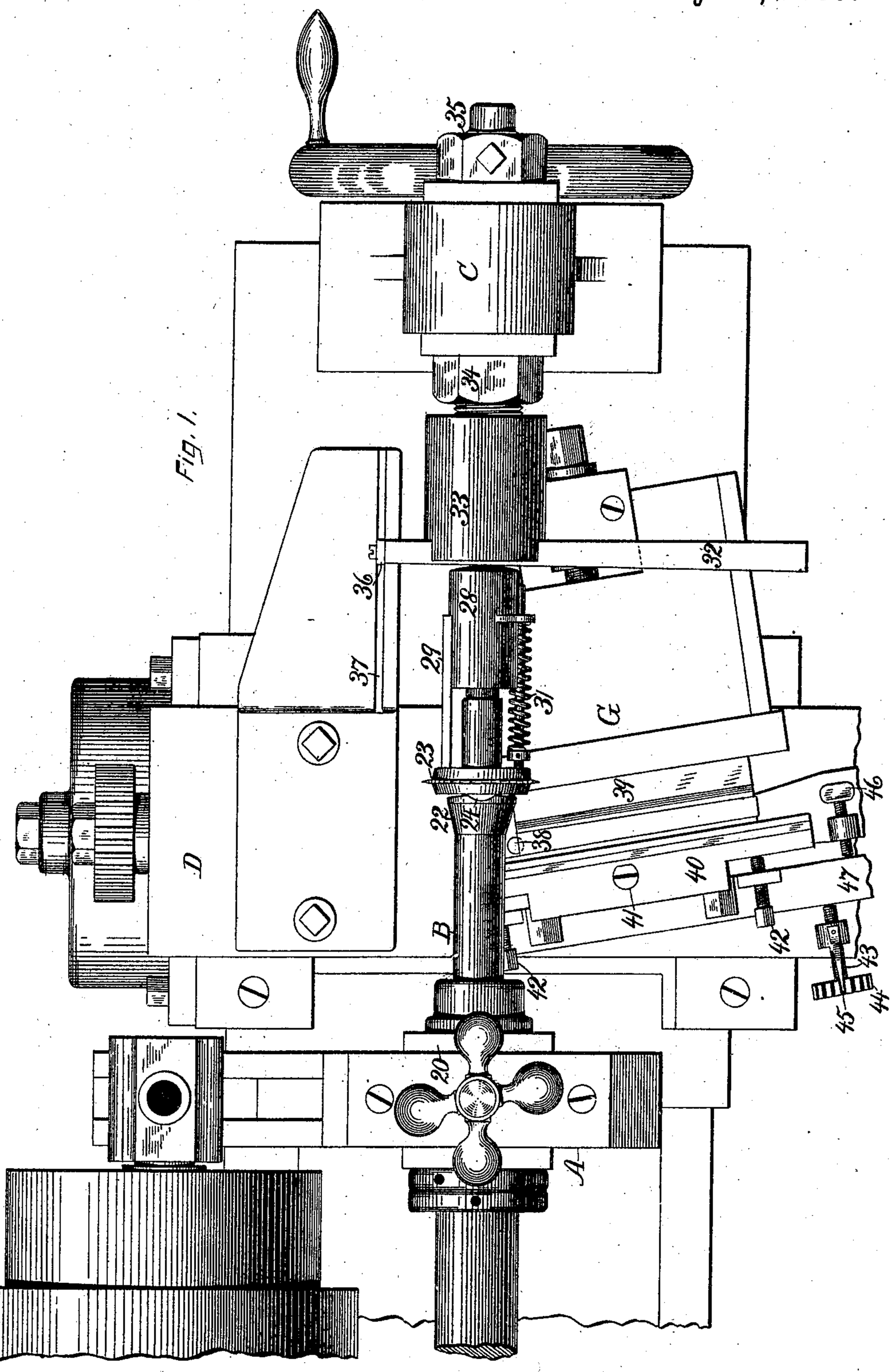
(No Model.) 4 Sheets—Sheet 1.

H. K. JONES.

APPARATUS FOR MILLING DIES FOR ROLLING SCREW THREADS.

No. 502,257. Patented July 25, 1893.

Fig. 1.



Witnesses.
John Edwards Jr.
B. L. Lewis.

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Horace K. Jones.
By James Shepard Atty.

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H. K. JONES.

