B. L. WORTHEN, DEC'D.
V. K. WORTHEN, EXECUTRIX.
DRILL.
APPLICATION FILED OCT. 11, 1917.

1,326,245.

Patented Dec. 30, 1919.

3 SHEETS—SHEET 1.

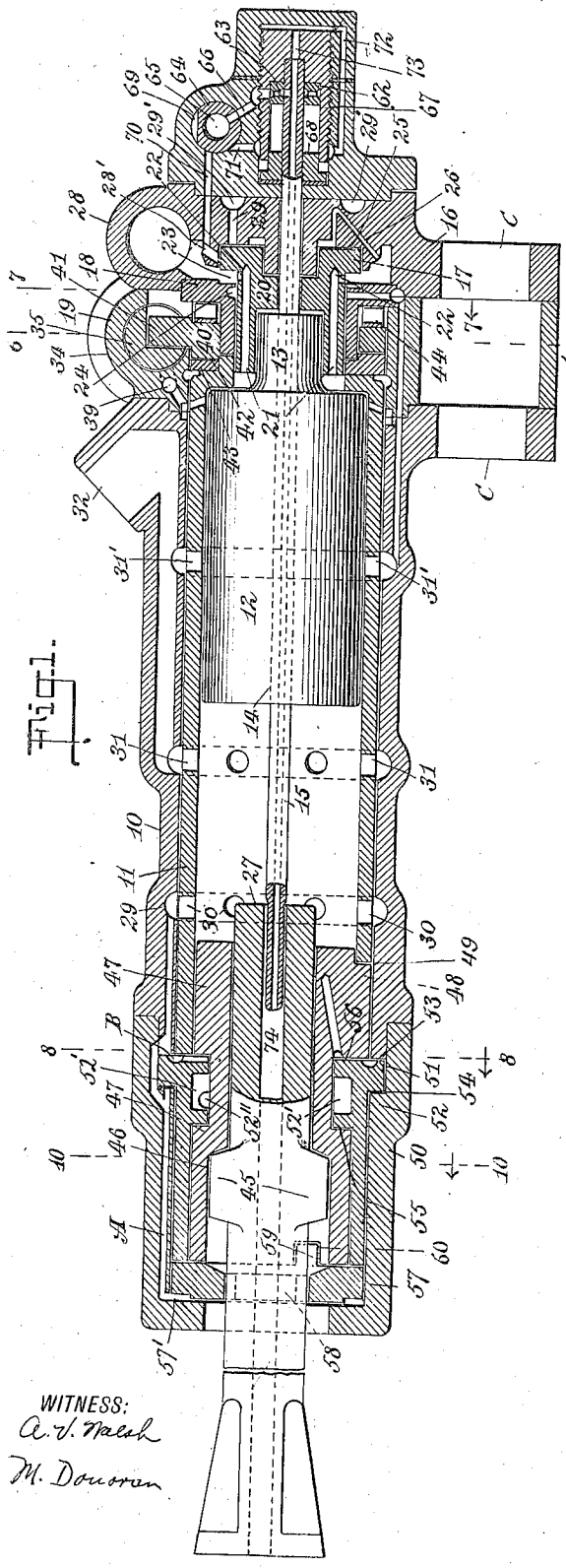


Fig. 1.

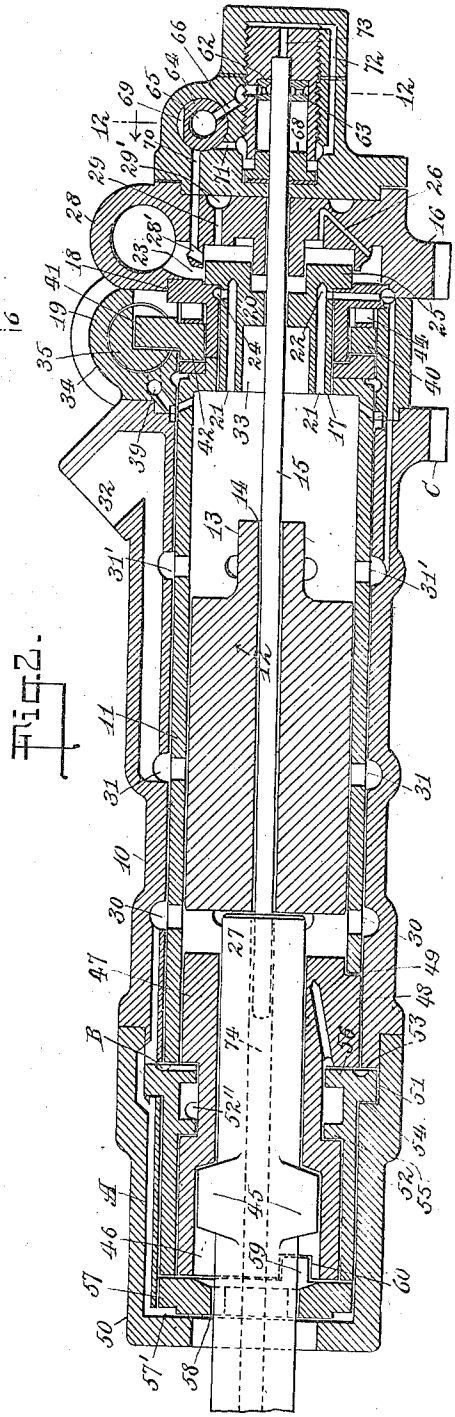


Fig. 2.

