No. 673,533. Patented May 7, 1901.

G. A. BURWELL.

AUTOMATIC DRILLING MACHINE.

(Application filed Apr. 8, 1899.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.

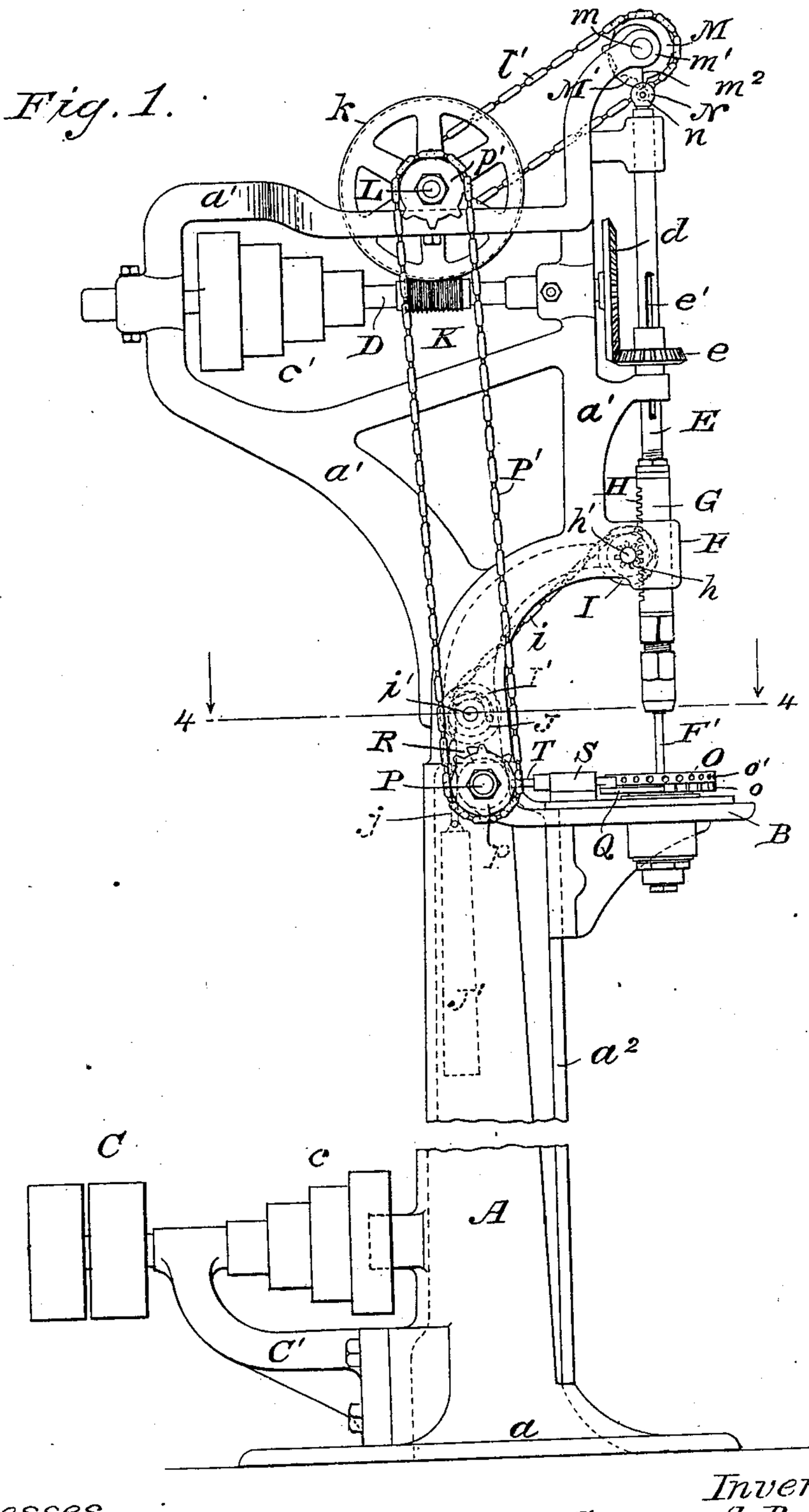

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Fig. 2.

