

No. 629,503.

Patented July 25, 1899.

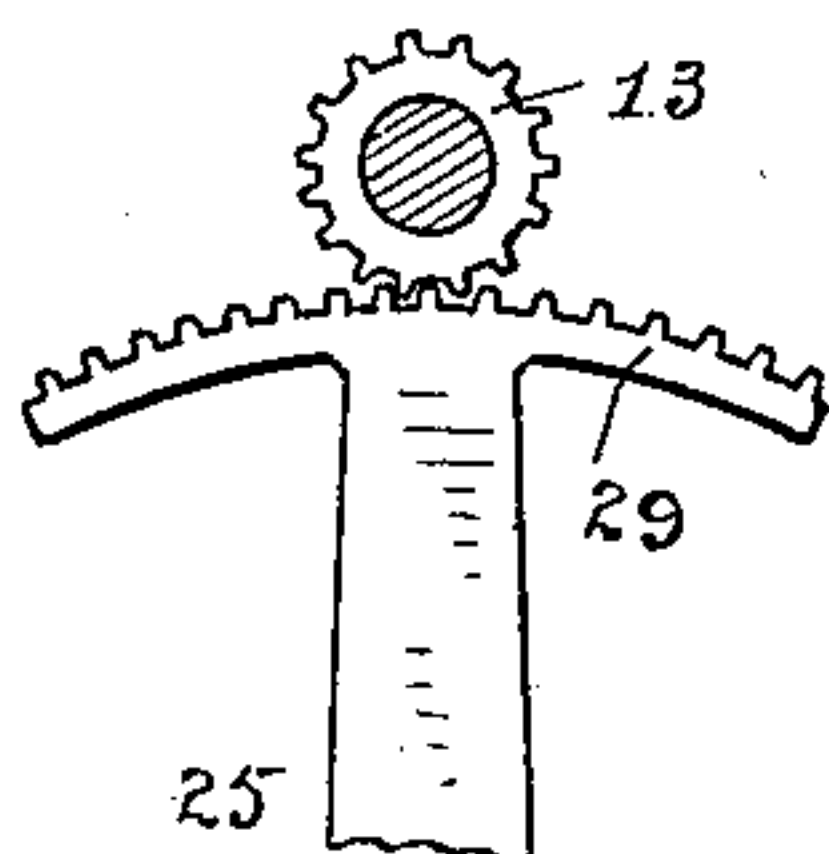
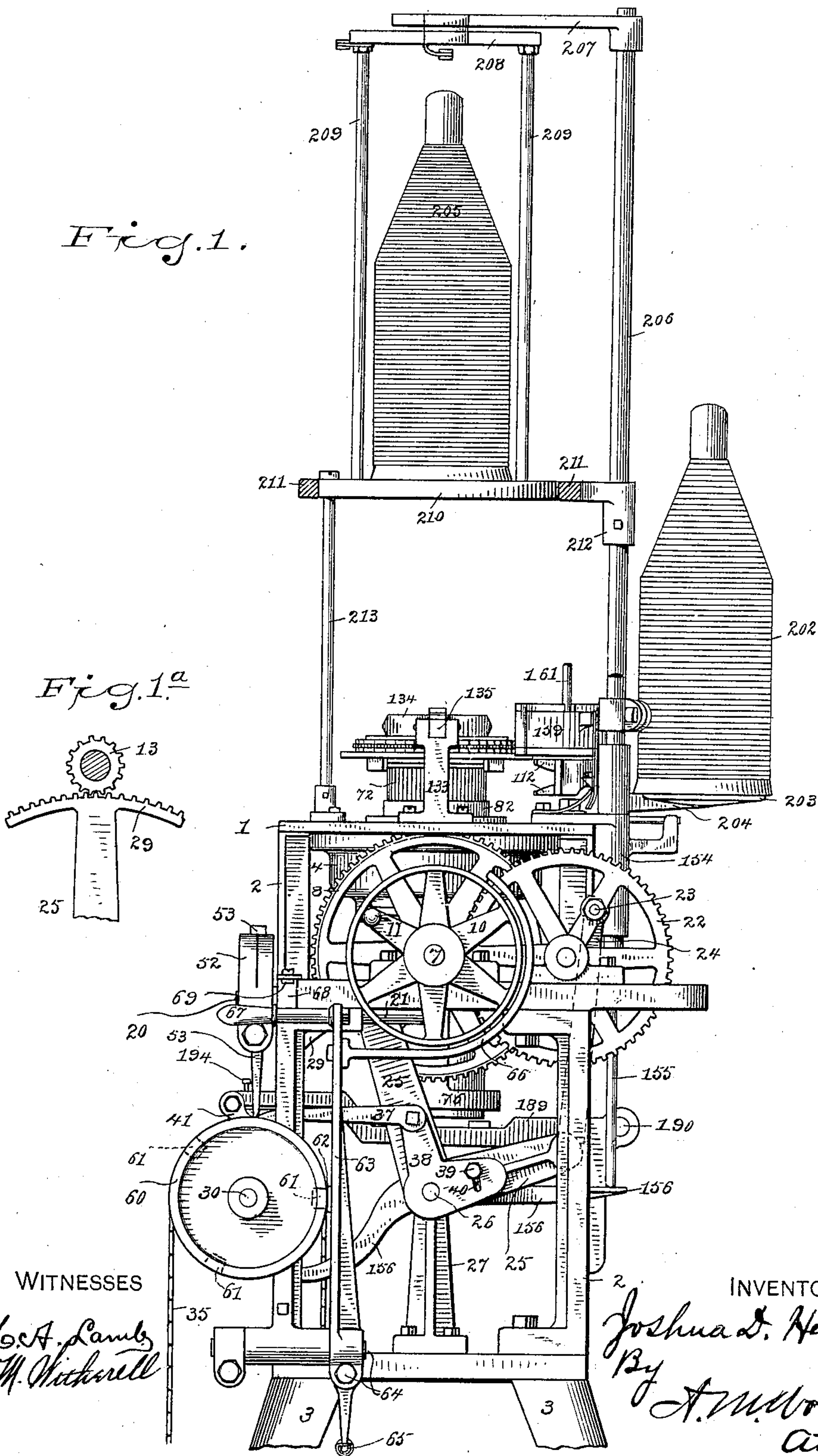
J. D. HEMPHILL.  
KNITTING MACHINE.

(Application filed Sept. 24, 1898.)

(No Model.)

12 Sheets—Sheet 1.

Fig. 1.



WITNESSES

H. A. Lamb  
A. M. Wooster

INVENTOR

Joshua D. Hemphill  
By  
A. M. Wooster  
Atty.

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12 Sheets—Sheet 2.

Fig. 3.