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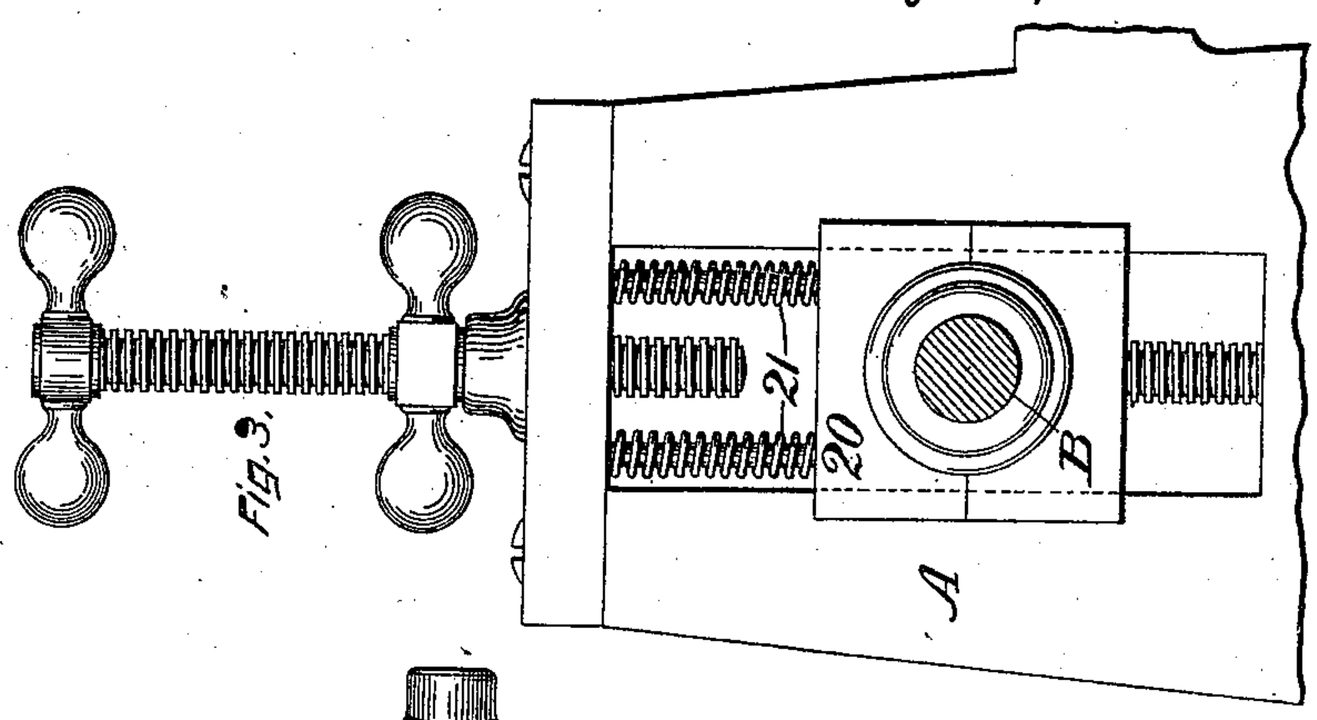

Fig. 3.

Fig. 2.

Fig. 2½.

Fig. 4.

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(No Model.)

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APPARATUS FOR MILLING DIES FOR ROLLING SCREW THREADS.

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Fig. 5.

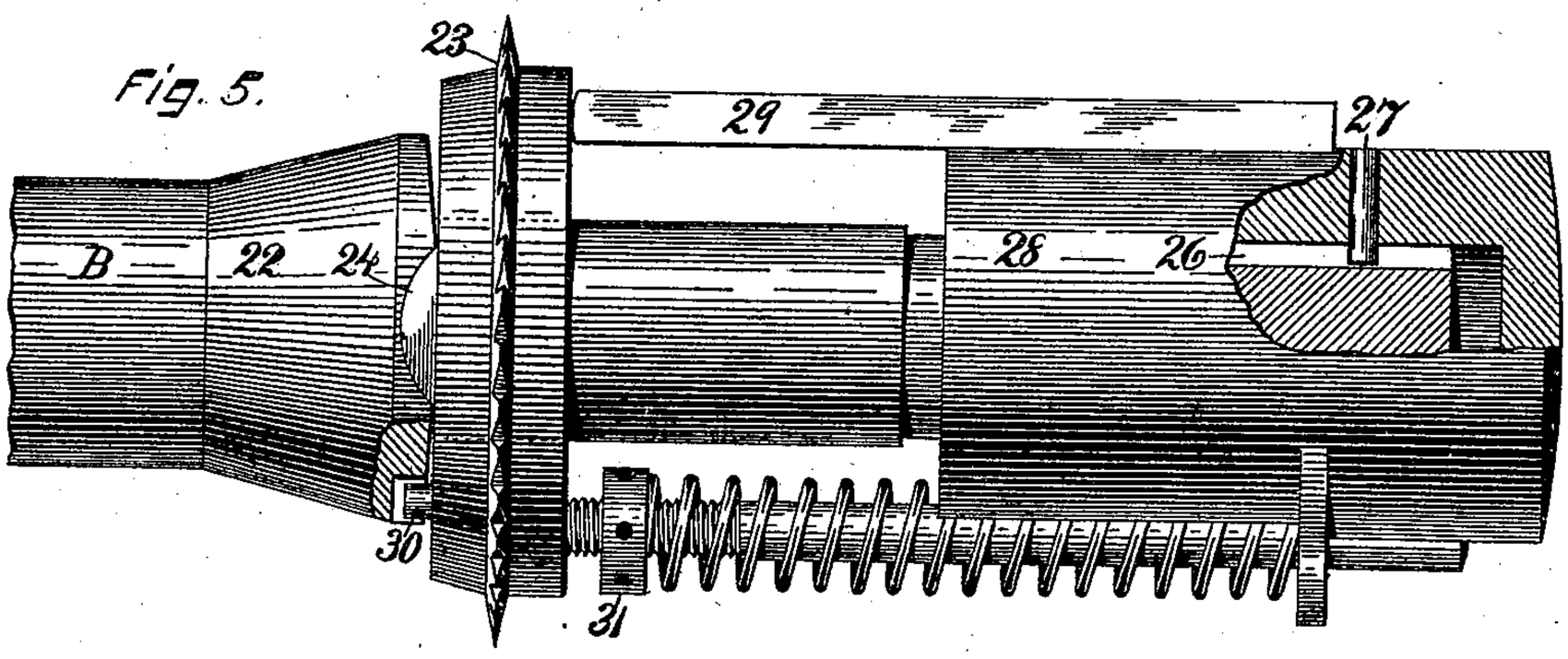


Fig. 6.

