W. G. ESTEP, A. E. HAMILTON, AND E. L. SIMONSON.

FLUTING MACHINE.

APPLICATION FILED DEC. 18, 1920.

1,415,819.

Patented May 9, 1922.

3 SHEETS—SHEET 1.

Fig. 1.

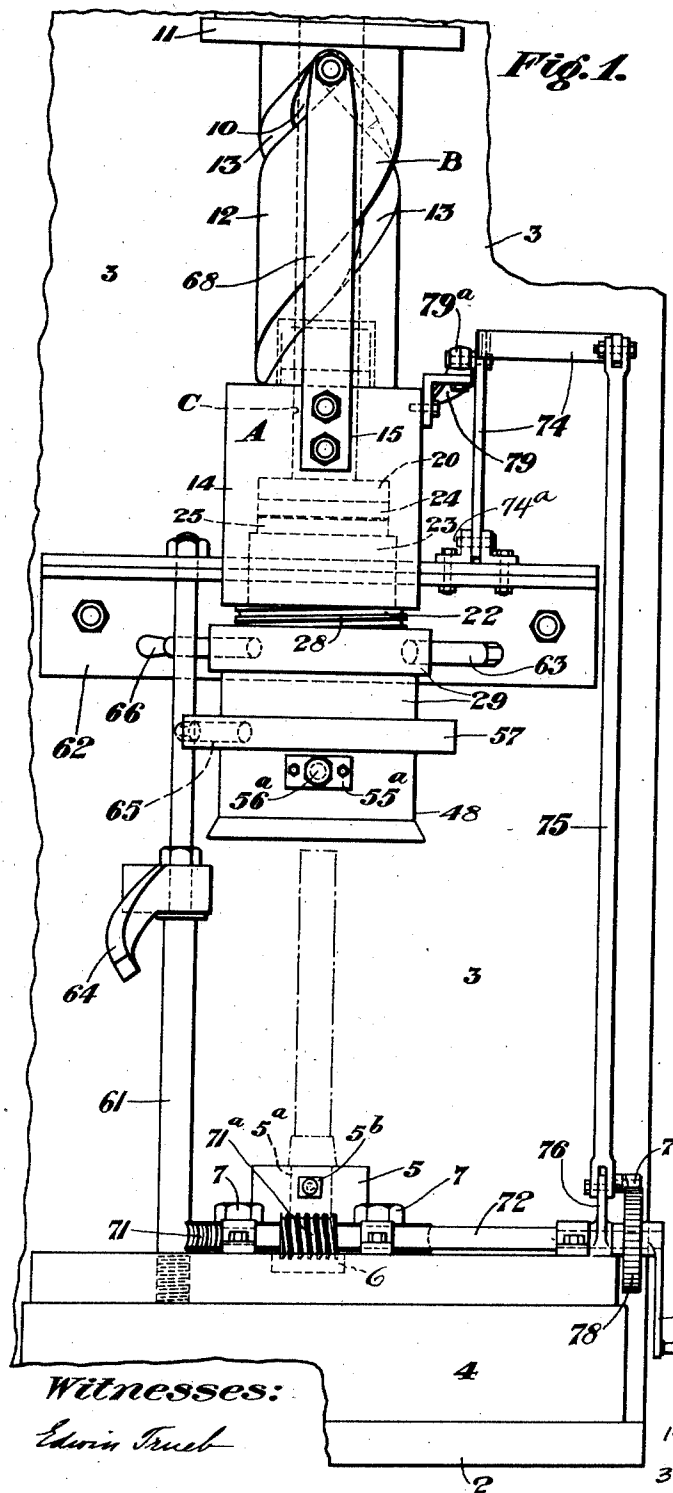
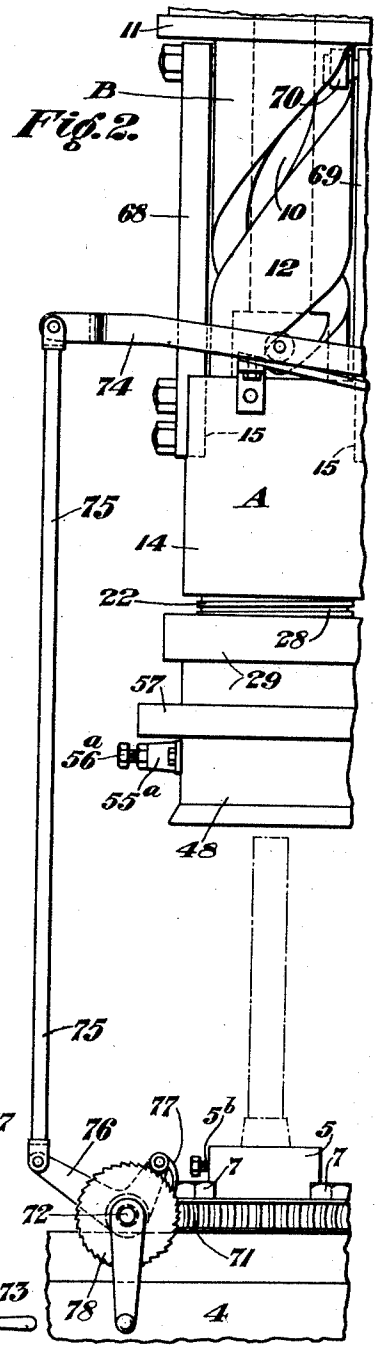


