No. 720,319. PATENTED FEB. 10, 1903.

W. A. BOX & E. Y. SAYER.

DRILL APPARATUS FOR DRILLING ROCK, MINING, &c.

APPLICATION FILED OCT. 18, 1901.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.

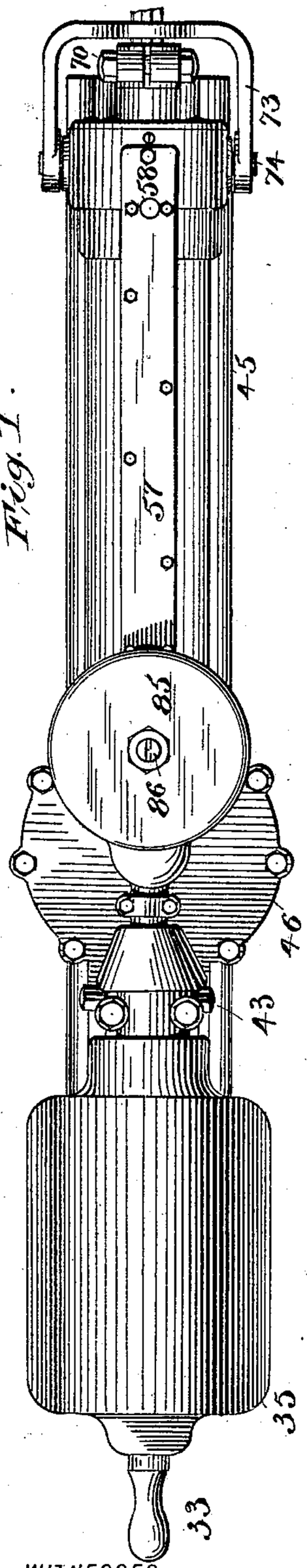


Fig. 6.

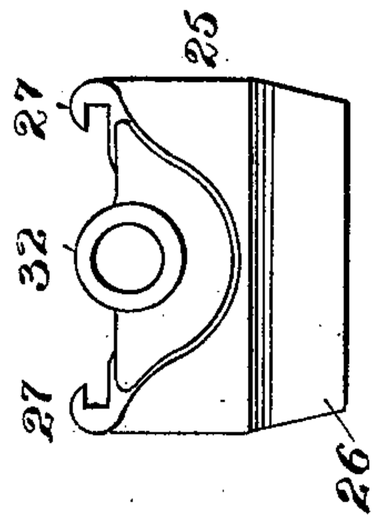


Fig. 7.

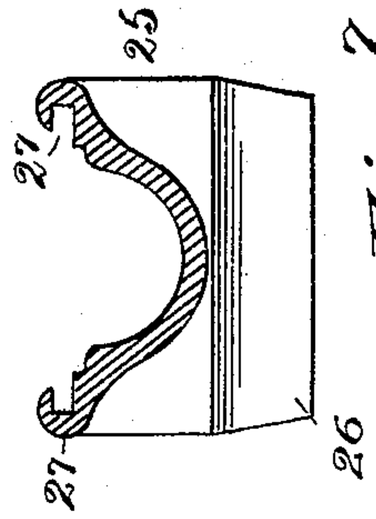


Fig. 4.