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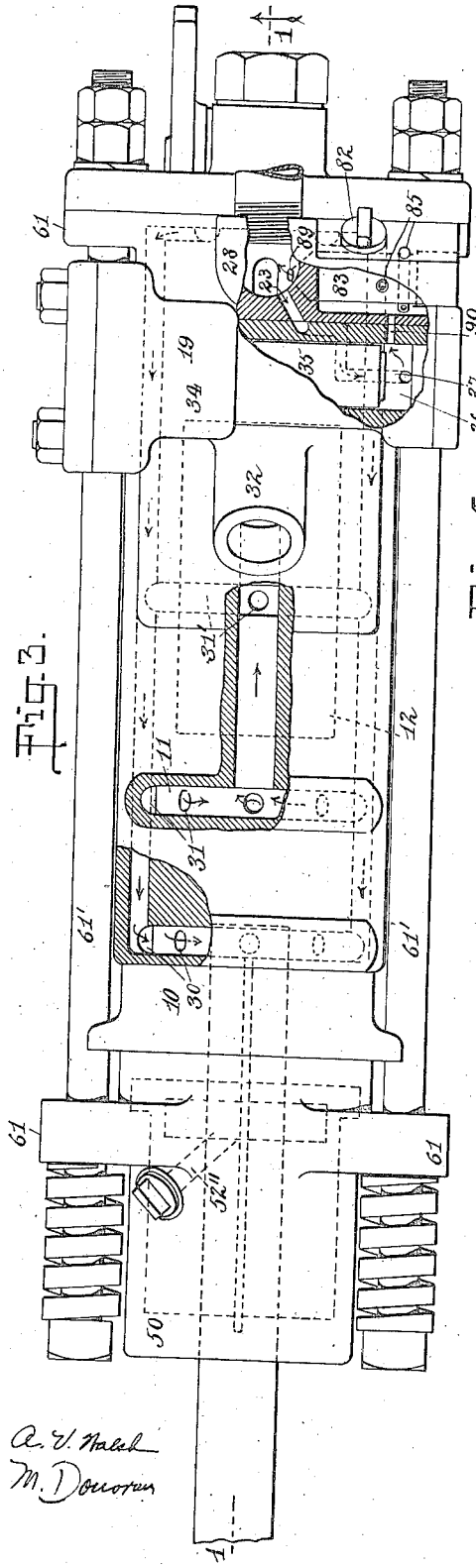


Fig. 3.

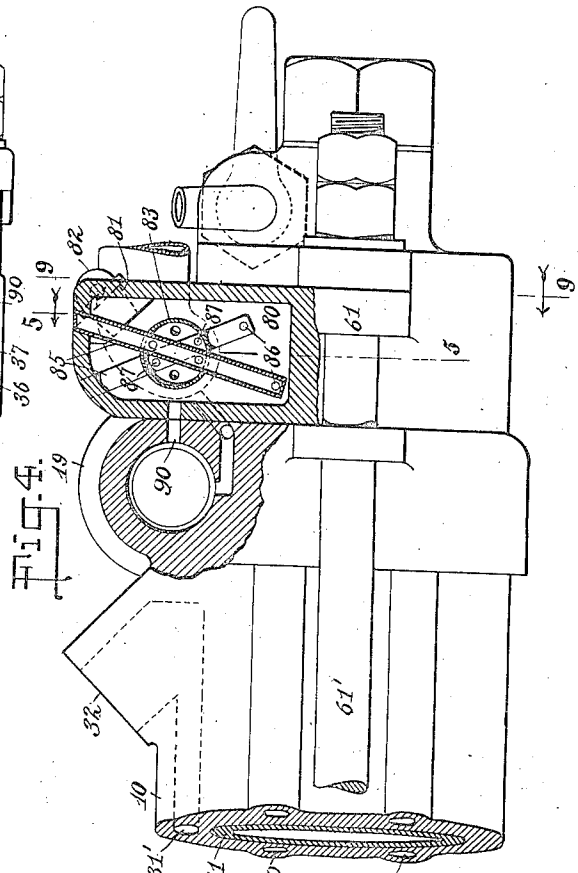


Fig. 4.

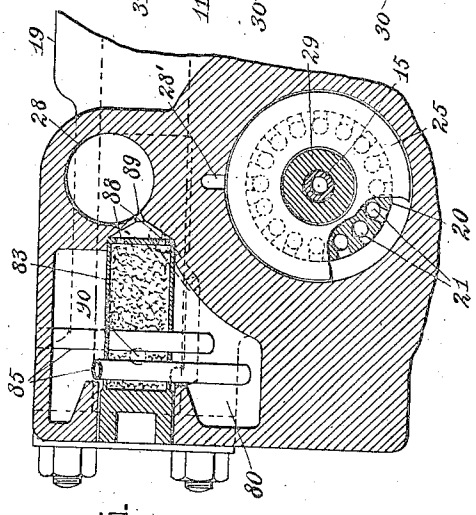


Fig. 5.

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3 SHEETS SHEET 3.