Fig. 2.



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3 SHEETS—SHEET 2.

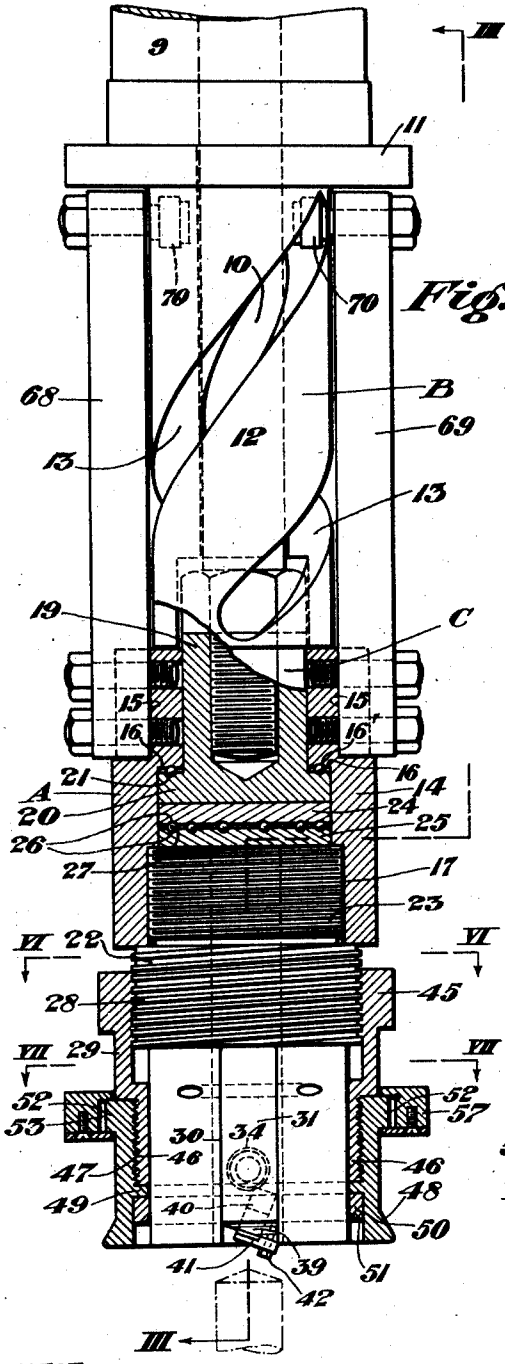


Fig. 4.

