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W. W. TUCKER.

TURNING AND DRILLING MACHINE.

No. 578,431. Patented Mar. 9, 1897.

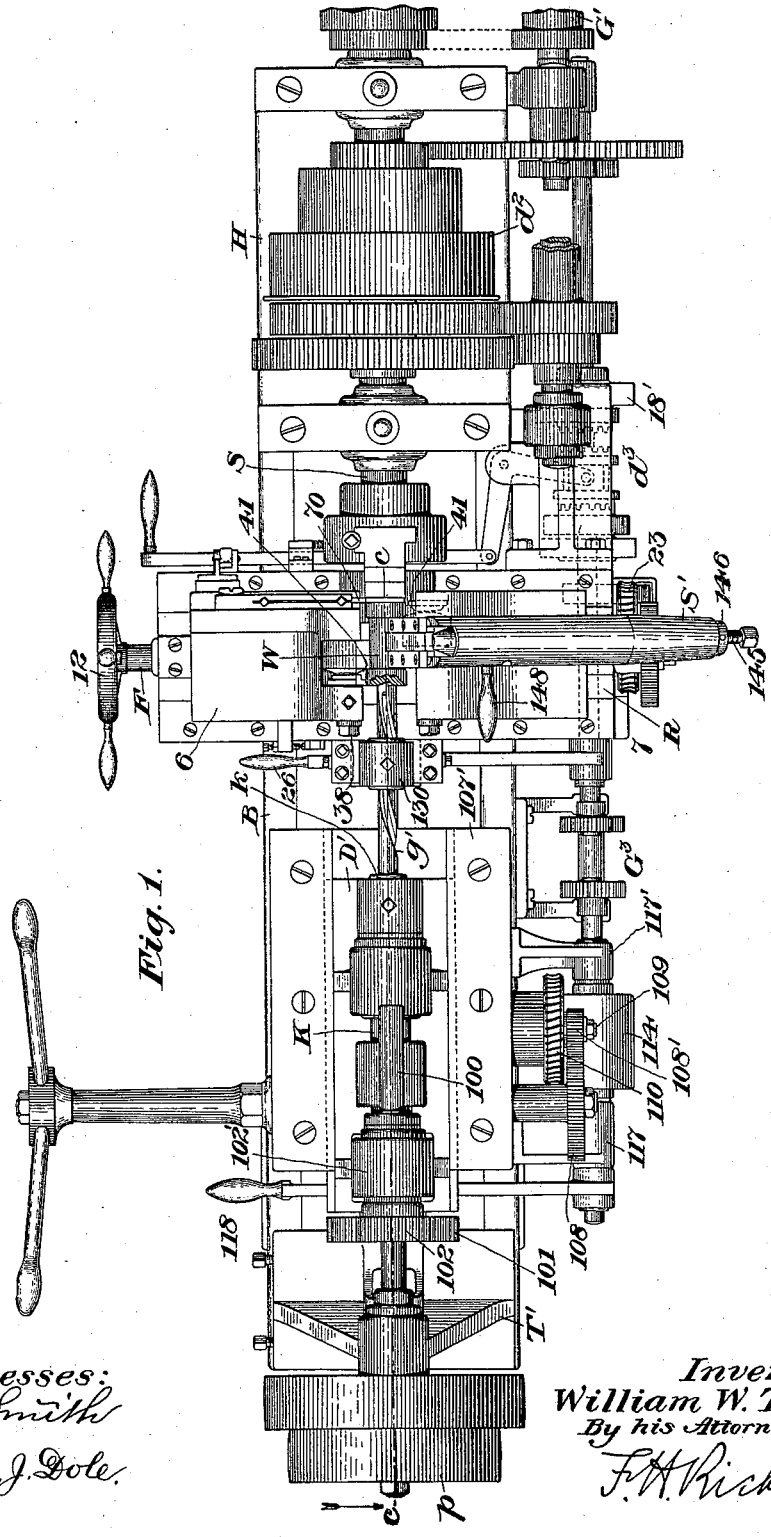

Fig. 1.

Witnesses:
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Inventor:
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By his Attorney,
F. W. Richards.

(No Model.) 6 Sheets—Sheet 2.

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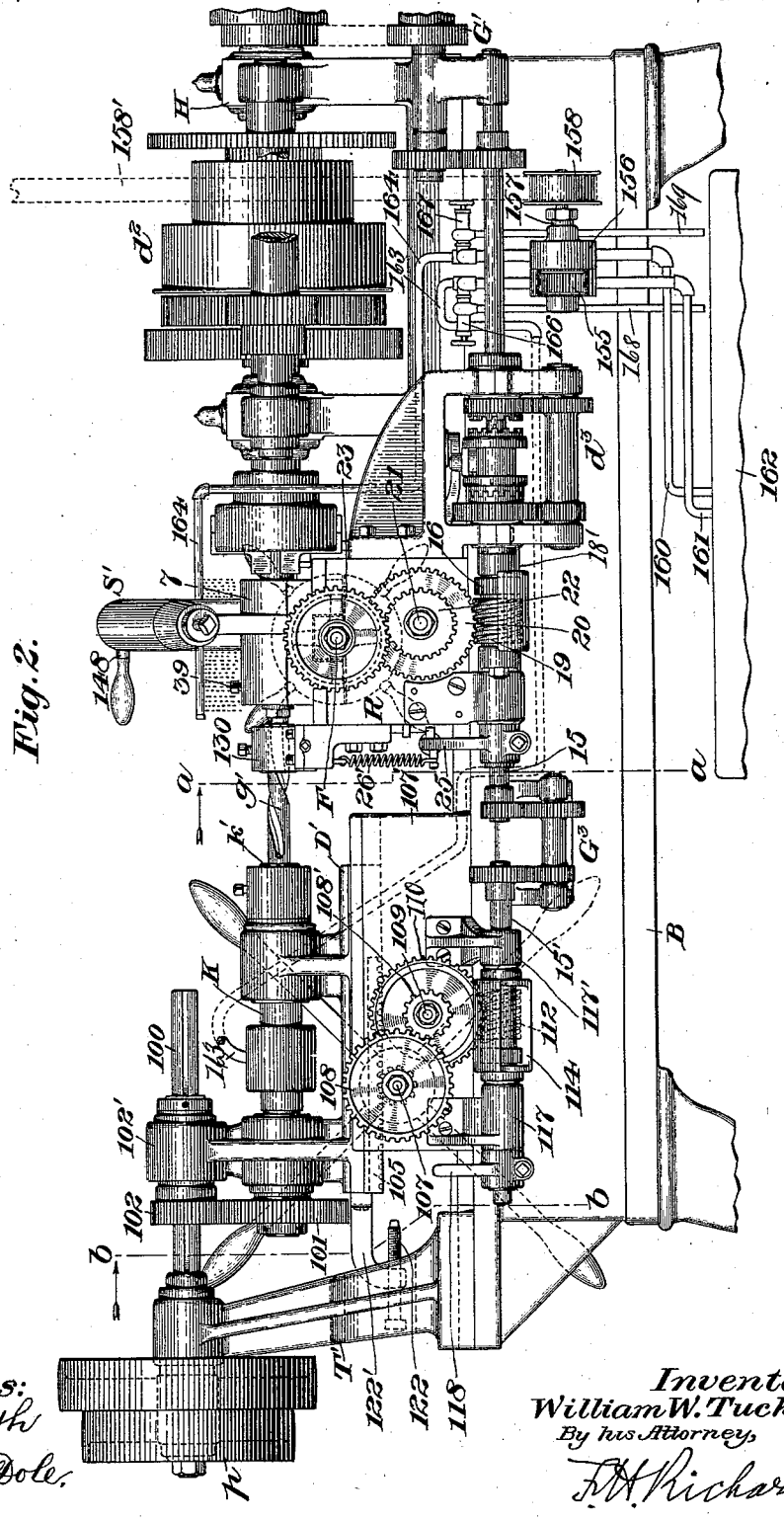

Fig. 2.

