

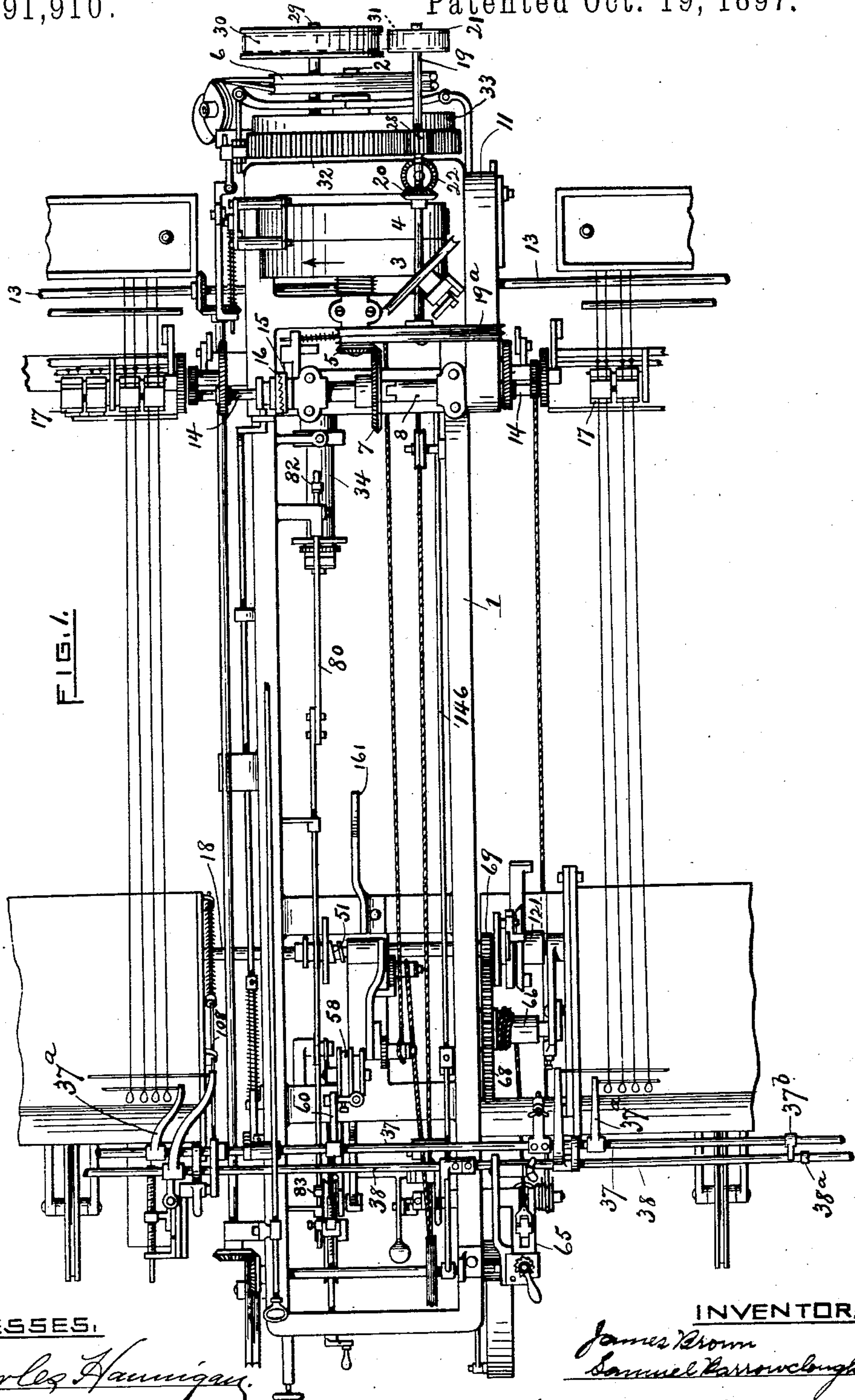
(No Model.)

14 Sheets—Sheet 1.

S. BARROWCLOUGH & J. BROWN.
SPINNING MULE.

No. 591,910.

Patented Oct. 19, 1897.



WITNESSES:

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Ira L. Fish

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(No Model.)

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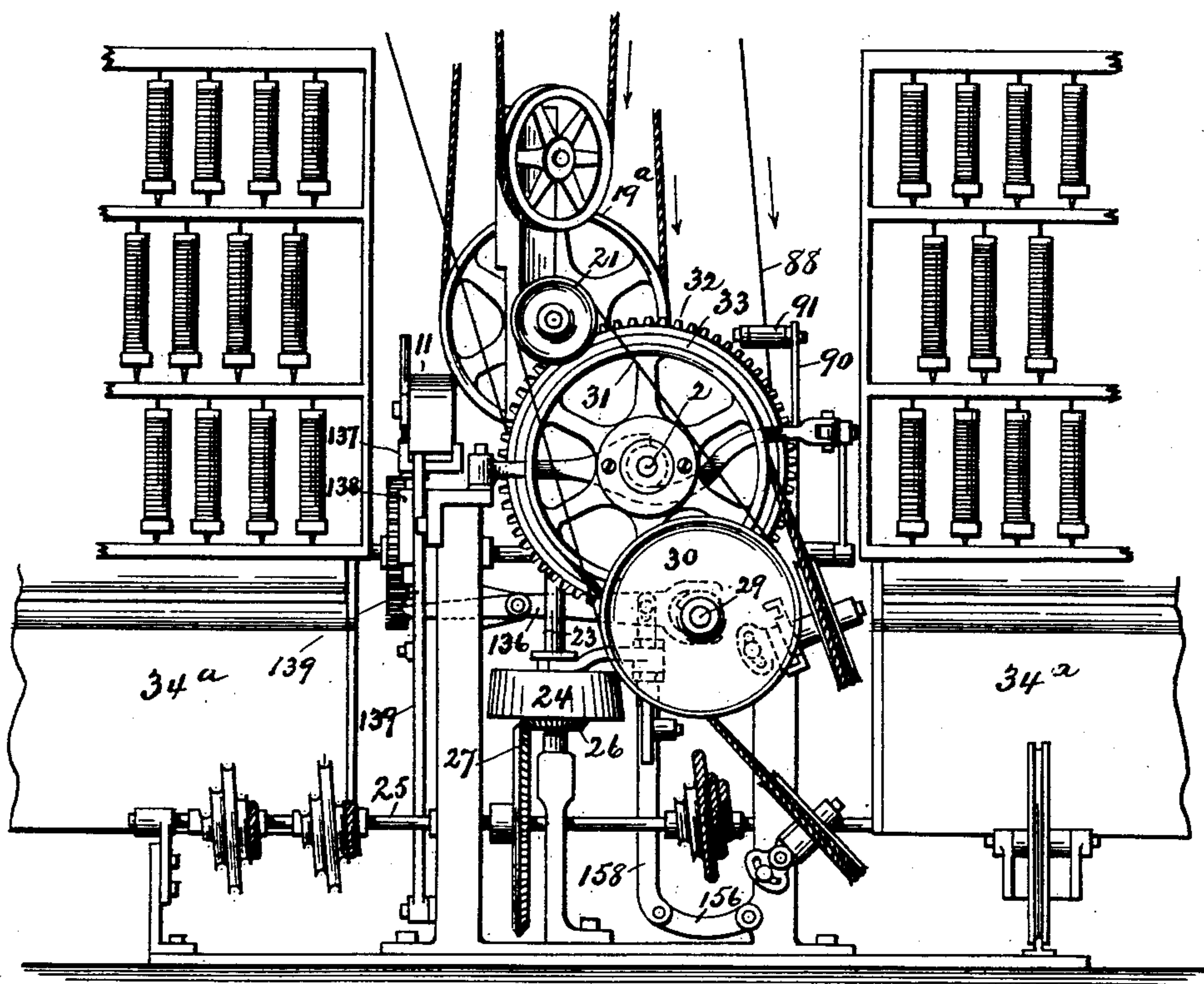


FIG. 2.

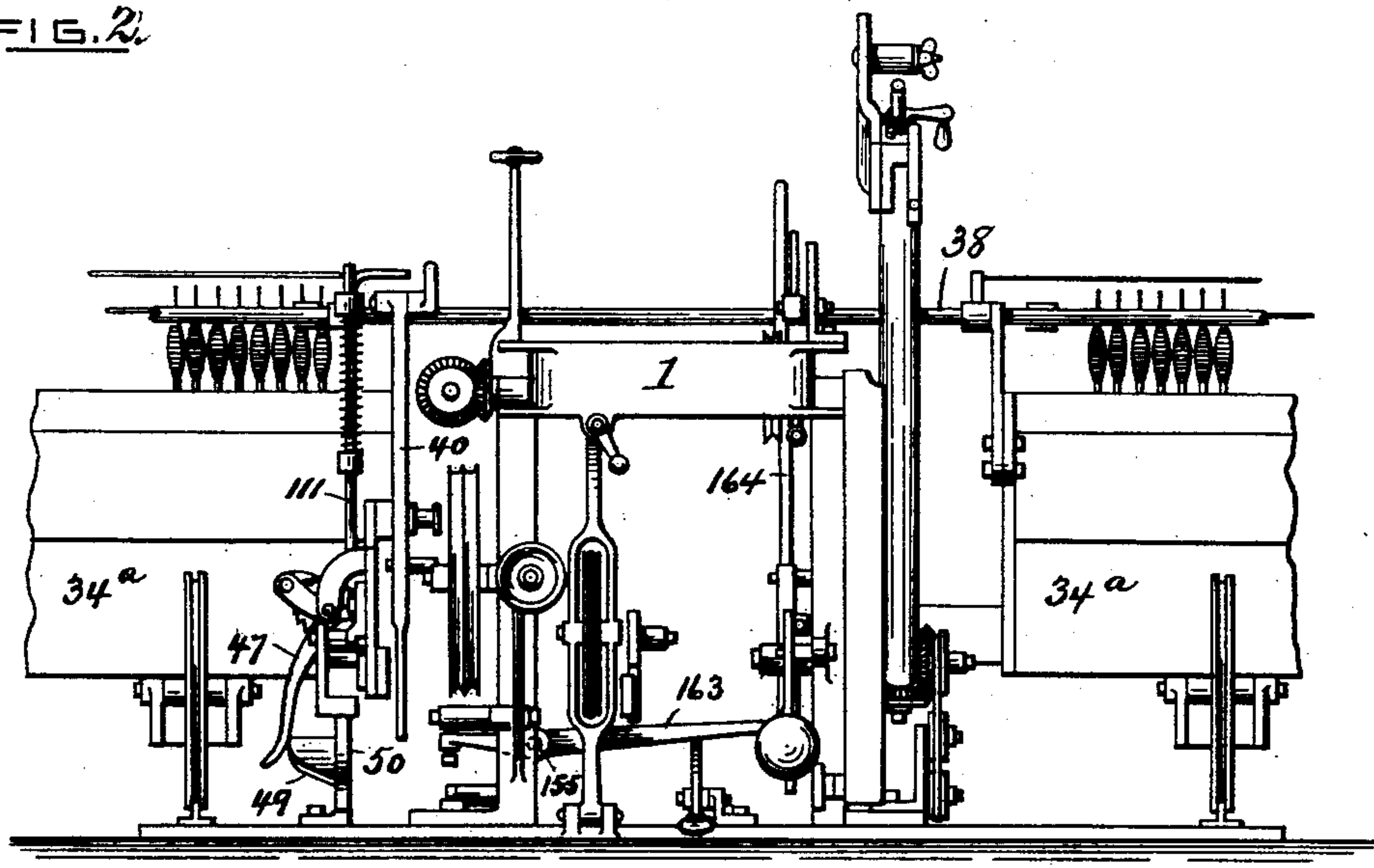


FIG. 3.

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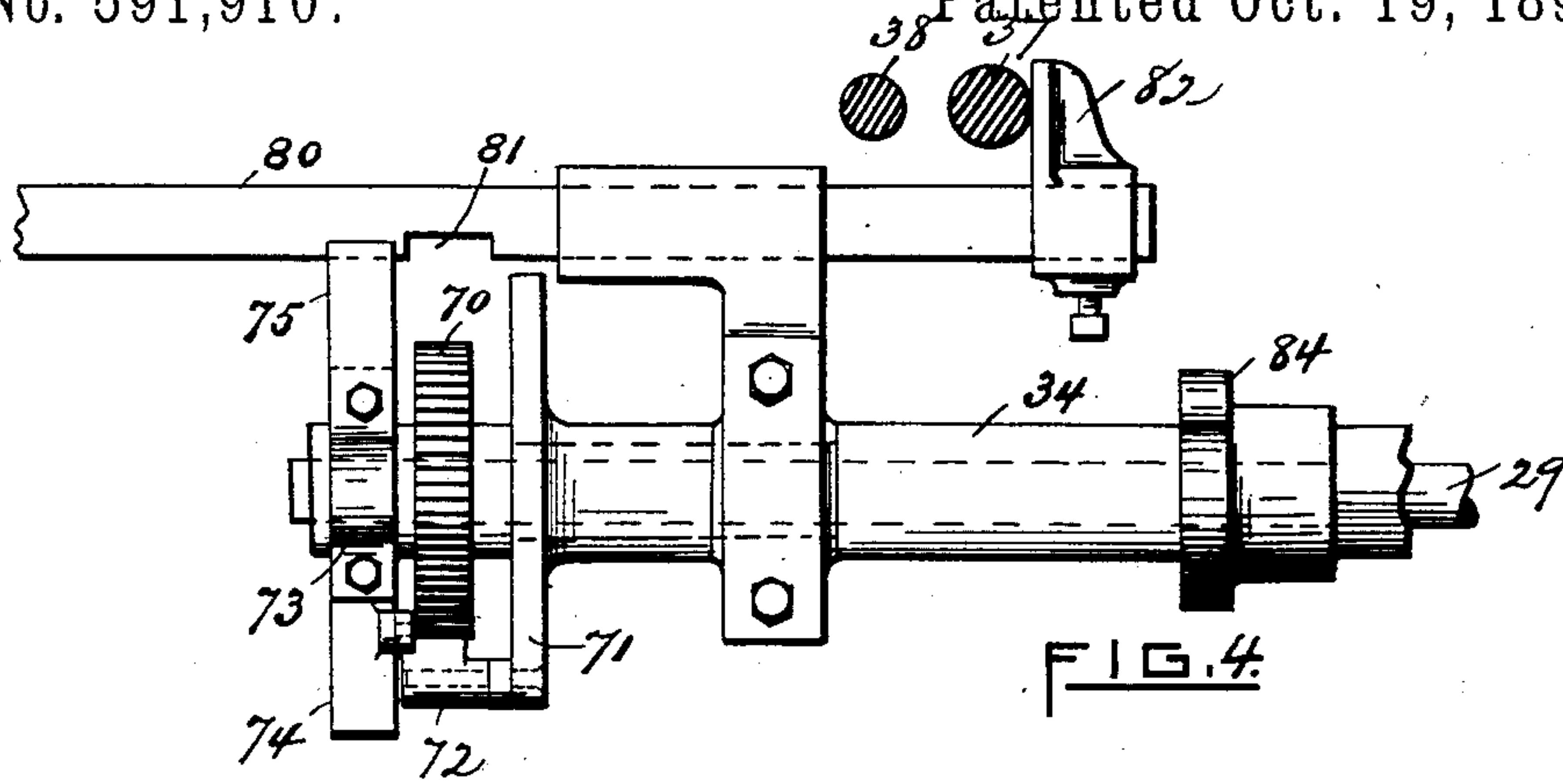


FIG. 4.

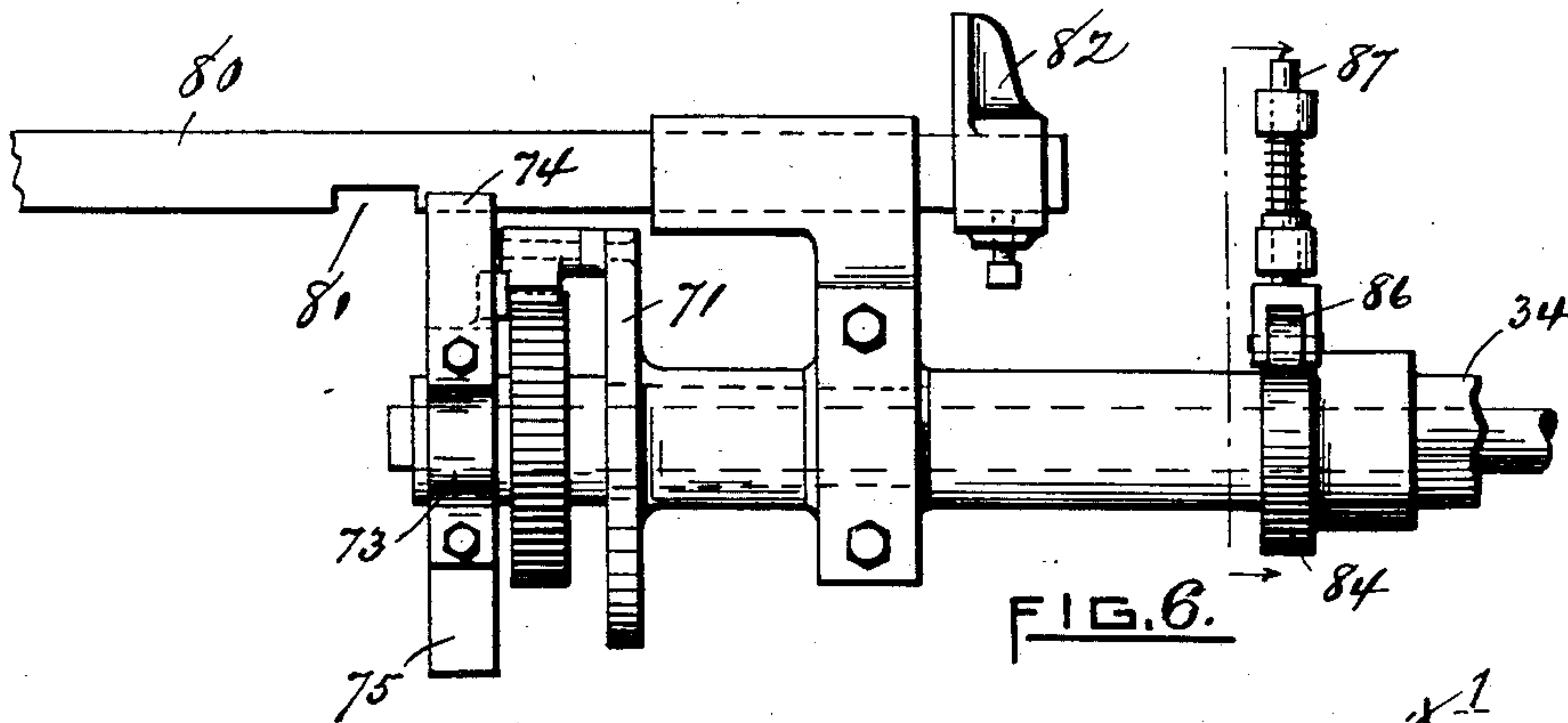


FIG. 6.

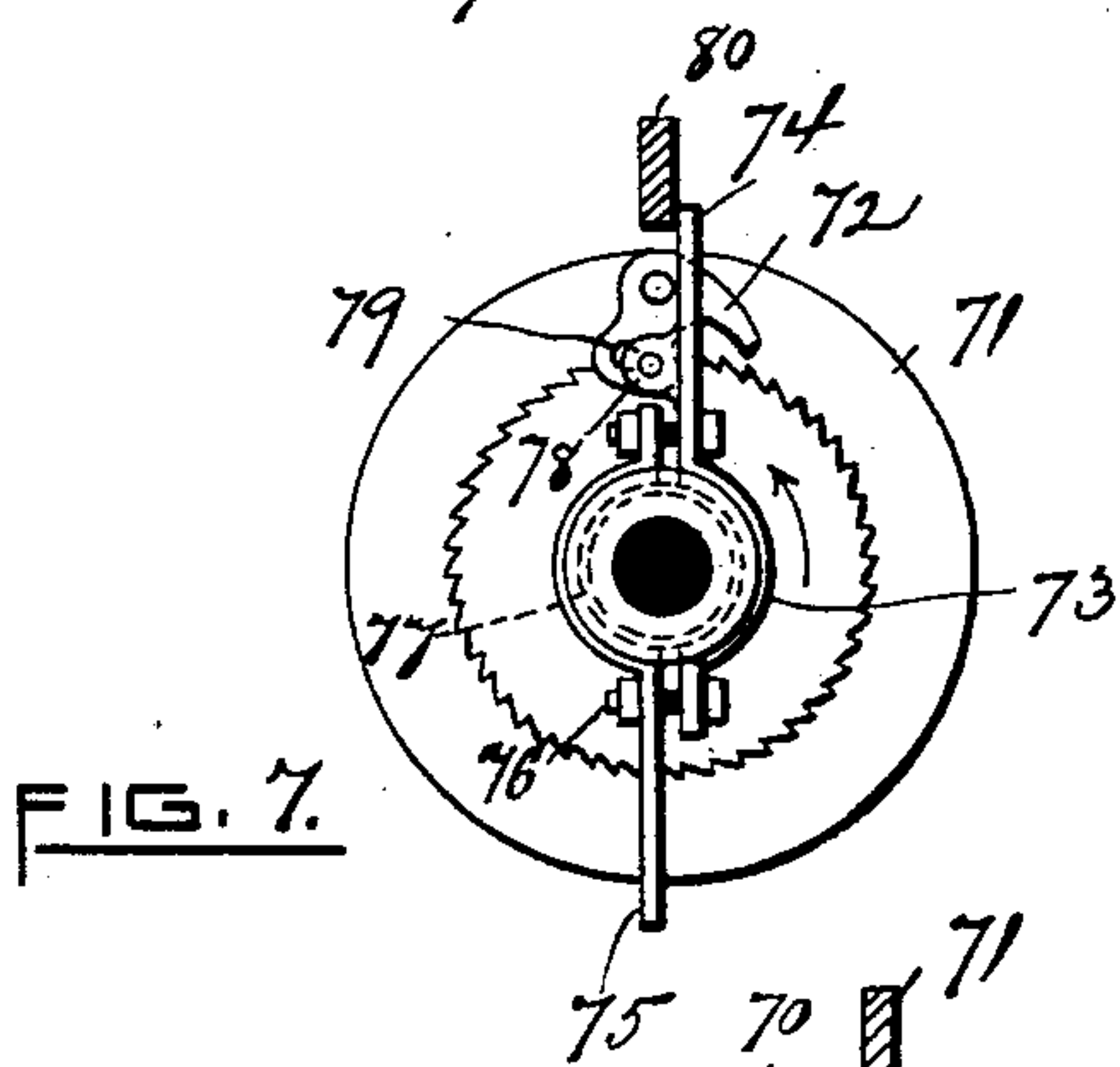


FIG. 7.

