

April 19, 1927.

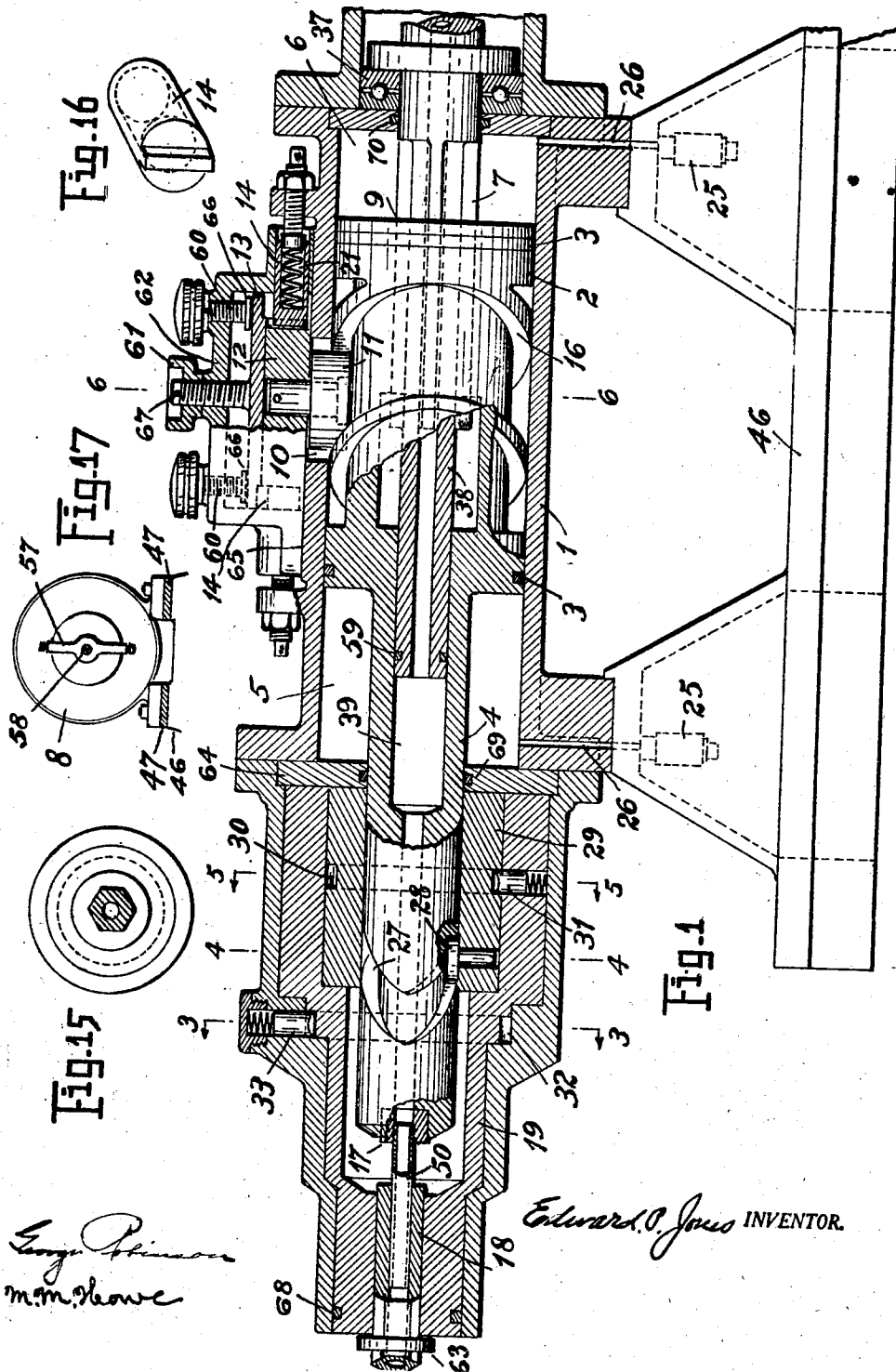
E. P. JONES

1,625,211

ELECTRIC DRIVEN ROCK DRILL AND AUTOMATIC HAMMER AND BORING MACHINE

Filed March 16, 1925

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

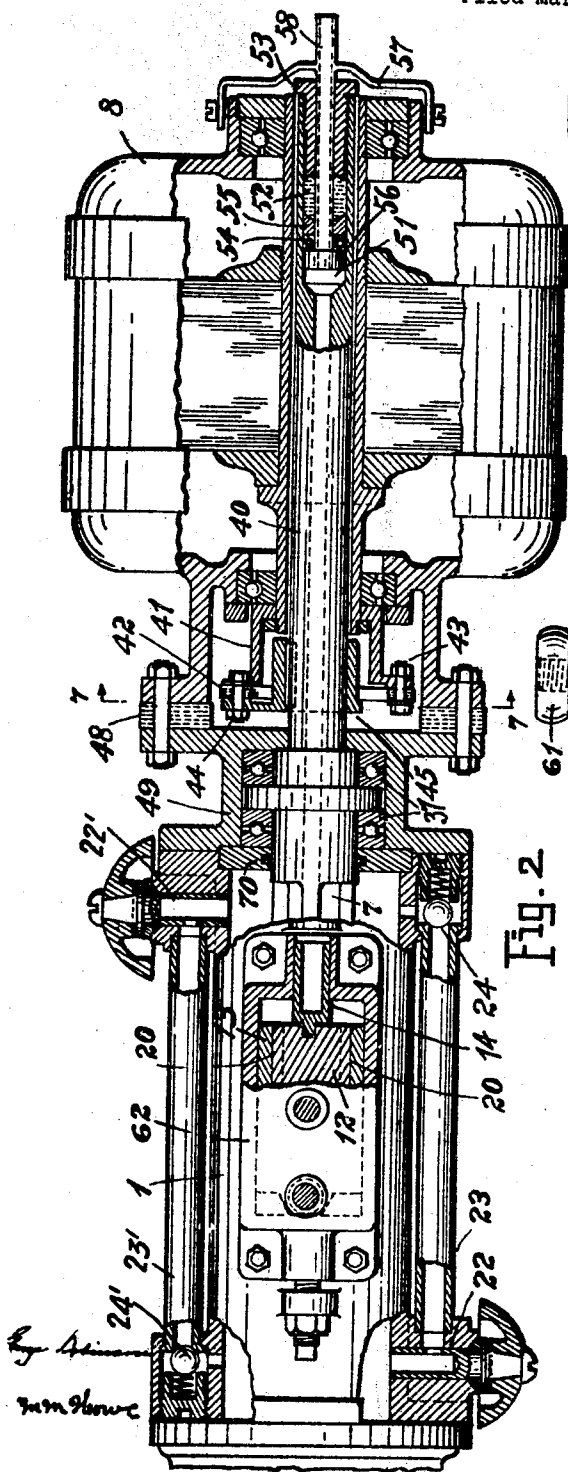


Fig. 2

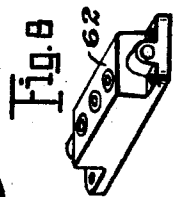


Fig. 8

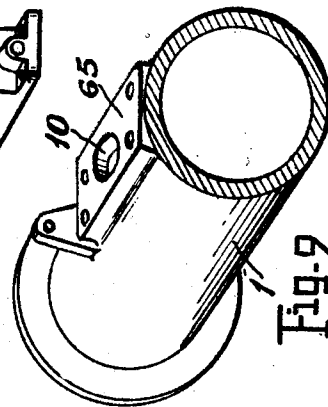


Fig. 9

