(No Model.) 4 Sheets—Sheet 1.

D. H. CHURCH.

DRILLING MACHINE.

No. 584,987. Patented June 22, 1897.

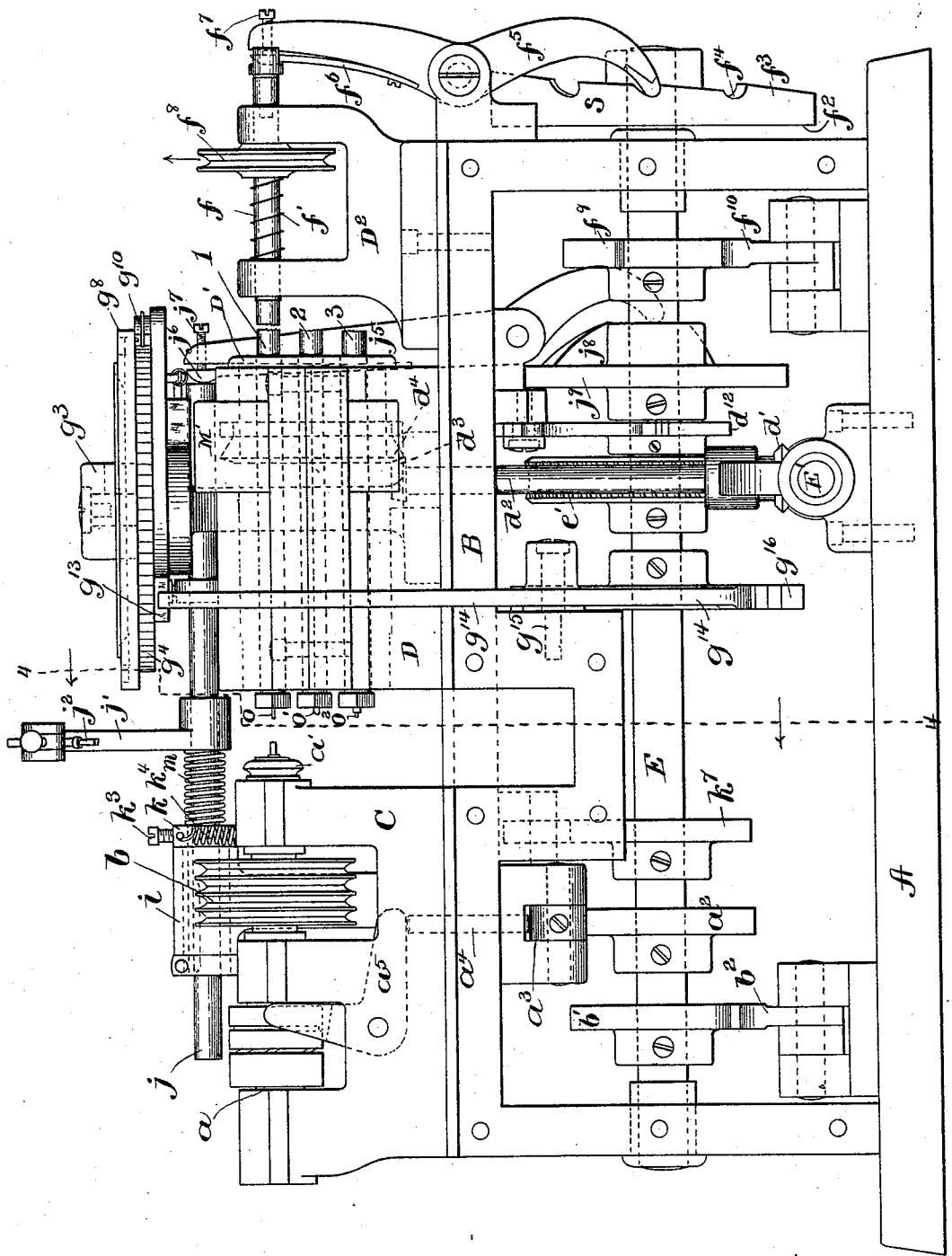

FIG. 1.

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A. D. Harriman.
P. W. Pezzetti.

INVENTOR:
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by Wright Brown & Quinby
Atty's.

(No Model.)

