(No Model.) 3 Sheets—Sheet 1.

M. C. BULLOCK.

HYDRAULIC FEED FOR DRILLING MACHINES.

No. 464,182. Patented Dec. 1, 1891.

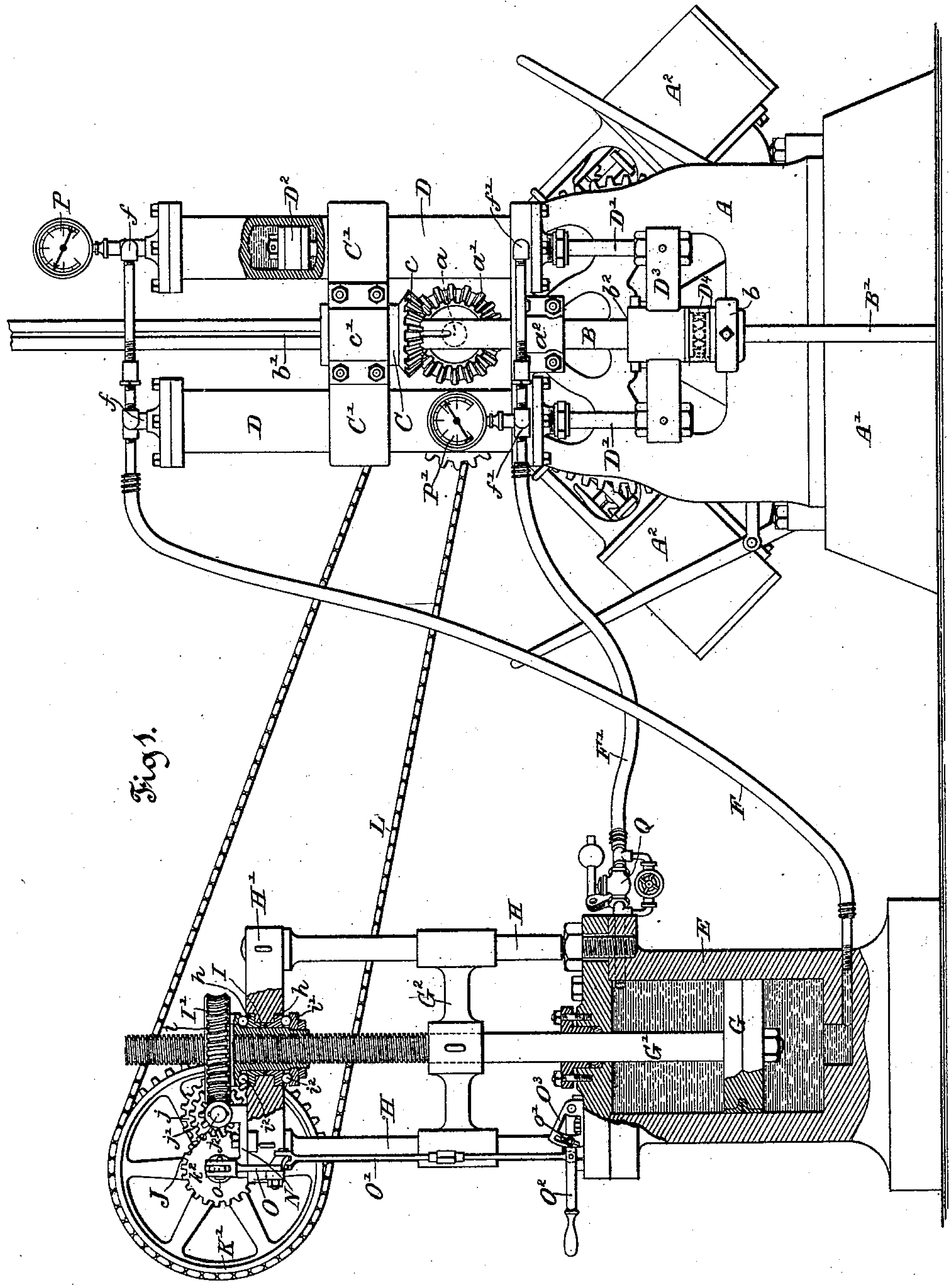

Fig. 1.

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(No Model.) 3 Sheets—Sheet 2.