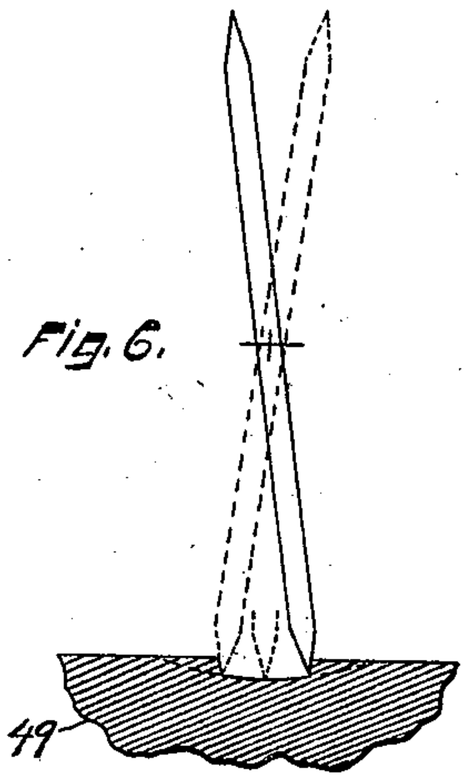


Fig. 7.

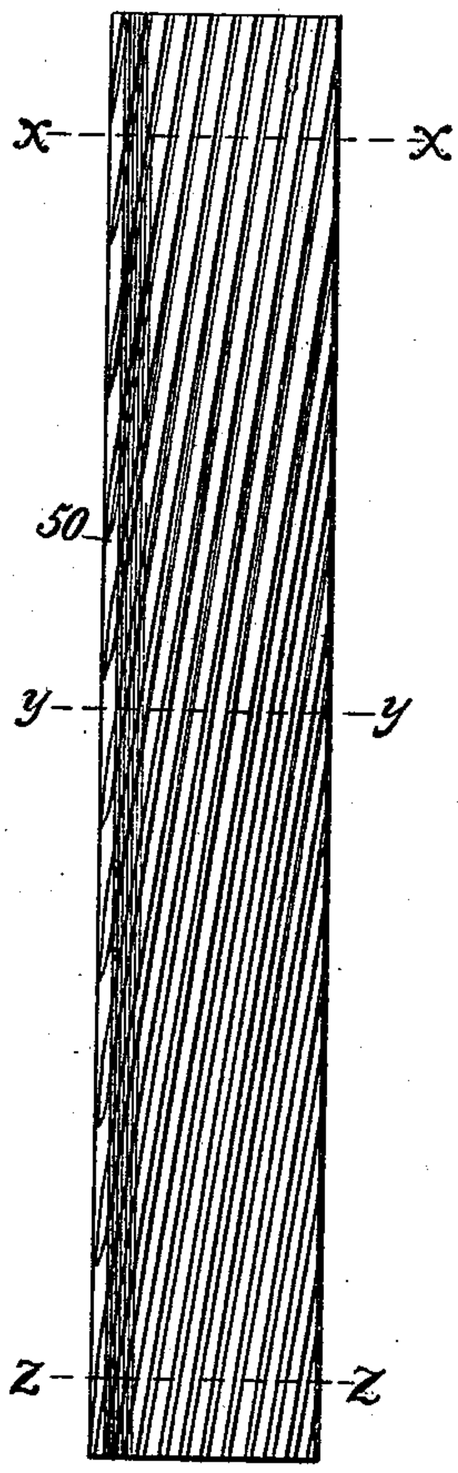


Fig. 8.

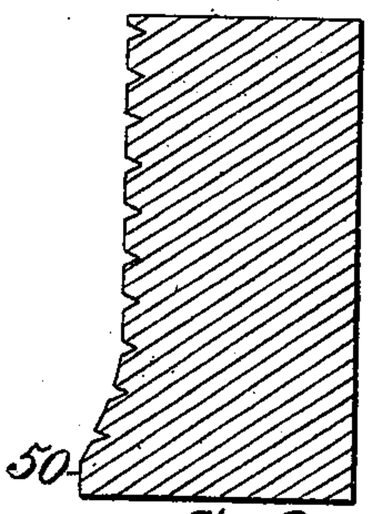


Fig. 9.

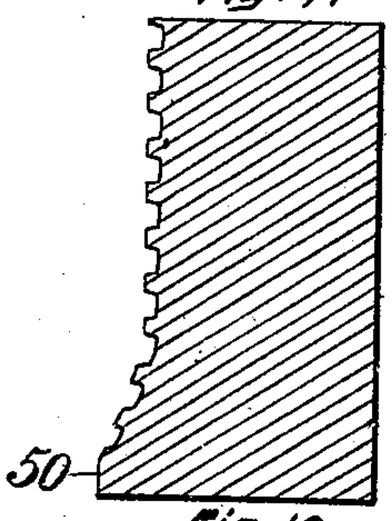


Fig. 10.

