(No Model.) 5 Sheets—Sheet 1.

W. S. TYLER.

MACHINE FOR SHAPING ROTARY CUTTERS.

No. 434,815. Patented Aug. 19, 1890.

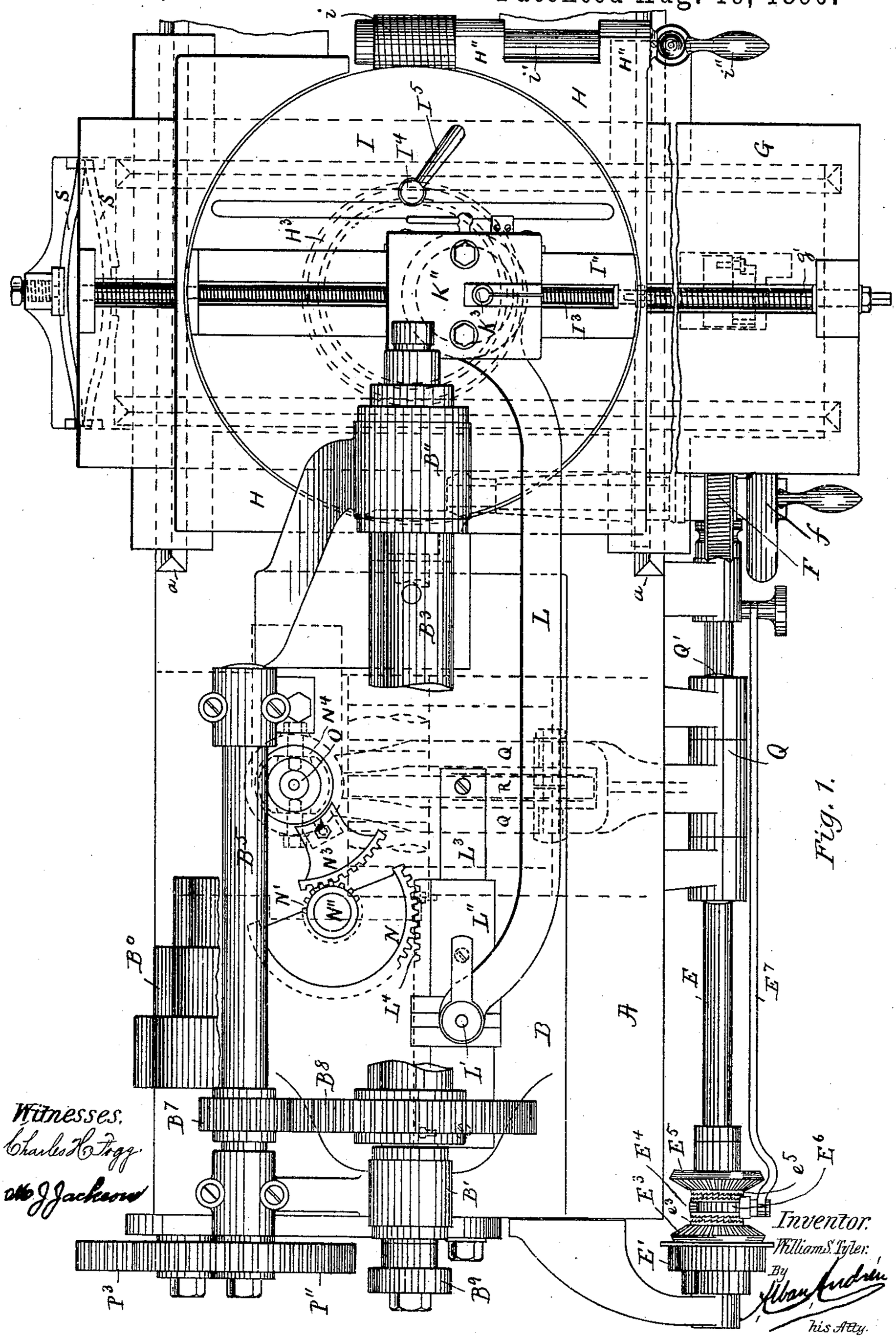

Fig. 1.

(No Model.) 5 Sheets—Sheet 2.