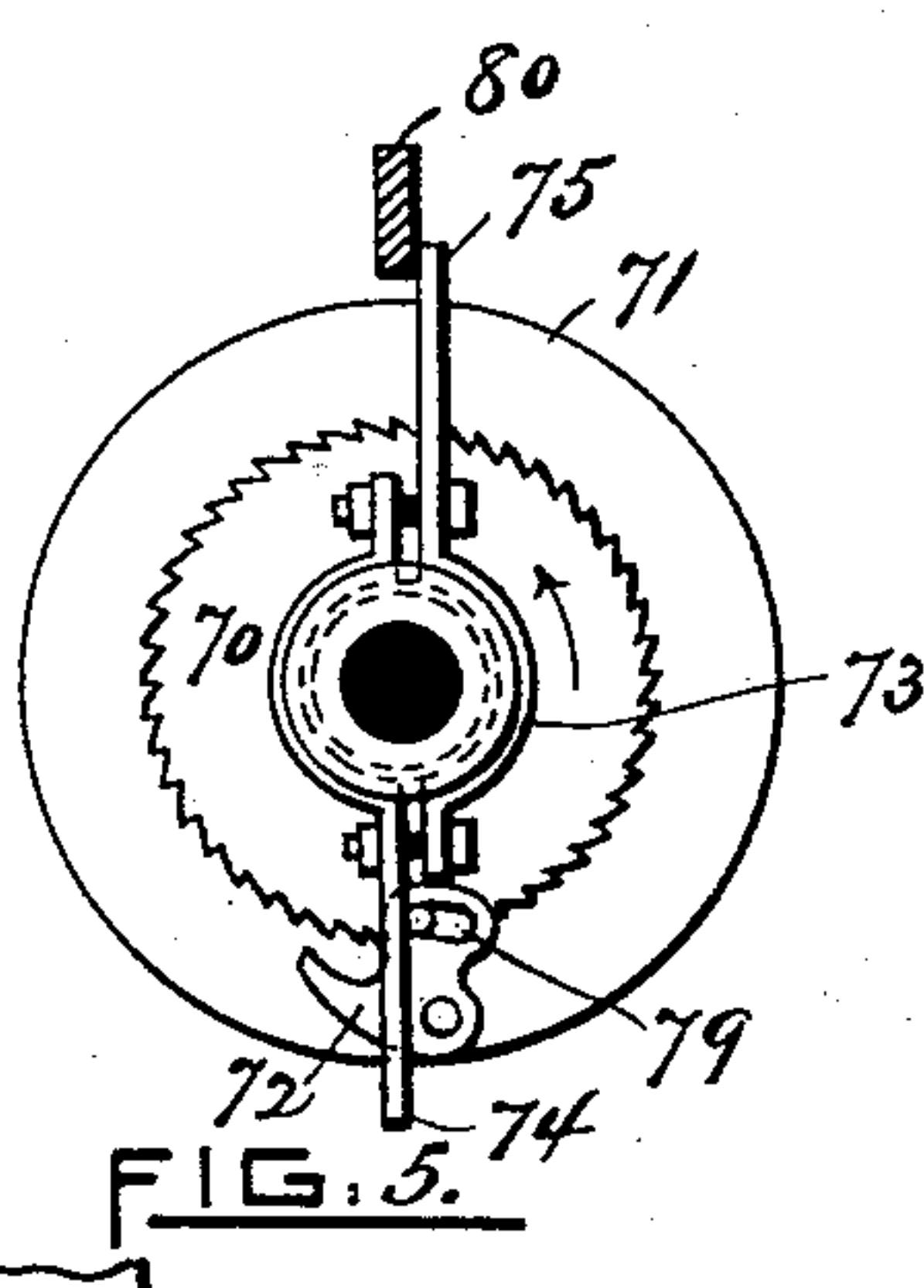


FIG. 5.

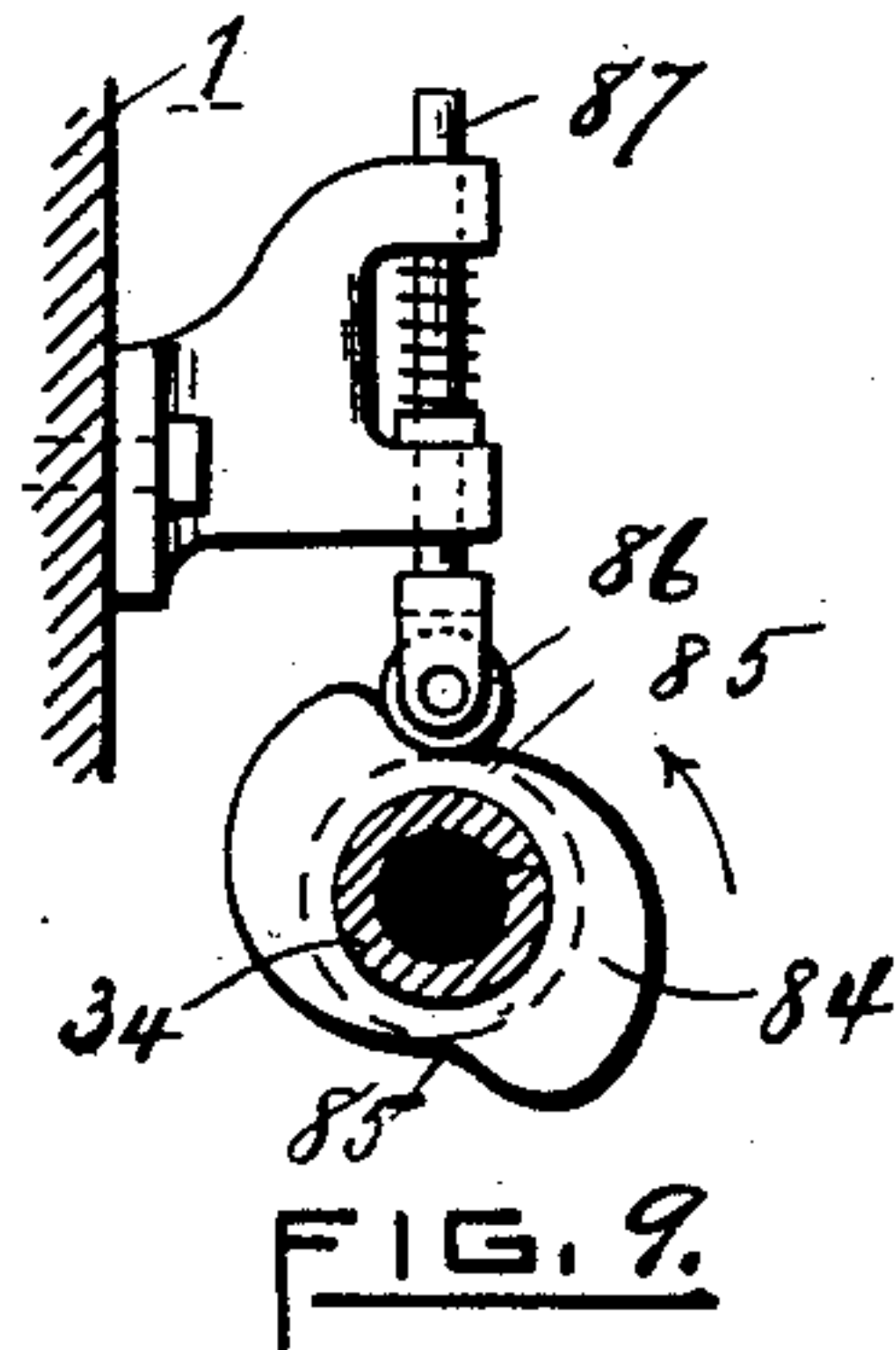


FIG. 9.

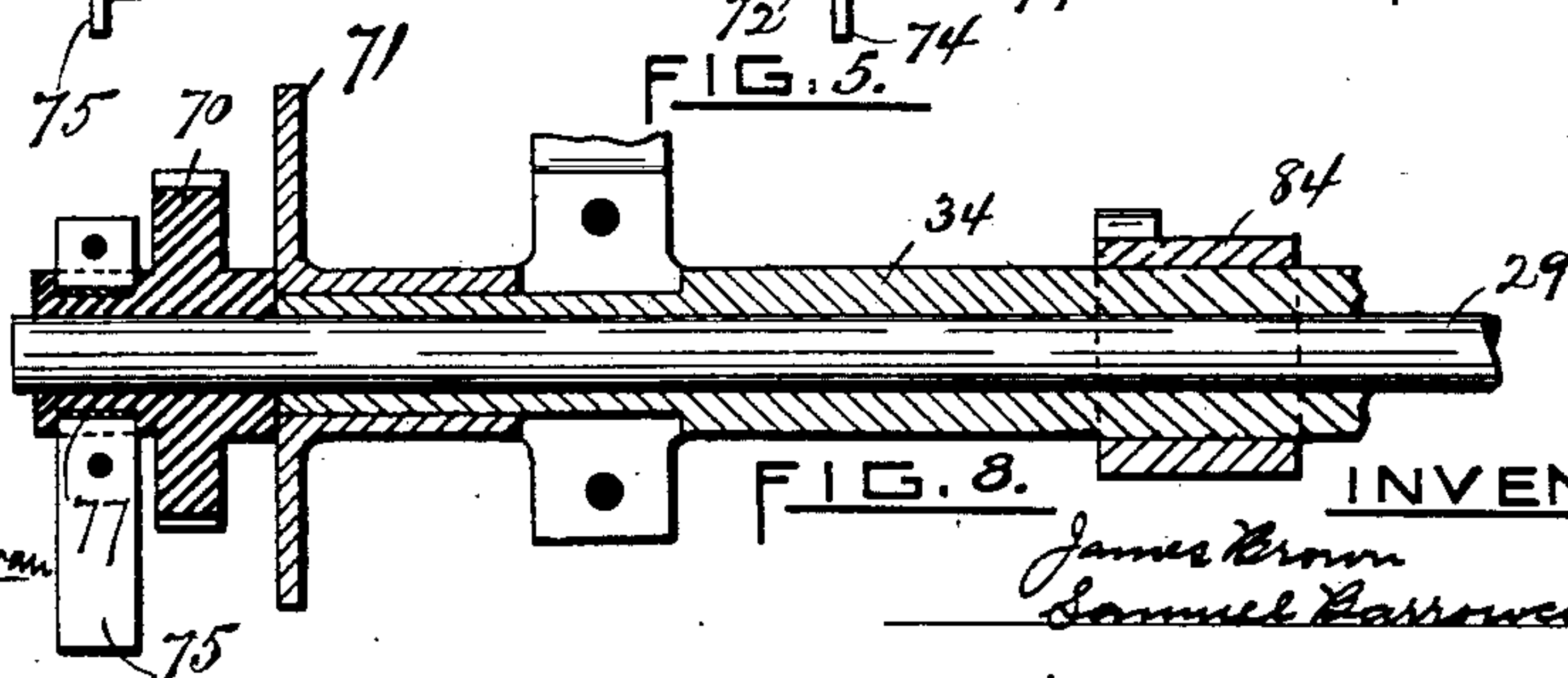


FIG. 8.

WITNESSES.

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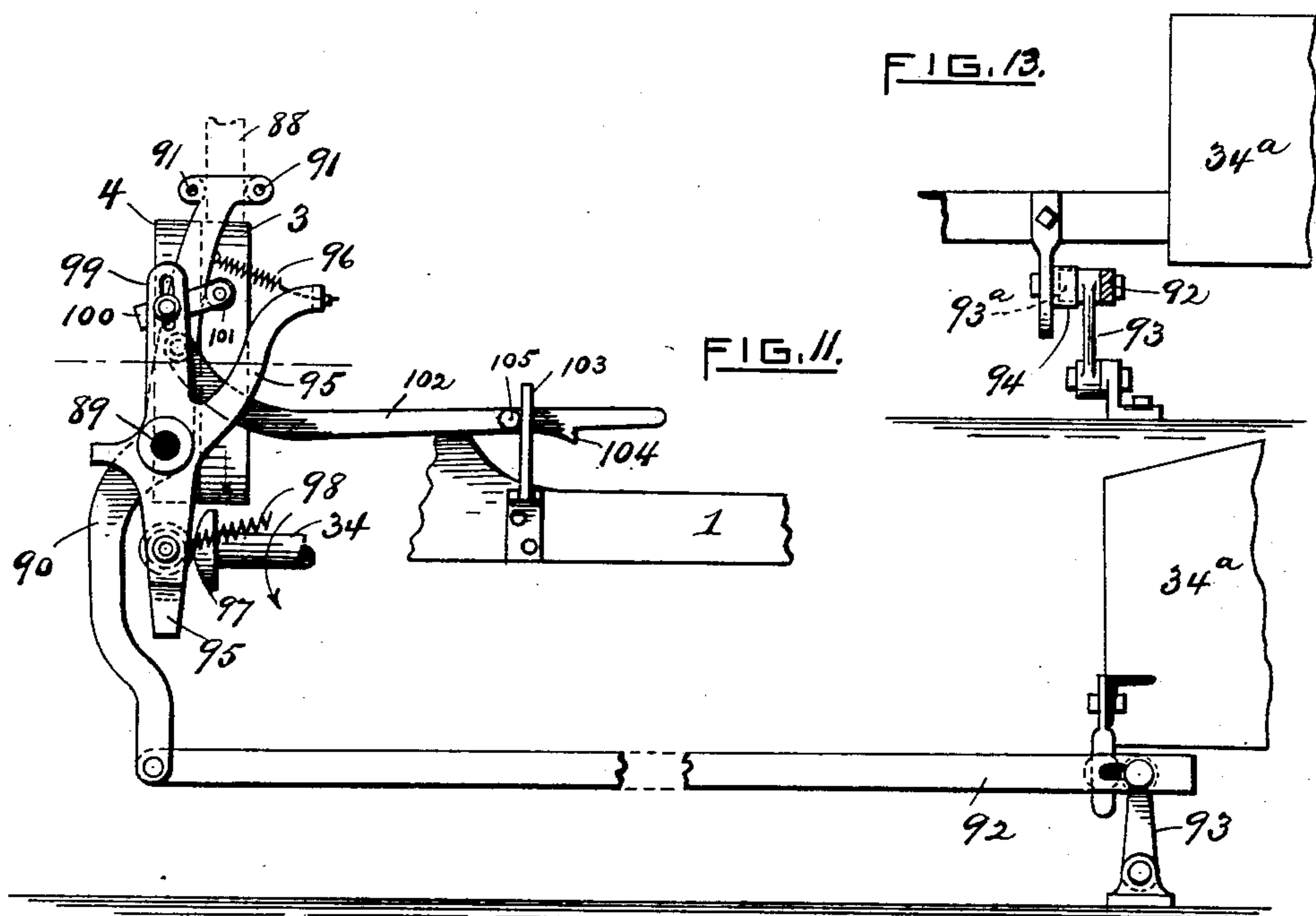
James Brown
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SPINNING MULE.