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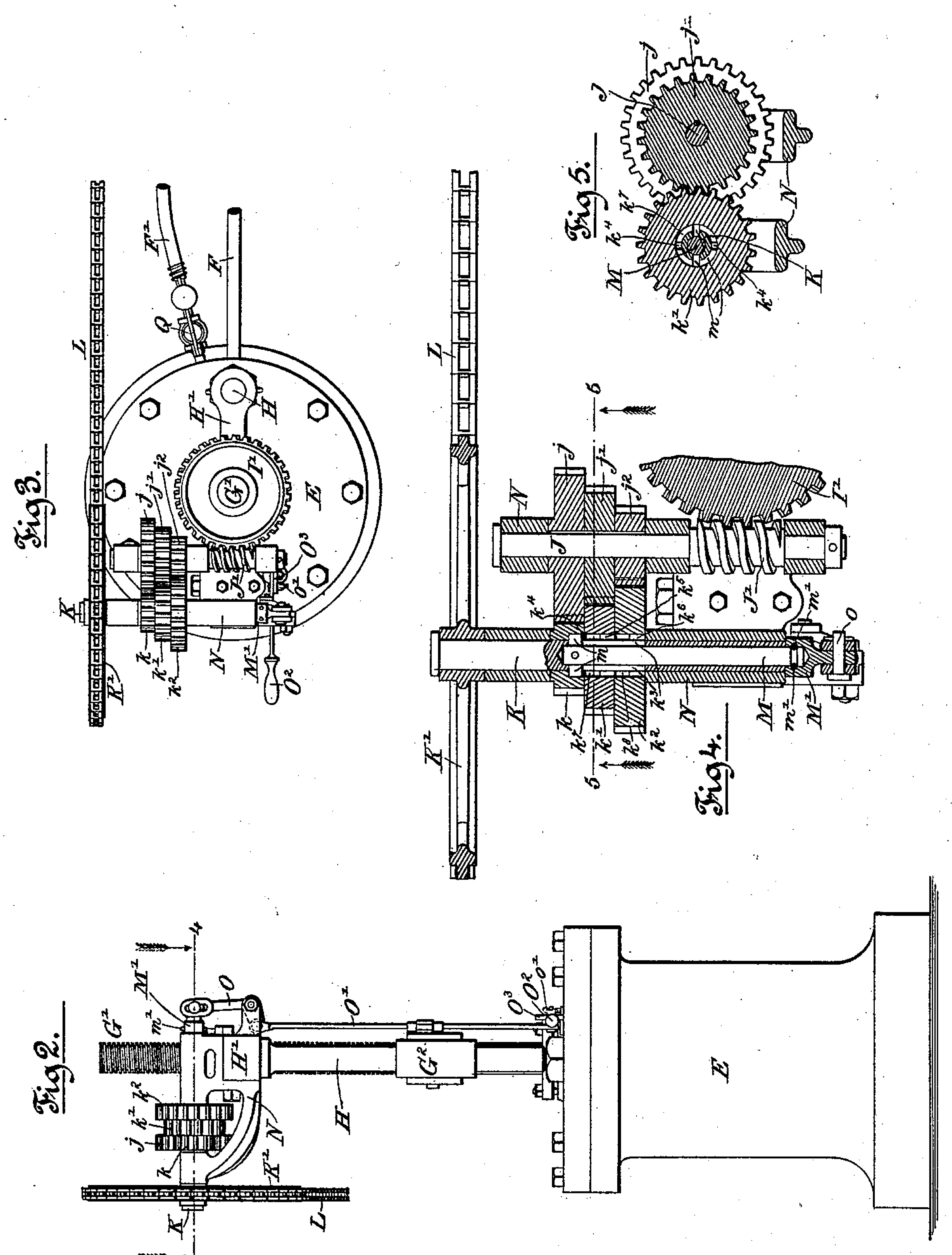

