No. 671,568. Patented Apr. 9, 1901.

G. SITTMANN.

SCREW MACHINE.

(Application filed Mar. 28, 1900.)

(No Model.) 8 Sheets—Sheet 1.

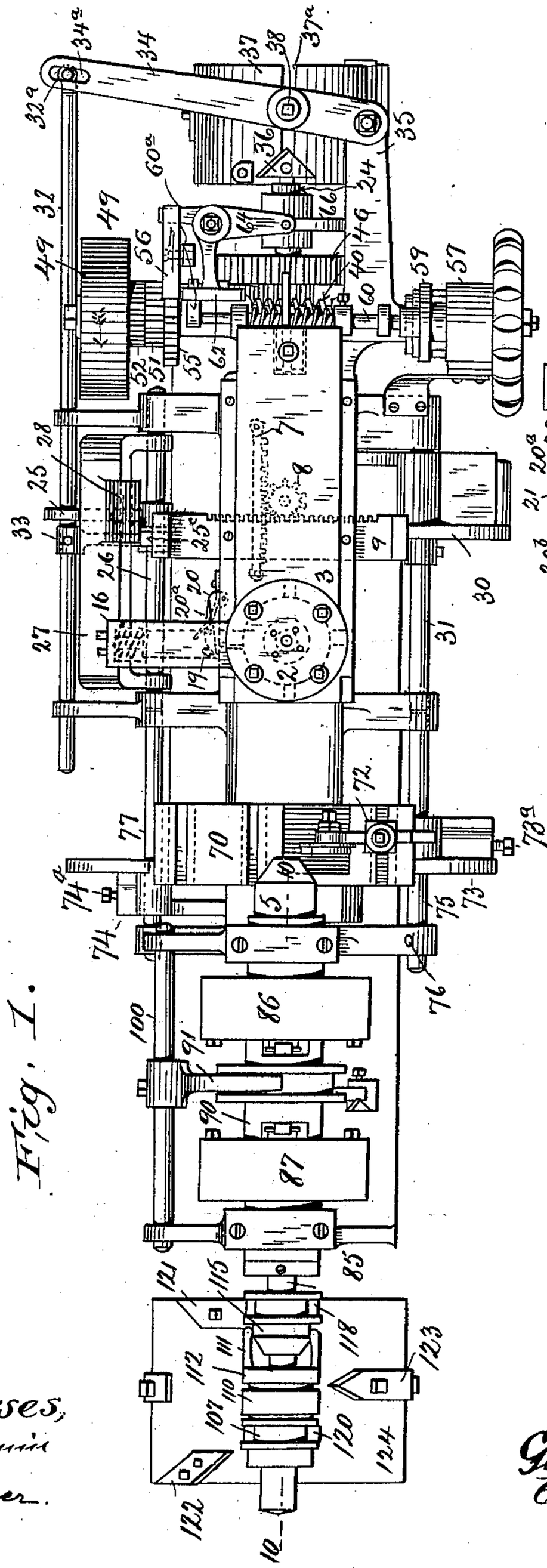

Fig. 1.

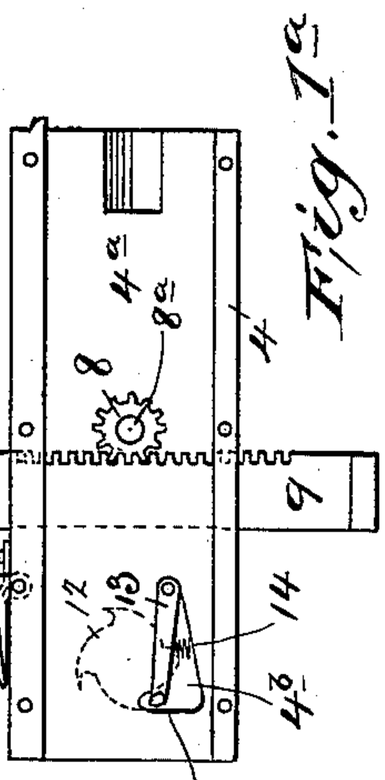

Fig. 1a.

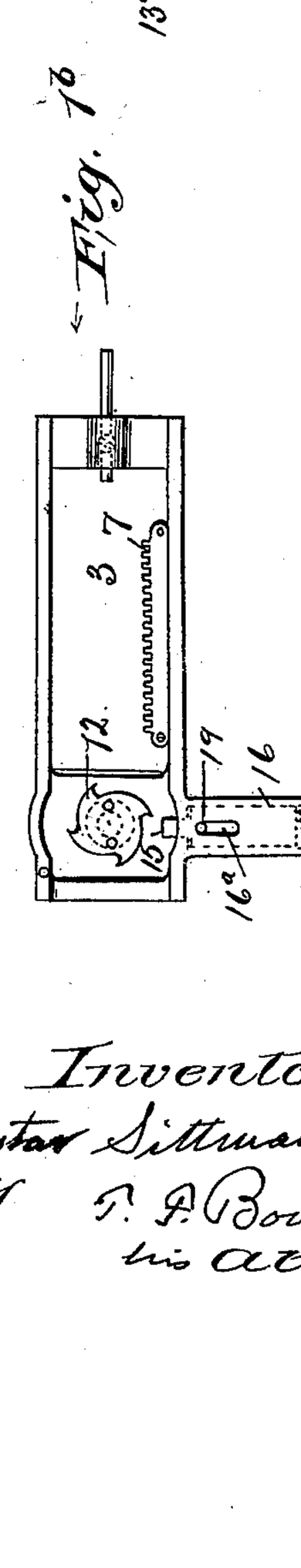

Fig. 1b.

Witnesses,
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F. E. Turner.

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by F. P. Bourne
his Atty

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(No Model.) 8 Sheets—Sheet 2.

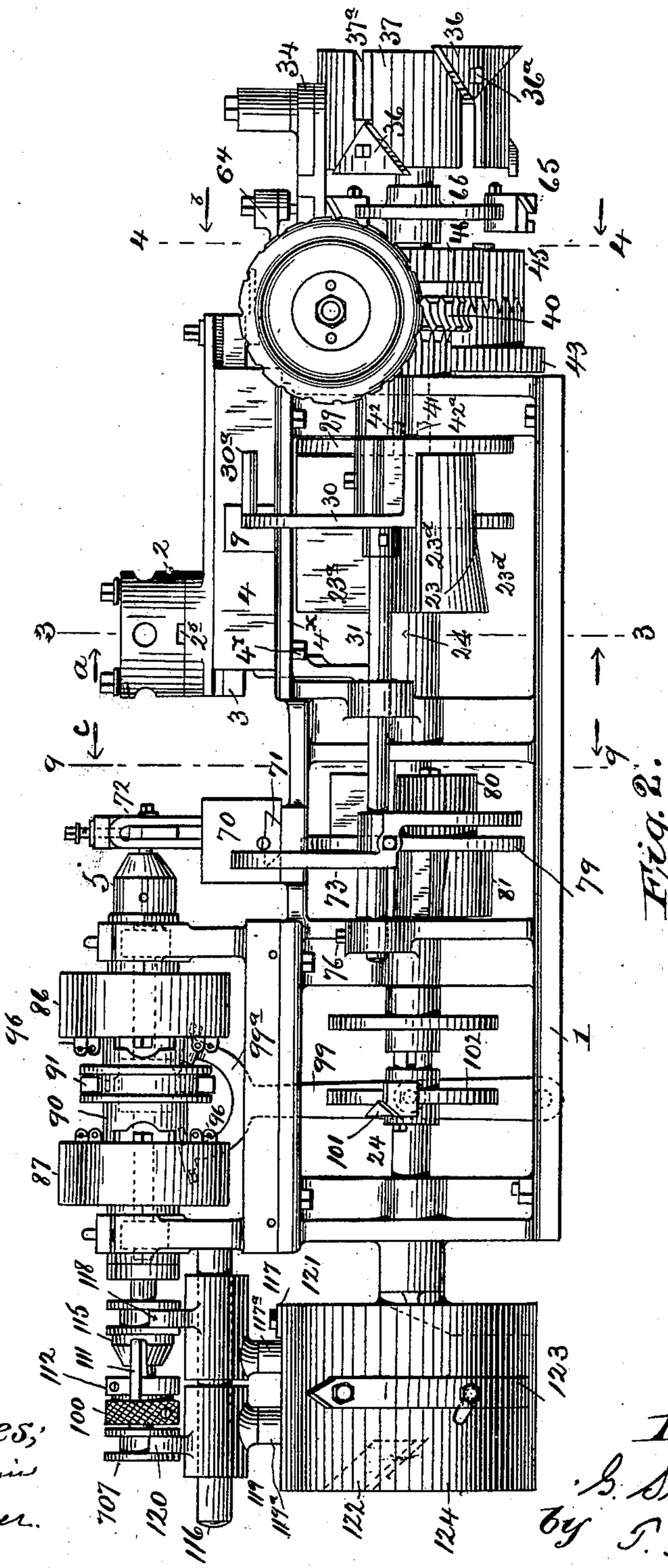

Fig. 2.

Witnesses;
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G. SITTMANN.

SCREW MACHINE.

(Application filed Mar. 28, 1900.)

(No Model.) 8 Sheets—Sheet 3.

