (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 Machines for Drilling and Channeling Rock, of which the following is a specification.

In machines employed in drilling or channeling stone difficulty has heretofore been experienced in holding the cylinder with the necessary firmness to prevent the same shaking and becoming displaced under the rapid reciprocation of the drilling tool and the piston therewith connected, especially during the movement of the cylinder and parts therewith connected under the action of the feed screw, because sometimes the tripod may stand still and the cylinder work loose in its connection with the tripod. In rock drills a difficulty has also arisen in connection with the movement of the valve by the action of the piston. When an arc valve is employed, such as shown in my Patent No. 362,617, granted May 10, 1887, the incline upon the piston gives a movement to the valve in first one direction and then the other, and the momentum frequently carries the valve so that its advancing end strikes against the smaller diameter of the piston, and the steam acting against the valve holds the same firmly to its place and the piston rubs against the end of the valve, and where the parts are subjected to a very rapid motion and the piston frequently becomes loose in the cylinder, the end of the valve is rapidly cut away.

The object of the present invention is to hold the cylinder very firmly in its connection with the tripod, and to allow the cylinder to be moved endwise as the drilling or channeling progresses, and the head of the cylinder is constructed with reference to its easy removal and replacement in case of wear, and the valve and its seat are made in such a manner that the valve is not arrested in its movement by the piston but by a portion of the valve case or cylinder with which such valve comes in contact, thereby insuring the proper position of the valve in relation to the ports and preventing wear upon the advancing end of the valve, as has heretofore taken place.

In the drawings, Figure 1 is a front elevation representing the cylinder and the parts connected therewith and the principal portions of the tripod. Fig. 2 is an elevation at right angles to Fig. 1. Fig. 3 is a section in larger size of the tube containing the extension-leg or spud of the tripod. Fig. 4 is a longitudinal section of the cylinder and the bearings for the screw. Fig. 5 represents the valve-seat with the valve and cap removed. Fig. 6 is an elevation of the chest and valve-seat detached. Fig. 7 is a section at the line 7, representing the valves for controlling the inlet and outlet of the steam. Figs. 8 and 9 show the face and side of the valve. Figs. 10 and 11 are elevations of the exhaust and steam valves; and Figs. 12 and 13 are sectional views of the exhaust-valves at the lines 27 and 28, respectively, of Fig. 10. Fig. 14 shows a portion of the stay-rod and a section of the middle bearings for the same. Fig. 15 is a section of the parts at the line 15 of Fig. 4. Fig. 16 is a section at the line 16, Fig. 4; and Fig. 17 is a section at the line 17 of Fig. 4.

The machine as a whole is supported on a tripod composed of the tubular legs B B and B′, and each leg is provided with a spud or point A that can be adjusted and clamped by the screw 2 so as to regulate the position of the machine either horizontally or at an inclination; and I have found that in consequence of the vibration, due to the rapid reciprocation of the drill or tool, that the screws that clamp the tool are liable to become loose. I make the surface of the spud against which the screw acts slightly tapering, as illustrated in Fig. 3, so that it acts as a wedge under the vibrating movement to cause the clamp screw to hold more firmly because the weight of the apparatus tends to drive the spud into its tubular leg and thereby tightens the screw and the wedge. The screw is flat on its inner end and perpendicular to the inclined surface.