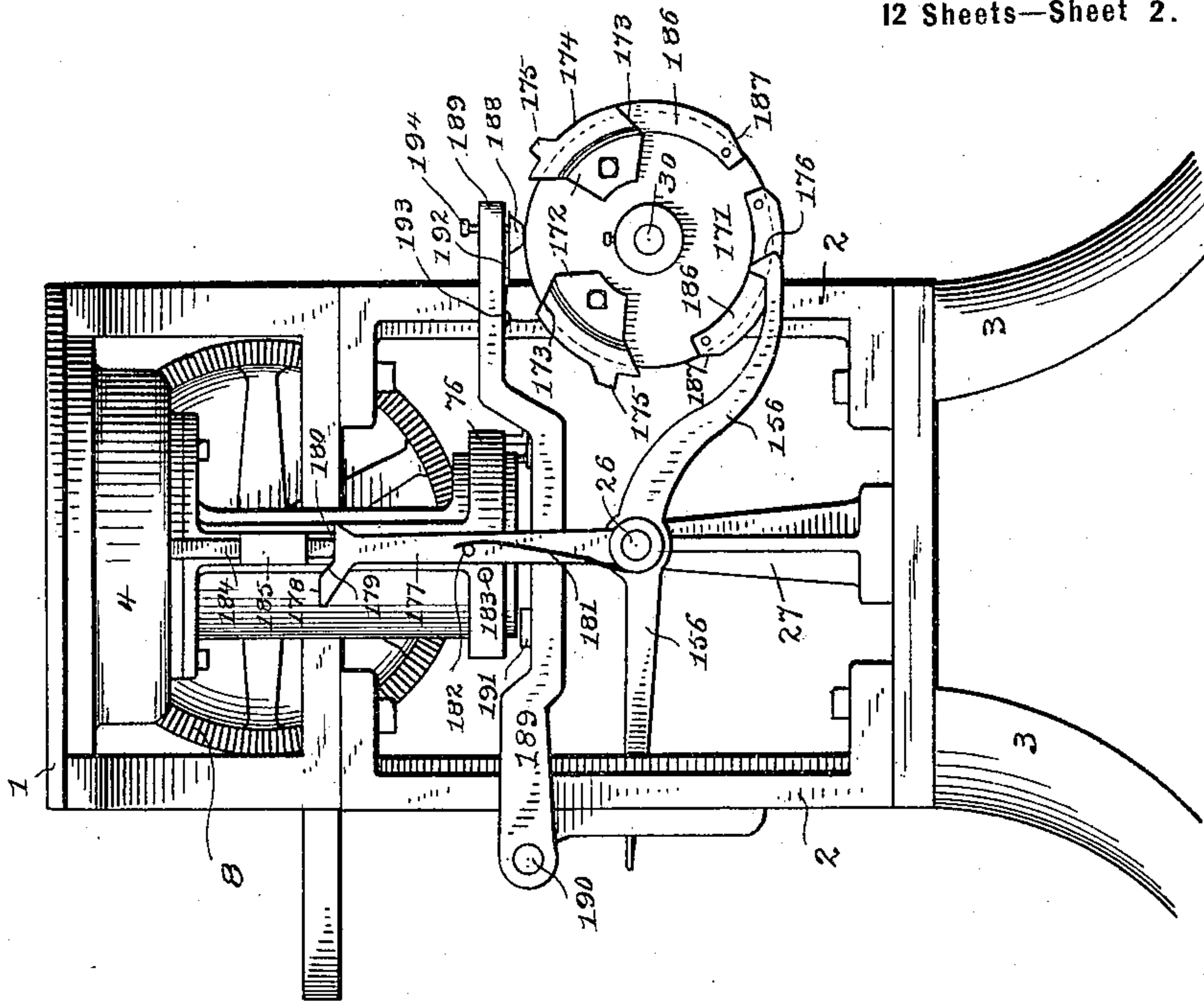
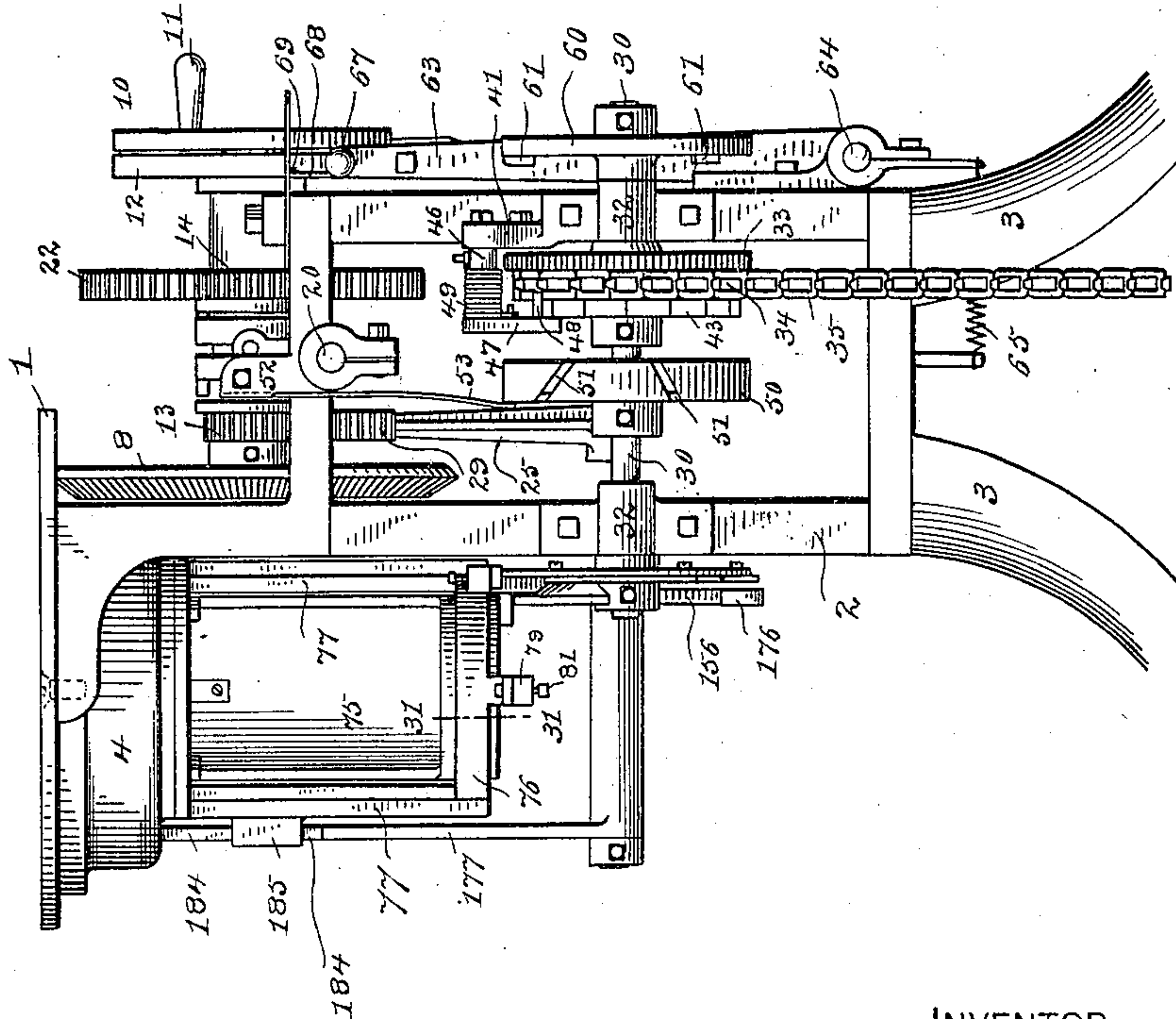


Fig. 2.



WITNESSES

H. A. Lundy  
G. M. Mitchell

INVENTOR

Joshua D. Hemphill  
By A. M. Wooster  
Att'y.