Witnesses:
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(No Model.) 6 Sheets—Sheet 3.

W. W. TUCKER.

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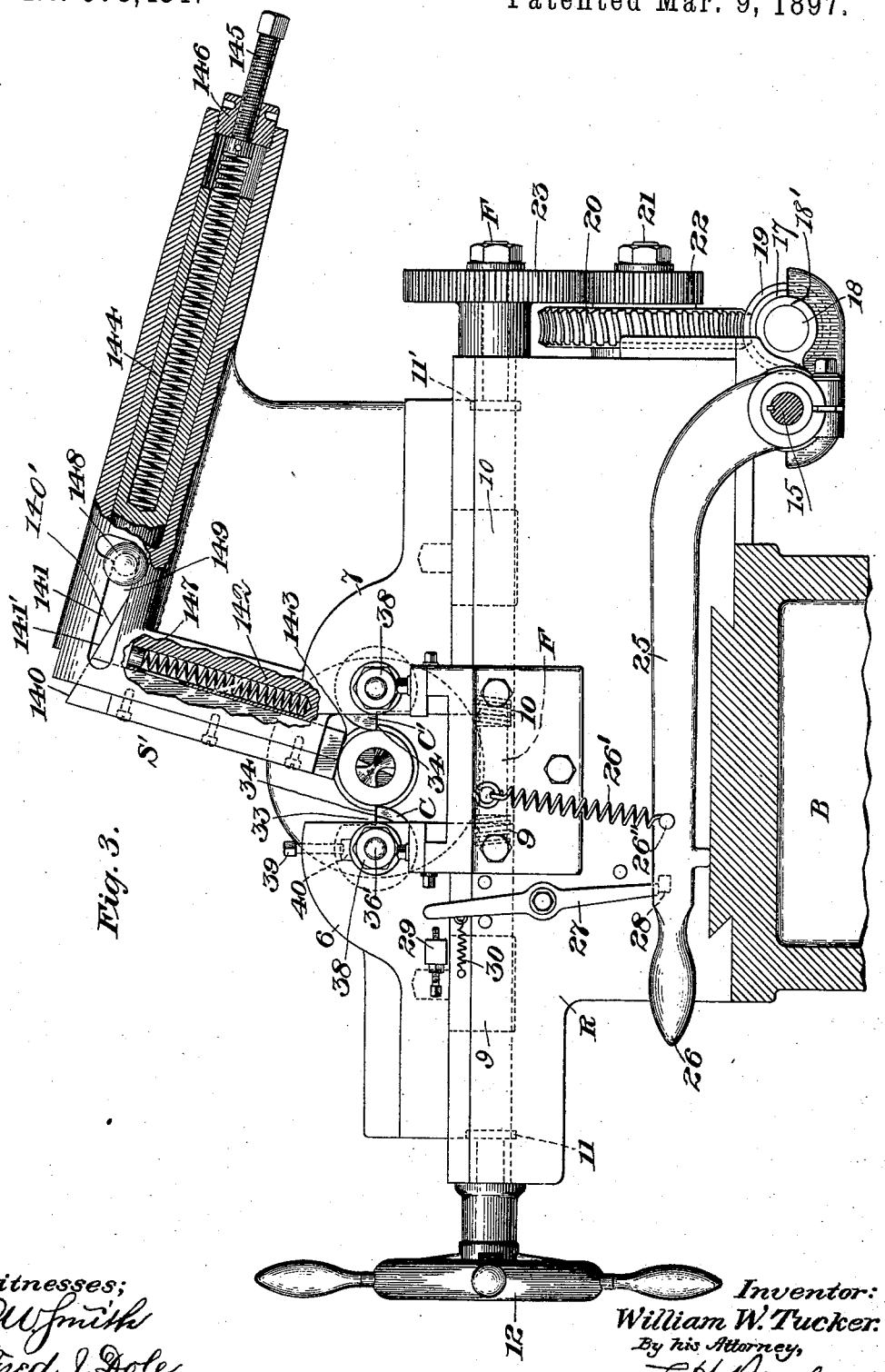

Fig. 3.

Witnesses;
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(No Model.) 6 Sheets—Sheet 4.

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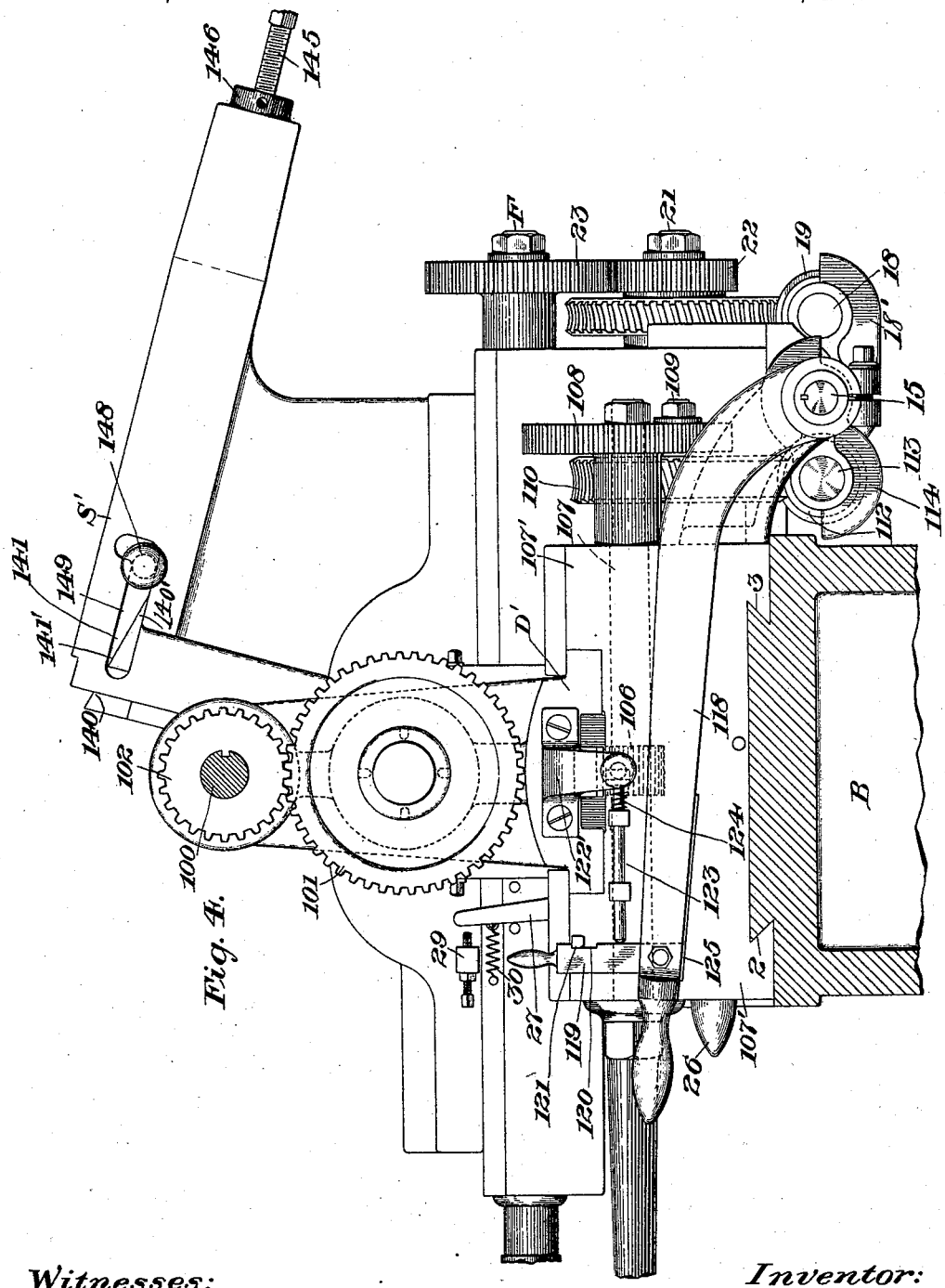