The upper ends of the tubular legs B B are received into the rigid sockets 3 4 upon the bars C that are bolted firmly at 5 to the yoke D, and between the back end of the bars C a tubular cross bar E is rigidly secured by a bolt 8 passing through the same, and this tubular cross bar has a socket 6 for the upper end of the tubular leg B′ made with or fastened to such tubular cross bar. Hence the back leg B′ can be swung upon the bolt 8 into any desired angular position to the legs B B, Between the lower portions of the tubular legs B B there is a frame F forming a brace between the two legs B B to hold them at a uniform distance apart, and such brace extends backwardly so as to pass behind the drill or channeling tool G and receive the lower ends of the stay rods H, which stay rods H are received in sockets in the frame F and bolted firmly thereto, and they extend upwardly and are tapered down to a smaller diameter where they pass through the yoke D so as to be firmly held in such yoke by the nuts 9, and such stay rods pass on and receive between their upper ends the cross head I, through the center of which passes the feed screw K, and there is a handle J upon the upper end of the feed screw by which such feed screw can be rotated to act upon the cylinder and move the same as the drilling or channeling progresses. It is important that this feed screw shall be sufficiently long to give the proper motion to the cylinder, and also that the cylinder should be guided both by the nut that surrounds the feed screw and also at its lower end. To accomplish this object the lower end of the feed screw K is received into a step 10 that extends down below and is bolted to the yoke D so as to firmly support this lower end of the feed screw. The nut L surrounds the feed screw and is firmly attached to the head M′ of the cylinder M, and the bearings N surround the stay rods H below the yoke D, and such bearings are connected with the cylinder M as hereinafter described, and they slide freely upon the stay rods H as the cylinder is moved up or down, and such bearings slide between the yoke D and the brace frame F, and the length of the stay rods between such points of support is sufficient for the nut on the cylinder to be moved endwise the length of the feed screw between the step 10 and the screw head I.

The top head M′ rests upon and fits into the upper end of the cylinder M and the lower head O sets within and against the end of the cylinder M and it is tubular for the passage of the piston rod P, and this head O is tapering upon a portion of its exterior surface and receives around it the clamping head Q having an opening through it with a tapering sleeve receiving such hear O, and through the clamping head Q and the head M′ the bolts R pass, and it is advantageous to make the bolts with heads passing from below through the clamping head Q, and such bolts R have nuts 11 at their upper ends by which the parts are tightly drawn together for holding the two heads M′ and O to the cylinder, and such clamping head O is also provided with sockets 12 which surround the stay rods H and through which sockets the tubular bearings N around such stay rods are passed and held by clamping bolts 13, each bolt preferably passing through ears upon the socket and into a notch in the side of the tubular bearing, as shown in Fig. 14, and this clamping head Q is also formed with tubular bushings v for the guide rods S that are connected with the cross head T at the end of the piston rod P, and this cross head receives the drill or channeling tool G, and into which head such tool is secured in any suitable manner, such for instance as by a U-shaped bolt or key, such as shown in my Patent No. 307,641.

The lower ends of the guide rods S, where they pass into the cross head T are tapering, as seen in Fig. 1, and hence it will be observed that the inertia of these guide rods will cause them to wedge tightly into the cross head, especially in view of the cross head and drill being suddenly arrested by striking the stone to be drilled or channeled. Hence these guide rods S will not become loose but they are easily detached from the cross head by a blow on their smaller and lower ends, and such guide rods slide freely through the clamping head Q.

In order to hold securely the packing gland that surrounds the piston rod P, such packing gland is made of a divided and flanged tube 18 that confines the packing 19 around the piston rod. There are clamping bars 20 at opposite sides of the divided packing tube 18, and such bars are caused to grasp and hold the packing tube by bolts 21 passing through them and through the downwardly projecting blocks or ears 22 that are upon the clamping head Q and at the sides of the packing tube 18. By this construction the packing around the piston can be held firmly and any blow on the head by the piston causes the tube 18 by inertia to compress the packing 19.

If the apparatus is made use of in channeling, the tool G will be of a shape adapted to that operation and the rods S guide such tool and maintain the proper alignment during the channeling operation. If the machine is to be used as a rock drill for a circular hole the guide rods S will be removed in order that the piston and piston rod may be rotated progressively as usual during the reciprocations of the piston P′ in the cylinder M. I have represented the piston P′ as adapted to a channeling tool, the recesses in the piston being at one side of the same, but when this improvement is made use of with a rock drill the central portion of the piston will be reduced in diameter, as shown in my Patent No. 362,617.