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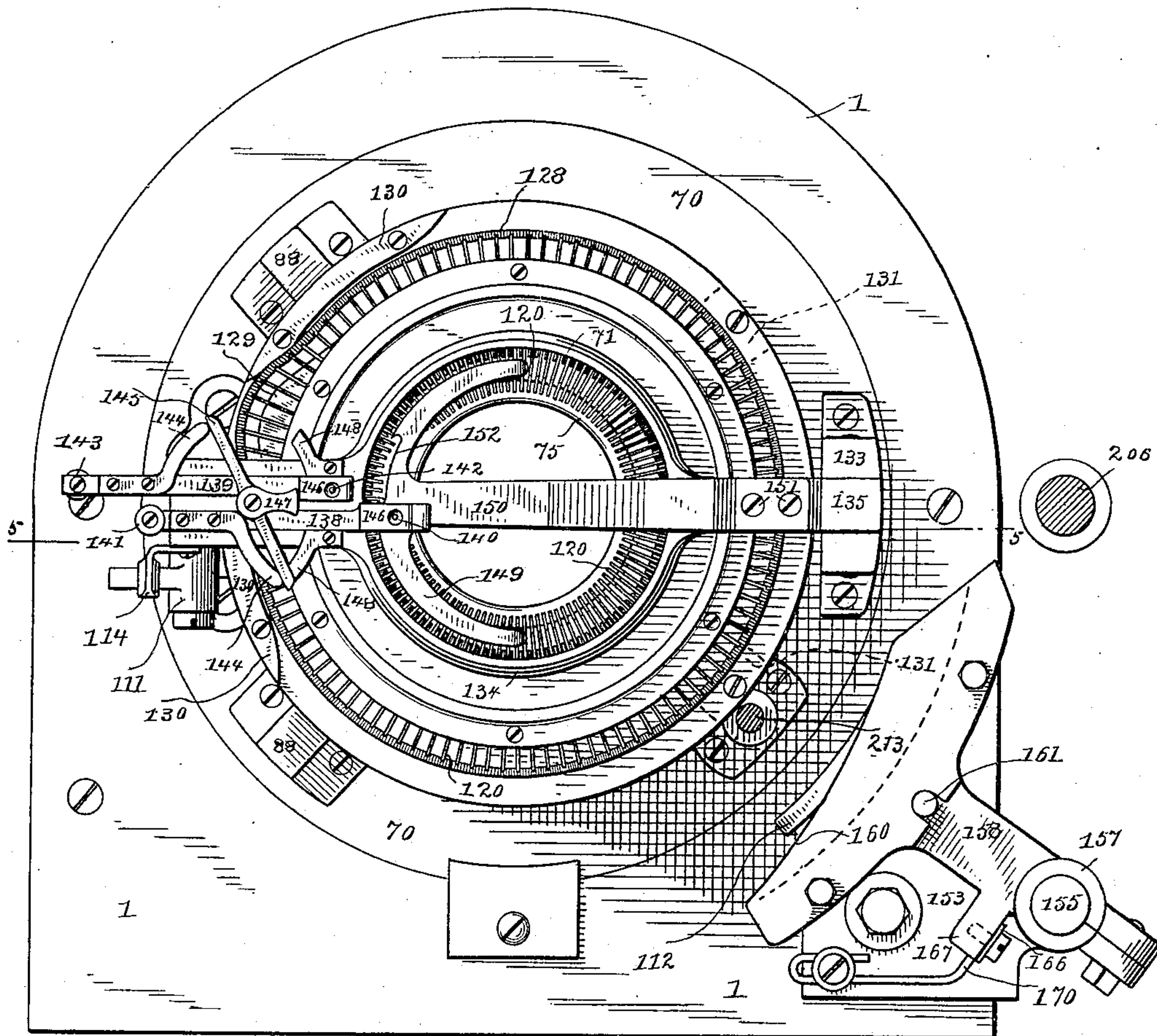
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Fig. 4.



WITNESSES

H. A. Lamb  
G. M. Withnell

INVENTOR

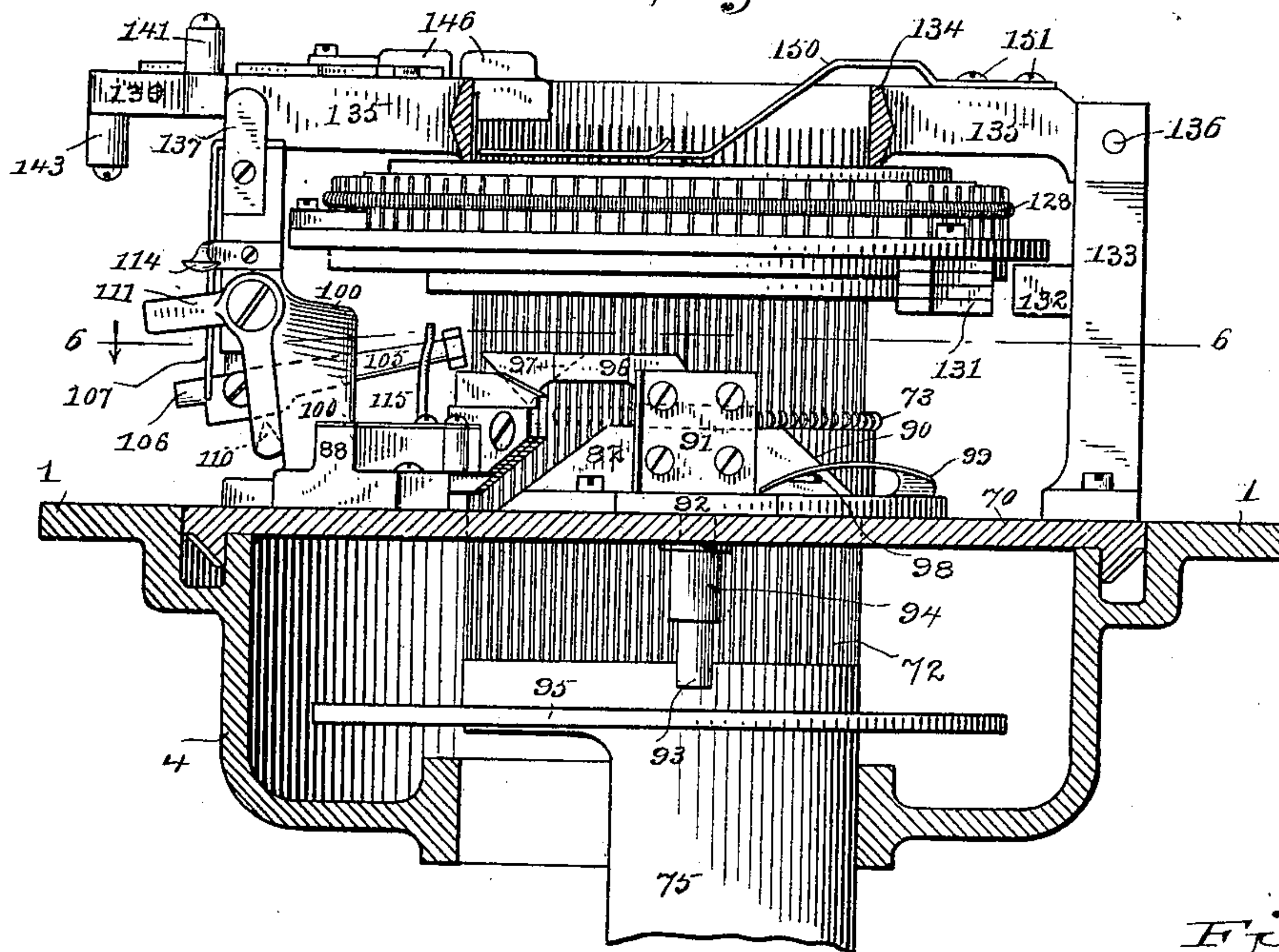
Joshua D. Hemphill  
By A. M. Wooster  
att.