4 Sheets—Sheet 2.

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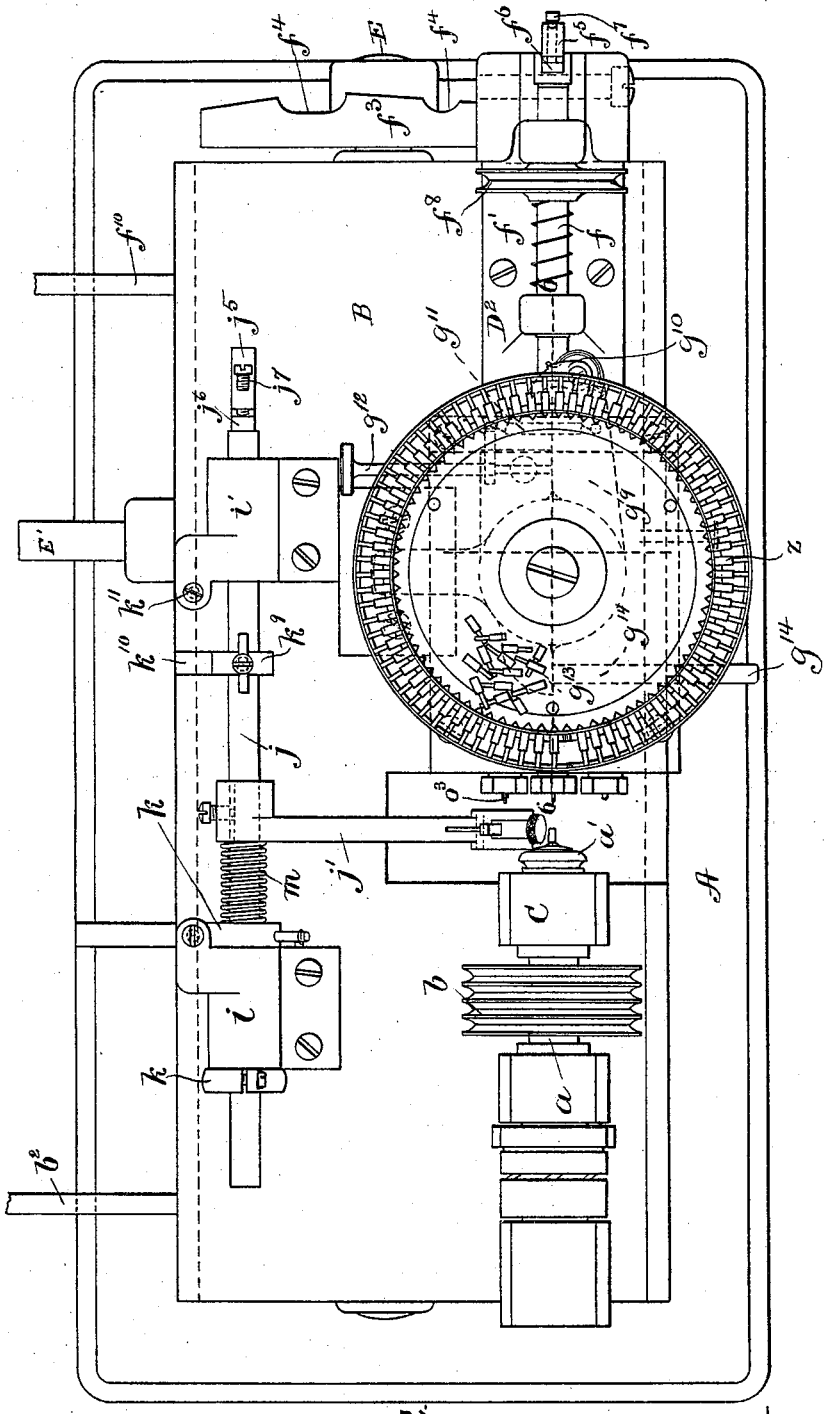

WITNESSES:
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FIG 2

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(No Model.) 4 Sheets—Sheet 3.

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DRILLING MACHINE.

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FIG. 4.

