4 Sheets—Sheet 1.

A. A. GOUBERT & N. W. PRATT.

ROCK-DRILL.

No. 192,068. Patented June 19, 1877.

Figure 1.

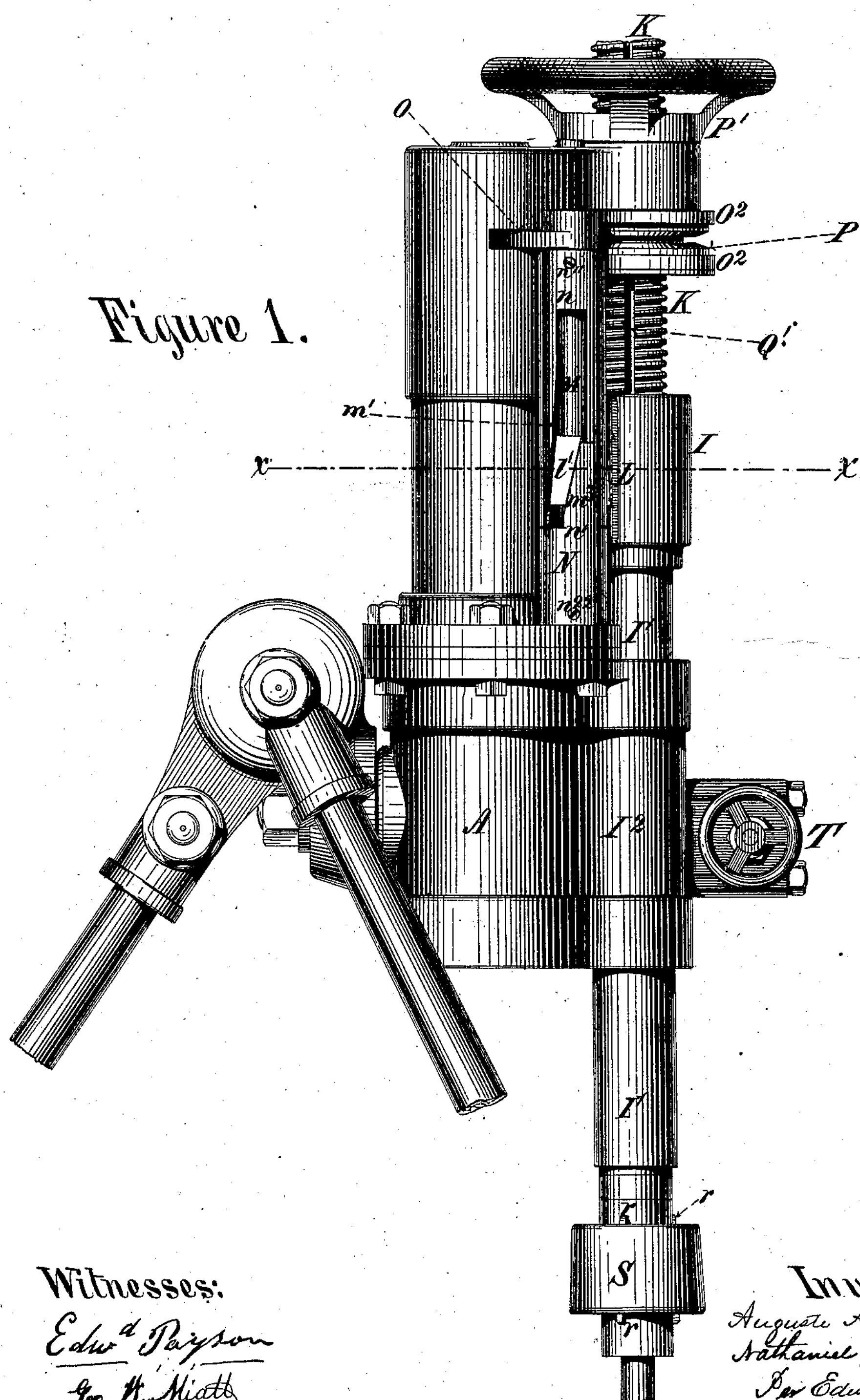

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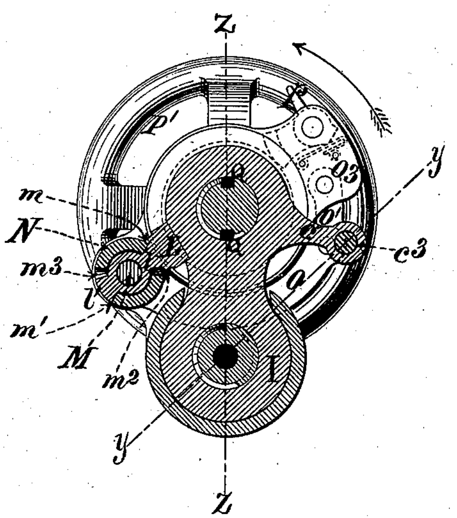