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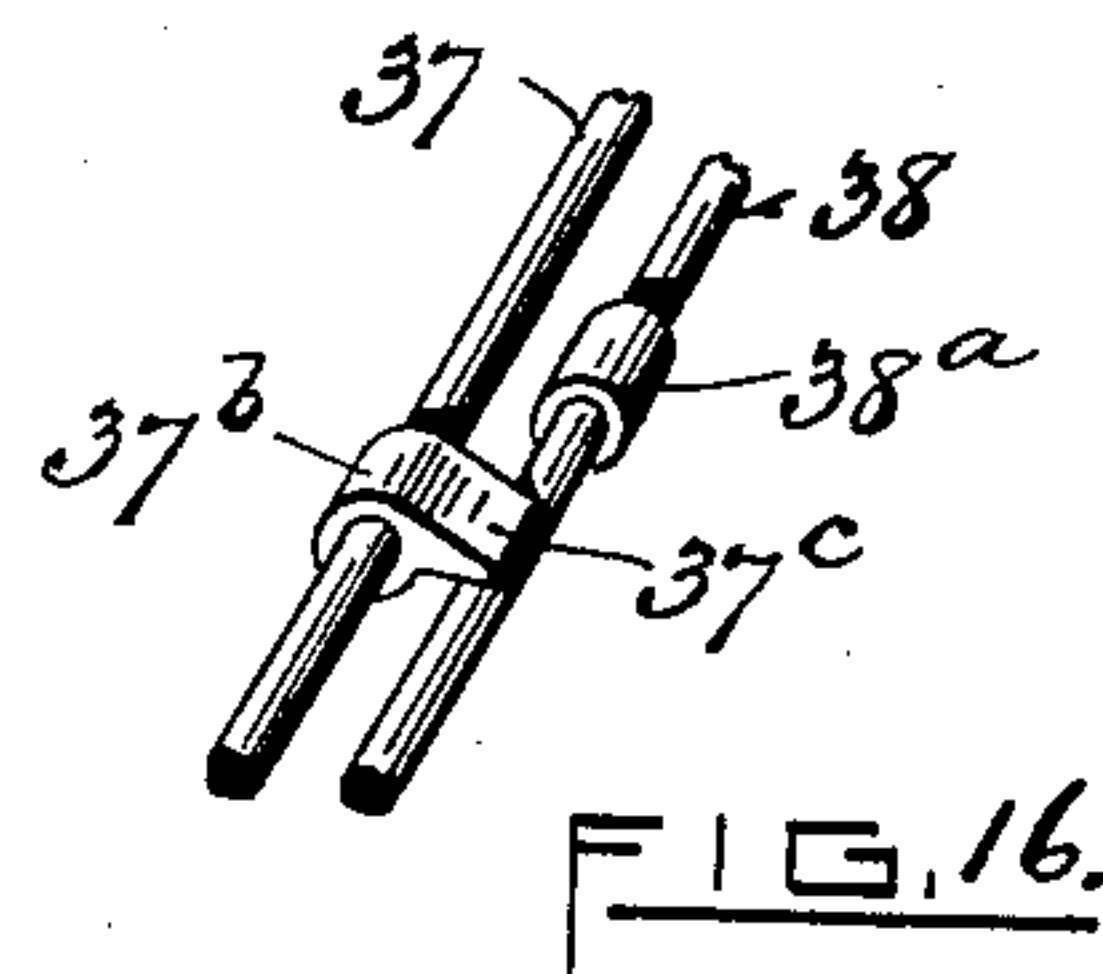
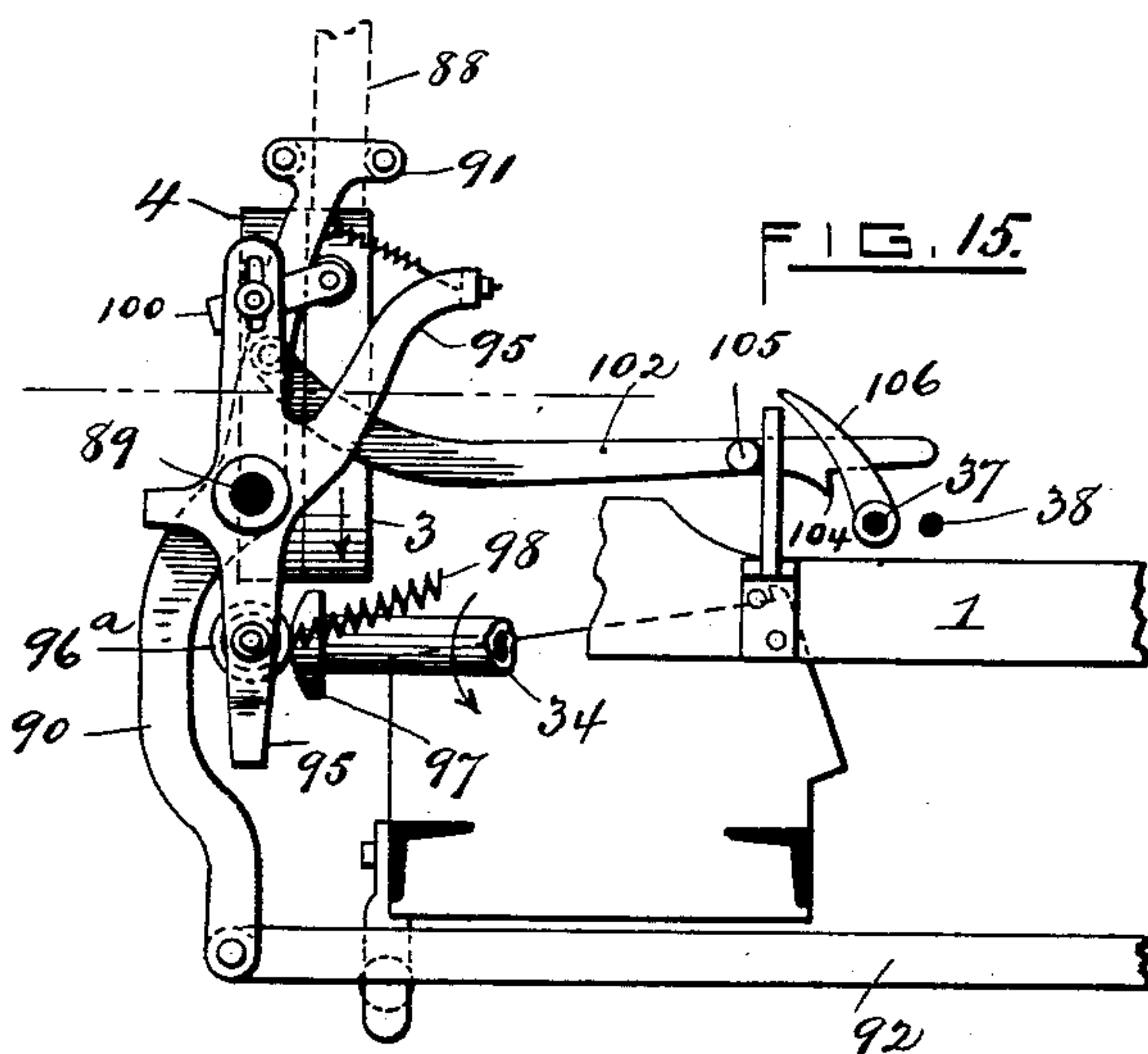
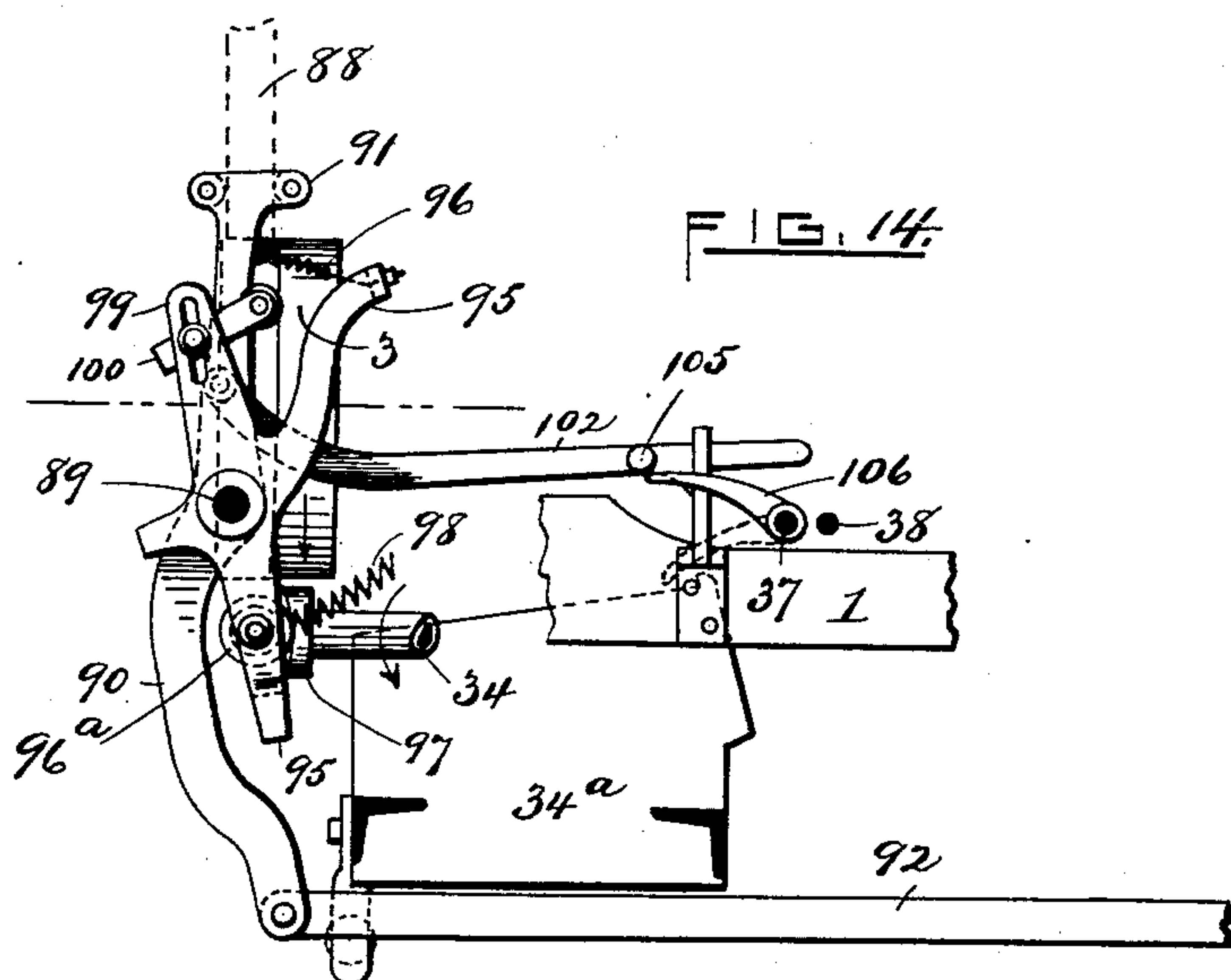
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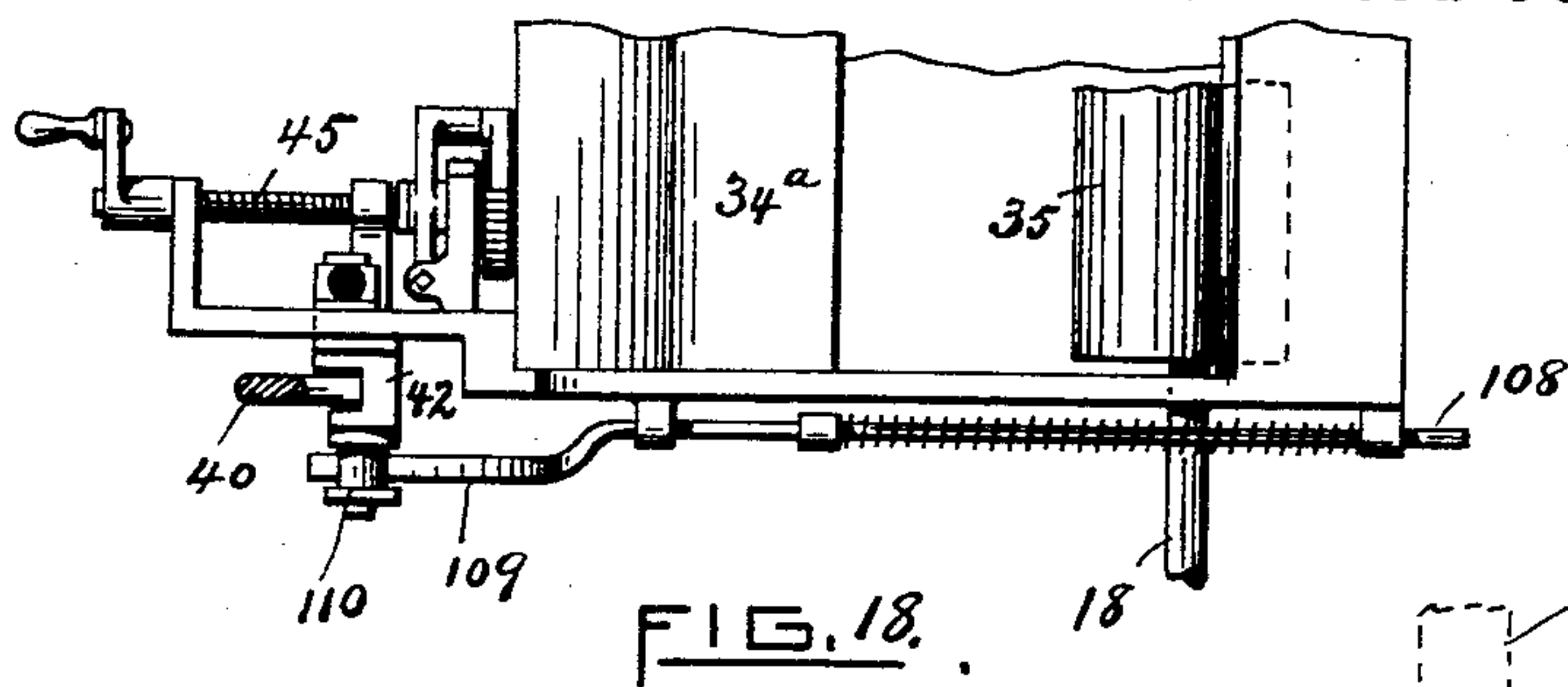


FIG. 18.

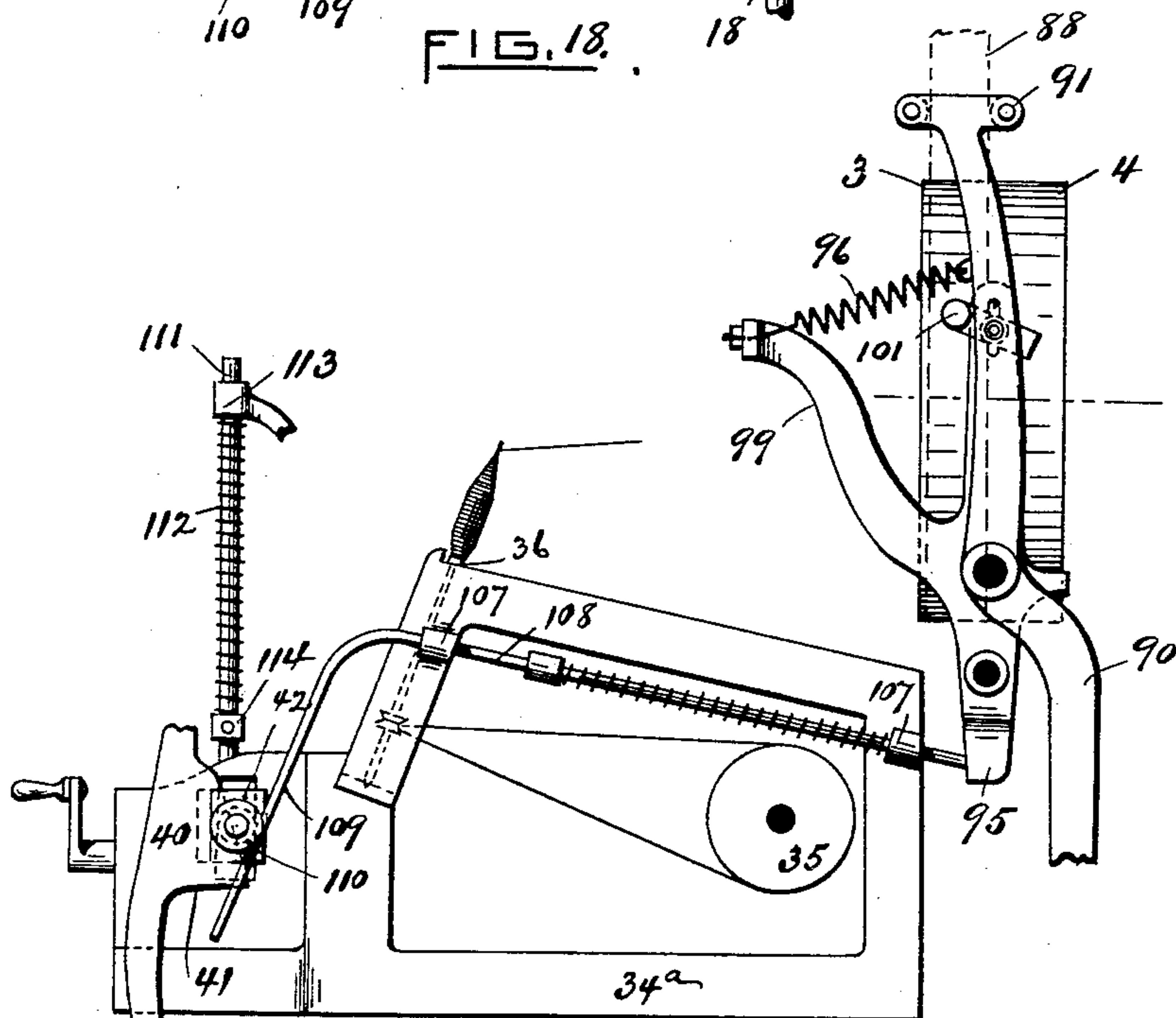


FIG. 17.

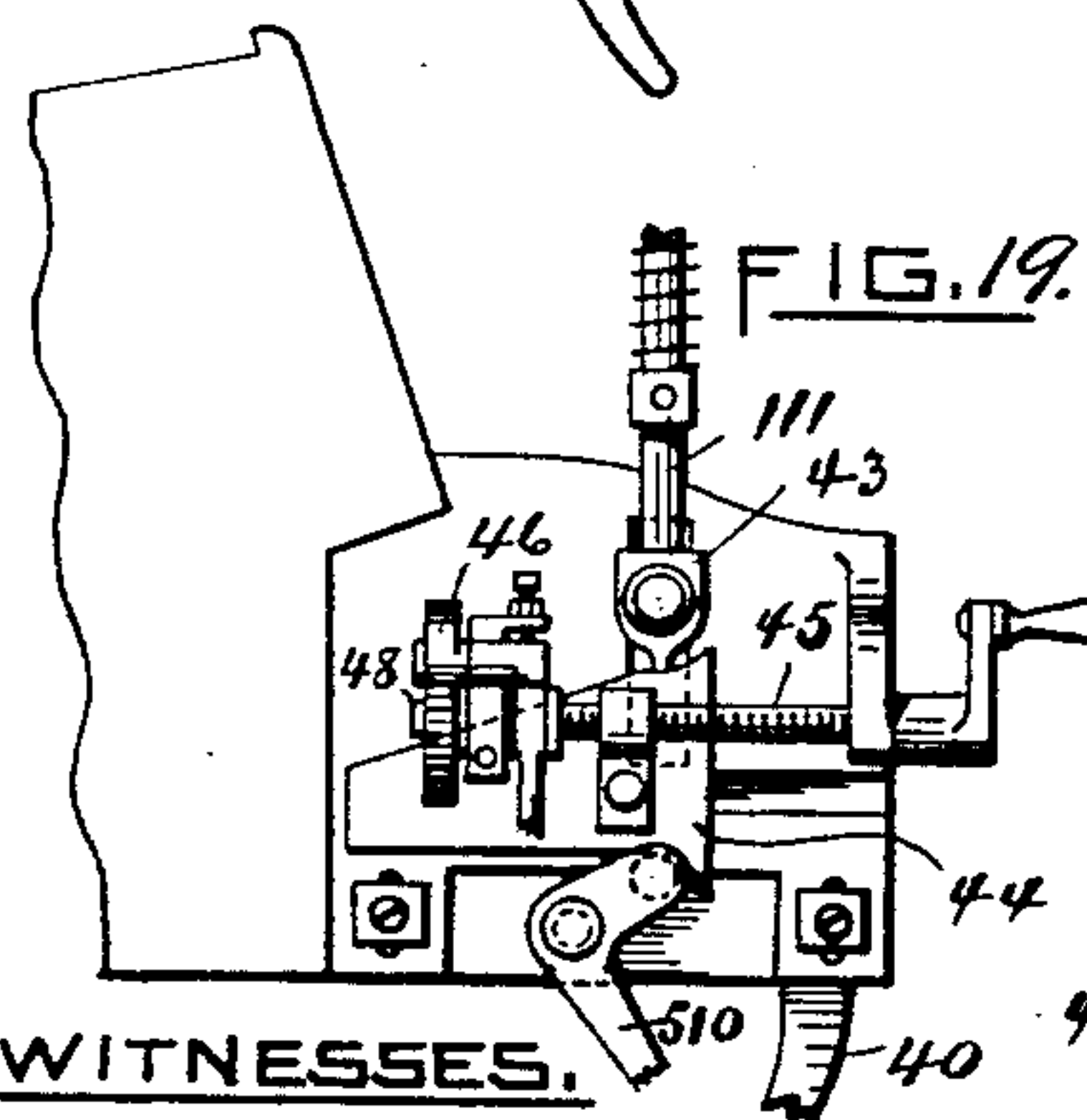


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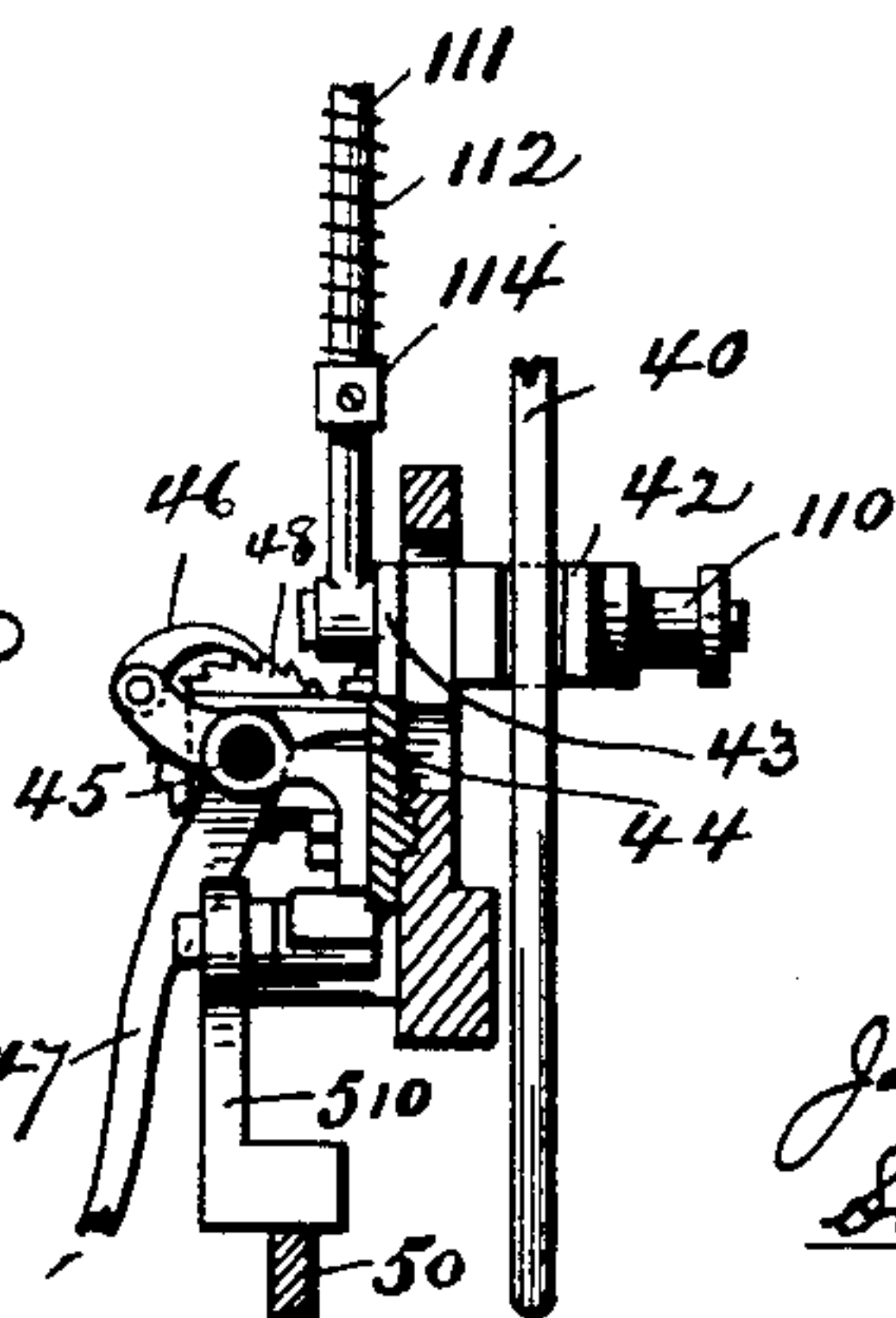


FIG. 20.

WITNESSES.

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(No Model.)

