No. 612,558. Patented Oct. 18, 1898.

E. E. CLAUSSEN.

METAL SCREW MACHINE.

(Application filed Sept. 11, 1897.)

No Model.) 7 Sheets—Sheet 1.

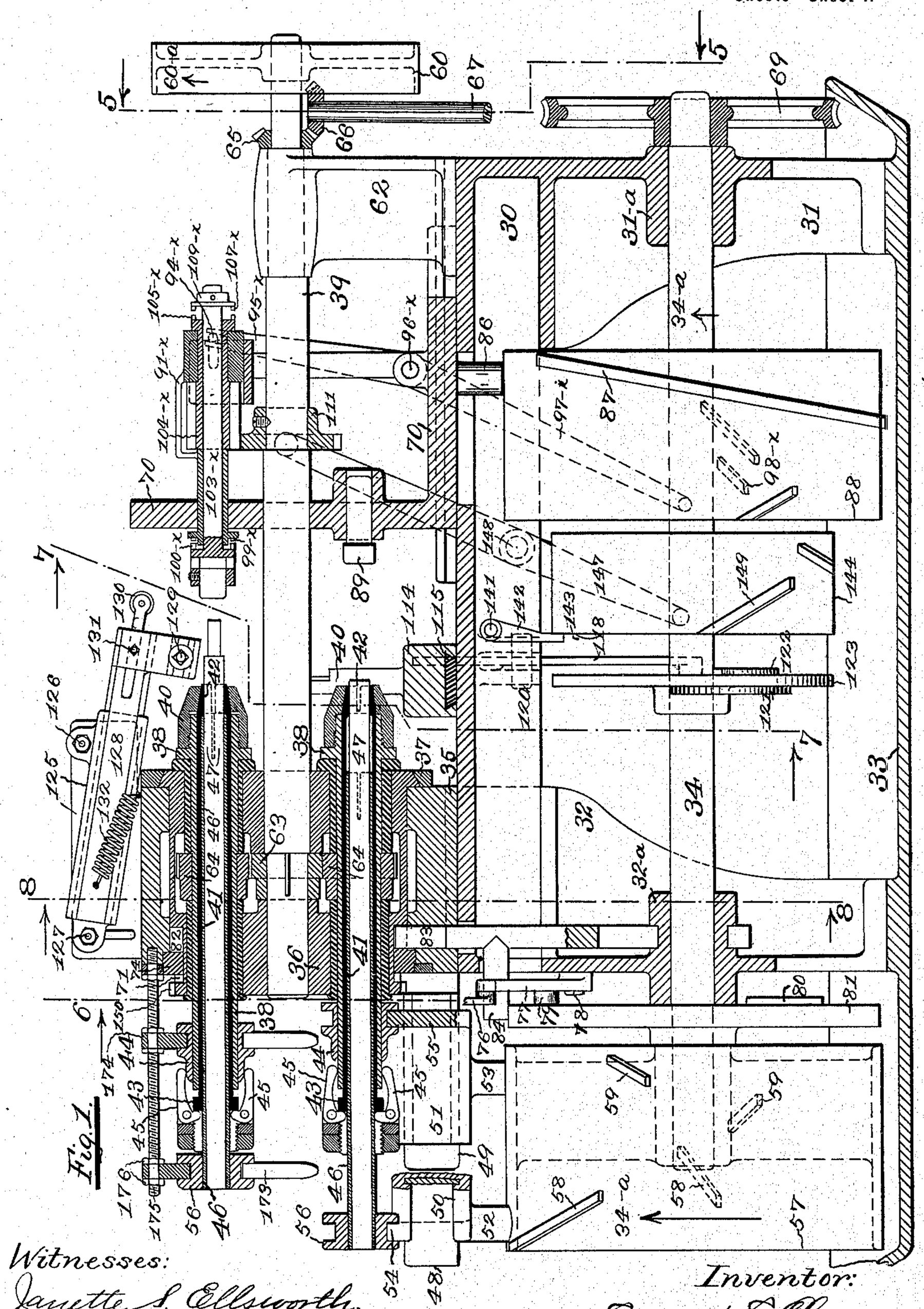

Fig. 1.

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Fig. 2.

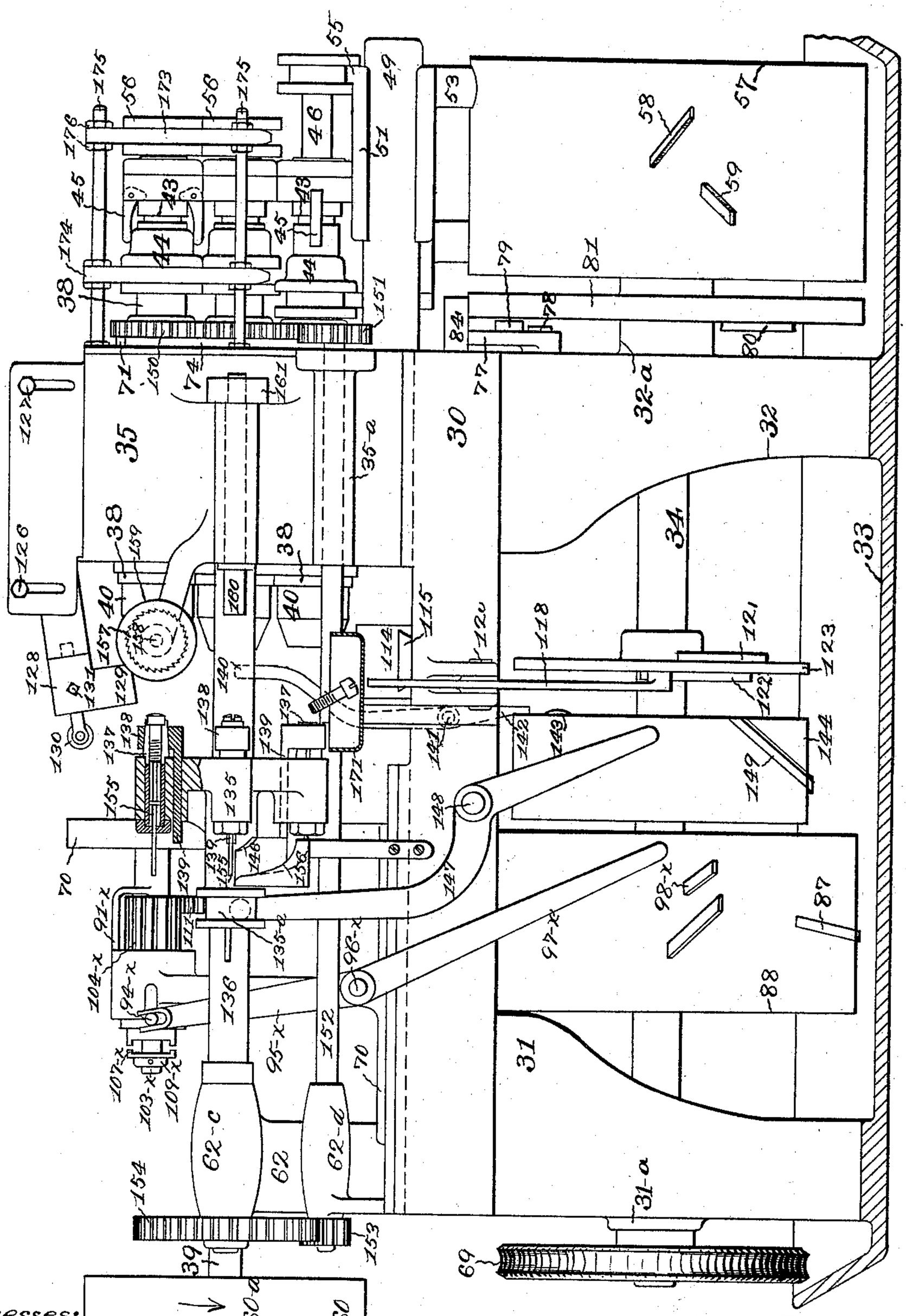

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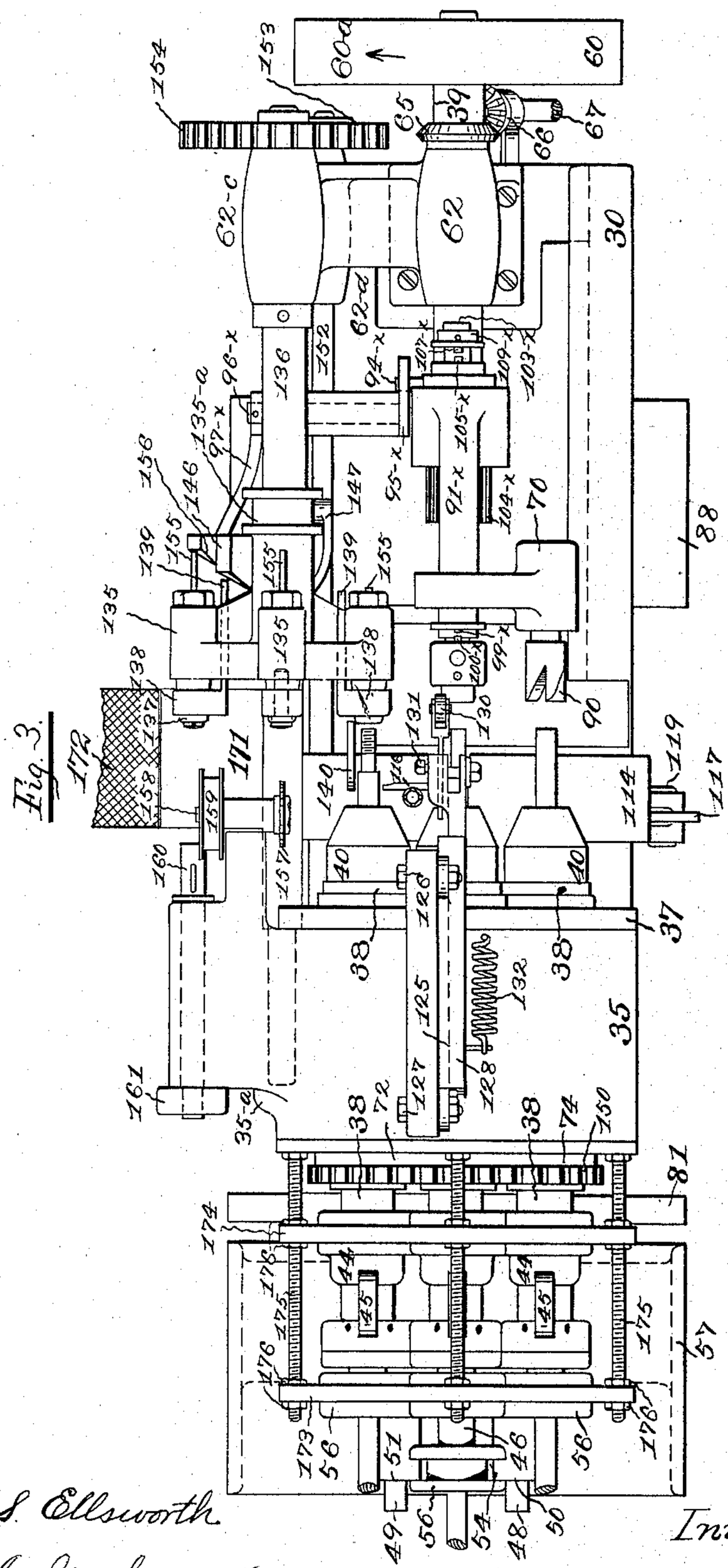
Fig. 3.