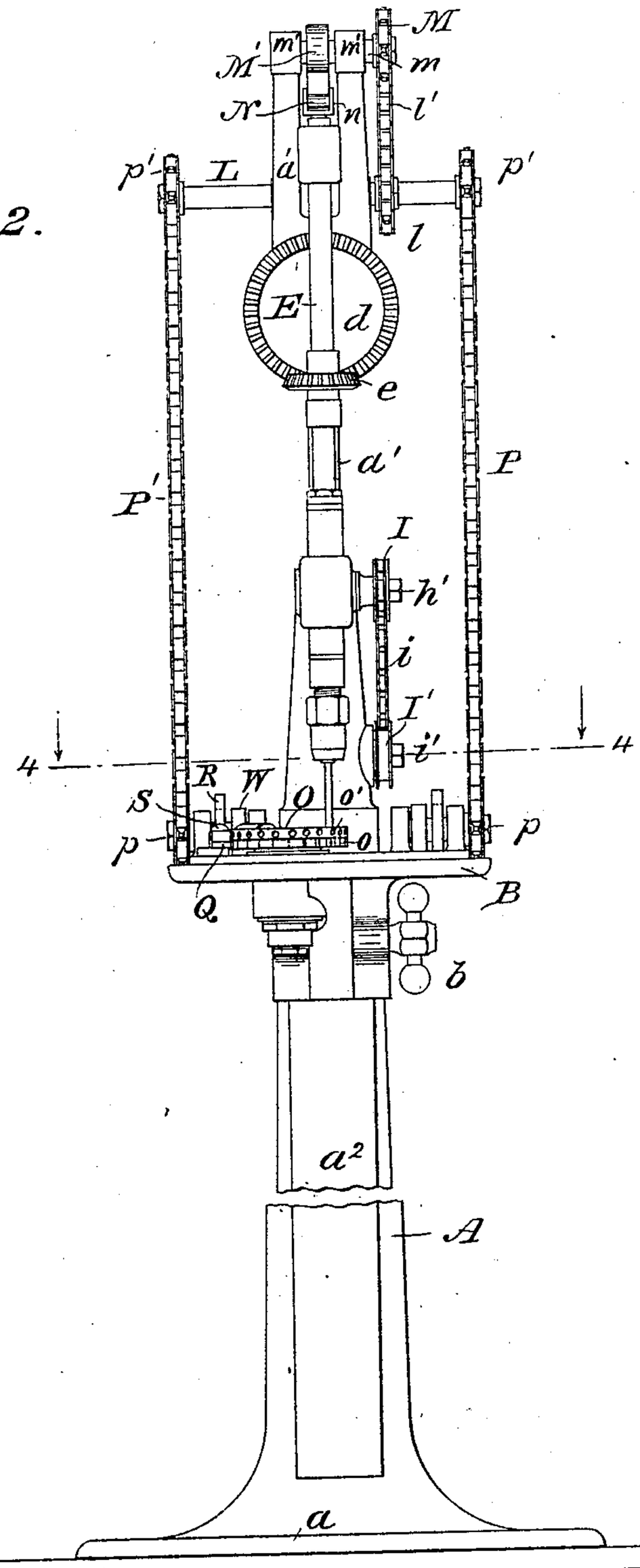

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Fig. 3.