Figure 3.

Figure 2.



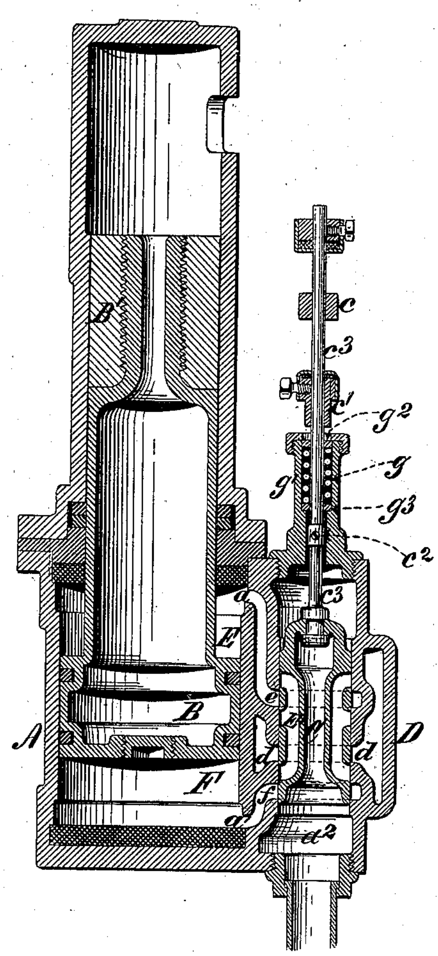


Figure 4.

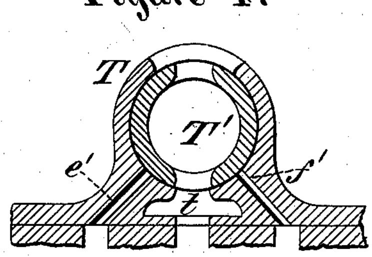


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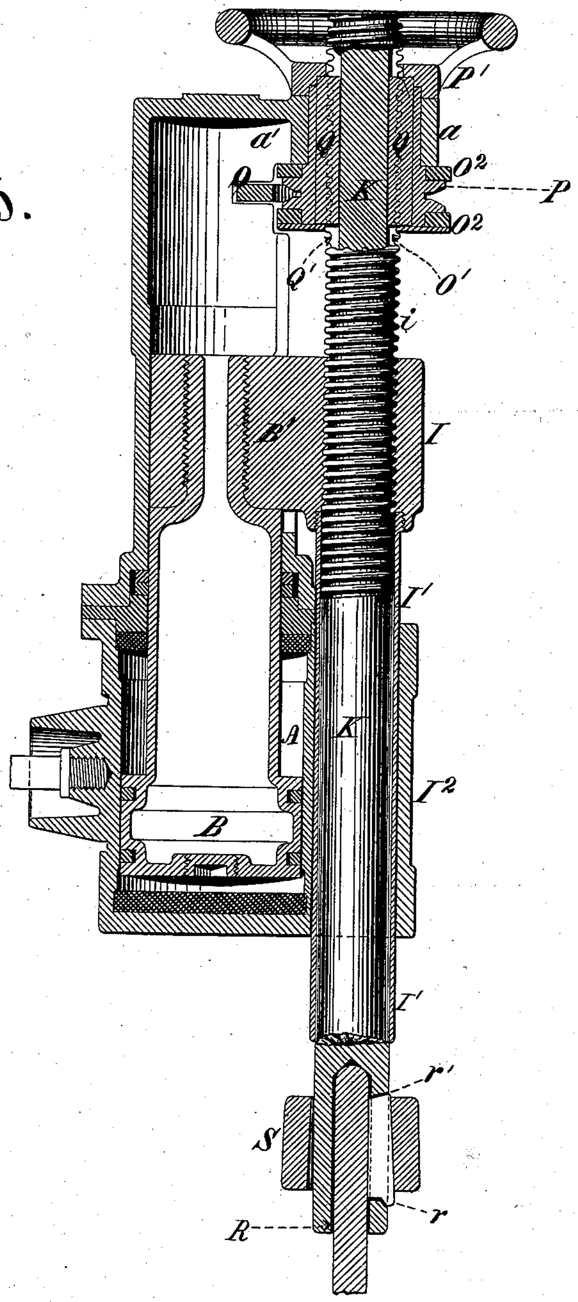
Figure 5.