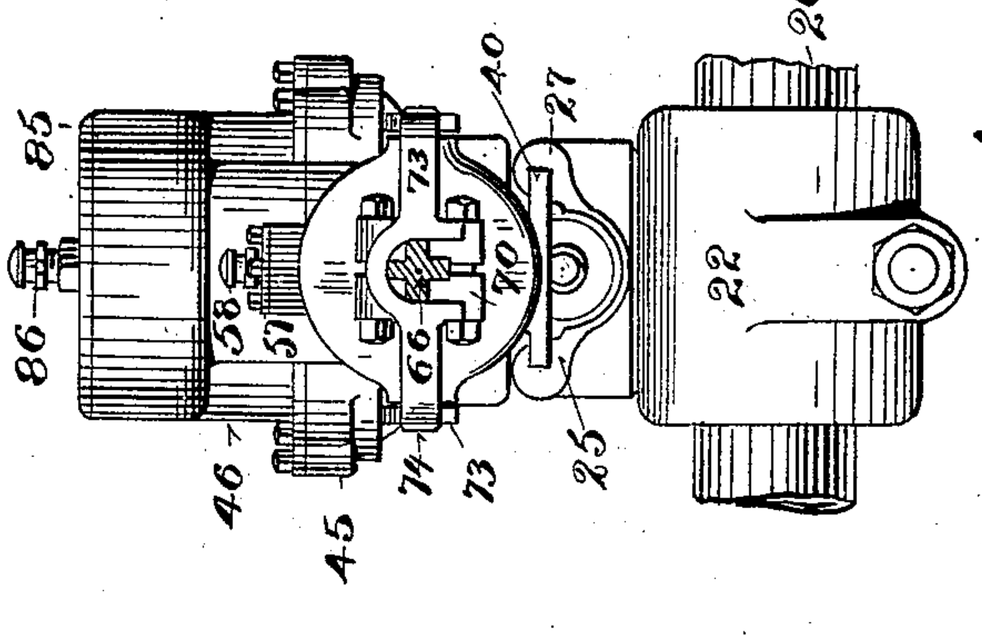
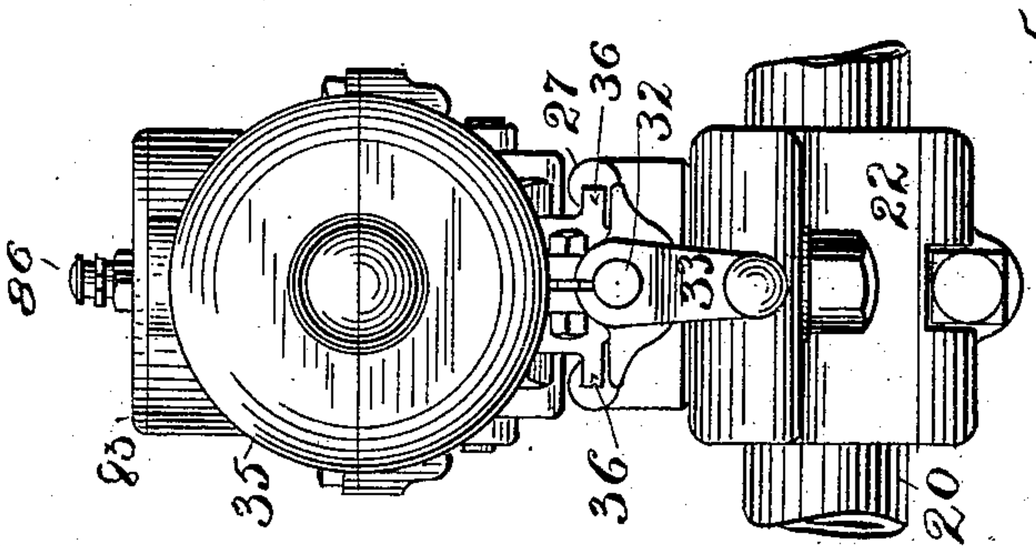


Fig. 5.



WITNESSES

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NO MODEL. 3 SHEETS—SHEET 2.

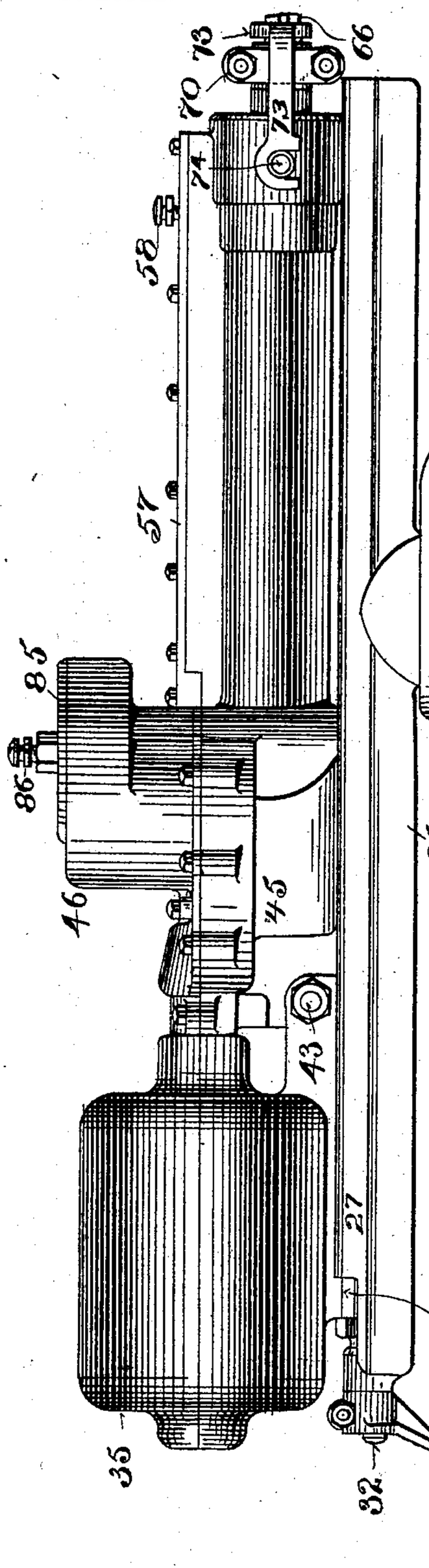

Fig. 2.