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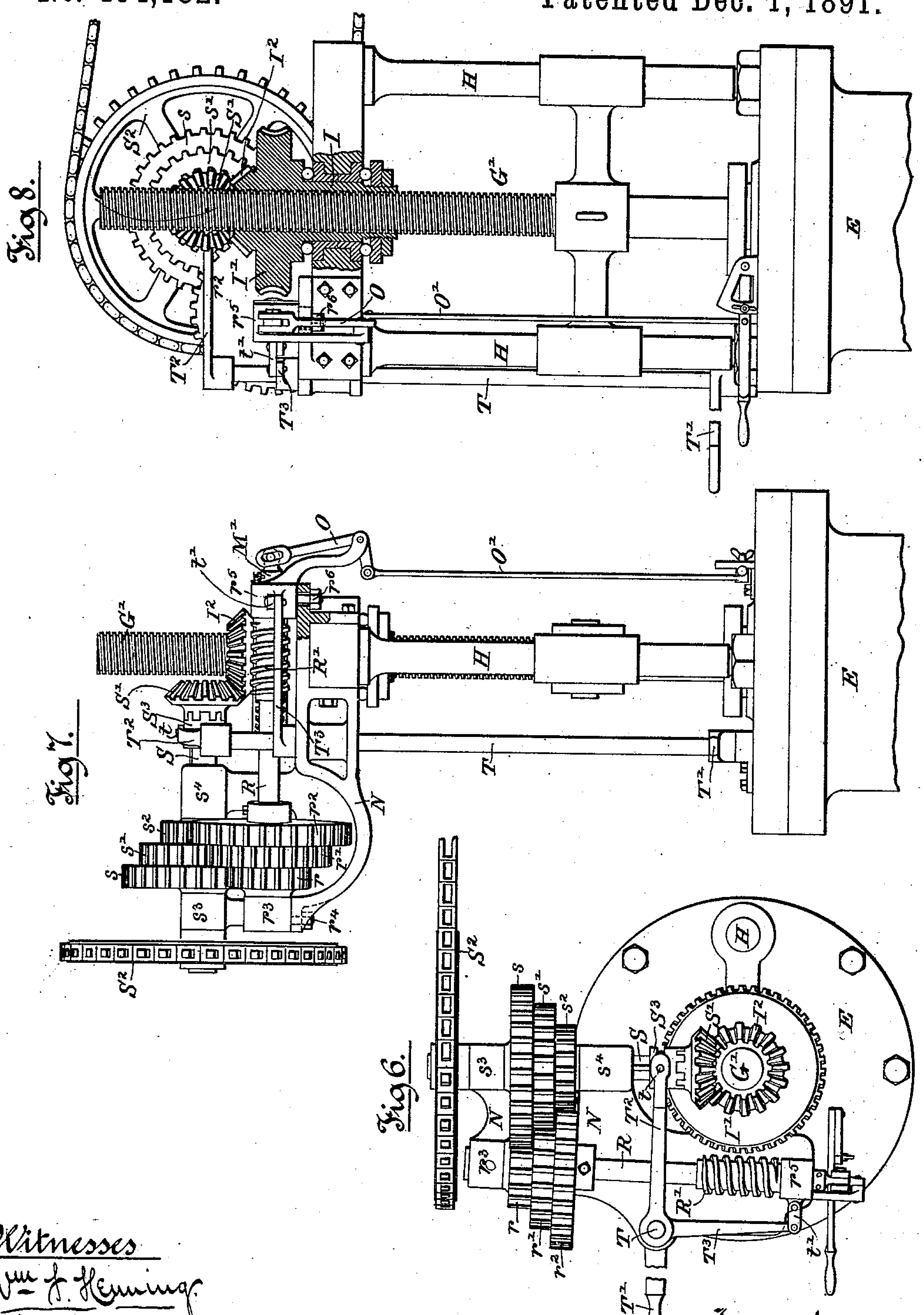

Fig. 8. Fig. 7. Fig. 6.

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UNITED STATES PATENT OFFICE.

MILAN C. BULLOCK, OF CHICAGO, ILLINOIS.

HYDRAULIC FEED FOR DRILLING-MACHINES.

SPECIFICATION forming part of Letters Patent No. 464,182, dated December 1, 1891.

Application filed July 12, 1889. Serial No. 317,321. (No model.)

To all whom it may concern:

Be it known that I, MILAN C. BULLOCK, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in a Hydraulic Feed for Drilling-Machines; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to a novel feed mechanism for revolving or diamond drills used in rock or earth boring, and more especially to improvements in that class of feed devices known as a "hydraulic feed," or that in which the drill is fed or carried forward by the pressure of water or other fluid which is pumped or forced into a cylinder behind a piston which acts upon the drill-rods to advance the same.

The invention consists in the matters hereinafter described, and pointed out in the appended claims.

In the accompanying drawings, illustrating my invention, Figure 1 is a view in elevation, with parts in section, of a drilling-machine provided with a feed mechanism made in accordance with my invention. Fig. 2 is a side elevation of the pressure-cylinder and connected parts of the hydraulic feed. Fig. 3 is a plan view of the same. Fig. 4 is an enlarged detail section taken upon line 4 4 of Fig. 2. Fig. 5 is a detail section taken upon line 5 5 of Fig. 4. Fig. 6 is a top or plan view of a form of gear for actuating the piston of the pressure-cylinder, differing somewhat from that shown in Figs. 1 to 5. Fig. 7 is a side elevation of the same. Fig. 8 is a side elevation of the same, with the parts adjacent to the piston-rod in central vertical section.

As shown in said drawings, A indicates the frame, and A′ the base, of a combined drilling-machine and hoisting-engine of a kind commonly used in well-boring and prospecting.

A^2 A^2 indicate the steam-cylinders of the engine, and *a* the main or crank-shaft, which is provided with a bevel gear-wheel *a′*, through which motion is communicated from the shaft to the drilling mechanism.