Fig. 4.

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(No Model.) 6 Sheets—Sheet 5.

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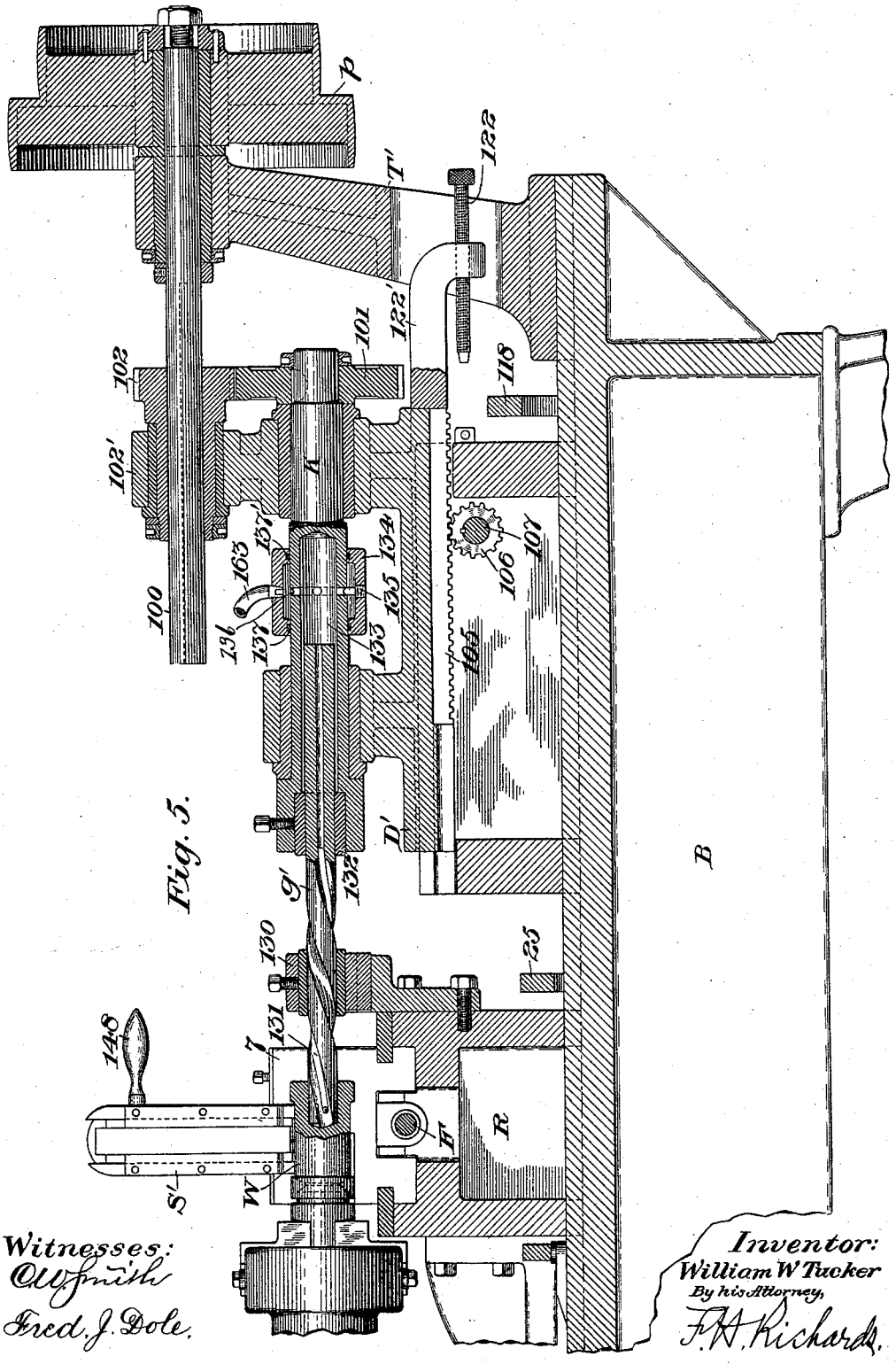

Fig. 5.

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(No Model.) 6 Sheets—Sheet 6.

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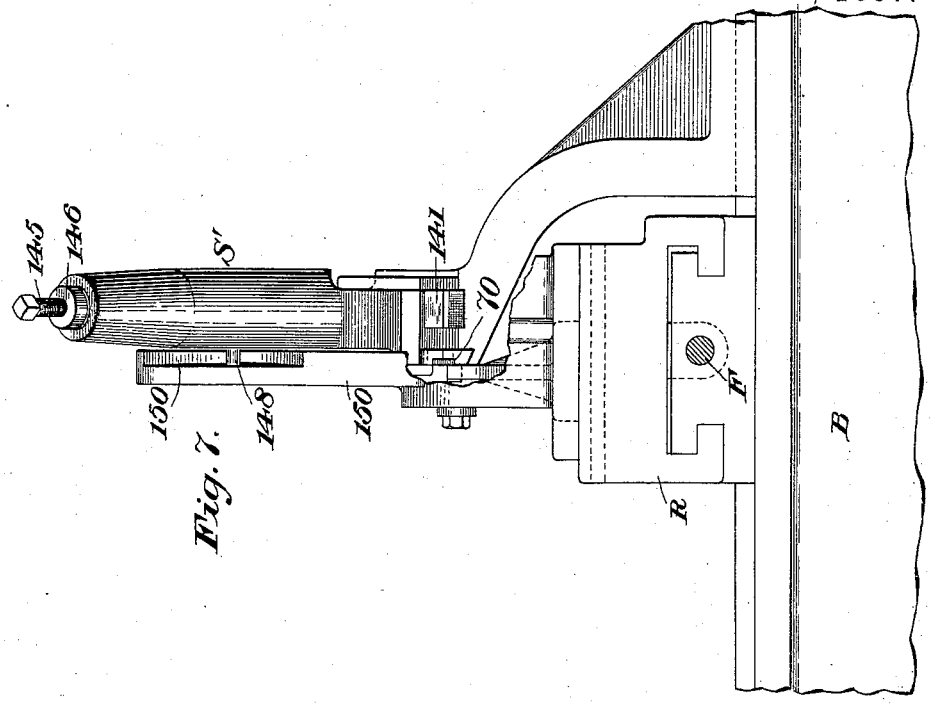

Fig. 7.