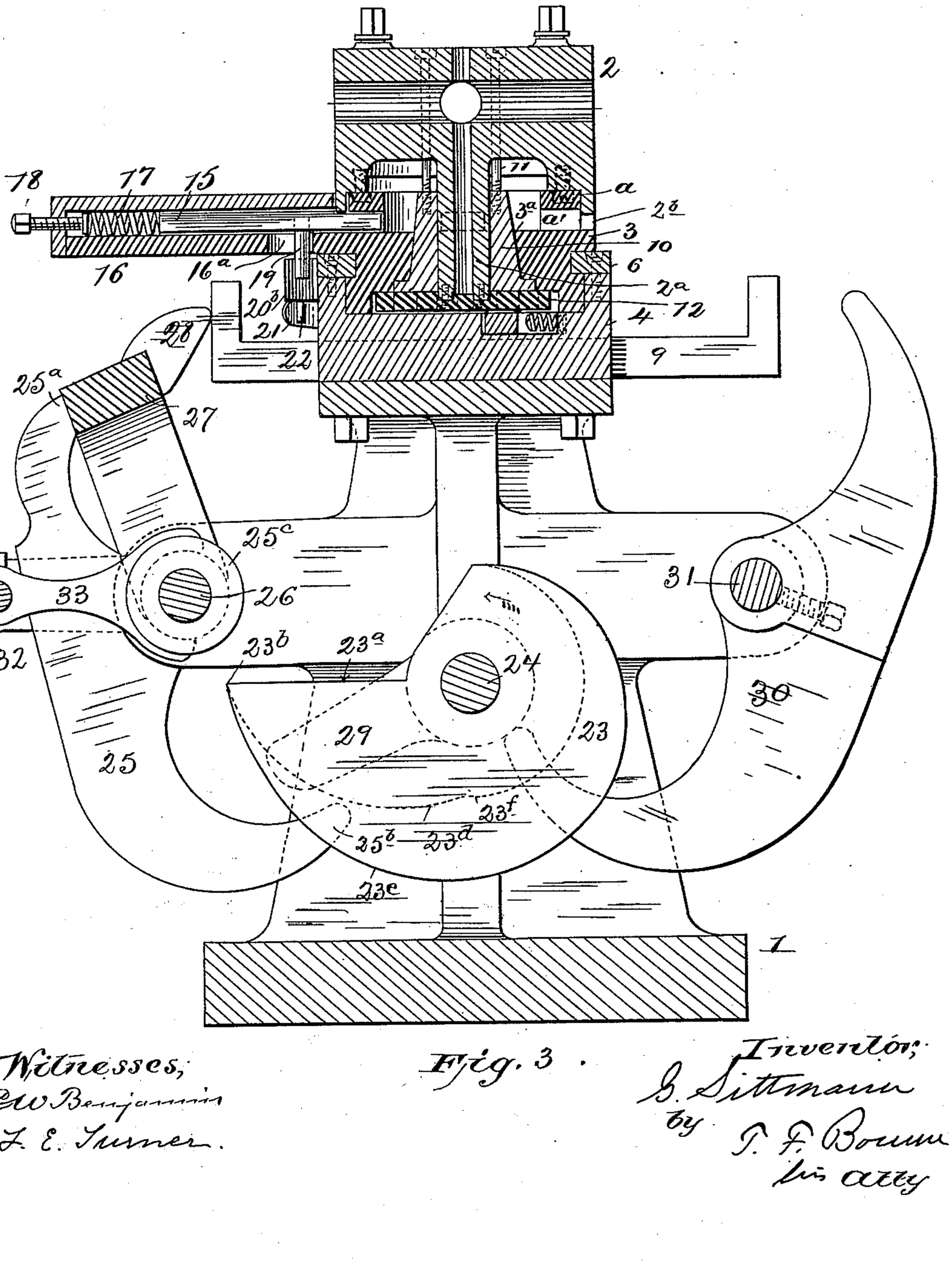

Fig. 3.

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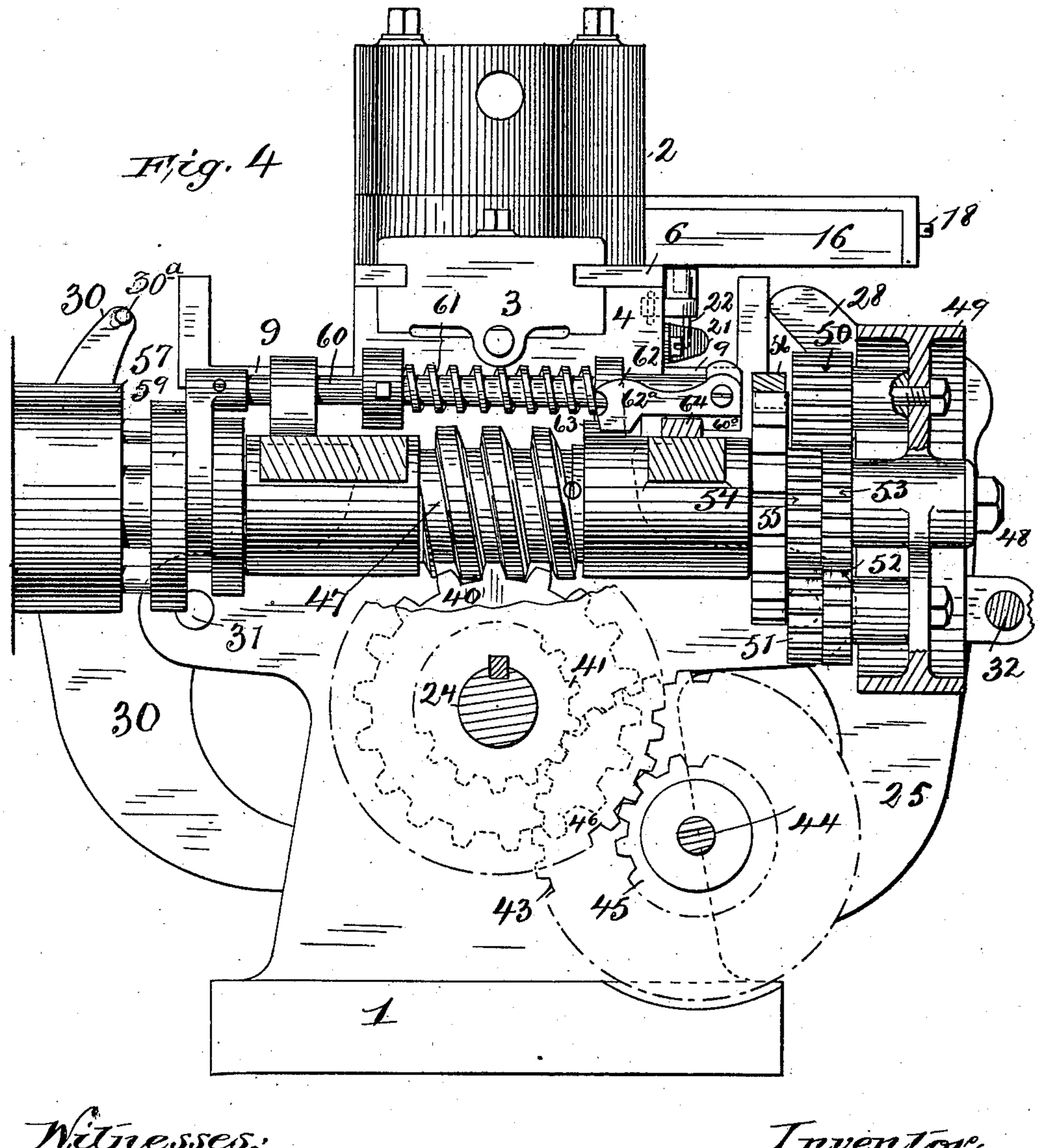
(No Model.) 8 Sheets—Sheet 4.

Fig. 4



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(No Model.) 8 Sheets—Sheet 5.

Fig. 5.

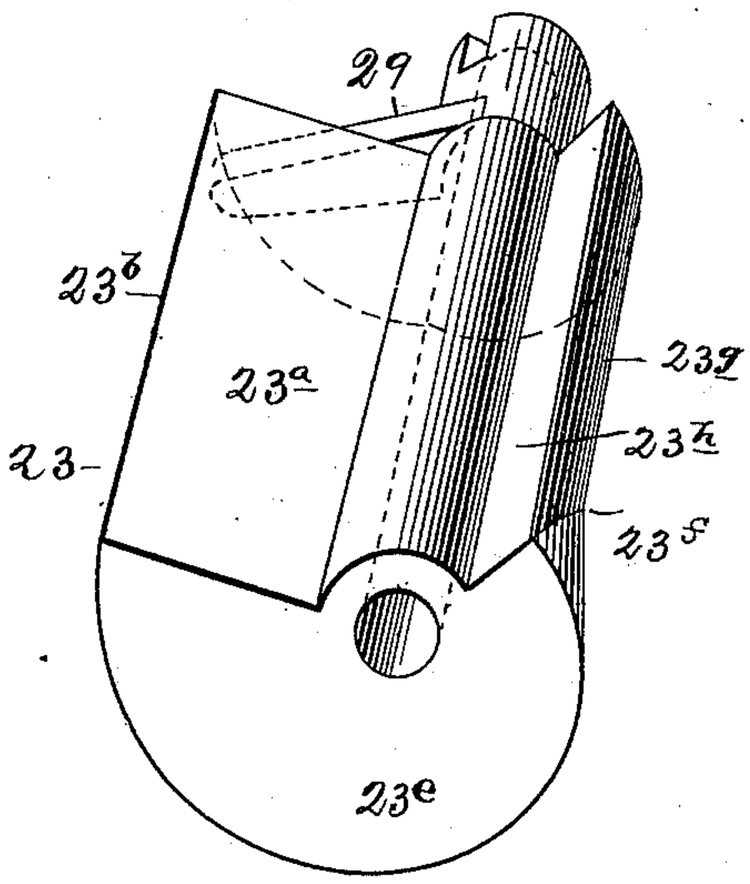
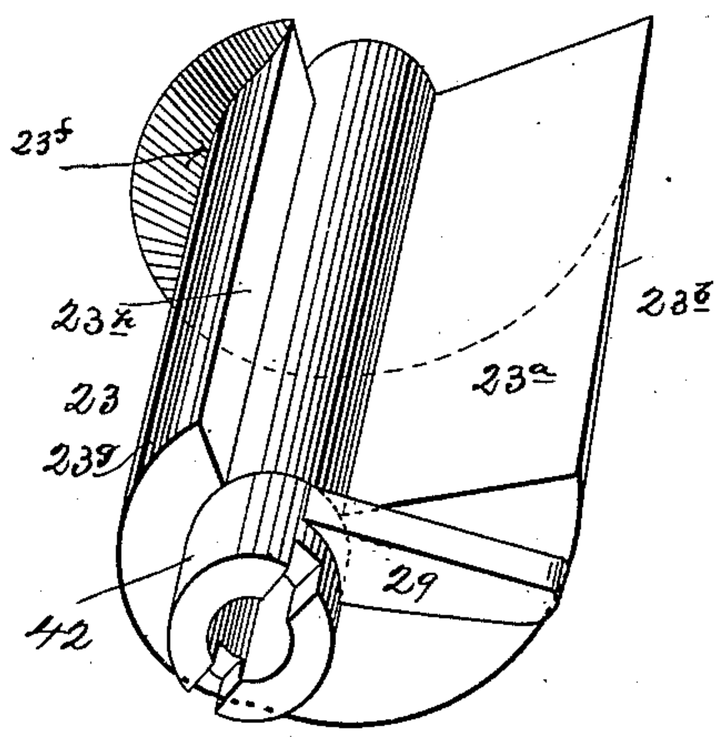


Fig. 7.