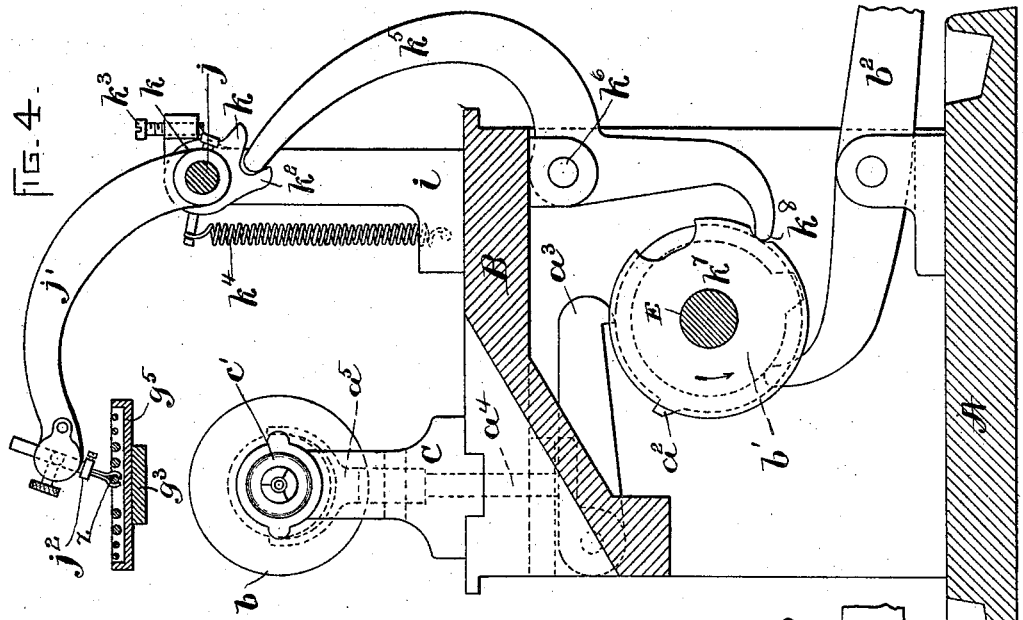
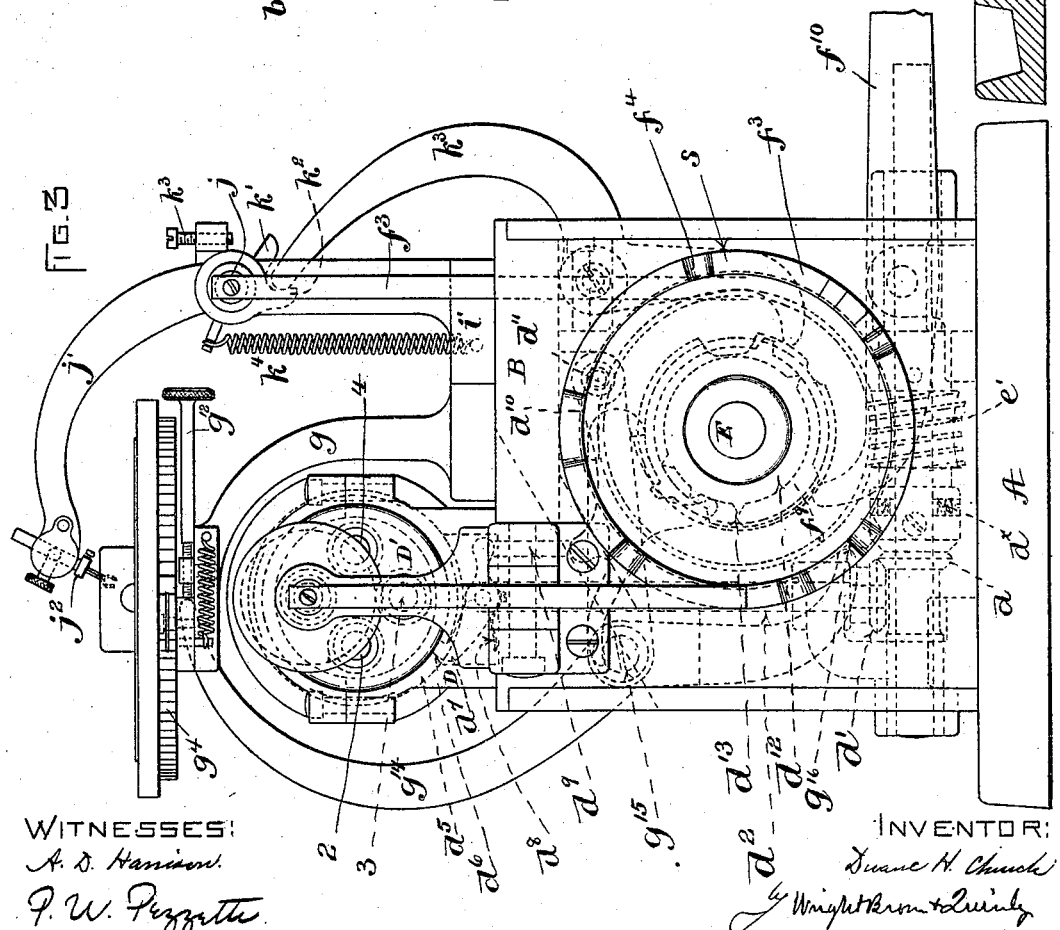


FIG. 3.