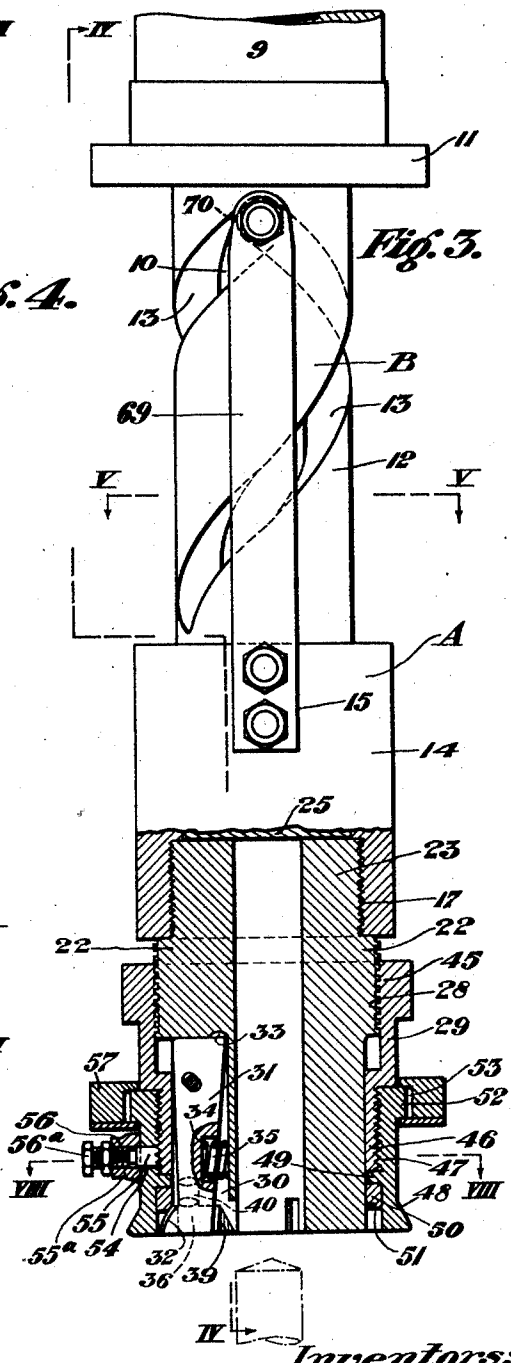


Fig. 3.

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3 SHEETS—SHEET 3.

Fig. 6.

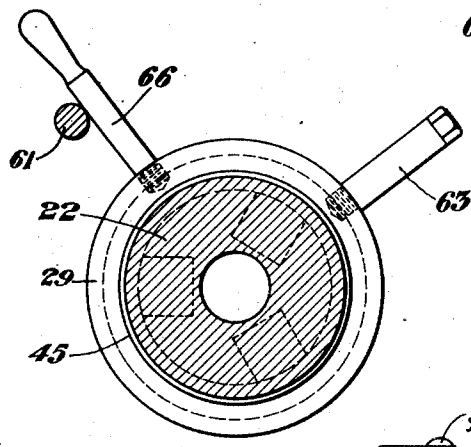
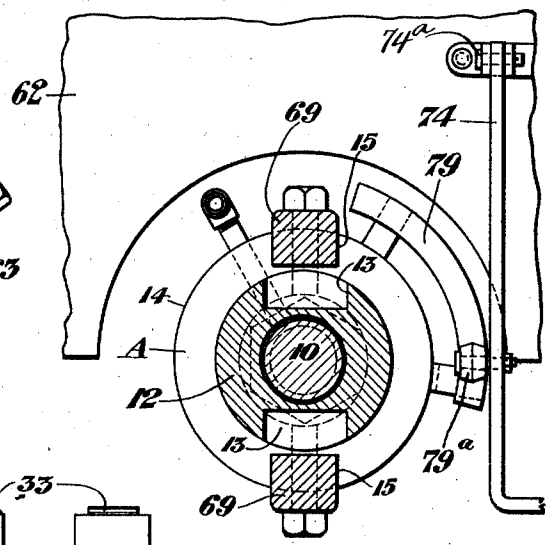


Fig. 5.



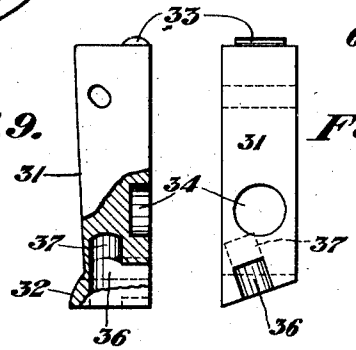


Fig. 9.

Fig. 10.

Fig. 7.