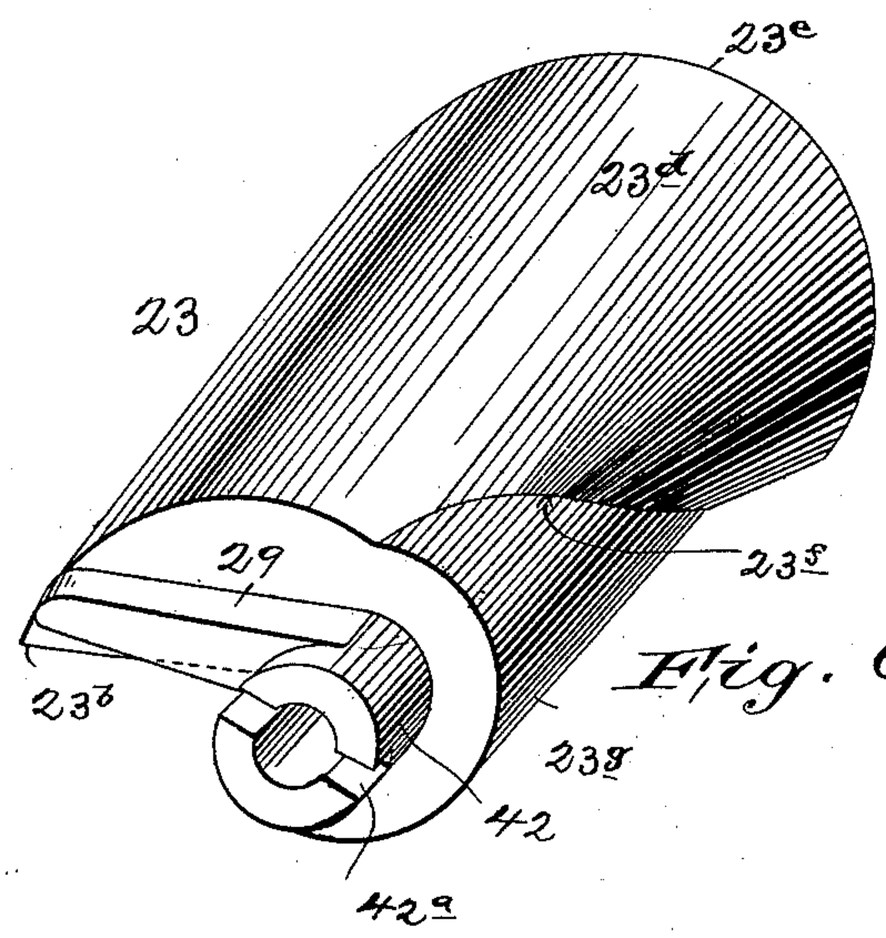
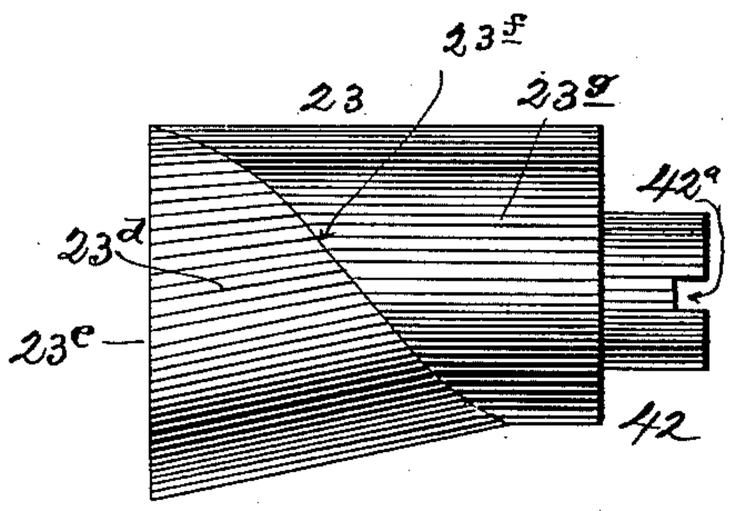


Fig. 6.

Fig. 8.



Witnesses;
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G. SITTMANN.

SCREW MACHINE.

(Application filed Mar. 28, 1900.)

(No Model.) 8 Sheets—Sheet 6.

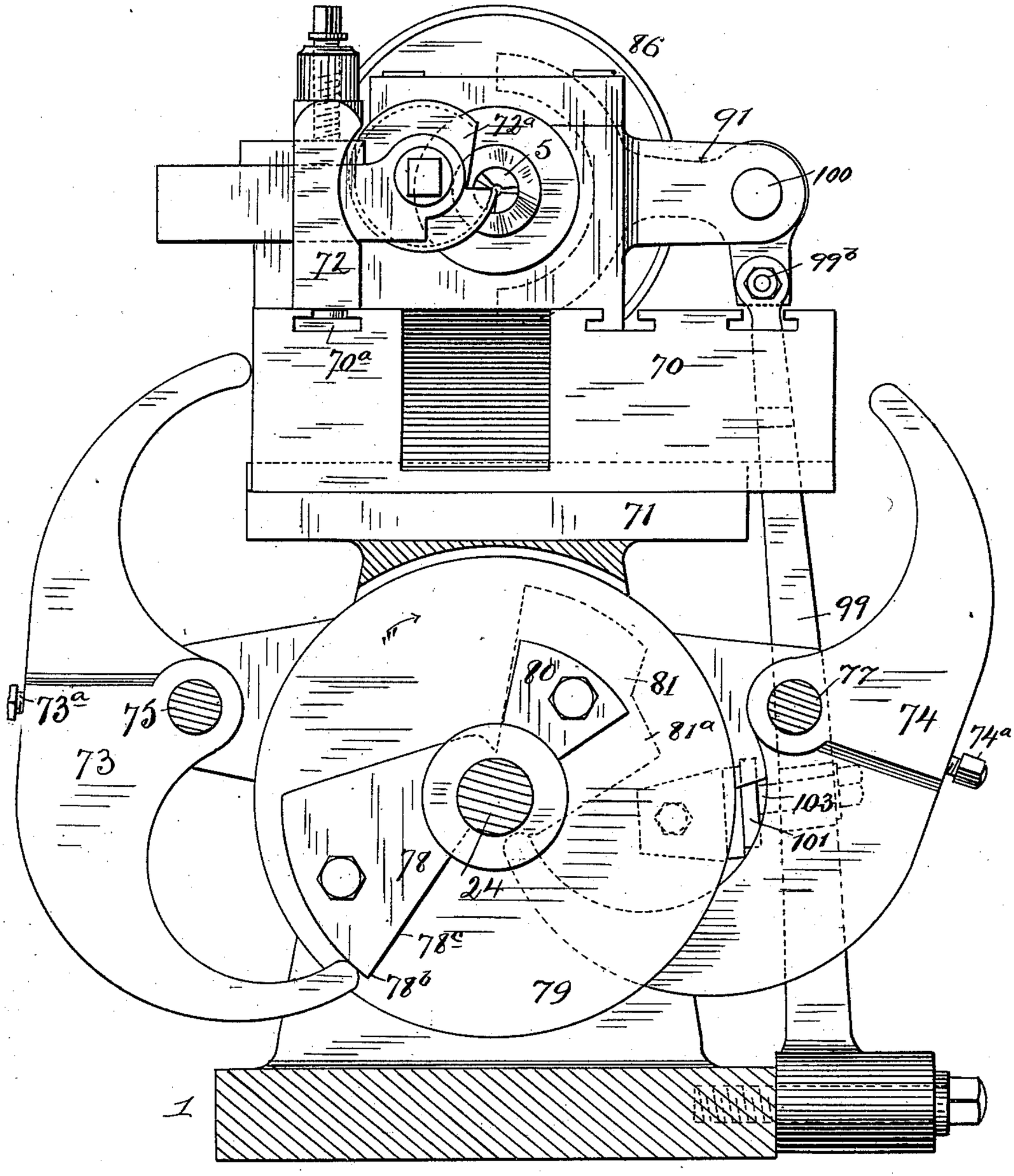

Fig. 9.

Witnesses;
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SCREW MACHINE.

(Application filed Mar. 28, 1900.)

(No Model.) 8 Sheets—Sheet 7.

Fig. 9a.