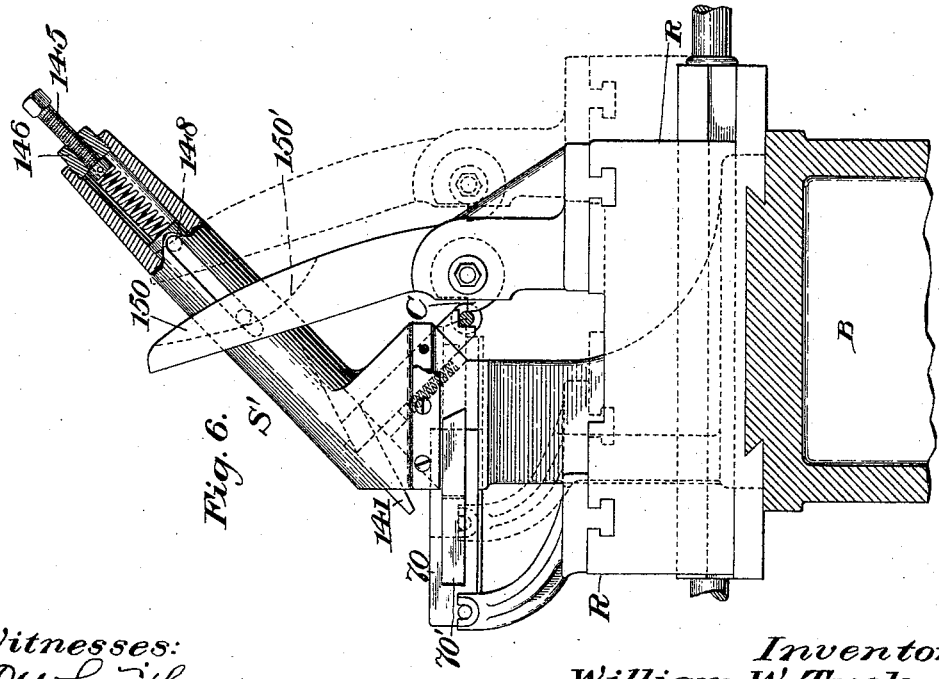

Fig. 6.

Witnesses:
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Fred. J. Dole.

Inventor:
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By his Attorney,
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UNITED STATES PATENT OFFICE.

WILLIAM W. TUCKER, OF HARTFORD, CONNECTICUT.

TURNING AND DRILLING MACHINE.

SPECIFICATION forming part of Letters Patent No. 578,431, dated March 9, 1897.

Application filed October 19, 1896. Serial No. 609,346. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM W. TUCKER, a citizen of the United States, residing in Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Turning and Drilling Machines, of which the following is a specification.

This invention relates to a combined turning and drilling machine, and more especially to that class of machines employed in the manufacture of bicycle-wheel-hub blanks, the machine constituting the subject-matter of the present invention being somewhat in the nature of an improvement upon the machine described in Letters Patent of the United States No. 527,907, granted to me October 23, 1894, to which reference may be had.

One object of my present invention is to furnish an improved machine of the class specified embodying automatic means whereby hub-blanks or other articles may be turned down to an approximately-finished size and bored at one operation, to thereby decrease the cost of manufacture by materially reducing the length of time necessary to complete the turning and drilling operations, which operations have heretofore been accomplished successively, the blank being first turned to the proper size and subsequently drilled, as described in the patent herein referred to.

A further object of the invention is to provide in operative relation with the work-carrying spindle in a machine of the class specified and in position for engaging the piece being operated upon an improved steady-rest embodying instrumentalities for engaging the piece being operated upon and also embodying means for maintaining the rest in constant contact with the piece during the turning operation, and to provide means in connection with the cutter-slide and steady-rest for automatically retracting the piece engaging or bearing member of the steady-rest simultaneously with the retractive movement of the cutter-slide.

A further object of the invention is to furnish in connection with the operative parts of the machine improved means for supplying oil automatically to those parts of the machine where it is necessary.

In the drawings accompanying and forming part of this specification, Figure 1 is a plan view of a combined turning and drilling machine embodying my improvements, a portion of one end of the machine being broken away and said figure showing the cutters and drill in operative relation with a hub-formative rod or piece of stock and in the position they occupy during the first stages in the turning-down and drilling operations. Fig. 2 is a side elevation of the machine as seen from the under side in Fig. 1, a portion of the bed or framework of the machine being broken away. Fig. 3 is a relatively large cross-sectional view of the machine, taken in dotted line *a a*, Fig. 2, and as seen from the left hand in said figure. This figure is more especially intended to illustrate the construction, organization, and operation of the steady-rest, which is shown partially in section, and the elements which automatically control the feed movements of the cutter-slides, and for convenience certain irrelative parts of the machine are omitted. Fig. 4 is a similar cross-sectional view of the machine, taken in dotted line *b b*, Fig. 2, as seen from the left hand. This figure is more especially intended to illustrate the construction, organization, and operation of those elements which automatically control the feed movements of the drilling mechanism, and for convenience certain parts of the machine inessential to this operation are omitted in this figure. Fig. 5 is a vertical longitudinal section, on a relatively large scale as compared with Fig. 2, of a portion of the machine, taken in dotted line *c c*, Fig. 1. Fig. 6 is a cross-sectional view of a portion of the bed of the machine and shows the preferred form of said steady-rest partially in section and in operative connection therewith and also shows one cutter-slide, a cutter carried thereby, a cutting-off tool also carried by said slide, and a steady-rest actuator in connection with said slide; and Fig. 7 is a side view of the parts shown in Fig. 6 as seen from the right hand in said figure.

Similar characters designate like parts in all the figures of the drawings.

In the preferred form thereof shown in the drawings my improved combined turning and drilling machine comprises in part a suitable framework, a rotative rod or work-carrying

spindle, a rotative drill-carrying spindle, independent driving mechanism in operative connection with and effective for rotating the working spindle and drill-spindle in relatively opposite directions at predetermined relative velocities, a cutter-carrying slide supported for movement in a plane transverse to the axial line of the work-spindle, feed mechanism operatively connecting the cutter-slide and drill-spindle and effective for simultaneously advancing and retracting the cutter-slide and drill-spindle in relatively intersecting planes, automatically-operable means for controlling the feed movements of the cutter-slide and drill-spindle, and a steady-rest in operative relation with the axial line with the work-spindle and embodying automatically-shiftable members.

Inasmuch as many of the parts of the machine constituting the subject-matter of my present application are substantially the same in construction, organization, and operation as like parts designated by the same characters in the patent hereinbefore referred to, a brief description of such parts is deemed sufficient herein, and for a more detailed description of such parts reference may be had to the patent hereinbefore referred to.

The framework of the machine, which may be of any suitable construction for carrying the several operative details, is shown similar in a general way to an ordinary lathe-frame, and it preferably consists of a bed B, having the usual longitudinal slideways 2 and 3 for directing the movements of certain parts.