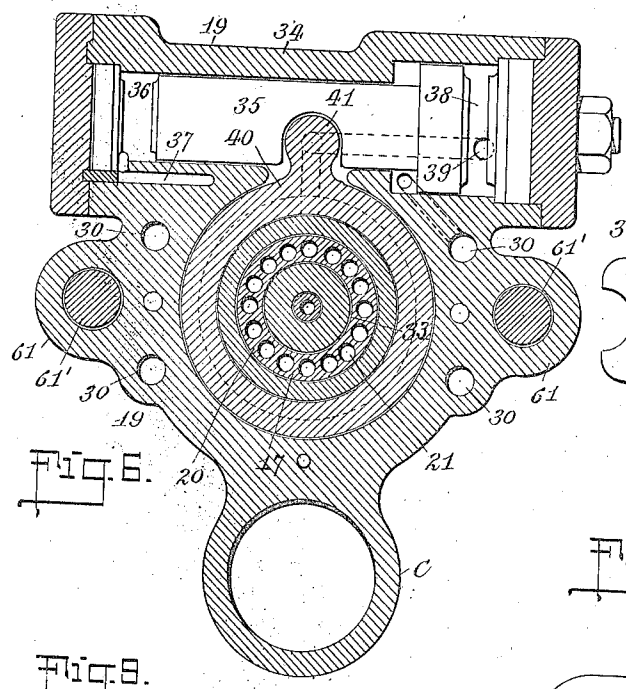


Fig. 6.

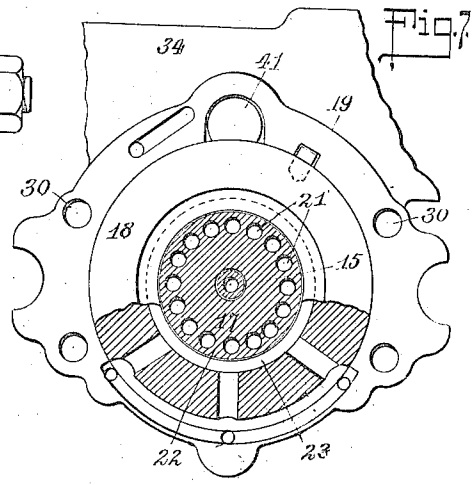


Fig. 7.

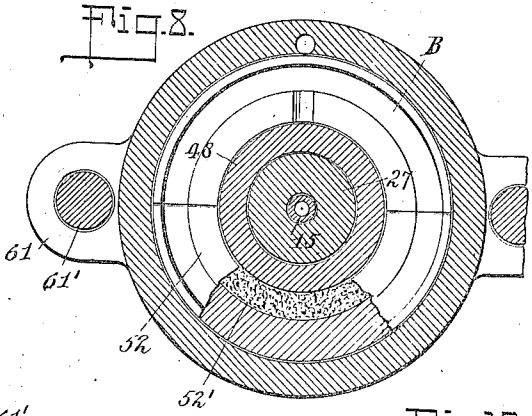


Fig. 8.

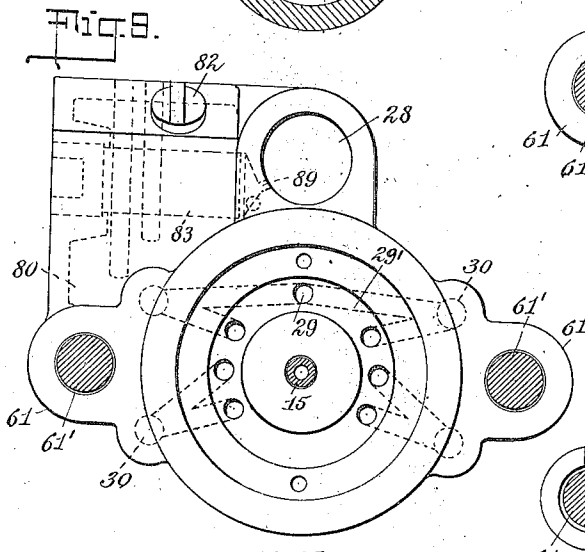


Fig. 9.

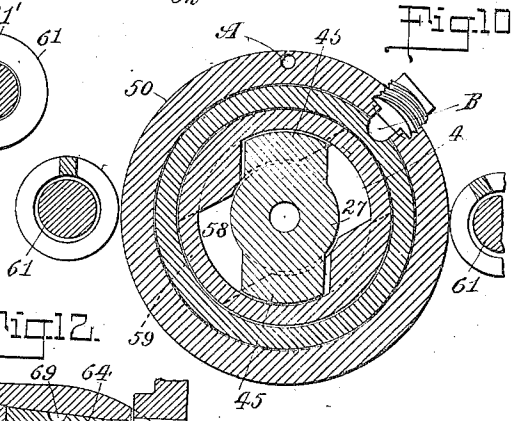


Fig. 10.

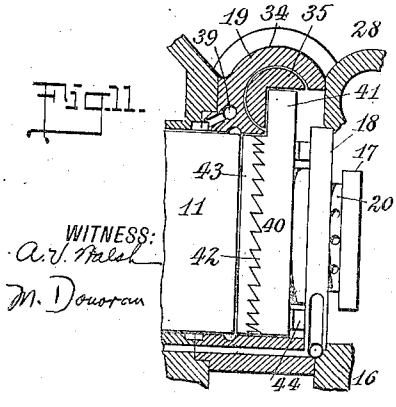


Fig. 11.