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7 Sheets—Sheet 4.

Fig. 5.

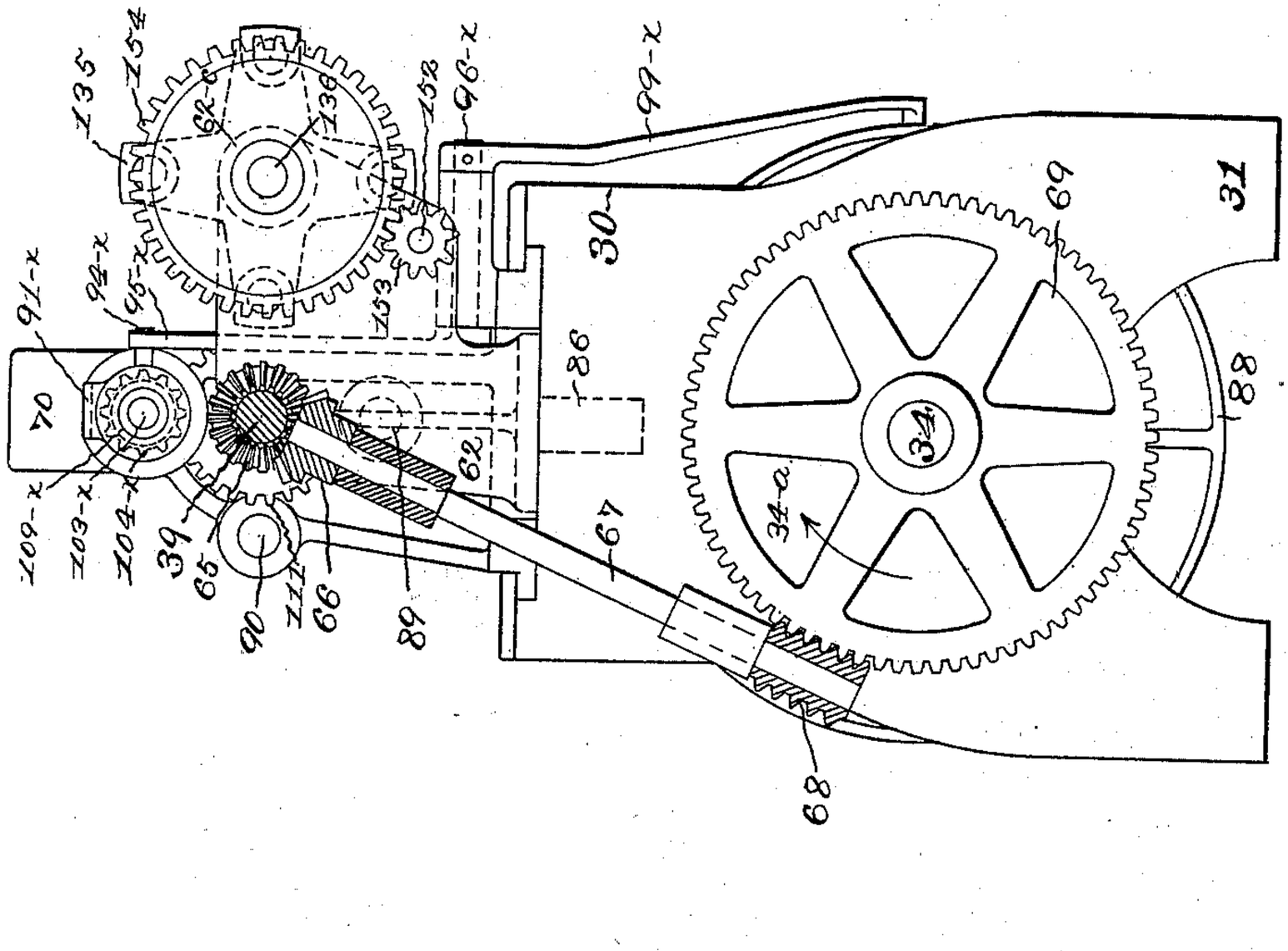

Fig. 4.

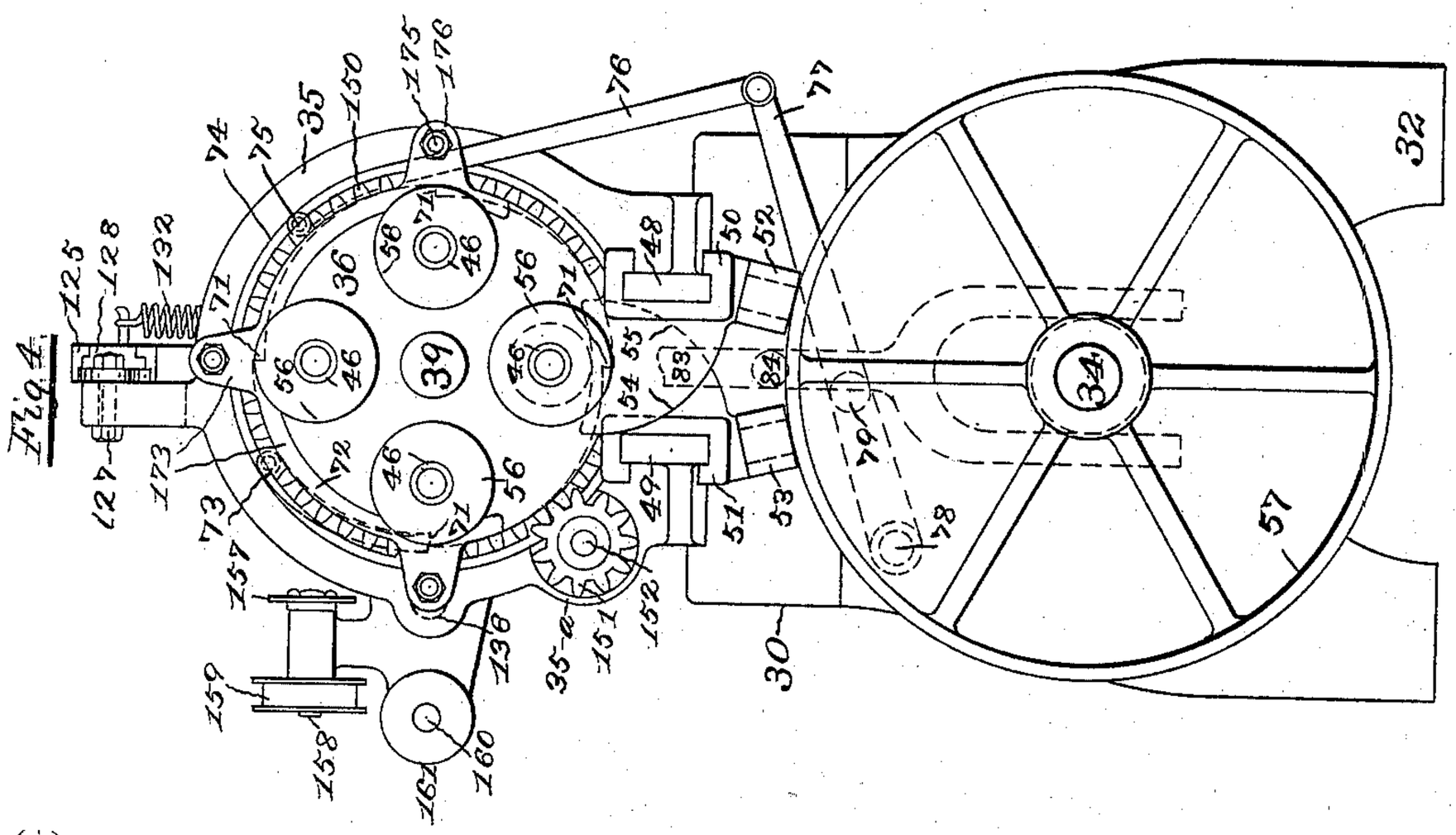

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Fig. 7.