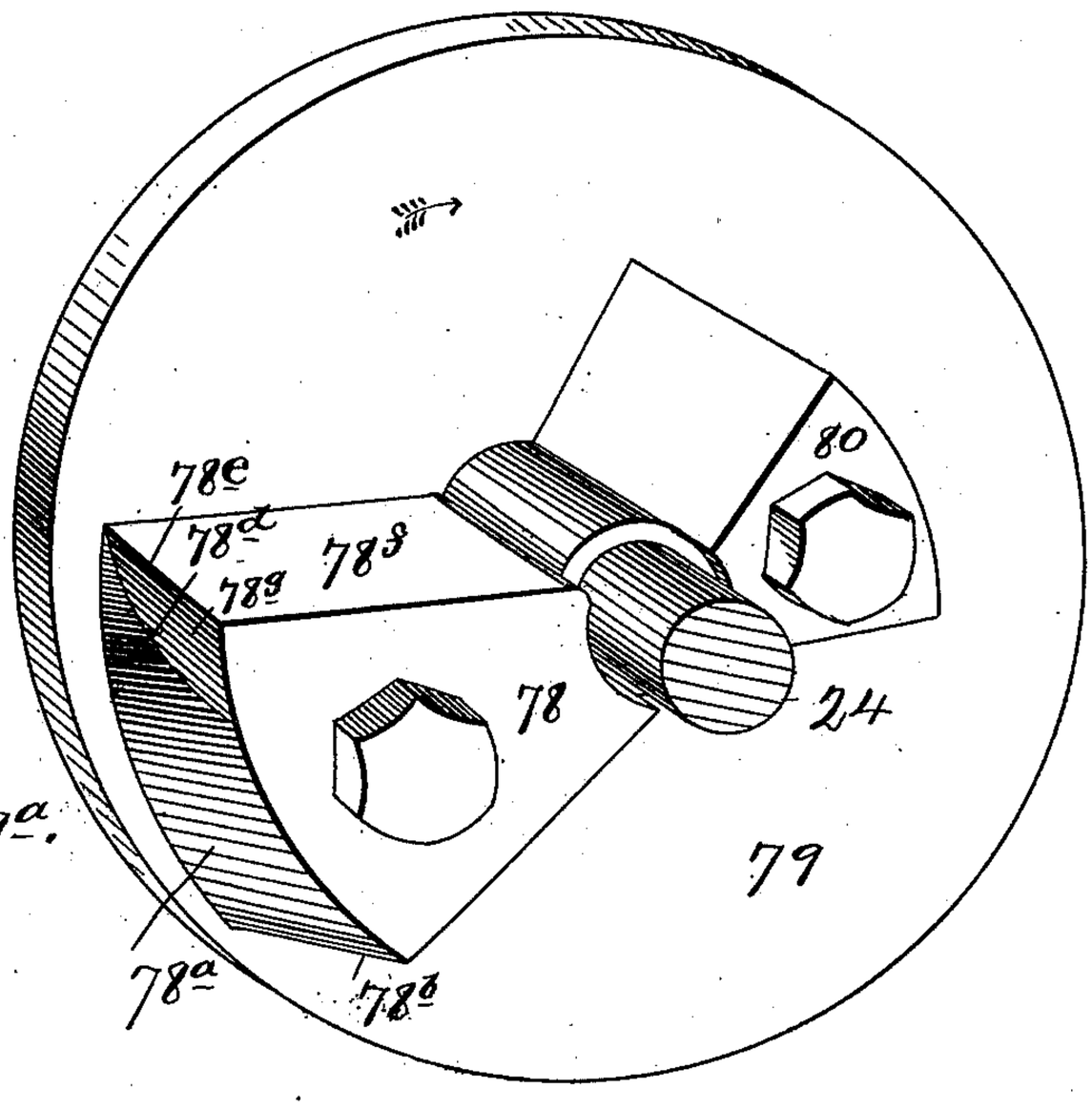
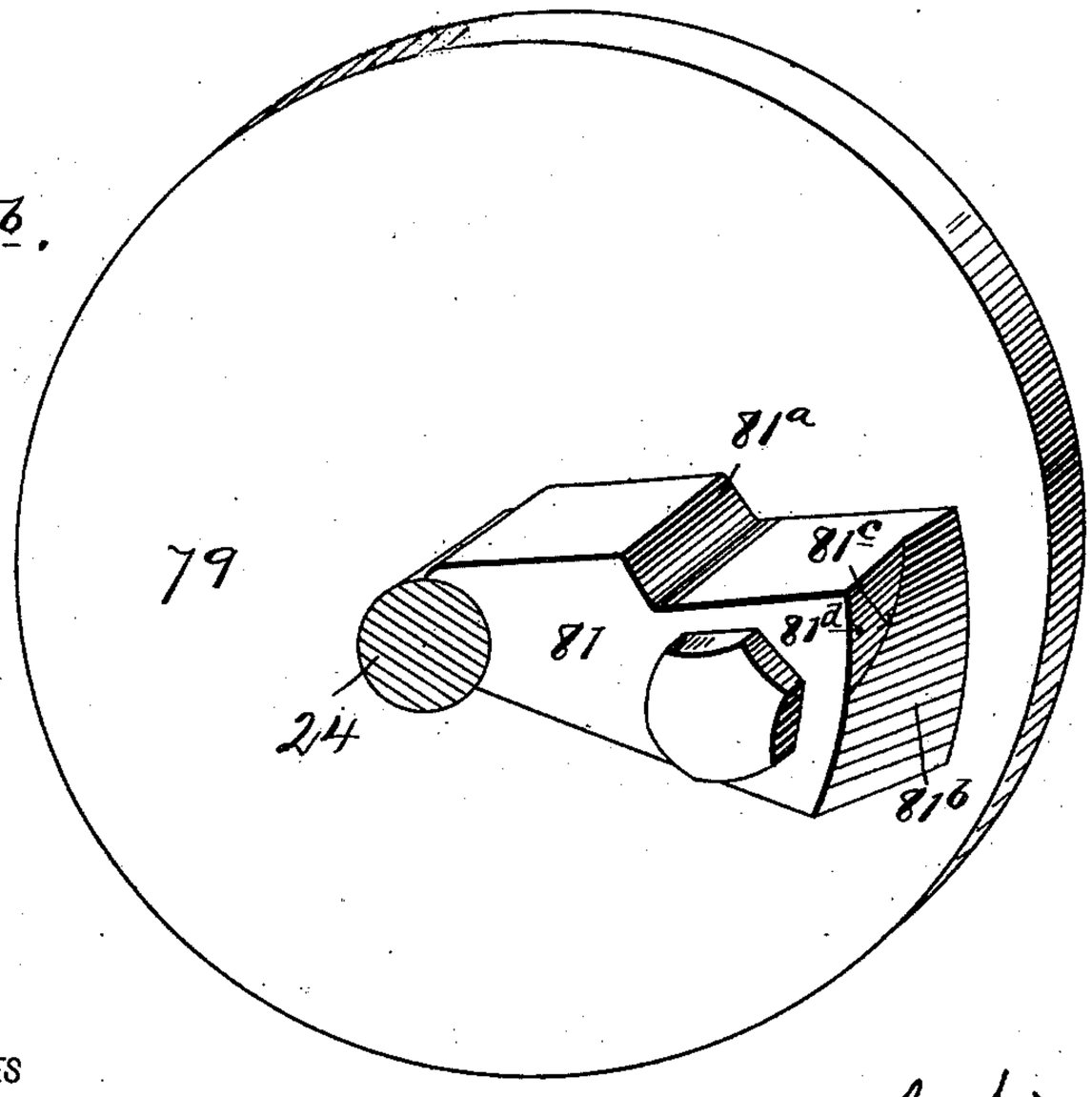


Fig. 9b.



WITNESSES

C. W. Benjamin

L. E. Turner.

INVENTOR

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his ATTY.

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G. SITTMANN.

SCREW MACHINE.

(Application filed Mar. 28, 1900.)

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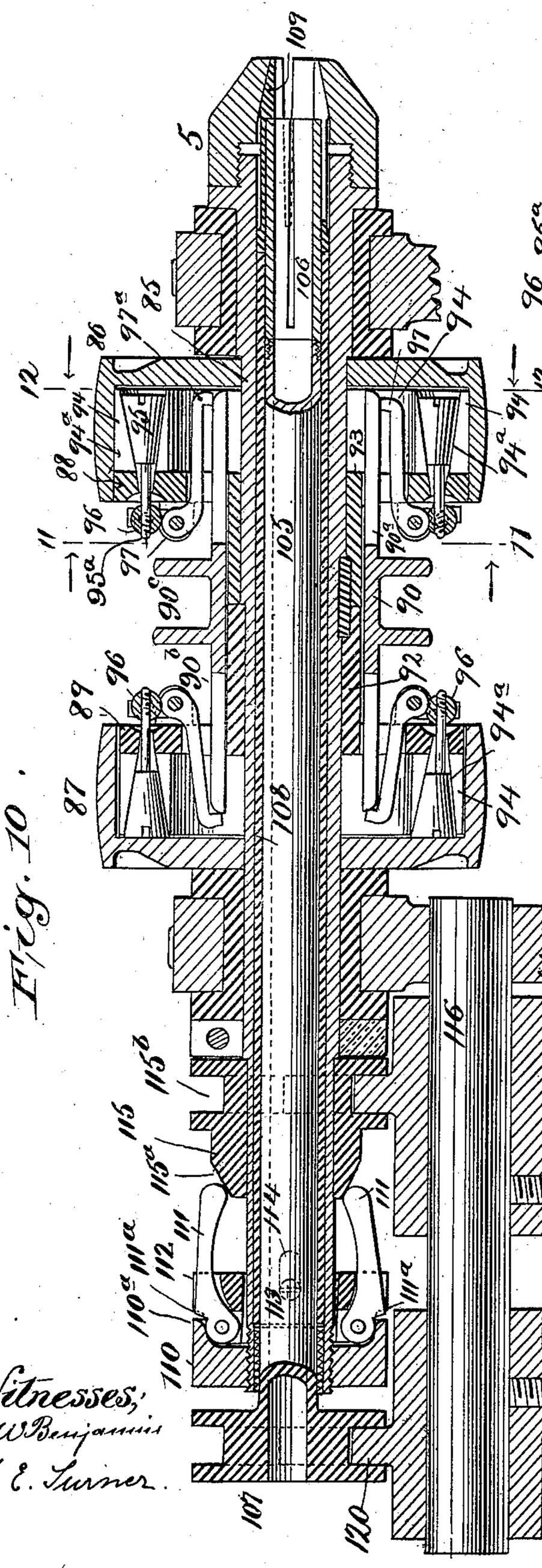

Fig. 10.

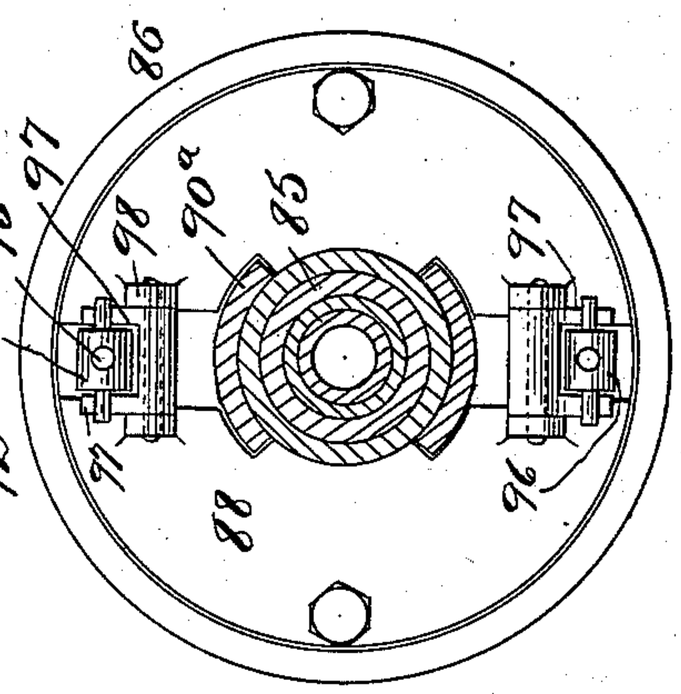

Fig. 11.