Located at one end of the bed (shown in Figs. 1 and 2 as the right-hand end) is the head-stock or spindle-carrying head H, in which is supported for rotative movement a work or rod carrying spindle S, which in the present instance is shown of the same general construction and organization as that described in the patent referred to, and is driven from any suitable source of power (not shown) through the medium of the spindle-driving mechanism, (designated in a general way by d^2,) which spindle-driving mechanism may be similar to that described in the patent referred to or similar to the driving mechanism for the spindle of an ordinary lathe.

The turning-down mechanism is shown in the drawings of substantially the same general construction and organization as that described in the patent referred to, and comprises two oppositely-disposed cutter-slides 6 and 7, one of which is located at one side the longitudinal axis of the spindle and the other of which is located at the opposite side said axis, and they are supported in suitable slideways upon a slide-rest R, which in turn is supported upon the bed B of the machine, said slides being adapted for simultaneous movement toward and from each other in a plane intersecting the plane of the longitudinal axis of the work-carrying spindle.

As a means for advancing and retracting the slides simultaneously I have provided a right and left hand feed-screw F, which extends through right and left hand screw-threaded bearings 9 and 10 (shown in dotted lines in Fig. 3) on the under side of and central with relation to the two slides 6 and 7, respectively, said screw being rotatably supported at its ends in bearings formed in the upper end of the slide-rest R and being provided with flanges 11 and 11′ at the ends adjacent to the inner faces of the end walls of the slide-rest, which flanges prevent longitudinal movement of said screws.

Mounted upon the inner ends of the cutter-slides 6 and 7 are two cutters C and C^1, the cutting-faces of which are shown oppositely disposed, these cutters having a cutting-face of substantially the length of the hub-blank being turned, as will be hereinafter described.

Located on the bed B of the machine, at the end opposite to that upon which the head-stock H is located, is a tail-stock T^1 in a bearing, at the upper end of which is journaled a longitudinally-grooved shaft 100, said shaft being furnished with pulleys p, by means of which the same may be rotated from any suitable source of power.

Supported in suitable slideways below the shaft 100 on the bed of the machine, for movement in a plane longitudinally of the work-spindle, is a drill-spindle carrier, (designated in a general way by D^1,) and rotatively supported in suitable bearings on said carrier is a drill-carrying spindle, (designated in a general way by K,) in the inner end of which is chucked a drill g^1, the axis of which is shown in alinement with the axis of the work-carrying spindle S.

As a means for rotating the drill-spindle and for facilitating a longitudinal movement thereof during such rotation said drill-spindle is shown furnished at the outer end thereof with a spur-wheel 101, which meshes with a pinion 102, splined to the drill-spindle-actuating shaft 100, which pinion is shown carried by a sleeve which is journaled in a bearing 102′ and surrounds the shaft 100 on the drill-spindle carrier D^1, said sleeve being flanged to prevent longitudinal movement thereof with relation to the bearing 102′. This organization of drill-spindle-driving mechanism facilitates a movement of the drill-spindle carrier and connected parts toward and away from the work-carrying spindle simultaneously with the rotation of the drill-spindle K through the medium of the shaft 100.

As a means for rotating the feed-screw F to bring the cutters C and C^1, carried by the cutter-slides 6 and 7, to the work I have provided an automatic feed mechanism which in the form thereof shown in the drawings is similar, in a general way, to the same mechanism described in the patent hereinbefore referred to, and which mechanism preferably consists of a horizontally-disposed shaft 15, journaled in suitable bearings upon the bed

of the machine at one side thereof, as shown most clearly in Figs. 2, 3, and 4, and carrying a pinion 16′, (shown in dotted lines in Fig. 1,) which meshes with a pinion 16 upon a shiftably-supported worm-shaft 18, which in turn carries a worm 19 in mesh with a worm-wheel 20, carried upon a stud 21, secured to the slide-rest R, which stud also carries a pinion 22, that meshes with a gear-wheel 23, fixed to the outer end of the feed-screw F. This shaft 15 may be driven in any suitable manner—as, for instance, through gearing or driving devices d^3, (see Fig. 2,) intermediate to and connecting said shaft 15 and the work-spindle-driving mechanism d^2. The worm-shaft 18 is shown journaled at its end in bearings formed in outwardly-projecting arms of the bracket 18′, which is supported for swinging movement upon the shaft 15, said bracket being furnished at one end thereof with a shifting lever 25, (shown in full lines in Fig. 3,) the free end of which is furnished with a handle 26, by means of which the same may be operated by hand.

During the operation of the machine the shifting lever 25 is locked in the depressed position shown in Fig. 3 of the drawings with the worm-wheel 20, and as a means for holding the worm up to its working position in engagement with said worm-wheel a locking-lever 27 is provided, which is herein shown pivoted midway of its length upon the slide-rest, with its lower end in normal engagement with a catch or lateral projection 28 upon the inner face of the shifting lever 25. The upper opposite end of the locking-lever is located in the path of movement of a tripping device 29, carried upon one of the tool-carrying slides, said locking-lever 27 being normally held with its lower end in engagement with the catch upon the shifting lever 25 by means of a spring 30, connected at one end to said lever and at its opposite end to the slide-rest, as shown most clearly in Figs. 3 and 4 of the drawings.

As a means for automatically throwing the shifting lever 25 into position to disengage the worm 19 from the worm-wheel 20 upon the release of the locking-lever 27, I have provided a retracting-spring 26′, which is secured at one end to a pin 26″ upon the shifting lever 25 and at its opposite end to a convenient portion of the slide-rest R.

From the foregoing description of this mechanism, which may be consistently termed the "automatic" feed-controlling mechanism, it will be seen that the feed movement of the cutter-slides may be readily limited, and that when said slides have traversed this limited distance the tripping device 29, which is shown as a screw adjustably carried in a screw-threaded bearing upon one of the cutter-slides, engages the upper end of the locking-lever 27, throwing the same out of engagement with the shifting lever 25, which is immediately elevated through the medium of the spring 26′, thus dropping the worm 19 out of engagement with the worm-wheel 20 and immediately stopping the feed movement of the cutter-slides.

In practice the feed-screw F will be provided at one end thereof with a hand-wheel 12, by means of which said feed-screw may be turned to bring the cutters into working position or retract the same when the feed mechanism before described is thrown into its ineffective position.

In the form thereof herein shown the cutters C and C^1 for forming the hub-blank are particircular in cross-section, each cutter being notched or cut away at one side thereof, as shown at 33, to form a cutting edge 34, the contour of said cutting edge coinciding with the contour of one-half of the wheel-hub being formed. It will be obvious, however, that the construction of the cutters may be varied to conform to any requirements. The two cutters will in practice be of such construction and will be so set with relation to each other and with relation to the rod or piece being operated upon as will enable them by their coöperation to form a complete hub-blank at one continuous cutting operation, one cutter acting upon and forming one half and the opposite cutter acting upon and forming the other half of said blank, said cutters acting upon opposite sides and at opposite ends, respectively, of the hub-forming portion of the blank, as will be readily understood by a comparison of Figs. 1, 3, and 5 of the drawings.

The construction and arrangement of the cutters C and C^1 may be substantially the same as those of the machine described in the patent referred to.

The cutter-carrying slides 6 and 7 will preferably be enlarged at their adjacent inner ends, as shown most clearly in Fig. 3, each slide having its enlarged end bored transversely to receive the stem or shank 36′ of the cutter and being counterbored concentrically from one end, as shown in dotted lines at 37, Fig. 3, to form a bearing for the cutter-head at a point opposite the cutting-point of said cutter.