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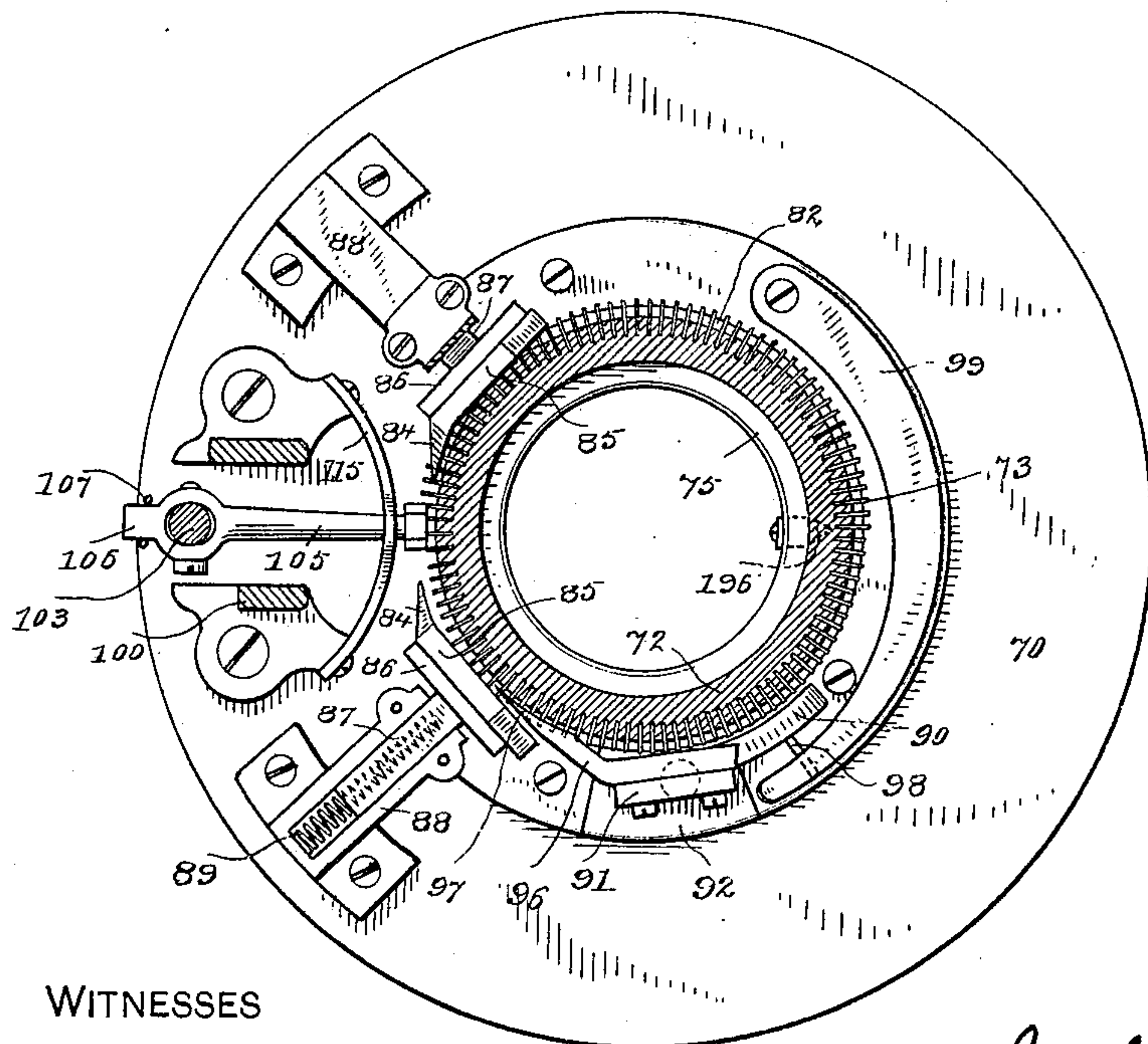
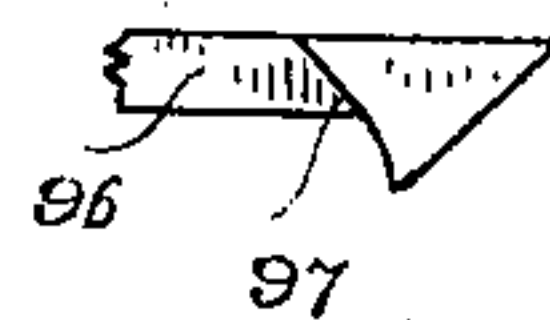
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*Fing. 5.*



Fing. 6.

Fing. 5.<sup>a</sup>



INVENTOR

H. F. Lamb.  
A. M. Withersell

INVENTOR  
Joshua D. Hemphill  
By A. M. Wooster  
att'y.



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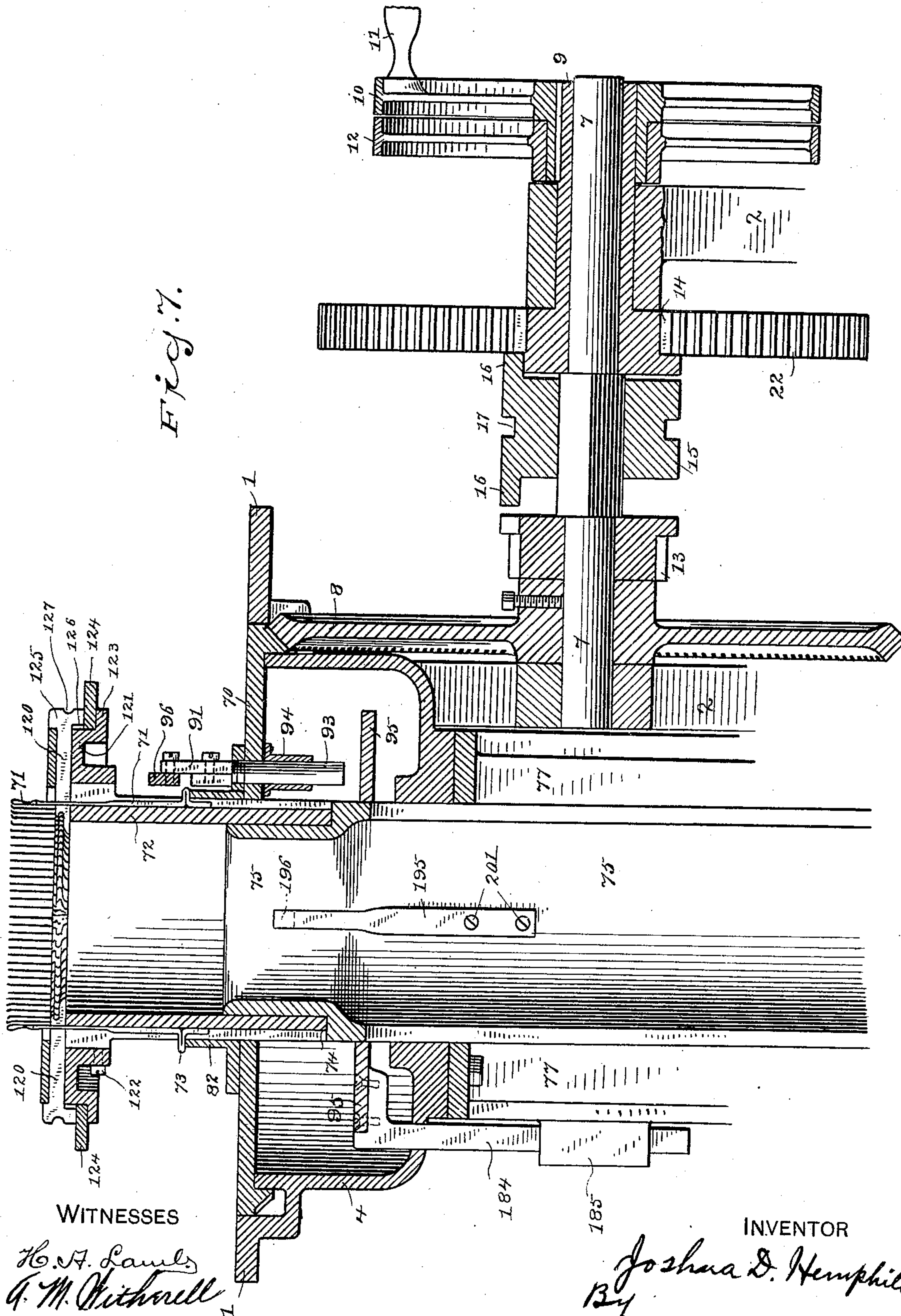
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WITNESSES

*H. W. Lamb*  
*G. M. Withnell*

INVENTOR

*Joshua D. Hemphill*  
By *A. M. Wooster*  
*att'y.*

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Fig. 8.