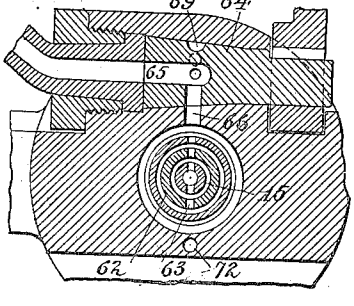


Fig. 12.

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DRILL.

1,326,245. Specification of Letters Patent. Patented Dec. 30, 1919.

Application filed October 11, 1917. Serial No. 195,942.

To all whom it may concern:

Be it known that I, BURT L. WORTHEN, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have made and invented certain new and useful Improvements in Drills, of which the following is a specification.

My invention relates to improvements in drills, and particularly to what is known as rock drills, and has the following objects in view:

To provide a rock drill containing a piston hammer member having unhampered reciprocating action, thus forming what I term a free-running hammer, suitable means being provided for revolving or turning the drill.

To provide a rock drill having a sleeve cylinder capable of revolving about its longitudinal axis and connected to, so as to rotate, the drill, and in which rotating cylinder is placed a piston hammer capable of free reciprocation therein, so that the entire impact of the hammer is brought to bear upon the drill point, the return motion of the piston hammer takes place in an unretarded manner and is accomplished in a minimum amount of time, so that the drill may operate at a high speed.

To provide an improved construction of drill having a rotating cylinder in which is placed a free-running hammer and combining therewith an admission and exhaust valve operated by the combined action of the hammer and air pressure, the arrangement being such that the valve is capable of rapid motion, consistent with the high speed at which the piston hammer may reciprocate, so that the drill may operate at a high speed; and further, providing, by means of an early and quick cut-off of the admission ports, an economically running drill.

To provide a drill combining certain new and novel features for revolving the drill without interfering with the free reciprocation or running of the piston hammer.

To provide a rock drill having an improved form of chuck whereby the drill point or steel is properly held in position in the drill and is balanced by air pressure so that the drill may be rotated without undue friction.

To provide a drill which will operate efficiently and effectively over a wide range of speed and in various types of rock or other material, and a drill capable of withstanding the extremely severe usage to which apparatus of this class are necessarily subjected.

With the foregoing and other objects in view, which will appear as the description proceeds, my invention resides in the combination and arrangement of parts and in the details of construction hereinafter described and claimed, it being understood that changes in the precise embodiment of the invention may be made within the scope of what is claimed without departing from the spirit thereof.

The preferred embodiment of my invention is disclosed in the accompanying drawings, wherein:

Figure 1 is a view in longitudinal vertical section of my improved rock drill, the piston hammer being at its rearmost position and the valves so placed as to cause the rapid forward propagation or movement of the hammer upon its working stroke;

Fig. 2 is a similar view showing the hammer at the completion of its working stroke and at the extreme forward end of the cylinder, the valves now occupying a position for admitting pressure at the forward end of the cylinder for the free return stroke of the hammer, the rear end of the cylinder being opened to the atmosphere through the exhaust ports;

Fig. 3 is a top plan view of the hammer, parts being broken away to disclose the structural features thereof;

Fig. 4 is a fragmental view in side elevation of the rear end of the drill, portions of the oiling system being broken away, disclosing the manner in which oil is fed into the drill;

Fig. 5 is a fragmental view in vertical section taken on the line 5—5 of Fig. 4;

Fig. 6 is a view in transverse vertical section of the drill taken on the line 6—6 of Fig. 1; Fig. 7 being a similar view taken on the line 7—7 of Fig. 1;

Fig. 8 is a view in transverse vertical section of the forward part of the drill taken on the line 8—8 of Fig. 1, disclosing the manner in which the revolving cylinder, chuck, and accompanying parts, are provided with balance or pressure, allowing them to freely rotate;

Fig. 9 is a view in end elevation, taken on the line 9—9 of Fig. 4, the parts being removed.

Fig. 10 is a view in vertical section taken on the line 10—10 of Fig. 1;

Fig. 11 is a fragmental view partially in side elevation and partially in vertical section, showing the means whereby the cylinder, and therefore the drill, is rotated, and adjacent parts of the main controlling valve; and

Fig. 12 is a view in vertical transverse section taken on the line 12—12 of Fig. 2.

Referring specifically to the several views, my improved rock drill comprises an outer and main casing 10, in which is mounted a sleeve cylinder 11, capable of turning about its longitudinal axis, but held against sliding or reciprocating, as will hereinafter appear.

Mounted within the cylinder 11 and adapted to freely reciprocate therein, is the piston hammer 12, from the rear end of which extends a projection or plunger 13. An opening 14 extends axially through the hammer so as to receive the water and air supply tube 15 therethrough, the arrangement being such that the hammer is adapted to reciprocate freely within the cylinder, so that the drill may operate at a high speed, and insuring that the maximum impact will be had upon the head of the drill rod or steel at the end of each working stroke.