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ROCK-DRILL.

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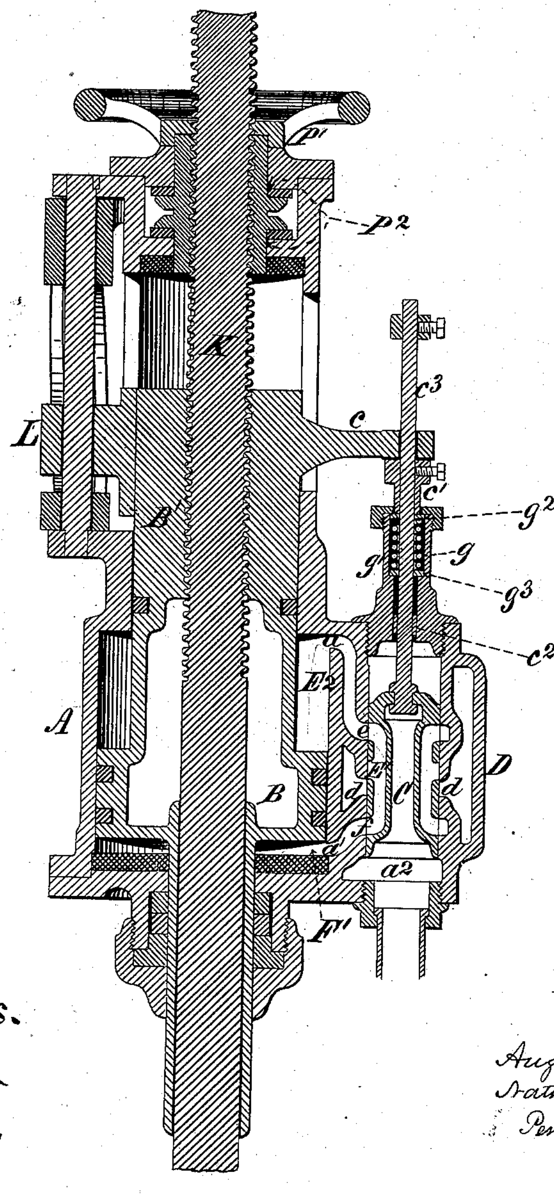
Figure 6.



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UNITED STATES PATENT OFFICE.

AUGUSTE A. GOUBERT, OF NEW YORK, AND NATHANIEL W. PRATT, OF BROOKLYN, N. Y.

IMPROVEMENT IN ROCK-DRILLS.

Specification forming part of Letters Patent No. **192,068**, dated June 19, 1877; application filed April 23, 1877.

To all whom it may concern:

Be it known that we, AUGUSTE A. GOUBERT, of the city and State of New York, and NATHANIEL W. PRATT, of Brooklyn, New York, have invented certain Improvements in Rock-Drills and other like machines, of which the following is a specification:

Our improvements relate to that class of machines in which a tool-stock is reciprocated by the direct action of steam or compressed air.

In machines of this kind the effective work is done by the stroke of the piston in one direction, and the return stroke of the piston is only required to withdraw the working parts into suitable position to enable them to repeat the working blow.

Our improvements consist, primarily, in effecting the reciprocation of a tool-stock by connecting it with a piston having variable areas upon its opposite sides, the side having the smaller area being that upon which the live steam acts for the purpose of delivering the working blow, while the side of the piston having the larger area is acted upon to withdraw the tool-stock and tool from its work, such withdrawal being effected by the operation of a suitable valve, valve-passages, and ports, whereby the steam which has effected the working stroke is conducted or whipped around to the opposite side of the piston, where it expands, and effects the return stroke of the piston by reason of the greater area which that side of the piston presents. The steam which has thus effected both strokes of the piston is discharged from the cylinder by the next working stroke; hence we exhaust at comparatively low pressure, and thus economize in the use of motive power.