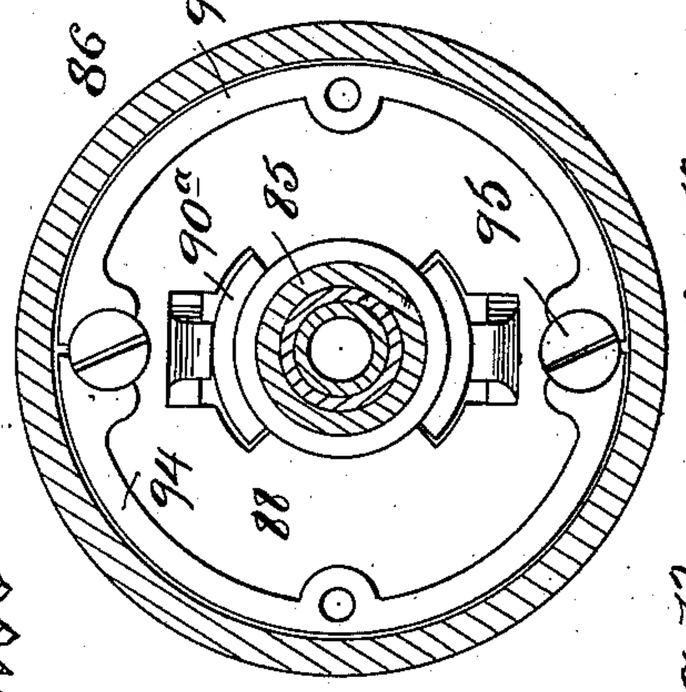

Fig. 12.

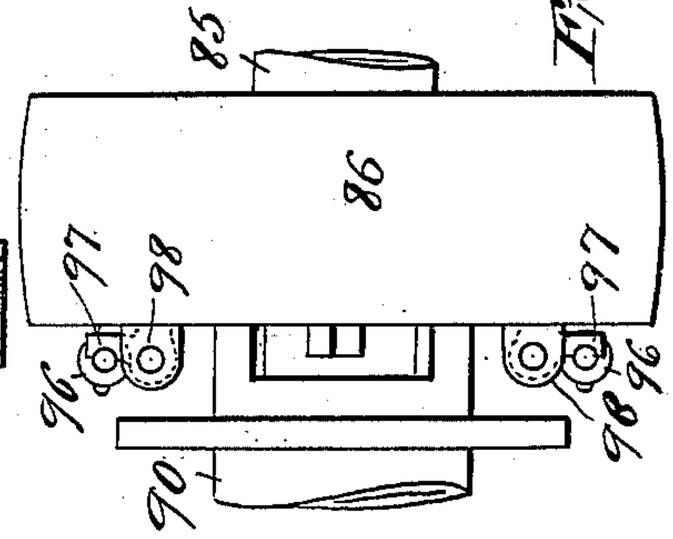

Fig. 13.

Witnesses;
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F. E. Turner.

Inventor;
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UNITED STATES PATENT OFFICE.

GUSTAV SITTMANN, OF BROOKLYN, NEW YORK.

SCREW-MACHINE.

SPECIFICATION forming part of Letters Patent No. 671,568, dated April 9, 1901.

Application filed March 28, 1900. Renewed January 31, 1901. Serial No. 45,475. (No model.)

To all whom it may concern:

Be it known that I, GUSTAV SITTMANN, a citizen of the United States, residing in New York city, borough of Brooklyn, State of New York, have invented certain new and useful Improvements in Machines for Making Screws, &c., of which the following is a specification.

My invention relates to improvements in machines for making screws and other articles from lengths of material, and has for its object generally to simplify and improve the construction and operation of this class of machines.

One of the principal portions of my invention relates to improved means for feeding the tools to the work or stock with a speed in accordance with the character of the work to be performed by the tool; and to this end I provide a reciprocative tool-carrier or turret and devices for advancing it toward the work, which devices comprise a novel cam arranged to rotate at a definite or constant speed for feeding tools, but having such a working surface that, in conjunction with an adjustable lever or arm, the cam-surface will cause the tool-carrier or turret to advance the tool to the work at a speed that accords with the portion of the cam with which such lever or arm is alined. Means are provided for shifting the lever or arm longitudinally of the cam and for holding it in any required position to produce the desired feeding speed of the tool. Means are also provided to cause the turret to return from the work at a speed relatively faster than the feed of the tool toward the work by said cam to save time in the complete travel of a tool toward and from the work.

The invention also comprises improvements in the immediate devices that coöperate with the tool-holder or turret, in devices for the cross-cut of the stock, in the devices for operating the stock-holding chuck and for rotating the latter, and also in the novel details of improvement, that will be more fully hereinafter set forth and then pointed out in the claims.

Reference is to be had to the accompanying drawings, forming part hereof, wherein—

Figure 1 is a plan view of a machine embodying my improvements. Fig. 1^a is a detail plan view of the turret or tool-carrying guide. Fig. 1^b is an inverted plan view of the turret-slide, showing the ratchet for rotating and the devices for locking the turret. Fig. 2 is a side elevation looking from the bottom of Fig. 1. Fig. 3 is a vertical cross-section, enlarged, on the plane of the line 3 3 in Fig. 2 looking in the direction of the arrow *a*. Fig. 4 is a vertical cross-section on the plane of the line 4 4 in Fig. 2 looking in the direction of the arrow *b*. Fig. 5 is a perspective view of the main cam. Fig. 6 is a perspective view of the same, inverted from the position shown in Fig. 5. Fig. 7 is a view similar to Fig. 5, showing the cam reversed end for end. Fig. 8 is a side view of the cam. Fig. 9 is a vertical cross-section, enlarged, on the plane of the line 9 9 in Fig. 2 looking in the direction of the arrow *c*. Fig. 9^a is a perspective view of the cam shown in Fig. 9. Fig. 9^b is a similar view of the cam shown in dotted lines in Fig. 9 looking from the opposite side. Fig. 10 is a longitudinal section, enlarged, on the plane of the line 10 in Fig. 1, showing the devices for feeding the work. Fig. 11 is a cross-section thereof on the line 11 11 in Fig. 10 looking from the left. Fig. 12 is a similar view on the line 12 12 in Fig. 10 looking from the right; and Fig. 13 is a detail side view of part of the devices shown in Fig. 10, more particularly illustrating the pulley and its connections.

In the accompanying drawings, in which similar characters of reference indicate corresponding parts in the several views, the numeral 1 indicates a suitable frame or bed, upon which the operative parts of the machine are mounted and which may be supported upon legs, a standard, or in any other suitable manner.

2 is a tool-holder or turret, which may be of any suitable form, provided with suitable means for supporting tools, and the same is mounted upon a slide 3, carried by a guide 4, to travel toward and from a work-holder 5, and the guide 4 is suitably supported upon an appropriate part of the frame 1, as upon a shelf or the like 4^x. Guide 4 is preferably made adjustable toward or from chuck 5, as by screws 4^y, to accommodate different lengths of stock or work projecting from the chuck. This also enables the tools to be held

close to the turret to reduce vibration, which would occur if the tools were adjusted outwardly from the turret to accommodate short lengths of stock, and it enables the turret to be set farther away from the chuck, so that longer lengths of stock can extend therefrom. The slide 3 is shown provided with longitudinal grooves on its sides, that receive gibs 6, secured to the guide 4. (See Fig. 3.)

While any suitable means may be provided for reciprocating the slide 3, the devices I have shown for the purpose comprise a rack 7, secured to slide 3 on the under side thereof and within a suitable space 4^a, formed in the upper surface of guide 4, and said rack meshes with a pinion 8, journaled on a pivot 8^a, carried by guide 4 within said space.

9 is a transversely-disposed rack arranged in bearings in guide 4 so as to reciprocate and in mesh with pinion 8, the ends of the rack 9 projecting from opposite sides of guide 4. (See Figs. 1 and 1^a.) Thus as rack 9 is reciprocated pinion 8 will transmit reciprocatory motion to slide 3 to move the turret toward and from the work-holder 5.

Any suitable means may be provided for rotating the turret to bring the tools in line with the work and for holding the tools in the working position. I have shown the turret 2 as provided with a depending stem 2^a, that passes through an aperture in a conical block 10 and is secured to the latter by screws 11, which block fits in a conical bore 3^a in slide 3, whereby the turret may be firmly held to said slide to keep from tilting, while having capacity to rotate properly on its vertical axis. To the turret 2 is attached a ratchet-wheel 12, (shown in Fig. 3,) secured to the lower end of stem 2^a, and 13 is a dog shown provided with a pin 13^a, adapted to engage the teeth of the ratchet, which dog is shown located in a recess 4^b in guide 4 and provided with a spring 14 to press it toward the ratchet 12. (See Fig. 1^a.) The position of the ratchet and dog is such that when the slide 3 is moved toward the work the ratchet will slip past the pin 13^a, and the spring 14 will then push said pin into the path of a tooth of the ratchet, and when the slide 3 is moved back from the work said pin will engage the ratchet, so that a continued movement of the slide will cause said ratchet to rotate the turret one step to bring another tool in line with the work. The ratchet 12 may move any desired distance from the dog toward the work.