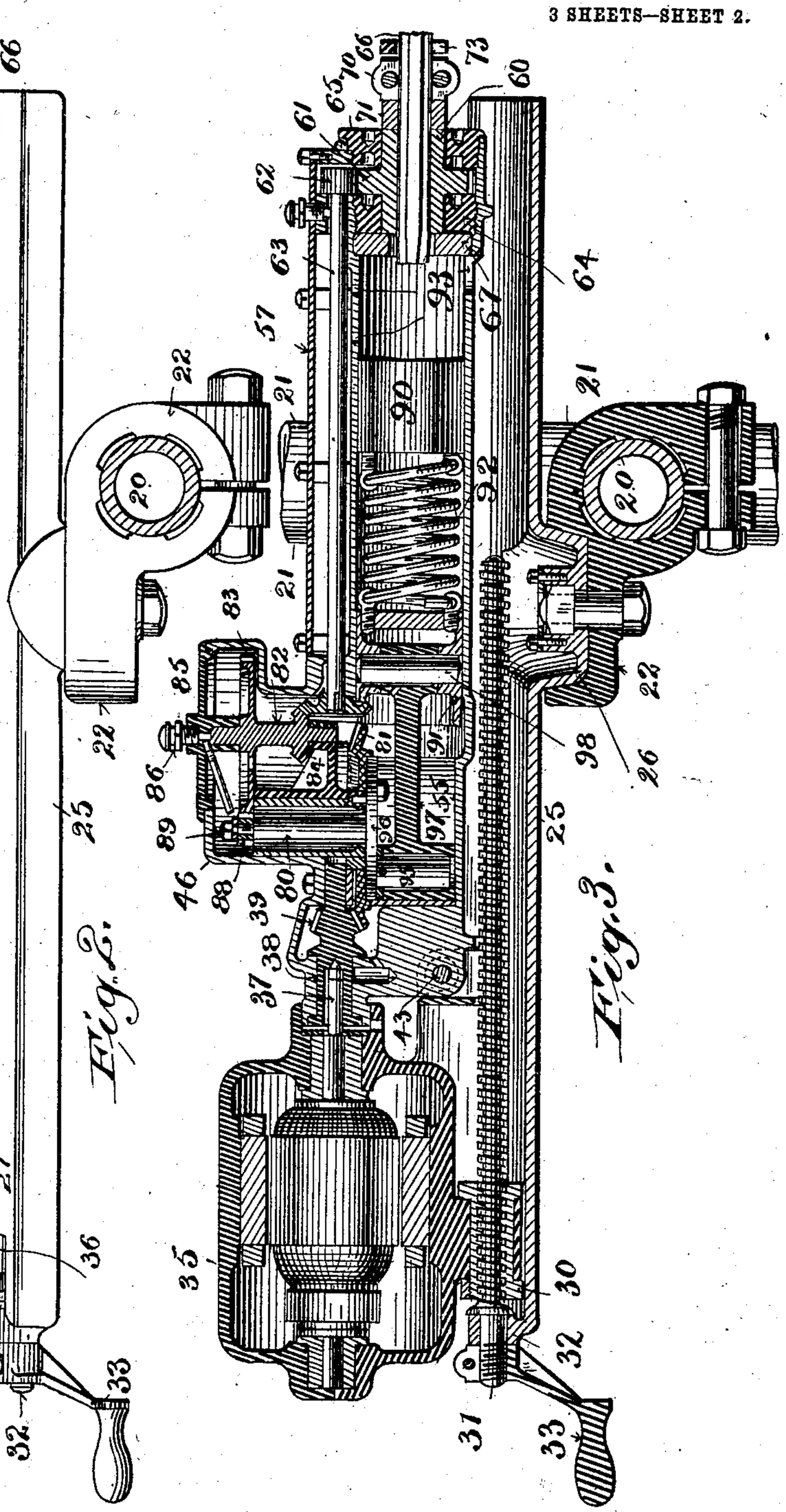

Fig. 3.

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NO MODEL. 3 SHEETS—SHEET 3.

Fig. 10.

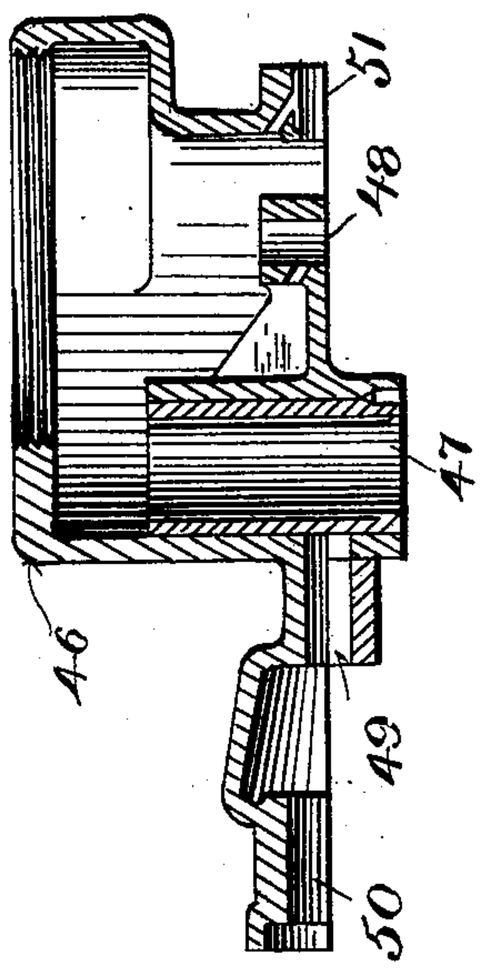


Fig. 8.