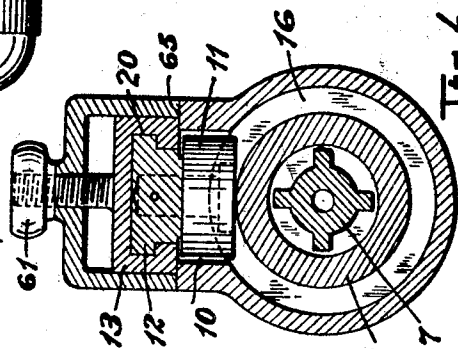


Fig. 6

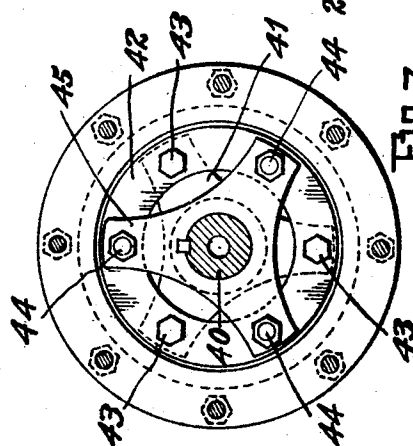


Fig. 7

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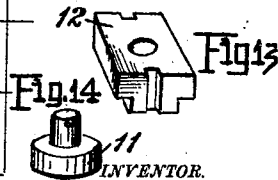
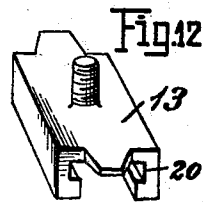
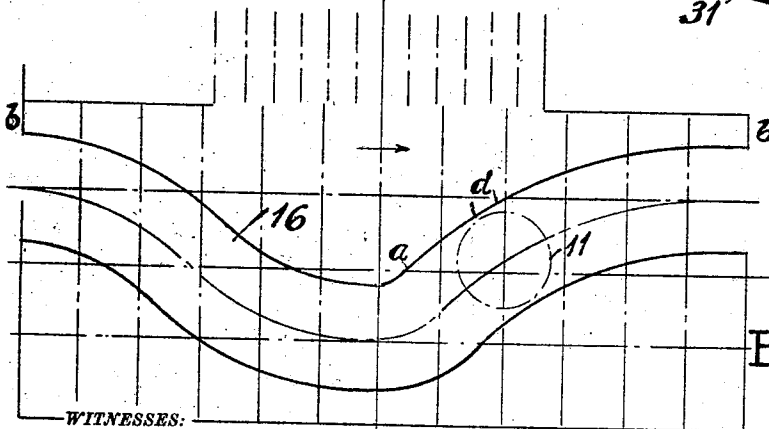
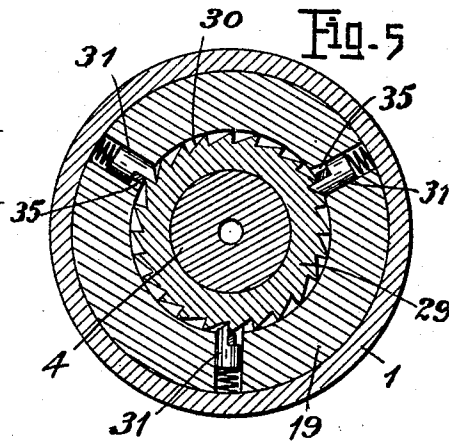
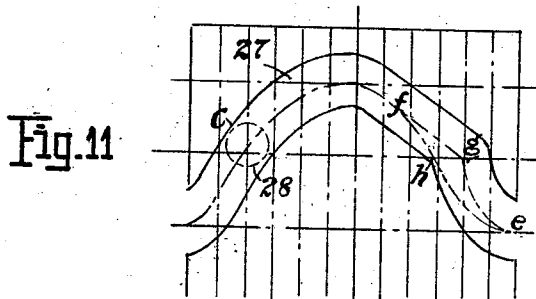
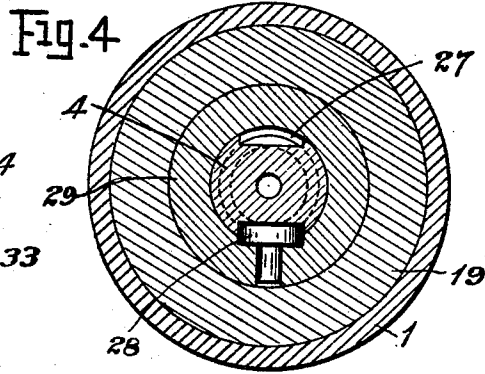
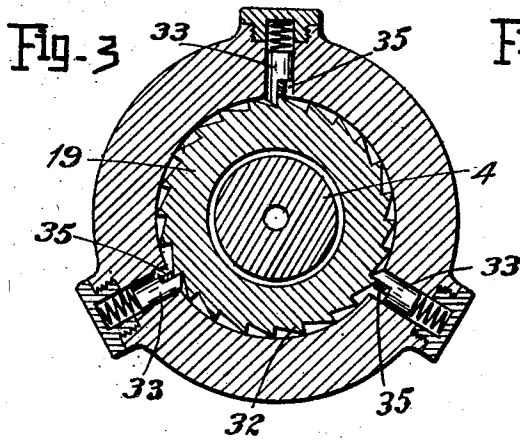
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ELECTRIC DRIVEN ROCK DRILL AND AUTOMATIC HAMMER AND BORING MACHINE

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3 Sheets-Sheet 3



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Fig. 10

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UNITED STATES PATENT OFFICE.