Another feature of our invention consists of an automatic friction-feed, the operation of which is governed by the extent of the advance of the tool at each working blow, the feed mechanism being set preparatory to performing its function by the last part of the motion of the tool-stock.

The accompanying drawings represent our improvements as applied to a rock-drill, and are as follows:

Figure 1 is an elevation of the rock-drill mounted upon an ordinary tripod. Fig. 2 is a transverse section through the line *x x* on Fig. 1. Fig. 3 is a central longitudinal section through the line *y y* on Fig. 2. Fig. 4 is a transverse section of the inlet-valve to the steam-chest, showing the principal steam-port wide open; also showing a small passage on each side of the principal steam-port for conducting steam into the extreme ends of the cylinder, in order to start the piston in case the sliding valve should not be in proper position for that purpose. Fig. 5 is a central longitudinal section through the line *z z* on Fig. 2. Fig. 6 is a central longitudinal section, showing a modification in the form of the rock-drill, which consists in inserting the reciprocating tool-stock in the center of a double trunk-piston.

The drawings represent a steam-cylinder, A, provided with the usual ports *a a'* at either end, and containing the trunk-piston B. A slide-valve, C, is so arranged with reference to the steam-chest D that, in the position which it occupies preparatory to the working stroke of the drill, it admits steam from the steam-chest into the annular space E, surrounding the trunk in the upper part of the cylinder. In its opposite position the valve opens the ports *e* and *f*, and thus establishes communication through the expansion-passage *e'*, between the annular space E in the upper part of the cylinder and the space F in front of the piston in the lower end of the cylinder. At the same time the valve closes the port *d* of the steam-chest.

In case of an excessive penetration of the drill the piston may overrun, and the valve being thus thrust beyond the point where it closes, the port *d* will open communication between the steam-chest and the space F, and thus admit live steam in front of the piston to act as a cushion therefor. The instant, however, that the return movement of the piston commences, the valve springs back, closing the steam-chest port *d*, and holding the ports *a* and *a'* wide open. This action of the valve in following back the tappet by which it is moved is effected by means of the spiral spring *g*, which surrounds the valve-stem, and is contained within the cylindrical chamber g^1, between the two movable disks g^2 and g^3. The valve-stem is provided with the two adjustable collars c^1 and c^2, which, respectively, bear upon the disks g^2 and g^3 when the valve has completed its motion in either direction. If the valve slides too far in either direction, one of the collars on the stem pushes the disk with which it is in contact into the cylinder, and thus compresses the spring. As soon as the valve-stem is relieved from the pressure of the tappet by which it has been moved, the spring throws out the disk which has been pressed in, and, thus acting upon the collar, carries the valve back into its appropriate position at either end, as the case may be. The valve is thus provided with a double-acting yielding spring-stop.

The rock-drills may penetrate more or less at different blows, according to the varying hardness of the rock in which they are worked, and as the forward movement of the piston, and consequently the movement of the valve, is determined by the position at which the drill brings up on the rock, it is necessary to provide valve-gear which is capable of effective operation under the circumstance of a varying stroke of the piston.

In our machine the working stroke of the drill is effected by live steam acting in the trunk end of the cylinder, and the return stroke is effected by the same steam acting expansively (through the open ports connecting the opposite ends of the cylinder) upon the greater area of the opposite face of the piston. Although it may happen that the valve will be thrown too far by the downward stroke of the piston, owing to the excessive penetration of the drill, and the steam-port d will thus be opened, we are enabled to close that port as soon as the return stroke commences, and thus prevent the waste of steam on the return stroke of the piston. While live steam is being admitted into the trunk end of the cylinder the exhaust-port a^2 is open, and we thus exhaust at low pressure, because we have only introduced live steam enough to fill the annular space E, and that quantity of steam, by passing around into the space F in front of the cylinder, has expanded during the back stroke of the piston. To facilitate the starting of the piston, in case the slide-valve is not in proper position when steam is first let on, we arrange, in connection with our inlet-valve T, two small passages, e' and f', on either side of the principal steam-port t. By turning the valve-plug T′ in either direction live steam may be admitted directly into the ends of the cylinder through the passages e' and f', respectively, and the piston being thus started, the valve-plug is turned to the position shown in Fig. 4, and thenceforward the machine will be operated by the slide-valve, as already described.