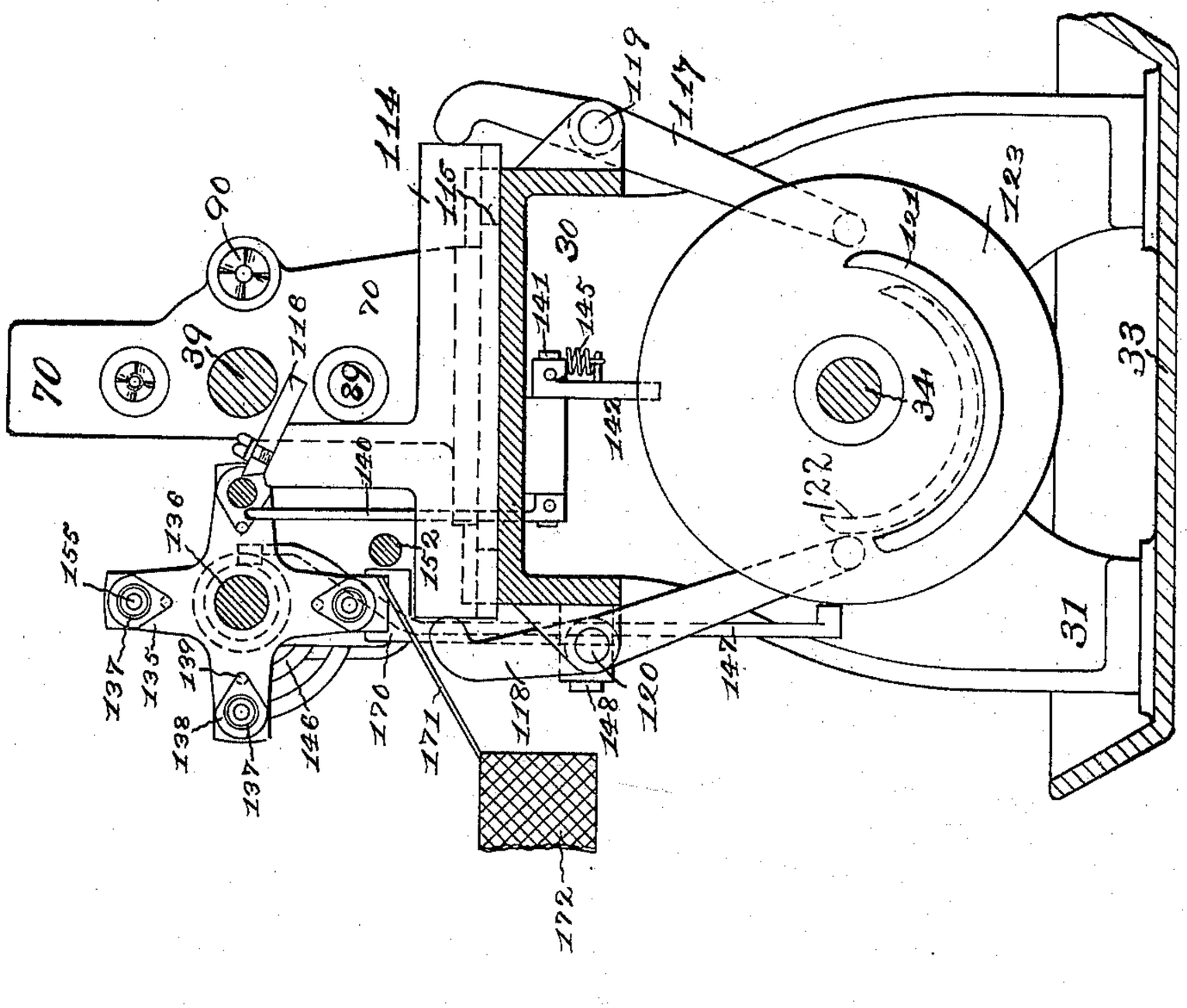

Fig. 6.

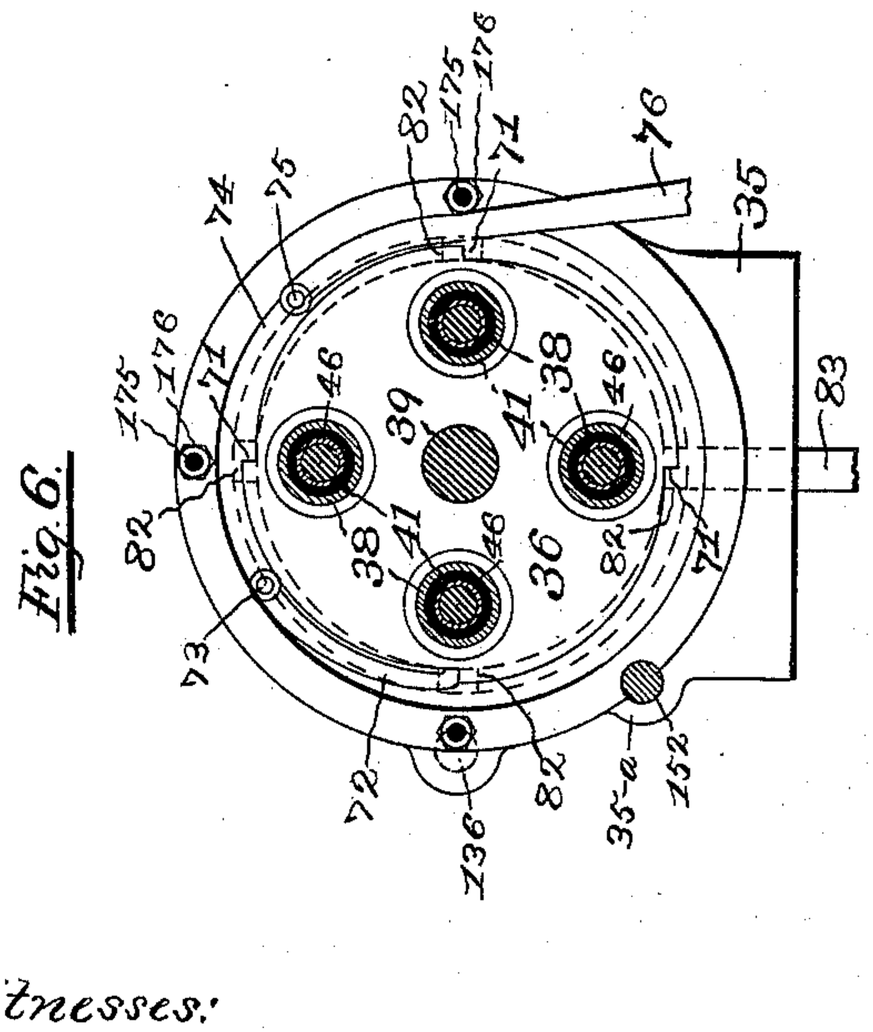

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Fig. 8.

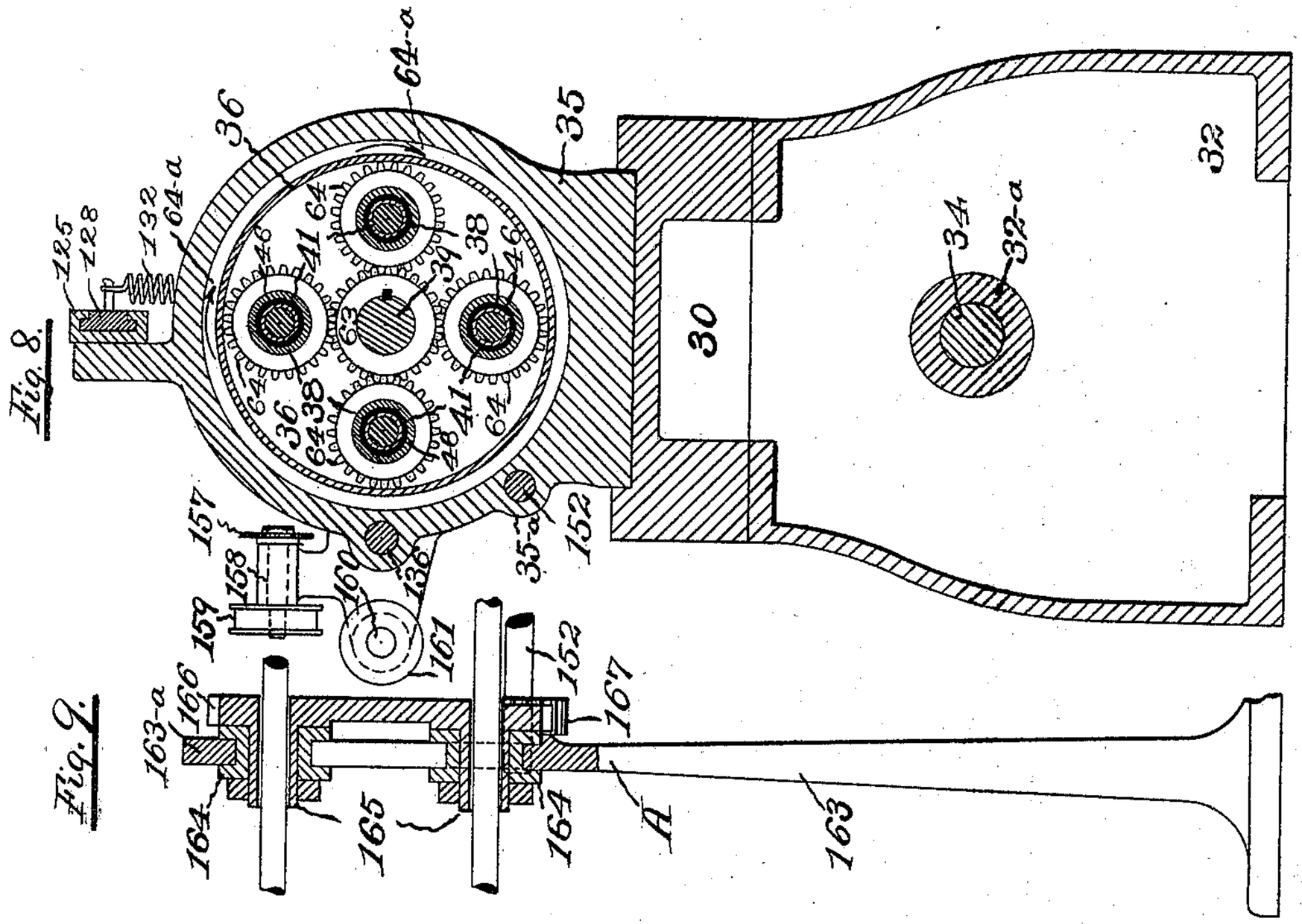

Fig. 9.

Fig. 10.