B is a tubular driving-spindle, which is provided at its lower end with a chuck *b*, by which the drill-rod B′, which is fed downwardly through the spindle, is attached to the same. Said spindle B is supported below the gear-wheel *a′* in a bearing a^2 upon the machine-frame, and rotary motion is given thereto from the said gear-wheel by means of a bevel-gear *e*, which intermeshes with the wheel *a′*, and is attached to a sleeve C, through which the spindle B passes, and which is provided with a spline or feather engaging a longitudinal groove *b′* in the shaft. The sleeve C is mounted in a stationary bearing *c′* upon a cross-piece C′, suitably sustained upon the machine-frame, in the instance illustrated by means of the feed-cylinders of the machine.

D D are the feed-cylinders, which are located at opposite sides of the spindle B and parallel with the latter. Said cylinders may be attached to or supported upon the frame A in any suitable manner. As herein illustrated, they are attached at their lower ends to the upper part of the vertical frame-standard of the machine.

D′ D′ are piston-rods which pass through the lower ends of the cylinders and are attached to pistons D^2 within the cylinders in the usual manner. The said pistons are attached at their lower ends to a cross-head D^3, which is connected at its central part with the lower end of the revolving spindle B by a thrust-bearing D^4, arranged to transmit downward pressure from the cross-head to said spindle. Said thrust-bearing may be of any preferred character, but is preferably a roller-bearing, as indicated in dotted lines in the drawings. The cross-head D^3 is shown as provided with a central hub through which the spindle B passes, said spindle being provided with a shoulder b^2, which engages the top of the hub, so that the spindle is moved or carried with the cross-head in both its up and down movements.

E is a pressure-cylinder, which is located at any convenient point adjacent to the drilling apparatus. The said pressure-cylinder may be mounted on the same frame with other parts of the apparatus, but is herein shown as separately sustained. The pressure-cylinder is connected at its opposite ends with the opposite ends of both feed-cylinders D D by means of pipes or hose F F′, having branches *f f′* leading to the ends of said feed-cylinders.

G is a piston within the cylinder E, and G′ is a piston-rod attached thereto and extending through a gland in one end of the cylinder. Attached to said piston-rod is a cross-head G^2, which slides at its ends upon stationary guide-bars H H, which are preferably attached to the end of the cylinder. At their ends remote from the cylinder the said guide-bars are attached to a rigid cross-head H′. The piston-rod G′ is extended outside of or beyond the sliding cross-head G^2 and passes through the stationary cross-head H′, and the part of said piston-rod outside of the sliding cross-head is screw-threaded, as shown. Within the cross-head H′ is located a revolving feed-nut I, which is engaged with the screw-thread of the piston-rod. Said feed-nut is held from endwise movement in the cross-head, while free to revolve therein, so that when the nut is turned the piston-rod will be moved endwise, and the piston thereby actuated within the cylinder. Attached to the nut I is a gear-wheel I′, through which rotary motion is transmitted to the said nut. The nut is held from endwise movement in the cross-head by suitable anti-friction thrust-bearings, herein shown as having the form of roller or ball bearings located at both sides of the cross-head, so as to take the endwise pressure of the nut in moving the piston in either direction. In the particular construction illustrated the nut I is cylindric and engages two bearing-rings *h h*, inserted in the cross-head H′ from opposite sides thereof. Said bearing-rings are provided at their outer ends with flanges between which and opposing shoulders *i i′* on the nut I anti-friction rollers i^2 i^2 are located. The shoulder *i* is formed on the end of the nut I adjacent to the wheel I′, while the shoulder *i′* is formed by a separate ring secured on that part of the nut which extends outside of the cross-head by a screw-threaded connection.

J is a shaft arranged transversely to the piston-rod G′ and provided with a worm J′, Fig. 3, which intermeshes with the wheel I′. Said shaft J is provided with a plurality of gear-wheels *j j′* j^2 of different sizes, of which three are shown in the drawings. K is a second shaft arranged parallel with the shaft J and provided with a plurality of gear-wheels *k k′* k^2, intermeshing with the gear-wheels *j j′* j^2. The gear-wheels *k k′* k^2 are loose upon the shaft K and are adapted to be separately connected therewith by a clutch device hereinafter described. Such shaft K is also provided with a sprocket-wheel K′, through which motion is given to said shaft K. The shaft K is actuated by suitable intermediate gearing from the engine or other motor used or from one of the revolving parts by which the drill-rod is fed and rotated, so that the motion of the said shaft K and the piston can be made to correspond with that of the drill-rod. In other words, the parts are so arranged that when the speed of the drill-rod varies a corresponding variation will take place in the speed of the piston automatically. The device for transmitting motion from the drilling-machine to the shaft K (herein shown) consists of a sprocket-chain L, passing over a sprocket-wheel on the drive-shaft *a* of the drilling-machine and over the sprocket-wheel K′ upon said shaft K.