The outer end of the trunk-piston is secured to the cross-head B′, the projecting portion of which constitutes the nut I, which engages the male thread i on the upper portion of the tool-stock or carrier-bar K. The lower end of the nut I is secured to the tube I¹, which affords a bearing for the carrier-bar K. The tube I¹ reciprocates with the nut, and is supported by the bearing I² on the side of the cylinder A. The tappet c projects laterally from the nut I, and is perforated to receive the valve-stem c^3. On the side opposite the tappet another arm, L, projects laterally from the cross-head, and is perforated to receive the rock-shaft M. The arm L is formed into two spiral wedges, l and l', which are, respectively, on opposite sides of the rock-shaft M, and are inclined in opposite directions.

The wedges reciprocate with the drill-bar, and act simultaneously upon the shell-cam N, which is affixed to the rock-shaft M. This cam is composed of two pieces, n and n^1, the ends of which, respectively, form tight-fitting collars, which are affixed to the rock-shaft by the pins or set-screws $n^{1\,1}$ and $n^{2\,2}$. Between the collars, the cam forms a tubular shell, surrounding the rock-shaft M, and having upon its opposite sides slots, in which the reciprocating wedges l and l' travel. The shell-cam is made in two pieces, to promote convenience in putting the machine together.

The operation of the wedges upon the cam is as follows: During the upward stroke of the piston the wedge l engages the longer spirally-inclined edge m of the slot on one side of the rock-shaft, and the wedge l' engages the corresponding incline m^1 on the opposite side of the rock-shaft. The action of the wedges upon the longer incline effects a partial rotation of the rock-shaft in the direction shown by the arrow in Fig. 2. The first effect of the return motion of the wedges is to withdraw them from contact with the inclines m and m^1, and they produce no effect upon the rock-shaft until near the completion of the downward stroke of the piston, when the opposite sides of the wedges l and l' engage the shorter spirally-inclined edges of the slots m^2 and m^3, respectively. The action of the wedges upon the shorter inclines effects a partial rotation of the rock-shaft in the direction opposite to the arrow in Fig. 2, and the extent of this rotation is determined by the distance to which the wedges travel in a downward direction, that distance being fixed by the point where the tool brings up on its work.

The upper end of the rock-shaft M is provided with the arm O, which is connected, by means of the short pitman O¹, with the loose collars O², which are hung on the hub P² of the feed-wheel P, on opposite sides of the feed-wheel, respectively.

The adjustable pawl p is pivoted between the projecting wings O³ of the collars O². The periphery of the feed-wheel has a V-groove, in which the face of the pawl fits.

When moving in one direction the pawl slides freely in the V-groove. When moving in the opposite direction the pawl binds in the groove, and hence rotates the feed-wheel in the direction shown by the arrow in Fig. 2.

The feed-wheel hub is a short hollow shaft, having its bearing in the lateral projection *a* from the shell-frame *a′*, to the opposite end of which the cylinder is bolted. The interior of the shell *a′* forms a guide for the cross-head upon the outer end of the piston-rod. The outer end of the feed-wheel shaft is provided with a fixed collar, P^1, which is formed into a wheel for convenience of turning the feed-wheel by hand. The interior of the hub of the feed-wheel is provided with fixed keys Q, which loosely engage the longitudinal key-seats Q′ in the upper portion of the carrier-bar K.

It will thus be seen that in the latter part of the downward motion of the piston the action of the wedges upon the short inclines of the shell-cam, rocks the shaft M and swings back the pawl *p* to a greater or less distance, which is determined by the point where the tool brings up on its work. In the upward stroke of the piston, by the contrary action of the wedges upon the shell-cam and rock-shaft, the pawl forces the feed-wheel to rotate, which, by means of its keyed connection with the drill-carrier bar, causes that to rotate, and be thereby fed forward longitudinally by the engagement of its male screw-thread with the female thread in the nut I. Thus the amount of work done in one blow governs the action of the feed mechanism preparatory to the next blow.