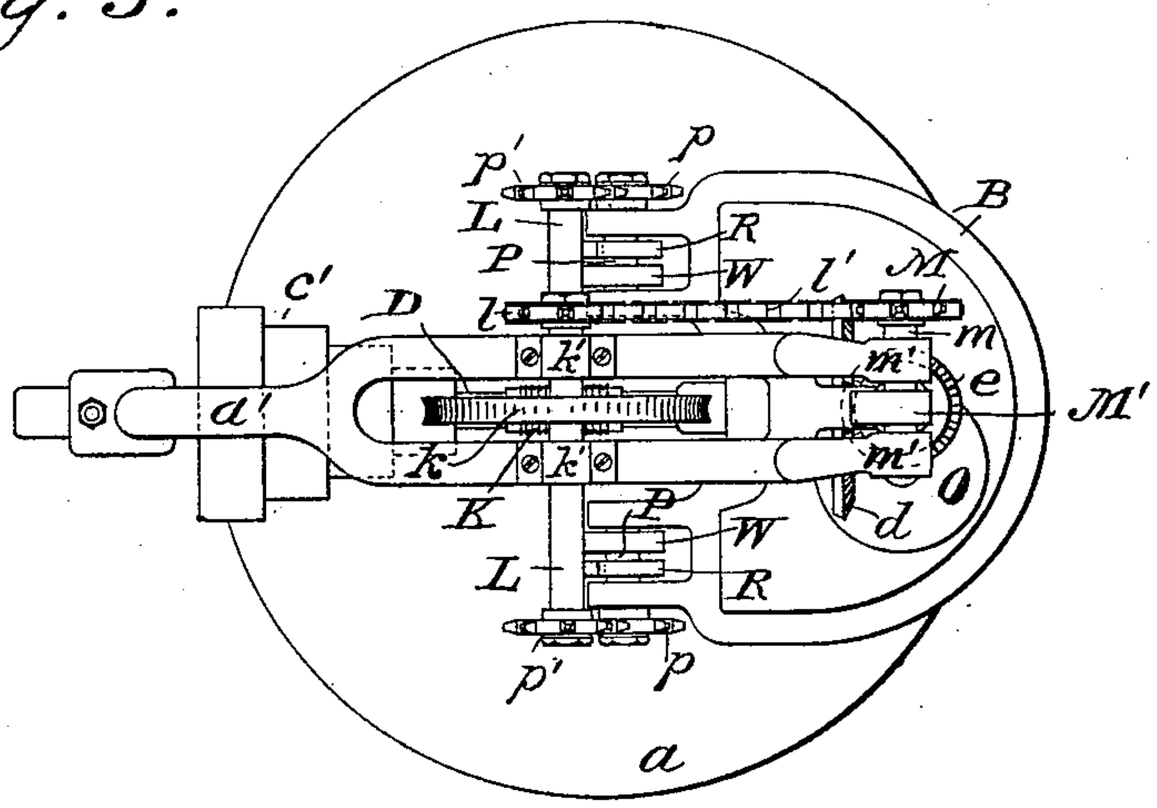

Fig. 4.

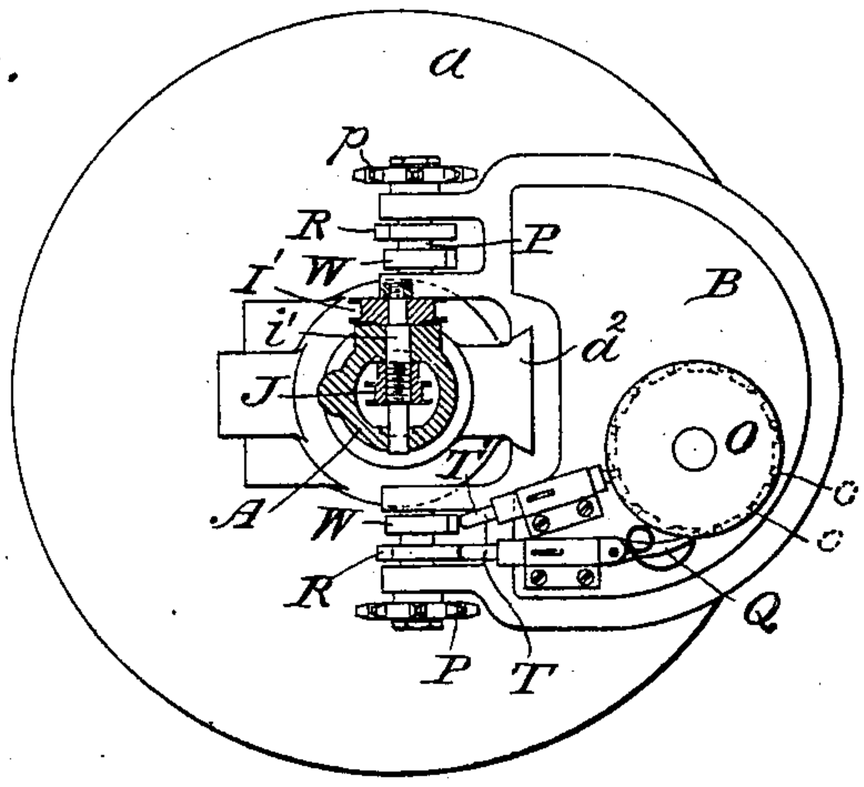

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Fig. 5.