At one side of the cylinder there is an opening, as shown at 23, having a surrounding flat face or flange 24 and the ports 25 and 26 extend to the distant ends of the cylinder M, as seen in Figs. 4 and 5, and the chest U is adapted to fit against the cylinder and may be reversible so that the induction port d' may be brought to either side that is desired, and bolts are provided as usual to hold the chest in position, and the valve seat a has a segmental surface adapted to receive the segmental valve V, and in this valve V are suitable ports adapted to directing the steam or fluid under pressure in the proper manner, and the inclines upon the piston P′ are adapted to move this segmental valve endwise and change the passages for the fluid under pressure as the piston reciprocates.

There are offsets, shoulders, or stops upon the valve for limiting the endwise movement. It is advantageous to make these upon radial lines to the center from which the segmental valve is described, as represented in Figs. 4 and 9, and it is usually advantageous to place these offsets or stops upon the sides of the valve, but I do not limit myself in this particular.

It will be observed upon comparison of Figs. 8 and 9 with Fig. 5 that the shoulders *b* that are upon the opposite faces of the opening 23, within which the valve is received, are farther apart than the shoulders *c* upon the valve V, the differences in the distance being such as to allow of the proper movement being given to the segmental valve by the inclines upon the piston. Hence when the valve receives an end motion by contact therewith of one incline upon the piston, its momentum carries the valve until the shoulders or stops come together and limit the further end movement and arrest the valve in the proper position for the ports to coincide, but at that time the movement given endwise to the valve is not sufficient to cause its advancing end to come into contact with and be arrested by the piston as at its smaller diameter. Hence the stop that limits the movement of the valve is not the surface of the piston as has heretofore been the case, but its offsets, or shoulders, coming into contact the one with the other and the pressure of the fluid will hold the valve to its seat, and the smaller portion of the piston in its reciprocating movement will not rub against the adjacent end of the valve. Hence that end of the valve will not be worn, and at the time when the valve is moved endwise the pressures upon the opposite sides of the valves have become more nearly equal and the valve is easily moved from one position to the other.

It will be apparent that the before mentioned improvement in the valve may be availed of with any desired arrangement of ports. I, however, prefer to allow the steam or fluid under pressure to pass from the inlet pipe *d* through the ports *e* into the cylinder so that the pressure will pass through the port *i* of the valve and by the ports 25 or 26 to the distant end of the cylinder, such ports 25 and 26 passing through the chest and terminating at the valve seat, and there are exhaust ports *n* passing to an exhaust pipe *o*, and where there is a second port in the cylinder, as shown at *e'*, Figs. 5 and 7, the steam chest U can be reversed to bring the induction and eduction pipes into the desired positions, so that the hose supplying fluid under pressure can be connected to either one side or the other of the cylinder.

In some characters of drilling or channeling machines the induction pipe *d* may be connected directly with the port *e* and the pipe *o* with the exhaust ports *n*; but I find it advantageous to employ regulating valves *t u* for regulating the amount of steam or other fluid admitted under pressure, and for regulating the escape or exhaust, and these valves *t* and *u* may be of any desired character, preferably cylindrical, as shown in Figs. 10, 11, 12 and 13, and each of these valves is provided with a suitable handle by which it may be moved so as to vary the openings through such valves. The inlet valve *t* only requires ordinary openings so as to regulate the size of the passage way for the fluid under pressure, but it is advantageous to make use of two sets of openings in the exhaust valve *u*, as seen in Figs. 10, 12 and 13, so as to vary the opening for the exhaust from either the top end of the piston or from the bottom end of the piston.

The object of providing a valve for the exhaust is to economize steam or air and at the same time to lessen the risk of injury to the drilling apparatus. When the tool is working upon soft stone there is but little rebound, and the drilling or channeling operation is usually quite rapid, but when drilling or channeling hard stone the rebound is usually considerable. It is therefore advantageous to confine the steam above the piston to such an extent that the rebound of the drill or channeling tool will be consumed in compressing or driving out the steam or fluid above the piston, so that such piston will not strike with violence against the top head, and the steam that is confined in this manner renders it unnecessary to admit such a large volume of steam to throw down the drill, and hence an economy of steam is effected.