The clutch device for connecting either one at will of the gear-wheels *k k′* k^2 to the shaft K is made as follows: Said shaft K is made tubular or hollow from its end remote from the sprocket-wheel to a point opposite the gear-wheel which is nearest said sprocket-wheel. Within the hollow or tubular shaft is placed a longitudinally-movable rod or spindle M, Fig. 4. Said spindle is provided with projecting lugs or pins *m m*, which pass through slots k^3 k^3 in the shaft K and enter slots k^4 k^5 k^6, formed in the inner or bearing surfaces of the gear-wheels *k k′* k^2, parallel with the axis of the shaft. The notches k^4 in the gear-wheel *k* remote from the open end of the tubular shaft K are extended only part way through the thickness of the wheel, but are of sufficient length to fully admit the pins *m m*. In the other wheels *k′* and k^2 annular recesses k^7 k^8 are formed in the inner surfaces of the wheels adjacent to one side of the same, said annular recesses being of suitable size to receive the said pins *m m*. The rod M will of course turn with the shaft K by reason of the engagement of the pins *m m* with the longitudinal grooves of the shaft, and that one of the gear-wheels *k k′* k^2 the notches of which are engaged by said pins *m m* will also turn with the shaft. By moving the rod M endwise of the shaft, therefore, the pins *m m* may be interlocked with either one of the gear-wheels at will, so that either of said wheels may be caused to turn with the shaft, as desired. The annular recesses k^7 k^8 are to enable the pins *m m* to be easily shifted from the notches of one wheel to those of another, it being entirely obvious that in the absence of such recesses such shifting could only take place when the notches in the two contiguous wheels were in alignment with each other.

The shafts J and K are herein shown as having bearings in a frame-piece or bracket N, attached to the cross-head H′; but they may be otherwise mounted or supported, as found convenient or desirable.

For convenience in operating the clutch-rod M devices are herein provided as follows: O, Figs. 1 and 2, is a bell-crank lever pivoted upon the cross-head H′. One arm of said bell-crank lever is connected with a swiveled head M′ upon the end of the rod M by means of a pin *o*, inserted through the swiveled head and engaging slots in the forked end of the lever. Said swiveled head is herein shown as connected with the rod M by means of pins *m′* in the head, which engage an annular groove in the rod, and thus prevent relative endwise movement of the parts while allowing the rod to turn freely in the head. The other arm of the bell-crank lever O is attached to a rod O′, which extends to and is connected with a hand-lever O^2, arranged in position convenient for the operator. The hand-lever is preferably provided with a clamp-screw o', engaging a slotted segment O^3, by means of which the hand-lever may be secured in any desired position. By shifting said hand-lever either one of the gear-wheels k k' k^2 may obviously be made to turn with the shaft, as desired, and said gear-wheels being of different sizes the speed at which the piston is driven, as compared with the speed of rotation of the drill, may be varied as desired.

At the opposite ends of the feed-cylinders and in communication with both of the same are located pressure-gages P P′, said pressure-gages being for convenience attached to the pipes f f' at points adjacent to the cylinders.

When the apparatus is in readiness for operation, both of the feed-cylinders are filled upon both sides of the pistons with water or other liquid, and the pressure-cylinder is similarly filled at both sides of the piston therein. When the several cylinders are thus filled, the obvious effect of moving the piston G of the pressure-cylinder by power applied to the piston-rod will be to force the liquid into one end of each feed-cylinder and allow the outflow of fluid from the opposite end of each cylinder, thereby moving the pistons in said feed-cylinder to either advance or retract the drill-rod. The water or other liquid used being practically non-compressible, the feed thus produced will be positive. After the piston G has been moved the length of its stroke in one direction, thereby carrying the spindle B through a distance equal to the stroke of the pistons within the cylinders D D, the direction of motion of the said piston G is changed and it is returned to its starting-point. In the construction shown in Figs. 1 to 5 the reversal of the movement of the piston is accomplished by the reversal of the engine, and the piston is moved backwardly at the same rate of speed as it is advanced. This is objectionable, however, inasmuch as it involves much loss of time in running the piston slowly back, and the use of a gear arranged to give greater speed in running back the piston is therefore desirable. A device of this kind is shown in the drawings, Figs. 6, 7, and 8, wherein is shown a gear by which the direction of motion of the piston G may be reversed and a higher rate of speed given the piston in its return movement. In a construction of this kind of course the driving-engine is not reversed for reversing the movement of the piston G. In this instance the nut I is provided with a gear-wheel I′, arranged in the same manner as hereinbefore described.

R is a shaft arranged transversely to the piston-rod and provided with a worm R′, which engages the gear-wheel I′ in the same manner as does the worm J′ on the shaft J, hereinbefore described. Said shaft R is provided with a plurality of gear-wheels r r' r^2. Said shaft R is supported at its end remote from the gear-wheel I′ in a bearing r^3, which is pivotally supported upon the bracket N by means of a vertical pivot r^4, and the end of said shaft R adjacent to the said gear-wheel I′ is sustained in a laterally-sliding bearing r^5, which rests and slides upon the horizontal top surface of the bracket N and is held in place thereon by a bolt r^6 passing through a slot in said bracket in the manner illustrated, Figs. 6 and 7. This construction enables the end of the said shaft R nearest the gear-wheel I′ to be swung or shifted toward and from said gear-wheel, so that the worm-wheel may be engaged with and disengaged from said gear-wheel, as desired.