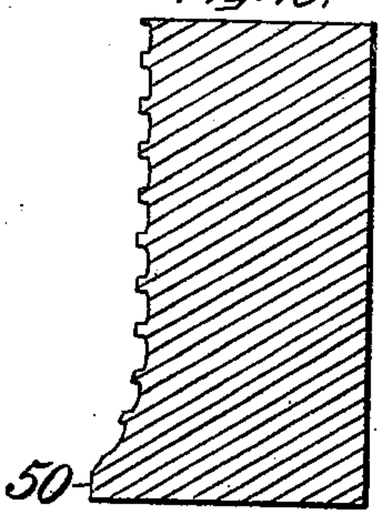


Fig. 11.

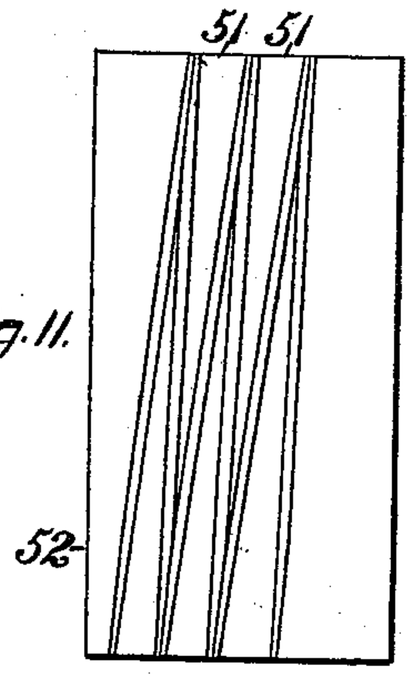
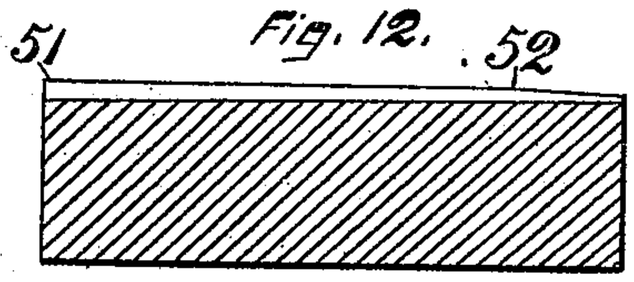


Fig. 12.



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APPARATUS FOR MILLING DIES FOR ROLLING SCREW THREADS.

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Fig. 13.

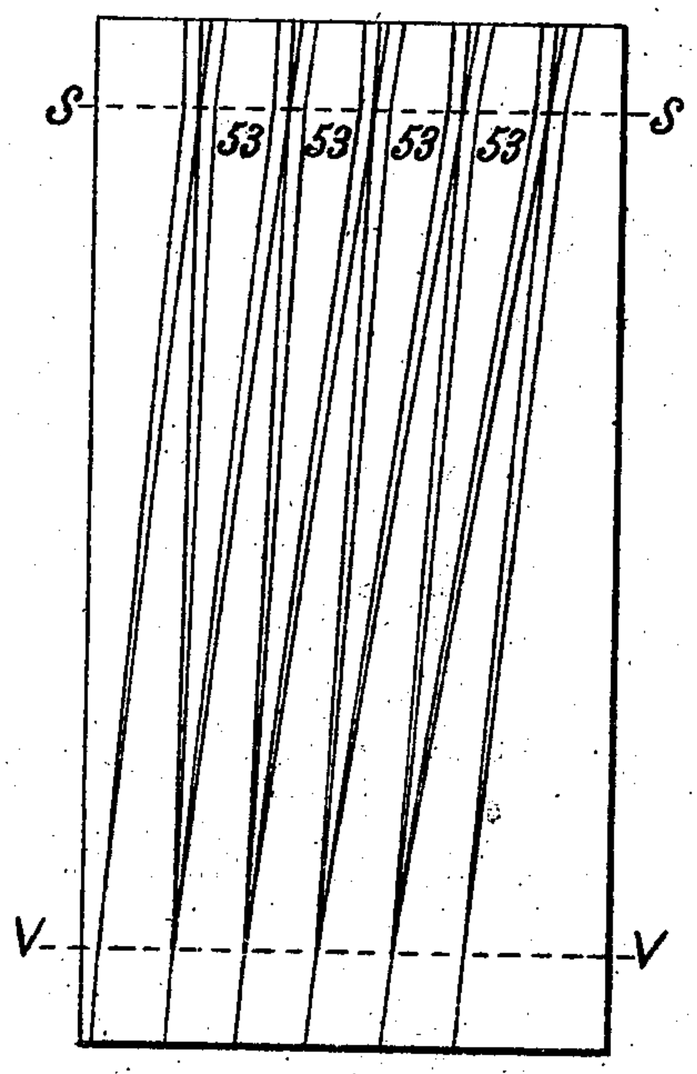


Fig. 16.