The shanks 36′ of the cutters C and C^1 are extended through transverse bores in the cutter-carrying slides, the ends of said shanks being screw-threaded and secured in place by means of nuts 38, screwed upon the screw-threaded ends thereof and bearing against the outer faces of said slides, clamping-bolts 39 being provided, which are herein shown extending vertically through the cutter-carrying slides and bearing at their lower ends against the shoes 40, (shown in dotted lines in Fig. 3,) which in turn bear upon the shanks of the cutters and prevent accidental rotation thereof. These cutters will usually be supported in their respective slides in such manner that the inner adjacent ends 41 thereof will lie in opposition in slightly-overlapping planes, (see Fig. 1,) so that each cutter will cut a fraction more than one-half the

length of the wheel-hub blank, the cutting-faces of the cutters being substantially in alinement and cutting in opposite directions.

As a convenient means for advancing the drill-spindle carrier D^1 and drill-spindle K, carried thereby, the drill-spindle carrier (see Fig. 5) is furnished with a rack-bar 105 on the lower face thereof, which is engaged by the teeth of a pinion 106, fixed to a shaft 107, journaled in suitable bearings in a block 107′, supported upon the bed B, and which shaft is provided at the outer end thereof with a gear-wheel 108, which meshes with a pinion 108′, journaled upon a stud 109, fixed to the block 107′, and having a hub on which is fixed a worm-wheel 110, (see Fig. 4,) which meshes with a worm 112 of a worm-shaft 113, journaled in a bracket 114, supported for oscillatory movement upon a shaft 15′, (see Fig. 2,) which in turn is journaled at opposite ends thereof in suitable bearings 117 and 117′ on the block 107′, and as a means for automatically shifting the worm 112 into and out of engagement with the worm-wheel 110 the bracket 114 is furnished with a shifting lever 118, which is similar in a general way to the shifting lever 25, hereinbefore described in connection with the feed mechanism for the cutter-slides 6 and 7. This shifting lever 118 is normally locked in an elevated position for the purpose of maintaining an operative engagement between the worm 112 and worm-wheel 110 by means, preferably, of a locking-lever 119, pivotally carried at the outer end of said shifting lever and having a lock-notch 120, one wall of which normally engages a catch 121, fixed to the block 107′, on which the drill-spindle carrier is shiftably mounted.

As a means for tripping the locking-lever 119 at a predetermined point in the advancing movement of the drill-spindle carrier D^1 I have provided a tripping device, which in the preferred form thereof (shown most clearly in Figs. 2 and 3 of the drawings) comprises a tripping-pin 122, adjustably carried in a bracket 122′ at the rear end of the carrier D^1, and a reactionary tripping-rod 123, supported in bearings on the block 107′ and having at the inner end thereof a cam-face in position to be engaged by the inner end of the tripping-pin 122. The outer end of the rod 123 is normally located in position to engage and throw the locking-lever 119 out of engagement with the catch 121 when said rod is shifted outwardly by means of the tripping-pin 122. The rod 123 is returned to its normal position by means of the spring 124, as will be readily understood by reference to Fig. 4 of the drawings. The locking-lever 119 is normally retained in the locking position shown in Fig. 4 by means of a spring 125, secured to the lower end of the shifting lever 118 and bearing against the lower end of the locking-lever 119.

For the purpose of actuating the feed mechanism of the drill-spindle carrier and the feed mechanism of the cutter-slides in synchronism and at predetermined relative velocities, so that the cutters C and C^1 and the drill g^1 will complete their respective operations at substantially the same time, these feed mechanisms are operatively connected together, preferably by means of a train of timing or speed-regulating gears (designated in a general way by G^3) intermediate to and connecting the shaft 15, which is the primary actuating factor for the feed mechanism of the cutter-slides, and the shaft 15′, which is the primary actuator for the feed mechanism for the drill-spindle carrier D^1.

Owing to the fact that a right and left hand screw is provided for directly imparting a feed movement to the cutter-slides C and C^1, and to the fact that a rack and pinion is provided for directly imparting a feed movement to the drill-spindle carrier D^1, it will be seen that it is necessary to provide means intermediate the rack and pinion of the drill-spindle carrier and the feed-screw of the cutter-slides for regulating the feed movements of the drill-spindle and cutter-slides, and for this purpose I have shown the shaft 15 of the cutter-feed mechanism and the shaft 15′ of the drill-feed mechanism connected together by a train of speed-reducing gears, the construction and organization of which will be such as to secure the proper ratio of feed movement between the cutters and drill. The two feed mechanisms for the cutters and drill, respectively, and the connection between said feed mechanisms constitute an actuating-connector between the cutter-carriers and drill-carrier, which is effective, during the operation of the machine, for advancing and retracting the cutters and drill in relatively intersecting planes at comparative velocities of a predetermined ratio, and said devices may be hereinafter briefly referred to as the "actuating-connector" between the cutter-slide and drill-spindle.

I do not desire to limit myself to the particular construction and organization of the elements constituting the actuating-connector between the cutter-slides and drill-spindle, as these may be variously modified without departure from this invention.

For the purpose of supporting the drill in close proximity to the piece being operated upon, and thereby prevent accidental flexure of the drill during the operation, I have provided a drill rest or bearing 130, which is shown bolted to the cutter-slide rest R, said drill rest or bearing being located and supporting the drill at a point slightly in advance of the outer end of the piece W being operated upon.

The shaft 107, which carries the pinion 106, which meshes with the rack of the drill-spindle carrier, is shown provided with a hand-wheel by means of which the same may be turned to advance or retract said carrier by hand.

Referring to Fig. 5 of the drawings, it will be seen that the drill g^1 is furnished with oil-

grooves 131, which extend longitudinally from the extreme end of the shank of the drill through the center of said drill and communicate with the periphery thereof near the cutting-point, and for the purpose of supplying oil to said drill the spindle K, which is furnished with a suitable chuck 132 at the forward end, has a central chamber 133 of slightly-greater diameter than the diameter of the drill-shank, and which chamber extends inward considerably beyond the end of said drill-shank, and said spindle has a series of transverse perforations near the inner end of the chamber 133, which communicate with the interior of a reservoir 134, which surrounds this end of the spindle and is held as against longitudinal movement upon the spindle preferably by means of a pin 135, which extends through the wall of the reservoir and has a bearing in an annular groove 136, formed in the periphery of the spindle. In practice oil is supplied to the interior of the reservoir through a conduit or feed-pipe 163, which leads to a pumping apparatus, hereinafter described. This conduit also constitutes a means for holding the reservoir against rotative movement with the spindle.

Packing-rings 137 and 137′ are interposed between the periphery of the drill-spindle and the annular reservoir to prevent the escape of oil at the junction of said parts.

During the operation of the machine the chamber 133 of the drill-spindle is kept constantly filled with oil from the reservoir 134, which is supplied through the conduit or feed-pipe 163, as before stated.