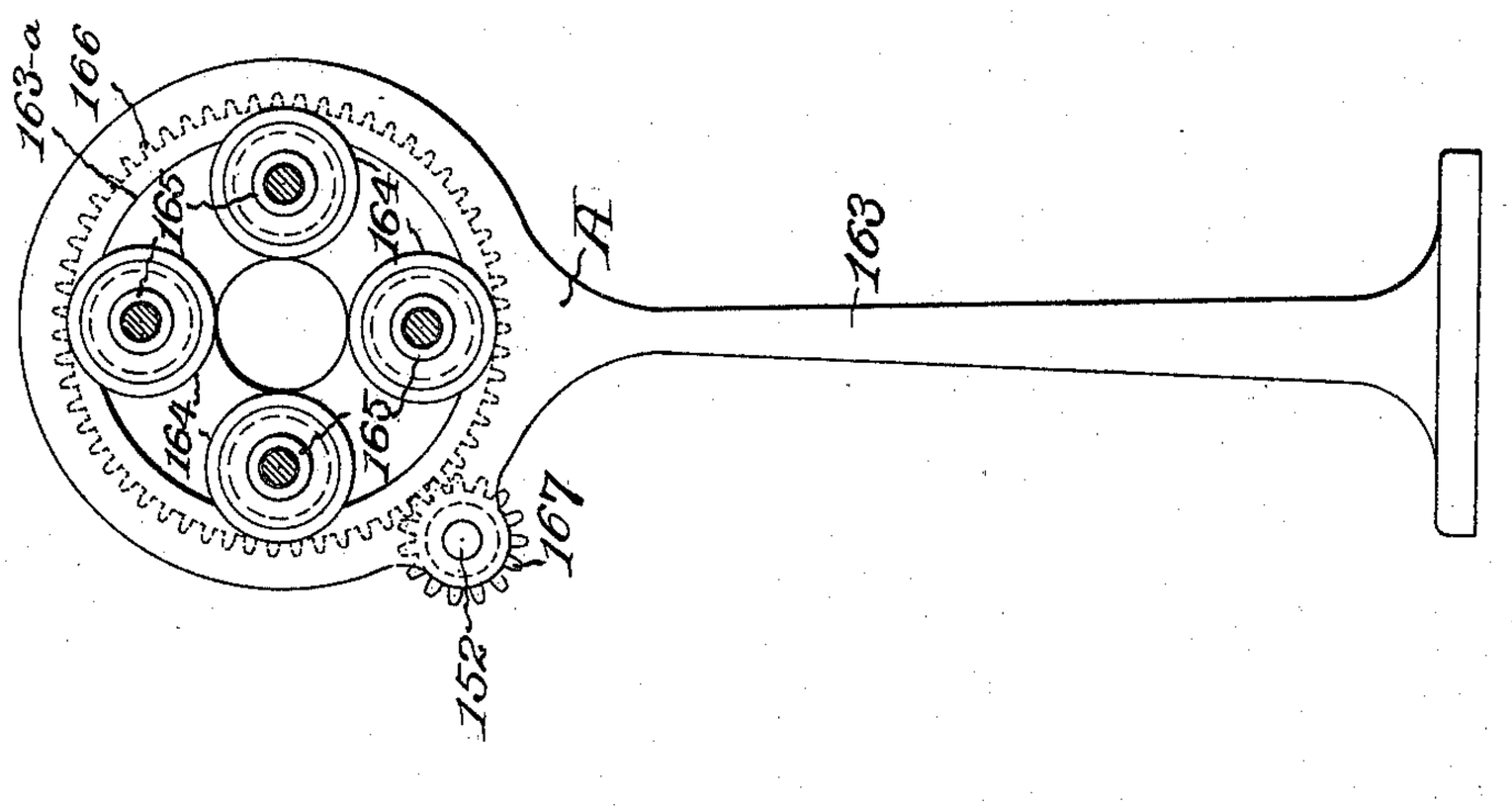

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Fig. 12.

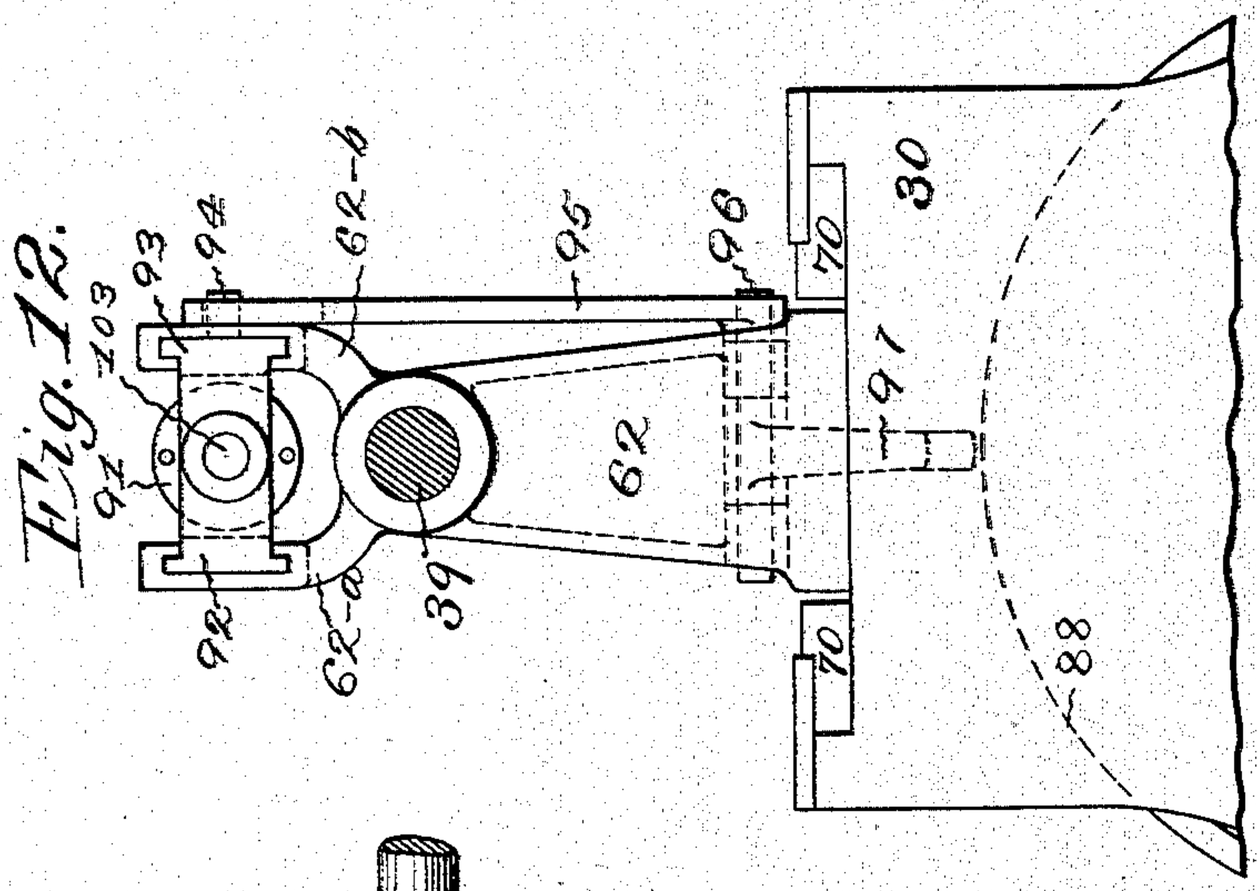


Fig. 13.

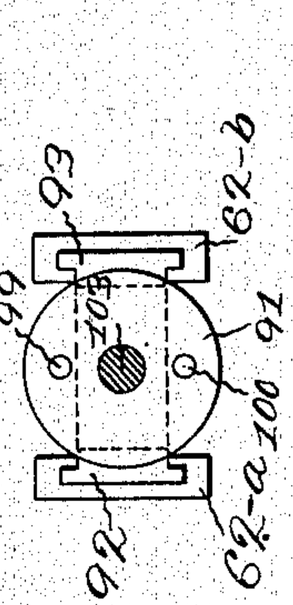
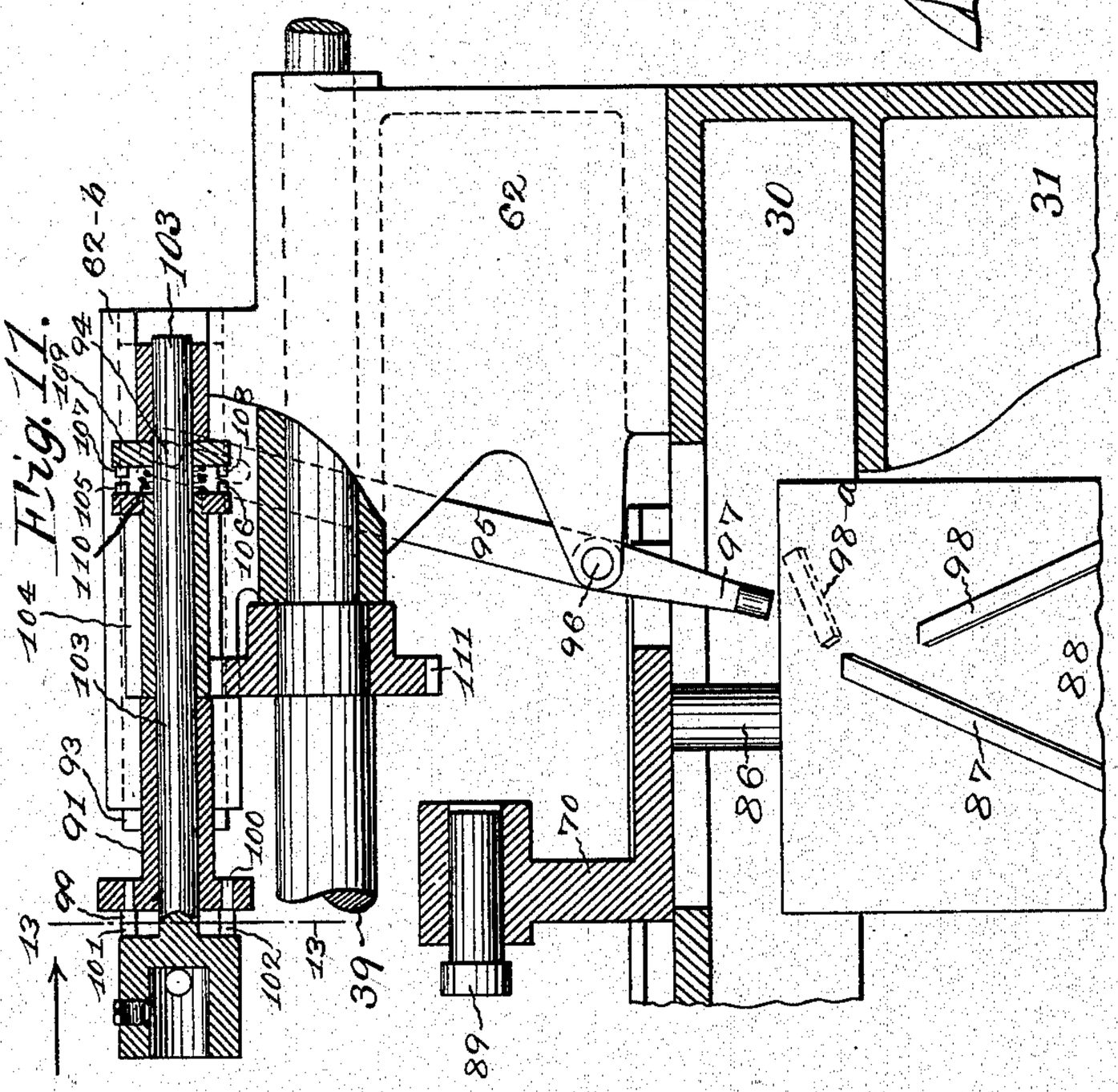


Fig. 14.