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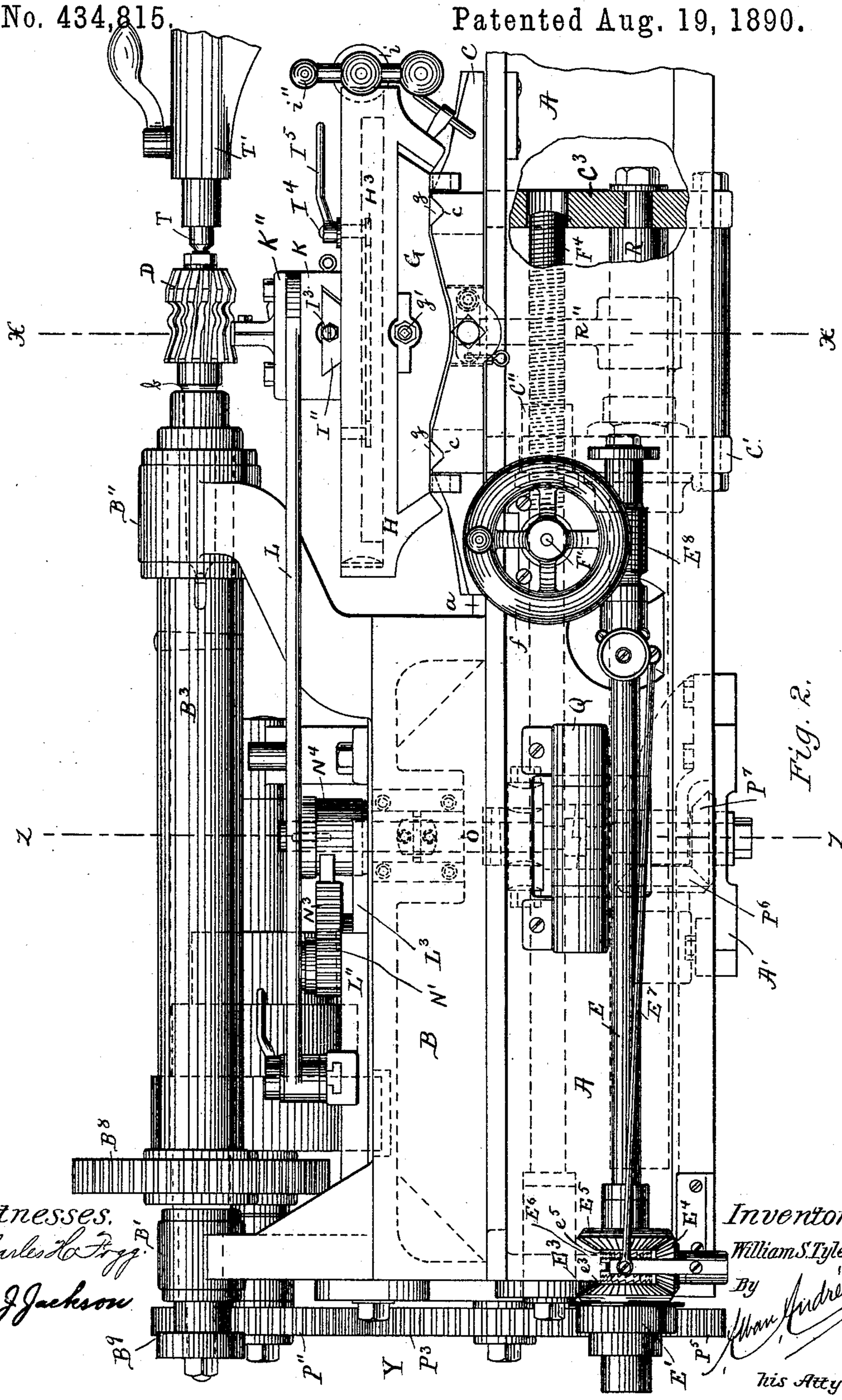

Fig. 2.

Witnesses.
Charles H. Fogg.
M. J. Jackson

Inventor.
William S. Tyler.
By Edwin Andrew
his Atty.

(No Model.) 5 Sheets—Sheet 3.