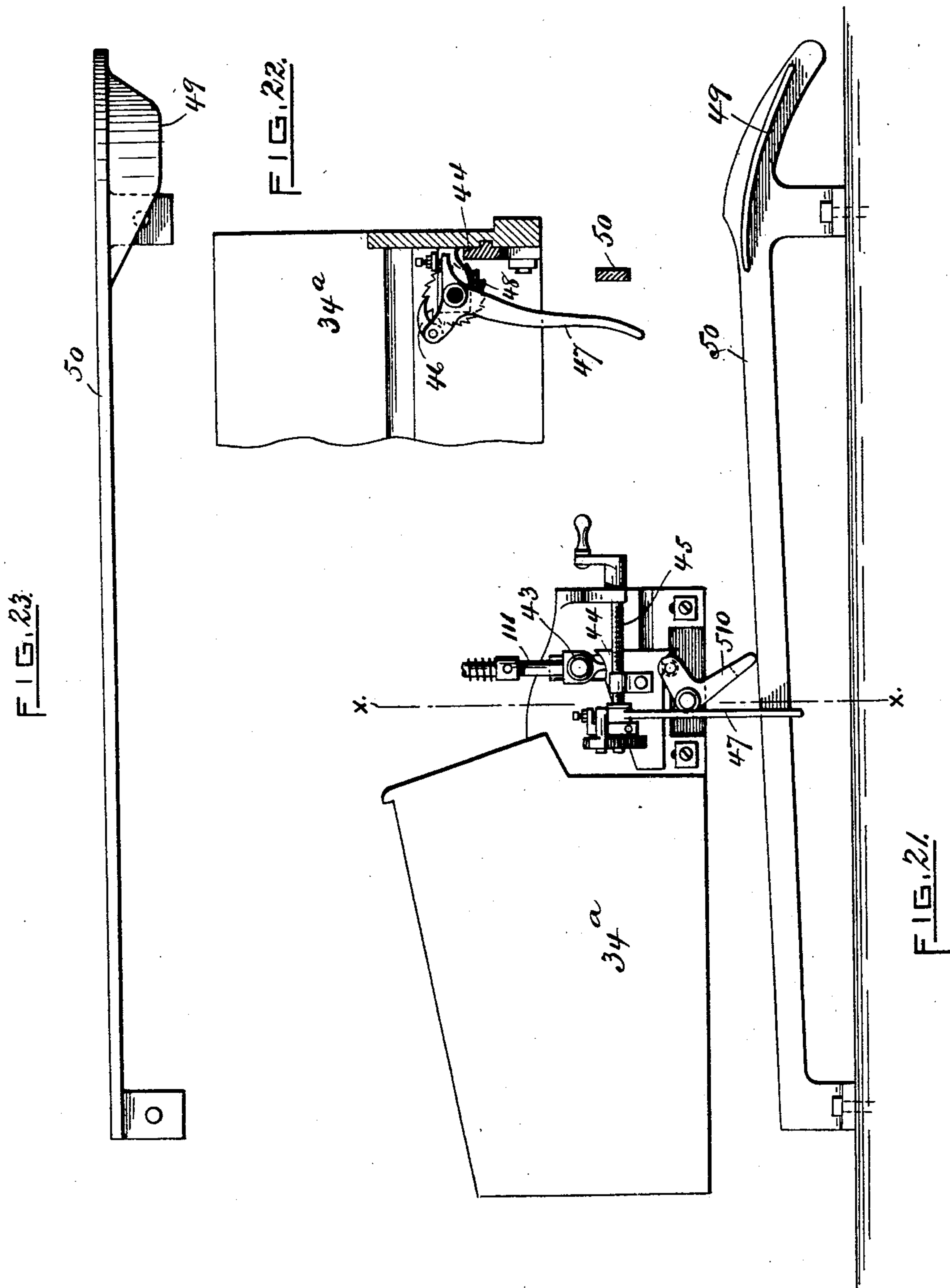
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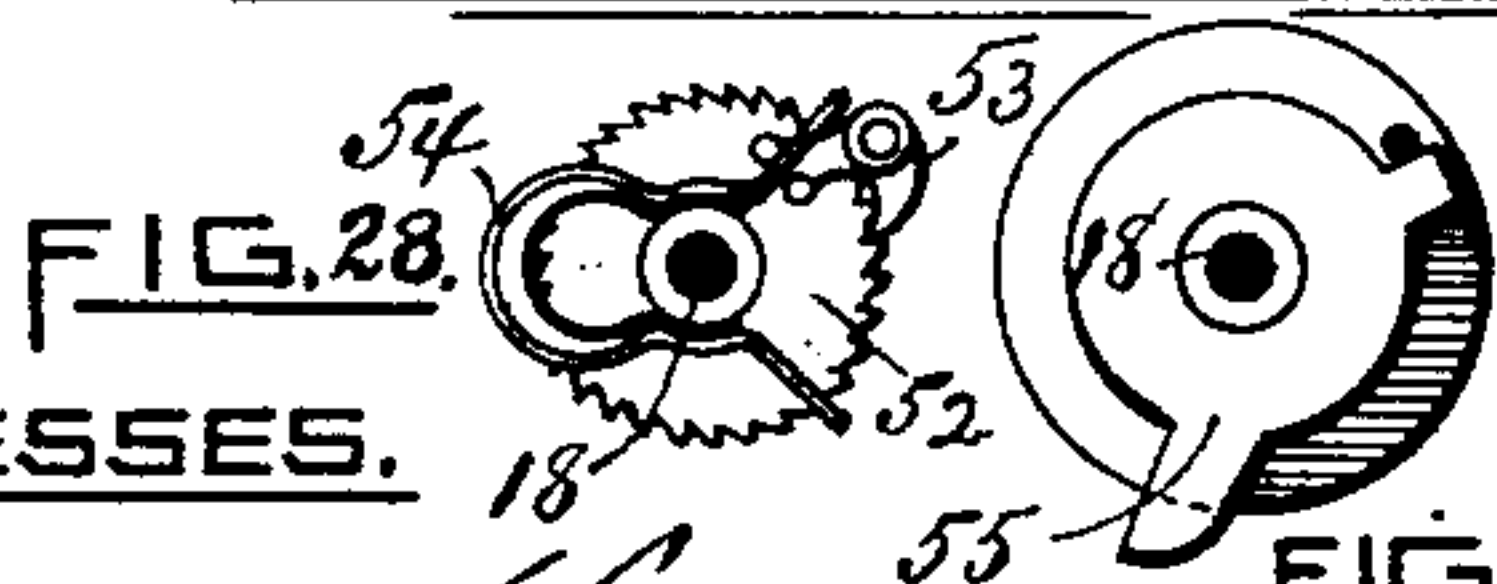
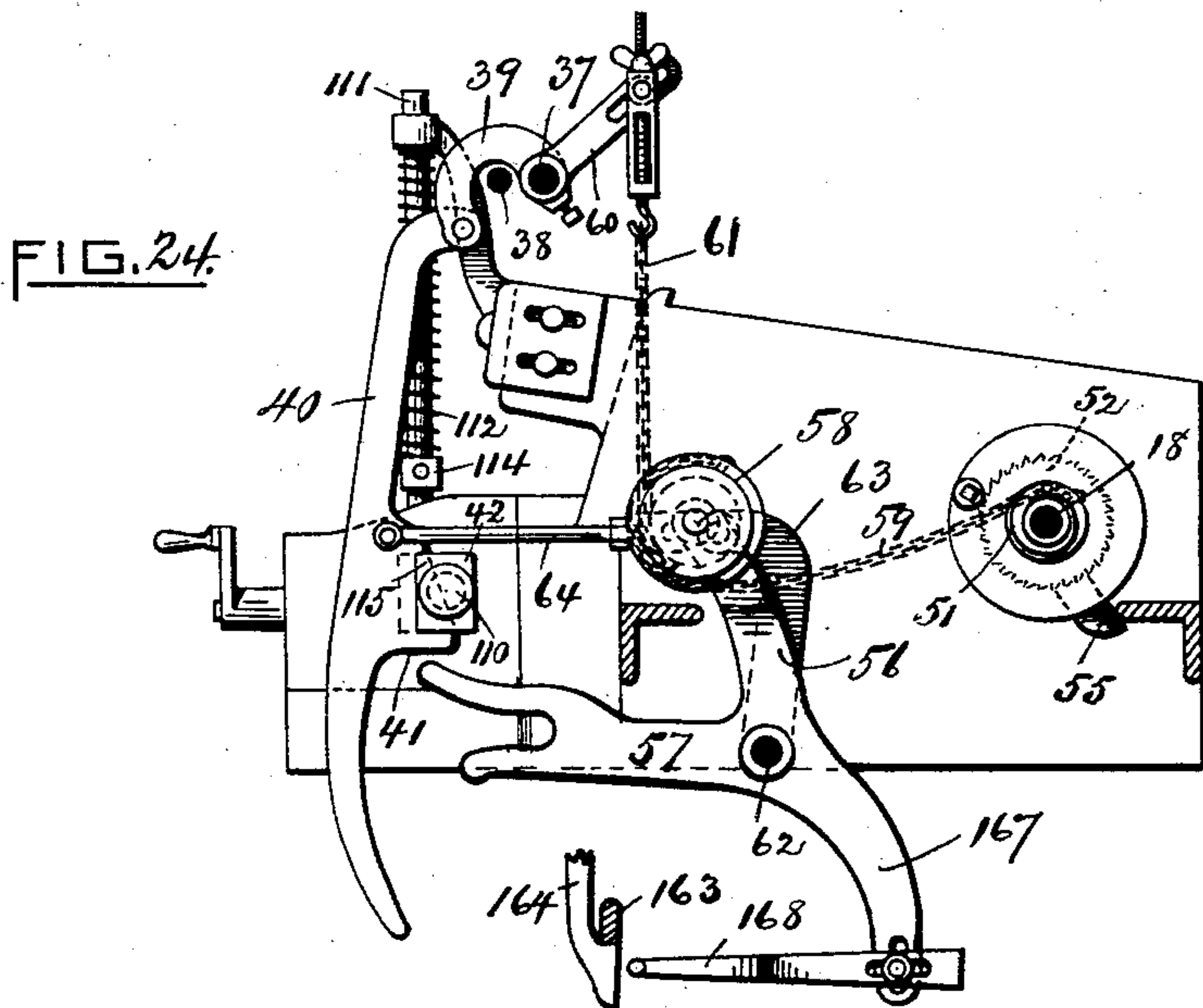
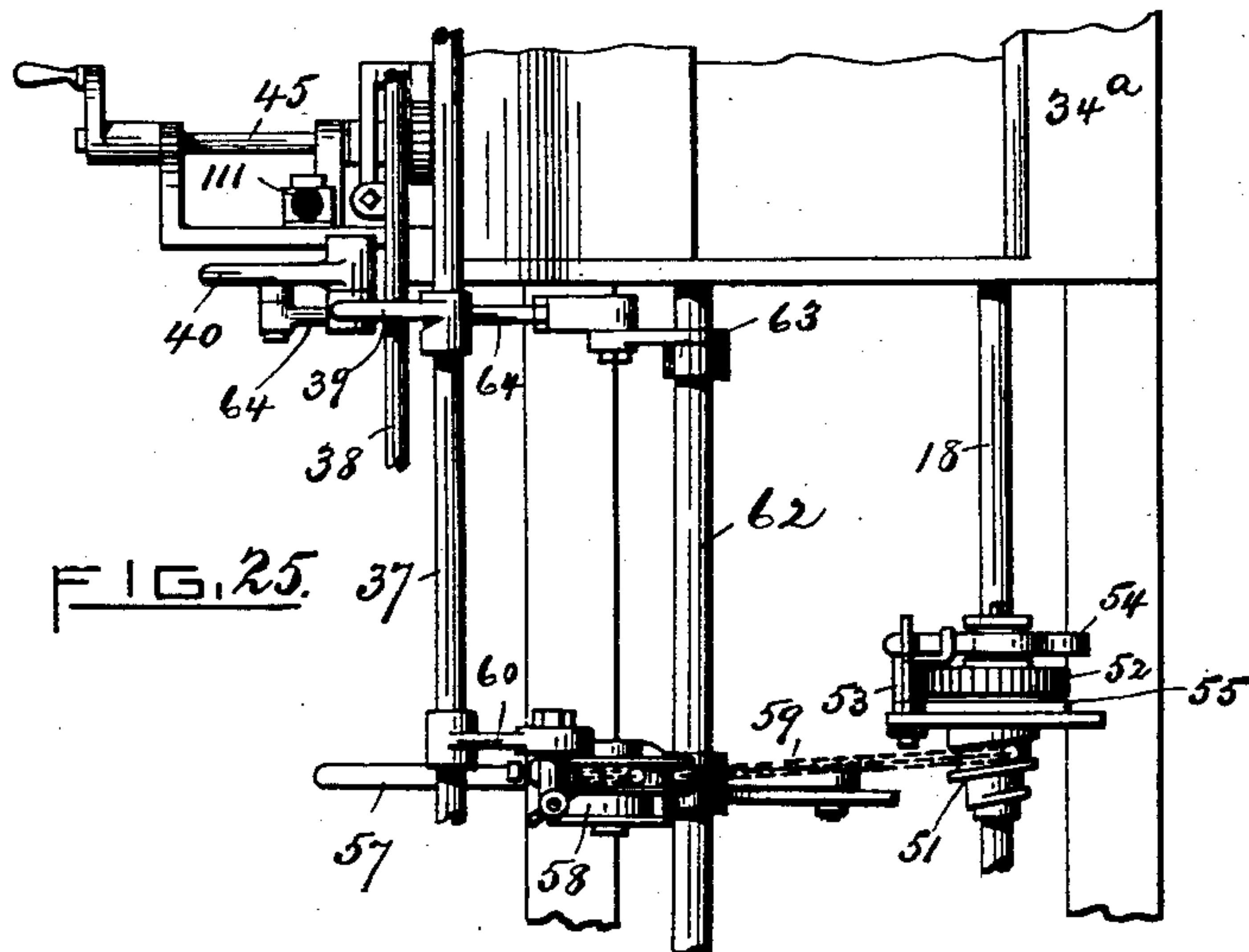
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FIG. 27.

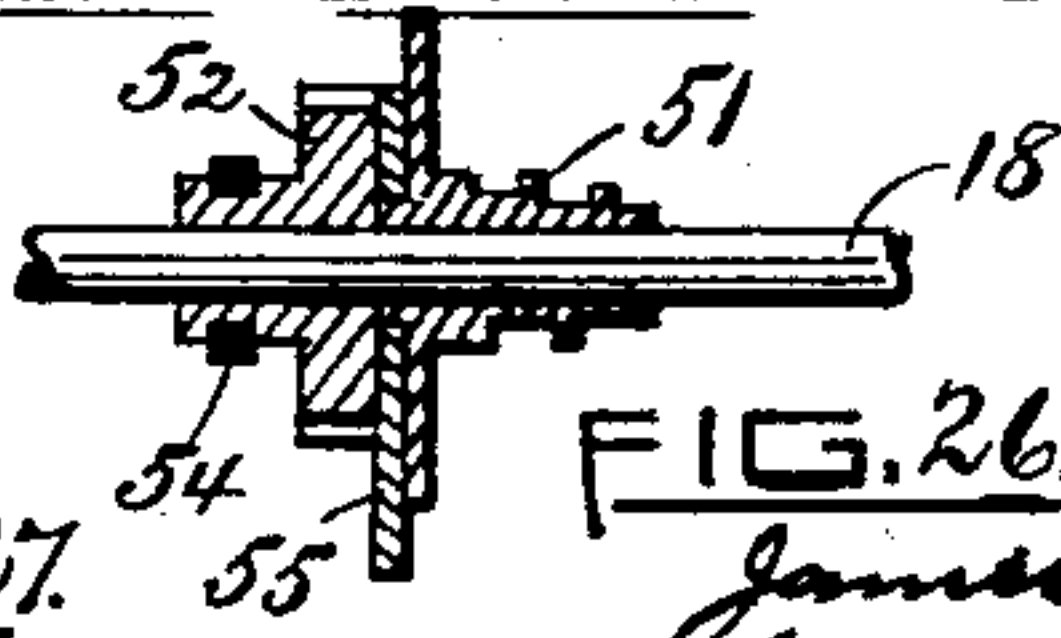


FIG. 26.

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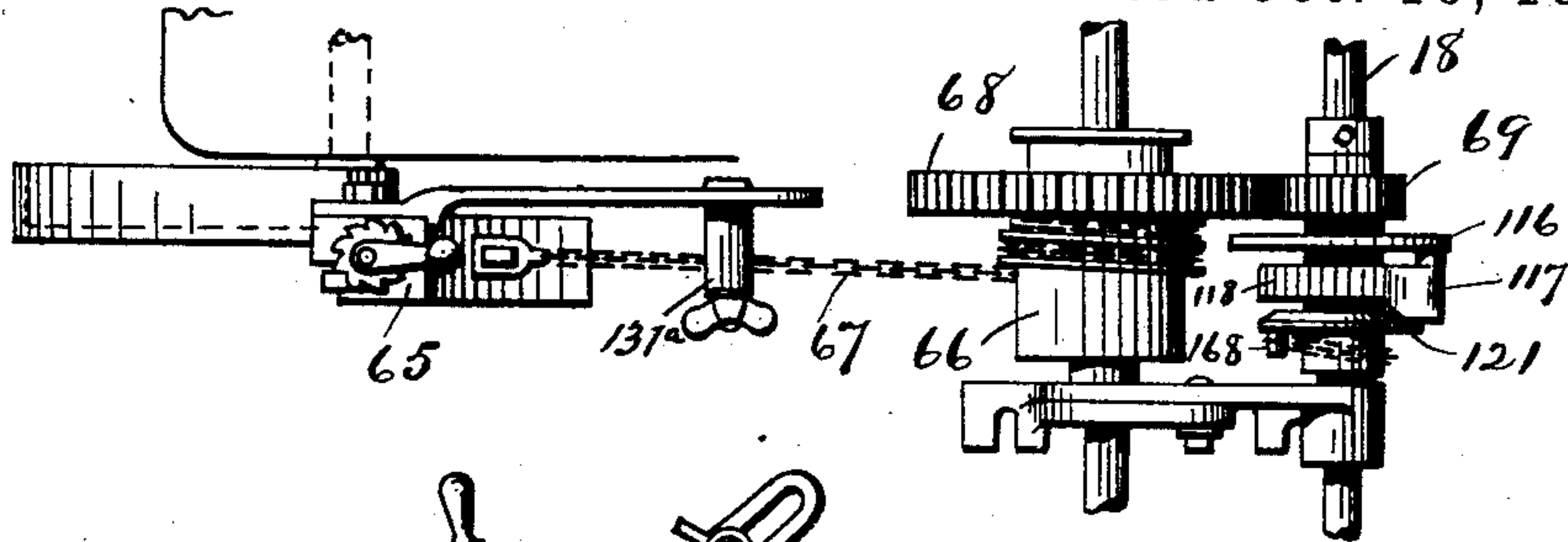


FIG. 31.

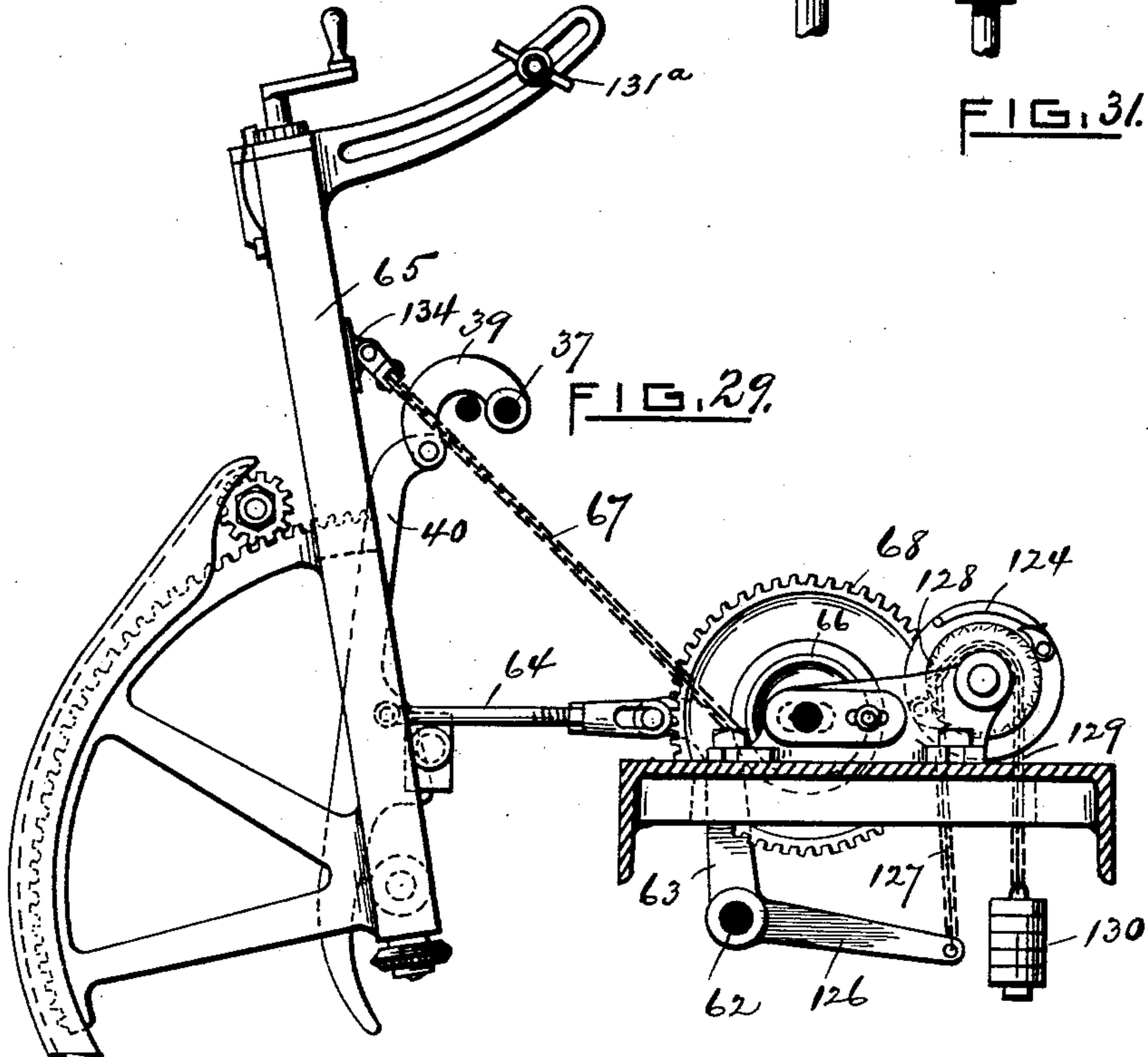


FIG. 29.