When drilling soft stone the force of the fluid under pressure is sometimes too great, and it is advantageous to confine the exhaust steam upon the under side of the piston so that the pressure of the steam may sufficiently accumulate to regulate the force of the blow upon the stone, and in so doing the volume of steam required to raise the piston and tool will be less. Hence by providing a valve, or valves, that can be made use of in regulating the escape steam, or fluid under pressure, the operation of the drill can be more easily controlled and a saving in the actuating power will be effected.

The valve that admits the regulation of steam or other fluid under pressure being closely adjacent to the valve that regulates the escape of the fluid under pressure, enables the attendant to regulate the action of the drilling apparatus with great accuracy and reliability so as to use the fluid pressure to the best advantage in regulating the action of the piston upon the drill or channeling tool.

The guide rods S, before mentioned, sliding through the head Q are liable to wear and become loose, especially as they are exposed to the gritty materials and particles of rock from the drilling operation, but it will be observed that in consequence of their ends being tapering and passing into the tool holding head they can be easily knocked out and turned off to render them true; and I have shown bushings v in the head Q surrounding such guide rods S, and these can be easily removed by taking out the bolts x, the bodies of which pass into notches in the sides of the bushings, as indicated in Fig. 16. Hence other bushings can be introduced that fit the guide rods after they have been turned down to remove wear or inequalities.

In drilling or channeling machines heretofore constructed the cylinder has in some instances been guided at its lower end by a trough in which such end of the cylinder slides, but it will be apparent that in the vibration due to the movement of the drill, this end of the cylinder becomes worn and also the trough becomes worn and the parts cannot be rendered true, and the looseness increases until the apparatus becomes unserviceable.

In the present improvement the lower end of the cylinder is connected with the head O, and the clamping head Q which is still farther removed from the nut L of the feed screw receives the bearings or bushings N that slide on the stay rods H. Hence the cylinder is sustained at three points, namely, the nut L and the bearings N, and these are as far apart as possible so as to hold the cylinder firmly between them, and there is ample room for the endwise movement of the parts for the full length of the feed screw, and in rock drills the wear is usually in one direction. Hence if the sides of the stay rods H become worn they can be turned around so as to present a fresh wearing surface, and when the parts become too loose the lower ends of the stay rods H are sufficiently large to allow them to be turned down and rendered true, and the bushings or bearings N can be removed and fresh ones supplied, thus giving facility for the repair of the rock drill in the parts that are most liable to injury.

I have found that the rapid reciprocation of the piston and rod renders it difficult to keep the packing gland 19 in good order. By introducing the packing tube 18 between the cylindrical end of the head O and the clamping head Q, the tube 18 is held reliably in position, but in consequence of this tube 18 being divided it is important that the clamping devices are free to accommodate themselves to the position of the divided tube upon the piston rod. For this reason the parts are made as represented in in Fig. 15, in which the bolts 21 pass freely through the downward projections from the clamping head Q and simply press the concave clamps 20 against the opposite sides of the divided tube 18 so as to hold the same properly in position, but such packing tube 18 can slide through the clamps and act to compress the packing whenever the piston strikes a blow against the inner end of the lower head O, the tube 18 being caused to move through the clamps 20 by its inertia.

It will be observed that in the segmental valve V there is a port i in the middle and two recesses in the face forming passages that connect between the ports 25 or 26 and one of the exhaust ports n, and in consequence of the air or steam under pressure passing by the inlet port e to the under or concave side of the valve, the pressure of the fluid keeps the valve against its seat and there is always more pressure on the concave side than can arise in either of the passages n that lead to to the exhaust. Hence there is no risk of the valve being thrown off its seat by the pressure as arises in instances where the fluid under pressure is confined in the chest by the valve itself.