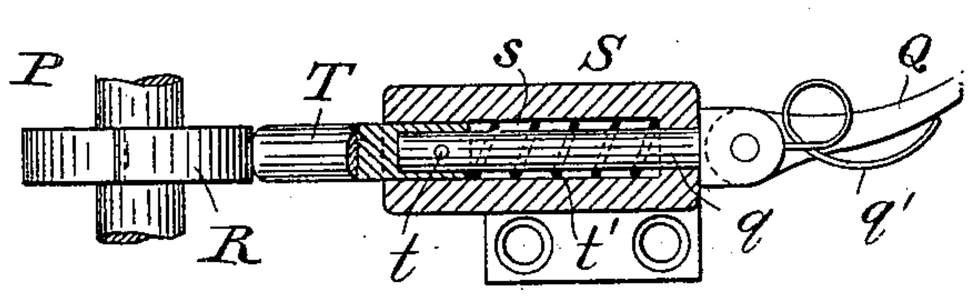


Fig. 6.

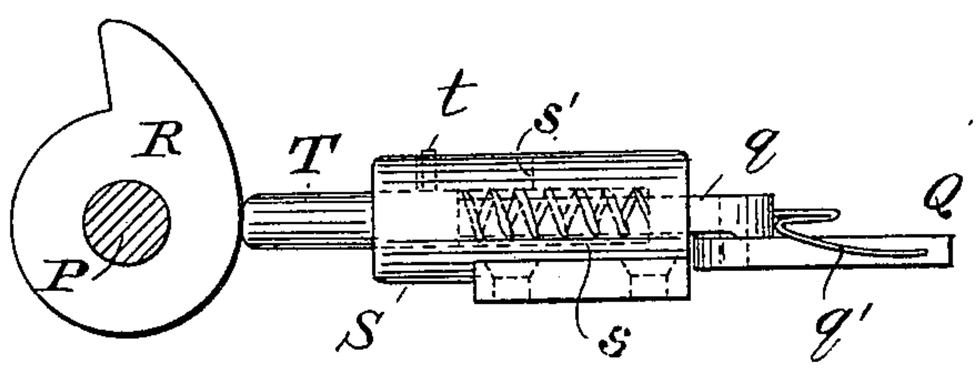
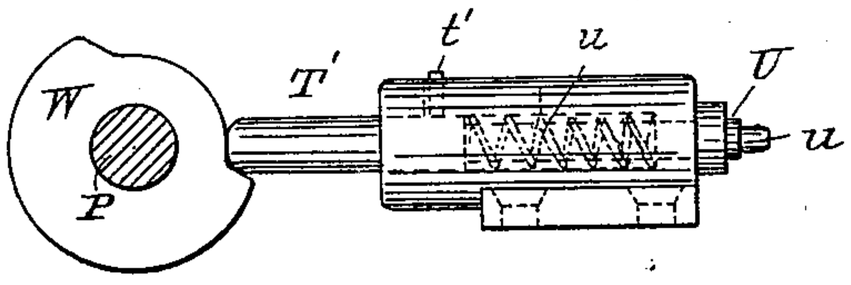


Fig. 7.



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UNITED STATES PATENT OFFICE.

GEORGE A. BURWELL, OF TOLEDO, OHIO.

AUTOMATIC DRILLING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 673,533, dated May 7, 1901.

Application filed April 8, 1899. Serial No. 712,333. (No model.)

To all whom it may concern:

Be it known that I, GEORGE A. BURWELL, a citizen of the United States, residing at Toledo, in the county of Lucas and State of Ohio, have invented certain new and useful Improvements in Automatic Drilling-Machines, of which the following is a specification, reference being had to the accompanying drawings, that will enable those skilled in the art to which my invention pertains to make and use the same.