In order to control the admission and exhaust of pressure to and from the cylinder, to insure the rapid operation of the drill, and to provide for the economical use of the air supply, I have devised a valve mechanism as shown in Figs. 1 and 2 of the drawings, which consists of a reciprocating valve member 17 located within the rear head 16 of the drill and moving freely within a valve guide ring 18, which, in turn, is clamped and held in position between the rear head 16 and a supplemental head 19. The valve member 17 is composed of a cylindrical body portion 20, through which pass the longitudinal ducts 21 extending from the forward face or extremity of the valve to, and terminating at, the surface of the cylindrical portion adjacent its rear end as at 22, forming ports which are first brought into alinement with air supply ports 23 and then with exhaust ports or openings 24, thus controlling the admission of pressure to, and the exhausting of pressure from, the rear extremity of the cylinder. The valve member 17 is reciprocated by providing it with an enlarged flange 25 which acts in the manner of a piston and is of such size that when pressure is admitted therebehind through suitable ducts 26 which communicate with the air supply ports or passages 23, the pressure acting upon the rear surface of the valve is greater than that acting upon the forward surface of the valve within the cylinder, so that the valve will be driven forwardly from the position shown in Fig. 1 to that illustrated in Fig. 2, the hammer 12 being simultaneously projected forward on its working stroke and impacting with the extremity 27 of the drill rod; the pressure behind the hammer, causing its forward propagation, entering through the air supply passages 23, ports 22 and ducts 21, the former communicating with the air supply pipe 28.

The valve, as it passes to its forward position illustrated in Fig. 2, cuts off the admission of air behind the hammer 12 and provides for the admission of air to the forward extremity of the cylinder through the front admission ports 28′; these ports being opened as the flange of the valve member passes forwardly; air pressure being admitted to the passages 29 which extend from the rear head of the cylinder forwardly, as shown in Fig. 4, and terminate at the channel 29′ at the adjacent forward extremity of the cylinder. The sleeve cylinder is provided with openings 30 which are in constant communication with the channel 29′, and therefore with the air supply passages 29. The casing 10 and cylinder 11 are provided with the exhaust ports 30 and 31′, which communicate with the exhaust pipe 32 and are so located that as the hammer is projected forwardly on its working stroke, air is relieved from thereinfront during the initial part of the stroke through the forward sets of exhaust ports 31, the pressure being relieved from thereinfront during the remainder of the stroke by the air escaping through the drill rod, as will hereinafter appear, and through the front portion of the drill to produce a balancing effect upon those parts, as will also be hereinafter explained. The pressure to the rear of the piston hammer upon its return stroke is relieved by the exhaust ports 31′, and by reason of the fact that the ducts 21 are now in communication with exhaust ports 24 provided in the valve guide member 18; the exhaust ports 24, as illustrated in Fig. 2, communicating in turn with the exhaust pipe 32.

The projection or plunger 13 upon the rear extremity of the hammer, is adapted to enter within the recess 33 provided in the forward extremity of the valve, and, compressing the air therein, causes the rearward or return movement of the valve, the same being readily accomplished as the pressure behind the plunger 25 is relieved as the air passages 29 are now in communication with the exhaust pipe 32 through the medium of the channel 29′, cylinder openings 30 and 31. The compression of air which takes place when the plunger 13 of the hammer enters the recess 33, not only provides for the rapid return movement of the valve to its initial position, but acts to check the

rearward movement of the hammer, forms an elastic cushion therefor, and materially aids in the rapid forward propagation of the hammer, which takes place immediately upon the admission of pressure from the rear portion of the cylinder, caused by the return of the valve.

To reiterate, with the valve and hammer in the positions as shown in Fig. 1, pressure enters to the rear of the hammer through passages 23, ports 22, ducts 21, and forcibly moves the hammer forward. Pressure in front of the hammer is relieved through the exhaust ports 31 and through the opening contained in the drill point shaft. As the hammer is propagated forward, pressure enters to the rear of the valve flange 25, through the duct 26, causing the valve to shift forward, so that at the time the hammer reaches the forward extremity of its working stroke the valve 17 has shifted, admitting pressure to the forward extremity of the cylinder through the admission ports 28′, air passages 29, and openings 29′ and 30, causing the return of the hammer, pressure being allowed to escape or exhaust from the rear of the cylinder through the ports 31 and through the ducts 21 and exhaust passages 24. As the hammer nears the extremity of its stroke, the plunger 13, entering the receptacle or cup 33, carries the valve rearwardly and thus completes a cycle of operation.

In drills of the present character, it is necessary to revolve the drill steel, and to this end it has heretofore been the practice to in some way connect the hammer with the drill steel. Such arrangement, however, materially interferes with the rapid working of the hammer, and in order to overcome such objections and provide a drill which may operate at a much higher rate of speed than heretofore thought practical, I provide a separate cylinder 34 extending at right angles to the main cylinder and in which is located a piston 35. The reciprocation of this piston corresponds with the reciprocation of the hammer, and it is accomplished by providing the cylinder in which it operates with ends of different diameters and maintaining within the smaller end 36 a constant air pressure through the air supply passage 37 which communicates with the air supply pipe 28 of the drill. The constant air pressure within the end 36 of the cylinder tends to maintain the auxiliary piston at the far and larger extremity 38 of the cylinder. The larger extremity 38 of the cylinder communicates with the rear extremity of the main cylinder 11 by the passage 39, so that while the forward and smaller extremity of the cylinder 34 is subjected to constant air pressure the remote and larger extremity of the cylinder is alternately exposed or supplied with such air pressure, and by reason of the larger diameter of this end of the piston, the piston is alternately driven forward and returned to correspond with the reciprocations of the piston hammer 12.