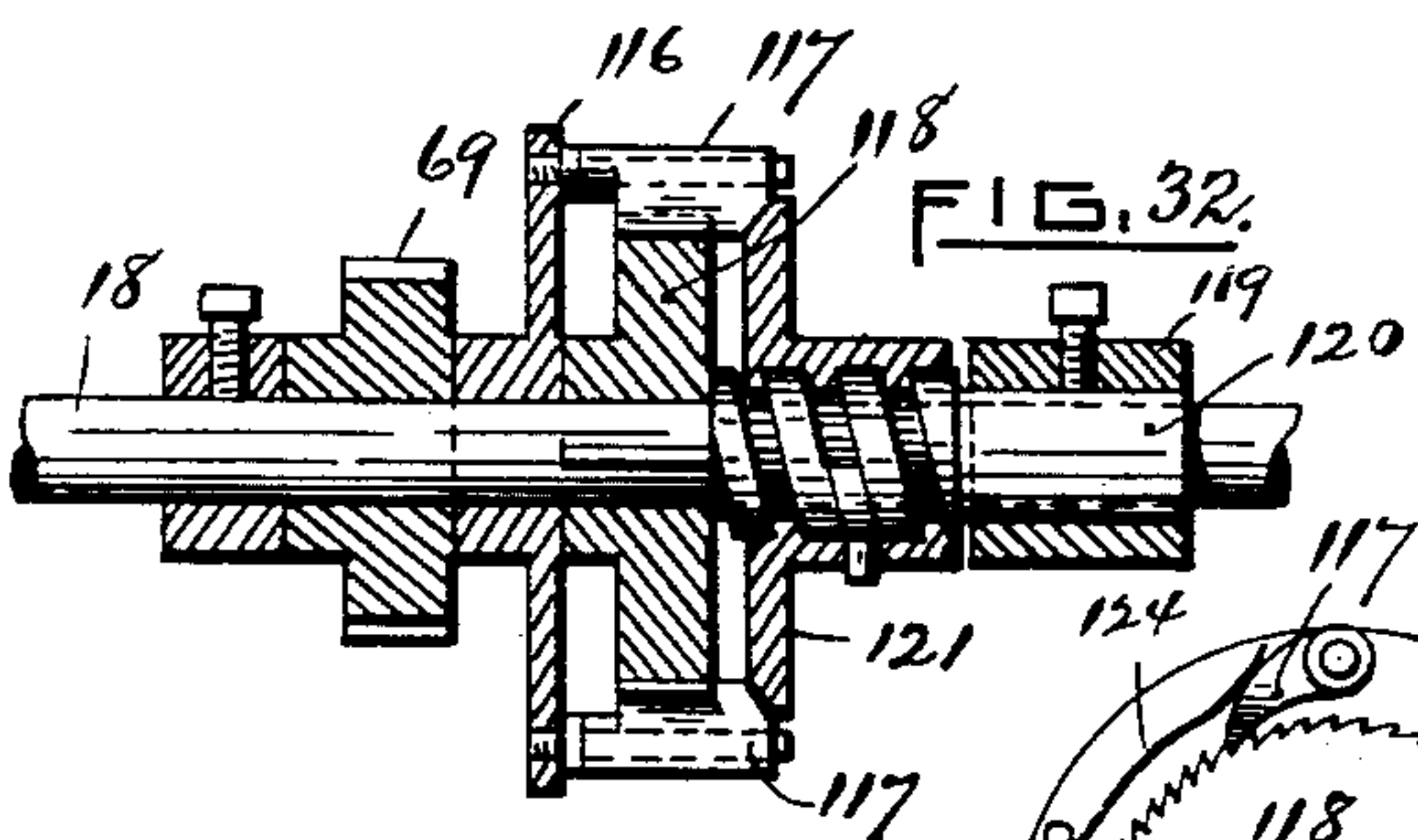


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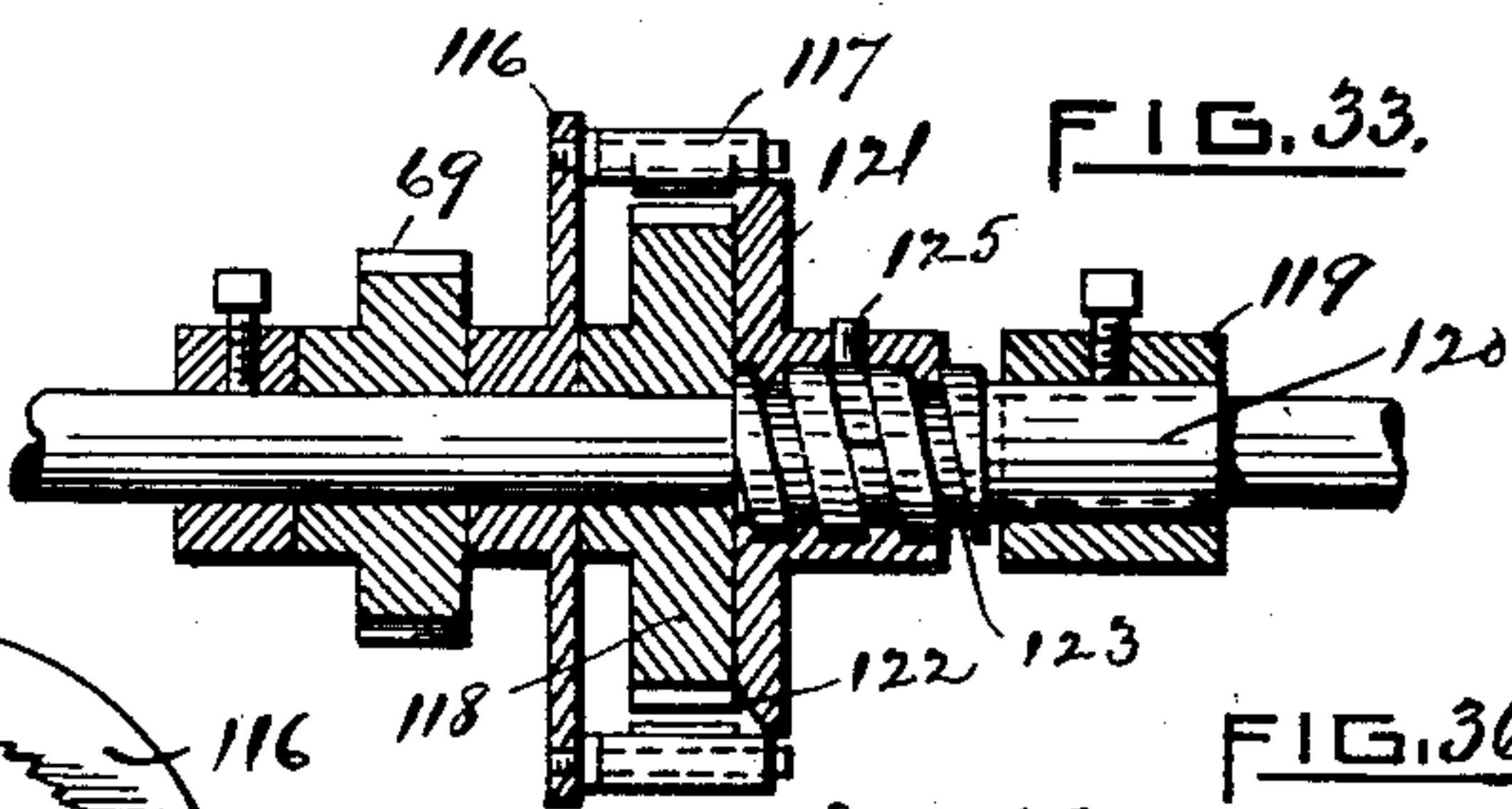


FIG. 33.

WITNESSES.

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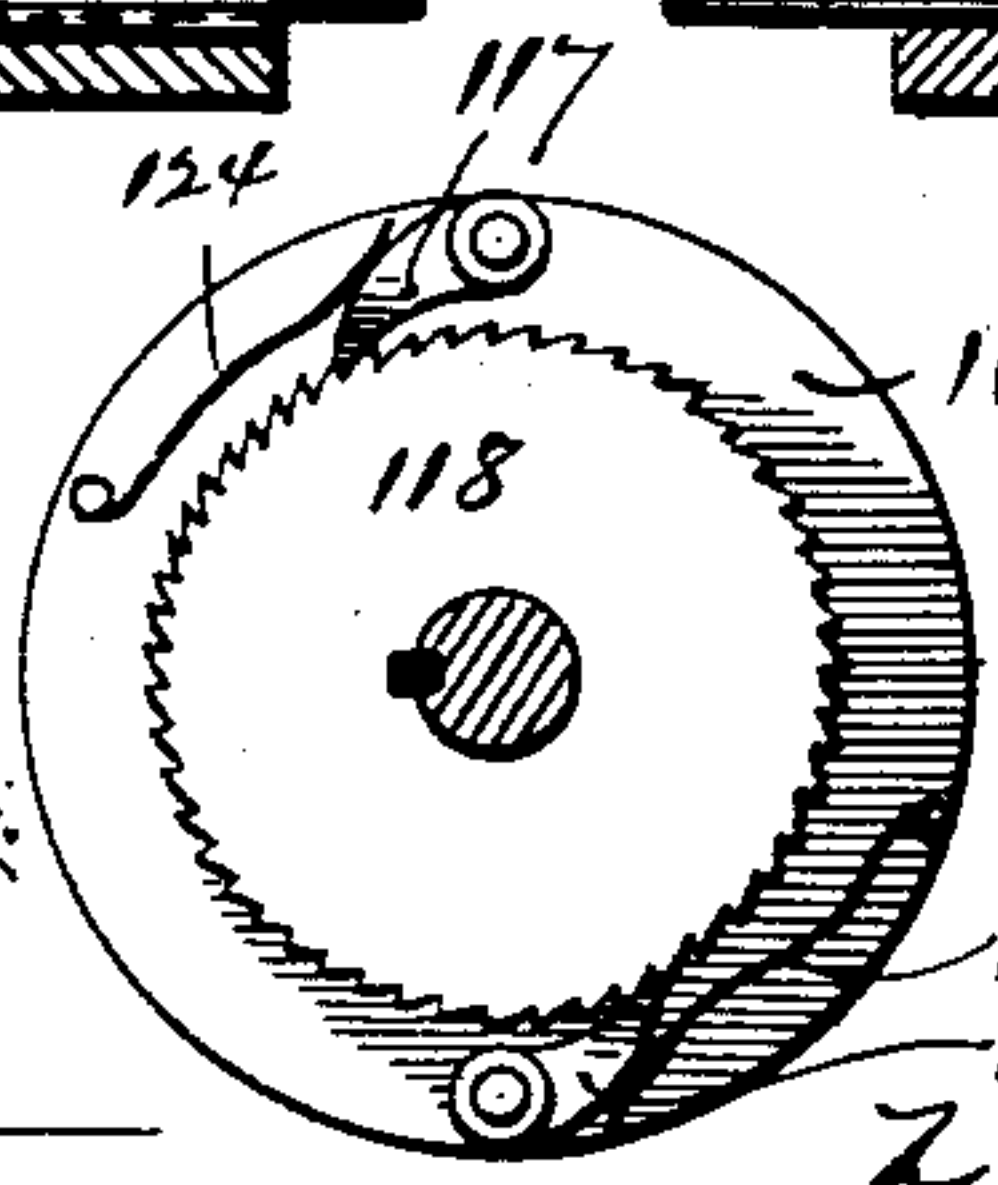


FIG. 34.

FIG. 35.



FIG. 36.

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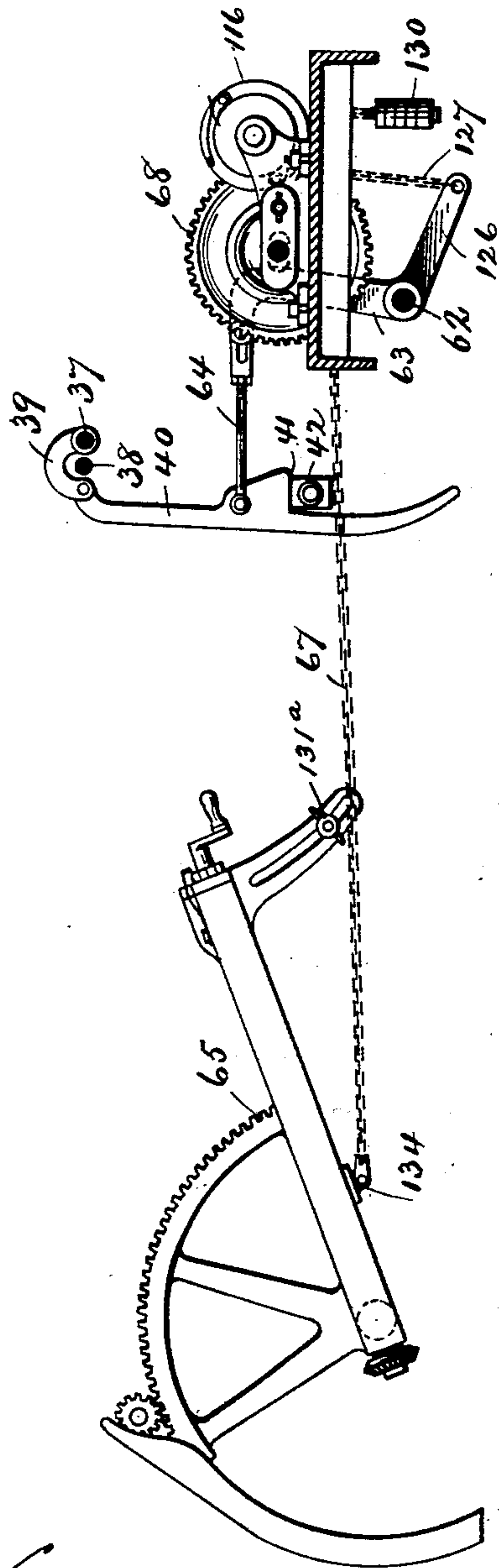


FIG. 30.