WITNESSES:
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(No Model.) 4 Sheets—Sheet 4.

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FIG. 6.

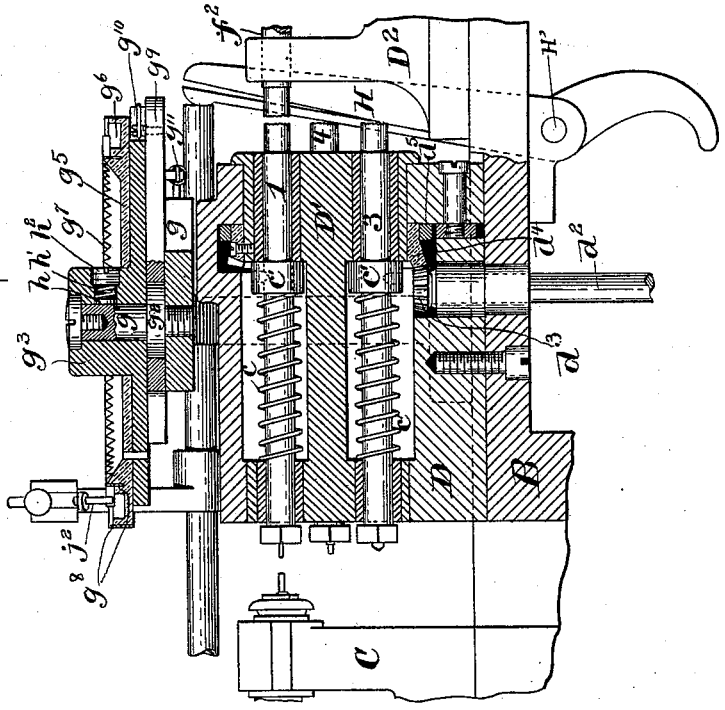
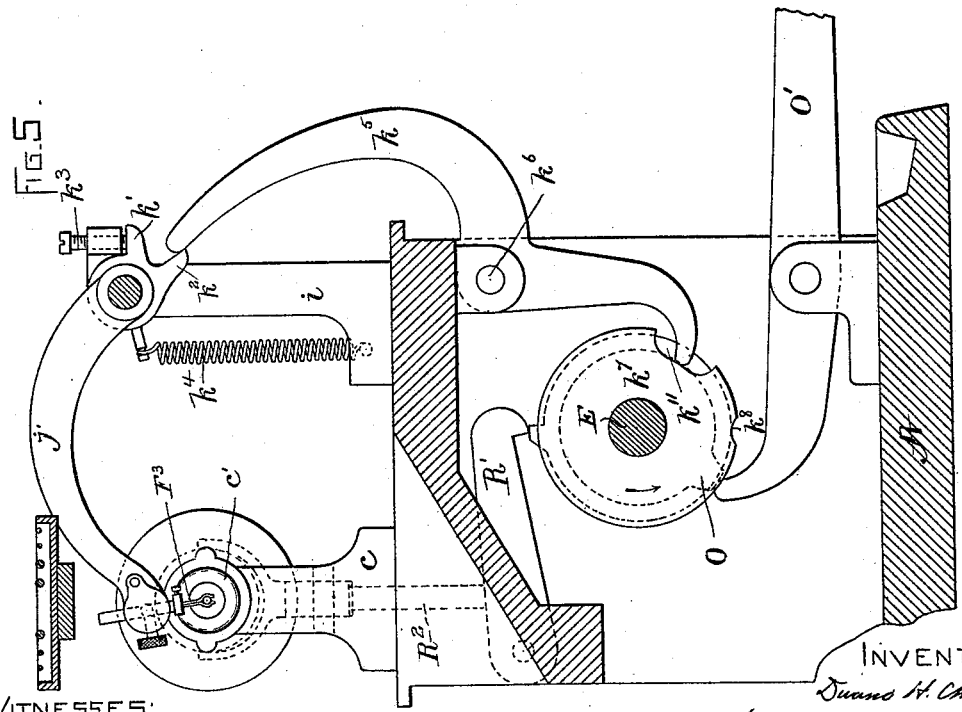


FIG. 5.



WITNESSES:
A. S. Harrison
P. W. Pezzetti.