S is a shaft arranged parallel with the shaft R and provided with a plurality of gear-wheels s s' s^2, intermeshing with the gear-wheels r r' r^2. Said shaft S is mounted in stationary bearings s^3 s^4 on the bracket N and is provided at its end nearest the shaft G′ with a beveled gear-wheel S′, which intermeshes with a beveled gear I^2, attached to the nut I. At the opposite or outer end of the shaft S is secured a sprocket-wheel S^2, over which is placed a sprocket-chain by which motion is transmitted to the said shaft. The gear-wheel S′ is mounted to turn upon the shaft S and is adapted for detachable connection therewith by means of a sliding clutch S^3, which is splined to the shaft and provided with teeth or projections engaging corresponding teeth or projections on the hub of said beveled wheel S′ in the usual manner.

T is a vertical shaft mounted at its upper end in the bracket N and at its lower end in a bearing at the top of the cylinder E and having at its lower end a hand-lever T′, by which it may be turned or oscillated. At the upper end of the said shaft is attached a rigid arm T^2, the outer end of which is forked and provided with pins t t engaging a groove in the sliding clutch S^3 in a familiar manner. Said rock-shaft T is also provided with a second rigidly-attached arm T^3, the outer end of which is connected with the sliding bearing r^5 of the shaft R, the connecting devices herein shown consisting of a link t'. These parts are so arranged that when the hand-lever T′ is actuated to turn the shaft T in a direction to carry the clutch S^3 away from or free from the beveled wheel S′ the worm R′ will be carried toward and engage with the gear-wheel I′, while the turning of the shaft in the opposite direction will engage the clutch with the beveled gear-wheel and release the worm from the gear-wheel I′. The shaft S being driven directly from the engine when the beveled wheel S′ turns with the shaft, the nut I will be given a relatively-rapid movement, and one which is much faster than that obtained when said nut is driven through the medium of the worm R′ and gear I′. By the use of the construction described, therefore, the piston G may be advanced slowly and with great power by throwing the worm

R′ into gear with the gear-wheel I′. When the clutch S^3 is released from the beveled wheel S′, said piston may be retracted rapidly by releasing the worm from the gear-wheel I′ and engaging said clutch with the beveled gear-wheel.

A clutch device may be used in connection with the gear-wheels r r' r^2 for connecting either of said wheels at will to the shaft R, of the same character as that illustrated in Figs. 4 and 5. The drawings illustrate the said shaft R as provided with a head M′, which is attached to a spindle running through the hollow interior of the shaft and is actuated by a bell-crank lever O, to which is connected an operating-lever O′, all of these parts being constructed in the same manner as the corresponding parts shown in Fig. 2 and in said Figs. 4 and 5.

Q is a safety-valve, which is located in and controls the passage leading from the lower ends of the feed-cylinders to that end of the pressure-cylinder which is in communication with the said lower ends of the feed-cylinders. Said safety-valve is herein shown as located upon the pipe F′ near the pressure-cylinder; but it may be otherwise located, as may be found convenient or desirable. The pressure within the lower end of said feed-cylinders at any one time obviously depends upon the weight of the drill-rods in use at that time, the drill-rods when not working or resting on the bottom of the hole obviously being sustained solely by the pistons within the feed-cylinders. Said safety-valve will be set or adjusted to allow the escape of liquid from the lower parts of the feed-cylinders into the pressure-cylinder and thereby permit the descent of the drill-rod only when the pressure in the lower parts of the feed-cylinders due to the weight of the drill-rods is exceeded. In other words, the drill-rods will be prevented from descending by their own weight, so that the weight thereof has no effect whatever upon the speed at which the drill is advanced; but such speed is determined solely by the movement of the piston of the pressure-cylinder. The object of such safety-valve, therefore, is to bring the rate of feed entirely under the control of the feeding devices and to prevent the drill from advancing rapidly or plunging ahead through soft or easily-penetrated strata under the weight of the drill-rods. A by-pass q, provided with a valve Q′, serves to allow the free backward flow of water from the pressure-cylinder to the lower parts of the feed-cylinders during the upward stroke of the pistons in said feed-cylinders.