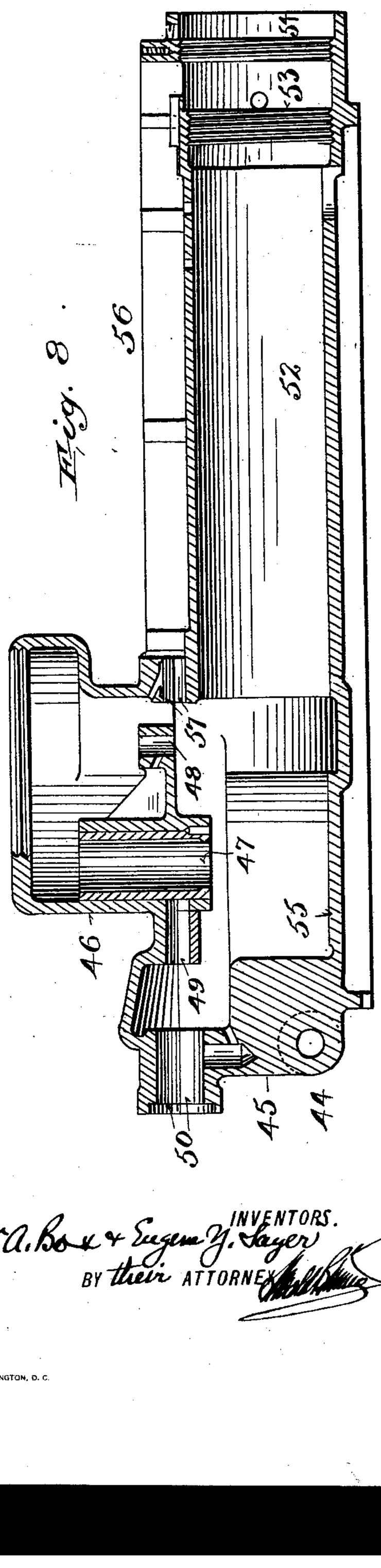
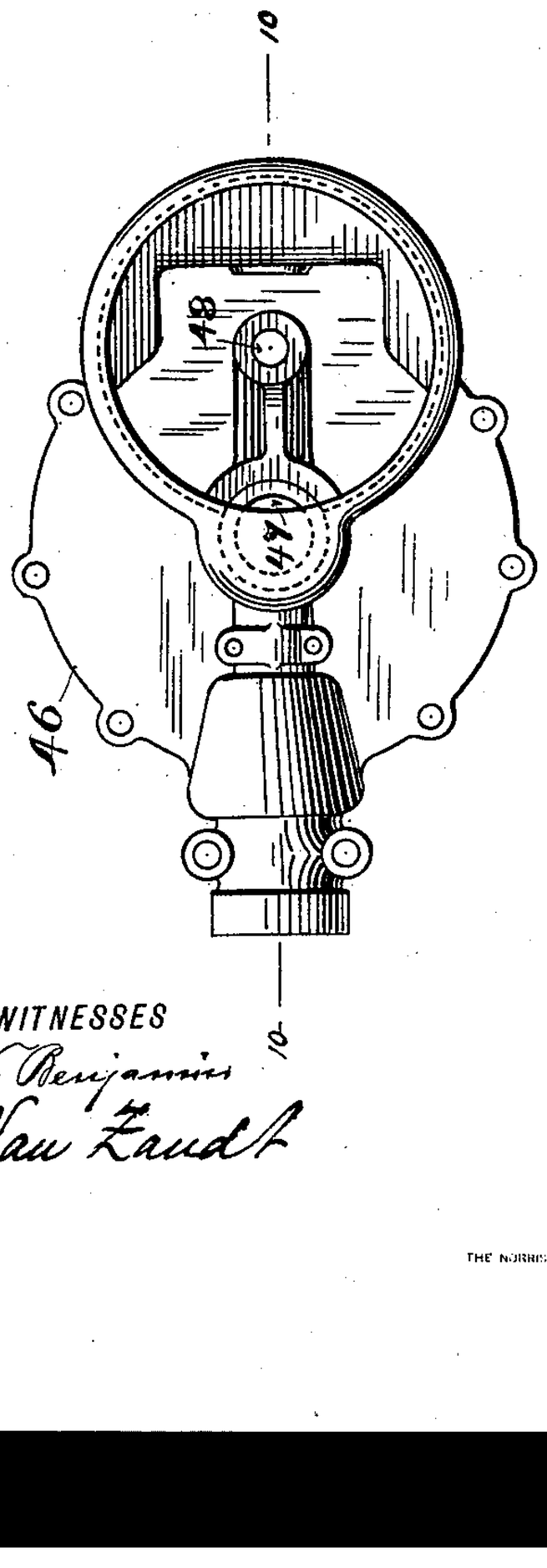


Fig. 9.