INVENTOR:
Duane H. Church
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UNITED STATES PATENT OFFICE.

DUANE H. CHURCH, OF WALTHAM, MASSACHUSETTS.

DRILLING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 584,987, dated June 22, 1897.

Application filed October 1, 1896. Serial No. 607,560. (No model.)

To all whom it may concern:

Be it known that I, DUANE H. CHURCH, of Waltham, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Drilling-Machines, of which the following is a specification.

The object of the present invention is to provide an organized mechanism whereby the drilling of watch-movement parts is effected by successive steps, commencing with the taking up of the blank and concluding with the delivery of the completed product, the whole being carried on automatically, whereby a number of machines, each exceeding in productive capacity the ordinary drilling-lathe, only require a single attendant. Not only does greater economy thus result from the practice of this invention, but uniformity in the product is more nearly insured than heretofore.

The essential elements of the invention are recited in the appended claims, and I will next proceed to describe an embodiment of the invention, which is illustrated in the accompanying drawings, forming a part of this specification, and whereof—

Figure 1 represents a front elevation of the machine. Fig. 2 represents a top plan view. Fig. 3 represents a right-hand end elevation. Fig. 4 represents a vertical transverse section taken on the line 4 4 of Fig. 1. Fig. 5 represents a similar section to Fig. 4, but with the parts positioned as they would appear at a different stage of the operation. Fig. 6 shows a longitudinal vertical section on line 6 6 of Fig. 2.

In the drawings the letter B designates the main supporting-frame of the machine, which stands upon a suitable base A and has mounted upon it a head-stock C, a tail-stock D, and a supplemental tail-stock D^2. The head-stock supports a spindle *a*, carrying a chuck *a'*, of any suitable form, but preferably one having a spring back piece or bottom for ejecting purposes. Said chuck is designed to be opened and closed by slight longitudinal movement of the spindle in a well-known manner, the chuck being normally spring-closed.

The automatic opening of the chuck is effected at intervals through the following-described means: A cam a^2 is affixed on the main driving-shaft E of the machine and coacts with a lever a^3, (see Figs. 4 and 5,) pivoted at one end to a fixed support and having resting upon its back edge a push-pin a^4, which at its upper end engages one arm of a bell-crank lever a^5, whose other arm is forked to embrace a collar on the chuck-spindle. The chuck-spindle carries a pulley *b*, which receives motion from a counter-shaft, (not shown,) but as the spindle is to rotate intermittently means are embodied in the machine for controlling its operative connection with the counter-shaft, said means comprising a cam *b'*, affixed on the main shaft E, and a lever b^2, coacting with said cam and connecting with suitable shipper mechanism associated with the counter-shaft, but not necessary to illustrate.

The tail-stock D has journaled in it eccentric to the chuck-spindle a drum D', which is fitted with bushings for a number of spindles, of which four are here illustrated, and designated, respectively, 1, 2, 3, and 4, and any of which may be brought into alinement with the chuck-spindle by turning the drum. Each of said spindles 1, 2, 3, and 4 is longitudinally movable in the drum and normally retracted by a spiral spring *c*, surrounding it and bearing at one end against the front bushing and at the other against a collar *c'*, affixed to the spindle and limiting its rearward movement. Spindles 1 and 2 are held from rotation by splines or otherwise, whereas spindles 3 and 4 are free to rotate, the reasons for which will hereinafter appear.

The following-described means are employed for turning the drum to bring the spindles 1, 2, 3, and 4 successively into alinement with the chuck-spindle and for locking the drum in its different positions.

A shaft E', which imparts motion to the shaft E through a worm *e*, affixed to the former, and a worm-wheel *e'*, affixed to the latter, carries a bevel gear-wheel *d*, not positively engaged with it, but arranged to be rotated by it through frictional connections of any suitable type, as indicated at d^4 in Fig. 3, so long as there is no sufficient resistance offered. Said bevel gear-wheel meshes into a bevel gear-wheel *d'*, affixed on the lower end of a vertical shaft d^2, carrying at its upper end a bevel-pinion d^3, meshing into a crown bevel-gear d^4, embracing the drum D' and affixed

thereto. (See Fig. 6.) There is also affixed to the drum, and shown in Fig. 6 as encircling the gear d^4, a disk d^5, having four squared notches d^6 in its periphery, corresponding in relative position with the four spindles 1, 2, 3, and 4. A latch d^7 (see Fig. 3) by engagement with these different notches locks the drum in its different positions of adjustment, said latch being pressed into engagement with the notches by a spring d^8. The disengagement of the latch is effected through the following instramentalities: One end of the said latch rests upon a push-pin d^9, and the latter rests upon the back edge of a lever d^{10}, which is pivoted at one end to the frame of the machine, as shown at d^{11}, and bears at the opposite end against the periphery of a cam-disk d^{12}, affixed to the shaft E, and whose cam projections d^{13} correspond in number with the spindles 1, 2, 3, and 4, three of the projections being grouped together at the side of the disk, as shown, and the other projections being at the opposite side of the disk to properly time the unlocking of the drum.