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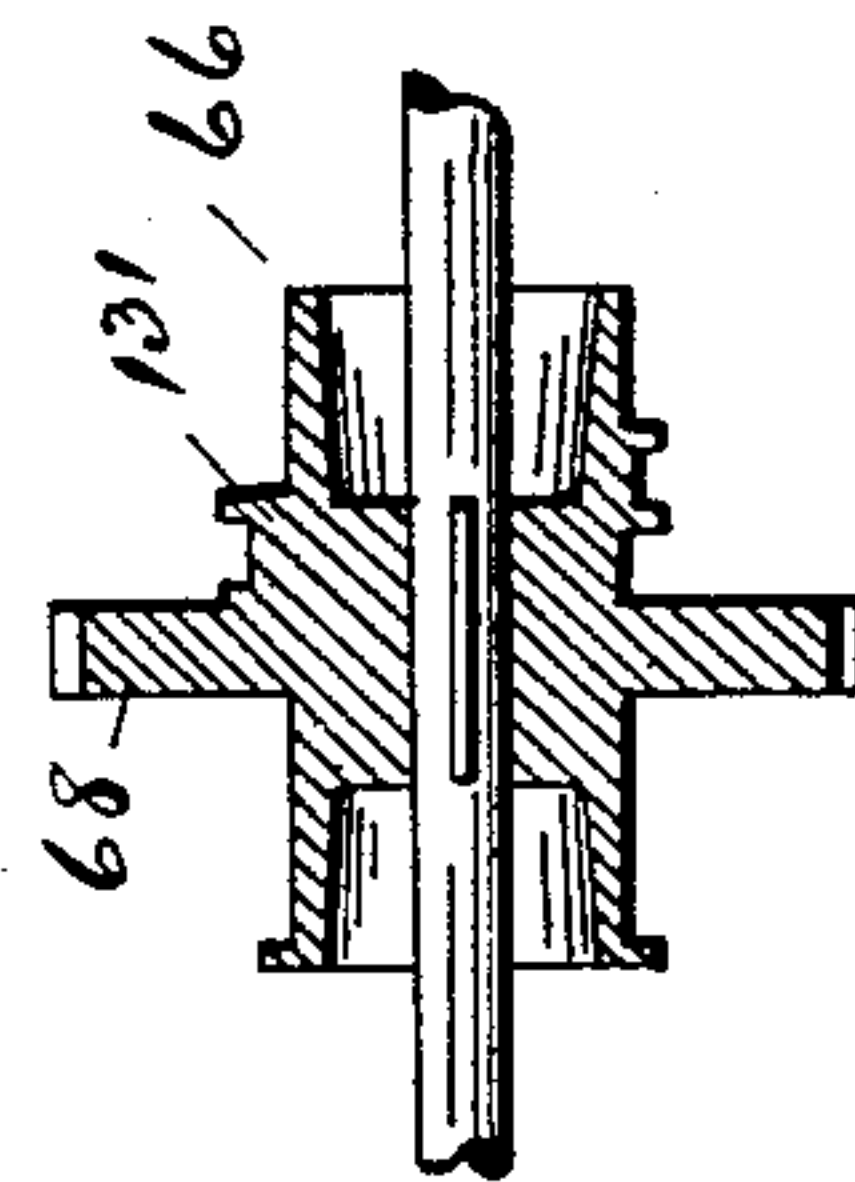
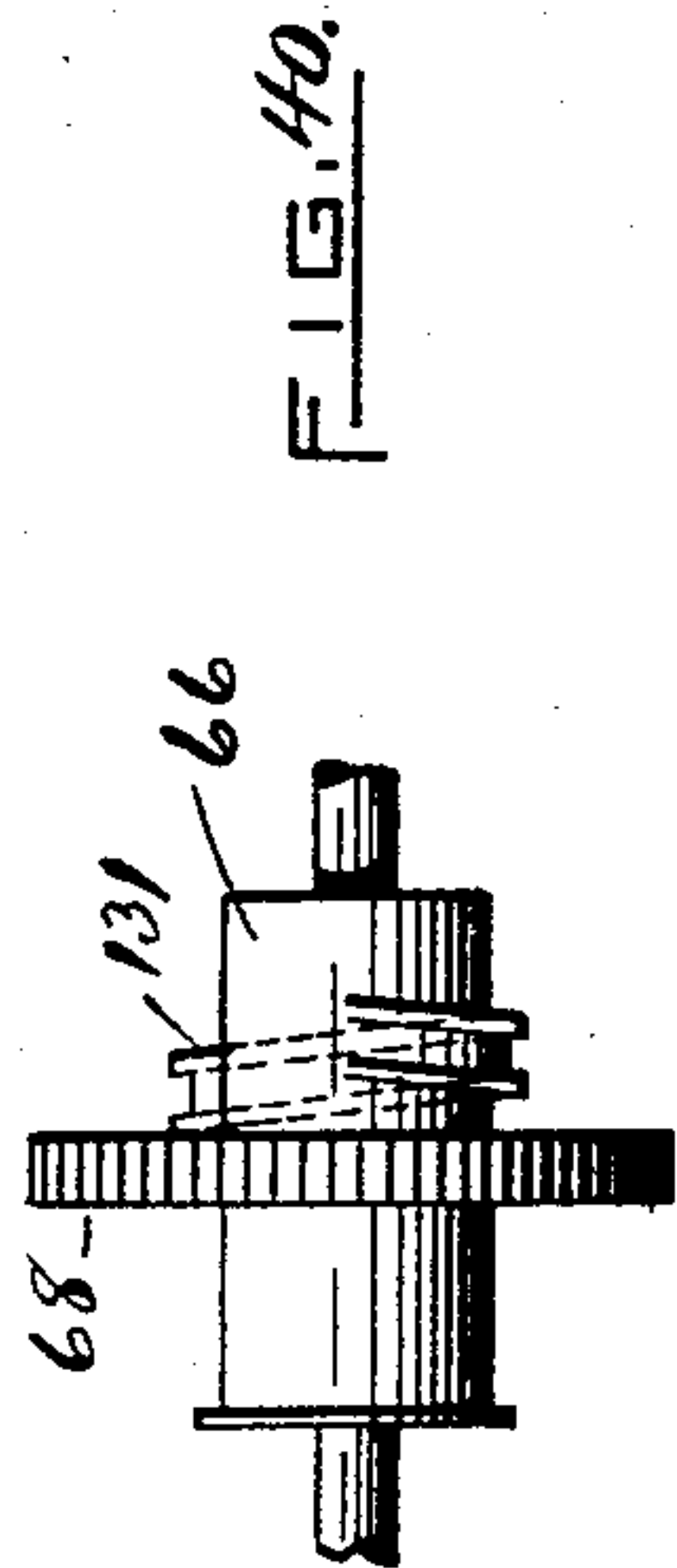
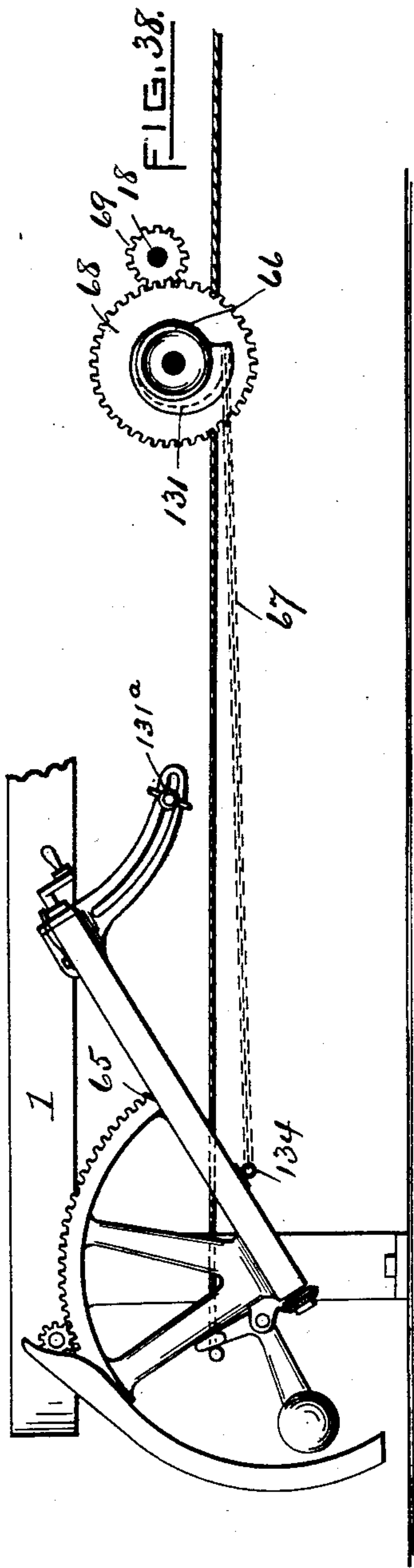
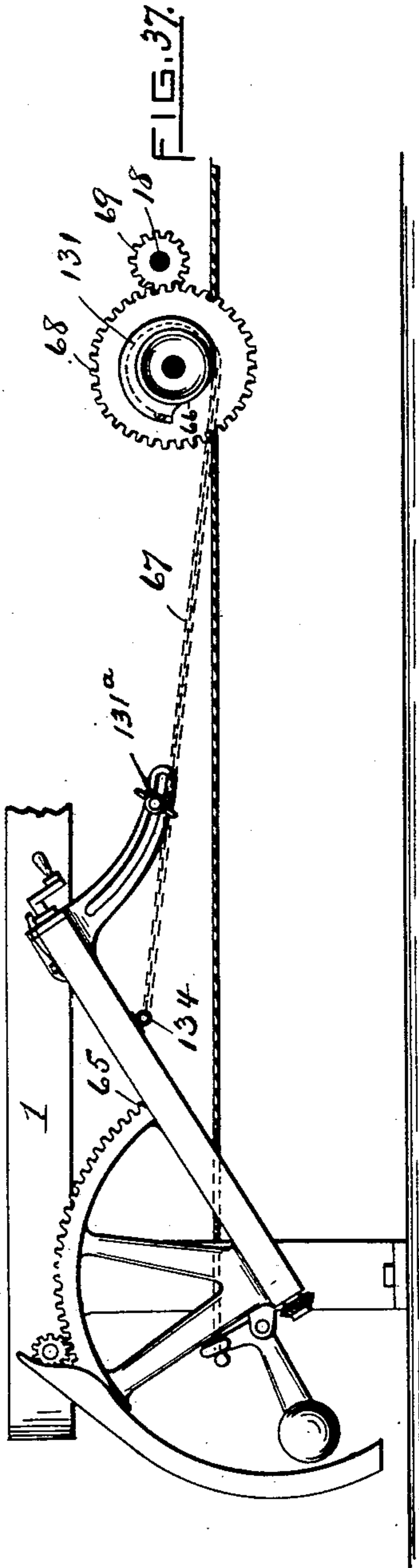
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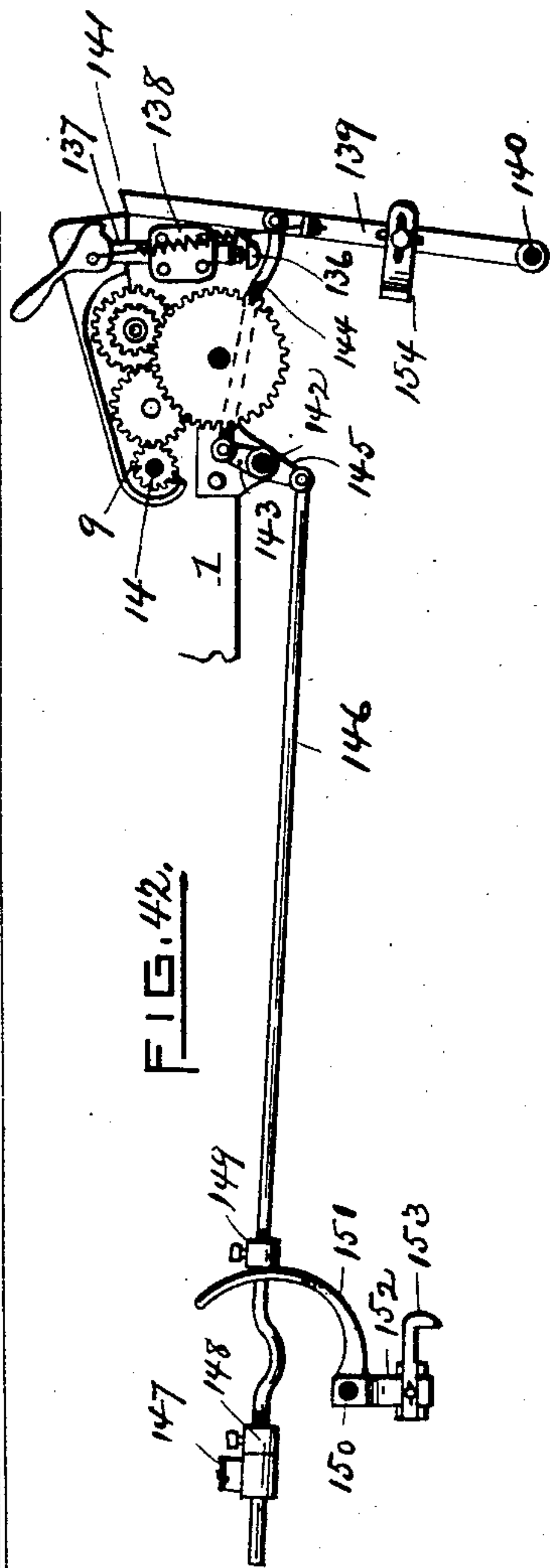
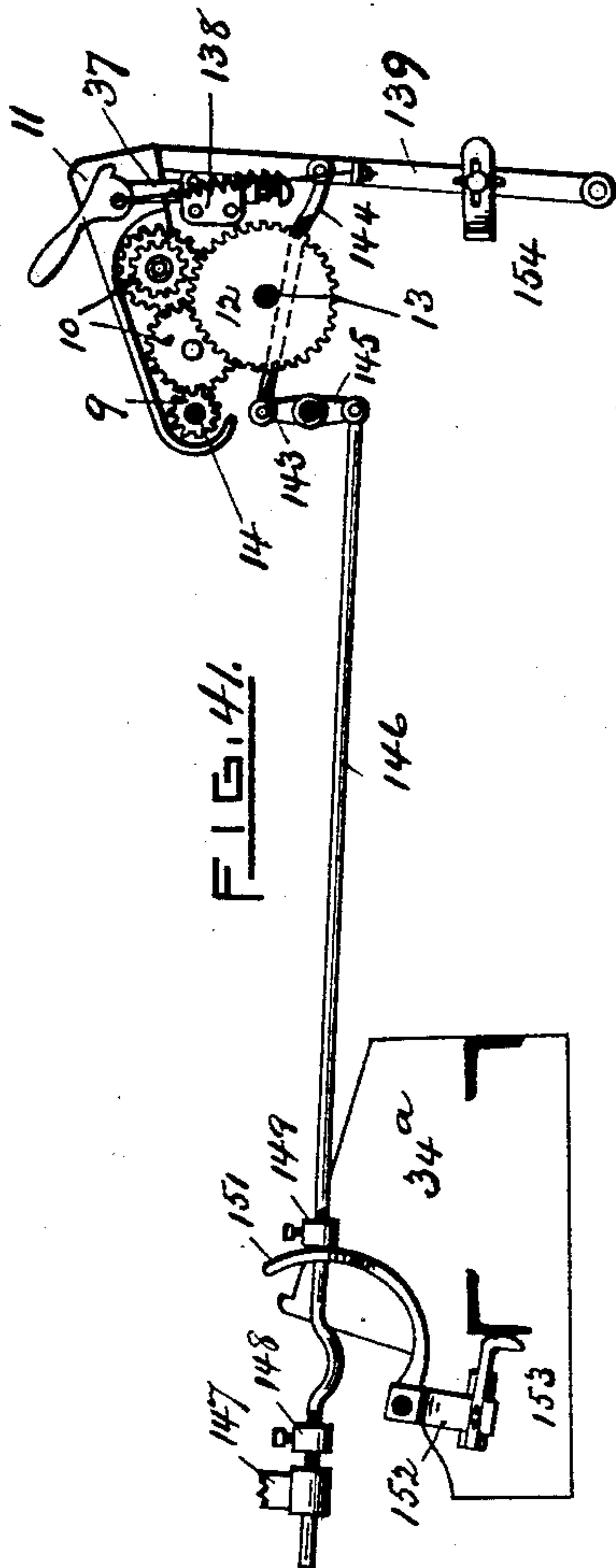
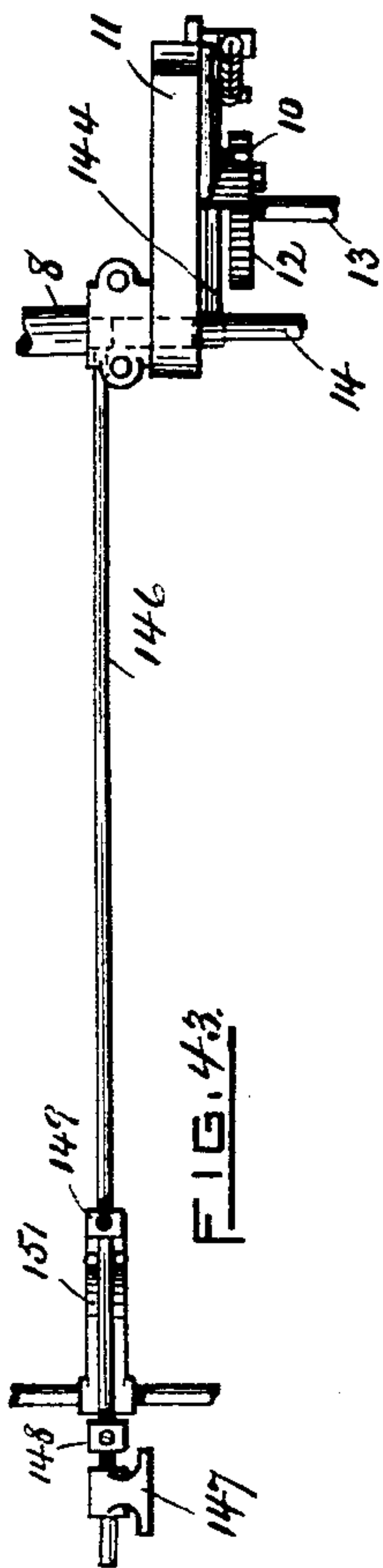
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Patented Oct. 19, 1897.



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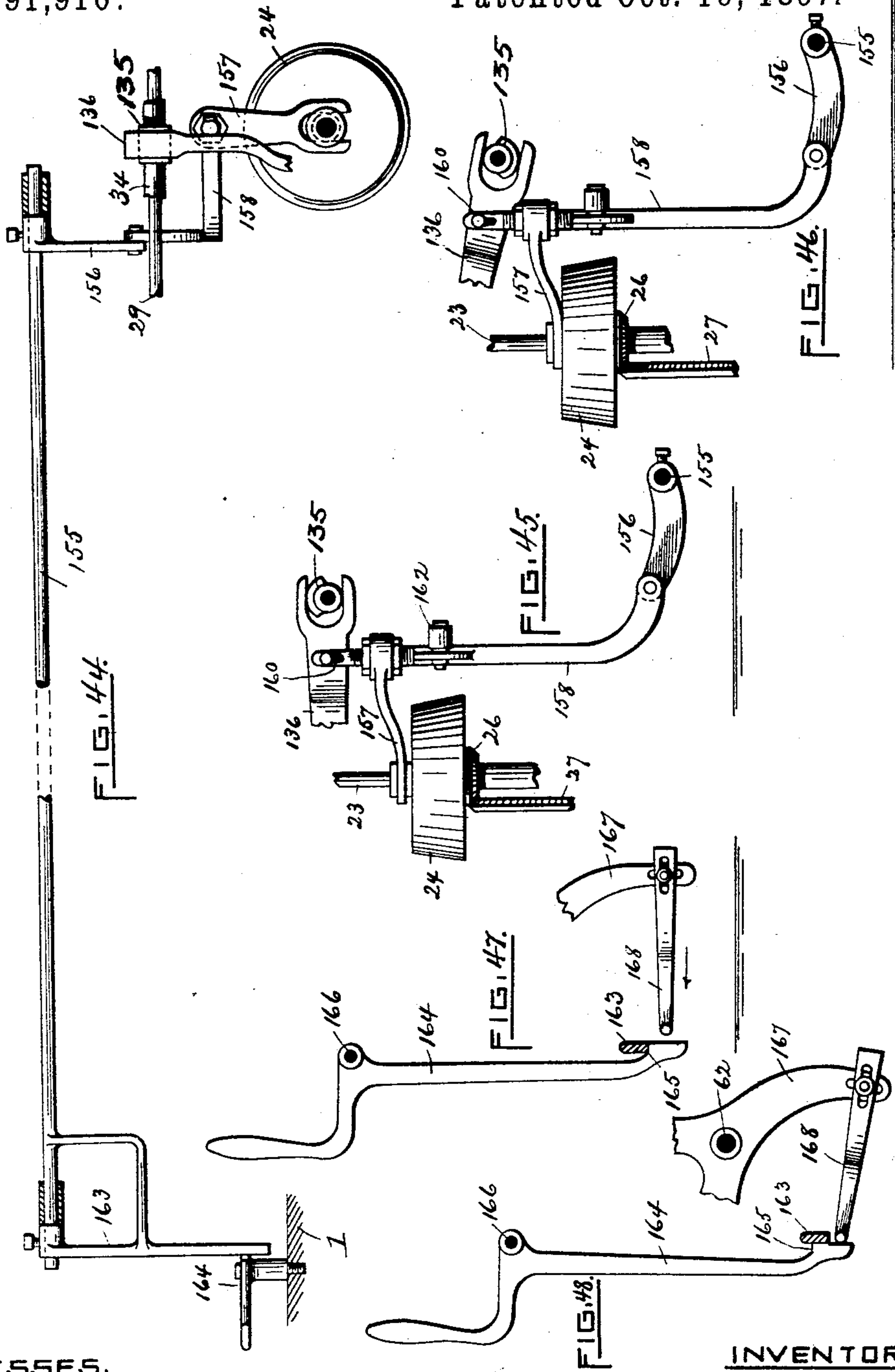
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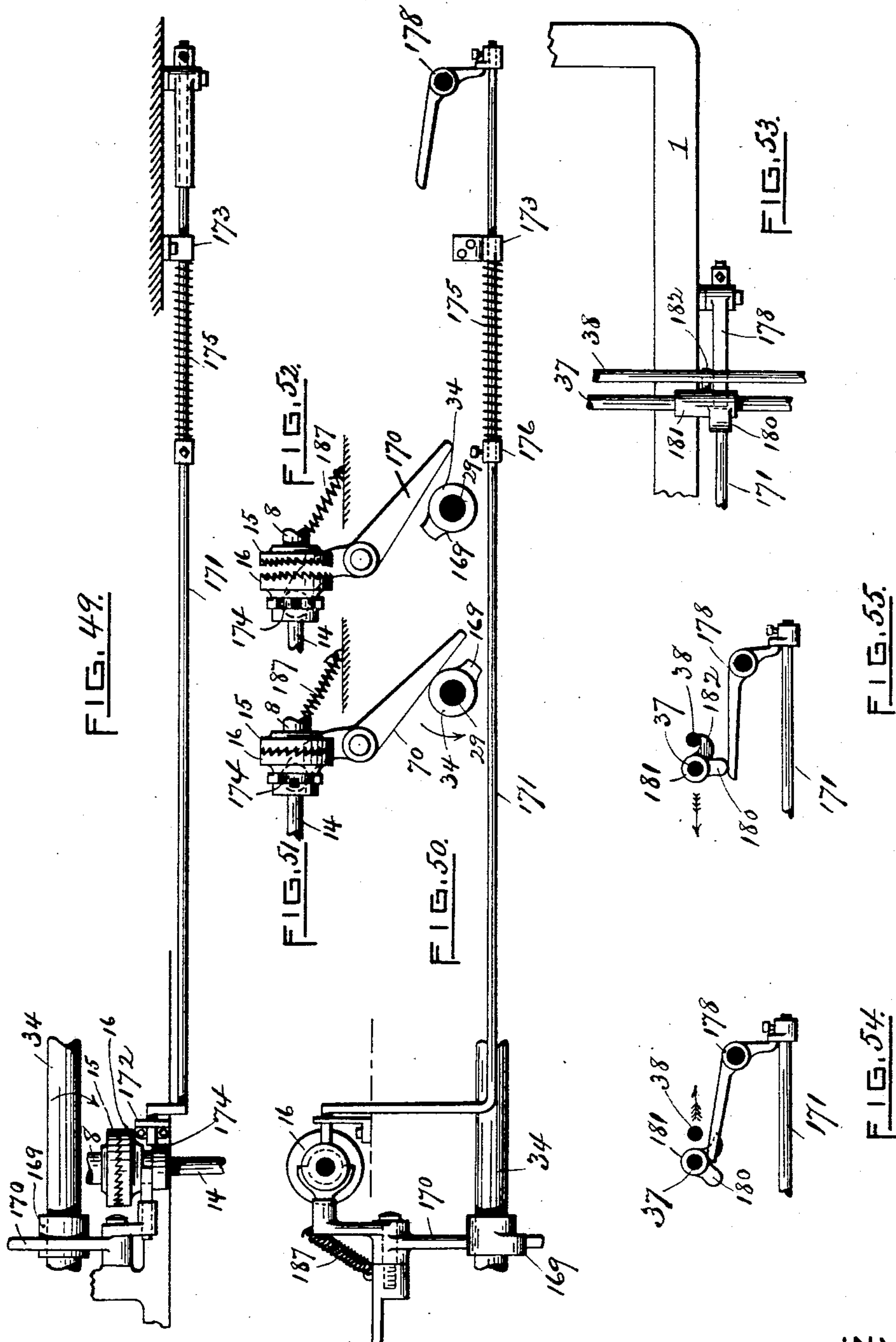
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UNITED STATES PATENT OFFICE.

SAMUEL BARROWCLOUGH AND JAMES BROWN, OF PAWTUCKET, RHODE ISLAND; SAID BARROWCLOUGH ASSIGNOR TO SAID BROWN.

SPINNING-MULE.

SPECIFICATION forming part of Letters Patent No. 591,910, dated October 19, 1897.

Application filed November 29, 1895. Serial No. 570,389. (No model.)

To all whom it may concern:

Be it known that we, SAMUEL BARROWCLOUGH and JAMES BROWN, of the city of Pawtucket and county of Providence, in the State of Rhode Island, have invented certain new and useful Improvements in Spinning-Mules; and we do hereby declare the following specification, taken in connection with the accompanying drawings, forming a part of the same, to be a full, clear, and exact description thereof.

The present invention relates to spinning-mules and more especially to that class of mules used for spinning cotton or worsted, and has for its object the production of an entirely automatic machine and the simplifying of the various mechanisms and the reduction of the number of parts, whereby the speed and efficiency of the machine is greatly increased and liability to get out of order reduced.

To that end the invention consists in the improvements hereinafter described.

In the accompanying drawings is shown a machine illustrative of the preferred forms of these improvements, in which—

Figure 1 is a plan view of the head of a spinning-mule embodying the present improvements. Fig. 2 is a rear elevation, and Fig. 3 a front elevation, of the same. Figs. 4 to 9 inclusive are details of the clutch-shaft-driving mechanism. Figs. 10 to 13 inclusive are detail views of the belt-shifting mechanism. Figs. 14 to 16 inclusive are detail views of the mechanism for causing the carriage to remain at the end of its inward stroke. Figs. 17 to 23 inclusive are detail views of certain devices carried by the carriage. Figs. 24 to 28 inclusive are detail views of the mechanism for taking up the slack in the backing-off chain. Figs. 29 to 36 inclusive are detail views of the mechanism for controlling the winding-on pawls. Figs. 37 to 40 inclusive are detail views of the winding-on drum. Figs. 41 to 43 inclusive are detail views of the drawing-out mechanism and the means for operating the same. Figs. 44 to 48 inclusive are details of the mechanism for holding the drawing-in friction out of engagement during the backing off. Figs. 49 to 55 inclusive are

detail views of the drawing-roll clutch and means for controlling the same.

General Description of Head and Parts Carried Thereby.

Mounted in the head-frame 1 is the shaft 2, carrying the tight pulley 3, the loose pulley 4, the beveled gear 5, and the grooved pulleys 6. The beveled gear 5 meshes with a beveled gear 7 on the sleeve 8, which has secured to its end outside the frame the pinion 9, which pinion drives a train of gears 10, carried by the pivoted frame 11, Fig. 41. The last of the train of gears 10 is adapted to engage a gear 12 on the back shaft 13 to drive said shaft and operate the drawing or running out scrolls.