W. S. TYLER.

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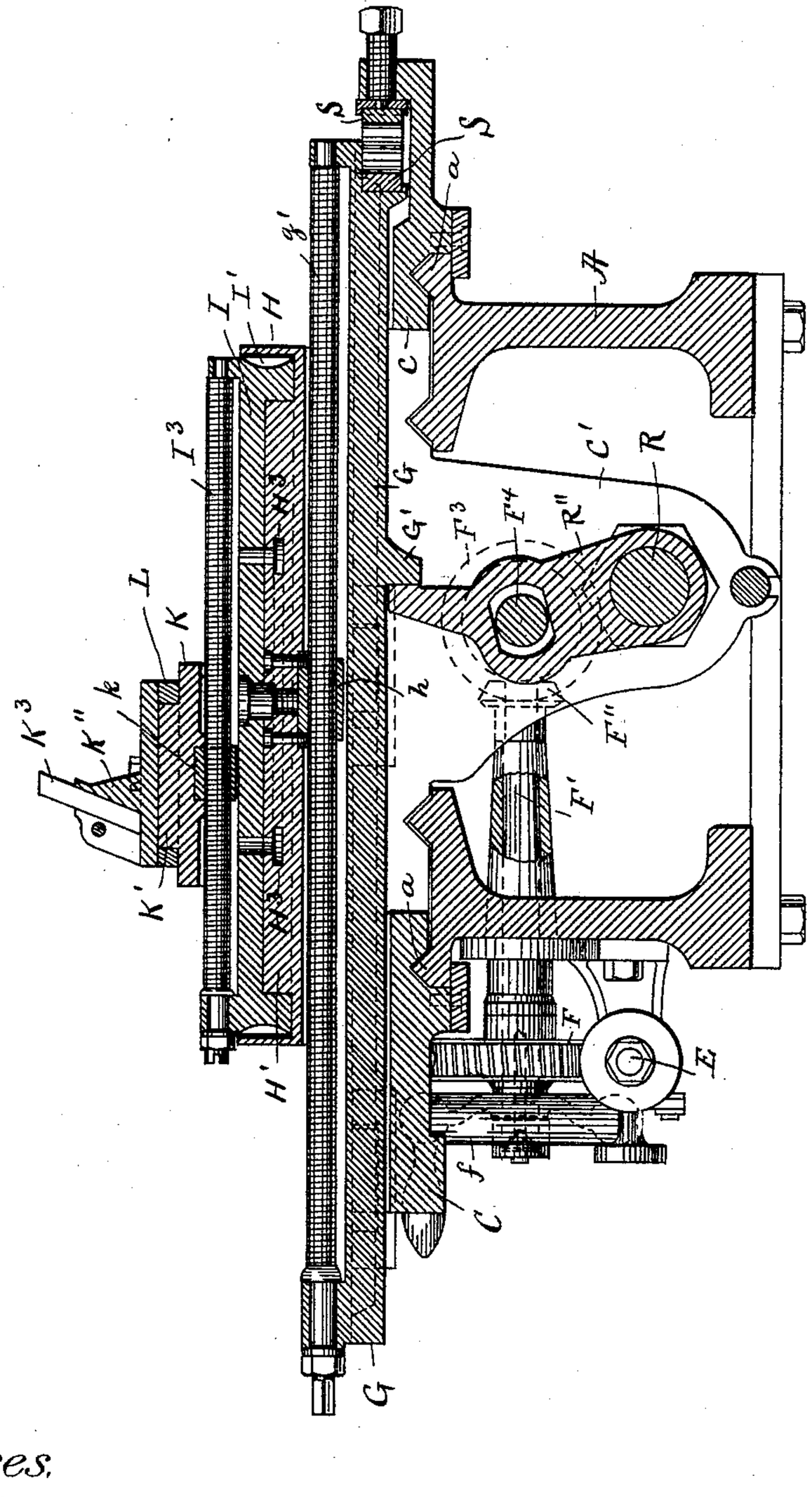

Fig. 3.

Witnesses.
Charles H. Fogg.
M. J. Jackson.

Inventor.
William S. Tyler.
By
Alban Eudrein
his Atty.

(No Model.) 5 Sheets—Sheet 4.

W. S. TYLER.

MACHINE FOR SHAPING ROTARY CUTTERS.