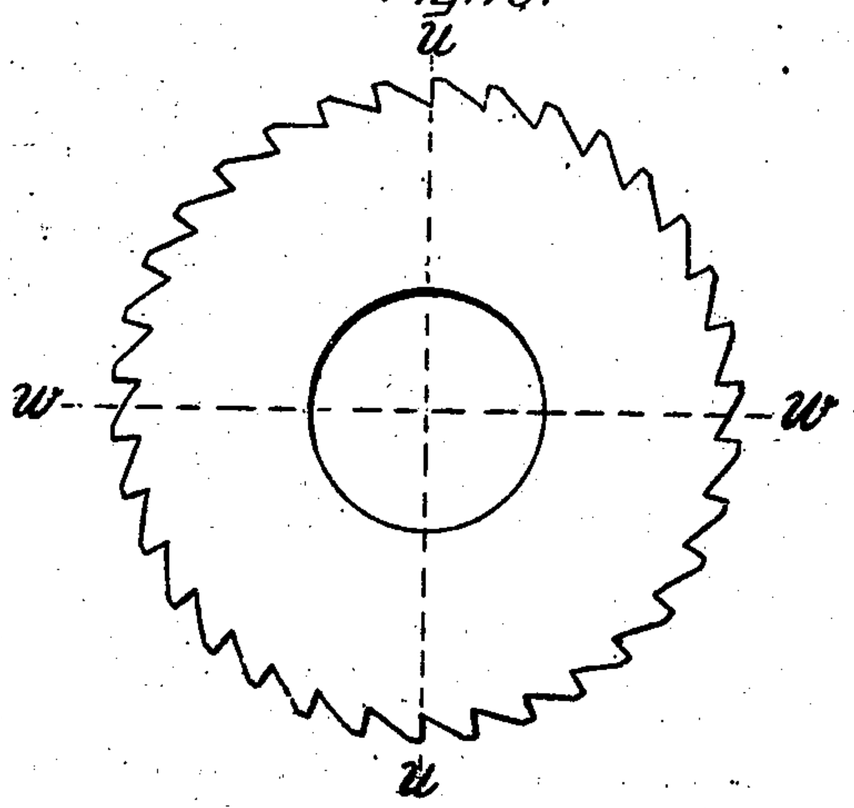


Fig. 14.

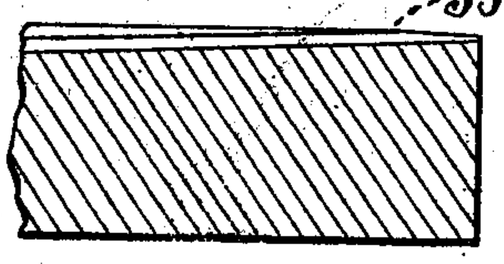


Fig. 17.

Fig. 18.

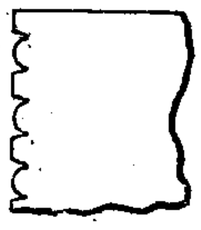


Fig. 15.

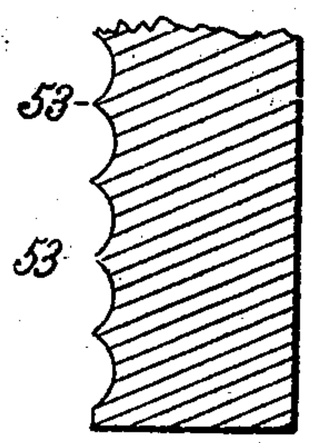


Fig. 20.

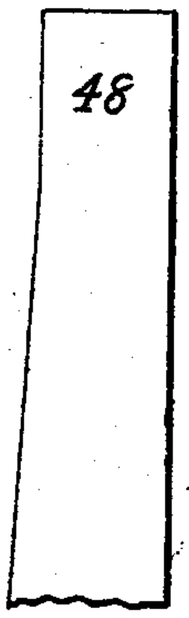


Fig. 19.

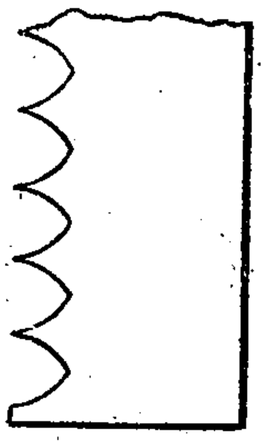
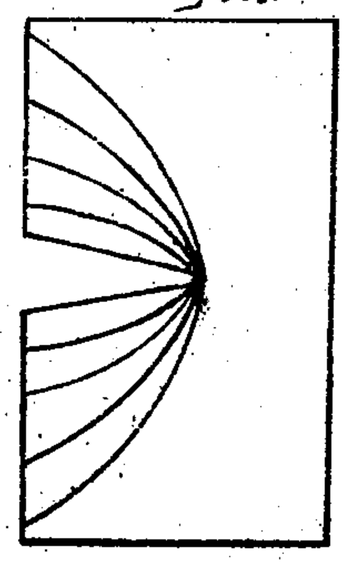


Fig 21.



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UNITED STATES PATENT OFFICE.

HORACE K. JONES, OF HARTFORD, ASSIGNOR TO THE RUSSELL & ERWIN MANUFACTURING COMPANY, OF NEW BRITAIN, CONNECTICUT.

APPARATUS FOR MILLING DIES FOR ROLLING SCREW-THREADS.

SPECIFICATION forming part of Letters Patent No. 502,257, dated July 25, 1893.

Application filed May 24, 1892. Serial No. 434,152. (No model.)

To all whom it may concern:

Be it known that I, HORACE K. JONES, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Apparatus for Milling Dies for Rolling Screw-Threads, of which the following is a specification.

My invention relates to improvements in an apparatus for milling dies for rolling screw threads or milling grooves in other articles, and the object of my improvement is to produce a simple and efficient apparatus for readily producing dies of the form hereinafter described or various other forms as may be desired.