As a convenient means for holding the piece of work against vibratory movement during the cutting or reducing operation I have provided, in operative relation with the work-carrying spindle S and the cutter of the machine, a reactionary steady-rest (designated in a general way by S^1) which in the preferred form thereof shown in Figs. 3 and 6 of the drawings comprises two coöperative members 140 and 141, respectively, supported for longitudinal movement in relatively transverse planes in suitable bearings formed in a steady-rest carrier or bracket 142, and having wedge-faces 140′ and 141′, respectively, in normal bearing engagement with each other. One of said members, as 140, is located with its longitudinal axis radial to the axis of the work-carrying spindle, and has a work-engaging face 143 in position to engage the periphery of the piece being operated upon, and this member will, for convenience, be termed the "bearing" member, and the other member, which may be termed the "thrust" member, as 141, is located with its longitudinal axis approximately at right angles to the bearing member 140, and the inner inclined face of said bearing member is normally retained in engagement with the inclined face of the bearing member by means of a spring 144, which constitutes the means for maintaining the bearing member in constant contact with the hub-blank during the cutting operation and regulates the stress of said member. This spring is shown seated in a longitudinal recess formed in the thrust member, and the tension of said spring is regulated by a set-screw 145, against which the outer end of said spring bears, the set-screw being shown adjustably seated in a nut 146, screwed into the outer end of the thrust-member bearing.

As a means for automatically retracting the bearing member 140 on the retractive movement of the thrust member 141 a retracting-spring 144′ is provided, which has a bearing at the lower end thereof in the carrier or bracket 142 and bears at its upper end against a projection 147 on the upper end of said bearing member.

In some cases it is desirable to secure the steady-rest carrier or bracket 142 to one of the cutter-slides, as shown in Fig. 3, so as to have a movement with said cutter-slide, and in other cases it is desirable to fixedly secure said bracket to the frame of the machine, as shown in Figs. 6 and 7. Therefore I do not desire to limit myself to any particular location of the cutter-slide upon the machine, as this is wholly a matter of preference.

In Fig. 3 of the drawings, which shows the steady-rest carried by one of the cutter-slides, I have shown hand-operable means for retracting the thrust member to release the bearing member from engagement with the piece being operated upon. This actuating means in the form shown in said figure comprises a pin 148, fixed to the thrust member and extending through an elongated slot 149 in the thrust-member bearing. For the purpose of locking the thrust member in its retracted position the slot 149 has a lateral extension at the outer end thereof, into which the pin 148 may be turned when the thrust member is in its extreme retracted position, the inner wall of the laterally-deflected slot forming a catch for holding the thrust member against advancing movement. This constitutes a simple and convenient means for retracting the thrust member by hand, and this means is also shown in connection with the modification illustrated in Fig. 7.

In Figs. 6 and 7 of the drawings I have shown the preferred construction and organization of steady-rest and actuating means therefor. In these figures the steady-rest carrier is shown fixed to the bed of the machine and the cutter-slide is shown furnished with a thrust-member actuator 150, having a cam-face 150′ near the upper end thereof in position to engage the pin 148 of the thrust member 141, and which cam-face during the retractive movement of the slide engages said pin and gradually retracts the thrust member, as will be readily understood by reference to said Fig. 6.

In Figs. 6 and 7 it will be seen that the machine is furnished with one cutter-slide instead of two, as illustrated in Fig. 3 of the

drawings, and it will also be seen that this cutter-slide is furnished at one end thereof with a turning-down cutter, which is the same as the turning-down cutters shown in Fig. 3, and is also shown furnished at the opposite end thereof with a tool-carrier 70, having a cutting-off tool 70′, which is located in position to engage and cut off the blank after the cutting-tool C has completed the turning-down operation and said slide has been retracted to the position shown in dotted lines in Fig. 6, the inner working end of the tool-carrier 70 being supported in a bearing, formed in one face of the steady-rest bracket.

The particular construction and organization of device shown in Figs. 6 and 7 of the drawings is more especially adapted for use in connection with ordinary lathes employed for turning and cutting off small cylindrical articles, such as bicycle-crank shafts and pulley-shafts and other similar articles; but it will be seen that the cutter-slide and steady-rest and associated devices shown in Fig. 6 are readily applicable to the machine shown in Figs. 1 to 5, inclusive.

In Fig. 1 of the drawings the cutter 70′ is shown pivotally supported upon one of the cutter-slides, so that the same may be thrust backward during the operation of the cutters C and C[1] and may be dropped into position to cut off the completed blank after the cutter-slides have been retracted. This construction and organization of cutting device (shown in Fig. 1) is substantially the same as that described in the patent hereinbefore referred to, to which reference may be had for a more complete description thereof.

As a convenient means for supplying oil in proper quantities to the cutters C and C[1] and to the reservoir 134, from which oil is conducted to the cutting end of the drill, I have provided a pumping apparatus, which in the preferred form thereof shown in Fig. 2 of the drawings comprises two gear-pumps 155 and 156, located upon and driven by the same shaft 157, which is furnished with a driving-pulley 158, driven by a belt 158′ (shown in dotted lines) from any suitable source of power, (not shown,) suction-pipes 160 and 161, leading from an oil-tank 162 to the pumps 156 and 155, respectively, feed-pipes or conduits 163 and 164, the one, 163, of which leads from the pump 155 to the reservoir 134, carried on the drill-spindle K, and the other feed-pipe, 164, of which leads from the pump 156 to a point above and between the cutters C and C[1], respectively, this feed-pipe being closed at its outer end and having a series of perforations through which oil is discharged upon the piece being operated upon, as will be readily understood by reference to Fig. 2 of the drawings.

The feed-pipes 163 and 164 are provided with cut-off valves, which are designated by 166 and 167, respectively, and are also furnished with overflow-pipes, which are designated by 168 and 169, respectively. The pumps 155 and 156 will preferably be of the ordinary rotating-gear type now in common use, but it will be obvious that any form of pump may be employed in lieu thereof.

The operation of my improved machine will be readily understood by a comparison of the several figures of the drawings by any one skilled in the art to which this invention appertains, and therefore a detailed description of such operation is deemed unnecessary for the purposes of my present invention, it being sufficient to say that the operations of turning down and drilling the piece are simultaneously and automatically effected.

In forming hub-blanks on my improved machine it is preferable to use a continuous rod, which extends through the hollow work-carrying spindle and is held therein by a suitable chuck in any well-known manner; but it will be obvious that the machine is applicable for turning down hub-blanks or other analogous articles which have been previously formed to approximate size in the usual manner of forging articles of this kind.

Having described my invention, I claim—

1. In a machine of the class specified, the combination of a work-spindle; a rotative drill-spindle; a cutter-carrying slide supported intermediate said spindles, for movement in a plane transverse to the axis of said spindles; means for rotating the two spindles concurrently in relatively opposite directions; and means for advancing the drill-spindle and cutter-slide concurrently in relatively intersecting planes.

2. In a machine of the class specified, the combination with a work-spindle and with rotating mechanism therefor; of a rotative drill-spindle; a cutter-slide; feed mechanism cooperatively connecting the drill-spindle and cutter-slide and embodying means for simultaneously advancing and retracting the drill-spindle and cutter-slide with relatively varying velocities of a predetermined ratio and in relatively transverse planes; and means for rotating the drill-spindle.

3. In a machine of the class specified, the combination with a rotative work-spindle; of a rotative drill-spindle located in axial alinement with the work-spindle; independent driving devices in connection with the work-spindle and drill-spindle and effective for rotating the two spindles in relatively opposite directions and at relatively variable velocities; a cutter-slide supported for movement in a plane transverse to the axis of and between the work-spindle and drill-spindle; and feed mechanism coöperatively connecting the drill-spindle and cutter-slide and effective for simultaneously advancing and retracting the said drill-spindle and cutter-slide at predetermined relative velocities.