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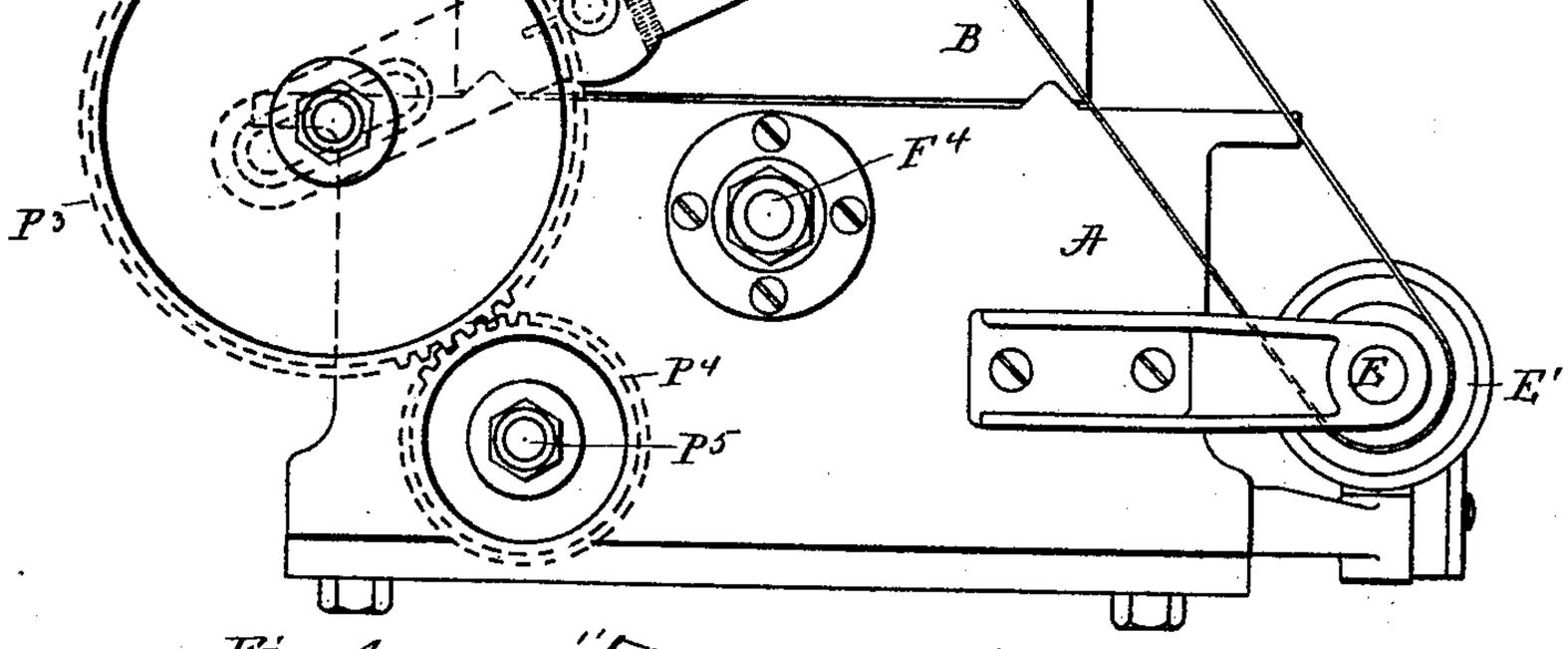

Fig. 4.