In the accompanying drawings Figure 1 is a plan view of my die milling apparatus and so much of a milling machine as is necessary to show its connection therewith. Fig. 2 is a front elevation of portions of the same, some of the parts being shown in sectional profile. Fig. 2½ is a like view showing the same parts in a modified form. Fig. 3 is a side elevation of a portion of the milling machine head, the cutter spindle being shown in transverse section. Fig. 4 is a side elevation of the cutter on an enlarged scale. Fig. 5 is a view on the same scale as Fig. 4 showing the devices for giving lateral vibration to the cutter. Fig. 6 is a diagram illustrating the action of the cutter on the die block. Fig. 7 is a face view of one form of die produced by my apparatus. Fig. 8 is a sectional view of the same on the line *x x* Fig. 7. Fig. 9 is a sectional view of the same on the line *y y* Fig. 7. Fig. 10 is a sectional view of the same on the line *z z* Fig. 7. Fig. 11 is a face view of a die block with a few grooves such as may be cut with my apparatus, although their taper is exaggerated as compared with a die for practical use. Fig. 12 is a longitudinal section of the block Fig. 11 through the middle of one of its grooves. Fig. 13 is a similar face view illustrating in an exaggerated form the die grooves and intervening ribs such as I prefer to use. Fig. 14 is a longitudinal section of a portion of the same through the middle of one of the grooves. Fig. 15 is a transverse section of the same on the line *v v* Fig. 13. Fig. 16 is a side view of an oval cutter for use in producing die grooves. Figs. 17, 18 and 19 are end views of the die blocks with grooves such as may be cut with my apparatus. Fig. 20 is a plan view of a modified form of wedge. Fig. 21 is an enlarged diagram illustrating the form of a die groove at various points along its length.

A designates the frame of the head of an ordinary milling machine in which the front boxes or bearings 20 are permitted to rise and fall as best shown in Fig. 3, the same being pressed downwardly by the springs 21.

B designates the cutter spindle fitted to rotate in said head and having a hub 22 the side of which farthest from the cutter 23, being preferably beveled off as shown. The other side of this hub 22 has a curved recess extending diametrically across its axis, while outside of said recess its face is beveled off in each direction as shown in Figs. 1 and 5. That side of the cutter which faces the hub 22 is provided with a diametrical rib 24 which is curved transversely to its length and which rests in the curved recess of said hub. The curve of this rib and recess is on a radius that equals the distance from the highest point of said rib to a plane passing through the apex of all the cutter teeth. The central hole in the cutter 23 is made slightly oval as shown in Fig. 4, the longer diameter of said hole extending at a right angle to the rib 24. The shorter diameter is of a size substantially equal to the diameter of that part of the spindle to which it is fitted. If desired I also provide the cutter with a dog pin 30, Figs. 4 and 5, that engages a radial groove in the confronting face of the hub 22 to assist in driving the cutter with the spindle.

The tail block end of the spindle B is grooved longitudinally as at 26 Fig. 5, and on this grooved portion is a sliding sleeve 28 having a spline or pin 27, which engages said groove, whereby said sleeve necessarily rotates with the spindle and at the same time is permitted to slide longitudinally thereon. Secured to this sleeve is a rigid arm 29 the end of which when in use bears upon one side of the cutter 23 toward its outer edge, on a diametrical line substantially at right angles to the middle longitudinal line or axis of the rib 24, and at a point diametrically opposite said rigid arm 29 a spring pressed arm

31, secured to said sleeve, bears upon the side of the cutter. Said sleeve and arms constitute a yielding mechanism for keeping the cutter in position. This sleeve is held in position on the spindle by contact with a wedge or pattern 32 in the tail block spindle 33, said spindle being held and adjusted within the tail block C by means of the nuts 34 and 35 on a threaded part of said tail block spindle. The wedge 32 is fitted to slide longitudinally from front to rear across the end of the tail block spindle, and at its rear end is an arm 36 which engages a groove 37 in a part that is rigid with the carriage D. Upon the carriage D a vise G is pivoted as at 38 and within the jaws of this vise I place the die block 39 for being milled. As in an ordinary milling machine, the carriage D is adapted for being fed in a right line from front to rear or vice versa and also to be moved longitudinally with the spindle, and set at any desired point. The vise is also provided with a lifting rib 40 the upper edge of which is preferably somewhat rounded and projects upward near the periphery of the cutter as shown in Fig. 2. This lifting rib is held by screw 41 within slot 41½, so that by turning the adjusting screws 42 its distance from the cutter or its angle of inclination to the vise and carriage may be varied as desired. Said hub 22 and lifting rib 40 may be of the form shown in Fig. 2½ without changing the result; in this case the hub has a rounded edge and the rib an inclined surface. An arm or projecting bar 47 that is rigid with the vise G is arranged between the index screw 43 having a division plate or index 44 and a holding spring catch 45 on the one side, and a set screw 46 on the other side, by means of which divisional operating device the inclination of the vise may be changed by moving said index screw a given distance. A stout spring to hold the opposite side of the arm 47 against the index screw 43 would be an equivalent of the set screw 46. Instead of a cutter that is round in side view I sometimes employ one that is more or less oval as shown in Fig. 16, and this will be fitted to the spindle B in a manner before described, for mounting the cutter 23 thereon. I generally form the diametrical rib which I will term the wabbling axis of the cutter, on the line of its longer diameter as indicated by the line *u u*, but for some uses the wabbling axis should be made on the line of its shorter diameter as indicated by the line *w w*. The difference between the longer and shorter diameter of the cutter may be varied according to the work to be performed. I may also change the shape of the wedge 32 which is in the nature of a guide or pattern, from the true taper shown in Fig. 1, by giving it parallel sides for a portion of its length as shown at 48 in Fig. 20, or any other desired form.