The means I have shown for locking the turret to hold a tool in the operative position are as follows: 15 is a sliding bar or bolt carried in an extension 16, projecting from slide 3, 17 being a spring adapted to project said bar or bolt toward the turret, and 18 is a screw to adjust the tension of said spring. The bar or bolt 15 has a pin 19, depending through a slot or aperture 16^a in extension 16. (See Fig. 3.) The inner end of the bar or bolt 15 is adapted to pass through apertures 2^b in the sides of the turret for holding the latter in position, and I have shown said turret provided with an internal ring a, having apertures a' alined with the apertures 2^b of the turret to receive the end of bar or bolt 15. The pin 19 is adapted to withdraw bar or bolt 15 from the turret, and to accomplish this I provide a latch 20, that is pivoted to the side of guide 4 and provided with an upwardly-extending web 20^a, that extends at an angle to the plane of the side of guide 4 to enable pin 19 to pass between the latter and said web. (See Fig. 1^a.) The forward outer end of latch 20 is beveled at 20^b for pin 19 to ride upon. A spring 21, carried by guide 4, serves to keep the latch in its normal position and for this purpose is shown acting upon the pin 22, depending from said latch. (See Fig. 3.) The arrangement is such that as the turret is fed toward the work the pin 19 will pass beyond and in front of said latch, and on the return movement of the turret said pin will encounter the beveled face 20^b of the latch, and will ride up on the same along the outer surface of the latch, thereby withdrawing the bar or bolt 15 from engagement with the turret, and the pin 19 will remain in engagement with the outer surface of said latch a sufficient time to enable ratchet 12 and dog 14 to rotate the turret one step, and thereupon pin 19 will slip from the end of web 20^a to enable spring 17 to project the bar or bolt 15 into an aperture in the turret.

My improved means for feeding the turret to the work comprise a cam of novel construction adapted to operate devices that act upon the rack 9, and the shape of the cam is such that the turret will be fed with a speed that accords with the cam-surface with which the operating devices are alined, the cam during the feeding of the tool to the work rotating at a predetermined or constant speed, and it is therefore not required that the cam be rotated at different speeds in accordance with the character of different tools or work. In this connection I also provide means for moving rack 9 to return the turret from the work, and these devices are arranged to return the turret at a speed increased over the speed of the feeding movement, so as to economize time. 23 is the cam referred to, and it is mounted to rotate freely upon a shaft 24, journaled in suitable bearings in frame 1 and extending longitudinally thereof, being shown beneath the tool-holder or turret 2. The cam 23 (shown more fully in Figs. 5, 6, 7, and 8) has a surface 23^a, which is substantially radial and rectangular, forming an edge 23^b, extending substantially parallel with the longitudinal axis of the cam. From the edge 23^b the working surface 23^d of the cam is formed on a gradual inward curve extending at one end 23^e more than half-way around the longitudinal axis of the cam (see Fig. 5) and at the other end less than that distance, (see Fig. 6,) and the edge 23^f of the working surface 23^d opposite edge 23^b extends in a curved or spiral direc-

tion around the axis of the cam. (See Figs. 6 and 8.) By this means the distance from the edge 23^b circumferentially or peripherally of the cam along the working face 23^d to 23^f varies at all points longitudinally of the cam, or, in other words, the working surface 23^d is of decreasing circumferential extent from one end to the other. The surface 23^d, furthermore, tapers from the end 23^e to the other end, notwithstanding that the edge 23^b is substantially parallel with the axis of the cam. The edge 23^f is where the work begins or, in other words, is where a lever, finger, or other part to be moved is presented to the working surface 23^d of the cam, and it will be understood that as the cam rotates it will move said lever or finger outwardly at a speed proportioned to the position of said lever or finger longitudinally along the face of the cam while the cam rotates at a predetermined or constant speed. In order to conveniently bring the part to be operated by the cam to the edge 23^f wherever desired along said edge, I provide the cam with a concentric surface 23^g, which terminates in a rectangular radial surface 23^h, extending lengthwise of the cam opposite edge 23^b, (see Fig. 5,) and the curved or spiral edge 23^f of the working face 23^d of the cam coincides with the corresponding edge of the concentric surface 23^g. (See Figs. 6 and 8.) The surface 23^h when approaching the lever or finger enables the latter to rise up on surface 23^g, and the lever may remain in contact with said surface until brought in engagement with the working face of cam 23^d at the edge 23^f, whereupon the lever or finger will ride up on said surface. This concentric surface 23^g, therefore, is a guide to enable the lever or finger to readily engage the main working surface 23^d of the cam without injury. As before stated, the cam 23 is to cause rack 9 to feed the turret to the work, and to accomplish this I have shown a lever 25, hung on a shaft 26, supported in suitable bearings on the frame 1 and extending longitudinally thereof, (see Figs. 1 and 3,) which lever is adapted to bear against the outer surface of a bail or rocking arm 27, supported by shaft 26 and adapted to operate upon rack 9 to push the same transversely of guide 4. The bail 27 is shown provided with a finger 28, adapted to engage the outer end of rack 9 and having a longitudinal face of sufficient length to permit the rack to be adjusted longitudinally of the machine while remaining in line with finger 28. (See Fig. 1.) This adjustment of the rack would occur when guide 4 is adjusted toward or from the work, as before stated. The outer surface of bail 27 is of sufficient length to enable the upper end 25^a of lever 25 to be adjusted lengthwise of said bail while remaining in operative position relative thereto. (See Fig. 1.) It will be understood that when the cam rotates in the direction of the arrow in Fig. 3 the end 25^b of lever 25 may pass into the space between the faces 23^a and 23^h of said cam, that said face 23^h will first engage the end of the lever, and that then the lever will ride up on the concentric surface 23^g and will remain in contact therewith until the edge 23^f of the cam engages the lever, whereupon the lever will ride up on said surface and will be gradually tilted on its shaft 26 until the cam has passed under said lever at the edge 23^b. Lever 25 will then slip off said cam into the space between surfaces 23^a and 23^h. Thus as the lever 25 is tilted it will act upon bail 27 and cause the same to push rack 9 transversely, whereby pinion 8 and rack 7 will cause the turret to advance to the work. During the time that the lever 25 is not upon surface 23^d the cam may be moved at an increased speed, and during such time the rack 9 is moved back to withdraw the turret from the work. This last-mentioned operation I accomplish as follows: At one end of cam 23 is a cam or finger 29, extending substantially to the outer surface of cam 23 and adjacent to the edge 23^b and adapted to engage a rock-lever 30, that is hung upon a shaft 31, supported in frame 1 and held from travel along said shaft, the upper end of lever 30 being adapted to engage one end of rack 9, whereby as cam or finger 29 engages lever 30 it may rock the same to cause the latter to push rack 9, whereby to withdraw the turret from the work. Lever 30 may have a pin or extension 30^a to engage rack 9 when the latter is adjusted away from the work-holder 5. While the end 25^b of lever 25 is not upon surface 23^d of cam 23, cam or finger 29 may operate lever 30 to return the turret, and thus by the alternate action of parts 23 25 and 29 30 upon rack 9 the turret will be reciprocated.

The speed with which the turret is advanced to the work will be in accordance with the character of the tool and the work, and this speed is governed by the position of lever 25 relatively to the surface 23^d of cam 23. These various feeding speeds of the turret are effected while the cam is given a constant or definite speed of rotation. To regulate the feeding speed of the tool to the work, I provide means for adjusting lever 25 longitudinally of cam 23 and for holding it in the adjusted position, and for this purpose a shift-rod 32 is carried in suitable bearings on frame 1 and provided with a forked arm or its equivalent 33, that engages a groove in the hub 25^c of lever 25, whereby said lever can rock, and yet when rod 32 is adjusted longitudinally said lever will be correspondingly shifted in position. Rod 32 is jointed to a lever 34, being shown provided with a pin 32^a, working in a slot 34^a of said lever, (see Fig. 1,) and said lever is pivoted on a support 35, carried by frame 1. Lever 34 is acted upon by adjustable cams 36 on a cam wheel or drum 37, carried by shaft 24, and said lever is provided with a pin or projection 38, adapted to lie in the path of and be engaged by cams 36. It will be seen that cams 36,

which may have suitable shape, are located at opposite sides of wheel or drum 37 and are shown provided with bolts or screws 36ª to enter slots 37ª in said wheel or drum, whereby said cams can be adjusted longitudinally of the machine. From this it will be understood that by adjusting the cams 36 to the proper positions the lever 34 can be caused to rock to a greater or less extent, thereby to shift rod 32 and lever 25 more or less lengthwise of cam 23 in either direction, and that after said lever has been so shifted to the required position relatively to the cam it will remain in such position during the time that the cam operates through said lever and rack 9 to feed the turret to the work. From what has been said it will be apparent that if lever 25 bears upon cam-surface 23ᵈ near the end 23ᵉ the feed of the turret will be relatively slow, owing to the long cam-surface that travels under the lever, and if lever 25 is adjusted near the opposite end of the cam-surface the feeding speed of the turret will be relatively fast because of the short cam-surface passing under the lever, and the feeding of the turret will be relatively fast or slow, according to the circumferential length of the cam-surface 23ᵈ, with which said lever engages, the cam meanwhile rotating at a constant speed.

I have provided means for rotating cam 23 at a predetermined speed for feeding the tool to the work, also at a faster speed during the time the tool is returned from the work, and for rotating the shaft 24 always at a speed commensurate with the speed of said cam, and the means I have shown for this purpose are as follows: Upon shaft 24 is loosely mounted a worm-wheel 40, with which is connected a gear 41, the hub or shaft of which gear or worm is adapted to be connected with cam 23 for rotating the same. For convenience in adjusting the parts I have shown said cam as provided with a hub 42, having notches 42ª, adapted to interlock with corresponding projections carried by said gear or worm wheel, whereby a coupling or clutch is formed for rotating said cam by said worm and at the same speed as the latter. The gear 41 is in mesh with a gear 43, mounted upon a shaft 44, carried by frame 1, and 45 is a pinion connected with gear 43 to be rotated thereby, said pinion being in mesh with a gear 46, secured to shaft 24, as by a key, (see Fig. 4,) whereby through said gearing said shaft is rotated. The speed of rotation of shaft 24 relatively to the speed of rotation of cam 23 may be regulated as desired by substituting other gears having a different ratio of diameters. The worm-wheel 40 is in mesh with a worm 47, that is adapted to be rotated at different speeds, one of which speeds is for rotating the cam 23 to feed the tool to the work, and the other speed is for returning the tool from the work, and the speed of shaft 24 will be correspondingly changed as the speed of rotation of worm 40 is changed.