The above-described device is one of the common forms of running-out mechanism.

Passing through the sleeve 8 is a shaft 14, which is driven from said sleeve through a clutch having one member 15 secured to said sleeve and the other member 16 secured to but sliding on the shaft 14. The shaft 14 is geared to and drives the drawing-rolls 17. The pulleys 6 serve to drive the spindle-driving shaft 18 during the spinning and backing off in the ordinary manner. Also mounted in suitable bearings in the frame 1 is a shaft 19, carrying the grooved pulleys 19^a, the beveled gear 20, the band-pulley 21, and the pinion 28. The gear 20 meshes with a gear 22 on the shaft 23, on which slides the friction-clutch 24 for connecting said shaft to the shaft 25, carrying the drawing-in scrolls, said connection being through the beveled gears 26 and 27. The pulley 21 drives the shaft 29 continuously through the pulley 30 and belt 31 and the shaft 29 serves to drive the cam shaft or sleeve 34 in a manner to be described. The pinion 28 meshes with a gear 32, loose on the shaft 2 but connected thereto at the proper time to operate the pulley 6 in backing off by the backing-off friction 33.

The carriage 34^a is drawn in and out in the ordinary manner by drawing-in and drawing-out scrolls and carries the usual drums 35, secured to shaft 18 for driving the spindles 36, Fig. 17. Mounted in suitable bearings on the carriage are the shafts 37 and 38, carrying the

faller and counter-faller, respectively, and acted on by weights or springs in the usual manner.

Pivoted to the arm 39, secured to the faller-shaft 37, is the faller-lock lever 40, provided with the locking-shoulder 41, which engages the block or catch 42 to lock the faller, Figs. 21 and 24. The block 42 slides in a guideway in the carriage 34^a and is attached to the toe-plate 43, which rides on the cop-plate 44, also mounted to slide in the carriage 34^a. The cop-plate carries a lug engaged by a screw-rod 45, which is actuated by the pawl 46, carried by the rock-lever 47, said pawl engaging a ratchet 48 on the rod 45 and said lever 47 being operated by a cam 49 on the builder or cop rail 50¹. The cop-plate 44 is acted on by the bell-crank lever 510, one arm of which bears against the lower edge of the cop-plate and the other end of which rides on the building or cop rail 50.

Loosely mounted on the shaft 18 is the backing-off scroll 51, which is operated in the usual manner through the ratchet-wheel 52, pawl 53, clip 54, and snail-plate 55, Figs. 24 to 28. Mounted on an arm 56 of the fish-jaw 57 is the chain-pulley 58, connected to the scroll 51 by chain 59 and to an arm 60 on the faller-shaft by chain 61. The fish-jaw is secured to the shaft 62, which also has secured to it the arm 63, which arm is connected to the faller-lock lever 40 by a link 64.

Pivoted to the side of the head-frame 1 is the quadrant 65, driven from the back shaft 13 by a system of shafts and gearing in a well-known manner, and connected to the winding-on drum 66 by the chain 67, Fig. 29. The winding-on drum carries a gear 68, which meshes with a pinion 69, loose on the shaft 18. The pinion 69 is connected to the shaft 18 at the proper time to operate the spindles in winding on by means to be hereinafter described.

The general structure of the parts above described is common in mules now in use and their operation except so far as modified by the improvements to be described is well known and need not be herein set forth.

The parts to which the present improvements relate and their operation will now be specifically set forth.

Mechanism for Connecting the Cam-Shaft to the Driver, (Figs. 1 and 4.)

The cam-shaft 34 is a hollow shaft or sleeve, and through this sleeve the continuously-rotating shaft 29 passes and is provided at its outer end with a ratchet-wheel 70. Adjacent to the ratchet and secured to the end of the cam-shaft 34 is a disk 71, carrying a pawl 72, pivoted thereto. The hub of the ratchet-wheel is provided with an annular groove which carries the friction-strap 73, provided with two radially-extending arms 74 and 75. The strap 73 is made in two parts secured together by bolts 76 and by these bolts the friction may be adjusted. A leather washer 77

may be interposed between the strap and hub to increase the friction. The arm 74 is provided with a laterally-projecting pin 78, which works in a slot 79 in the tail of the pawl 72. Mounted on the cam-shaft is a cam 84, provided with two depressed portions 85 and engaged by a bowl 86 on a spring-pressed rod 87.

Sliding in suitable bearings attached to the frame 1 is a bar 80, provided with a notch 81 and having the lugs or projections 82 83 secured to its inner and outer ends, respectively, and projecting into the path of the faller and counter-faller shafts.

The operation is as follows: During the inward movement of the carriage the parts are in the position shown in Figs. 6 and 7 with the arm 74 bearing against the bar 80 and with the pin 78 holding the pawl 72 out of engagement with the ratchet-teeth on wheel 70, the bowl 86 resting in one of the recesses 85 and preventing any displacement of the cam-shaft. As the carriage reaches the end of its travel the faller-shaft engages the lug 82 and moves the rod 80 into the position shown in Fig. 4, allowing the arm 74 to pass through the notch 81. As the arm 74 revolves the pin 78 rocks the pawl 72 into engagement with the ratchet-wheel 70 and the cam-shaft is revolved a half-revolution or until the arm 75 engages bar 80 and stops the strap 73, when the pawl 72 is disengaged from the ratchet-wheel 70, as shown in Fig. 5. The parts remain in this position until the carriage reaches the end of its outer travel, when the counter-faller shaft 38 engages lug 83 and returns the bar 80 to its former position, allowing the arm 75 to pass through the notch 81 and the cam-shaft is turned another half-revolution.

Mechanism for Shifting the Belt onto the Loose Pulley and Locking it Thereon, (Figs. 10 to 13.)

In mules heretofore constructed in which the belt is shifted from the tight to the loose pulley by the movement of the carriage, the belt-shifting mechanism is so constructed that the entire work of moving said mechanism is done by the carriage. This results in a strain or drag on the carriage as it approaches the end of the outward movement, tending to retard said carriage and prevent its being moved out to the same point on each stroke. To overcome this difficulty, the present machine is provided with a belt-shifting mechanism moved by the carriage so constructed that the strain or drag on the carriage is relieved before it reaches the end of its movement, thus allowing the carriage to be moved out to the same point on each stroke. This is preferably done by arranging the mechanism so that the weight of the parts shall assist the carriage in shifting the belt.

Pivoted on a stud 89, mounted in the frame 1, is a lever 90, carrying at its upper end rollers 91, which engage either side of the driving-belt 88. Pivoted to the lower end of lever 90 is a bar 92, whose outer end is pivoted

to an arm 93 in turn pivoted to the floor. The arm or the bar 92 is provided with a projection 93^a, which is in the path of a bowl 94, carried by an arm secured to the carriage 34^a.

Also pivoted on the stud 89 is a second lever 95, connected to lever 90 by means of a spring 96 and carrying at its lower end a bowl 96^a, which is held in engagement with the cam 97 on the cam-shaft 34 by means of a spring 98, one end of which is secured to said lever and the other end to the frame. An arm 99 of the lever 95 has adjustably secured to it a bar 100, carrying a roll 101, adapted to engage lever 90 and hold it in place.

As the carriage moves out the bowl 94 engages the arm 93, swinging it into a vertical position, as shown in Fig. 11, and as the arm passes the vertical the weight of said arm and bar 92 assists in rocking the lever 90 and thus relieves the strain or drag on the carriage. The belt 88 is thus shifted against the tension of the spring 96 and as the carriage reaches the end of its outward movement the cam-shaft 34 makes a half-revolution, thus moving the cam 97 to allow the spring 98 to move the lever 95 and bring the roll 101 into engagement with the lever 90 and complete the shifting of the belt.

It will be seen that the belt-shifting mechanism is operated by the movement of the carriage, but it is so arranged that the strain upon the carriage is relieved before it reaches the end of its stroke, thus allowing the carriage to be moved out to the same point each time.

Whenever the running-out mechanism is thrown out of operation, either by the shifting of the belt, as above described, or by the shifting of the cam 97, should the bar 80 be moved accidentally, said mechanism is locked out of operation and remains so locked until released either by the operator or automatically by suitable means.

The preferred means for locking the running-out mechanism out of operation is as follows: Pivoted to the lever 90 is a locking arm or bar 102, the free end of which rides in the support 103, secured to frame 1 and is provided with a shoulder or latch 104. When the belt is moved onto the loose pulley, the shoulder 104 engages the support 103 and locks the lever 90 in the position shown in Fig. 10 until said shoulder is disengaged from said support. Any suitable means may be employed for automatically disengaging the latch 104 at the proper time; but the means hereinafter described is preferably used.

Mechanism for Causing the Carriage to Remain at the End of its Inner Stroke, (Figs. 14 to 16.)

In operating spinning-mules it is frequently necessary to cause the carriage to remain at the beam—that is, at the end of its inward stroke—so that the operator may have access to the drawing-rolls. In mules as

heretofore constructed it is necessary in order to accomplish this for the operator to go to the head and shift the driving-belt on the counter-shaft, thus stopping the entire machine. When it is desired to again start the mule, the operator must return to the head. It will be seen that time is consumed in going back and forth and in stopping and starting the machine and that when started some time is required for the machine to come to full speed. To prevent this waste of time, the present machine is provided with means accessible from any part of the carriage for causing the carriage to remain at the end of its inward stroke, and such means are preferably so arranged that when the carriage is started outward again it starts at full speed.

Secured to the faller-shaft 37 is an arm 106, which moves under a pin 105 on the locking-arm 102 as the carriage moves in. When the faller is unlocked, the faller-shaft rocks under the influence of the usual weights or springs and the arm 102 engages pin 105 and disengages the catch 104 and the belt 88 is shifted onto the tight pulley 3 to run out the carriage. If the rocking of the faller-shaft is prevented or is arrested at the instant the arm 106 engages the pin 105, then the catch 104 is not disengaged and the carriage remains at the end of its inner stroke until the faller is raised to rock the faller-shaft.

The movement of the faller-shaft may be arrested at the proper time by grasping one of the arms 37^a, which carry the faller-wire. It is preferred, however, to secure collars 37^b to the faller-shaft at intervals throughout its length, which collars are provided with lugs 37^c. Rings 38^a are loosely mounted on the counter-faller shaft. When it is desired to arrest the movement of the faller-shaft, one of the rings is slid under the lug and thus prevents the faller-shaft from rocking far enough to disengage the catch 104. When it is desired to start the carriage out, the ring is slid from under the lug and the faller-shaft rocked by means of one of the arms 37^a.

Mechanism for Shifting the Belt onto the Tight Pulley, (Figs. 17 and 18.)

The lever 95 is shifted into the position shown in Fig. 17 in advance of the cam 97 by the following means: Mounted in suitable bearings 107 in the carriage 34^a is a spring-pressed slide or rod 108, which is provided with a downwardly-extending inclined end 109, forming a cam-surface and engaged by a bowl 110 on the block 42. On the inward stroke of the carriage the rod 108 strikes the end of lever 105 and moves it into the position shown in Fig. 17. As the cop is built up the block 42 moves gradually down, thus projecting the rod 108 into position to strike the lever 105 earlier on each reciprocation of the carriage. Since the pressure of rod 108 on the bowl 110 tends to raise the toe-plate, a rod 111 is secured thereto and is pressed down-

ward to hold the toe-plate against the cop-plate by means of a spring 112 interposed between the bearing 113 and a collar 114 on said rod.

5 If the locking-bar 102 were not present, the belt 88 would be shifted by the movement of the lever 95 when struck by rod 108, and so far as the present invention relates to the automatic adjusting of the rod 108 such might
10 be the action. In the machine shown, however, the belt is locked on the loose pulley and the rod 108 acts to put more and more tension on the spring 96, resulting in a more rapid shifting of the belt 88 when released,
15 and consequently the carriage will remain at the beam a shorter time on each successive stroke as the cop builds up.

Means for Taking Up Slack in Backing-Off Chain, (Figs. 24 and 25.)

20 As the cop builds up there are fewer turns of yarn on the spindles to be backed off and it is therefore necessary to draw down the faller sooner on each stroke of the carriage.
25 This has usually been accomplished by moving the backing-off scroll in relation to its driving-ratchet, thus taking up the slack in the backing-off chain. As a result of this movement of the scroll the chain was wound
30 on a smaller diameter of the scroll in drawing down the faller and the speed of the faller thus decreased, so that it did not follow up and hold the yarn quickly enough to prevent the backing off of too much yarn. In the pres-
35 ent machine means independent of the scroll are employed for taking up the slack in the backing-off chain, and thus the speed of the faller is the same at every part of the cop. The preferred means for taking up the slack
40 in the backing-off chain are as follows: The faller-lock lever 40 is provided with an incline or cam-face 115, which when the faller is unlocked bears against the block or catch 42. As the toe-plate gradually moves down
45 the incline on the cop-plate the block 42 will occupy a lower position with relation to the incline 115 and will consequently hold the faller-lock farther forward at each shifting of the cop-plate. This step-by-step movement
50 of the faller-lock has the effect, through the link 64, arm 63, shaft 62, and arm 56, of moving the chain-pulley 58 and gradually taking up the slack in the backing-off chain.

55 *Means for Controlling the Winding-On Pawls, (Figs. 29 to 36.)*

As before stated, the winding-on drum 66 is provided with a gear 68, which meshes with a pinion 69, loose on the shaft 18. Also loose
60 on the shaft and connected to the pinion 69 is a disk 116, carrying the pawls 117, which are adapted to engage the ratchet-wheel 118, fast to shaft 18. These pawls 117 are thrown into engagement with the ratchet-wheel 118
65 after the completion of backing off and as the carriage starts in, thus connecting the

shaft 18 to the winding-on drum 66, so that the spindles shall be rotated by said drum to wind the yarn on the cops. The pawls are thrown out of engagement with the ratchet
70 after the completion of the inward movement and as the carriage starts out, at which time the shaft 18 is rotated from the pulleys 6 to rotate the spindles in spinning the yarn. Heretofore these pawls have been thrown in
75 and out by means of a spring-clip similar to the clip 54, Fig. 28, embracing the spindle-driving shaft, the projecting ends of which knock the pawls in one direction or the other. This arrangement is objectionable in not be-
80 ing positive, the spring being held on the shaft by friction, and is further objectionable in being liable to trip and throw off and not hold the pawls in engagement. This construction is further objectionable for the reason that the
85 pawls are disengaged by the inward movement of the carriage and thus the connection between the winding-drum and spindle-driving shaft thrown out of operation before all the yarn is wound on the spindles. To over-
90 come these difficulties, the following improved means for controlling the pawls have been devised: Secured in the bearing 119 is an extending bushing 120, loosely surrounding the shaft 18 and provided with a spiral
95 groove 123 in its periphery. The disk 121 is loosely mounted on said bushing adjacent the ratchet-wheel 118 and provided with a beveled edge 122 and also with a pin or shoe 125, engaging the groove in bushing 120. When the
100 disk is turned in one direction, the spiral groove 123 acts on the shoe 125 and the disk is moved toward the ratchet-wheel 118, the beveled edge 122 engaging the pawls 117 and holding them out of engagement with the
105 ratchet 118. When the disk is turned in the other direction, the spiral groove acts to move it away from the ratchet 118 and the pawls are released and are held in engagement with the ratchet 118 by their springs 124.

110 It will be seen that with the above arrangement the means for controlling the pawls is a positive means.

It is important that the pawls should be engaged and disengaged accurately and regu-
115 larly at the beginning and termination of the winding of the yarn on the spindles under the different conditions of speed, and any suitable means may be employed to properly actuate the disk 121 at such times. It is pre-
120 ferred to so connect the disk 121 with the faller that its movement in throwing the pawls into action shall be governed by the position of the faller and to control or govern the ac-
125 tion of the disk in throwing the pawls out of action from the spindle-driving shaft.

Secured to shaft 62 is an arm 126, connected to the disk 121 by means of a chain 127, se-
cured to a pin 128 on said disk and to the end of said arm. A chain 129 has one end attached
130 to the pin 128 and passes over the hub of disk 121 and carries a weight 130 at its free end.

The operation is as follows: As the faller-lock lever 40 moves in to lock the faller the shaft 62 is rocked, through the arm 63 and link 64, causing the arm 126 to draw down chain 127 and thus turn the disk 121 and release the pawls. The parts are so timed that the engagement of the pawls takes place at the moment the locking of the faller is completed and the carriage starts in. The unlocking of the faller-lock at the end of the inward movement of the carriage relieves the strain on chain 127, and if the weights 130 were heavy enough the disk 121 would be turned to release the pawls, but the weights 130 are not heavy enough to disengage the pawls while they are pressed against the ratchet-wheel 118 by reason of the tension on chain 67. When belt 88 is shifted onto the tight pulley and the carriage starts outward, the shaft 18 is revolved under the action of pulleys 6 to spin the yarn and the ratchet 118 runs ahead of the pawls, thus relieving the strain thereon, and the weight 130 moves the pawls out of engagement with the ratchet-wheel 118.

With the above construction it will be seen that the winding mechanism is not thrown out of action by the inward movement of the carriage, as in the mules in common use, but that said mechanism is held in action during the entire inward movement of the carriage and also during the time that the carriage remains at the beam and the faller is rising, thus insuring the winding on of all the yarn and also preventing any backing off of the yarn from the spindles under the tension of the yarn while the carriage is at the beam.

Quadrant-Chain Drum, (Figs. 37 to 40.)

In mules in which the yarn is wound on spindles and the cop is built up on said spindles in the form of a double cone until the said cop reaches its largest diameter the first stretch of yarn is wound onto a substantially cylindrical surface, and as the cop is built up the yarn is wound onto a conical surface, the base of which gradually increases in size as each succeeding stretch of yarn is wound on until the cop is built to its largest diameter, after which the base of the cone remains the same until the cop is finished. It follows, therefore, that in order for the yarn to be properly wound on the spindles without undue strain the spindles should revolve at a substantially constant speed during the winding on of the first stretch of yarn, and that as the cop builds up and the yarn is wound from the base toward the apex of the cone the speed of the spindles should increase from one end of the stretch to the other in order that the speed of the winding-surface may be constant, and that the variation of speed during each stretch should increase as the base of the cone increases, but should remain constant after said cone has reached its largest diameter. It has been attempted to obtain this result heretofore by the use of

the quadrant and the winding-drum which are in common use, but this construction acts imperfectly and is objectionable in several respects. At the beginning of the cop the quadrant-nut is near the lower end of the quadrant and the spindles are revolved at a high rate of speed, and this speed increases toward the end of the stretch, owing to the fact that the quadrant-nut has little or no motion in the direction of the carriage at that time, and owing to this high speed at the end of the inward movement of the carriage the spindles overrun and produce a severe strain on the yarn, tending to cut the same. Moreover, with the construction of quadrant and winding-drum commonly used it is necessary that at the beginning of the cop the quadrant-nut shall be at such a distance from the lower end of the quadrant that when the cop is built to its largest diameter the difference in movement between the quadrant and carriage is not sufficient to wind all the yarn on the spindles, and a nose-peg is therefore necessary which will strike the quadrant-chain and give additional motion to the spindles. To overcome these objections and provide a winding-on mechanism which will act properly at all parts of the cop and without producing any undue strain on the yarn, the present machine is provided with means for reducing the speed of the spindles as the carriage approaches the end of its inward movement, which means is operative at the beginning of the cop and gradually becomes inoperative as the cop is built to its largest diameter and is then inoperative during the building of the remainder of the cop. Thus this means serves to counteract the action of the quadrant during the winding on of the first stretch and counteracts said action less and less on each succeeding stretch until the cop is built to its largest diameter, when said means is out of action and the spindles are revolved by the action of the quadrant unaffected by said means. The preferred embodiment of said means is shown in the drawings, in which the drum 66 is provided with a cam-surface or scroll 131 of increasing diameter, the chain 67 being attached to said scroll at the largest diameter. When the nut 134 is at the lower end of the quadrant 65, the chain 67 is drawn from the gradually-increasing scroll at the final inward movement of the carriage, and the speed of the spindles thus gradually decreased at this point. As the nut 134 moves up in the quadrant less of chain 67 is unwound from the quadrant-drum in the inward movement of the carriage, until finally, when the cop has been built to its largest diameter and the nut is near the upper end of the quadrant, the chain 67 unwinds only from the cylindrical portion of the drum.

By making the scroll of the proper shape the position of the nut 134 may be lower at the beginning of the cop than could be the case if no scroll were used, with the result that when the cop has been built to its largest

diameter the nut 134 is not so high in the quadrant as it would be were no scroll used. With the nut lower in the quadrant, while the remainder of the cop is being built up the difference in speed between the quadrant and carriage is greater, with the result that the spindles make more revolutions during the inward movement of the carriage and all the yarn is wound upon the spindles without the use of the nose-peg.

The nose-peg may be retained, if desired, and the scroll so arranged that it will perform only the function of decreasing the speed of the spindles, and the drawings show the mule as provided with both the scroll and nose-peg. It is preferred, however, to dispense with the nose-peg and adjust the scroll to perform both the functions above described.

Means Throwing Gearing for Driving Drawing-Out Shaft Out of Operation, (Figs. 41 to 43.)