The reciprocating motion of the piston 35 is transmitted to a ratchet ring 40 by a projection or lug 41, the ratchet ring in turn oscillating to and fro upon the valve guide ring 18. The ratchet ring is provided with ratchet teeth 42 which engage with corresponding teeth 43 formed or secured to the end of the cylindrical sleeve 11. These teeth may be provided directly upon the end of the rotating sleeve or cylinder 11 adjacent which the oscillating ratchet ring 40 operates or, as best shown in Figs. 1 and 2, the said teeth may be formed upon a ring separate from the cylinder and having an inter-locking engagement therewith to drive the same; the upper portions of these figures showing a lug on the cylinder extending through a recess formed in the inner edge of the tooth-carrying ring, while the lower portions of said figures show a lug extending inward from the inner edge of said ring and lying between two lugs carried by the rotating cylinder. A spring or resilient member 44 extends to the rear of the oscillating ratchet ring 40 and holds the teeth thereof in mesh with the ratchet teeth of the cylinder 11. Thus as the piston hammer 11 reciprocates, a synchronous motion is assumed by the piston 35, which latter oscillates the ratchet ring, which in turn picks up the teeth of the cylinder 11 and rotates the latter through a certain arc, the rotation of the cylinder being accomplished during the stroke of the auxiliary piston 35 when acted upon by the constant air pressure in the smaller end 36 of the cylinder, the presure within the larger end 38 being then relieved, corresponding to the exhausting of the rear extremity of the cylinder 11. The reciprocating motion of the cylinder is transmitted to the drill point 27 by means of lugs 45 which are formed upon the latter and engage with corresponding recesses 46 formed in the drill point chuck 47. The chuck 47 is in turn provided with external lugs 48 which project within the recesses 49 formed in the end of the cylinder 11. Thus as the cylinder 11 is rotated, a corresponding movement is imparted to the drill chuck 47 and thence to the drill 27.

The chuck 47 is held in place within the forward extremity of the drill and at the same time mounted for free rotation by providing the front head 50 of the drill with an enlarged recess 51 adjacent its rear extremity and clamping within said recess a split sleeve or ring 52. The split ring 52 abuts against a shoulder 53 at the rear extremity of the casing 10, and a shoulder 54 of the front head, and is accordingly held

rigidly in place. The split ring also contacts with the shoulders 55 and 56 provided upon the chuck 47, so that the chuck is held against lengthwise movement but may freely rotate. In order to maintain the drill point in place within the chuck, a fastening ring 57 is provided, having openings 58 adapted to receive the lugs 45 of the drill point therethrough, and the ring is further provided with a tooth 59 which engages with a corresponding opening 60 in the extremity of the chuck, the tooth and opening being so located as to hold the lug openings 58 of the fastening ring and the lug openings 46 of the chuck out of alinement, so that after the ring has been passed over the lugs and the lugs inserted within the recesses 46 of the chuck and the ring rotated so as to bring the tooth 59 into engagement with the recess 60, said drill is locked in place and the ring is held so positioned by the front head 50 of the drill.

The split ring 52 is provided with the grease pockets 52′ in which a lubricant may be injected through the passage 52″ illustrated in Fig. 3, the same being provided with an external cap. In order that the chuck and cylinder may freely rotate, the front head of the drill is provided with an air passage A communicating with the air inlet supply port 29′. The passage A extends to the forward end of the drill head and communicates with a recess 57′ formed in the fastening ring 57. The remote extremity of the split ring and the adjacent parts of the drill chuck are provided with the channels B forming cushion pockets communicating with the air pressure within the forward part of the cylinder 11, so that the chuck, fastening ring and split ring are balanced with regard to pressure and the cylinder and chuck may accordingly rotate without undue friction.

The casing 10, rear head 16, and front head 50, are provided with outstanding perforated ears 61, through which extend holding rods 61′, clamping the heads to the casing. The casing and rear head are further provided with outstanding perforated projections C, allowing the drill to be readily mounted upon a drill stand. The water and air supply tube 15 which extends axially through an opening in the hammer, terminates at its forward extremity in the extremity of the drill, as illustrated in Fig. 1; and at its rear extremity is provided with a packing ring 62 through which small ducts or openings 63 pass, providing for the admission of water under pressure to the tube 15. A water and air controlling valve for the drill point is provided in the member 64, the same being in the form of a tube, the water supply flowing from the central opening 65 down through the water duct 66 and thence through the opening 63 into the tube 15. A packing gland 68 engages the water tube 15 and prevents the leakage of water or air from around the supply tube 15. The water and air valve 64 has a flattened portion 69 which when turned into a given position connects the air supply passage 70 (which communicates with the main air supply 28) with the air duct 71, the latter extending around the packing gland 68, as at 72, and communicating with the rear opening of the tube 15 through the duct 73. Thus when the valve 64 is in one position, water is supplied to the drill point; when in a second position, air under pressure is supplied to the drill point for cleaning the drilled hole; while a third position of the valve shuts off both the air and water supply. The extremity of the water supply tube 15 is somewhat reduced in diameter and extends within the opening 74 in the drill point; a loose fit being provided so that air pressure may also enter from the cylinder 11 into the opening 74 of the drill and thence to the drill point proper.