4. In a machine of the class specified, the combination with a work-spindle and its carrier and with a drill-spindle and its carrier; of two oppositely-disposed cutter-slides located at opposite sides, respectively, of the

common axis of said spindles; means for rotating the work-spindle; and feed mechanism operatively connecting the two cutter-slides and the spindle-carrier and operable for simultaneously advancing the two cutter-slides toward the axis of the drill-spindle and for simultaneously advancing the drill-spindle at a predetermined velocity with relation to the velocity of feed movement of the cutter-slides.

5. In a machine of the class specified, the combination with a work-spindle and its carrier and with a drill-spindle and its carrier; of two oppositely-disposed cutter-slides located at opposite sides, respectively, of the common axis of said spindles; means for rotating the work-spindle and drill-spindle concurrently in opposite directions and at predetermined relative velocities; and feed mechanism operatively connecting the two cutter-slides and the spindle-carrier and automatically operative for simultaneously advancing the two cutter-slides toward the axis of the drill-spindle and for simultaneously advancing the drill-spindle carrier at a predetermined velocity with relation to the velocity of feed movement of the cutter-slides.

6. In a machine of the class specified, the combination with a work-spindle and a drill-spindle and with independent driving mechanism in operative connection with and adapted for rotating the work-spindle and drill-spindle in opposite directions at relatively varying velocities of a predetermined ratio; of two cutters located at opposite sides, respectively, of the axis of the drill-spindle; cutter-carrying slides on which said cutters are mounted; and feed mechanism operatively connecting the drill-spindle and cutter-slides and effective for advancing the drill-spindle and for simultaneously advancing the cutter-slides toward each other and in a plane intersecting the axial line of the drill-spindle.

7. The combination with a suitable supporting-frame and with a rotative work-spindle, of two tool-carriers supported one for movement in the plane of the axis of said spindle and the other for movement in a plane transversely to said axis; an actuating-connector between and effective for advancing and retracting the two carriers concurrently; a tool-carrying spindle rotatively mounted upon one of said carriers; and means for rotating said spindle simultaneously with the advancing movement of the carrier.

8. The combination with a suitable supporting-frame and with a rotative work-spindle, of two tool-carriers supported one for movement in the plane of the axis of said spindle and the other for movement in a plane transversely of said axis; an actuating-connector between and effective for advancing and retracting the two carriers concurrently and embodying a time-train for effecting a predetermined ratio of movement between said carriers; means in connection with each carrier and operable for automatically stopping the advancing movement of said carriers at predetermined points within the range limit thereof; a rotating tool carried by one of said carriers; and means for rotating said tool throughout the advancing movement of said carrier.

9. The combination with a suitable supporting-frame and with a rotative work-spindle journaled in said frame, of two tool-carriers supported one for movement in the plane of the axis of said spindle and the other for movement in a plane transversely of said axis; an actuating-connector between and effective for advancing and retracting the two carriers concurrently; a tool-spindle rotatably mounted upon one of said carriers; driving mechanism for said tool-spindle, embodying a driving-shaft journaled in a fixture of the frame; a gear-wheel splined to the driving-shaft and movable longitudinally with the tool-spindle; and a gear carried by the tool-spindle and meshing with the gear on the driving-shaft.

10. The combination with a suitable framework, of two tool-carriers supported for advancing and retractive movements in relatively transverse planes; drop-feed mechanism in connection with each tool-carrier; and a speed-reducing train of gears operatively connecting the two drop-feed mechanisms.

11. In a machine of the class specified, the combination with a suitable framework and with a rotative work-carrying spindle journaled in bearings on said framework, of two tool-carrying slides supported for movement in opposite directions and in a plane transversely of the longitudinal axis of the work-spindle and having, respectively, right and left hand feed-screw bearings; a feed-screw having right and left hand threads in engagement with the right and left hand screw-threaded bearings of the tool-carrying slides; a drill-spindle carrier supported on the frame, for movement longitudinally thereof and having a rack; a feed-shaft journaled transversely in the framework of the machine and having a pinion in mesh with said rack; and connecting driving mechanism between the rack, pinion-shaft, and feed-screw, and embodying means for rotating the pinion-shaft and feed-screw at relatively varying velocities of a predetermined ratio.

12. The combination with a suitable framework and with a rotative work-carrying spindle journaled on said framework, of a tool-carrying slide supported for movement in a plane transverse to the axis of the work-carrying spindle; two oppositely-disposed cutting-tools supported at opposite ends, respectively, of said slide, with their cutting-faces at opposite sides, respectively, of the axis of the work-spindle; means for reciprocating said slide, to cause the tools to successively act

upon the work carried by the spindle; and a reactionary steady-rest supported in position to engage the work carried by the spindle.

13. The combination with a suitable framework, a work-carrying spindle, and with means for rotating said spindle; of a cutter-slide supported for movement in a plane transverse to the axis of said spindle; a steady-rest supported in operative relation with the work-carrying spindle and embodying two coöperative reciprocatory members, one of which has a bearing-face for engaging the work and the other of which constitutes a thrust member for normally holding the first-mentioned member in engagement with the work; means carried by the cutter-slide, for retracting the thrust member automatically upon the retractive movement of the slide; means in connection with the bearing member, for retracting the same upon the retractive movement of the thrust member; and means for reciprocating the cutter-slide.

14. The herein-described steady-rest, it comprising a suitable frame having angularly-disposed bearings whose axes are in relatively intersecting planes; a bearing member shiftably supported in one of said bearings and having an inclined face normally intersecting the axis of the other bearing; a thrust member shiftably supported in the other bearing and having an inclined bearing-face in normal engagement with the bearing-face of the bearing member; a spring in connection with the thrust member and effective for normally thrusting said member against the bearing member; means for retracting the thrust member; and means for retracting the bearing member simultaneously with the retractive movement of the thrust member.

15. The herein-described steady-rest for a machine of the class specified, it consisting of a suitable frame having two angularly-disposed bearings whose axes are in relatively intersecting planes; two coöperative members shiftably supported in said bearings, and one of which members is actuated by the other in one direction; and means in connection with the two members, for effecting a simultaneous retracting movement of said members.

16. In a machine of the class specified, the combination with the framework and with a rotative work-carrier; of a steady-rest supported in operative relation with said work-carrier and comprising two coöperative spring-actuated members, one of which constitutes a thrust member for imparting an advancing movement to the other member; and means for retracting the thrust member.

17. In a machine of the class specified, the combination with the framework and with a rotative work-carrier; of a steady-rest supported in operative relation with said work-carrier and comprising a shiftably-supported, reactionary bearing member; a thrust member supported with its longitudinal axis in a plane intersecting the axial plane of the bearing member, and said two members having coacting wedge-faces; a spring in operative connection with, and effective for automatically advancing, the thrust member; and a tension device in connection with the thrust member, for regulating the thrust of said member and the bearing stress of the bearing member.

18. In a machine of the class specified, the combination with the work-spindle, the turning-down cutter, and the drill-spindle; of a compound oil-feeding apparatus comprising two independent rotary pumps mounted upon the same shaft; means for rotating said shaft; an oil-tank; two independent suction-pipes leading from the oil-tank to the two pumps; two independent feed-pipes leading one from one pump to the drill-spindle and the other from the other pump to a point above the turning-down cutter; and a valve and overflow-pipe in connection with each pipe.

WILLIAM W. TUCKER.

Witnesses:
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