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UNITED STATES PATENT OFFICE.

WILLIAM A. BOX AND EUGENE Y. SAYER, OF DENVER, COLORADO.

DRILL APPARATUS FOR DRILLING ROCK, MINING, &c.

SPECIFICATION forming part of Letters Patent No. 720,319, dated February 10, 1903.

Application filed October 18, 1901. Serial No. 79,062. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM A. BOX and EUGENE Y. SAYER, of Denver, in the State of Colorado, (post-office address for both Box 1,526, Denver, Colorado,) have invented certain new and useful Improvements in Drill Apparatus for Drilling Rock, Mining, and other Uses, of which the following is a specification accompanied by drawings.

The invention is designed and adapted especially for motor-driven rock-drills, and more especially electric rock-drills; but in some aspects of the invention it is certainly not limited to this use.

The invention relates to the percussive type of drill and contemplates improvements in the mounting of the drill and in the actuating mechanism of the drill.

In the preferred forms of the invention as pointed out in some of the following claims the electric motor is directly applied to actuate the drill mechanism proper.

The objects of the improvements are to economize power and to accomplish the greatest amount of work by the drill for a given expenditure of power, to simplify the construction and the operation of the apparatus, to reduce its liability to breakage, to increase the facility with which the parts may be assembled or be taken apart for inspection, cleaning, or repair, as well as to improve the apparatus in certain other aspects which more readily appear from the following description.

The improved mechanisms and their combinations in a complete machine are described in one preferred embodiment in the following description, and the characteristic features which form the subject-matter of our joint invention are enumerated in the claims that follow.

In the drawings, Figure 1 is a plan view of a complete apparatus as designed for a rock-drill, omitting the rigid supporting-arm upon which the drill is adjustably secured when in use, and the electrical conductors, controlling-switches, and other parts foreign to the drill mechanism proper. Fig. 2 is a side elevation of the same. Fig. 3 is a longitudinal central section. Fig. 4 is a front end view showing the drill or tool in cross-section. Fig. 5 is a rear end view of the same. Fig. 6 is a rear end view of the guide-frame of the apparatus. Fig. 7 is a transverse cross-section of the same. Fig. 8 is a longitudinal cross-section of the shell or housing of the drill mechanism separated from the motor and the guide-frame upon which it is adapted to be mounted and with certain caps and detachable parts removed. Figs. 9 and 10 are a plan view and longitudinal section of a detachable portion of such shell or housing.

The rigid arm 20, column 21, and clamp 22, by which the guide frame or bed of the apparatus is rigidly held when in use, are not peculiar to this invention and appear only in Figs. 2, 3, 4, and 5. The guide-frame 25 should have the usual boss 26 or other suitable means by which it may be adjustably secured to the clamp 22. The guide-frame 25 has guides 27, upon which slide the motor and the drill mechanism, as will be presently described. Either the motor or the drill mechanism is provided with a screw-threaded nut 30, through which is threaded the feed-screw 31, which gives travel to the drill mechanism when it is desired to advance or feed the drill forward or retract it. The screw 31 turns in the bearing 32 in the guide-frame 25 and is prevented from moving longitudinally therein by means of shoulders or collars, as shown, and is turned by means of a handle 33. The motor 35, of any suitable type, but preferably a small high-speed motor, is mounted to slide in the guides 27 of the guide-frame 25, being preferably provided with slide-flanges 36, as clearly seen in Fig. 5. A shaft of the motor, preferably the armature-shaft, as shown, projects from the motor-casing and is splined or provided with a square end 37, by which it may be made to fit into and turn the sleeve 38 of the pinion 39 without being rigidly secured to the pinion.

The shell or housing of the drill mechanism (shown detached in Fig. 8) is also provided with slide-flanges 40, (see Fig. 4,) which slide in the guides 27 of the guide-frame 25. This shell or housing may be coupled to and uncoupled from the frame of the motor by a pin or bolt 43 passing through a bolt-hole 44 in the shell or housing and registering bolt-hole in the base of the motor-frame. By withdrawing the bolt or pin 43 the motor and the drill mechanism may be slid apart upon

the guide-frame or entirely removed therefrom; but when both are together the two parts are rigidly held and adjustable together upon the guide-frame 25.