The means I have shown for rotating worm 47 at a high and a low speed are substantially like the devices shown in the patent issued to me on October 24, 1899, No. 635,518, to which reference is hereby made for a more full and detailed description thereof. To illustrate the coaction of these devices with my present improvements, I will describe the same generally as follows: Worm 47 is mounted to rotate freely around a shaft 48, suitably supported in frame 1, and upon which shaft a pulley 49 is secured, and said pulley carries a wide-faced pinion 50 and two differential pinions 51 52, which pinions mesh with differential gears 53 54, (see Fig. 4,) the gear 53 being rigidly connected with worm 47 and gear 54 being free to rotate, all as in my said patent. 55 is a toothed wheel or ratchet mounted to rotate freely around shaft 48 and rigidly connected with gear 54, and 56 is a dog pivotally connected with frame 1 and adapted to permit ratchet 55 and gear 54 to rotate in one direction, but to hold them from rotation in the reverse direction. When pulley 49 rotates in the direction of the arrow in Fig. 1, the pinions 50 51 52, acting upon the differential gears 53 54, will cause worm 47 to rotate and drive cam 23 and shaft 24 at a relatively low speed, gear 54 being held by ratchet 55 and dog 56 from reverse rotation. To drive worm 47 at the same speed as pulley 49, a clutch is provided to connect said worm direct with shaft 48. 57 is a hand-wheel secured to the hub or sleeve of worm 47 and inclosing a disk, as in my said patent, forming part of the clutch, the disk being secured to shaft 48, 59 being the sliding member of the clutch-engaging hand-wheel 57, so that when the clutch members are in engagement worm 47 will be locked to shaft 48, as more fully set forth in my said patent. The clutch member 59 is connected with a sliding rod 60, having a spring 61 to hold the clutch members in engagement, and said rod has a latch 62 to engage a stop 63 (see Fig. 4) to hold the clutch members disengaged. The latch 62 is to be released from said stop at the proper time to cause the clutch members to engage, for which purpose a rocking lever or finger 64 is provided and suitably pivoted upon frame 1 and adapted to engage the beveled edge 62ª of latch 62 (see Fig. 4) to release said latch from stop 63, said lever also being adapted to engage an abutment 60ª on rod 60 to move said rod to the right in Fig. 4 to uncouple the clutch. Finger or lever 64 is rocked by means of adjustable cams 65, carried by a disk 66, secured to shaft 24. The arrangement is such that when the working surface 23ᵈ of cam 23 is acting upon lever 25 the clutch will be held uncoupled by latch 62, the cam 65 and the lever 64 having so adjusted the parts whereby cam 23 and shaft 24 through the connected gearing will be rotated by pulley 49, &c., at a relatively slow speed to cause the turret to feed to the work. When the edge 23ᵇ of cam 23 passes from le-

ver 25, a cam 65 will cause lever 64 to release latch 62 from its stop 63, and thereupon the clutch will couple, whereby pulley 49 will rotate worm 47, cam 23, and shaft 24 at the high speed until edge 23^f is again presented to lever 25, and during this time finger or cam 29 causes lever 30 to operate rack 9 to withdraw the turret from the work, whereby the latter rotates to present a new tool in working position. During this same time if the feeding speed of a tool is to be changed from the feeding speed of the preceding tool lever 34 will be moved to adjust lever 25 longitudinally of cam 23 into the proper position for so feeding said tool.

I have also provided improved means for feeding crosscut-tools at different speeds, according to the requirements of the tool and the work. To this end I have provided the following arrangement: 70 is a cross-feed slide suitably guided on frame 1, as by a way 71, which slide is provided with means, such as slots 70^a, for adjusting a tool-holder 72 longitudinally of frame 1, which tool-holder is adapted to hold a tool in position to operate crosswise upon stock or material held by the chuck or holder 5 in well-known manner. The slide 70 is reciprocated transversely of frame 1 through the medium of levers 73 and 74 and cams of peculiar construction carried by shaft 24. Lever 73 is mounted upon a shaft 75, journaled in bearings on frame 1 and held from longitudinal movement by suitable means, as a pin or screw 76, a screw 73^a or the like serving to lock lever 73 to shaft 75 in any position to which said lever may be adjusted along said shaft. Lever 74 is mounted upon a shaft 77, journaled in bearings in frame 1 and held similarly to shaft 75, a screw 74^a or the like serving to lock lever 74 to shaft 77 in any position desired. Lever 73 is acted upon by a cam 78 to move slide 70 crosswise, which cam is shown secured to a disk 79, attached to shaft 24. (See Figs. 9 and 9^a.) The working surface 78^a of cam 78 is in general characteristics similar to the working surface 23^d of cam 23, the face 78^a having an edge 78^b coincident with a substantially radial face 78^c, and from the edge 78^b the face 78^a gradually approaches shaft 24 and the face 78^a of the cam tapers transversely. One end of working face 78^a is beveled or inclined on a line or edge 78^d, and between that line and the edge 78^e, coincident with the face 78^f, the cam has a concentric surface 78^g. The speed of cross-feed of slide 70 by cam 78 and lever 73 will be proportioned to the position of said lever against the working face 78^a of said cam, and the concentric face 78^g causes the end of said lever to ride up on the cam, so that the lever will be in proper position to engage any portion of the face 78^a at the edge 78^d. 80 is a cam or projection shown connected with disk 79 and projecting in a direction opposite to cam 78 and adapted to engage lever 73 for the purpose of causing said lever to move slide 70 to a central position after said slide has been moved by a lever 74. When edge 78^b of cam 78 passes from lever 73, said lever is free to be moved by cross-slide 70 until engaged by cam 80. Lever 74 is adapted to be moved by cam 81 to move slide 70 in a direction opposite to its movement by lever 73, either to return tool 72^a from the work or to cause another tool to operate on the work. Cam 81 is shown connected to disk 79, but on the side of said disk opposite cam 78, and cam 81 is also disposed in a radial direction opposite to cam 78. (See Fig. 9.) Cam 81 has a step or working face 81^a, adapted to first encounter lever 74 to cause the latter to move slide 70 to a central position, and said cam also has a working face 81^b, similar in general characteristics to the working face 78^a of cam 78 and provided with a curved edge 81^c, coincident with a concentric face 81^d. The face 81^d first encounters the end of lever 74 to cause said lever to ride up on face 81^b in manner described with reference to cam 78. As cams 78 and 81 are connected with shaft 24 they will be rotated coincidently with the operation of the parts that reciprocate the turret, and while the cams 78 and 81 may be set in any position desired it will be understood that said cams will bring the cross-cut tools in a proper position ready for operation and retain said tools in such position while the turret-tool is operating, and that when the turret-tool has performed its work the cams 78, 80, and 81 will operate the cross-slide 70 to cause the tool or tools connected therewith to perform any desired operation.

Any suitable means may be provided for holding the work in the holder or chuck 5 and for feeding the work the desired extent. Furthermore, as it is sometimes desirable to reverse the rotation of holder or chuck 5 I have provided improved means for this purpose, as follows: 85 is a hollow shaft or sleeve, to which chuck or tool-holder 5 is attached, which shaft may be supported to rotate in suitable manner, and 86 87 are loose pulleys mounted to rotate freely around said shaft. Each pulley is provided with a disk or plate 88 89, respectively, connected with shaft 85, and 90 is a sliding sleeve or spool mounted to rotate around shaft 85 and provided with arms 90^a 90^b, projecting from opposite ends and passing through slots in disks or plates 88 and 89. (See Figs. 10, 11, and 12.) Sleeve 90 is provided with an annular groove 90^c to receive a shifting fork 91. 92 93 are bushings keyed on the shaft 85 and secured to or formed on disks or plates 88 89, respectively, being provided for convenience in adjusting the parts together, and upon these bushings sleeve 90 is mounted to rotate. Friction devices are provided within the pulleys 86 87 for connecting shaft 85 rotatively with said pulleys, and as these devices are substantially alike for both pulleys a description of one will suffice. To this end one or more flexible arms 94 are secured to the plates 88 89 and adapted to engage the inner

surface of said pulleys, and the ends of said arms have enlargements provided with cone-shaped recesses 94ª, adapted to receive conical plugs 95 for expanding said rings, in Fig. 12 the plugs 95 being shown located between the opposed coned recesses 94ª at the ends of two arms 94. The stems 95ª of the plugs 95 are connected with blocks 96, whose pivots engage rock-levers 97, journaled on lugs 98, or the like, carried by the plates 88 89, the opposite arms of said levers projecting through slots in said plates and having outwardly-bent ends 97ª, adapted to engage the beveled ends of arms 90ª 90ᵇ. (See Fig. 10.) As said arms ride under the levers 97 the latter will be rocked on their pivots to draw the cone-plugs 95 outwardly between the ends of arms 94 to expand the latter into engagement with the pulleys. At the right in Fig. 10 the parts 95 and 97 are shown in the operative position, whereby pulley 86 is in frictional connection with shaft 85, while the friction devices connected with pulley 87 are not operated, so that pulley 87 is free to rotate. By sliding sleeve 90 to the right or left either pulley 86 or 87 can be caused to rotate shaft 85, and as said pulleys are to be rotated by belts in opposite directions shaft 85 can be correspondingly rotated. When sleeve 90 is in a central position, both sets of friction devices will be free, so that shaft 85 and the tool-holder 5 can come to rest. I have provided means for automatically shifting sleeve 90, which means comprise a rocking arm 99, pivotally connected with frame 1 and adapted to shift fork 91 along its supporting-shaft 100, which is suitably mounted in bearings on frame 1, and the arm 99 is shown provided with a forked end 99ª, having set-screws 99ᵇ to engage fork 91, (see Fig. 2,) whereby proper adjustment for the desired amount of movement can be effected. By preference arm 99 is rocked by means of one or more cams 101, adjustably secured upon a disk 102, carried by shaft 24, (see Figs. 2 and 9,) arm 99 having a pin 103, Fig. 9, to be engaged by said cams, whereby as shaft 24 rotates the arm 99 can be rocked to move slide 90 in either direction along shaft 85 or to bring the slide to a central position. The cam or cams 101 can be adjusted around disk 102 in accordance with the time at which arm 99 shall be rocked.