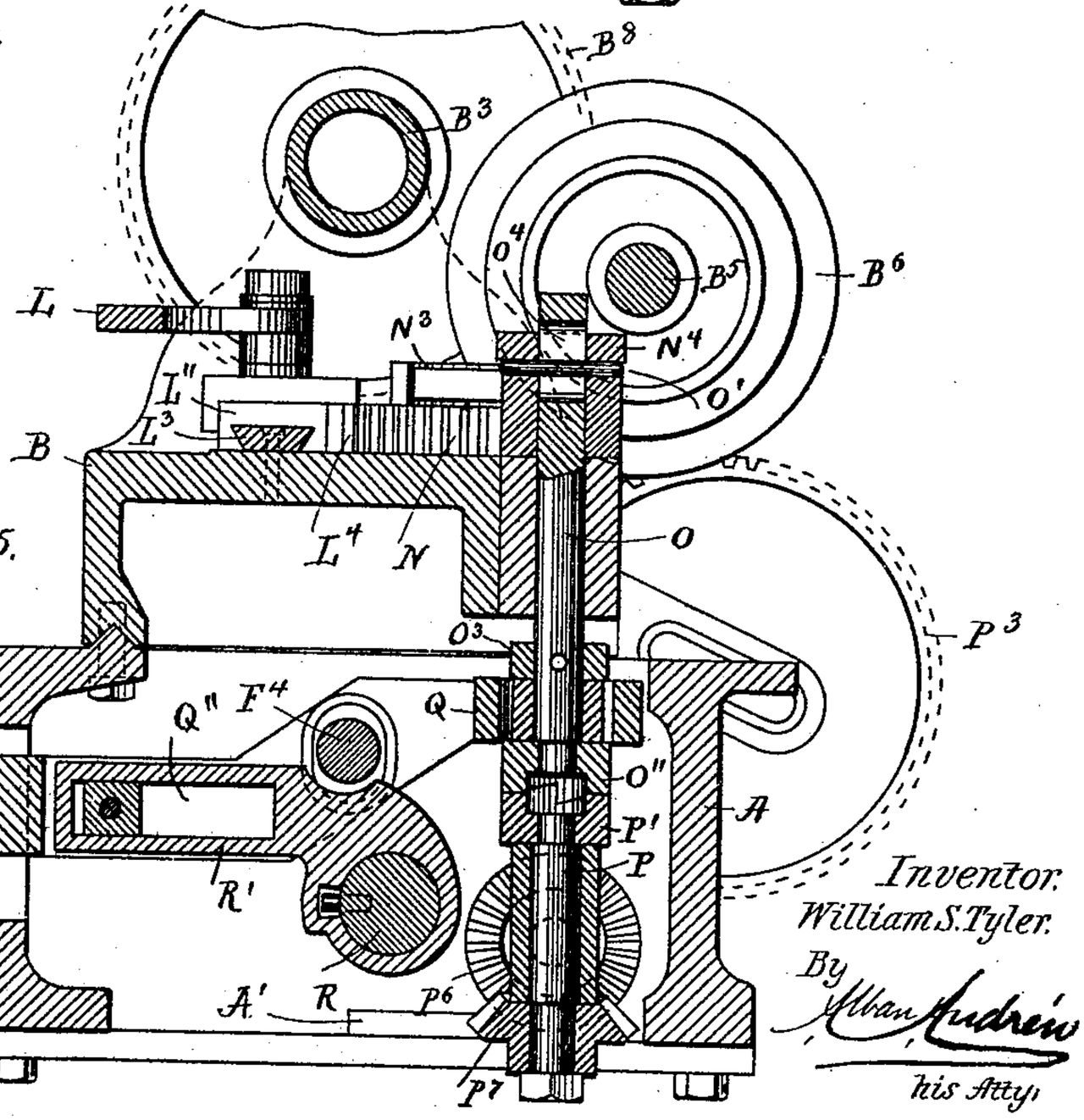

Fig. 5.

Witnesses.
Charles H. Fogg.
M. J. Jackson.

Inventor.
William S. Tyler.
By Alban Andrew
his Atty.

(No Model.) 5 Sheets—Sheet 5.

W. S. TYLER.

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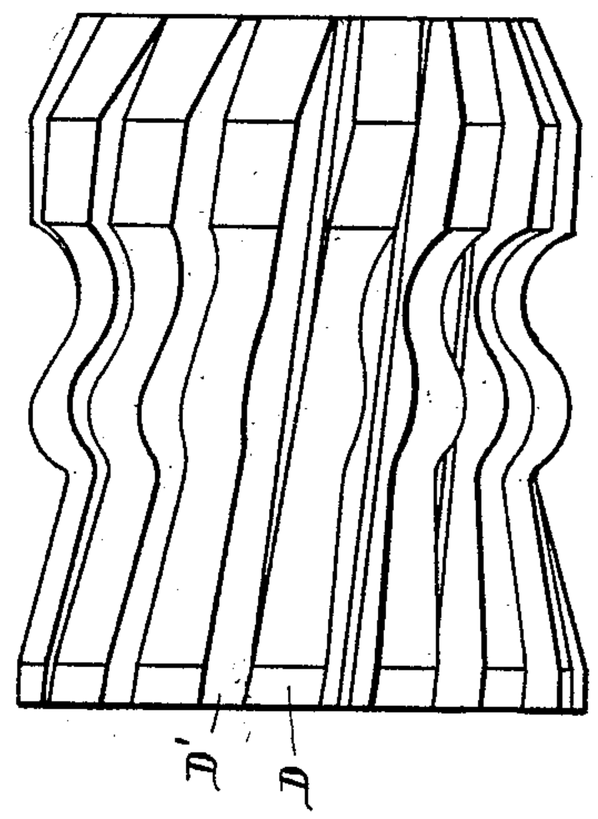

Fig. 6.

Witnesses.
Charles H. Trigg
M. J. Jackson.

Inventor.
William S. Tyler.
By Wm. Andrew
his Atty.

UNITED STATES PATENT OFFICE.

WILLIAM S. TYLER, OF PAWTUCKET, RHODE ISLAND.

MACHINE FOR SHAPING ROTARY CUTTERS.

SPECIFICATION forming part of Letters Patent No. 434,815, dated August 19, 1890.

Application filed April 1, 1890. Serial No. 346,180. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM S. TYLER, a citizen of the United States, and a resident of Pawtucket, in the county of Providence and State of Rhode Island, have invented new and useful Improvements in Machines for Shaping Rotary Cutters, of which the following, taken in connection with the accompanying drawings, is a specification.

This invention relates to improvements in machinery for the purpose of shaping rotary-toothed cutters of the kind which are adapted to be ground on the faces of their teeth when worn without destroying or altering the contour of the cutting-edges of such teeth; and it consists in the construction, arrangement, and combination of parts, as will hereinafter be more fully shown and described, reference being had to the accompanying drawings, where—

Figure 1 represents a plan view of the machine. Fig. 2 represents a front elevation of the same. Fig. 3 represents a cross-section on the line X X, (shown in Fig. 2,) omitting the arbor and the cutter-blank carried thereby. Fig. 4 represents an end view of the machine as seen from Y in Fig. 2. Fig. 5 represents a cross-section on the line Z Z in Fig. 2, and Fig. 6 represents in side elevation and cross-section one of my improved cutters as shaped by my improved machine.