The high speed at which the drill is adapted to operate renders necessary a thorough lubrication of the drill at all times, and to this end I have provided a lubricant receptacle or chamber 80 formed in the rear head 16 of the drill. Oil or other lubricant is introduced within the chamber 80 through the opening 81, the same being normally closed by the plug 82. Located within the lubricant chamber 80 is the sleeve 83 which contains packing 84 therein, and communicating with the lubricant chamber 80 and with the sleeve 83, are the cross tubes 85, their function being to allow oil to escape or pass from the lubricant chamber 80 into the sleeve 83, the cross tubes having small openings 86 and 87 for this purpose. The extremity of the oil-distributing sleeve 83 is provided with outlet openings 88 communicating with the air supply pipe 28 by the duct 89. The lubricant chamber 80 in turn communicates with the restricted or smaller end 36 of the auxiliary cylinder 34 by the duct 90. Thus as the oil-distributing sleeve 83 is subject to constant air pressure of the air supply pipe 28 through the duct 89, and the chamber 80 is in turn subjected to the fluctuating pressure of the smaller end of the auxiliary cylinder 34, a predetermined quantity of oil or other lubricant will be forced from the lubricant chamber 80 into the oil-distributing sleeve 83 as the pressure within the smaller end 36 of the auxiliary cylinder is increased when the auxiliary piston is driven upon its return stroke as air pressure is admitted into the larger end of the said auxiliary cylinder. The pressure which is momentarily backed up in the smaller end of the auxiliary cylinder, causes the oil or lubricant to be forced into the sleeve 83 and thence into the air supply

pipe 28, the packing or waste within the sleeve 83 limiting the amount of oil which is thus supplied upon each reciprocation of the auxiliary piston. Inasmuch as the auxiliary piston which is used to reciprocate the drill is controlled in its movements by the movements of the piston hammer, so will the amount of oil which is delivered to the drill be regulated by the speed at which the drill operates.

What I claim is:—

1. A drill consisting of a casing, a cylinder mounted therein and adapted to oscillate about its longitudinal axis, means whereby a drill point is supported by said casing, a piston hammer adapted to reciprocate within said cylinder and strike said drill point, an inlet and exhaust valve adapted to control the supply of air under pressure to, and the exhaust thereof from, the interior of said cylinder, and means whereby the movements of said valve are jointly controlled by the supply pressure of the drill and by the impact of the piston hammer at the completion of its return or non-working stroke.

2. A drill consisting of a casing, a drill chuck at the forward extremity thereof and mounted for rotation therein, a cylinder mounted within said casing adapted to rotate about its longitudinal axis and engaging, and adapted to rotate, said chuck, a piston hammer mounted for unhampered or free reciprocation within said cylinder, and auxiliary means controlled by the pressure within a portion of said cylinder adapted to intermittently rotate the said cylinder for the rotation of the said chuck and the drill point which it is adapted to support.

3. A drill consisting of a casing, a cylinder therein mounted for rotation about its longitudinal axis, a chuck contained within the forward extremity of said casing, mounted for rotation therein, and means whereby the pressure upon the forward extremity of said chuck is balanced so as to reduce the frictional resistance to rotation thereof, a piston hammer mounted for free reciprocation within said cylinder, means for controlling the supplying and exhausting of pressure in said cylinder, for the reciprocation of said hammer.

4. A drill consisting of a casing, a cylinder therein mounted for rotation about its longitudinal axis, a chuck contained within the forward extremity of said casing, mounted for rotation therein, means whereby the pressure upon the forward extremity of said chuck is balanced so as to reduce the frictional resistance to rotation thereof, a piston hammer mounted for free reciprocation within said cylinder, means for controlling the supplying and exhausting of pressure in said cylinder, for the reciprocation of said hammer, and auxiliary means, mechanically independent and functionally dependent upon the reciprocation of said piston hammer, adapted to rotate the said cylinder.

5. A drill comprising a casing, a cylinder mounted for rotation therein, a piston hammer adapted to reciprocate within said cylinder, an auxiliary cylinder carried by said casing provided with ends of different diameters, an auxiliary piston having ends of different diameters fitting within said auxiliary cylinder, means whereby the smaller end of said cylinder to the rear of said piston is exposed to constant air pressure, and the larger end of said auxiliary piston intermittently exposed to the same constant air pressure for the intermittent reciprocation of said auxiliary piston, and means whereby the reciprocation of said auxiliary piston rotates said first-mentioned cylinder.

6. A drill comprising a cylinder, a piston hammer mounted for reciprocation therein and adapted to impact with a drill point, an auxiliary cylinder having ends of unequal bore carried by said first-mentioned cylinder, a piston having ends of unequal diameter fitting within said auxiliary cylinder, the smaller extremity of said auxiliary cylinder communicating with the air supply of said drill, the larger extremity of said auxiliary cylinder communicating with the one extremity of said main cylinder, whereby the auxiliary piston reciprocates synchronously with the reciprocation of the said piston hammer, and means whereby the reciprocation of said auxiliary piston is adapted to rotate the drill point of the drill.