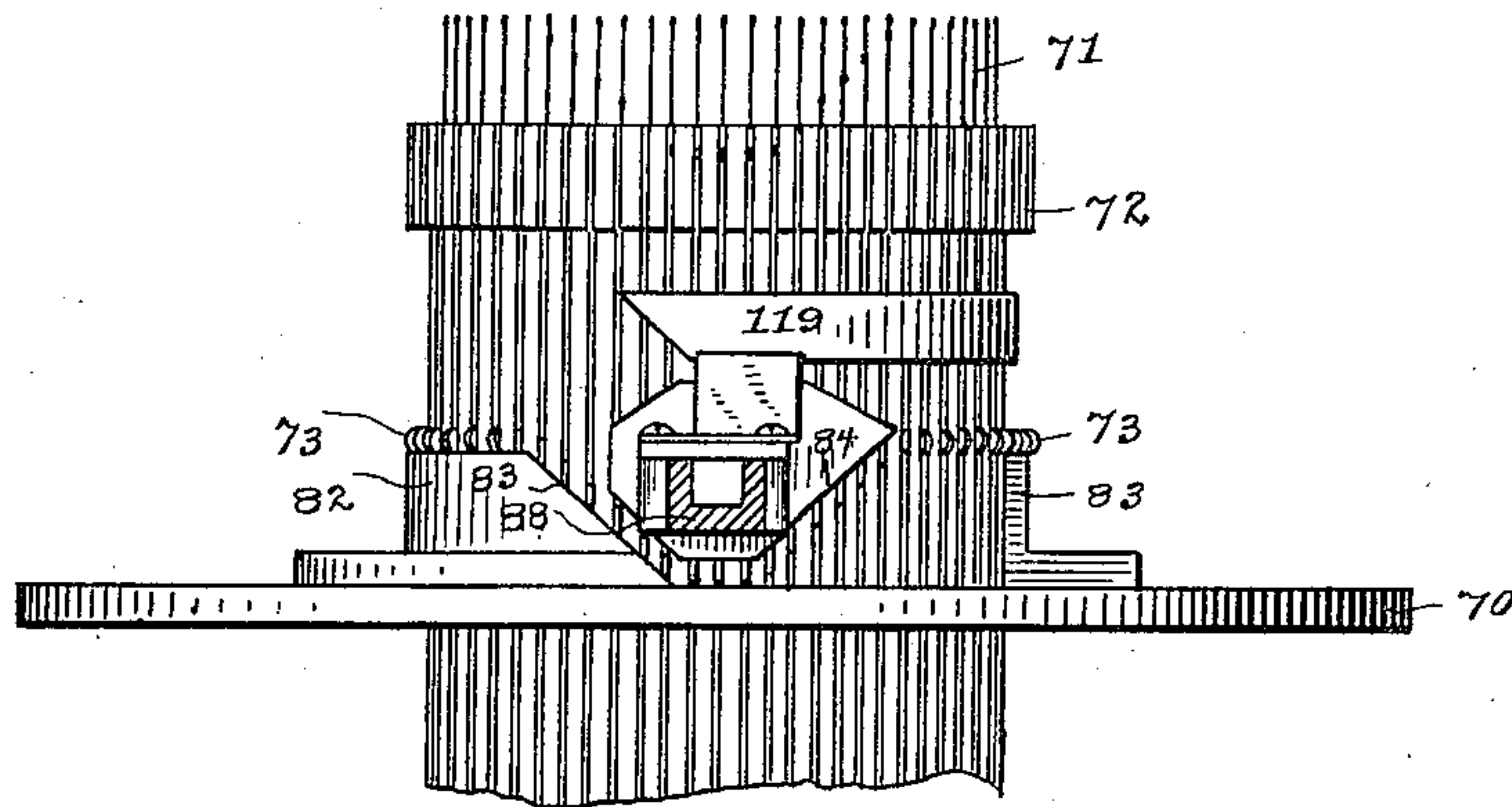


Fig. 9.

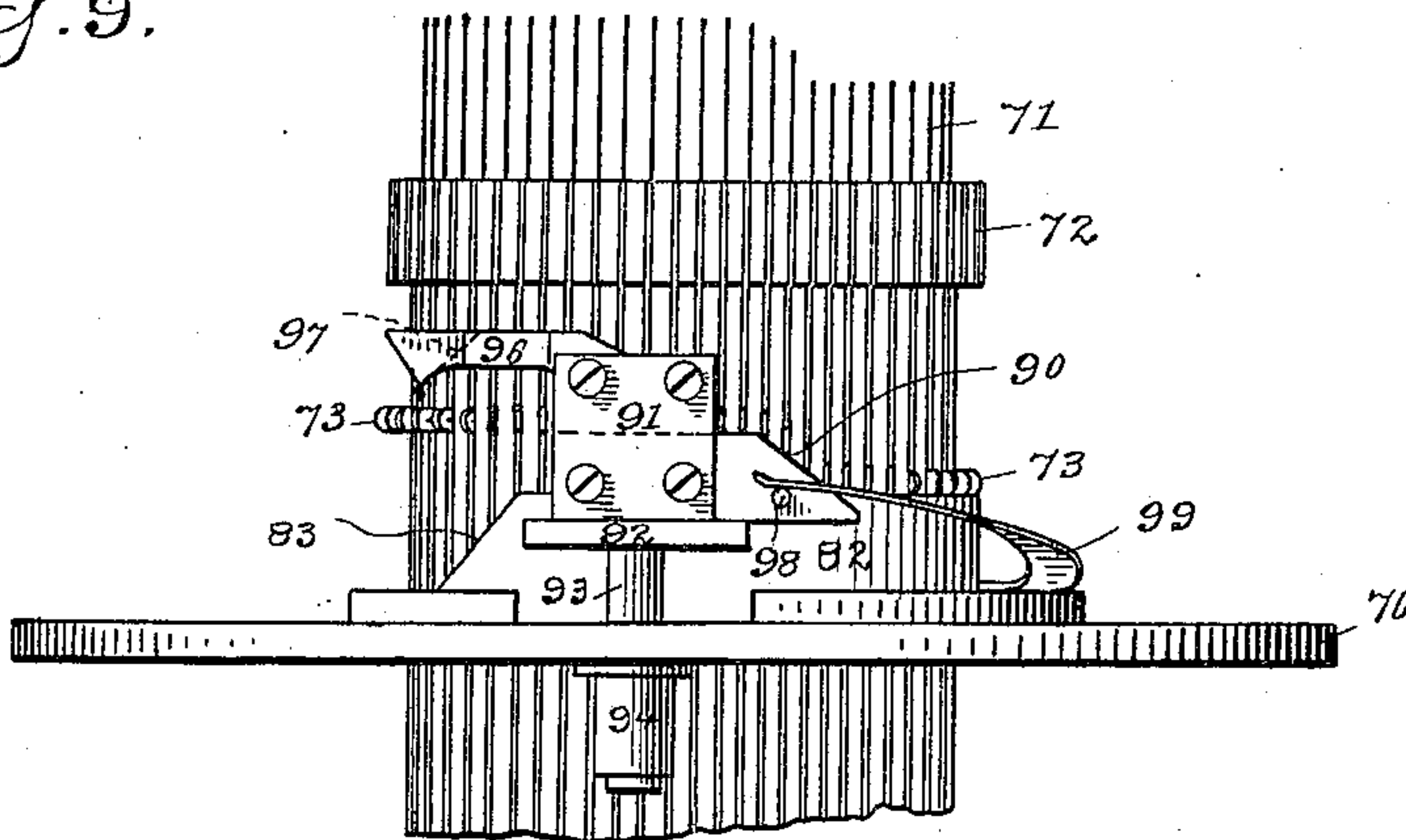
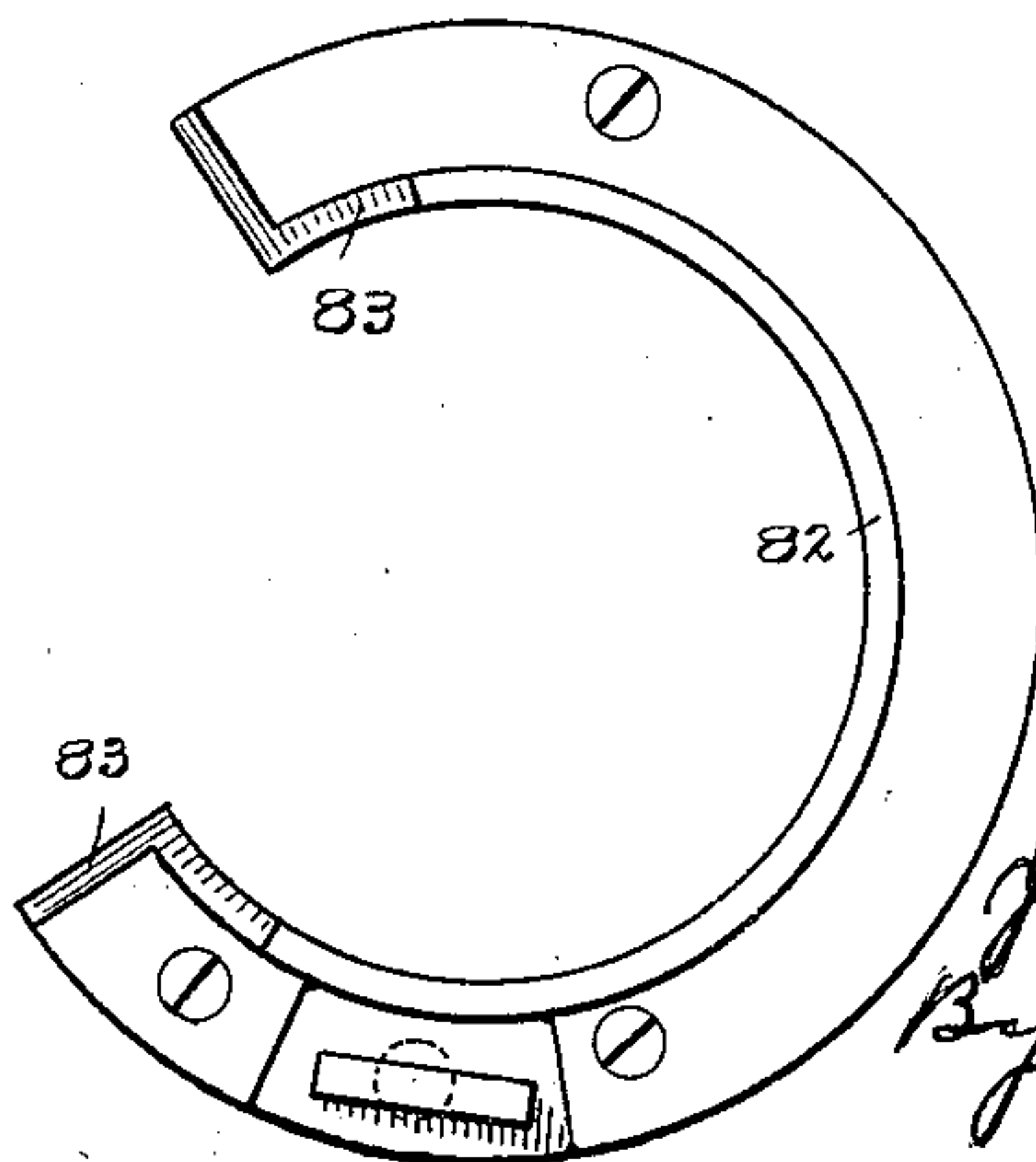