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UNITED STATES PATENT OFFICE.

EDWARD E. CLAUSSEN, OF HARTFORD, CONNECTICUT.

METAL-SCREW MACHINE.

SPECIFICATION forming part of Letters Patent No. 612,558, dated October 18, 1898.

Application filed September 11, 1897. Serial No. 651,265. (No model.)

To all whom it may concern:

Be it known that I, EDWARD E. CLAUSSEN, 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 Metal-Screw Machines, of which the following is a full, clear, and exact specification.

This invention relates to improvements in metal-screw machines such as used for the manufacture of fancy nuts, knobs, balls, screws, bolts, washers, &c., from the end of a metal rod or wire; and the object and features embraced by the invention are of such construction and organization that a series of screw-rods may be operated upon at the same time, but independently, by the tools, each performing distinct functions, thereby enlarging the production of the machine and turning out articles which require to be duplicated a great many times very cheaply, which heretofore necessitated supplemental operations to complete them or required to be finished partly by other machines or a series of manual operations.

The main difficulty in machines of this nature lies in the fact that as a rule too much is required of the cams at a single operation, and it is usually the case that a single cam is called upon to perform several functions at a single operation. This is a very serious mistake, not only because too much work is thereby thrown upon a single element of the machine, but for the further reason that the parts are thus overworked and thereby frequently fail to respond to their requirements, and the machine is therefore constantly undergoing repairs, and, furthermore, it is of great importance that each individual operation should be forced on the rods or screw-stock at its required speed and to the proper extent, which is impossible when all the tools are mounted in one tool-head. It is therefore another object of my invention to give each tool, wherever I deem it necessary, its individual motion, and thereby attain greater perfection of product, and also a larger output is insured and a great amount of expense saved, and the machine is more quickly adjusted when changing from one style of screw or article manufactured to another.

In order that those skilled in the art to which my invention appertains may more fully understand the nature and construction of the same and may obtain a better knowledge of the several operations required, I will proceed to a detailed description thereof, reference being had to the accompanying drawings, which form a part of this specification, and in which—

Figure 1 represents a sectional front elevation from the right-hand side of the machine, which is shown to be in a position where the push-chuck for holding the rod in the lower spindle is opened, and the feed-sleeve is in its rear position ready to feed that rod forward, also showing the tool-head in its rearward position and having the threading mechanism represented in a modified construction. Fig. 2 is a front elevation of the left-hand side of the machine, showing one of the screw-slotting members in section. Fig. 3 is a plan view of that which is represented in Fig. 1. Fig. 4 is an end view of the left-hand end of the machine, omitting the oil-pan. Fig. 5 is a sectional end view of the right-hand end of the machine, the section being taken on the broken line 5 5 and in the direction of the arrows of Fig. 1. Fig. 6 is a sectional end view taken on line 6 6 and in the direction of the arrow of Fig. 1. Fig. 7 is a sectional end view of the machine taken on the broken line 7 7 of Fig. 1 and in the direction of the arrow, showing the tool-head, the slotting-turret, and the cutting-off slide. Fig. 8 represents a sectional end view of the spindle-head, the section being taken on the broken line 8 8 and in the direction of the arrow of Fig. 1. Figs. 9 and 10 represent a sectional and an end elevation of a rod-supporting stand which is placed several feet rearward of the machine, according to the length of the rods or stock used. Fig. 11 shows a sectional side elevation of the threading mechanism in the preferred construction. Fig. 12 is an end view of what is represented in Fig. 11 and taken upon the right-hand side of the same, while Fig. 13 shows a sectional front view on line 13 13 of Fig. 11 in the direction of the arrow.

The machine of my present invention consists of the screw-rods carried by running screw-rod-supplying spindles provided with chucks and mounted in a drum and arranged

at equal distances about a circle which is concentric with the center line of the drum and having the capacity of an intermittent step-by-step rotation about its axis in a stationary head; a tool-holder head carrying a set of tools and having the capacity of reciprocating toward and from the screw-rods, thereby advancing upon and withdrawing the tools in the direction of the length of the wire and the intermittent step-by-step rotation of the rod-supplying spindles shifting the screw-rods rotatively, so as to present in succession each tool to the following rod after each reciprocation of the tool-holder head; the improved threading-die spindle having an independent motion of the tool-holder head for advancing upon and withdrawing the same; the clutches for holding the die-spindle stationary and running the same at an increased speed over the rod-supplying spindles and caused to be operated and so timed entirely independent of the reciprocating movement of the tool-holder head; the tapering attachment mounted on the stationary head and operatively connected to the tool-holder head; the series of chucks mounted in the chuck-turret and arranged at equal distances about a circle which is concentrical with the axis of the chuck-turret, the chucks having the capacity of gripping the screw-blank after being severed from the rod and the chuck-turret having a step-by-step orbital rotation, driven and operated by the rod-supplying spindle-drum and mounted and operated independently from the tool-holder head, and the orbital step-by-step rotative motion causing the chuck to shift concentrically, to present the work held in the chuck to the various auxiliary spindles mounted on the stationary head, and, as the chuck-turret reciprocates, the work held in the chuck is advanced upon and withdrawn from the tools in the auxiliary spindles.

The important advantages of the machine are its great capacity for rapidly turning out work, duplicated a great many times, and the complete automatic action of the machine, which may be run continuously with little or no attention from the operator.

In the accompanying drawings like numbers of reference designate like and corresponding parts throughout.

Referring to the drawings, the numeral 30 designates the bed of the machine, of any construction suitable for supporting the operative parts of the machine, and which has rigidly affixed the legs 31 and 32, which are carried by the oil-pan 33. The legs 31 and 32 are provided with hubs 31^a and 32^a, in which the cam-shaft 34 is rotatively mounted, which carries the various cam-drums for operating and communicating motion to the various parts of the machine. Upon the bed 30 is rigidly mounted the spindle-head 35, in which is revolubly supported the spindle-turret 36 and held in position by the ring 37, having its inner side beveled to prevent longitudinal movement of the spindle-turret. In the spindle-turret is rotatively mounted a series of rod-carrying spindles 38 in substantial parallelism with the driving-shaft 39, which are equidistantly disposed and on a circle concentrical with the driving-shaft. Any desired number of rod-supplying spindles may be arranged, the number depending upon the quantity of articles to be made and also upon the number of operations it is desired to perform upon the blank. In the construction of the machine herein illustrated I have shown the same equipped to make one screw, and therefore four rod-supplying spindles, which are preferably horizontally mounted.

The rod-carrying spindles are of the usual and well-known construction and consist of the tubular spindles 38, each having secured upon one end a spindle-casing 40, the inner side of which is beveled for the purpose as hereinafter specified. Mounted in each spindle 38 and concentrical therewith is the chuck-sleeve 41, which has the front end beveled off to form a push-chuck 42, and that chuck is made to fit the inner side of the bevel of the spindle-casing 40. On the rear end of the chuck-sleeve is fitted the chuck-sleeve collar 43. Mounted loosely on each spindle is the cone 44, which is adapted to be moved longitudinally thereon, and when caused to be moved it forces its conical side under the two levers 45, which are thus brought against the collar 43, which carries the sleeve, with its beveled chuck, into the beveled opening of the spindle-casing, thereby forcing the jaws of the chuck together to clamp the rod in the well-known manner. The feed-sleeve 46 is provided at the front end with springs 47, which are adapted to press upon the rod with sufficient friction so that the rod may be carried thereby when the push-chuck 42 is opened. When the rod is clamped by the push-chuck, the springs 47 may slide back over the rod to be in position to carry the rod forward when the clutch is again opened.

The mechanism for operating the feed-sleeve for automatically feeding the rod into position and the chuck-sleeve to which the push-chuck is attached to grasp the rod when it is fed forward into its proper position and also to release the same automatically is as follows: To the spindle-head 35, and extending rearward at each side of the machine, are rigidly connected two guide-bars 48 and 49, upon which are longitudinally movable the slides 50 and 51, provided with projections 52 and 53 and also with segmental flanges 54 and 55, engaging a groove in the collar 56, rigidly connected to the feed-sleeve and the groove in the cone 44, respectively. At the rear end of the machine, and directly under the slides and mounted on the cam-shaft 34, is the cam-drum 57, provided with detachable cam-strips 58 and 59, which engage the projections 52 and 53 as that drum is revolved, as will hereinafter be more fully described.

Power is communicated to the machine in

the direction of the arrow 60ª by the pulley 60, fastened on the driving-shaft 39, which is journaled in the end bearing 62 and the spindle-turret 36 and carries rigidly connected thereto the driving-gear 63, which meshes into the spindle-gears 64, keyed to the spindles 38, thereby communicating a rotary motion to the rods in the direction of the arrow 64ª. (See Fig. 8.) Fastened to the shaft 39 is a bevel-gear 65, meshing into the bevel-gear 66 on shaft 67, and that shaft carries on its lower end a worm 68, meshing into the worm-wheel 69, securely keyed on the cam-shaft 34, whereby motion is communicated to the cam-shaft and drums thereon in the direction of the arrow 34ª. As previously stated, the rod-carrying spindles 38 (in this case four in number) are equidistantly disposed and parallel and are mounted in the spindle-turret 36 and have not only a rotary motion about their individual axes, but have also an intermittent orbital rotary motion with the driving-shaft as center, and that motion is imparted to the turret for the purpose of bringing the screw-rods carried by said spindles into successive axial alinement with the various tools carried by the tool-head 70, so that they may operate upon those rods, as will hereinafter be more fully explained.