The main object of my invention is to provide a machine that will drill or otherwise operate upon a piece of material in any desired number of places in circular series and at any desired pitch, the piece of material being properly mounted upon a rotatable spindle or carrier which is automatically moved step by step to bring the work under the drill and is automatically and positively locked against rotation while the drilling or other operation is in process; and it consists of certain mechanical elements and combinations to carry out this main purpose and also to effect other improvements in drilling-machines, as will hereinafter be more fully set forth.

My automatic drilling machine is preferably of the upright style mounted upon a vertical pillar which supports the moving parts of the mechanism and a vertically-adjustable platen or table upon which the pieces to be worked upon rest.

The accompanying drawings show my invention in the form I now consider most desirable; but certain changes within the skill of a good mechanic and not requiring the exercise of invention might be made in the specific forms of the details and in the relative arrangement of the parts without departing from the spirit of my invention as set forth in the claims at the end of this specification.

Figure 1 is a general side elevation of an automatic drilling-machine embodying my invention. Fig. 2 is a front elevation of the same. Fig. 3 is a plan or top view thereof. Fig. 4 is a plan section on the line 4 4 of Figs. 1 and 2. Fig. 5 is a plan view, partly in section, of the mechanism for rotating the carrier upon which the work is supported. Fig. 6 is a side elevation of the same. Fig. 7 is a side elevation of the mechanism for locking the carrier in exact position and against accidental rotation while the drilling or other operation is in process.

My automatic drilling mechanism is mounted upon a hollow column A, having a flat base *a*, by which it may be secured to a foundation or floor. At its top the column terminates in an open frame *a'*, in which are bearings and supports for various parts of the moving mechanism. At its front the column is faced with a vertical dovetailed guide a^2, upon which is supported a vertically-adjustable platen or table B, which may be fixed in position at any desired elevation on the guide by a clamping-screw *b*.

Power is imparted to the machine by a belt driven from any suitable source and acting upon the fast and loose pulleys C, carried by a bracket C', extending from the lower end of the column. A cone-pulley *c* is mounted upon the shaft of the driving-pulley C and located immediately below a corresponding cone-pulley *c'*, mounted on a shaft D, supported by bearings in the frame *a'* at the top of the column. This shaft is driven at high speed and has on its front end a bevel-wheel *d*, which engages a bevel-pinion *e* on the drill-spindle E. A groove or keyway *e'* is formed in the spindle and engaged by a suitable key or spline in the hub of the pinion, so that the spindle is free to move lengthwise through the hub of the pinion and is compelled to rotate with it.

The drill-spindle E is mounted in bearings on the front of the frame *a'* and has at its lower end a chuck to hold the drills, &c., and immediately above this chuck a sleeve G, which is guided by a bearing F on the frame. The sleeve is held on the spindle by nuts and suitable washers at each end, the spindle rotating within the sleeve, which is held from rotating by a key or spline in the bearing F, though it is free to move vertically therein, and thus raise or lower the spindle without sharing its rotary movement. On the back side of the sleeve is formed a toothed rack H, which is engaged by a spur-pinion *h*, carried by a shaft *h'* and located in a hollow space inside of the frame *a'* and at the rear of the bearing F. This shaft projects at one end outside of its bearings and carries a small pulley I, between the flanges of which is secured one end of a sprocket-chain *i*, partly

encompassing the circumference of the pulley. The other end of this chain partially surrounds the circumference of another pulley I′, between the flanges of which it is also attached. This second pulley I′ is mounted on the outer projecting end of a shaft *i′*, which extends into the hollow of the frame, where it carries a pulley J, having one end of a sprocket-chain *j* partially wound around it and lying between its flanges, to which the end is connected by a cross-pin. The lower end of this chain *j* is connected to a counterweight J′, dangling in the hollow of the frame, as shown. The tendency of the counterweight is to revolve the shafts *i′* and *h′* and through the pinion *h* and the rack H to raise the sleeve and the drill-spindle, exerting a constant pull thereon to this purpose.

I have thus far described the means for rotating the drill-spindle at high speed and for lifting it away from the work when unrestrained and will now describe the method of feeding it down to its work.