Similar letters refer to similar parts wherever they occur on the different parts of the drawings.

A is the bed of the machine, to which is secured the head-stock B in the usual manner common to turning-lathes. The head-stock B has upwardly-projecting bearings B′ B″, in which is journaled the spindle B^3, in the forward end of which is inserted the arbor *b*, on which the grooved cutter-blank D to be shaped and finished is secured during the operation of the machine, as shown in Fig. 2. The spindle B^3 is set in a rotary motion from the rotary driving-shaft B^5, which is journaled in bearings in the head-stock B and provided with cone-pulleys B^6, to which a rotary motion is imparted by belt-power, as usual. To the driving-shaft B^5 is secured a pinion B^7, the teeth of which mesh in the teeth of the gear B^8, secured to the spindle B^3.

On the top of the bed A are a pair of longitudinal V-shaped ways *a a*, on which the carriage C is made to slide to and from the head-stock B.

The carriage C is operated by mechanism from the rotary spindle B^3 in a manner similar to that usually employed in turning-lathes, and I wish to state that I do not desire to confine myself to the particular mechanism shown in the drawings for this purpose, as any other equivalent or well-known mechanism may be used to impart a forward-and-back sliding motion to the said carriage without departing from the essence of my invention. The mechanism shown for this purpose in the drawings consists of a shaft E, journaled in bearings attached to the side of the bed A. On said shaft is loosely journaled a cone-pulley E′, to which a rotary motion is imparted by means of a belt E″, leading from a similar cone-pulley B^9 on the spindle B^3. The pulley E′ has secured to its face a bevel-gear E^3, the teeth of which mesh in a loose running bevel-pinion E^4, the teeth of which mesh in the teeth of a bevel-gear E^5, loosely journaled on the shaft E.

The bevel-gears E^3 and E^5 have on their inner ends the respective clutch-surfaces e^3 and e^5, adapted to engage with a longitudinally-sliding clutch E^6, splined on the shaft E and operated by hand by means of the clutch-rod E^7 and a suitable handle attached thereto. It will thus be seen that no motion is imparted to the feed-shaft E when the clutch E^6 is in its midway position, (shown in Fig. 2,) and that said shaft will be rotated toward the right or left, according to that one of the clutch-gears E^3 E^5 which for the time being is connected to the adjustable clutch E^6.

On the shaft E is a worm E^8, meshing in the teeth of the worm-wheel F, adapted to have frictional contact, as usual, with the hub of a hand-wheel *f*, which is secured to a shaft F′, located in a stationary bearing secured to the bed A, as shown in Fig. 3, and to the inner end of said shaft is secured a bevel-pinion F″, the teeth of which mesh in the teeth of a bevel-gear F^3, secured to the feed-screw F^4, journaled in bearings secured to the bed

A, which screw works in a nut C″, secured to the bracket C′, projecting downwardly from the carriage C, as shown in Fig. 3.

In the upper part of the carriage C are two V-shaped parallel grooves *c c*, arranged at right angles to the ways *a a* on the bed A, as shown in Figs. 1 and 2. In said grooves is movable the slide G, having for this purpose V-shaped ways *g g* on its under side fitting in the grooves *c c*, as shown in Fig. 2.

Upon the slide G is adjustable the saddle H in the same direction in which the said slide is movable. Said saddle is adjustable by means of a screw *g′*, journaled in the ends of the slide G and working in a nut *h*, secured to the under side of the saddle H, as shown in Fig. 3.

On top of the saddle H is a cylindrical hub H′, made in one piece with or secured to it, on which is arranged the rotating turret I, having on its under side a cylindrical recess for receiving the hub H′ on the saddle H, as shown in Fig. 3. The turret I is rotated by hand by means of a worm *i*, meshing in circumferential teeth I′ on the turret I. The said worm *i* is secured to a shaft *i′*, located in bearings H″ H″ on the side of the saddle H, and provided with a handle or crank *i″*, as shown in Figs. 1 and 2.

On top of the turret I is a dovetailed way I″, on which is adjustable the tool-holder block K by means of a screw I^3, journaled in the ends of the way I″ and working a nut *k*, secured to the under side of the tool-holder block K, as shown in Fig. 3.