Feeding devices for drills acting by hydraulic pressure have heretofore been made; but in such feeding devices, as far as I am aware, the pressure to accomplish the advance or feed of the drill has been obtained by a feed-pump operating independently of the machine by which the drill is driven or rotated. A feed-pump working independently in this manner will always advance the drill with a definite and uniform pressure whether the rock is hard or soft, so that the drill is advanced rapidly through soft strata and slowly through harder rock. A constant load is thus maintained on the drill-engines, whether the drill is penetrating only one-half inch a minute, as when working in quartz, or boring at the rate of twenty-four inches in thirty-five seconds, as when boring through soft brown sandstone. The load in this case being constant, the speed of rotation on the drill-engine is uniform. Consequently the operator cannot tell by the action of his engine whether the drill is working in a hard or soft stratum, and is only able to determine the character of the rock by observing the speed at which the drill-rod is advanced. This gives no reliable means of estimating the speed of the drilling, and if the operator relaxes his attention the drill may jump or plunge through a soft stratum, such as coal, hematite iron ore, or other soft material, in passing from hard rock into the same without attracting his attention, so that he may fail to arrest the speed of the drill or take any steps to determine the extent and character of the soft stratum. In advancing rapidly through soft material in this manner the core is liable to be broken up or destroyed, thereby making it impossible to determine the character of the soft deposit bored through. In boring through hard broken rock the drill, actuated by such feed device, will jump ahead into cracks or crevices, thereby breaking or destroying the core or injuring the diamonds on the drill-head. On the contrary, in the device herein illustrated, in which the flow of water to the feed-cylinders is effected by means actuated by direct connection with the parts by which the drill is revolved, the feed is as positive as a mechanical or screw-feed, and the drill cannot jump forward. The rate of advance of the drill-rod is in practice figured out so as to give a definite advance movement for a certain number of revolutions of the drill, such as is found to produce desirable results in practice.

To more fully illustrate the utility of the construction described and of the safety-valve Q, the following may be stated: Suppose the line of drill-rods weighs one thousand pounds, and a drill is used which in hard blue lime-stone requires a load of fifteen hundred pounds on the pistons to feed the drill forward one inch for three hundred revolutions of the spindle. With the old form of hydraulic feed this would require a load of five hundred pounds on top of the pistons in addition to one thousand pounds weight of the rods, to drill at the same speed in the limestone; but if the drill of an apparatus thus arranged passed from the limestone to a coal-shale, which requires a pressure of two hundred or three hundred pounds to feed the drill an inch for two hundred revolutions thereof, the drill would run at exactly the same speed, but would penetrate about five times as fast. With the apparatus herein shown under the same conditions if the safety-valve is set for a pressure on the piston slightly above the weight of the drill-rods—say ten hundred and five pounds—a pressure of fifteen hundred and five must be carried on the top of the pistons to obtain a pressure of fifteen hundred pounds to feed the drill forward one inch for two hundred revolutions of the drill. When the drill is at work under these circumstances, the upper gage will show a pressure of fifteen hundred and five pounds and the lower gage a pressure of ten hundred and five pounds. If the drill operating in the limestone under the conditions named suddenly passes into a coal shale requiring only three hundred pounds pressure to feed one inch in three hundred revolutions, the pressure on the upper gage will drop from fifteen hundred and five pounds to thirteen hundred and five pounds, and the engines will increase their speed, as the working load will have largely diminished, and the rate of feed will be correspondingly increased. The operator will thus have two positive indications of the entrance of the drill into a soft stratum—namely, the increase of speed and decrease of pressure. Furthermore, the drill will be prevented from plunging forward in soft material, because it can advance only when the pressure of ten hundred and five pounds, for which the safety-valve is set, is overcome by the pressure on the upper ends of the feed-cylinders, and even at that time the speed is limited by that of the piston of the pressure-cylinder, the movement of which piston is controlled by the drilling-engine, which in turn is under the control of the operator. The breaking up of the core in soft material and injury to the diamonds in hard broken fissured rock will thus be prevented.

All of the above-named matters are of great advantage in machines for prospecting, where the sole object is to obtain full information as to the character of the strata passed through by the boring-tool.

Any kind of a motor may be employed in place of the steam-engine shown, and the piston of the pressure-cylinder may be actuated by any suitable driving connection with one of the moving parts of the drilling-machine or any moving part actuated by the motor without departure from my invention, which is not therefore limited to the details of construction illustrated, except as pointed out in the appended claims.

I claim as my invention—

1. The combination, with a rotary drill and a motor for actuating the same, of a feed mechanism comprising a feed-cylinder provided with a piston, and a pressure-cylinder which is immediately connected with the feed-cylinder and which is provided with a piston actuated by or from the motor, said pistons of the feed-cylinder and pressure-cylinder being constructed to move in unison in the advance of the drill, substantially as described.

2. The combination, with a rotary driving-spindle, gearing giving rotary motion to said spindle, and a motor, of a feed-cylinder provided with a piston acting to give endwise movement to the said spindle, and a pressure-cylinder which is immediately connected with the feed-cylinder and provided with a piston actuated by or from the motor, said pistons of the feed-cylinder and pressure-cylinder being constructed to move in unison in the advance of the drill, substantially as described.