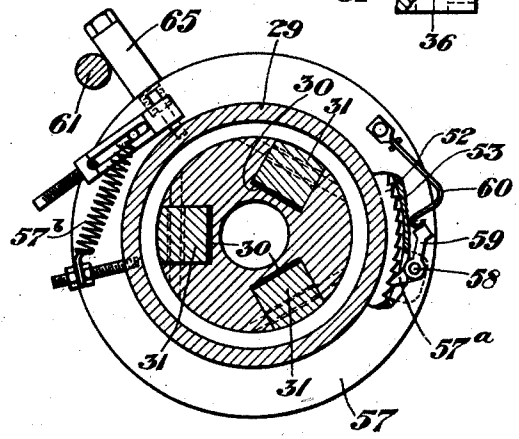
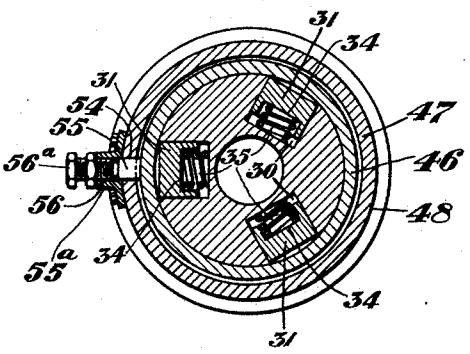


Fig. 8.



Witnesses:

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UNITED STATES PATENT OFFICE.

WILLIAM G. ESTEP, OF DUQUESNE, AND ALFRED E. HAMILTON AND ELMER L. SIMONSON, OF HOMESTEAD, PENNSYLVANIA.

FLUTING MACHINE.

1,415,819. Specification of Letters Patent. Patented May 9, 1922.

Application filed December 18, 1920. Serial No. 431,677.

To all whom it may concern:

Be it known that we, WILLIAM G. ESTEP, of Duquesne, ALFRED E. HAMILTON, of Homestead, and ELMER L. SIMONSON, of Homestead, all in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Fluting Machines, of which the following is a specification.

This invention relates to machine tools usable in making fluted or grooved articles such as milling machine cutters, twist drills, and the like. The invention more particularly relates to machines for use in making fluted cutters and drills, and similar articles having spiral flutes.

One object of our invention is the provision of a fluting machine of novel construction, whereby fluted tools or other articles are made more rapidly and much more economically than is possible with the ordinary and well known milling machine.

Another object of the invention is to provide a slotter having novel means whereby any desired number of flutes are simultaneously formed and completed in the article being machined, and whereby the time required in making such articles is lessened and the cost of manufacture greatly reduced.

A still further object of this invention is the provision of a fluting machine having the novel constructions, arrangements and combination of parts, shown in the drawings, hereinafter described in detail, and particularly pointed out in the appended claims.

Referring now to the drawings, forming part of this specification, Figure 1 is a front elevation of a flute cutting machine embodying the novel features of our invention.

Figure 2 is a side elevation of the apparatus shown in Figure 1.

Figure 3 is a front elevation, partly in section, showing details in the construction of the machine, of Figures 1, 2, and 3, the section being taken on the irregular line III—III of Figure 4.

Figure 4 is a side elevation, partly in section, of the apparatus, the section being taken on the line IV—IV of Figure 3.

Figure 5 is a sectional plan of the machine on the line V—V of Figure 3.

Figure 6 is a sectional plan, the section being taken on the line VI—VI of Figure 4.

Figure 7 is a sectional plan taken on the line VII—VII of Figure 4.

Figure 8 is a sectional plan, on the line VIII—VIII of Figure 3.

Figure 9 is a detail plan, partly in section, of the tool holders forming part of our improved fluting machine.

Figure 10 is a side elevation of the tool holder of Figure 9.

In the accompanying drawings, the numeral 2 designates a base plate having an upwardly extending back plate or bracket 3 secured thereto, which carries or supports the cutting head and associated operating parts of the apparatus.

Also secured on the base 2 is a stationary table 4 having a work holding chuck 5 mounted thereon. The chuck is provided with a socket 5^a, having a clamp or set screw 5^b for fastening the work in position on the chuck 5. The bottom of the chuck 5 is countersunk to fit over a pivot bearing 6 mounted in the top of the table 4, and is held against displacement thereon by means of a plurality of bolts 7.