On the high-speed shaft D is a worm K, engaging the teeth of a worm-wheel *k*, mounted on a shaft L, supported in bearings *k′* on the frame. The use of the screw and worm-wheel at this point effects a greatly-slower speed of rotation of the shaft L than that of the shaft D, by which it is driven. The shaft L extends considerably beyond its bearings, and at one side, close to the bearing, it carries a sprocket-wheel *l*, which is engaged by a continuous sprocket-chain *l′*. This chain also engages a similar sprocket-wheel M, carried by a shaft *m*, which is mounted in bearings *m′* at the top of the frame. A cam M′ is carried by this shaft, between the bearings *m′ m′*, and acts upon the head of the drill-spindle to force it down to its work against the lifting tendency of the counterweight, before described, until the end m^2 of the cam runs off the spindle-head, leaving it free to be lifted by the weight. To lessen the frictional resistance, I have this cam act upon the surface of a roller N, carried by a pin between the sides of a yoke or fork *n* at the top end of the spindle.

The piece of work to be operated upon is mounted upon and secured in any suitable manner to a rotatable disk or carrier O, which is supported in suitable bearings upon the table B. This carrier is provided with a series of ratchet-teeth *o* and also a series of holes *o′* on its periphery, preferably in different planes. The ratchet-teeth are engaged by a reciprocating pawl to turn the disk step by step to bring new portions of the piece to be operated upon under the drill F′, and the holes are engaged by a reciprocating bolt, which enters them in rotation, bringing the carrier into exact position for each operation of the drill and locking it against accidental movement while the operation is in progress. The number and pitch of these ratchet-teeth and holes will be varied to suit the requirements of each different kind of work to be performed, the carriers or the series of racks and holes on the carriers being changed with each change of work. The carrier-actuating pawl and the locking-bolt are operated by cams on a shaft P, mounted in bearings on the table B and having a sprocket-wheel *p*, engaged by a sprocket-chain P′, which also engages a sprocket-wheel *p′* on the overhanging end of the shaft L. The actuating-pawl Q is operated by a cam R on the shaft P. (See Figs. 5 and 6.) The pawl is pivotally connected to the head of the bolt *q* and is pressed by a spring *q′* into contact with the ratchet. The body of the bolt passes through the head of a socket S, which is counterbored from its outer end, making a chamber *s* larger in diameter than the bolt. The outer end of the bolt enters into a socket in the end of a bearing-pin T, of the same diameter as the chamber, and is united to the pin by a cross-pin *t*, the end of which lies in a slot *s′* in socket and prevents the bolt and bearing-pin from turning. A spring *t′* is coiled around the body of the bolt, its end against the end of the chamber and the end of the bearing-pin T, respectively, tending to retract the pawl, &c., and hold the outer end of the bearing-pin against the face of the cam. The carrier-locking bolt U, with its bearing-pin T′, (see Fig. 7,) is operated by a cam W on the shaft R in substantially the same manner as the actuating-pawl. Instead of the pivoted pawl on the front end of its bolt, however, it is provided with a metal tip or stud *u*, slightly rounded or tapering at its point to insure engagement with the holes of the series, into which it is projected by the cam W against the yielding spring *u′* around the bolt in the chamber of the socket. It will be noticed that I have duplicated the shaft P and the cams R and W, there being an independent set at each side of the table, with independent driving-chains P′ from the shaft L, so that I may arrange the carrier at either side of the drill center and operate it with a complete set of pawl and locking-bolt mechanisms to turn it in one direction or the other, as desired. The driving-shaft D and the drill-spindle run at high speed, while the cam-carrying shafts run at greatly-reduced speeds, all, however, running continuously. The cams are so shaped, set, and timed that the cam W first pushes the locking-bolt tip into one of the series of holes on the carrier and holds it there while the drill-spindle is being forced down by the cam M′. Immediately the drilling operation is finished the spindle is lifted by the counterweight, and the locking-bolt, relieved by the cut-away portion of its cam W, is retracted by its spring, leaving the carrier free to be rotated by the pawl Q, which is immediately advanced by its cam R to accomplish this object. The carrier being turned to about the desired distance, the locking-bolt again advances, centering its point in one of the holes and locking the carrier for another operation of the drill, these various operations being successive and repeated automatically as long as the machine is running.