The shell or housing preferably consists of two principal and separable parts 45 and 46 in addition to certain caps, bearings, and smaller separate parts. In Figs. 8, 9, and 10 the working or moving parts are omitted, so that the structure of the shell is clearly apparent. The upper detachable portion 46 of the shell preferably contains two vertical bearings 47 and 48 and one complete horizontal bearing 49 for the shaft of the pinion 39. It also contains the upper half of a horizontal bearing 50 for the sleeve 38 and pinion 39 and the upper portions of the bearing 51 for the horizontal shaft that rotates the tool-chuck, as will be presently described.

The lower and larger portion 45 of the shell or housing contains the guideway, preferably a cylindrical surface 52, for guiding the reciprocating hammer and actuating-head, that is connected with the hammer by a spring. At the forward end of the shell are two sets of screw-threads 53 54, which receive screw-threaded collars, in which the rotary chuck is mounted. The shell 45 contains the lower cooperating halves of the horizontal bearings 50 and 51, already mentioned. Opposite and beneath the vertical bearing 47 is a horizontal plane bearing-surface 55 for the pitman, which will be presently described. Along the upper forward portion of the shell there is provided a trough-like protecting-box 56 for the shaft that actuates the tool-holding chuck. This is covered above by the plate or cover 57, provided with an oiling device 58.

The moving parts of the drill mechanism proper consist, primarily, of the means for holding the drill and for turning it and the means for hammering the rear end of the drill. It is preferable under this invention to hammer the rear end of the drill directly instead of hammering the whole tool-holder. The tool-holder is illustrated in the form of a rotary chuck 60, provided with gear-wheel 61, that meshes with the pinion 62 on shaft 63. The rotary chuck 60 is held between the two collars 64 65, which are screw-threaded into the threads 53 and 54, already described. The chuck has bearings in these collars. The drill or tool 66 extends through an axial aperture in the chuck, which is square or otherwise fitted to the drill-iron, so that while the drill is free to move lengthwise it turns with the chuck. Protecting the inner end of the chuck from the hammer is a rubber washer 67, so that when the end of the drill is not in place to be struck by the hammer the blow of the hammer will be cushioned on the elastic washer 67 instead of strking the metallic parts of the mechanism. In order to hold the tool in proper position longitudinally while still allowing a sufficient play, a collar 70 is secured to the drill and a rubber collar or cushion 71, interposed between the collar and the front of the chuck or of the casing. This prevents the tool being thrust back too far into the chuck and also prevents the drill being advanced too far by the feed-screw 31 when the tool or drill proper is pressed against the rock or other surface that is to be drilled.

A yoke 73, fitting loosely over the drill proper or tool in front of the collar 70, prevents the tool from dropping out when the apparatus is pointed downward. The yoke 73 is preferably secured to the shell or housing of the apparatus by pins 74, fitting into appropriately-shaped notches or slots in the yoke 73. This yoke also enables the operator to utilize the power of the screw 31 in withdrawing the drill from the drill-hole when it is too tight to be drawn out by hand. The pinion 62 is driven, preferably continuously, by means of gearing actuated by the pinion 39. In the bearing 47 is mounted a vertical shaft 80, rigidly secured to and turned by the beveled gear 81, which meshes with and is actuated by the beveled pinion 39. In the bearing 48 is mounted a vertical shaft 82, provided with gear-wheel 83 and beveled gear 84 and having an upper bearing, as shown, in the cap 85. This cap is screw-threaded into the detachable portion 46 of the shell or housing and is provided with an oiling device 86, by which the oil may be introduced into the whole interior of the shell or housing, the movement of the working parts being sufficient to distribute the oil thoroughly over every part. The gear-wheel 83 is driven by a small pinion 88, which turns with the shaft 80, but is frictionally secured thereto by a rawhide or other washer and a nut 89, as shown, in order to provide a frictional yielding or slipping connection, which will relieve excessive stress upon the mechanism that rotates the tool-holding chuck in case the drill or tool sticks in the work.

The beveled gear 84 meshes with and turns the beveled gear, as shown, upon the end of the shaft 63. Consequently when the motor rotates the beveled gear 39 the shaft 80 is actuated thereby and drives the shaft 82, which in turn drives the shaft 63, and thereby the chuck 60. The forward bearing for the shaft 63 is preferably detachable from the shell or housing 45 of the apparatus, but is held firmly in place when the cover 57 is bolted or otherwise secured in its place. The hammer 90 and the reciprocating head 91 are fitted to slide and be guided on the cylindrical surface 52. These parts are connected by a spring 92. In front of the hammer air-holes 93 are provided in the wall of the shell or housing, so that the blow of the hammer shall not be weakened or cushioned by the confined air; but between the hammer and the reciprocating head the confined air acts as an elastic medium which stores up and delivers energy to the hammer 90 when the hammer is actuated rapidly by the reciprocating head 91. The spring 92 also serves this function; but in addition it forms a means of per-

manently preserving the proper spacing or interval between the reciprocating head and hammer which could not practically be maintained by air alone on account of leakage. On account of the elasticity of the air, however, a much lighter spring 92 may be used than if the air were not also available as an elastic medium.