The supplemental tail-stock D^2, hereinbefore mentioned, supports a running spindle f in alinement with the chuck-spindle and both rotatively and longitudinally movable in its bearings. This spindle f is designed to successively act against the protruding rear ends of the spindles 1, 2, 3, and 4 to move the same longitudinally and also to rotate those of them which are free to rotate—viz., spindles 3 and 4—to which end clutch-teeth are formed in the ends of the spindles, as shown in Fig. 1. A spiral spring f' surrounds the spindle f and normally holds it retracted. Its forward motion is produced through the following agencies: On the right end of the shaft E there is affixed a disk f^2, having a circumferential flange f^3 with a gradual rise or increase in width and depressions f^4 at intervals. A lever f^5 is centrally pivoted to a bracket on the end of the frame and at its lower end bears against the edge of the flange f^3, while at its upper end it bears, through the medium of a flat spring f^6, attached to it, against the end of the spindle f, a screw f^7, entered through the lever and bearing against the spring, providing for adjustment. The spindle f carries a pulley f^8, to which rotary motion is imparted through connections with a counter-shaft, (not shown,) but as the said spindle is only to rotate intermittently means are embodied in the machine for automatically controlling its operating connections with the counter-shaft, said means comprising a cam f^9, affixed to the shaft E, and a lever f^{10}, coacting with said cam and suitably connected with shipper mechanism associated with the counter-shaft.

There is erected upon the frame of the machine just back of the tail-stock D a standard g, whose upper portion overhangs the tail-stock and supports an upstanding stud g', (see Fig. 6,) formed with a collar g^2, extending over the top surface of the said standard. A circular table g^3 journals upon said stud and rests upon said collar and is formed in its edge with ratchet-teeth g^4, and there is mounted upon said table a circular plate g^5, annularly grooved in the upper side near the margin, as shown at g^6, and formed with V-shaped grooves g^7, crossing the annular grooves. The blanks z rest in these V-shaped grooves and are confined endwise by plates or bands g^8, closing the ends of the grooves. The collar g^2 is loosely embraced by an arm g^9, extending outwardly beyond the periphery of the table and carrying pivoted to it a pawl g^{10}, spring-pressed against the periphery of the table. A spiral spring g^{11} is attached at one end to the arm and at the other to a fixed support, and an adjustment-screw g^{12} determines the extent of movement the said spring may impart to the arm. On the opposite side of the collar g^2 the arm has a projection g^{13}, arranged to be acted upon by a vertically-disposed lever g^{14}, pivoted at g^{15} to the frame of the machine and bearing at its lower end against the periphery of a cam g^{16}, affixed on the shaft E.

It will be seen that the movement of the lever g^{14} effected by the cam causes the arm g^9 to be moved about its center in a direction to slide its pawl back over a ratchet-tooth of the table, and then the spring g^{11} throws the pawl against the tooth and turns the table one step. To prevent the table moving farther than desired, friction is created between it and the stud by means of a pad h in a recess of the table and bearing against the stud, a spiral spring h' being placed between said pad and confined by a screw h^2. (See Fig. 6.)

At the back part of the frame there are erected a pair of standards i and i', which support between them a longitudinally-movable rod j, having affixed to it at a central point an arm j', which is equipped at its outer end with an adjustable clip j^2, of suitable construction to grasp one of the blanks z, this device being here shown as consisting of a pair of spring-fingers fastened to a suitable shank. The standard i constitutes a bearing for a sleeve K, through which the rod i slides, being splined thereto to prevent rotary movement independent thereof. The sleeve has no longitudinal motion, but may rock in its bearing to produce up-and-down vibrations of the arm j', and to this end is provided at one end with a pair of short arms K′ and K^2, (see Figs. 4 and 5,) one of which arms abuts an adjustment-screw K^3 in the standard to limit the movement of the sleeve in one direction produced by the action of a spiral spring K^4, fastened at one end to a pin projecting from the sleeve and at the other end to the frame of the machine. The other of said short arms bears against the upper end of a lever K^5, pivoted at K^6 to the frame and bearing at its lower end against the periphery of a cam K^7, affixed to the shaft E. When said lower end of the lever is in a depression K″ of the disk, the spring K^4 is free to turn the