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ELECTRIC-DRIVEN ROCK DRILL AND AUTOMATIC HAMMER AND BORING MACHINE.

Application filed March 16, 1925. Serial No. 16,016.

My invention relates to improvements in automatic portable drills and hammers of the type adapted to earth and rock drilling and boring; and to riveting, caulking, chip-

ping and similar operations.

More particularly this invention consists in improvements in drills and hammers of the type disclosed in U. S. Patent Number 1,467,433, issued September 11, 1923.

Still further advantages of my present construction will appear from the following description and claims.

Fig. 1 is a sectional elevation of the forward portion of one form of my device, showing the hammer-piston unit at half stroke.

Fig. 2 is a plan view partially in section of the central and rearward portion of the form shown in Fig. 1.

Fig. 3 is a sectional view on line 3—3 of Fig. 1 showing the retaining pawls in the body and the ratchet on the chuck engaging them.

Fig. 4 is a sectional view along line 4—4 of Fig. 1 showing the drill-rotating roller and the cam groove in the hammer engaging it.

Fig. 5 is a sectional view along line 5—5 of Fig. 1 showing the retaining pawls in the chuck and the ratchet teeth on the roller mounting sleeve engaging them.

Fig. 6 is a sectional view along line 6—6 of Fig. 1 showing the hammer-reciprocating roller with its retractible mounting, the roller cam groove in the piston engaging the roller, and the splined driving shaft.

Fig. 7 is a sectional view along line 7—7 of Fig. 2 showing the flexible coupling connection between the motor and the hammer-driving splined shaft.

Fig. 8 is a perspective view of the hammer-reciprocating roller supporting mechanism.

Fig. 9 is a perspective view of a portion of the main cylinder body showing the aperture for the hammer-reciprocating roller.

Fig. 10 is a diagrammatic development of the surface of the piston showing in outline the reciprocating cam groove in the piston.

Fig. 11 is a diagrammatic development of a portion of the surface of the hammer showing the outline of the chuck-rotating cam groove in the hammer, being here shown in operative relation to Fig. 10.

Fig. 12 is a perspective view of the ele-

I have found that a greater efficiency and a much greater durability is secured for this type of drill through certain novel cushioning arrangements for the reciprocating and other parts of the mechanism, and from other arrangements of parts which permit of more forceful and effective blows being delivered, without corresponding injury and derangement of the parts, and also result in a more effective utilization of the power employed.

Another benefit from my cushioning and other improved devices is the guarding more fully against injury to the apparatus through the unavoidably rough and abusive usage common to this class of tools.

Another object of my invention is to provide means whereby the cushioned driver for reciprocating the hammer member may be temporarily disconnected or re-connected very simply at will of the operator, for obtaining a simple boring action or for quickly restoring the percussive action, as varying strata of soft and hard rock may be encountered.

Still another object of my invention is to provide a novel and direct means for supplying water, air, or other cooling and flushing medium to the drill point from beyond and through the body of the direct-connected driving motor; securing a direct, simplified, and protected connection between stationary and rotating members having a low frictional loss, and for securing a compact and rugged construction better adapted to operation in confined and hazardous locations.

Further novel features embodied in my invention are the concentrating of power of the forward or working stroke and also ad-

vating and guiding member for the hammer-reciprocating roller supporting block.

Fig. 13 is a perspective view of the reciprocating roller supporting block.

5 Fig. 14 is a perspective view of the hammer-reciprocating roller with its trunnion pin.

Fig. 15 is a partial front elevation showing the chuck and drill rod assembly.

10 Fig. 16 is a perspective view of the guide tube for the cushioning spring.

Fig. 17 is an end elevation of the driving motor showing the shock-absorbing pads between the motor frame and the base plate.

15 Within the cylinder body 1 (Fig. 1) the rotatable piston 2 carrying packing rings 3 and the hammer 4 is so mounted for reciprocation that when the piston is at mid-stroke the air chamber 5 at the forward end is relatively larger than the air chamber 6 at the rearward end. When the keyed or splined drive shaft 7 is rotated by the driving motor 8 the piston and hammer are caused to rotate at motor speed through the engagement of the splines in the slotted bore of the rear piston head 9. Through an aperture 10 in the wall of the body cylinder the hammer-reciprocating roller 11 is mounted in the supporting block 12, being yieldably 20 guided in the elevating and guiding member 13 for a slight longitudinal movement between the spring tubes 14.