Having thus described my invention, what I claim as new and useful, and desire to secure by Letters Patent, is—

1. The combination of a driving-shaft, bevel-gears and a drill-spindle movable endwise in its bearings continuously rotated thereby, a non-rotatable sleeve on said spindle provided with a rack, and a pinion engaging said rack, means for automatically raising said spindle, and means for automatically depressing same at regular intervals, substantially as described.

2. The combination of a driving-shaft, and a drill-spindle movable endwise in its bearings, means for continuously driving said spindle, a counterweight operatively connected with said spindle for continuously and automatically raising same, a cam engaging said spindle, said cam being operatively connected with the driving-shaft and adapted to depress the spindle at regular intervals against the resistance of the counterweight, substantially as described.

3. The combination of a driving-shaft, the bevel-gears and the drill-spindle continuously rotated thereby but movable endwise in its bearings, means exerting a constant tendency to lift the spindle, a cam operating on the head of the spindle to force it down against the resistance of the lifting mechanism, the worm on the driving-shaft and the worm-wheel engaged by it, with the sprocket-wheels and the chain-belt through which the cam is driven by the worm-wheel to automatically depress said spindle at regular intervals, substantially as described.

4. The combination of the driving-shaft, the endwise-movable drill-spindle and means for continuously rotating it from the driving-shaft, a cam actuated from the driving-shaft and operating upon the head of the drill-spindle to push it down at regular intervals, with means for raising the spindle when it is released from the cam, a rotatable work-carrier located below the drill-spindle and provided with series of ratchet-teeth and holes, a pawl to operate upon the ratchet-teeth and a bolt to engage the holes with cams for operating the pawl and bolt, actuated through suitable means from the driving-shaft.

5. The combination of the endwise-movable rotating drill-spindle, a cam operating upon the head of the spindle to push it down, means for raising the spindle when it is released from the cam, a rotatable work-carrier located below the drill-spindle and provided with a series of ratchet-teeth and a series of holes in its periphery, a pawl to operate upon the ratchet-teeth and a bolt to engage the holes, cams to actuate the pawl and bolt, the drill-spindle cams the pawl-cam and the bolt-cam being actuated from a common shaft through suitable mechanism and so timed that the bolt locks the carrier while the drill-spindle is descending, and unlocks it while the spindle is rising, the pawl then turns the carrier the required distance when it is immediately reëngaged by the locking-bolt before the descent of the drill-spindle for its next operation on the work.

6. The combination of a driving-shaft D, and the endwise-movable drill-spindle rotated at high speed thereby through suitable gears, the worm on the driving-shaft and the worm-wheel engaged thereby and mounted on a shaft L, a cam to push the drill-spindle down and means for raising the spindle when released from the cam, a rotatable carrier located below the drill-spindle and provided with rows of peripheral ratchet-teeth and holes, a pawl to operate upon the ratchet-teeth and a bolt to engage the holes of the carrier, cams to operate the pawl and bolt with sprocket-wheels on the shaft L, and sprocket-chains extending therefrom to sprocket-wheels on the shaft of the drill-spindle cam, and on the shaft of the pawl and bolt cams to actuate them.

7. The combination of the rotating endwise-movable drill-spindle, means for automatically raising the spindle and means for automatically depressing same, of a rotatable carrier located below the spindle and provided with a series of ratchet-teeth and a series of holes on its periphery, an endwise-moving pawl to engage the ratchet-teeth, an endwise-moving bolt to engage the holes, the shaft P, with its cams which actuate the pawl and bolt when the spindle is in its raised position and springs to retract the pawl and bolt when released by the cams.

8. The combination of a hollow drill-post or standard, a rotating endwise-movable drill-spindle mounted in bearings at the top of the post, a non-rotating sleeve on the drill-spindle provided with a gear-rack, a pinion engaging said rack, a shaft carrying said pinion and having a pulley on its end, and connected by a chain to a pulley on a counter-shaft extending through its bearings into the hollow column, a pulley supported by said shaft within the hollow column, a chain connected to said pulley and a counterweight attached to the end of said chain within the column.

In testimony whereof I affix my signature, in the presence of two witnesses, at Toledo, Ohio, March 21, 1899.

GEORGE A. BURWELL.

Witnesses:
WM. H. RAYNOR,
LULA F. PERRY.