The various features of my dies will be described in connection with the operation of the machine. As in ordinary dies for rolling screw threads, the grooves extend along the length of the die block somewhat obliquely, the angle of inclination being determined by the position that the die block is set on the carriage with reference to its movement across the axis of the spindle. For convenience I will describe each groove and the operation of cutting it as if all the grooves extend alike from end to end of the die block, although in fact some of them are shorter by extending across the corners of the block. The carriage is set in proper position to bring the path of the die block and carriage from front to rear under the cutter in the line of the grooves to be cut. If the sleeve 28 is set so that the arms 29 and 31 hold the cutter with the plane through the points of the teeth at right angles to the axis of the spindle, the cutter will run perfectly true and make a groove exactly the shape of its cutting teeth, the same in this instance being that of a perfect V, but if the sleeve is set farther to or from the cutter the combined action of the rigid arm and spring arm will swing the cutter on the rib 24, the longitudinal axis of which is the wabbling axis of the cutter, and consequently said cutter will in revolving, vibrate from side to side or in other words will wabble. By adjusting said tail block spindle by means of the nuts 34 and 35, the wedge 32 may be set so that the cutter will run perfectly true when any desired point of the wedge is in contact with said sleeve and thus the cutter may be made to run true when the parallel portion 48 of the modified wedge, Fig. 20, is in contact with said sleeve. When I use a wedge that has a uniform taper throughout its bearing face, I adjust the tail block spindle so that the cutter runs true, (which for convenience I will call the focusing point,) when the sleeve is a short distance from the rear end of this bearing face. I start the cutter in at the rear end of the die block at which point the cutter wabbles and cuts a somewhat truncated V, the same growing gradually less truncated until the point of focus is reached and a perfect V shaped slot is made. From this point on, as the wedge 32 is drawn back with the carriage, the sleeve 33 is gradually pressed toward the cutter so that its rigid arm pushes that side of the cutter and inclines it more and more on its wabbling axis, while the spring arm 31 yields to accommodate said movement and at the same time it holds the cutter firmly in its seat. Thus the cutter wabbles more and more while its beveled sides cut the side of the groove with a gradually warped or changing angle of inclination, making the groove wider and wider, while the apex of the cutter sweeps out the bottom of the truncated V shaped groove on the arc of a circle as illustrated in Fig. 6, in which one position of the cutter on the wider part of the groove is shown in full lines while its position as vibrated to the opposite side of the groove is represented by the broken outlines of the complete cutter, and the posi-

tion of the cutter at the point of focus where the perfect V shaped groove is made is indicated by the broken lines of a portion of the cutter's edge midway between the other two positions. This same view also shows that if the vibration of the cutter were great enough so that the apex of the cutter would run out on the surface of the die block 49 the entire groove at that point would be on the arc of a circle.

The die block Fig. 7 was cut with a concentric cutter, the focusing point thereon being indicated by the line *x x* while the vibration of the cutter was not great enough to make the apex run out at the face of the block. This block was also set in the vise with the upper end of Fig. 7 a little higher than its opposite end; hence the grooves are deepest at said upper end. This die block is also provided with a raised portion 50 for threading the gimlet point, a well known feature in this class of dies. After each cut the die block was brought forward again and then moved laterally the desired distance for the next groove and so on repeatedly. Furthermore after several of the shorter grooves that extend across the lower right hand corner of the die block had been milled and the point threading elevation approached the cutter, the lifting rib 40 came in contact with a tapering end of the hub 22 of the spindle and gradually raised the cutter up, said rib at first striking the lower part of said taper and then by reason of the inclination of said lifting rib its point of contact gradually worked up said taper and lifted the cutter over the point threading projection at just the proper height to let the cutter groove said projection in continuation of the groove in the flat part of the die. The shape of the die Fig. 7 as thus made is shown by cross section in Figs. 8, 9 and 10 at the respective lines *x*, *y*, and *z* of said Fig. 7. Of course the die Fig. 7 is one of a pair. In Figs. 11 and 12 I have shown the same form of groove made in the same way but on a more abrupt taper. Furthermore after one groove has been milled and the carriage drawn to the front and moved laterally toward the right a given distance equal to the distance from the center of one groove to the next at the focusing point, the index screw 44 was let back or unscrewed a given distance of the index and followed up by the set screw 46, thereby bringing the rear end of the die block, (the lower end in Fig. 11, the same being the entering end of the die in use,) a little nearer to the path of the next groove to be cut and so on before starting each groove, whereby the longitudinal centers of the die grooves diverge as they approach the finishing end of the die. In practice this divergence is too small to be shown by an ordinary drawing and therefore Fig. 11 is exaggerated in this particular. In Figs. 11 and 12 I have also shown the grooves so wide at the entering end of the die that the plain flat surface of the ribs 51 between them vanish at 52 and from that point to the lower end of the block the ribs are V shaped with their summit or apex sloping longitudinally toward said lower end, the same being formed by merely making the grooves proportionally wider so that their sides run together.