The principle of operation of the spring and elastic medium between the reciprocating head and the hammer is probably as follows: After the hammer has struck the tool 66 it has parted with substantially all its kinetic energy, for substantially all its energy, with the exception of such as is lost by heat, is delivered to the tool. As the head 91 is drawn backward the tension has of course first to be developed between the head and the hammer before the hammer will be drawn back. This stretches the spring 92, while at the same time relieving the motor from the sudden jerk or stress which would result from a rigid connection between the hammer and the reciprocating head. After the head has reached the backward end of its stroke the momentum or inertia of the hammer 90 of course causes it to continue to move backward until the resulting compression of the spring brings it to rest. As the head moves forward, strongly compressing the spring and also the air between the head and the hammer, the hammer is forced forward under the elastic pressure and acquires a velocity considerably greater than the velocity of the reciprocating head. Obviously as the reciprocating head slows up in approaching the forward end of its movement the hammer is not so retarded, and the kinetic energy stored up in the hammer 90 is delivered in full strength of impact upon the tool or drill 66.

The reciprocating head 91 is actuated by a wrist-pin or crank-pin 95, secured to the disk 96 at the lower end of the shaft 80, and by a pitman 97, the actuated end of which receives the crank-pin 95 and the other end of which is pivoted to the reciprocating head 91 by the pin 98. The pin 98 is of such length that it is kept in place by the cylindrical bearing-surface 52 of the guides upon which the head reciprocates, and it does not require any other fastening. The end of the pitman that receives the crank-pin 95 is not secured to the crank-pin, but is prevented from endwise movement upon the crank-pin by bearing on its lower side against the plane bearing-surface 55 of the shell, and on its upper side it rests against and, indeed, may form the sole support of the disk 96 and the shaft 80. In taking the apparatus apart, therefore, the detachable portion 46 of the shell may be removed and the shaft 80, disk 96, and crank-pin 95 drawn away from the pitman, and then after the rotary chuck 60 and the collars 64 and 65 have been removed the hammer, spring, reciprocating head, and pitman may be drawn out through the forward end of the shell and the pin 98 may be dropped or pushed out of place, disconnecting the pitman from the reciprocating head. The parts may of course be put together in the reverse order. When the detachable portion 46 of the casing is removed and the motor 35 drawn away from the sleeve 37 and beveled pinion 39, the sleeve and pinion are free to be taken from their bearings. The shaft 80 and disk 96 may be drawn freely from their bearings, and when the plate or cover 57 is removed the shaft 63 is free to be raised from its bearings. The shaft 82 and the gears that turn with it may be lifted out by merely removing the cap 85 without detaching the portion 46 of the shell. In addition, therefore, to extreme simplicity of construction it is clear that the drill may be entirely taken to pieces and put together again with the greatest rapidity and ease.

It is to be noted that when the rotary parts of the motor are rigidly connected to drive the crank and actuate the reciprocating head, as above described, the need of a separate fly-wheel is obviated, and, furthermore, as the momentum of the rotary parts acts upon the spring and never directly upon the hammer great smoothness, certainty, and economy of operation are assured.

While the foregoing description and the accompanying drawings illustrate the invention in the form in which in our present opinion it has reached its highest development, nevertheless it will be clear to those skilled in the art that in the matter of details and design the apparatus is capable of wide variation without departing from the principles of operation that characterize it. Obviously also parts of the invention may be made use of in subcombinations without including all the combinations and improvements which complete the apparatus in its most preferred form.

We claim as the substantial and characteristic features that distinguish our invention the following:

1. In a drilling apparatus, the combination of a frame adapted to be suitably held in position and having guideways, a rotary motor supported to travel on said guideways, a casing also supported to travel on said guideways, means for detachably connecting the casing to the motor, feed mechanism connected to the frame for moving the motor and casing uniformly along the frame, drilling mechanism supported in said casing, and means for mechanically connecting the motor to the drilling mechanism to operate the latter, substantially as set forth.

2. In a drilling apparatus, the combination of a frame adapted to be suitably held in position and having guideways, a rotary motor supported to travel on said guideways, drilling mechanism also supported to travel on said guideways, means for detachably connecting the motor to the drilling mechanism to insure uniform movement of both on the guideways, feed mechanism connected to the frame for moving the motor and drilling mech-

anism on the guideways, and means for mechanically connecting the motor to the drilling mechanism to operate the latter, substantially as set forth.

3. In a drilling apparatus, the combination of a guide-frame adapted to be suitably held in position, a drill shell or housing mounted to travel thereon and provided with an instrumentality for giving travel to it, a drill or tool, drill-operating mechanism arranged within said shell or housing, and mechanism for continuously rotating said drill, said housing having a detachable portion provided with bearings for the rotary parts of both the drill-operating mechanism and the mechanism for rotating the drill, the principal parts of said mechanisms being free to be drawn apart when the said detachable portion of the housing is detached, substantially as set forth.