In the construction of the machine herein illustrated I have equipped the rear end of the turret 36 for imparting the intermittent orbital rotary motion with four notches 71, (see Figs. 4 and 6,) against which the pawl 72 can press and turn that turret when caused to do so by its cam. The pawl 72 is pivotally mounted on a stud 73, fastened in the ring 74, which is loosely mounted on the turret and carries the stud 75, to which is connected the connecting-rod 76, which, again, is pivotally connected to the cam-arm 77, and that arm is fastened to the leg 32 by the stud 78. The cam-arm 77 is provided with the projection 79, which engages the adjustable cam-strip 80 of the index-cam 81. The throw of the cam-strip, that causes to operate the projection 79, is sufficient to rotate the ring 71 one-quarter of a revolution and thereby also causing the pawl 72 and the turret to be rotated one-quarter of a revolution.

As a means for locking and unlocking the turret in its proper position after receiving the intermittent orbital rotary motion I have provided the turret with four recesses 82, into which the locking-bolt 83 is adapted to be projected and hold the same until automatically released by its cam. For this purpose the locking-bolt is provided with a projection 84, engaging the outer circumference of the cam-disk 81, and that locking-bolt is bifurcated at its lower end and straddles the hub 32ª to guide the same in its vertical up-and-down motion.

The timing of the cam-strips 58, that operate the feed-sleeve 46, the timing of the cam-strips 59, that operate the chuck-sleeve to open and close the push-chuck 42, the timing of the cam 81, that regulates the releasing and locking of the locking-bolt 83, and, finally, the location and length of cam-strip 80, that causes to throw the turret 36 one-quarter of a revolution, are all in such relation to one another that the feed-sleeve is drawn back, the push-chuck is opened, and then the feed-sleeve is pushed forward and feeds a new section of rod forward. The push-chuck is then forced back into its seat, thereby gripping the same. The spindle-turret is then unlocked and turned one-quarter of a revolution and locked again by the locking-bolt.

In the drawings I have represented the tool-head 70, to which some of the tools are rigidly affixed, as a sliding reciprocating carriage provided with a projection 86, engaging the adjustable cam-strips 87 on the cap-drum 88, by which the tool-head is governed to the proper extent in its backward-and-forward motion and at the proper speed when the tools engage and disengage the rods.

Securely fastened in the tool-head 70 is the stop or bunter 89, against which the screw-rod is fed just as or before the tool-head arrives at the extreme end of its forward movement, the last part of that forward movement being utilized to push back the stock, the rod thereby receiving an exact positive feed, in which position the stock is then clamped by the push-chuck and may then be operated upon by the various tools.

The box-tool 90 is of any construction well-known to the art as used in this class of machines and is also carried in the tool-head 70.

As a novel and convenient means for operating the threading-spindle I have in its preferred construction shown the same in Figs. 11, 12, and 13, and the same consists of the threading-slide 91, having the two laterally-projecting cross-heads 92 and 93, sliding in the guides 62ª and 62ᵇ, integral with the end bearing 62. Fastened to the cross-head 93 is the stud 94, which is operated by the arm 95, fastened to the cross-shaft 96, which is journaled for oscillation in projecting lugs of the end bearing 62, and that cross-shaft carries the cam-arm 97, which is operated by its cam-strip 98, fastened on the drum 88, and whereby the threading-slide is moved forward and backward at the proper time and to the extent required. At the front end of the threading-slide I have arranged the clutch-pins 99 and 100, which engage the pins 101 and 102, fastened in the threading-spindle 103, which has a limited axial movement and which is enlarged at its front end and provided with a socket adapted to receive a threading-die of well-known construction. Mounted loosely on the threading-spindle 103 is the pinion 104, carrying the clutch-pins 105 and 106, adapted to engage the pins 107 and 108 of the collar 109, fastened upon the die-spindle 103. Around the die-spindle I have arranged the coil-spring 110, which tends to force the spindle in its limited axial line of movement into

engagement by virtue of the pins 99 and 100 with the threading-slide. On the driving-shaft 39 is fastened the gear 111, of larger diameter than the gear 63, and which meshes into the pinion 104 and drives the same continuously at a higher rate of speed than the rod-rotating spindles.

The manner in which the threading-die operates upon the respective rod-rotating spindles and the screw-rods held thereby is as follows: The screw-stock having been previously cut down by the box-tool to the proper extent and to the required diameter, the threading-slide 91 is forced forward by the engagement of the cam-arm 97 against the cam-strip 98 and the spring 110 forcing the die-spindle back, so that the pins 101 and 102 engage the pins 99 and 100, respectively, thereby holding the die-spindle stationary, and as the threading-slide advances will force the die upon the rod and cut the thread. When the thread is cut far enough, the cam-arm 97 engages the cam-strip 98[a], thereby reversing the movement of the threading-slide and causing it to disengage the pins 99 and 100 from the pins 101 and 102, respectively, and engage the pins 107 and 108 with the pins 105 and 106, respectively, of the rotating pinion, and as that pinion rotates faster than the screw-rod the die is backed off from that rod. The forward and backward movements of the die-spindle in this construction are entirely independent of any other movements or operations of other tools, which saves a great deal of trouble in adjusting the threading-dies to cut properly and to the required extent, and therefore better and more work is produced by arranging the die-spindle separately from the movement of the tool-head.

The cutting-off mechanism (best shown in Figs. 1 and 7) consists of the cross-slide 114, mounted transversely on the bed 30 of the machine in the guide 115 and supporting the cutting-off tool 116, which is caused to move laterally against and also retrograde from the rotating rod or screw-stock by a set of levers 117 and 118, operating on each end of the cross-slide and pivotally mounted in projecting hubs adjacent to the side of said bed by the studs 119 and 120, respectively. The lower ends of said levers are acted upon by cam-strips 121 and 122, respectively fastened to the cam 123. The timing of the two cam-strips relatively to one another is such that the cutting-tool is forced against the rotating screw-stock by the lever 117, and when the blank has been severed from that rod the slide is returned by the lever 118 acting against the cam-strip 122.

For turning tapers I have arranged on the top of the spindle-head 36 the tapering attachment, which consists of a platen 125, bolted to the spindle-head by bolts 126 and 127, by which the same may be set at any desired angle. On the platen is mounted the slide 128, which supports the cutting-tool in the tool-post 129 and carries at its free end the operating-roll 130, adjustably clamped to the slide by the set-screw 131. The spring 132 is fastened with one end to the slide and the other to the spindle-head, which therefore tends to draw the slide in the direction of the tool-head 70. When the taper attachment is set to an operative adjustment, the tool-head 70 when moving forward presses against the roll 130 and on its continued movement forces the slide 128 forward with it until it reaches its full stroke. When the tool-head is drawn back again, the spring 132 draws the slide back to its starting-point.

The mechanism for receiving the blank after the same has been severed from the rod, so that the auxiliary spindles may operate thereon, will now be described. The same consists of a chuck-turret adapted for reciprocatory movement and provided with a series of chucks adapted to grip the screw-blanks as they are cut off from the screw-rods and having an independent cam for operating that reciprocatory chuck-turret, suitable mechanism for rotating the chuck-turret simultaneously with and operated from the spindle-turret, mechanism for closing the chucks when the screw-blank is in its proper position and to hold the same while the slotting-saw or auxiliary rotating tools are operating upon the reversed end while the chuck-turret is moving forward in the direction of the spindle-turret, and chuck opening and ejecting devices operating simultaneously when the chuck-turret receives its intermittent step-by-step orbital rotation. The chuck-turret 135, mounted on the shaft 136, which has its bearings on one side in the hub 62[c] of the end bearing 62 and on the other side in a projecting hub of the spindle-head 35, carries a series of chucks 137, each having the front or projecting end split to form spring-jaws, and cone-shaped, to which is fitted the bushing 138, having the extension 139 integral therewith and adapted for axial movement, so that when the bushing is forced upon the cone the split chuck will close and clamp a screw-blank that may be placed therein, as will be more fully explained hereinafter, and when drawn off from that cone the split chuck will open and release that blank.

The manner in which the bushing is forced upon the cone is as follows: Pivotally mounted under the bed is the arm 140 (best shown in Figs. 2 and 7) on the shaft 141, which also carries the cam-arm 142, held in engagement with the cam-lug 143 on the cam-drum 144 on the cam-shaft 34 by the spring 145, and as that cam-shaft rotates the bushing is forced upon the cone at its respective intervals.

The time and mode of operation of forcing the bushing off from the split chuck will now be explained and is best shown in Figs. 2, 3, and 7. For reasons which will be more fully explained hereinafter the chuck-turret has besides the reciprocating movement an orbital intermittent rotary motion with the shaft

136 as a center, and this motion is utilized to force the bushing off from the split chuck by having the extension 139 engage the circular quadrant cam-piece provided with the cam 146.

The means whereby the chuck-turret is reciprocated and by which the orbital intermittent rotary motion is effected is as follows: Keyed to the shaft 136 by a spline and a feather is the chuck-turret 135, having on its hub the groove 135[a], into which the arm 147, pivoted on the stud 148, engages and is operated by the adjustable cam-strip 149 on the cam-drum 144, whereby the chuck-turret is reciprocated.

The intermittent orbital rotary motion of the chuck-turret is transmitted from the spindle-turret as follows: On the end of the spindle-turret, either fastened thereto or integral therewith, is the gear 150, meshing into the pinion 151, fastened on the shaft 152, which extends to both sides, on the one side to the rod-supporting stand A and through to the other side to the driving-pulley side of the machine, and has its bearings on one side in the lug 35[a] of the spindle-head 35 and in the lug 62[d] of the end bearing 62. On the driving-pulley end the shaft 152 has connected thereto the gear 153, meshing into the spur-gear 154, which is fastened to the shaft 136. The intermittent orbital rotary motion, which is imparted to the spindle-turret 36, as previously described, is therefore transferred to the shaft 136 and to the chuck-turret, the ratio or proportion of the gears 150, 151, 153, and 154 being such that one revolution of the spindle-turret gives one revolution of the chuck-turret.

The ejecting of the screw-blank out of the chuck is accomplished by the ejectors 155, mounted in each chuck, and as the respective chuck which is in alinement with the spindle on which the cutting-off tool is operating and severing the blank is forced on the screw-blank the ejector 155 is pushed back, and when that blank is completely severed the arm 140 is forced against the bushing 138, thus closing the split chuck and holding the blank to enable the auxiliary tools to perform their functions. When the chuck-turret 135 has reached its extreme limit of rearward movement, it has imparted thereto the orbital intermittent rotary motion which is utilized to force the ejector 155 against the screw-blank and out of the same by striking against the circular quadrant cam-piece provided with the cam-surface 156 and depositing the same in the chute 171 and receptacle 172, which is preferably in the shape of a wire basket fastened in any convenient place on the side of the machine.