A vertical fluid pressure cylinder 9 of ordinary construction (shown broken away in Figures 3 and 4) is secured to the upper portion of the back plate or bracket 3 and has a reciprocatory plunger 10 adapted to carry the tool-head, which is designated generally by the letter A.

A tool-head guide, designated in a general way by the letter B, is bolted or otherwise secured to the lower end of the fluid pressure cylinder 9, and this guide has a flange 11 which engages the lower end of the cylinder 9, and a cylindrical body 12 with helical guiding grooves or slots 13 formed in the periphery thereof.

The tool-head A comprises an upper hollow, cylindrical support 14, with diametrally opposite slots 15 in its periphery adjacent its top edge and having its inner surface counterbored so as to form a shoulder 16 therein, the lower half of said counterbored portion having an internal screw thread 17. The shoulder 16 has a slot or groove 16′ therein which forms the upper half of the ball race of a ball bearing.

The support 14 is secured to the threaded lower end of the plunger 10, being held in

position on this threaded end of the plunger by a lock nut C. The nut C has a neck portion 19 adapted to fit within the upper portion of the support 14, and an enlarged end or flange 20 which engages the shoulder 16 of the support 14. The face of the shoulder 20 has an annular groove 21 therein adapted to co-operate with the groove 16′ in the shoulder 16 to complete the race of the so formed ball bearing.

The lower portion of the tool head A comprises a cylindrical body 22 having a reduced neck 23 which is screw threaded and extends into the lower internally threaded portion of the supporting member 14. The space between the upper face of the body 22, and the lower face of the nut C is arranged to receive and hold two bearing plates 24 and 25, each having grooves 26 therein forming a bearing race for the balls 27.

The enlarged portion of the body 22 below the neck 23 is provided with screw threads 28 which carries an internally threaded tool adjusting ring 29, yet to be described.

The lower portion of the body 22 also is provided with a plurality of radial slots 30 therein to receive the tool holders 31. Each tool holder includes a body portion having one (its forward) face tapered downwardly and inwardly to a point adjacent to the lower edge of the holder, where it flares downwardly and outwardly and forms a bearing face 32. The upper end of the tool holder has a projecting bearing surface 33, which is curved and which is arranged to fit into and rock within a depression in the top face of the tool slots 30. (See Figure 3.) Each tool holder 31 has a recess 34 in the rear face thereof to receive a coil spring 35 which bears against the bottom of the slot 30 in the body 22, and yieldingly maintains the tool-holders 31 in position against the ring or collar 48 for contracting the tool holders 31, this collar being further described hereinafter.

The lower end of each tool holder 31 has a slot 36 therein to receive a cutting tool, this slot having an aperture 37 in its bottom surface at the inner end of the slot. (See Figures 9 and 10.)

Suitable cutting tools, which are held in the slots 36, have a head 39 and a shank or stem 40 fitting the hole 37. The cutting tools are held in place in the slots 36 by clamps 41 which are detachably secured to the end of the tool holders by set screws 42.

The upper counterbored end of the tool adjusting ring 29, which is internally threaded, screws on the threaded lower end 28 of the body 22, and has a reduced portion 46 provided with an external thread which extends into the internally threaded upper end 47 of the contracting ring or collar 48. The internal flange 49 of the collar 48 engages with a hardened steel ring 50 which is seated in the unthreaded recess in the lower end of the collar 48, of which the flange 49 forms the bottom.

The ring 50 has a beveled edge 51, forming a bearing surface which coacts with the bearing faces 32 of the tool holders 31, (see Figure 3) and the end of the collar 48 has a peripheral flange 52 provided with ratchet teeth 53, for a purpose to be described. (See Figures 3 and 7.)

The collar 48 also has a transverse hole 54 extending through its screw threaded portion 47, and a friction plug 55 of soft metal is slidably mounted therein to lock the collar in adjusted position on the reduced end 46 of the body 29. A boss 55^a on the outer surface of the collar has a threaded hole 56 in alinement with the aperture 54, and a set screw 56^a is provided in the hole 56 which bears against the plug 55 to tighten the plug on the screw threads of the ring 29 and prevent relative axial movement between the ring 29 and collar 48.

The tool head A is arranged to rotate and to simultaneously reciprocate vertically, and the cutting tools are arranged to be adjusted radially, by means by the beveled portion 51 of the ring 50 and engaging portion 32 of the tool holders, as the ring 29 and collar 48 are rotated on the threaded shoulder 28.