7. A drill comprising a cylinder, a piston hammer mounted for reciprocation therein, an auxiliary cylinder carried by said main cylinder, with one extremity thereof communicating with one extremity of said main cylinder, an auxiliary piston mounted within said auxiliary cylinder, means for maintaining said auxiliary piston at one extremity of said auxiliary cylinder, opposite to the extremity said auxiliary piston is forced by the pressure received from the main cylinder, means whereby the drill point is held to said drill and receives thereon the impact of said piston hammer, and means whereby the reciprocation of the auxiliary piston rotates said drill point.

8. A drill comprising a casing, a sleeve mounted for rotation therein, a hammer mounted for reciprocation within said sleeve, a drill chuck carried at the forward extremity of said casing and provided with inter-locking means engaging said cylinder and adapted to be rotated thereby, a ring engaging said chuck holding the same against endwise movement and mounting it for rotation, a front head engaging said casing and clamping said ring in place, said chuck pro-

vided with an axial opening and communicating recesses adapted to receive the offset lugs of a drill point therein, and a locking ring adapted to retain the lugs of the drill point within said recesses.

9. A drill comprising a casing, a sleeve mounted for rotation therein, a hammer mounted for reciprocation within said sleeve, a drill chuck carried at the forward extremity of said casing and provided with interlocking means engaging said cylinder and adapted to be rotated thereby, a ring engaging said chuck holding the same against endwise movement and mounting it for rotation, a front head engaging said casing and clamping said ring in place, said chuck provided with an axial opening and communicating recesses adapted to receive the offset lugs of a drill point therein, a locking ring adapted to retain the lugs of the drill point within said recesses, and means mechanically independent of said hammer adapted to rotate said cylinder.

10. A drill consisting of a casing, a cylinder mounted for rotation therein, a drill point carried by said casing and adapted to be rotated by said cylinder, an auxiliary cylinder carried by said casing, an auxiliary piston mounted therein, a piston hammer mounted within said main cylinder, means whereby the pressure in said auxiliary cylinder is controlled by the pressure within the main cylinder for synchronous reciprocation of said piston hammer and auxiliary piston, said rotatable cylinder provided with ratchet teeth thereon, a ratchet ring engaging the ratchet teeth of the cylinder and connected to said auxiliary piston, for the intermittent rotation of said cylinder with the reciprocation of said auxiliary piston, and means for controlling the pressure in the front and rear extremities of said rotatable cylinder.

11. A drill consisting of a casing, a cylinder mounted for rotation therein, a drill point carried by said casing and adapted to be rotated by said cylinder, an auxiliary cylinder carried by said casing, an auxiliary piston mounted therein, a piston hammer mounted within said main cylinder, means whereby the pressure in said auxiliary cylinder is controlled by the pressure within the main cylinder for synchronous reciprocation of said piston hammer and auxiliary piston, said rotatable cylinder provided with ratchet teeth thereon, a ratchet ring engaging the ratchet teeth of the cylinder and connected to said auxiliary piston, for the intermittent rotation of said cylinder with the reciprocation of said auxiliary piston, a piston valve located at the rear extremity of said rotatable cylinder and in the path of travel of the said piston hammer, a projection carried by said piston hammer adapted to enter within a recess formed in said piston valve for checking the motion of said piston hammer and causing the return movement of said piston valve, and means whereby an unbalanced pressure is impressed upon said piston valve when the latter is in its rearmost position, said piston valve controlling the pressure within the extremities of said cylinder.

12. A drill comprising a cylinder, a piston hammer mounted for reciprocation therein and adapted to impact with a drill point, an auxiliary cylinder having ends of unequal bore carried by said first-mentioned cylinder, a piston having ends of unequal diameter fitting within said auxiliary cylinder, the smaller extremity of said auxiliary cylinder communicating with the air supply of said drill, the larger extremity of said auxiliary cylinder communicating with the one extremity of said main cylinder, whereby the auxiliary piston reciprocates synchronously with the reciprocation of the said piston hammer, means whereby the reciprocation of said auxiliary piston is adapted to rotate the drill point of the drill, a lubricating chamber carried by said drill, said lubricating chamber provided with a pressure inlet port communicating with the smaller extremity of said auxiliary cylinder and provided with a lubricant outlet port communicating with the air supply of the drill.

13. A drill comprising a cylinder, a piston hammer mounted for reciprocation therein and adapted to impact with a drill point, an auxiliary cylinder having ends of unequal bore carried by said first-mentioned cylinder, a piston having ends of unequal diameter fitting within said auxiliary cylinder, the smaller extremity of said auxiliary cylinder communicating with the air supply of said drill, the larger extremity of said auxiliary cylinder communicating with the one extremity of said main cylinder, whereby the auxiliary piston reciprocates synchronously with the reciprocation of the said piston hammer, means whereby the reciprocation of said auxiliary piston is adapted to rotate the drill point of the drill, a lubricating chamber carried by said drill, said lubricating chamber provided with a pressure inlet port communicating with the smaller extremity of said auxiliary cylinder and provided with a lubricant outlet port communicating with the air supply of the drill, and a sleeve having radially extending tubes communicating with the said outlet lubricant port.

Signed at Chicago, in the county of Cook and State of Illinois, this 8 day of Oct., A. D. 1917.

BURT L. WORTHEN.

Witnesses:
JOHN BIDERBERG,
ALFRED MACK.