sleeve and throw the arm j' downward, as shown in Fig. 5; but when the outer portion of the cam's periphery rides under the lever the sleeve is turned against the stress of the spring and the arm j' raised. It will be observed that the cam has a slight depression K^8, which is to allow the slight movement of the arm j' necessary to engage its clip with one of the blanks, as shown in Fig. 4. To limit this downward movement, the rod j has fastened to it a collar K^9, having a projecting arm K^{10}, which when the rod occupies its right-hand position extends under an adjustment-screw K^{11}, entered through an ear on the standard i'.

The rod j is moved to the right by a spiral spring m, surrounding it between the sleeve K and the arm j', and in the opposite direction by a lever j^5, bearing against its end through the medium of a flat spring j^6, attached to it, and adjusted by a screw j^7, said lever being pivoted to the frame of the machine and bearing at its lower end against a cam projection j^8 on the side of a disk j^9, affixed on the shaft E.

Having now set forth the details of construction of the machine, I shall next proceed in a general way to recite its operation.

The turn-table being loaded with blanks and the transfer-arm j' being at the right-hand end of its movement and elevated, said arm descends far enough to cause its clip j^3 to grasp the blank directly below it, as well illustrated in Fig. 4, and then the arm rises sufficiently to clear the table with the blank, and the rod j being then impelled toward the left the blank is carried to a position over the center of the machine, as in Figs. 1, 2, and 3. Next the chuck opens and the transfer-arm descends, stopping with the blank in line with the open chuck, (see Fig. 5,) and thereupon spindle 1 is advanced and the tool o on its end pushes the blank endwise from between the fingers of the clip and into the chuck and the latter closes upon it. The transfer-arm rises, after the blank has left it, to the limit of its upward movement, which takes its clip above the level of the table. The arm then moves to the right and descends, as before, to grasp the blank, the table in the meantime having been turned one step to bring a new blank to position. The clip having moved upward with the blank remains with the latter suspended over the table during the operations which are being performed on the blank which has been placed in the chuck. When the chuck closed on the blank, the shipper mechanism acted to connect the chuck-spindle with its counter-shaft, and thereupon said spindle was set to rotating. The spindles having been retracted, the drum D' is unlocked and moved through a partial revolution to bring spindle 2 into alinement with the chuck-spindle and the drum is locked again. Spindle 2 advances, and the pointed tool o' it carries comes against the rotating work and produces a slight recess at the axial center thereof. That spindle then recedes, the drum is unlocked and again turned until spindle 3 is brought into alinement with the chuck-spindle, and the drum is locked, while said spindle is advanced to bring the drilling-tool o^2 it carries up to the blank and is then gradually advanced to work said tool into the blank, all the time rotating; but during its progress it is once or twice withdrawn from the blank by means of the depressions in the cam-flange f^3 to clear out the chips. When the third tool-spindle is brought into play, the shipper mechanism acts to connect the actuating-spindle f with its counter-shaft. Having completed its work, the spindle 3 is finally withdrawn, the drum again unlocked and turned to bring the spindle 4 to position of alinement with the chuck-spindle, and this spindle 4 is advanced, rotating with the reaming-tool o^3 it carries, and the finishing of the drilled hole is accomplished. At this time the transfer-arm has started over with its second blank and is ready with the blank as soon as the preceding one has been completed, when the head-stock spindle stops, the chuck opens, and the finished blank is ejected. This completes a cycle of the machine's operation, and it will be seen that the object primarily stated is thoroughly accomplished by it.

Having thus explained the nature of my invention and described a way of constructing and using the same, though without attempting to set forth all the ways in which it may be made or all the modes of its use, what I claim, and desire to secure by Letters Patent, is—

1. In a machine of the character described, the combination with a chuck and a reservoir for blanks, of a blank-conveyer movable into and out of the said reservoir and to and fro between the reservoir and the chuck, the said conveyer having blank-grasping means and adapted to take the blanks singly from the reservoir and deliver them to the chuck; and means for imparting appropriate movements to the conveyer for the purpose described.