Fig. 10.



WITNESSES

H. A. Lundy  
G. M. Withers

INVENTOR

Joshua D. Hemphill  
By A. M. Booster  
Atty.

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Fig. 11.

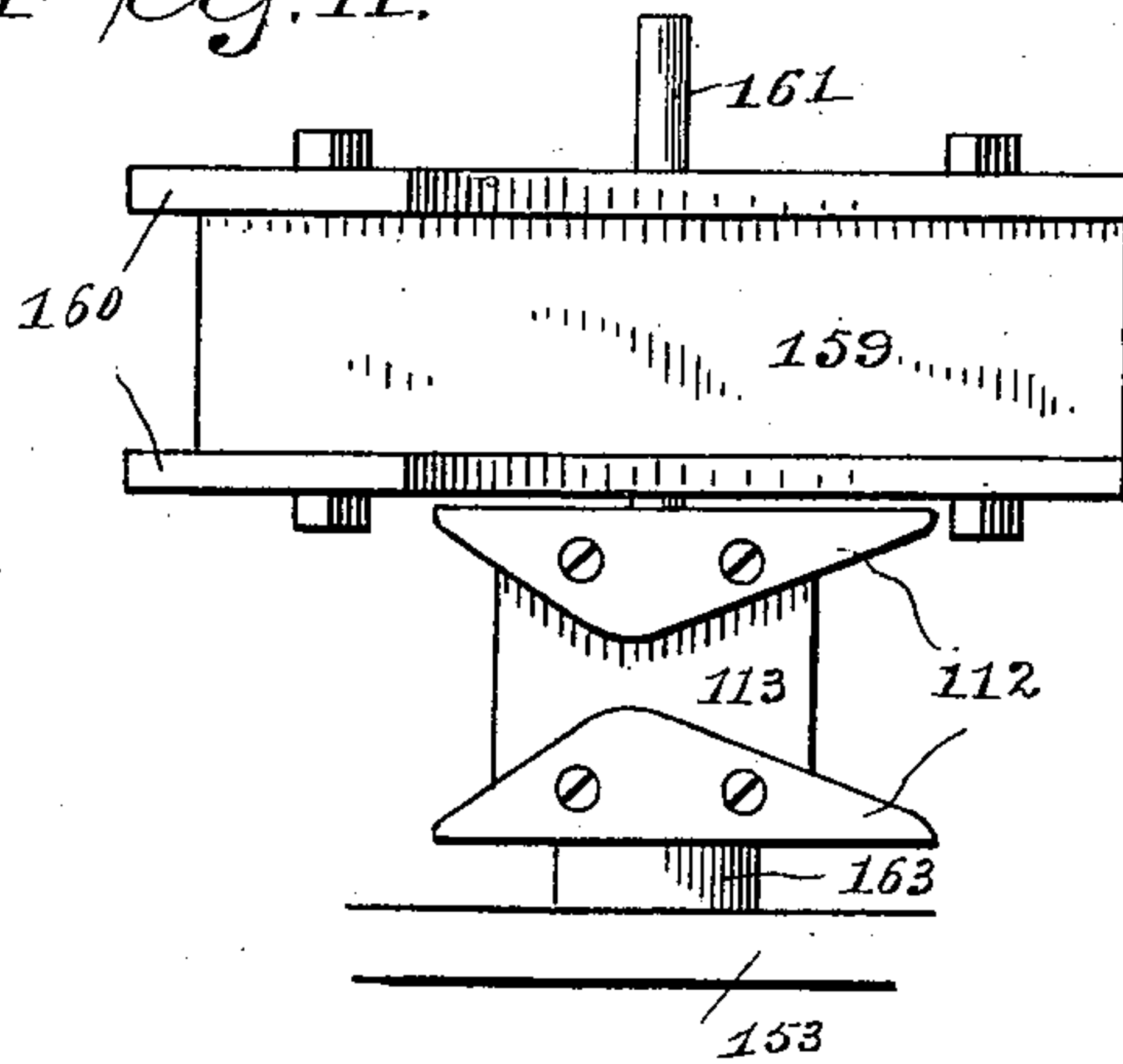


Fig. 12.