Figs. 13, 14 and 15 show a die block as made with an oval cutter. The focusing point is indicated by the line *s s*. The grooves widen each way from this point, gradually changing from the perfect V to the truncated V with curved bottom until the point *v v* is reached. Here the periphery of the cutter ran out at the face of the die block and from that point on to the lower end of the die the grooves are formed wholly by a curve as shown by the section Fig. 15. These curves are on a smaller radius than are the curved bottoms of the grooves as made by the round cutter 23. The tops of the ribs 53 between these also slope toward the lower or entering end of the die as in Figs. 11 and 12, but unlike the grooves in said Figs. 11 and 12 they do not have any part which in transverse section shows a right line or beveled sides, because the right lines at the sides of the grooves are made by the beveled sides of the cutter teeth and the curved lines are made by the apex of the teeth. From this it will be seen that there is a gradual change of the right lined and warped inclined sides and curved bottom of the grooves from the line *v v* to the upper end of the die. By the use of the wedge with parallel sides 48 at one end and with the tail block spindle set to make the cutter focus when the sleeve is on said parallel end, the grooves in the finishing end of the die may be perfect V shaped grooves with parallel sides throughout that part of the die block which is cut when the sleeve is on the straight part of the wedge and then they may taper as before described as the sleeve is acted upon by the tapering portions of the wedge.

By giving more or less of the oval form to the cutter, grooves may be cut of either of the forms shown in Figs. 17 and 19, and by changing the wabbling axis of the oval cutter from *u u* to *w w* Fig. 16, grooves of the form shown in Fig. 18 may be cut at a single pass of the cutter.

When a cutter that is V shaped in edge view and oval in side view is used whose eccentricity exceeds the depth of the grooves in the die block the tapering portion of the groove will be in the form of a modified V or a V with curved sides as shown in Figs. 19 and 21 and a true V shape at the focusing point as indicated by the middle portion of the diagram Fig. 21. The curved lines on each side of this middle V, represent sections through the tapering portion of the grooves at several successive points along the length of the groove, from which it will be seen that the sides of the groove of this form as well as in the form shown in Figs. 6, 7, 8, 9 and 10 have a warped surface extending along their

length with a constantly changing angle of inclination. Of course grooves of other forms could be cut by giving the cutter a different form in edge view.

By means of my apparatus I am enabled to make a die with a series of rounded grooves with narrow ridges between them at the entering end of the die, followed by grooves with the bottom filled up in the form of a truncated V and then a finishing portion where there is no increase of pressure on the stock substantially like the die patented to me April 8, 1890, the specification of which clearly describes making the wider part of the grooves "in the form of a truncated V," but my improved die as made by this apparatus gives a curved form to the bottom of the truncated V shaped groove instead of a flat form as contemplated in said patent. I can make the finishing end of the die either with parallel sided grooves as in said patent by use of the wedge Fig. 20, or by use of the wedge 32 I make said finishing end taper in the reverse direction.

My apparatus is capable of milling a great variety of grooves, each of which can be made at a single pass of the cutter, the variations being accomplished by varying the angle of the wedge or giving different forms to its face; by changing the position of the wedge relatively to the sleeve on the tail block end of the spindle; by changing the contour of the cutter either in side view or edge view or both; by raising the cutter up and down with the lifting rib and hub, the form and position of which may be changed; by swinging the vise and die block between the stated points of feeding it along to cut different grooves; and by tipping the die block to raise one or the other end more or less.

It is obvious that a wabbling cutter of non-circular contour, or a circular cutter with a variable wabble, may be used for giving an uneven surface to various materials for various purposes, and therefore I do not confine the use of this device exclusively to the making of dies as herein described.

I claim as my invention—

1. In an apparatus for forming uneven surfaces the combination of a rotating spindle, a cutter mounted thereon and provided with a wabbling axis transverse to that of said spindle, and means for controlling the wabbling movements of said cutter on said axis, substantially as described and for the purpose specified.

2. The combination of a spindle having a shoulder with transverse curved recess, a cutter mounted on said spindle and having a transverse axial rib fitted in said curved recess, the axis of which rib is in the plane of the apices of the cutter teeth, and devices for holding said cutter in place, substantially as described and for the purpose specified.

3. The combination of a wabbling cutter mounted upon a rotating spindle, of a yielding holding mechanism, a carriage and a moving wedge or pattern bearing upon said yielding holding mechanism to govern the position of the cutter on its wabbling axis, substantially as described and for the purpose specified.

4. The combination of a wabbling cutter mounted upon a rotating spindle, with the sleeve 28, rigid arm 29, yielding arm 31, and a moving wedge or pattern for acting upon said sleeve, substantially as described and for the purpose specified.

5. The combination of a spindle mounted to rise and fall a hub and cutter on a spindle, a carriage for moving the work by said cutter and the lifting rib on said carriage for acting on said hub to raise the cutter, substantially as described and for the purpose specified.

6. The combination of a mounted milling machine cutter for milling screw threading dies, the carriage of said machine, the vise pivoted to said carriage as at 38, and a divisional operating device for moving said vise a given distance on said pivot after cutting each groove to change the angle of inclination, substantially as described and for the purpose specified.

7. In a machine for making ribbed dies for rolling screw threads, the combination of a carriage adapted to be repeatedly moved laterally a given distance, a pivoted vise mounted on said carriage for holding said dies, and a divisional operating device for moving said vise a given distance on its pivot in connection with said lateral movement of said carriage, substantially as described and for the purpose specified.

8. In a machine for forming uneven surfaces, a cutter with teeth upon its periphery which periphery is of oval or eccentric or cam shaped contour and means for giving the same a wabbling motion, substantially as described and for the purpose specified.

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Witnesses:
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