3. The combination, with a drill and a motor for actuating the same, of a feed-cylinder provided with a piston, a pressure-cylinder immediately connected with the feed-cylinder and which is provided with a piston actuated by or from the motor, said pistons of the feed-cylinder and pressure-cylinder being constructed to move in unison in the advance of the drill, and pressure-gages located at opposite ends of said feed-cylinder, substantially as described.

4. The combination, with a drill and a motor for actuating the same, of a feed mechanism comprising a feed-cylinder, a pressure-cylinder connected with the opposite ends of the feed-cylinder and provided with a piston actuated by or from said motor, a safety or regulating valve in the passage connecting the lower part of the feed-cylinder with the upper part of the pressure-cylinder, and a valved by-pass extending around said safety-valve, substantially as described.

5. The combination, with a drill and a motor for actuating the same, of a feed mechanism comprising a feed-cylinder, a pressure-cylinder, and gearing connecting the said motor with the movable part or piston of the pressure cylinder or pump embracing a change-speed mechanism, substantially as described.

6. The combination, with a driving-spindle, gearing giving rotary motion to said spindle, and a motor, of two feed-cylinders arranged at opposite sides of the said spindle, a cross-head connecting the piston-rods of said cylinders with the said spindle, and a pressure-cylinder connected with opposite ends of said cylinders, the moving part of said pressure cylinder or pump being actuated by or from the said motor, substantially as described.

7. The combination, with a rotary driving-spindle and a motor actuating the same, of a feed-cylinder, a pressure-cylinder, a piston therein, a piston-rod attached to the piston and screw-threaded on its part which protrudes from the cylinder, and a revolving nut engaging the screw-threaded part of the piston-rod, said nut being driven from or by the motor, substantially as described.

8. The combination, with a drill and a motor for actuating the same, of a feed mechanism comprising a feed-cylinder, a pressure-cylinder, a piston therein, a piston-rod provided

with screw-threads on its outer part, a nut engaging the screw-threaded part of the piston-rod, and gearing connecting said motor with said nut embracing a change-speed mechanism, substantially as described.

9. The combination, with a drill and a motor for actuating the same, of a feed mechanism comprising a feed-cylinder, a pressure-cylinder, and gearing connecting said motor with the movable part or piston of the pressure-cylinder, said gearing embracing a change-speed mechanism consisting of two parallel shafts, gear-wheels of different sizes affixed to one of said shafts, gear-wheels of different sizes mounted loosely upon the other shaft, and a longitudinally-sliding rod mounted in said last-named shaft and provided with a lug or pin engaging one of said loosely-mounted gear-wheels, substantially as described.

10. The combination, with a drill and a motor for actuating the same, of a feed mechanism comprising a feed-cylinder, a pressure-cylinder, a piston in the latter, a piston-rod screw-threaded on its part outside of the cylinder, a revolving nut engaging the screw-threaded part of the piston, a worm-wheel attached to said nut, a shaft provided with a worm engaging said worm-wheel, gear-wheels of several sizes upon said shaft, a second shaft parallel with the first, gear-wheels loosely mounted in said second shaft intermeshing with those on the first shaft, gearing connecting the motor with the second shaft, and a clutch device detachably connecting either one of said loosely-mounted gear-wheels with the shaft supporting them, substantially as described.

11. The combination, with a drill and a motor for actuating the same, of a feed mechanism comprising a feed-cylinder, a pressure-cylinder, a piston in the latter, a piston-rod screw-threaded in its part outside of the cylinder, a revolving nut engaging the screw-threaded part of the piston-rod, a worm-gear for turning the nut to advance the piston, said worm-gear embracing means by which it may be thrown out of operation, and a separate gear embracing a clutch device for retracting the piston, substantially as described.

12. The combination, with a drill and a motor for actuating the same, of a feed-mechanism comprising a feed-cylinder, a pressure-cylinder, a piston in the latter, a piston-rod screw-threaded in its part outside of the cylinder, a revolving nut engaging the screw-threaded part of the piston-rod, said nut being provided with a worm-wheel and with a gear-wheel, a shaft provided with a worm engaging the worm-wheel, said shaft being bodily movable toward and from the same, a shaft provided with a gear-wheel intermeshing with the gear-wheel of the nut, a clutch connecting the said shaft with the gear-wheel thereon, and connections between said worm-shaft and the clutch by which both are moved at the same time, substantially as described.

In testimony that I claim the foregoing as my invention I affix my signature in presence of two witnesses.

MILAN C. BULLOCK.

Witnesses:

C. CLARENCE POOLE,
HARRY COBB KENNEDY.