In order to attain a perfect alinement of the slotting-chucks with the auxiliary spindles and maintain the same throughout the running of the machine, I have arranged the guide 170 adjacent to the bed of the machine, provided with two flanges, between which the outer parts of the chuck-turret engage, thereby bringing the axes of the slotting-chucks in line with the axes of the auxiliary spindles, which would not be the case relying wholly upon the gears 150, 151, 153, and 154.

The auxiliary spindles consist of a series of rotating spindles having tools attached thereto, as the saw 157, fastened on the arbor 158, mounted on a hub of a spindle-head driven by the pulley 159 and which has the axis of the spindle at ninety degrees to the axial line of the movement of the turret and which is driven by any convenient overhead counter-shaft. Another form of spindle 160 I have represented, in which the axis of the spindle is in alinement with the axial line movement of the chuck-turret, and that spindle is adapted to be provided with a drill-chuck to receive the drill or hollow mill or boring tool, as the case may be. The spindle 160 is journaled in a hub of the spindle-head and is driven by the pulley 161.

As the screw-rods are quite long and apt to become entangled with one another when the intermittent orbital rotary motion is imparted, besides the rods being revolved about their own axes, I placed a rod-supporting stand A (best shown in Figs. 9 and 10) in front of the machine, through which the rods pass before they are placed in the spindles of the screw-machine, and the same consists of the supporting-column 163, having at the upper end the annular head 163[a], in which the rollers 164 are adapted to revolve, journaled on the hubs 165 of the retainer, consisting of the spur-gear 166, which is preferably of the same size as the spindle-turret gear 150, and that spur-gear meshes into the pinion 167, of the same size as the gear 151, which is fastened on the shaft 152. The intermittent orbital rotary motion that is therefore imparted to the spindle-turret is also transferred to the spur-gear 166, and the screw-rods are thereby supported and held in alinement with their respective spindles.

As a novel and convenient means for retaining the cone 44 and the collar 56 of the feed-sleeve in position when the intermittent orbital rotary motion of the spindle-turret takes place and after leaving the flanges 54 and 55 of the slides 50 and 51, respectively, I have arranged the semicircular rings 173 and 174, fastened to the spindle-head 36 by the stud-bolts 175 and each capable of longitudinal adjustment by nuts 176. The lower part of the rings is cut away, so that the collars 56 and cones 44 may be brought out of their normal position, caused by the slides and their respective cams 58 and 59, and the width of the semicircular rings 173 and 174 corresponds to the groove in the cone 44 and collar 56, and when the machine is adjusted the planes passing through the front and rear of the semicircular rings 173 and 174 will correspond with the planes through the front and rear faces of the cone 44 and collar 56 when the same are in the positions where the

feed-sleeve is forced forward and the push-chuck clamps the rod respectively, and thereby maintains these positions during the time the tools are operating upon the rods.

In the drawings I have shown a modified form where the threading-slide and die-spindle are mounted in the tool-slide instead of upon the stationary end bearing, but receiving the independent motion by its respective cam-strip and entirely independent of the forward and backward reciprocatory motion of that tool-slide. The modification consists of the threading-slide $91^{\times}$, adapted for backward and forward reciprocatory movement and having the stud $94^{\times}$ fastened thereto, which is engaged by the arm $95^{\times}$, fastened to the cross-shaft $96^{\times}$, which has securely fastened thereto the cam-arm $97^{\times}$, which engages the cam-strip $98^{\times}$ and whereby the slide is governed in its reciprocatory movements. In the threading-slide is mounted for limited axial movement the die-spindle $103^{\times}$, which has an enlargement at its operative end provided with a socket which receives the die of the required size and pitch to be cut and is provided with clutch-pins $100^{\times}$, adapted to engage the clutch-pins $99^{\times}$ in the threading-slide $91^{\times}$. On the rear end of the die-spindle is the collar $109^{\times}$, provided with clutch-pins $107^{\times}$, adapted to engage the clutch-pins $105^{\times}$ in the pinion $104^{\times}$, meshing into the gear 111 on the driving-shaft 39 and whereby the pinion is continuously revolved in the direction for backing off the die and at a speed faster than the rod-rotating spindles. As the threading-slide is forced forward, caused by its respective cam-strip, in the direction toward the spindle-head the pins $100^{\times}$ of the die-spindle engage the pins $99^{\times}$ of the threading-slide $91^{\times}$, thereby holding the die-spindle stationary, and as the slide continues to advance will force the die upon the rotating screw-rod and cut the thread. When the thread is cut far enough, the cam-arm $97^{\times}$ is reversed, which disengages the pins $99^{\times}$ and $100^{\times}$ and engages the pins $105^{\times}$ and $107^{\times}$ of the rotating pinion, and as that pinion rotates faster than the screw-rod it causes the die to back off from the rod.

The operation of the machine may be described as follows: The various tools of proper size and shape having been set and adjusted to place to suit the requirement the stock or screw-rods may be inserted into and through the hubs 165 of the retainer, mounted in the supporting-stand A, which is placed several feet from the screw-machine, and also having been inserted into and through the rod-carrying spindles 38, and the rods having been firmly clamped by the push-chuck 42 and the clutch device, as previously explained, to the spindle-casing 40 and therefore to the spindles, and, furthermore, the spindles having been set into a rotary motion and the tool-head having arrived at its outer limit of retreat, the push-chuck of the lower spindle having been released and the corresponding feed-sleeve having been drawn back its full stroke, the parts of the machine assume at this time the relative positions as shown in the drawings. After having fed the rod forward and clamped the same into position the spindle-turret is released and then rotated a quarter of a revolution and then relocked, which brings that rod in alinement with the box-tools, and as the tool-head advances the box-tool 90 is forced upon that rod and cuts the same down to the required diameter and length. After the tool-head is retracted to its rearward limit the spindle-head is again unlocked, turned one-quarter of a revolution, and locked again against axial rotation. The rod at this location arrives at the upper position in axial alinement with the threading-spindle, and as the die-spindle is held stationary or in contact against rotation by virtue of the spring 110, forcing the engagement of the pins 99 and 101 and also 100 and 102, respectively, of the slide, and as that threading-slide 91 is brought forward by its independent cam, the die is forced upon the rod and when cut far enough the motion of the threading-slide is reversed, thereby disengaging the pins 99 and 101 and also 100 and 102 and engaging the pins 107 and 108 of the collar with the pins 105 and 106 of the pinion 104, and as that pinion revolves faster than that rod the die is thereby backed off from the rod. When the thread is completed and the threading-slide has reached its rearward limit, the spindle-head is again unlocked, rotated one-quarter of a revolution, and relocked into position. The rod at this stage has arrived in position for the cross-slide, with its cutting-off tool, to operate thereon and into axial alinement with one of the chucks of the chuck-turret, and as the cutting-off tool is brought into operation by virtue of the cam-strip 121 acting against the lever 117 it forces the cutting-off tool across the path of that rod and severs the screw-blank from the rod. Contemporaneously with this movement of the cross-slide the chuck-turret moves slowly toward the spindle-head, guided by the guide 170, and as one of said chucks is in alinement with the spindle that chuck will pass onto that screw-body, and when the screw-blank is completely severed from the screw-rod the arm 140 pushes the bushing 138 upon the conical seat of that chuck by means of the cam-lug 143 of the drum 144, thereby holding and retaining the completed screw-blank in that chuck of the chuck-turret to complete the screw by the operations of the auxiliary spindles. The spindle-turret is then again unlocked and turned one-quarter of a revolution, which operation also rotates the chuck-turret one-quarter of a revolution by means of the gear 150, pinion 151, shaft 152, pinion 153, and gear 154 on the chuck-turret shaft 136, bringing the screw-blank in line with the slotting-saw. The spindle-turret is then locked, and as the cam-shaft continues to revolve the cam-strip 149 causes to move the chuck-turret

forward, through the intermediate mechanism, until the screw-blank engages the slotting-saw 157 and receives the proper depth of slot from the saw. The chuck-turret is then retracted to its rearward limit and turned one-quarter of a revolution, as previously explained, and when again forced forward the tool in the rotating spindle 160 is brought into operation upon the blank. The chuck-turret is then retracted to its rearward limit and then again rotated about its axis one-quarter of a revolution, which latter motion is utilized to force the bushing 138 from its conical seat on the chuck by the extension 139 striking on the inclined cam-surface 146 of the circular quadrant, and when thus released the completed screw is ejected by the ejector 155 striking on the cam-surface 156 of the circular quadrant upon the chute 171 and into the receptacle 172.

Previous to my invention multiple-spindle screw-machines have been operated in which the whole series of spindles have their rotary motion reversed to back off the die, which operation is very cumbersome, and a losing of time results. Another form of construction is to provide the rod-rotating spindles with clutch members and to interrupt their rotation and to rotate the die-spindle continuously, and in that way back off the die. A still further construction in this class of machines is to mount the threading-die in the tool-carriage, and as the advancing movement of that tool-carriage must be very slow, on account of the cutting-down or box tool, the die-spindle is forced to cut the thread on the rod by a difference between the speed of rotation of the rod-spindles and the die-spindle, and when the thread is cut far enough the die-spindle has its rotary movement checked and then backs off the die. All of these devices are, however, the source of a great deal of trouble and bad work, whereas in my present invention the die-spindle is mounted independently in its slide and independently of any other tool and has its own cam to be operated by. The die is therefore set and adjusted entirely to its requirements as to speed for forcing the thread on the rod, and when cut far enough may be backed off at its required speed independently of the backward or forward movements of any other tools. It will be clearly seen that the separating of the several operations which are required to be performed upon the rod successively to complete the screw are in this construction simplified, so that they are more accurately and more rapidly adjusted to their distinct requirements, and, in fact, the output of the machine increased and far better and more satisfactory results attained than in the previous machines of this character.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination of the framework; of the spindle-turret mounted for rotation in the framework; a plurality of spindles mounted in the spindle-turret and provided with chucks; mechanism for driving said spindles, mechanism for imparting to the spindle-turret an intermittent orbital rotary motion; mechanism for locking the spindle-turret after each partial rotation, the cam-strip 87, the tool-head provided with tools and operated by said cam, the cam-strip 98, the threading-slide adapted to be operated by said cam, the threading-die spindle provided at each end with the clutch members, the pinion 104, clutch-pins on that pinion, combined and operating so that at the forward movement of the threading-slide the die-spindle is stationary and on the rearward motion thereof, the die-spindle revolves with the pinion, substantially as described.