The tool-holder block K has on its upper side a circular hub K′, on which is loosely hung a circular eye L^5, formed at the forward end of the link L, the object of which will hereinafter be described. To the top of said hub is detachably secured the tool-holder K″, in which the cutting-tool K^3 is secured, the cutting-point of which is directly over the center of the hub on which the link L is pivoted, as shown in Figs. 2 and 3.

The turret I and tool-holder block K are turned on the saddle H by means of the worm *i* and handle *i″* when the device is used for the purpose of shaping and cutting curved portions on the cutter. In shaping or cutting inclined portions on the cutter the turret is held stationary after it has been adjusted to the desired angle, and for this purpose I secure the turret to the saddle by means of a clamping-screw I^4, going through a perforation in the turret I and having its head inserted in a circular T-groove H^3 in the saddle H, as shown in Figs. 2 and 3.

I^5 is a nut and lever screwed on the upper end of the clamping-screw I^4, as shown in Fig. 2. The rear end of the link L is pivoted to a pin L′, which is adjustably secured to a slide L″, working on a dovetailed way L^3, secured to the head-stock B, and said slide is provided with a rack L^4, the teeth of which mesh in the teeth of the segment-wheel N, to which is secured the pinion N′, said segment-wheel and pinion being loosely journaled on a stud or pin N″, secured to the head-stock B, as shown in Fig. 1. The teeth of the pinion N′ mesh in the teeth of the segment-gear N^3, preferably detachably secured to the hub N^4, located on the upper end of the vertical shaft O, which shaft is capable of a vertical movement independent of the segment-gear N^3, it being for this purpose provided with a lateral key or pin O′, working in a vertical slot O^4 in the shaft O, as shown in Figs. 2 and 5. It will thus be seen that a reciprocating rotary motion is imparted to the shaft O from the tool-holder block K, as the latter is adjusted or moved in a direction parallel with the spindle B^3.

To the lower end of the shaft O is secured a level toothed collar or inclined hub O″, which is actuated by a similar level toothed collar or inclined hub P′, secured to a vertical shaft P, to which a continuous rotary motion is imparted from the driving-shaft B^5 in any suitable manner.

In the drawings I have shown a gear P″ secured to the driving-shaft B^5, having its teeth meshing in an intermediate gear P^3, the teeth of which mesh in the teeth of a pinion P^4, secured to a horizontal shaft P^5, located in bearings on the bed B, and having secured to its inner end a bevel-gear P^6, the teeth of which mesh in the teeth of a bevel-gear P^7 on the shaft P, as shown in Figs. 2, 4, and 5. As the shaft P rotates, its level toothed collar or inclined hub P′ causes the level toothed collar or inclined hub O″ on the shaft O to rise upward for the purpose of actuating a lever Q, pivoted at Q′ on the bed A, as shown in Fig. 5.

On the shaft O, above the lever Q, is secured a suitable collar or ring O^3, between which and the cam O″ the end of the lever Q is guided.

Below the feed-screw F^4 is arranged the rock-shaft R, having its rear end supported in a bearing A′, secured to the under side of the bed A, as shown in Figs. 2 and 5, and having its forward end journaled in a downwardly-projecting bracket C^3 on the carriage C, as shown in Fig. 2, in such a manner that said shaft will partake of the sliding motion of said carriage C.

On the shaft R is splined a lever R′, having its end adjustably connected to the lever Q by means of an adjustable block *r*, Fig. 5, adapted to slide in a slot Q″ in said lever Q, by which a rocking motion is imparted from the latter to the shaft R.

To the forward end of the rock-shaft R is secured a lever R″, the upper end of which operates against a lug G′ on the under side of the slide G for the purpose of automatically moving the said slide, the saddle H, turret I, and tool-holder in the direction of the arrow shown in Fig. 3, and after the upper end of said lever R″, operating against the lug G′, has moved the slide G the desired distance the said slide, saddle, turret, and tool-

holder are automatically returned to their normal positions by the influence of suitable adjustable springs S S, interposed between the back ends of the carriage C and slide G, as shown in Figs. 1 and 3.