As before stated, the back shaft 13, which carries the drawing or running out scrolls, is driven from the sleeve 8 by the running-out gearing comprising, in the form shown, the pinion 9, the gearing 10, carried in the frame 11, and the gear 12 on the said back shaft, said gearing forming a part of the drawing or running out mechanism. In mules as commonly constructed the frame is lifted to throw the gearing out of operation by a cam 135 on the cam-shaft acting through a pivoted lever 136, which lever engages the lower end of a bar 137, sliding in a bearing 138, secured to the frame 1. The upper end of the bar 137 is forked and supports the frame 11. The frame 11 is raised or lowered according as the cam 135 is turned into the position shown in Figs. 46 and 45.

In the present machine the frame 11 is lifted by the movement of the carriage in advance of the cam, thus relieving the cam of a portion of its work and also effecting the stopping of the carriage by its own movement instead of by a cam which must be accurately timed. This stopping of the carriage by its own movement and independently of any other part of the machine also prevents any injury to the machine should any of the parts connected with the cam-shaft become deranged.

The preferred form of means for throwing the gearing out of operation by the movement of the carriage is as follows: A bar 139 is pivoted to the frame 1 at 140, and has an inclined end or cam-surface which engages and lifts the frame 11 when the bar is rocked into the position shown in Fig. 41. Secured to a rock-shaft 142, mounted in frame 1, is an arm 143, connected to bar 139 by means of a link 144. The shaft 142 carries an arm 145, having its free end pivoted to rod 146, sliding in a bearing 147, secured to frame 1, which rod has two adjustable collars 148 149 secured thereto. Pivoted to the frame 1 at 150 is a bell-crank lever provided with a forked arm

151, which straddles the rod 146 and engages the collar 149. The other arm 152 of the bell-crank lever carries an adjustable bar 153, arranged in the path of the carriage 34^a. As the carriage reaches the end of its outward travel it strikes the bar 153 and through the above connections rocks the bar 139 into the position shown in Fig. 41 and throws the gearing 10 out of engagement with the gear 12. The cam 135 then turns into position shown in Fig. 46 to hold the frame 11 in its raised position should the bar 139 become displaced. When the carriage reaches the end of its inner travel, the carriage strikes an adjustable stop 154, carried by bar 139, and knocks said bar back into the position shown in Fig. 42, the collar 148 striking the bearing 147 and limiting the backward movement.

Mechanism for Holding and Releasing the Drawing-in friction, (Figs. 2, 24, and 44 to 48.)

Whenever the running-in mechanism is thrown out of operation said mechanism is held or locked out of operation until it is unlocked either by the operator or automatically at the completion of the backing off. The preferred means for locking the running-in mechanism out of operation is as follows:

The drawing-in friction 24 is connected to the floor-shaft 155 in the usual manner through the arms 156 157 and rod 158. The rod 158 has a slot 159 in its upper end in which plays a pin 160 on lever 136, as is also common. The friction is thrown out in advance of the cam 135 in the usual manner by a cam-arm 161 on the carriage 34^a, which engages a bowl 162 on rod 158.

Secured to the floor-shaft 155 is a laterally-extending arm 163, having its free end in position to be engaged by a catch or shoulder 165, formed on an arm 164, pivoted at 166 to the frame 1. When the friction 24 is out, as in Fig. 45, the arm 163 is raised, as in Fig. 47, and the arm 164 swings in bringing the catch 165 under said arm 163 and holds the friction out until the arm is swung outward when the arm 163 is released and the friction is free to be thrown in by its own weight or under the influence of a spring.

The catch may be disengaged from the arm 163 at the completion of the backing-off operation by any suitable mechanism, but it is preferable to provide means connected to the faller in such a manner that the movement of the faller shall cause the catch to be disengaged, and one form of such means is shown in the drawings. The fish-jaw 57 is provided with a depending arm 167, to which is adjustably attached a projecting arm 168. When the carriage reaches the limit of its outward movement, the arm 168 occupies the position shown in Figs. 24 and 47 just back of the arm 164. As the faller is drawn down at the completion of the backing-off operation and as the faller-lock moves in to lock the faller the shaft 62 is rocked as before described and

the arm 168 strikes the arm 164, rocking it outward and releasing the arm 163, thus releasing the friction 24 through the connections above described.

5 It will be seen that by reason of the fact that both the running-in and running-out mechanisms are locked out of operation whenever thrown out of operation, any accidental shifting of the cam-shaft will merely serve to
 10 stop the carriage and will not cause any damage to the machinery or the yarn. Thus during the running out of the carriage the running-in mechanism is locked out of operation and should the cam-shaft be accidentally
 15 shifted to throw the running-out mechanism out of operation said mechanism will also be locked out of operation, and any further shifting of the cam-shaft will not affect either the running-out or running-in mechanism until
 20 said mechanism is unlocked by the operator. Again if the cam-shaft is accidentally shifted during the running in, the running-in mechanism will be thrown out of operation and locked out of operation and the running-out
 25 mechanism will remain locked out of operation, with the result that the carriage will stop and remain at rest until the operator has shifted the cam-shaft into its proper position and unlocked the running-in mechanism.

30 *Means for Operating the Drawing-Rolls during the Running in of the Carriage, (Figs. 49 to 55.)*

In mules as heretofore constructed in which
 35 the drawing-rolls are rotated during the running in of the carriage they are adapted to feed the same amount of yarn during each inward movement whether at the beginning or at the end of the cop, with the result that
 40 the yarn at the beginning of the cop is twisted tighter than the yarn at the end of the cop. In the present machine means are provided for so driving the drawing-rolls that the amount of yarn fed is gradually decreased
 45 as the cop builds up, thus insuring an even twist throughout. The preferred means for accomplishing this result is as follows: The cam 169, which operates the lever 170 to throw the clutch member 16 out of engagement with
 50 the clutch member 15, instead of being shaped to hold the clutch member 16 disengaged, as is common, simply serves to disengage said clutch member. A sliding bar 171, suitably mounted in guides 172 173, secured to frame
 55 1, has its rear end in position to engage the groove 174 in the clutch member 16 when said member is disengaged by the cam 169. A spring 175, interposed between guide 171, tends to force said rod rearward. Pivoted to
 60 the frame near its forward end is a bell-crank lever 178, one end of which bears against a collar 179 on the rod 171, and the other end of which is inclined and is in the path of a toe 180, formed on a collar 181, loosely mounted
 65 on the faller-shaft 37. The collar 181 is also provided with a lug 182, arranged to engage

the counter-faller shaft 38. The operation is as follows: As the carriage runs out the toe 180 yields and rides over the end of lever 178. When the carriage reaches its outer limit, the
 70 cam 169 is turned from the position shown in Fig. 51 to that shown in Fig. 52, forcing the clutch member 16 out of engagement with the member 15, thus stopping the drawing-rolls, and the catch 171 engages the groove 174 and
 75 holds the clutch out of engagement. When the backing off is completed and the carriage moves in, the toe 180, being prevented from yielding by the engagement of lug 182 with shaft 38, forces down the end of lever 178, thus
 80 forcing the catch 172 back against the tension of spring 175 and allowing spring 187 to throw the clutch member 16 into engagement with member 15. During the inward movement of the carriage the drawing-rolls are rotated
 85 from the winding-on drum through shaft 18, rim band-pulleys 6, shaft 2, gears 5 and 7, and sleeve 8. It will thus be seen that the rotation of the drawing-rolls is directly proportional to the amount of yarn wound on the
 90 spindles at each inward movement of the carriage, and as this amount gradually decreases as the cop is built up the amount of yarn fed by the drawing-rolls decreases proportionally.

What we claim as our invention, and desire 95 to secure by Letters Patent, is—

1. In a spinning-mule the combination with the cam-shaft of a rotating ratchet-wheel, a pawl carried by said cam-shaft and intermittently-acting mechanism for throwing said
 100 pawl into and out of engagement with said ratchet-wheel, substantially as described.

2. In a spinning-mule the combination with the cam-shaft of a rotating ratchet-wheel, a pawl carried by said cam-shaft, an arm en-
 105 gaging said pawl, means for holding said arm stationary to hold the pawl out of engagement with the ratchet-wheel and means for moving said arm when released to engage said pawl with said ratchet-wheel, substantially as de-
 110 scribed.

3. In a spinning-mule the combination with the cam-shaft of a rotating ratchet-wheel, a pawl carried by said cam-shaft, an arm frictionally mounted on said ratchet-wheel and
 115 engaging said pawl and means for stopping and releasing said arm substantially as described.

4. In a spinning-mule the combination with the cam-shaft and carriage of a rotating shaft,
 120 means for connecting and disconnecting said shafts including an arm frictionally engaged by said shaft a sliding bar in the path of said arm and provided with a notch, and means whereby the shifting of the bar is controlled
 125 by the carriage substantially as described.

5. In a spinning-mule the combination with the cam-shaft of a rotating ratchet-wheel, a pawl carried by said cam-shaft a friction-
 130 strap provided with two arms carried by said ratchet-wheel, one of said arms engaging said pawl, a sliding bar in the path of said arm

and provided with a notch, and lugs on said bar in the path of the carriage substantially as described.

6. In a spinning-mule the combination with the carriage and the drawing-out mechanism comprising a shaft carrying a driving and an idle pulley, of a belt-shifting mechanism engaged and operated by the carriage and constructed to assist the carriage in shifting the belt whereby the strain on the carriage is relieved as it reaches the end of its outward movement substantially as described.

7. In a spinning-mule the combination with the carriage of a belt-shifter, a substantially horizontal bar connected to said belt-shifter, a pivoted arm supporting said bar and arranged in the path of the carriage, the parts being so arranged that the carriage moves the arm past the vertical whereby the weight of the arm and bar assist in shifting the belt substantially as described.

8. In a spinning-mule the combination with the carriage and the running-out mechanism therefor, of means for throwing said running-out mechanism into operation, a device carried by the carriage for engaging said means, and mechanism for advancing said device as the cop builds up, substantially as described.

9. In a spinning-mule the combination with the belt-shifting device and the reciprocating carriage of a device carried by the carriage for engaging said belt-shifting device and mechanism for advancing said engaging device as the cop builds up substantially as described.

10. In a spinning-mule the combination with the belt-shifting device and the reciprocating carriage carrying the toe-plate of a rod carried by said carriage for engaging said device, and means whereby the position of the toe-plate determines the position of said rod substantially as described.

11. In a spinning-mule the combination with the belt-shifting device and the reciprocating carriage carrying the toe-plate and means for gradually lowering said toe-plate, of a sliding rod carried by said carriage and provided with a cam-surface, a projection on the toe-plate engaging said cam-surface, whereby the rod is gradually projected as the cop is built up substantially as described.

12. In a spinning-mule the combination with the reciprocating carriage of a belt-shifting device including a spring and means carried by the carriage for controlling the tension on said spring substantially as described.

13. In a spinning-mule the combination with the carriage and the driving-shaft carrying a driving and an idle pulley, of a belt-shifting lever, a second lever a spring connecting said levers, means for locking said belt-shifting lever in position to hold the belt on the idle-pulley, an adjustable projection carried by the carriage for engaging said second lever, and means carried by the carriage for unlocking said belt-shifting lever substantially as described.

14. In a spinning-mule the combination with the carriage the faller carried thereby and means for reciprocating the carriage of means including the faller-shaft for causing the carriage to remain in its inner position substantially as described.

15. In a spinning-mule the combination with the carriage and running-out mechanism therefor, of means for throwing said mechanism into and out of operation, means for locking said mechanism out of operation and means for unlocking said mechanism, substantially as described.

16. In a spinning-mule the combination with the carriage and running-out mechanism therefor, of means for locking said mechanism out of operation, and means carried by the carriage and under the control of the operator for unlocking said mechanism, substantially as described.

17. In a spinning-mule the combination with the carriage and running-out mechanism therefor, of means for locking said mechanism out of operation, and means extending substantially the length of the carriage for unlocking said mechanism, substantially as described.

18. In a spinning-mule the combination with the carriage and means for reciprocating the same including a shaft carrying a driving and an idle pulley, of means including a cam for shifting the belt on said pulleys and means for locking the belt upon the idle-pulley substantially as described.

19. In a spinning-mule the combination with the carriage of means for reciprocating the same including a shaft carrying a driving and an idle pulley, of means including a cam for shifting the belt on said pulleys, means for locking the belt upon the idle-pulley and means carried by the carriage for unlocking the belt substantially as described.

20. In a spinning-mule the combination with the carriage and means for reciprocating the same including a shaft carrying a driving and an idle pulley, of means including a locking-bar for locking the belt upon the idle-pulley, a rock-shaft carried by the carriage, an arm carried by said rock-shaft and arranged to engage said locking-bar substantially as described.

21. In a spinning-mule the combination with the carriage and means for reciprocating the same including a shaft carrying a driving and an idle pulley, of a means including a locking-bar for locking the belt upon the idle-pulley, the faller-shaft carried by said carriage, and an arm carried by the faller-shaft arranged to engage said locking-bar substantially as described.

22. In a spinning-mule the combination with the carriage and means for reciprocating the same including a shaft carrying a driving and an idle pulley, of means including a locking-bar for locking the belt on the idle-pulley, the faller-shaft carried by said carriage, an arm on said faller-shaft arranged

to engage said locking-bar and devices carried by the carriage for arresting the movement of the faller-shaft substantially as described.

23. In a spinning-mule the combination with the faller, backing-off chain and a scroll for drawing down said chain, of means independent of said scroll for automatically taking up the slack in said chain as the cop is built up substantially as described.

24. In a spinning-mule the combination with the faller and catch-block of means controlled by the position of the catch-block for drawing down the faller, substantially as described.

25. In a spinning-mule the combination with the faller, toe-plate, backing-off chain and means for drawing down said chain, of means controlled by the position of the toe-plate for taking up the slack in the backing-off chain substantially as described.

26. In a spinning-mule the combination with the faller, catch-block, and means for drawing down said faller, of a faller-lock lever connected to said means and provided with a cam engaging said block, substantially as described.

27. In a spinning-mule the combination with the faller, catch-block, backing-off chain, chain-pulleys and means for winding said chain, of a faller-lock lever provided with a cam-surface engaging said block and a connection between said faller-lock lever and said chain-pulley substantially as described.

28. In a spinning-mule the combination with the spindle-driving shaft and the winding-drum of a pawl-and-ratchet connection between said shaft and drum, means for disengaging said connection embodying a cam-surface and means for giving said cam-surface an oscillating and progressive movement, substantially as described.

29. In a spinning-mule the combination with the spindle-driving shaft carrying a ratchet-wheel, the winding-drum and one or more pawls connected therewith, of means for operating said pawls embodying a cam-surface and means for giving said cam-surface an oscillating and progressive movement, substantially as described.

30. In a spinning-mule the combination with the spindle-driving shaft carrying a ratchet-wheel, the winding-drum, and one or more pawls connected therewith, of a disk adjacent to said ratchet-wheel and provided with a beveled edge for engaging said pawls, and means for oscillating said disk about its axis and moving said disk longitudinally of the spindle-driving shaft, substantially as described.

31. In a spinning-mule the combination with the spindle-driving shaft carrying a ratchet-wheel, the winding mechanism, one or more pawls connected therewith, means for operating said pawls embodying a cam-surface and means for giving said cam-sur-

face an oscillating and progressive movement, substantially as described.

32. In a spinning-mule the combination with the spindle-driving shaft and winding mechanism, of means including a cam mounted to oscillate about its axis for connecting and disconnecting said shaft and winding mechanism, the faller-lock lever, and connections between said cam and lever and means for moving said cam longitudinally of its axis, substantially as described.

33. In a spinning-mule the combination with the reciprocating carriage the spindle-driving shaft carried thereby and the winding-drum, of connections between said drum and shaft, means for holding said connection in operation during the inward movement of the carriage and means for throwing said connection out of operation as the spindle-driving shaft starts to revolve substantially as described.

34. In a spinning-mule the combination with the spindle-driving shaft and the winding mechanism, of means controlled from said shaft for throwing said mechanism out of operation, substantially as described.

35. In a spinning-mule the combination with the spindle-driving shaft and the winding-drum, of connections between said shaft and drum, and means controlled from said shaft for throwing said connections out of operation, substantially as described.

36. In a spinning-mule the combination with the spindle-driving shaft, winding mechanism and faller, of means controlled from said faller and driving-shaft for connecting and disconnecting said shaft and winding mechanism, substantially as described.

37. In a spinning-mule the combination with the spindle-driving shaft, winding mechanism and faller, of a pawl-and-ratchet connection for connecting said driving-shaft and winding mechanism, a cam for operating said pawl, connections between said faller and cam for moving the said cam in one direction and means controlled by said driving-shaft for moving said cam in the other direction, substantially as described.

38. In a spinning-mule the combination with the reciprocating carriage, the spindle-driving shaft and the winding-drum, of a pawl and ratchet in engagement during the inward movement of the carriage, and a weight acting to disengage said pawl and ratchet as said shaft starts to revolve substantially as described.

39. In a spinning-mule the combination with a ratchet-wheel, a pawl arranged to engage said ratchet-wheel, a stud, a cam mounted on said stud, a spiral groove in one of said parts, a projection on the other of said parts engaging said groove, and means for oscillating said cam, substantially as described.

40. In a spinning-mule the combination with a ratchet-wheel a pawl arranged to engage said ratchet-wheel, a stud provided with

a spiral groove, a beveled-edge disk mounted on said stud and provided with a projection engaging said groove and means for oscillating said disk substantially as described.

5 41. In a spinning-mule the combination with the faller-lock lever, spindle-driving shaft, winding-drum and a pawl-and-ratchet connection between said shaft and drum, of a disk arranged to engage said pawl, a spirally-grooved stud carrying said disk, connections between said disk and faller-lock lever for rocking said disk in one direction and a weight for rocking said disk in the opposite direction substantially as described.

15 42. In a spinning-mule the combination with the reciprocating carriage carrying the spindles, of means for rotating said spindles at gradually-increasing speed during the inward movement of the carriage, means for counteracting the action of said rotating means to a less and less degree as the base of the cop is formed, substantially as described.

20 43. In a spinning-mule the combination with the winding-drum, quadrant and quadrant-chain of means for counteracting the action of said quadrant to a less and less degree as the base of the cop is formed, substantially as described.

30 44. In a spinning-mule the combination with the quadrant and quadrant-chain of a winding-drum provided with a cam-surface for a portion of its length, the parts being so arranged that said chain will not unwind from said cam-surface after the cop is built to its largest diameter, substantially as described.

35 45. In a spinning-mule the combination with the quadrant and quadrant-chain of a winding-drum provided with a cam-scroll substantially as described.

40 46. In a spinning-mule the combination with the carriage and the running-out gearing of means positively operated by the carriage for throwing said gearing out of operation substantially as described.

45 47. In a spinning-mule the combination with the carriage and the running-out gearing including a movable gear, of means positively operated by the carriage for moving said gear out of engagement, substantially as described.

50 48. In a spinning-mule the combination with the carriage the running-out gearing and a frame carrying a part of said gearing, of a cam for lifting said frame and means whereby the cam is positively operated by the carriage substantially as described.

55 49. In a spinning-mule the combination with the carriage, the running-out gearing, and a pivoted frame carrying a part of said gearing, of a pivoted lever engaging said frame, a lever in the path of the carriage and connections between said levers whereby said frame is positively operated by the carriage substantially as described.

65 50. In a spinning-mule the combination with the carriage and running-in mechanism, of means comprising a catch independent of

said carriage for holding said mechanism out of operation during the backing off, and means carried by the carriage for engaging and operating said catch, substantially as described.

51. In a spinning-mule the combination with the carriage and running-in mechanism, of means comprising a catch independent of said carriage for holding said mechanism out of operation, the faller carried by said carriage and means controlled from said faller for engaging and operating said catch, substantially as described.

52. In a spinning-mule the combination with the carriage and means for reciprocating the same, comprising the running-in mechanism and the running-out mechanism, of means for throwing each of said mechanisms into and out of operation means for locking said running-in mechanism out of operation means for locking said running-out mechanism out of operation and devices for unlocking said mechanisms, substantially as described.

53. In a spinning-mule the combination with the carriage and the running-in mechanism of means for holding said mechanism out of operation during the backing off, comprising a catch, means carried by the carriage for engaging and releasing said catch substantially as described.

54. In a spinning-mule the combination with the carriage and running-in mechanism, of means for holding said mechanism out of operation during the backing off comprising a catch, the faller carried by said carriage and means controlled by said faller for engaging and releasing said catch substantially as described.

55. In a spinning-mule the combination with the carriage and running-in mechanism comprising a clutch, of a rock-shaft connected with said clutch, an arm secured to said shaft, a catch engaging said arm, a rock-shaft carried by said carriage an arm carried by said latter shaft and arranged to engage said catch, the faller and connections between the faller and said latter shaft, whereby the locking of the faller disengages the catch and allows the clutch to be engaged substantially as described.

56. In a spinning-mule the combination with the drawing-rolls of means for operating said rolls to feed a variable amount of yarn during the winding on substantially as described.

57. In a spinning-mule the combination with the drawing-rolls and the winding-drum of means for driving said rolls from said drum substantially as described.

58. In a spinning-mule the combination with the carriage the drawing-rolls and the drawing-roll clutch, of means for holding the members of said clutch in engagement during the inward movement of the carriage substantially as described.

59. In a spinning-mule the combination with the carriage and the drawing-roll clutch,

of means for disengaging the members of said clutch, a latch to hold said member disengaged and means whereby the inward movement of the carriage withdraws said latch
5 substantially as described.

60. In a spinning-mule the combination with the carriage of a clutch, means for disengaging the clutch, a spring-latch for holding said clutch disengaged, a lever engaging

said latch and a projection carried by the carriage for engaging said lever and withdrawing the latch substantially as described.

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Witnesses:

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