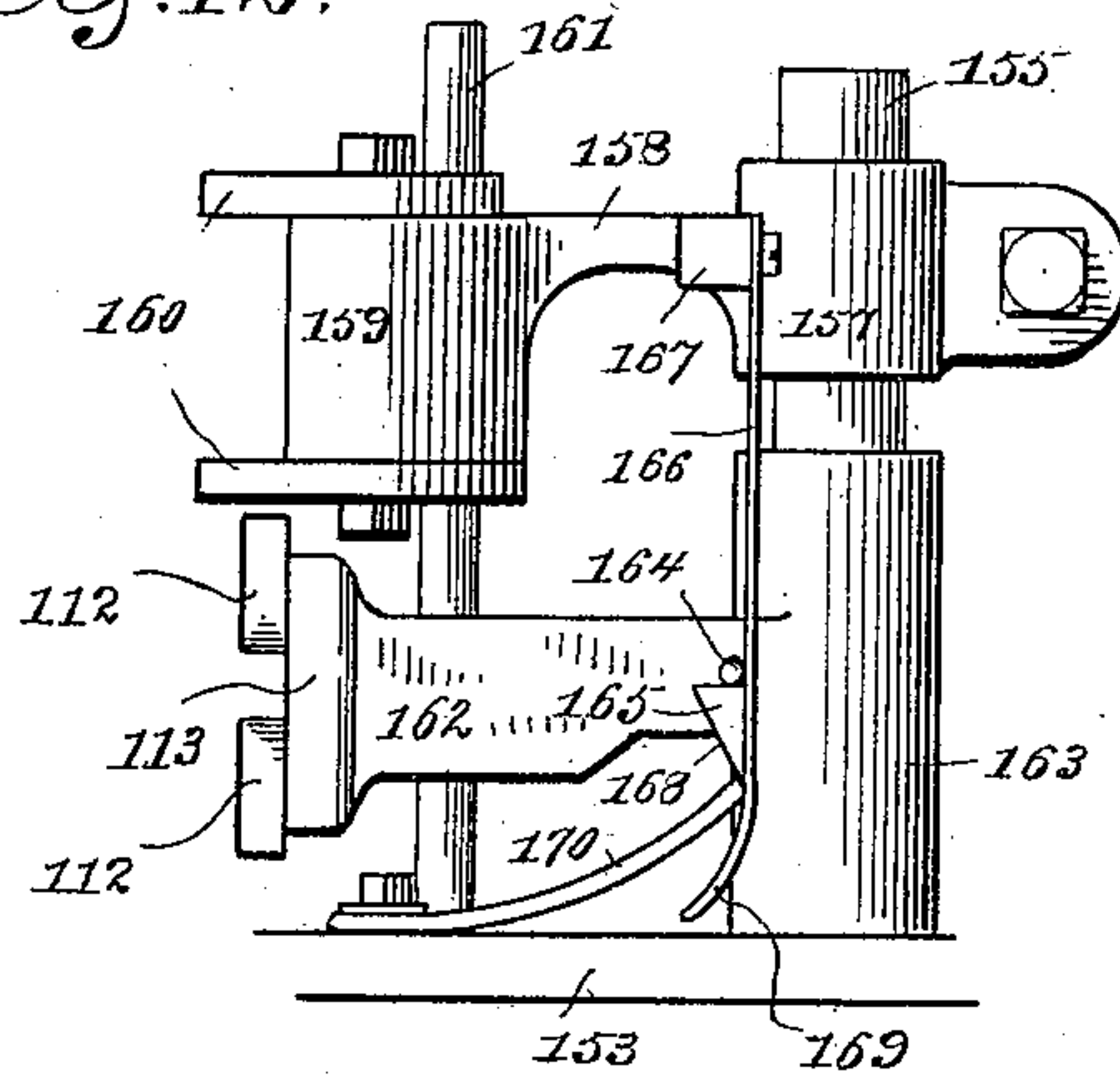


Fig. 13.

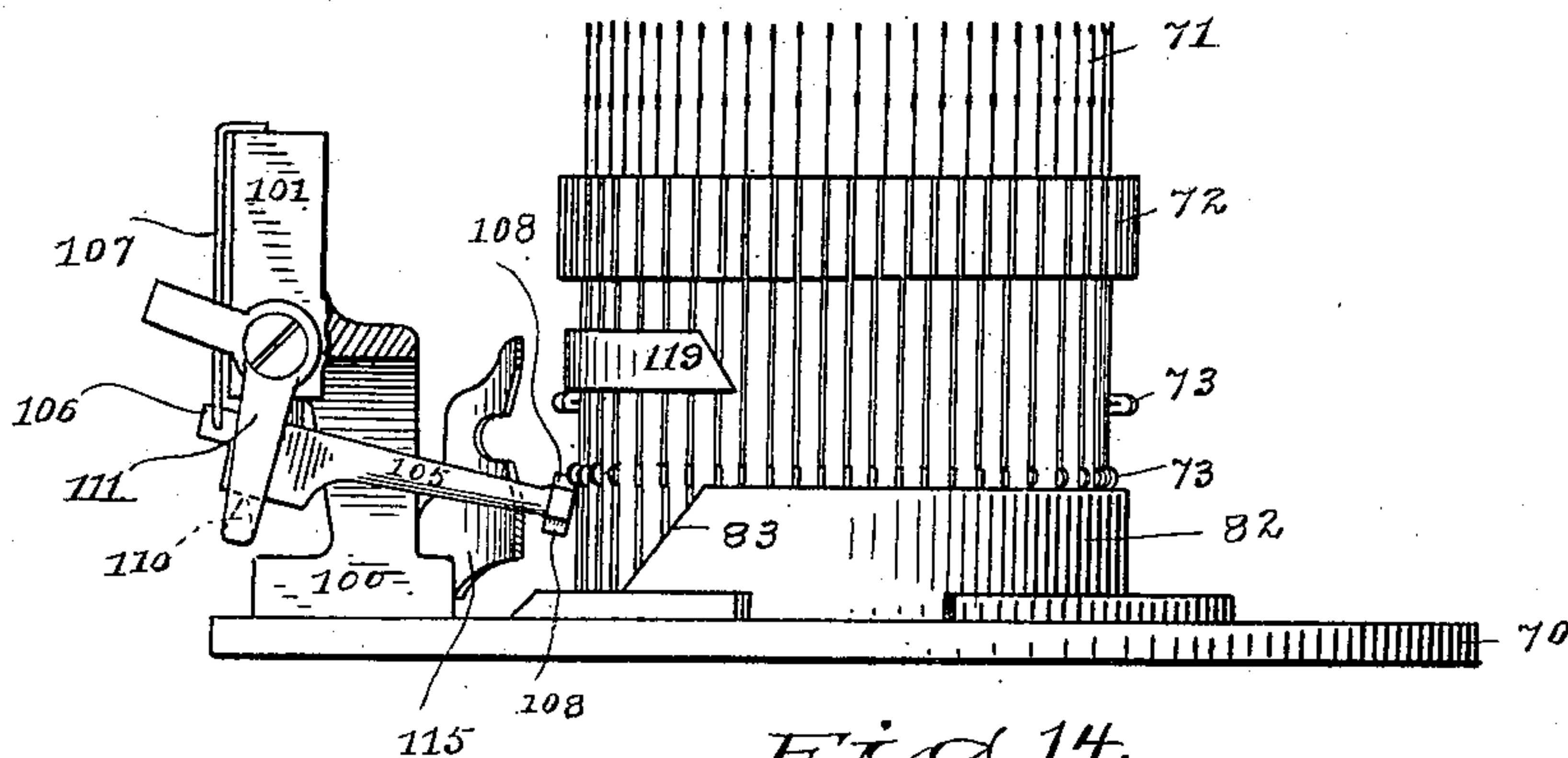


Fig. 14.