The devices I have shown for feeding stock through the holder and chuck 5 and clamping it thereto are as follows: 105 is a tube within the bore of shaft 85 and having at one end a removable clamping-jaw 106 to grasp the stock and at the other end a grooved head 107. (See Fig. 10.) 108 is a tube within the shaft 85 and surrounding tube 105 and having at one end a clamping-jaw 109, provided with external beveled faces to coact with the internal beveled faces of chuck 5 to grip the stock that projects from the jaw 106. At the opposite end of shaft 85 is a head 110, having abutments 110ª, against which shoulders 111ª of levers 111 are adapted to bear, which levers are pivoted to a ring 112, mounted to slide on shaft 85. From ring 112 a pin 113 projects through a slot 114 in shaft 85 and is secured to tube 108. When levers 111 are pressed outwardly, their shoulders 111ª engage head 110, and thereby ring 112 is moved forwardly and pin 113 pushes tube 108 so that its jaw 109 in chuck 5 grips the stock projecting from jaw 106. Levers 111 are pressed outwardly by a spool 115, having the beveled face 115ª, which spool is mounted to slide upon shaft 85, and is shown provided with an annular groove 115ᵇ. 116 is a rod projecting from a suitable part of frame 1, and upon said rod a sleeve 117 is mounted to slide, said sleeve having a fork 118 to engage the groove of spool 115. 119 is a sleeve mounted upon rod 116 and having a fork 120 to engage the groove in head 107. These sleeves are reciprocated at the proper time by means of a cam-wheel, and for this purpose the sleeves are shown provided with wear-pieces 117ª 119ª, respectively, adapted to be engaged, respectively, by cams 121 122 123 on a cam-wheel 124, carried by shaft 24, means, such as slots and bolts, being provided to shift said cams upon the wheel, so as to move sleeves 117 and 119 along rod 116 more or less. The reciprocations of sleeves 119 and 117 will at the proper time allow jaw 106 to take a new grip on the work, cause jaw 109 to release the work, permit jaw 106 to project the work forwardly from the chuck 5 a proper distance, and cause levers 111 to act with tube 108 to grip the stock in the chuck, and said operations will occur in accordance with the positions of the cams upon wheel 124, as may be necessary.

While I have shown the cam 23 as made in a single piece of metal, it is evident that it could be produced by making a series of pieces placed side by side and the working surfaces thereof made to conform to the requirements of the working surface 23ᵈ, and it is also evident that instead of shifting the lever or finger 25 along the cam the latter could be shifted relatively to the lever, producing the same result as described, and it is also apparent that the various details of construction shown and described may be varied without departing from the spirit of my invention.

Having now described my invention, what I claim is—

1. The combination of a tool-holder or turret, with a cam, and means between the turret and cam to feed the turret by the cam at speeds that accord with the position of said means relatively to the cam, substantially as described.

2. The combination of a tool-holder or turret, with a cam, means for rotating said cam at a constant speed, and devices between the turret and cam, the cam being adapted to feed the turret at speeds that accord with the operating-surface of the cam, substantially as described.

3. The combination of a tool-holder or tur-

ret, with a cam having a working surface of varying circumferential extent from one end toward the other, and devices between said cam and turret for feeding the turret at speeds which accord with the operating circumferential length of the surface of the cam, substantially as described.

4. The combination of a tool-holder or turret, with a rotative cam, devices between the turret and the cam for feeding the former at varying speeds by the latter, and means for adjusting the position of the coacting device along the cam relatively to the working face of the latter, substantially as described.

5. The combination of a tool-holder or turret, with a cam having a working surface extending in the direction of the axis and provided with a spirally-disposed edge extending in the direction of the axis, and devices between the turret and the cam for feeding the former by the latter, substantially as described.

6. The combination of a tool-holder or turret, with a cam having a circumferential working surface provided with an edge substantially parallel with the axis of the cam and an opposed spirally-disposed edge forming a surface of varying circumferential extent between said edges, and devices between the turret and the cam for feeding the former by the latter, substantially as described.

7. The combination of a tool-holder or turret, with a cam provided with an eccentric working surface having a spiral edge and a concentric surface adjacent thereto having a corresponding spiral edge, and devices between said turret and cam for feeding the former by the latter, whereby said concentric surface will bring the coöperating device into position to act upon the eccentric surface, substantially as described.

8. The combination of a tool-holder or turret, with a cam having an eccentric working surface provided with an edge extending longitudinally and a concentric surface adjacent thereto and provided with an edge extending longitudinally of the cam forming a space between said edges, and devices between the turret and the cam, whereby said longitudinal face will cause the coöperating device to rise upon the concentric surface to guide it to the eccentric surface, substantially as described.

9. The combination of a tool-holder or turret, with a cam having an eccentric working surface provided with an edge extending longitudinally of the axis of the cam and a spirally-disposed edge opposed thereto, a concentric surface adjacent to said spiral edge and having an edge disposed longitudinally of the axis of the cam, and devices between the turret and the cam for feeding the former by the latter, substantially as described.

10. The combination of a tool-holder or turret, with a cam having a working surface provided with an edge substantially parallel with the axis and an opposed edge extending spirally of the axis, a lever adapted to be operated by said cam, devices between said lever and the turret to feed the latter, and means for adjusting the position of said lever and cam relatively to each other, substantially as described.

11. The combination of a tool-holder or turret, a lever adapted to operate the same, a cam to operate said lever, said cam having a working surface of varying circumferential extent tapering from one end to the other, and adjustable devices adapted to shift said lever to different positions relatively to the cam, substantially as described.

12. The combination of a tool-holder or turret, with a lever to operate the same, a cam to operate the lever, shifting devices to move the lever into different positions relatively to the cam, and a cam-wheel to operate the shifting devices, substantially as described.

13. The combination of a tool-holder or turret and its actuating devices, with a cam, a lever adapted to be shifted along the cam, and a bail or rocker interposed between the lever and the turret-actuating devices and having a surface along which said lever can be shifted, substantially as described.

14. The combination of a tool-holder or turret, with a cam provided with an eccentric surface having a varying circumferential extent, and a concentric surface adjacent thereto, a lever to be operated by said cam to feed the turret to the work, a finger or cam coöperative with the first-mentioned cam, a lever to be operated thereby, and devices intermediate said levers and the turret for reciprocating the same by the action of said cams, substantially as described.

15. The combination of a tool-holder or turret, a shaft, a cam mounted to rotate relatively to said shaft, a wheel or drum carried by said shaft and provided with adjustable cams, means for rotating said cam and shaft at relative speeds, a lever to operate said turret and adapted to be actuated by said cam, and shifting devices connected with said lever and adapted to be operated by the cams of said wheel or drum to shift the lever into different positions relatively to said cam, substantially as described.

16. The combination of a tool-holder or turret, with a cam, a shaft around which said cam is adapted to rotate, means for rotating said cam at a relatively high and low speed, gearing connecting said cam and shaft for rotating them at relative speeds, and a lever adapted to be operated by said cam to feed said turret, substantially as described.

17. The combination of a turret, with a cam, a shaft upon which the same is adapted to rotate, a worm and worm-wheel to rotate said cam, means for rotating said worm at different speeds, gearing connecting said worm-wheel with said shaft, a lever to operate said turret by said cam, and devices connected

with said shaft and with said lever for shifting said lever along the face of the cam, substantially as described.

18. The combination of a turret and a guide therefor, with a rack connected with the turret, a rack and pinion to operate the first-mentioned rack, and means for reciprocating the second-mentioned rack to cause the pinion and first-mentioned rack to reciprocate the turret, substantially as described.

19. The combination of a turret, and a guide therefor, with a rack connected with the turret, a rack and pinion to operate the first-mentioned rack, a cam, and devices intermediate said cam and the second-mentioned rack for reciprocating the latter to reciprocate the turret, substantially as described.

20. The combination of a turret and a guide therefor, with a rack connected with the turret, a rack and pinion to operate the first-mentioned rack, a bail or rocker to act on the second-mentioned rack, a cam, and a lever intermediate said bail and cam to operate the former by the latter, substantially as described.

21. The combination of a turret, and a guide therefor, with a rack connected with the turret, a rack and pinion to operate the first-mentioned rack, a pair of levers to reciprocate the second-mentioned rack to reciprocate the turret, and a pair of cams to operate said levers, substantially as described.

22. The combination of a turret and a guide therefor, with a rack connected with the turret, a rack and pinion to operate the first-mentioned rack, a pair of levers to reciprocate the second-mentioned rack, a cam, and means for shifting one of said levers along the face of said cam to vary the feeding speed of the turret, substantially as described.

23. The combination of a turret, a slide therefor, a guide for the slide, a support for the guide, and means for adjusting the guide toward and from the work, with means to reciprocate the slide, a bail or rocker to act on said means, a lever to operate the bail or rocker, and a cam to actuate the lever, whereby when the guide is adjusted the bail or rocker will remain in operative relation to the turret-reciprocating means, substantially as described.

24. The combination of a cross-slide, and means for supporting a tool thereon, with a pair of levers to operate the same, a pair of cams to operate said levers, and means for adjusting said levers along the faces of the cams for varying the speed of movement of said cross-slide, substantially as described.

25. The combination of a cross-slide, and means for supporting a tool thereon, with a pair of levers to operate the same, a pair of cams to operate said levers, means for adjusting said levers along the faces of the cams for varying the speed of movement of said cross-slide, and means for operating said levers to move the cross-slide to a central position, substantially as described.

26. The combination of a cross-slide, and means for supporting a tool thereon, with a pair of levers to operate said slide, and a pair of cams to operate said levers, said cams having working faces of varying circumferential lengths for varying the feeding speed of the cross-slide according to the position of the levers relatively to said working faces, and means for holding said levers in the required position relatively to the cams, substantially as described.

27. The combination of a cross-slide and means for supporting a tool thereon, with a pair of levers to operate said slide, a rotative support located between said levers, and cams secured upon opposite sides of said support to operate said levers respectively, said cams each having a working face of varying circumferential length in the direction of rotation, substantially as described.

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