In legs for rock drills the spuds or extension bars have sometimes been made slightly tapering and the point of the screw has embedded itself more or less into the metal, either in consequence of being slightly pointed or in consequence of the screw not being perpendicular to the inclined surface of the spud. Hence when the leg has to be shortened and the screw is loosened, such screw has to be drawn back sufficiently far to pass out of the recess or to separate from the burr thrown up by the point, and the screw thus drawn back allows a much greater movement in almost all cases than is desired so that the tube slides down over the spud an indefinite distance.

In consequence of placing the screw perpendicular to the inclined surface of the spud and providing a flat end to the screw, there will not be any indentation of the screw in the surface of the spud, and hence by slightly loosening the screw the tubular leg can slide down upon the spud the desired distance according to the amount that the screw is loosened, and the inclined surface of the spud will remain true and flat. Hence the adjustment is easily effected by simply loosening the set screw and allowing the parts to move by gravity.

With ordinary rock drills where the piston rotates the middle portion of the piston is turned down to form a space for the fluid under pressure, and the metal is conical to act upon the valve. In my improvement when applied with a channeling machine the recess in one side of the piston has a flat bottom surface and flat inclined ends. Hence it acts all across the ends of the valve or nearly so to render the parts more durable.

I claim as my invention—

1. The combination with the cylinder and feed screw, of a tripod, stay rods parallel with the cylinder and having a cross head for one end of the screw, a frame connecting two of the tripod legs and receiving the lower ends of the stay rods, bearings connected with the cylinder and sliding on the stay rods, substantially as set forth.

2. The combination with the cylinder and feed screw, of a tripod, stay rods parallel with the cylinder and having a cross head for one end of the screw, a frame connecting two of the tripod legs and receiving the lower ends of the stay rods, bearings connected with the cylinder and sliding on the stay rods, a frame to which the upper ends of two of the tripod legs are connected, and a tubular cross bar and bolt for connecting the third tripod leg, substantially as set forth.

3. The combination with the cylinder and feed screw, of a tripod, stay rods parallel with the cylinder and having a cross head for one end of the screw, a frame connecting two of the tripod legs and receiving the lower ends of the stay rods, bearings connected with the cylinder and sliding on the stay rods, a frame connecting the tripod legs at their upper ends, and a step connected with the frame and receiving the lower end of the feed screw, substantially as set forth.

4. The combination in a drilling apparatus, of a cylinder and feed screw, tripod legs, a yoke connecting the upper ends of two of the tripod legs, stay rods supported by the yoke, a frame for connecting the lower ends of the stay rods and two of the legs, a cross head to the stay rods, and a support for the lower end of the screw, a nut upon the cylinder near one end through which the screw passes and bearings near the other end of the cylinder around said stay rod, substantially as set forth.

5. The combination with the cylinder in a rock drilling mechanism, of stay rods and means for holding the same, a feed screw and supports connected with the stay rods for both ends of the screw, a nut for the screw connected with the cylinder and bushings around the stay rod and connected with the cylinder near one end, substantially as set forth.

6. The combination with the cylinder, feed screw and nut in a rock drill, of rods and a cross head for one end of the feed screw, a support for the other end of the feed screw, and bearings surrounding and sliding upon the guide rods and connected with the cylinder at the opposite end thereof to the nut, a tripod, connections from two of the legs thereof to the lower ends of the rods that guide the cylinder, substantially as set forth.

7. The combination with the cylinder, piston and piston rod in a rock drill, of a head at the upper end of the cylinder, a head surrounding the piston rod, a clamping head and stuffing box and rods extending from the clamping head to the upper head of the cylinder for drawing the parts together, clamping bars to hold the tube of the stuffing box and bolts to connect the bars to the clamping head, substantially as set forth.

8. The combination with the cylinder, piston and piston rod in a rock drilling or channeling apparatus, of a divided head for the cylinder surrounding the piston rod, a tool holding head integral with the piston rod, guides projecting from the cylinder head, and guide rods secured in the tool holding head and sliding through the guides and outside the cylinder, substantially as set forth.