The operation of the machine is as follows: For the purpose of making spiral cutters D, as shown in Fig. 6, the blank is first turned out in any ordinary lathe and provided with inclined spiral or longitudinal grooves D′ D′ by means of a suitable milling or grooving machine. The blank so made is then secured on the arbor *b* of the spindle B^3, and the end of said arbor is supported by the center T of the foot-stock T′, secured to the bed A, as is common in lathes or turning devices. The cutting-edge of the tool is then adjusted so as to lie in contact with the face of the tooth to be cut, after which the spindle B^3 and cutter-blank held thereon are set in a continuous rotary motion, and during such operation the slide G and the tool held upon it are intermittently moved forward the desired distance toward the bottom of the tooth on the cutter-blank or axial line thereof by means of the rotary shaft P^5 and intermediate connecting mechanism to the slide G, as described, the forward motion of the tool being controlled by the adjustment of the lever R′ on the rock-shaft R relative to the lever Q, and said levers being actuated by the cams O″ P′, as described, and when the latter cam has completed one-half a revolution the levers Q R′ are released and the slide G and tool-holder held thereon are returned to their normal position by the influence of the springs S S, and this operation is continued until the cutter-blank has made one complete revolution, after which the carriage C is fed, either by hand or automatically, sufficiently to make a new cut, and so on.

In shaping spirally-grooved cutters it will be noticed that the inward starting position of the cutting-tool must vary in proportion as it is fed toward the right or left, so as to conform to the spiral pitch of the tooth on the cutter, and for this purpose I use the link L and its connecting mechanism to the vertically-movable cam O″, by which the position of the latter will be automatically changed relative to the carriage C or cutting-tool K^3 and the continuously-rotating cam P′, by which the cutting-tool is caused to advance later toward the grooved cutter for each time in which it is fed toward the left, and vice versa.

The above-named operation is descriptive of the method of making cylindrical right-handed spiral cutters. In shaping curved surfaces on the cutters the tool-holder block K is adjusted on the turret I so that the point of the cutting-tool shall be at the desired distance from the center of the turret, according to the radius of the desired curve, after which the turret and tool-holder are swung around the axis of the turret in the desired direction and the required distance by means of the handle *i*″ and worm *i*, as described. In forming inclined surfaces on the cutter and shaping the same the turret I is swung around its axis to the desired position or angle with the axial line of the cutter operated upon and the cutting-tool fed forward according to such taper or incline, as set forth. In shaping convex portions on the cutter the cutting-point of the tool K^3 is moved a desired and corresponding distance in front of the axis of the turret I, and said turret is partially rotated around its axis during the operation of shaping such convex portion. In shaping concave portions on the cutter the cutting-point of the tool K^3 is moved a desired and corresponding distance back of the axis of the turret I and the latter turned around its axis sufficiently to cause the tool to shape the desired concave part of the cutter.

In Fig. 6, D is the finished cutter, having inclined or spiral grooves D′ D′, formed in a suitable grooving or milling machine, as described. *d d* are the faces of the teeth on said cutter, and *d′ d′* are the clearance-surfaces shaped by my improved shaping-machine, as hereinabove described.

Having thus fully described the nature, construction, and operation of my invention, I wish to secure by Letters Patent, and claim—

1. The cutter-shaping machine, as described, consisting of a rotary cutter-carrying spindle, a longitudinally-movable carriage, a slide adapted to move laterally on said carriage, a saddle mounted and adapted to move on said slide, a rotary turret arranged on said saddle, a tool-holder block adjustable on said turret and tool-holder mounted on said block, and automatic means, substantially as described, for moving the cutting-tool and its connections to and from the rotating cutter-blank, substantially in a manner and for the purpose set forth.

2. The cutter-shaping machine, as described, consisting of a rotary cutter-carrying spindle and a rotary driving-shaft geared together, a longitudinally-movable carriage, a slide adapted to move laterally on said carriage, a saddle mounted and adapted to move on said slide, a rotary turret arranged on said saddle and having arranged adjustably upon it a tool-holder, a rock-lever for moving the cutting-tool and its connections against the influence of return spring or springs, and intermediate connecting mechanism, substantially as described, from the driving-shaft to the said rock-lever, as and for the purpose set forth.

3. The cutter-shaping machine, as described, consisting of a rotary cutter-carrying spindle and a rotary driving-shaft geared together, a longitudinally-movable carriage, a slide adapted to move laterally on said carriage, a saddle mounted and adapted to move on said slide, a rotary turret arranged on said saddle and having arranged adjustably upon it a tool-holder, a rock-lever and spring for reciprocating the slide and its connections,

intermediate adjustable connecting mechanism, substantially as described, between said rock-lever and the driving-shaft, a link pivoted to the tool-holder, a vertically-movable cam-shaft and cam thereon actuated by said link and its connections, a rotary cam adapted to actuate said cam-shaft, and a pair of adjustably-jointed levers connected to the vertically-movable cam-shaft and slide rock-lever for the purpose of intermittently carrying the cutting-tool relative to the curves or inclines of the grooved cutter that is being shaped, substantially as specified.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, on this 3d day of March, A. D. 1890.

WILLIAM S. TYLER.

Witnesses:
ALBERT C. WHITE,
WILLARD S. MARTIN.