Means are provided for automatically adjusting or feeding the tools radially inward, or transversely of the head, at the termination of the upward strokes thereof and other means are provided for releasing the tools at the termination of the downward or cutting stroke and provide the necessary clearance for the tools so that the head may move freely upward. These means include a ratchet ring 57, which is rotatably mounted on the shoulder 52 of the collar 48. The ring 57 is yieldingly held in normal position by a coil spring 57^b, this spring having one end fastened to the ratchet ring, and its other end being secured to the release ring 29. (See Figure 7.) A pawl 57^a is pivotally secured within the ratchet ring 57 by an integral pin 58, this pin extending through the ring and having a lever 59 secured thereon. The swinging end of the lever 59 engages with the spring 60 which normally holds the pawl 57^a in engagement with the teeth 53 of the ratchet ring 57.

A vertical bar 61 having its lower end fixed on the table 4 and extending upwardly in a plane parallel with the tool head A with its upper end secured to the bracket 62, forms a stop that limits the extent of rotary movement of the ring 29 on and relative to the cylindrical body 22. A release lever 63 is mounted in the ring 29 and is positioned so as to strike a stop 64 on the bar 61 just prior to the termination of the spi-

rally downward stroke of the head A, thereby causing a reverse or upward movement of the ring 29 and collar 48 on the body 22 of the tool-head, and allowing the cutting tools to be moved away from the work by the action of the springs 35 on the tool holders 31.

A second lever 65, secured in the ratchet ring 57 is positioned to strike the rod or bar 61 just prior to the termination of the upward stroke of the tool head, thereby causing the collar 48 to rotate on the ring 29 and feed downward, thus engaging and forcing the radially movable tool holders inward and resetting the cutters for a new cut, by engagement of the dog 57^a with the teeth 53 on the flange 52. This relative movement between the ring 29 and ratchet ring 56 will also extend the spring 57^b, so as to return the ratchet ring to its normal position, during the downward stroke of the device.

The movement of collar 48 on ring 29 to reset the cutters does not cause the ring 29 to return to the position it occupied on the body 22 prior to the upward movement caused by the lever 63 striking the stop bar 64. Therefore, a third lever 66, which is mounted on the ring 29, is positioned to strike the rod 61 immediately after the lever 65, and causes a downward rotary movement of the ring 29 and collar 48 relative to the body 22 of the tool head, this last movement being adjusted to equal the upward movement caused by the release lever 63.

Vertical movement is imparted to the tool head A by means of the plunger 10 of the fluid pressure cylinder 9, and rotary movement thereof is imparted to the head during its vertical movement by means of the pair of guide arms 68—69 which are rigidly secured in the slots 15 formed in the support 14 on the head, and have their upper ends provided with anti-friction rollers 70 extending into the spiral guide slots or grooves 13.

The work holding chuck 5 has a segmental worm-wheel 71 thereon which is in mesh with a worm 71^a on the shaft 72, the shaft being journaled on the table 4. This shaft 72 is provided with an operating hand crank 73 for rotating the chuck manually.

A crank arm 74, pivoted by the pin 74^a to the bracket 62 on the back plate 3, is connected by a link 75 which is of considerable weight, to a second crank arm 76 pivoted on the shaft 72, and the crank arm 76 has a pawl 77 pivoted thereon which engages the teeth of the ratchet wheel 78 on the shaft 72. (See Figures 1 and 2).

A lifting cam bar 79 secured to the upper end of the tool-head support 14, is arranged to engage the anti-friction roller 79^a on the crank arm 74 on each upward stroke of the head to raise the link 75 and crank arm 76, and through the pawl 77 move the ratchet wheel 78 and turn the chuck 5 so that the work will present a new face to the cutting tools on each downward stroke of the tool head. The roller 79^a on the cam bar 79 will be disengaged from the crank arm 74 on the beginning of the downward stroke of the head A so as to permit the levers 74 and 76 and link 75 to drop by gravity and move the pawl relative to the ratchet wheel 78.