Under rotation of the drive shaft by the motor the roller 11 engaging the wall of the 35 groove 16 causes the piston and hammer to advance and recede as well as rotate, making one stroke forward and back during each revolution of the motor. When the hammer has advanced, during any stroke, the full 40 travel as determined by the configuration of the groove 16, so that the hardened anvil 17 strikes the head of the drill rod 18 fixed in the chuck 19, instead of a dead blow being delivered, as would occur in the case of a 45 rigidly maintained relation existing between the cylinder body and the roller, the inertia of the swiftly moving hammer and piston is permitted to carry these somewhat beyond their nominal travel by causing the roller-supporting block 12 to slide in its guides 20 and compress the adjustable springs 21.

During the forward travel of the piston, air confined in the forward chamber 5 is first 55 compressed and later partially discharged through the controllable throttle valve 22, thence through the pipe 23, past the check valve 24. During the rearward travel of the piston, the air confined in the rearward chamber 6 will be transferred back to the 60 chamber 5 through the pipes 22¹, 23¹, and valve 24¹. Thus by suitable adjustment of the control valve 22 the air is caused to operate first in conjunction with the spring 21, to cushion the blow of the hammer, and later

to assist the cam groove in reversing the motion of the hammer and piston. 65

A similar resilient action and corresponding re-transfer of air to the forward chamber takes place on the return stroke of the piston, except that, since the air chamber or 70 piston clearance is smaller at the end of the return stroke than at the end of the forward stroke, the cushioning is relatively greater on the return stroke.

In order to replenish possible leakage of 75 air from the cylinder during continued operation of the apparatus, suitably adjusted check valves 25 communicate through passages 26 with the respective ends of the cylinder. 80

Referring to Fig. 11 the slope of the piston-reciprocating cam groove 16 is more acute at *a* near the end of the roller's travel on the forward stroke than at *b* near the end of the roller's travel on the backward stroke, 85 so that a blow of more effective force is delivered on the forward stroke, and the return is effected with a reduced mechanical shock to the mechanism.

Referring to Fig. 10 the contour of the 90 drill ratchet-rotating cam groove 27 conforms at every point as *c* with the similarly timed point as *d* on the reciprocating cam groove (Fig. 11), except between *e* and *f* where the path of the ratchet-rotating cam 95 roller 28 is displaced along the line *e-g-f* instead of following the neutral line *e-h-f*, so that the roller 28 instead of traversing the entire length of its groove idly throughout the reciprocation cycle, as would be the case under the latter condition, is diverted by 100 pressure of the wall of the cam groove by the amount *g-h*, and reacting through the mounting sleeve 29 and its ratchet 30 against the pawls 31 in the drill chuck, cause the 105 chuck and drill to rotate approximately one ratchet tooth space on the ratchet ring 32. Reverse rotation of the chuck is thereafter prevented by the pawls 33 in the cylinder body engaging in the chuck ratchet ring 32. 110

Pawls 31 and 33 have inserted across the apertures in which they are mounted bridge 115 pieces 35 which serve to maintain the engaging faces of the pawls in proper alignment with the ratchet teeth at all times.

Obviously the sole object to be accomplished by the rotation of the roller supporting sleeve 29 is to cause an advance of one ratchet tooth on the chuck at some approximately predetermined part of each stroke 120 cycle. Hence the occurrence of slight accidental oscillations during other parts of the stroke cycle will be without practical effect. Thus should the rebound of the hammer, 125 finding the roller 28 past the dead center of its cam groove, cause the roller supporting sleeve or the drill chuck to oscillate either forward or backward by any small amount

less than one ratchet tooth space, the practical operation of the apparatus will not thereby be disturbed.

Splined drive shaft 7 supported in bearings 37 is steadied by a forward extending cylindrical portion 38 entering a recess 39 in the hammer. The motor armature shaft is hollow and the rearward extending cylindrical portion 40 of the drive shaft passes through the armature shaft for its entire length. The bore of the armature shaft is appreciably larger than the outer diameter of the drive shaft at this point, thus the drive shaft extends within but entirely out of contact with the motor armature shaft.