Our chuck for holding the drill consists of the cylindrical recess R in the lower end of the drill-carrier bar, the wedge-keys *r r r*, loosely contained in the longitudinal slots *r′ r′ r′*, in that part of the drill-carrier bar which constitutes the shell of the recess R, and the conical collar S. By pushing up the collar S we are enabled to insert the stem of the drill in the cylindrical recess R, and we hold the drill by then driving down the collar S, and thereby wedging the keys *r r r* between the interior of the collar and the stem of the drill.

In the modification of our invention shown in Fig. 6 the tool-stock is carried through the center of a double trunk-piston. The large end of the trunk constitutes the nut for engaging the screw-thread on the tool-stock, and the smaller trunk on the opposite end of the piston is the guide for the tool-stock. The feeding mechanism in this case is the same as that shown in Fig. 1.

The nut or end portion of the larger trunk has two laterally-projecting arms, *c* and L, which work through slots in the shell of the chamber adjoining the cylinder. One of these arms, *c*, is the tappet for operating the valve, and the other arm, L, is for carrying the wedges which operate the feed-cam.

The valve is of the same character as that previously described, and by its operation live steam is admitted into the space E^2, wherein it acts to effect the working blow of the tool, and from which it is whipped around by the operation of the valve, as before, into the space F′ in front of the piston, and therein, by its expansion, effects the return stroke of the piston, and the withdrawal of the tool from its work.

We claim as our invention in a rock-drill substantially such as described—

1. A trunked piston and suitable tappets reciprocating therewith, in combination with a valve operated by the tappets, and adapted to admit live steam to the upper and smaller area of the piston during the whole of the working stroke, and at the conclusion of the working stroke to open communication between the opposite ends of the cylinder, and thus admit the steam which has effected the working stroke to the lower and larger area of the piston for the purpose of effecting the return stroke, substantially as described.

2. A reciprocating valve, the stem of which is provided with shoulders or collars, in combination with a reciprocating tappet, and with a double-acting yielding spring-stop, two of the collars acting to receive and transmit to the valve-stem the reciprocating motion of the actuating-tappet, and similar collars serving to receive and transmit to the valve-stem the thrust of the yielding spring-stop, whereby, if the valve overruns, it is made to follow back the actuating-tappet on the reverse stroke, and return to one of its two normal positions, where it holds the ports respectively wide open.

3. In combination with a steam-cylinder provided with a trunk-piston, substantially such as described, wherein the live steam which is used for effecting the working stroke is whipped around to the opposite side of the piston to effect, by its expansion, the return stroke, the reciprocating valve C and the ports *d* and *f*, whereby, when the piston overruns, the valve-motion is prolonged sufficiently to open the live-steam port, and thus admit live steam in front of the piston, to form a steam-cushion to arrest the blow of the piston, and whereby the live-steam port is closed immediately after the commencement of the return stroke of the piston.

4. The feeding-cam N, composed of the two parts n^1 and n^2, keyed to the opposite ends of the rock-shaft M, substantially as shown, and for the purpose set forth.

5. A reciprocating tool-stock provided with a male screw-thread which engages a reciprocating nut, whereby the tool-stock is fed longitudinally by the rotation of a wheel which is loosely keyed to the tool-stock, in combination with a vibrating friction-clutch, whereby such wheel may be rotated any part of a revolution within the range of motion of the vibrating friction-clutch.

6. A rocking cam for operating the actuating-pawl of the feed-wheel, provided, first, with a short and sharply-inclined face or tappet, by means of which the cam is suddenly rocked in one direction during the latter part of the downward stroke of the tool-stock, and,

secondly, with a longer and less sharply inclined face or tappet, by means of which the cam is more gradually rocked in the opposite direction during the return stroke of the tool-stock, substantially as and for the purpose described.

7. The cam N and the reciprocating wedge which actuates it, in combination with a friction-pawl and feed-wheel, for effecting the longitudinal feed of a reciprocating tool-stock, substantially as set forth.

8. A device for operating the feed, which consists of a tappet, which gives a quick movement during the latter part of every working stroke of the tool-stock, and of a second tappet, which gives a slower motion in the opposite direction to feed the tool-stock more or less during every return stroke, the amount of such feed for each successive blow being automatically governed by the extent to which the tool, at the preceding blow, has penetrated the material operated upon, substantially as set forth.

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