2. In a machine of the character described, the combination with a chuck, means for opening and closing the same, a reservoir having provisions for holding a plurality of blanks in a regular series, and means for moving said reservoir step by step to bring the blanks successively to position for removal, of a blank-conveyer movable into and out of the reservoir and to and fro between the reservoir and the chuck, the said conveyer having blank-grasping means and adapted to take the blanks singly from the reservoir and deliver them to the chuck; and means for imparting appropriate movements to the conveyer.

3. In a machine of the character described, the combination with a chuck, a rotary reservoir having provisions for holding a plurality of blanks in a circular series, and means for turning the reservoir step by step to bring the blanks successively to position for removal, of a blank-conveyer movable into and

out of the reservoir and to and fro between the same and the chuck, the said conveyer having blank-grasping means and adapted to take the blanks singly from the reservoir and deliver them to the chuck; and means for imparting appropriate movements to the conveyer.

4. In a machine of the character described, the combination of a horizontally-rotatable table with provisions on its upper side for holding blanks in a circular series, means for imparting step-by-step movement to said table, a transferring device with provisions for holding a blank, and means for operating the said transferring device to engage it with the blank and to remove the latter from the table and present it to be treated.

5. In a machine of the character described, the combination of a horizontally-rotatable table, with provisions in its upper side for holding blanks in a circular series, means for imparting step-by-step movement to said table, a vertically and horizontally movable transfer-arm, and means for actuating the latter to take the blanks singly from the table and present them to be treated.

6. The combination of a chuck-spindle, a revoluble support carrying a plurality of longitudinally-movable tool-holding spindles, means for turning said support to, and locking it in predetermined positions to bring the said tool-holding spindles severally into alinement with the chuck-spindle, a longitudinally-movable actuating-spindle in line with the latter, and adapted to engage the tool-holding spindles, and means for imparting an appropriate motion to said actuating-spindle.

7. The combination of a chuck-spindle, a revoluble support carrying a plurality of longitudinally-movable tool-holding spindles, means for turning said support to, and locking it in predetermined positions to bring the said tool-holding spindles severally into alinement with the chuck-spindles, a longitudinally-movable rotary actuating-spindle in line with the latter, and adapted to engage the tool-holding spindles, means for moving said actuating-spindle longitudinally, and means for effecting intermittent rotation thereof.

8. The combination with a chuck-spindle, and means for effecting intermittent rotation thereof, of a revoluble support carrying a plurality of longitudinally-movable tool-holding spindles, some rotatable in said support, means for turning said support to, and locking it in predetermined positions to bring said tool-holding spindles severally into alinement with the chuck-spindle, a longitudinally-movable rotary actuating-spindle in line with the latter, and adapted to engage the tool-holding spindles successively, means for moving said actuating-spindle longitudinally, and means for effecting intermittent rotation thereof.

9. The combination of a chuck-spindle, a revoluble support carrying a plurality of longitudinally-movable tool-holding spindles, means for turning said support to, and locking it in predetermined positions to bring the said tool-holding spindles severally into alinement with the chuck-spindle, a longitudinally-movable rotary actuating-spindle in line with the latter, and adapted to engage the tool-holding spindles, means for imparting variable longitudinal movement to said actuating-spindle, and means for effecting intermittent rotation thereof.

10. The combination with a chuck-carrying spindle, means for automatically opening and closing the chuck, and means for effecting intermittent rotation of said spindle, of a revoluble support or drum; one or more longitudinally-movable tool-holding spindles therein, one or more longitudinally-movable rotary tool-holding spindles in said drum, means for turning said drum to, and locking it in predetermined positions to aline the said tool-holding spindle successively with the chuck-spindle, a longitudinally-movable rotary actuating-spindle in line with the chuck-spindle, and adapted to engage the said tool-holding spindles successively, means for imparting variable longitudinal movement to said actuating-spindle, and for effecting intermittent rotation thereof, a horizontally-rotatable table having provisions for holding a circular series of blanks in its upper side, means for imparting step-by-step movement to said turn-table, a transfer-arm longitudinally movable in a rocking support, means for effecting longitudinal movement of said arm, and means for rocking its support.

11. In a machine of the character described, the combination of a horizontally-rotatable table having radial repositories for blanks, a transfer-arm affixed to a sliding rod, an oscillatory sleeve rotatively engaged with said rod, means for imparting step-by-step movement to the table, means for reciprocating the rod, and means for oscillating the sleeve, said means including a variable cam.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 28th day of September, A. D. 1896.

DUANE H. CHURCH.

Witnesses:
BEATRICE E. MOSHER,
CARRIE L. ADAMS.