The operation of our improved machine when planing flutes in a drill blank is as follows—The complete machine being assembled and the tool head A being in its raised position, the chuck 5 is revolved clockwise by operating the hand crank 73 of the shaft 72. The drill blank or other work to be machined is then set in the chuck and locked in position by the set screw 5^b.

The collar 48 is now rotated by hand on the portion 46 of the ring 29 so as to force the beveled face 51 of the ring 50 against the bearing face 32 of the tool holders 31 and thereby set the tools for the first cut, which is slight. Fluid pressure is then admitted to the cylinder 9 thus forcing the plunger 10, and tool head A downwardly on the work with a rotary movement, due to the guide arms 68—69 traveling in helical guide grooves 13, and making the first spiral cut. Just prior to the termination of the downward stroke of the head A, the release bar 63 will strike the stop 64 on the rod 61, holding the ring 29 and collar 48 against rotation while the remainder of the tool head continues its rotary downward movement, thereby causing the ring 29 and collar 48 to move upward on the threaded rim 28 of the body 22. This movement of the ring 48 and collar 29 will remove the beveled face 51 of the ring 50 from engagement with the bearing surface 32 of the tool holders 31 and allow the coil springs 35 to force the tool holders 31 and tools 38 outwardly so as to clear the work, and permit the head to move freely into its upper position.

Fluid pressure is then admitted to the cylinder to raise the plunger, which lifts the plunger and tool head. As the tool head A nears the termination of its upward stroke, a lever 65 mounted in the ratchet ring 57 will strike the bar 61 and hold the ratchet ring and the collar 48 stationary by means of the pawl 57^a in the ring 57, engaging the teeth 53 formed on the collar 52. While the ring 57 and collar 48 are held stationary, the remainder of the head A is continuing its upward rotating movement, and consequently the collar 48 will move downward on the threaded portion 46 of the ring 29, thus forcing the beveled portion 51 of ring 50 against the bearing surface 32 of the tool holders 31, resetting them for a deeper cut on the next downward stroke.

Just prior to the termination of the up stroke of the head A the cam lift 79 will

engage the crank arm 74 and raise connecting link 75 and rock the crank arm 76 to draw back the dog 77 a predetermined distance along the ratchet wheel 78. At the beginning of the down stroke and before the tools engage the work, the cam lift 79 will be released from engagement with the crank arm 74 and crank arms and connecting link will fall by gravity and rotate the shaft 72, due to the engagement of the dog 77 with the ratchet 74, thus rotating the chuck and work 5 through the worm gear 71^a and worm-wheel segment 71 so as to present a new cutting face on the work to the tools.

The above cycle of operations is continued until the flutes in the work piece are cut to the desired depth and width, and experience has shown that to cut any number of regulation flutes in a 14 inch drill it only requires approximately ten minutes of time against a time interval of one hour for each flute cut by the usual milling operations.

It will be apparent to those skilled in the art that the above described machine is an extreme advance in the art and has many advantages, some of which have been specifically set forth.

While we have shown and described one specific form of our invention, it will be apparent that various changes may be made within the scope of the appended claims without departing from the spirit of the invention.

If found desirable the fluid pressure cylinder may be replaced by other power means, and also if it is desired to produce a machine capable of machining flutes of different pitches, this may be accomplished by providing change gearing to rotate the tool head guide B, during the time the head A is reciprocating.

We claim:—

1. A fluting machine comprising a base, a work holding chuck on said base, a vertically movable tool head, said tool head being arranged to reciprocate above said chuck, tool holders carried by said head, and means for automatically adjusting said tool holders transversely of said head on each upward stroke thereof.

2. A fluting machine comprising a base, a work holding chuck on said base, a tool head above said chuck, adapted to have a combined vertical reciprocatory and rotary movement, a plurality of tool holders mounted in said head, and means for automatically adjusting said tool holders transversely of said head on each upward stroke thereof.

3. A fluting machine comprising a base, a work chuck mounted for rotary movement on said base, a tool head above said chuck, said tool head being adapted to reciprocate in a helical path, a plurality of tool holders mounted in said head, and means for automatically adjusting said tool holders transversely of said head.

4. A fluting machine comprising a base, a work holding chuck mounted for rotary movement on said base, a tool head above said chuck adapted to reciprocate in a helical path, a plurality of tool holders mounted for transverse adjustment in said head, means for actuating said head, and means for automatically adjusting said tool holders transversely of said head at approximately the termination of each upward stroke.