4. In a drilling apparatus, the combination of a guide-frame adapted to be suitably held in position, a drill shell or housing mounted to travel thereon and provided with an instrumentality for giving travel to it, a drill or tool, reciprocating mechanism arranged within the shell or housing, a shaft connected to continuously rotate said drill, and operative connections for said reciprocating mechanism and shaft, said shell or housing having a detachable portion provided with bearings for the rotating parts of said operative connections, substantially as set forth.

5. In a drilling apparatus, the combination of a guide-frame, a drill or tool, a shell consisting of separable portions, drilling mechanism comprising means within the shell for imparting force to the drill and mechanism for rotating the drill, and operative connections for said mechanisms, the separable portions of the shell being provided with coöperating bearings for the rotary parts of said drilling mechanism, and one of said portions being provided with a plurality of separate bearings for said operative connections, whereby when the portions of the shell are detached, the principal parts of the drilling mechanism may be removed, substantially as set forth.

6. In a drilling apparatus, the combination of a guide-frame, a shell and means for moving the same on the frame, a drill, drilling mechanism within the shell, said shell consisting of separable portions provided with coöperating bearing portions for the rotary parts of the drilling mechanism, whereby when the portions of the shell are separated, the principal parts of the drilling mechanism may be removed, substantially as set forth.

7. In combination as an improvement in a drilling apparatus, a drill shell or housing within which are guided the reciprocating portions of the mechanism and which has a detachable portion containing bearings, rotary driving parts mounted in said bearings, reciprocating parts connected to be actuated thereby, and yielding driving connections for continuously rotating the drill and for relieving excessive stress between the power applied and the drill.

8. In a drilling apparatus, the combination of a shell consisting of separable portions provided with coöperating bearing portions, one of said separable portions having in addition another bearing, reciprocating parts guided in said shell, a pitman for actuating the reciprocating parts, a crank for actuating the pitman mounted in said additional bearing in one separable portion of the shell and held thereby in engagement with the said pitman, and means supported in the coöperating bearing portions of the shell for rotating said crank, whereby the parts may be drawn apart by separating the portions of the shell, substantially as set forth.

9. In combination as an improvement in a drilling apparatus, a drill shell or housing, a reciprocating hammer guided therein, a reciprocating head also guided therein, a spring connecting the hammer and the head, a pitman, a loose pin coupling the pitman to the head and normally held from displacement by the said shell or casing, a crank for the said pitman mounted in bearings detachable from the guides of the reciprocating head and hammer, and means for actuating the said crank, whereby the said crank is held by the said bearings in engagement with the pitman and thereby the said pin is locked in place till the pitman is disengaged.

10. In combination as an improvement in a drilling apparatus, a drill shell or housing, a reciprocating hammer guided therein, a reciprocating head also guided therein, a spring connecting the hammer and the head, a tool-holding chuck mounted to turn in the shell or housing, a rotary shaft mounted on the shell or housing and connected to turn the chuck, and mechanism for simultaneously rotating the said shaft and reciprocating the said head.

11. In combination as an improvement in a drilling apparatus, a drill shell or housing, a reciprocating hammer guided therein, a reciprocating head also guided therein, a spring connecting the hammer and the head, a tool-holding chuck mounted to turn in the shell or housing, a rotary shaft mounted on the shell or housing and connected to turn the chuck, and mechanism for simultaneously rotating the said shaft and reciprocating the said head, provided with a yieldable connection between the applied power and the rotary shaft for relieving excessive stress.

12. In combination as an improvement in drill apparatus, a rotary tool-holding chuck therefor having an axial aperture adapted to receive the tool and allow it longitudinal play, means for hammering the rear end of the tool, and a yoke detachably secured to the housing of the apparatus for loosely securing the tool.

13. In combination as an improvement in drill apparatus, a rotary tool-holding chuck therefor supported against longitudinal movement and having a tool-holding aperture

through which the end of the tool is adapted to project, mechanism for hammering the end of the tool and an elastic cushion interposed between the chuck and the hammer of the hammering mechanism, and means for turning the chuck.

14. In a drilling apparatus, the combination of a shell, reciprocating parts mounted to operate therein, a disk arranged adjacent one side of the shell and means for rotating said disk, a pitman connected to operate the reciprocating parts within the shell, the head of the pitman being confined between the disk and the shell, and a crank-pin on the disk and connected to the pitman, whereby the disk and shell form guides for the pitman-head in the orbital motion given to it by the pin, substantially as set forth.

Signed this 3d day of October, 1901, at Denver, Colorado.

WILLIAM A. BOX.
EUGENE Y. SAYER.

Witnesses:
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HAROLD C. STEPHENS.