Secured to the forward end of the armature shaft is a clutch spider 41 and the other end of the spider is connected to a flexible and resilient driving ring 42 by bolts 43. Similarly attached by bolts 44 to the flexible driving ring is a clutch spider 45 keyed to the main drive shaft.

Interposed between the feet of the driving motor frame and the common base-plate 46 are resilient shock-absorbing pads 47 (Fig. 17).

Similarly a resilient separator ring 48 is interposed between the motor frame and the cylinder extension 49.

Thus due to the clearance space surrounding the drive shaft extension within the armature shaft, to the resilient connection between driving spiders, and to shock-absorbing elements interposed between the motor frame and its connected members, shocks of impact received by the forward portion of the apparatus are appreciably cushioned and absorbed before reaching the more delicate mechanism of the driving motor.

The splined drive shaft, the piston and hammer, and the drill rod each have central passages throughout their respective lengths.

A short pipe 50 (Fig. 1) attached at the forward end of the hammer protrudes and slidably enters the bore of the drill rod for a distance. The rearward end of the drive shaft has an enlarged recess 51 (Fig. 2) for receiving packing 52 and a packing gland 53.

Bearing 54 disposed between the packing follower 55 and the enlarged head of the tubular member 56 receives thrust from the compressed packing. Tubular member 56 has steadying arms 57 loosely attached to the body of the motor, so that despite rotation of the drive shaft, a stationary sealed connection is provided for the attachment of a fluid supply hose at 58.

Thus a protected fluid communicating passage is provided, extending continuously from the supply hose through the tubular member to the drive shaft, thence to and through the hammer and its pipe extension, thence to the bore of the drill rod, and so to the rock breast.

To assist in maintaining the fluid seal a packing ring 59 (Fig. 1) may be applied to the forward end of the drive shaft.

Whenever a simple boring action, as distinguished from percussion, is desired from the apparatus the operator raises the steadying screws 60 their full travel until their stop head strikes the housing 62. Thereafter by turning the nut 61 the elevating guide member 13 is raised, withdrawing the reciprocating roller and leaving the piston and hammer free to be rotated by the motor through the splined shaft.

During the first revolution under these conditions the hammer will be driven forward by the cam action of the ratchet operating groove 27 and, since the drill rod will now be pressed backward by contact of its point with the breast wall, the hammer anvil will come into pressure contact with the head of the drill, and the angularity of the groove 27 will tend to maintain this pressure while the drive shaft continues to rotate the drill. The torque on the hammer being under these circumstances transmitted by the wall of the groove to the roller 28, thence to the supporting sleeve 29, to the ratchet pawls 31, and thus to the drill chuck; pawls 33 in the meantime clicking idly over the ratchet ring on the chuck. The longitudinal thrust due to pressure on the drill point reacts against the collar 63, thence to the chuck, thence to the cylinder head plate 64.

On completion of the boring operation, and for a return to the percussive action, the elevating member 13 is lowered and the reciprocating roller is re-engaged in the piston groove by reverse rotation of the nut 61, after which the elevating member together with its roller is tightened down firmly on its bearing surface 65 by reverse rotation of the steadying screws 60.

Heads 66 provided on the steadying screws, and a pin 67 above nut 61 limit the travel of these parts and avoid their accidental detachment and loss. The object of the left-hand screw thread on the central elevating screw, combined with right-hand threads on the adjacent steadying screws is to avoid confusion for the operator, thus all movements for disconnecting the roller are left-hand turns, while all movements for re-engaging the roller are right-hand turns.

It is preferable that the interior parts of the apparatus operate in a bath of lubricant, and to seal the mechanism against loss of lubricant packing rings 68, 69, and 70 may be provided at various points.

It is obvious that the ratchet mechanism and also the central passage for the flushing medium shown and described have particular reference to drilling operations, and that they may be omitted from apparatus in-

tended for chipping, caulking and riveting.

It is also obvious that various other changes, modifications, and re-combinations may be made by those skilled in the art without departing from the spirit of my invention.

I claim:

1. An automatic hammer, a hammer element controlled by a rotatable and slidable piston, a driving groove in said piston, a drive member coacting with said groove,

and a slidable carriage supporting said drive member.

2. The combination set forth in claim 1 and resilient means for limiting and controlling the movement of said carriage.

3. The combination set forth in claim 1 and means for disengaging said drive member from said groove without removing any part of the device for the purpose set forth.

EDWARD P. JONES.