9. The combination with the cylinder, piston and piston rod in a rock drilling or channeling apparatus, of a divided head for the cylinder surrounding the piston rod, a tool holding head integral with the piston rod, guide rods secured in the tool holding head, guides projecting from the cylinder head and through which the guide rods slide, the ends of the guide rods being tapering and wedged into the tool holding head, substantially as set forth.

10. The combination with the cylinder, piston and piston rod in a rock drilling or channeling apparatus, of a divided head for the cylinder surrounding the piston rod, a tool holding head integral with the piston rod, guide rods secured in the tool holding head and sliding through guides that project from the cylinder head, the ends of the guide rods being tapering and wedged into the tool holding head, and removable bushings in the cylinder head for such guide rods, substantially as set forth.

11. The combination with the cylinder and piston in a rock drilling apparatus, of a segmental valve, a segmental valve seat and ports, and stops for limiting the end movement given to the valve by the piston acting directly on the valve, substantially as set forth.

12. In a rock drilling apparatus, the combination with the cylinder and piston having inclines upon its surface, of a segmental valve, a curved valve seat for the said valve, ports for the fluid under pressure, and radial stops for limiting the movement of the valve as such valve receives its motion from the inclines upon the piston, substantially as set forth.

13. The combination with the piston and cylinder in a rock drilling apparatus, of a valve chest having a projection entering an opening in the cylinder and terminating as a curved valve seat, there being inlet and exhaust ports and the chest being reversible upon the cylinder, and a segmental valve upon the valve seat and acted upon by the piston, substantially as set forth.

14. The combination with the piston and cylinder in a rock drilling or channeling apparatus, of a valve seat and ports leading to the ends of the cylinder, a valve moved directly by the piston for regulating the admission and discharge of steam or other fluid under pressure, and a separate valve for regulating the discharge of the exhaust from one end of the cylinder and thereby confining the fluid under pressure to a greater or less extent, substantially as set forth.

15. The combination with the piston and cylinder in a rock drilling or channeling apparatus, of a valve seat and ports leading to the ends of the cylinder, and a valve moved

directly by the piston for regulating the admission and discharge of steam or other fluid under pressure, and valves for separately regulating the escape of fluid under pressure from the top and bottom ends of the cylinder, substantially as set forth.

16. The combination in a drilling apparatus, of a cylinder, pistons, piston rod, and tool holding head, a feed screw, stay rods, bushings connected with the cylinder head and sliding on the stay rods, and a tripod, side bars and a yoke for connecting the tripod to the middle portions of the stay rods, substantially as set forth.

17. The combination with the cylinder in a rock drilling or channeling apparatus, of a divided head for the cylinder surrounding the piston rod, a tool holding head integral with the piston rod, removable bushings upon the cylinder head, and guide rods connected to and moving with the tool holding head and passing through the removable bushings, substantially as set forth.

18. The combination in a drilling apparatus of a cylinder, pistons, piston rod and tool holding head, a feed screw, stay rods, bushings connected with the cylinder head and sliding on the stay rods, and a tripod for supporting the apparatus, a tool holding head, and guide rods between the tool holding head and cylinder head, substantially as set forth.

19. The combination with the cylinder, piston and tool holder in a rock drilling engine, of a chest having a valve seat, a segmental valve having a central port passing through the valve, and passages in the face of the valve there being two ports in the valve seat passing to the exhaust, and two ports connecting with the ends of the cylinder, substantially as set forth.

20. The combination with the cylinder and valve in a channeling machine, of a piston rod and piston having a recess in one side with inclined ends to act upon and move the valve and means for preventing the piston and rod rotating, substantially as specified.

Signed by me this 28th day of December, 1894.

GEO. M. GITHENS.

Witnesses:
GEO. T. PINCKNEY,
S. T. HAVILAND.