5. In a fluting machine of the class described, having a base, and a work holding chuck, a tool head mounted above said chuck and adapted to have a combined vertical reciprocatory and rotary movement, said head comprising a body portion having a plurality of recesses formed therein, a plurality of tool holders adjustably mounted in said recesses, each of said tool holders having a tapered bearing surface, a ring member having screw threaded engagement with said body portion and adapted to move vertically thereon, a collar member having screw threaded engagement with said ring and adapted to engage said tapered bearing surface of said tool holders, means for reciprocating and rotating said head, and means for automatically adjusting said collar member against and from said tool holders to adjust them transversely of said head.

6. In a fluting machine of the class described, having a base, and a work holding chuck, a tool head mounted above said chuck and adapted to have a combined vertical reciprocatory and rotary movement, said head comprising a body portion having a plurality of recesses formed therein, a plurality of tool holders adjustably mounted in said recesses, means for automatically adjusting said tool holders transversely of said head, and means for reciprocating and rotating said tool head.

7. In a fluting machine, a base, a work holding chuck mounted for rotary movement on said base, a tool head mounted above said chuck and adapted to reciprocate in a helical path, said head comprising a body portion having a plurality of recesses formed therein, a plurality of tool holders adjustably mounted in said recesses, means for automatically adjusting said tool holders transversely of said head at substantially the termination of each reciprocatory stroke, and means for reciprocating and rotating said tool head.

8. In a fluting machine having a base, a back plate, a work holding chuck on said base, a plunger and means on said back plate for reciprocating said plunger vertically, a tool head mounted on said plunger for reciprocatory movement therewith, and

means for rotating said head during its reciprocatotry movement.

9. In a fluting machine, the combination with a reciprocatory plunger, of a tool head mounted on said plunger and adapted to reciprocate therewith, said tool head comprising a supporting member mounted on said plunger and adapted to rotate relative thereto, a solid body member secured in said supporting member and having a plurality of recesses formed therein, a plurality of spring pressed tool holders adjustably mounted in said recesses, a collar having threaded engagement with said body member and adapted to engage said tool holders to move them inwardly against spring pressure, and means for automatically adjusting said collar at substantially the termination of each reciprocatory stroke.

10. In a fluting machine, the combination with a reciprocating plunger, of a tool head mounted on said plunger and adapted to reciprocate therewith, said tool head comprising a supporting member mounted on the plunger and adapted to rotate relative thereto, a body member secured in said supporting member, having a plurality of recesses formed therein, a plurality of spring pressed tool holders adjustably mounted in said recesses, a collar having threaded engagement with said body member, a bearing ring mounted in said collar adapted to move said tool holders inwardly against spring pressure when said collar is moved downwardly, means for automatically adjusting said collar at substantially the termination of each reciprocatory stroke of said head, and means for rotating said head during each reciprocatory stroke.

11. In a fluting machine, the combination with a base, back plate, a work holding chuck on said base, a plunger, and means on said back plate for supporting and reciprocating the plunger, of a tool head mounted on said plunger and adapted to reciprocate therewith, said tool head comprising a supporting member mounted on the plunger and adapted to rotate relative thereto, a body member secured in said supporting member having a plurality of recesses formed therein, a plurality of spring pressed tool holders adjustably mounted in said recesses, a collar having threaded engagement with said body member and adapted to move said tool holders inwardly against spring pressure when moved downwardly, means for automatically moving said collar from said tool holders on substantially the termination of the downward reciprocatory stroke, means for automatically moving said collar against said tool holders to move the tool holders inwardly against spring pressure at substantially the termination of the upward reciprocatory stroke, means for automatically rotating said work holding chuck at substantially the beginning of each downward reciprocatory stroke, and means for rotating said tool head during each reciprocatory stroke.

12. A fluting machine, including a work holding chuck, a longitudinally movable tool head, transversely movable tool holders carried by said head, and means for giving said tool head a combined reciprocating and rotary movement to cause said tool holders to travel in a helical path.

In witness whereof, we have hereunto signed our names.

WILLIAM G. ESTEP.
ALFRED E. HAMILTON.
ELMER L. SIMONSON.