2. The combination of the framework; of the spindle-turret mounted for rotation in the framework; a plurality of spindles mounted in the spindle-turret and provided with chucks; mechanism for driving said spindles, mechanism for imparting to the spindle-turret an intermittent orbital rotary motion; mechanism for locking the spindle-turret after each partial rotation, the semicircular rings, said rings retaining the feed-sleeve and the chuck-collar in position, substantially as described.

3. The combination of the framework; of the spindle-turret mounted for rotation in the framework; a plurality of spindles mounted in the spindle-turret and provided with chucks; mechanism for driving said spindles, mechanism for imparting to the spindle-turret an intermittent orbital rotary motion; mechanism for locking the spindle-turret after each partial rotation, and the semicircular rings, the same being attached to the spindle-head and having the lower sections omitted so that the feed-collar and the cone may be brought out of and again returned to their normal position, substantially as described.

4. The combination of the framework; of the spindle-turret mounted for rotation in the framework; a plurality of spindles mounted in the spindle-turret and provided with chucks mechanism for driving said spindles, mechanism for imparting to the spindle-turret an intermittent orbital rotary motion; mechanism for locking the spindle-turret after each partial rotation, the semicircular rings, the stud-bolts 175 upon which those rings are adjustably mounted, all substantially as described.

5. The combination of the framework; of the spindle-turret mounted for rotation in the framework; a plurality of spindles mounted in the spindle-turret and provided with chucks; mechanism for driving said spindles; power mechanism for imparting to the spindle-turret an intermittent orbital rotary motion; the supporting-stand, the retainer mounted in that supporting-stand, and operatively connected by the gears 150, 151, shaft 152, gears 167, 166, substantially as described.

6. The combination of the framework; of the spindle-turret mounted for rotation in the framework; a plurality of spindles mounted in the spindle-turret and provided with chucks mechanism for driving said spindles, mechanism for imparting to the spindle-turret an intermittent orbital rotary motion, mechanism for locking the spindle-turret after each partial rotation, the gear 150 secured to, or forming a part of, the spindle-turret, the gear 151, shaft 152, gear 167 and gear 166 the latter provided with hubs through which the rods pass, all combined and operating to retain the rods in alinement, substantially as described.

7. In a screw making and slotting machine, the combination of a spindle-turret, a plurality of spindles mounted in said turret, mechanism for imparting an intermittent orbital rotary motion to that spindle-turret, one or more auxiliary spindles mounted in the stationary spindle-head, a chuck-turret adapted to receive the screw-blank and capable of a reciprocatory motion by means of the cam and to present the screw-blank to the auxiliary spindles while the chuck-turret receives the following screw-blank, substantially as described.

8. In a screw making and slotting machine, the combination of a spindle-turret; a plurality of spindles mounted in said spindle-turret, mechanism for imparting an intermittent orbital rotary motion to that spindle-turret; one or more auxiliary spindles mounted in the stationary spindle-head; a rotary chuck-turret provided with a series of chucks adapted to receive the screw-blank, mechanism for imparting an intermittent orbital rotary motion from that spindle-turret to the chuck-turret; mechanism for reciprocating that chuck-turret, and to slot the screw during the time the chuck-turret is receiving the following blank substantially as described.

9. In a screw making and slotting machine, the combination of a spindle-turret, a plurality of spindles mounted in said spindle-turret, mechanism for imparting an intermittent orbital rotary motion to that spindle-turret, one or more auxiliary spindles mounted in the spindle-head, a rotary chuck-turret provided with a series of chucks adapted to receive the screw-blank, mechanism for imparting the intermittent orbital rotary motion from that spindle-turret to the chuck-turret consisting of the gears 150 and 151, the shaft 152 and gears 153 and 154, and mechanism for reciprocating the chuck-turret by the cam-strip 149, substantially as described.

10. In a screw making and slotting machine, the combination of a spindle-turret; a plurality of spindles mounted in said spindle-turret, mechanism for imparting an intermittent orbital rotary motion to that spindle-turret, one or more auxiliary spindles mounted in the stationary spindle-head, a rotary chuck-turret provided with a series of chucks adapted to receive the screw-blank, mechanism for imparting an intermittent orbital rotary motion from that spindle-turret to the chuck-turret, and mechanism for ejecting the blank substantially as described.

11. In a screw making and slotting machine, the combination of a spindle-turret, a plurality of spindles mounted in said spindle-turret, mechanism for imparting an intermittent orbital rotary motion to that spindle-turret, one or more auxiliary spindles mounted in the spindle-head, a rotary chuck-turret provided with a series of chucks adapted to receive the screw-blank, mechanism for imparting the intermittent orbital rotary motion from that spindle-turret to the chuck-turret, the guide 170 to bring the chucks in alinement with the rod-spindle mechanism for reciprocating that chuck-turret, substantially as described and for the purpose set forth.

12. In a screw making and slotting machine, the combination of a spindle-turret; a plurality of spindles mounted in said spindle-turret, mechanism for imparting an intermittent orbital rotary motion to that spindle-turret; one or more auxiliary spindles mounted in the spindle-head; a rotary chuck-turret provided with a series of chucks adapted to receive the screw-blank, mechanism for imparting an intermittent orbital rotary motion from that spindle-turret to the chuck-turret; and mechanism to force the bushing 138 on the chuck to retain the screw-blank in the chuck, mechanism for reciprocating that chuck-turret and to slot the screw-blank while the chuck-turret receives the following blank, substantially as described.

13. In a screw making and slotting machine, the combination of a spindle-turret; a plurality of spindles mounted in said spindle-turret, mechanism for imparting an intermittent orbital rotary motion to that spindle-turret; one or more auxiliary spindles mounted in the spindle-head; a rotary chuck-turret provided with a series of chucks adapted to receive the screw-blank, mechanism for imparting an intermittent orbital rotary motion from that spindle-turret to the chuck-turret; mechanism for forcing the bushing 138 on the chuck to retain the screw-blank in the chuck mechanism for reciprocating that chuck-turret and to slot the screw-blank while the chuck-turret receives the following blank and mechanism to force the bushing 138 off from its seat, substantially as described.

14. In a screw making and slotting machine, the combination of a spindle-turret; a plurality of spindles mounted in said spindle-turret, mechanism for imparting an intermittent orbital rotary motion to that spindle-turret; one or more auxiliary spindles mounted in the spindle-head; a rotary chuck-turret provided with a series of chucks adapted to receive the screw-blank, mechanism for imparting an intermittent orbital rotary motion from that spindle-turret to the chuck-turret; mechanism for forcing the bushing 138 on the chuck to retain the screw-blank in the chuck, mechanism for reciprocating that chuck-tur-

ret and to slot the screw-blank while the chuck-turret receives the following blank and mechanism to force the bushing 138 off from its seat, acting during the intermittent orbital rotary motion of the chuck-turret, substantially as described.

15. In a screw making and slotting machine, the combination of a spindle-turret; a plurality of spindles mounted in said spindle-turret, mechanism for imparting an intermittent orbital rotary motion to that spindle-turret; one or more auxiliary spindles mounted in the spindle-head; a rotary chuck-turret provided with a series of chucks adapted to receive the screw-blank, mechanism for imparting an intermittent orbital rotary motion from that spindle-turret to the chuck-turret; mechanism for forcing the bushing 138 on the chuck to retain the screw-blank in the chuck mechanism for reciprocating that chuck-turret and to slot the screw-blank while the chuck-turret receives the following blank and mechanism to force the bushing 138 off from its seat, and mechanism for ejecting the slotted screw-blank, substantially as described.

16. In a screw making and slotting machine, the combination of a spindle-turret; a plurality of spindles mounted in said spindle-turret, mechanism for imparting an intermittent orbital rotary motion to that spindle-turret; one or more auxiliary spindles mounted in the spindle-head; a rotary chuck-turret provided with a series of chucks adapted to receive the screw-blank, mechanism for imparting an intermittent orbital rotary motion from that spindle-turret to the chuck-turret; mechanism for forcing the bushing 138 on the chuck to retain the screw-blank in the chuck mechanism for reciprocating that chuck-turret and to slot the screw-blank while the chuck-turret receives the following blank and mechanism to force the bushing 138 off from its seat, and mechanism for ejecting the slotted screw-blank, acting during the intermittent orbital rotary motion of the chuck-turret, substantially as described.

17. The combination of the framework; of the spindle-turret mounted for rotation in the framework; a plurality of spindles mounted in the spindle-turret and provided with chucks mechanism for driving said spindles, mechanism for imparting to the spindle-turret an intermittent orbital rotary motion; mechanism for locking the spindle-turret after each partial rotation, the tool-head provided with one or more tools and adapted for reciprocatory movement, the threading-slide provided with the die-spindle also adapted for reciprocatory movement independent of the movement of that tool-slide, the rotary chuck-turret provided with a series of chucks adapted to receive the screw-blank, mechanism for imparting the intermittent orbital rotary motion simultaneously with and from the spindle-turret, mechanism for reciprocating the chuck-turret independently of the tool-head, to receive and grip a screw-blank and slot the preceding blank on its forward movement and release and eject the blank while the chuck-turret receives its intermittent orbital rotary motion, substantially as described.

18. The combination of the framework; of the spindle-turret mounted for rotation in the framework; a plurality of spindles mounted in the spindle-turret and provided with chucks mechanism for driving said spindles, mechanism for imparting to the spindle-turret an intermittent orbital rotary motion; mechanism for locking the spindle-turret after each partial rotation; the tool-head provided with one or more tools, and adapted to receive a reciprocatory motion; the slide 128 mounted on the spindle-head and operated by the tool-head, substantially as described.

19. The combination of the framework; of the spindle-turret mounted for rotation in the framework; a plurality of spindles mounted in the spindle-turret and provided with chucks; mechanism for driving said spindles, mechanism for imparting to the spindle-turret an intermittent orbital rotary motion; mechanism for locking the spindle-turret after each partial rotation; the tool-head provided with one or more tools and adapted to receive a reciprocatory motion; the platen 125 adapted for angular adjustment and mounted on the spindle-head, the slide mounted in the platen and operatively connected to the tool-head, substantially as described.

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