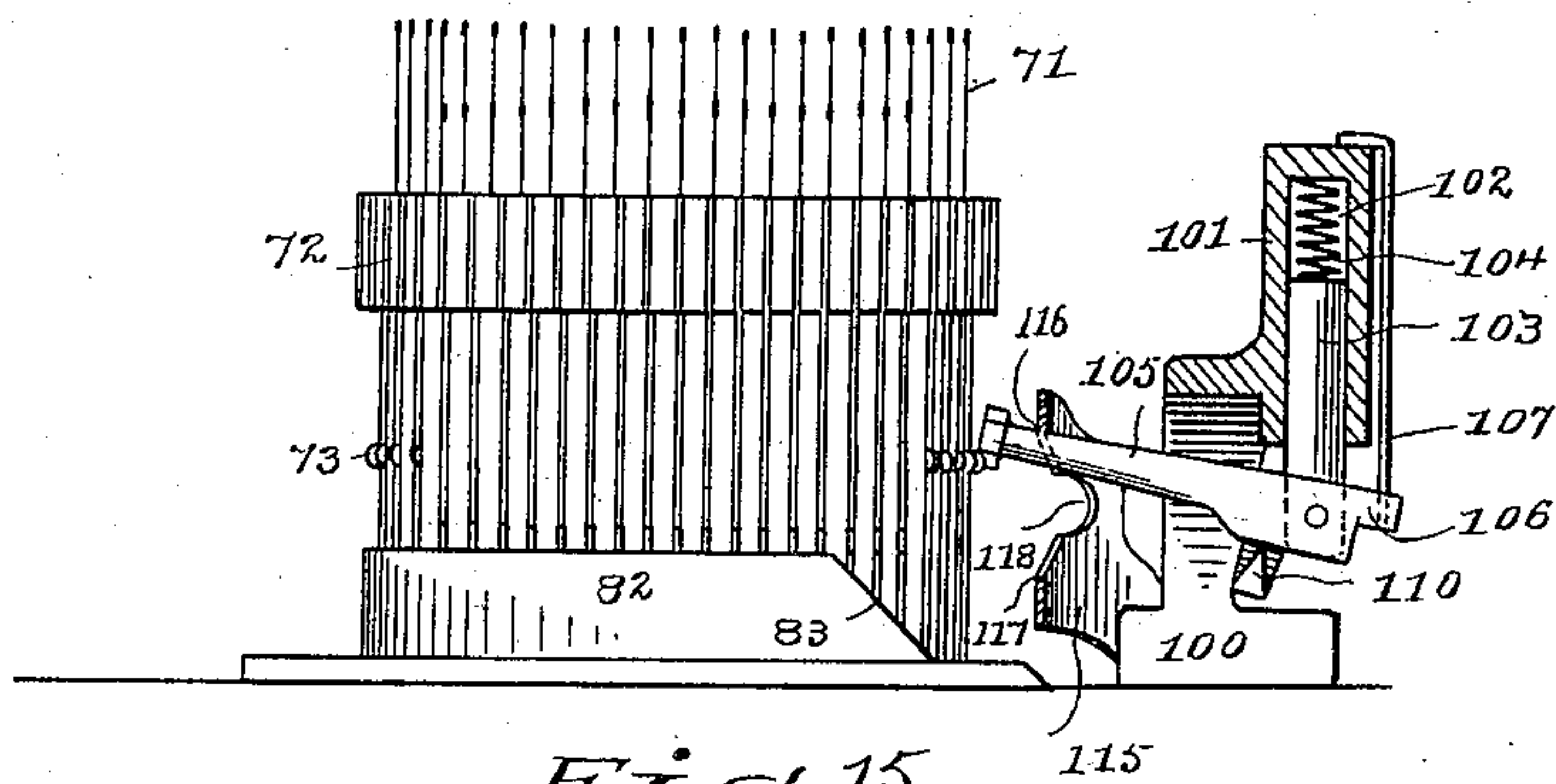
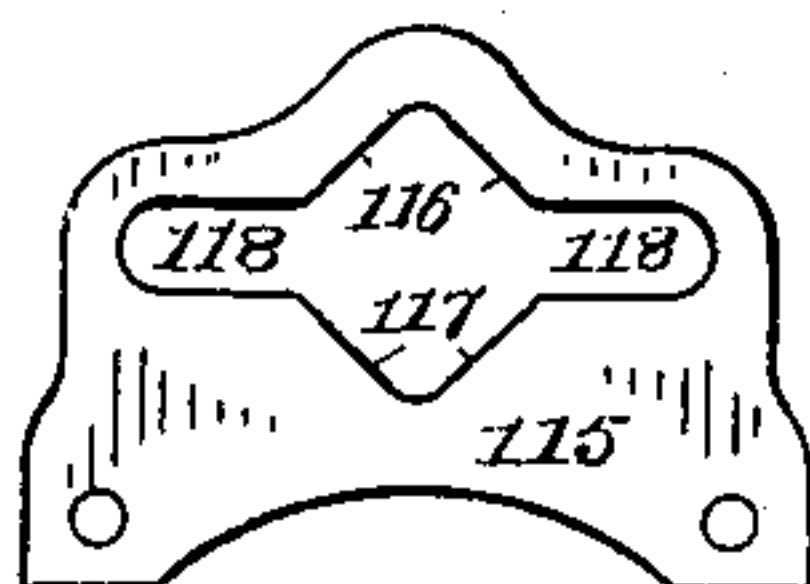


Fig. 15.

WITNESSES

H. A. Lamb  
A. M. Withersell



INVENTOR

Joshua D. Hemphill  
By A. M. Wooster  
Attor



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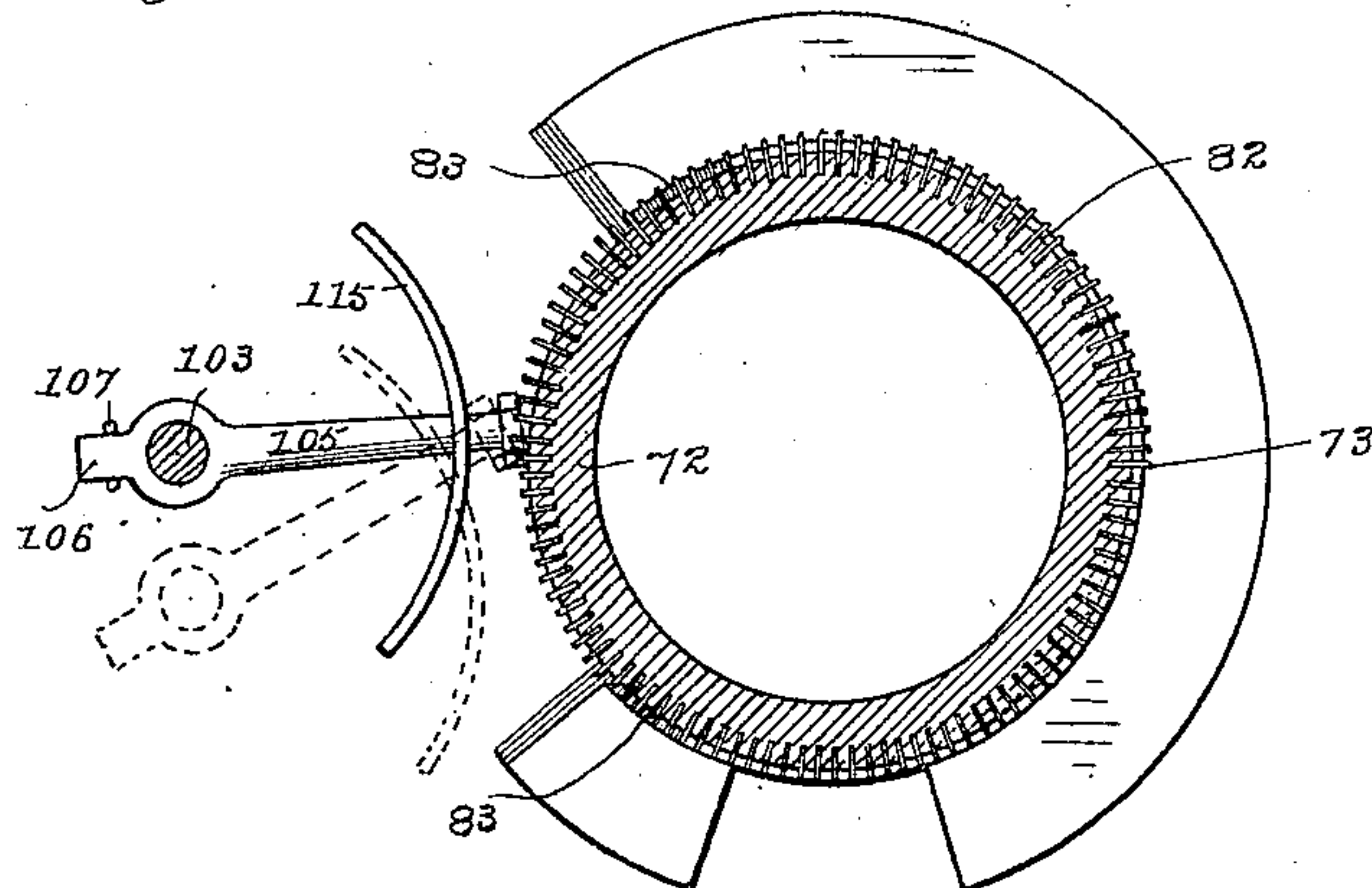
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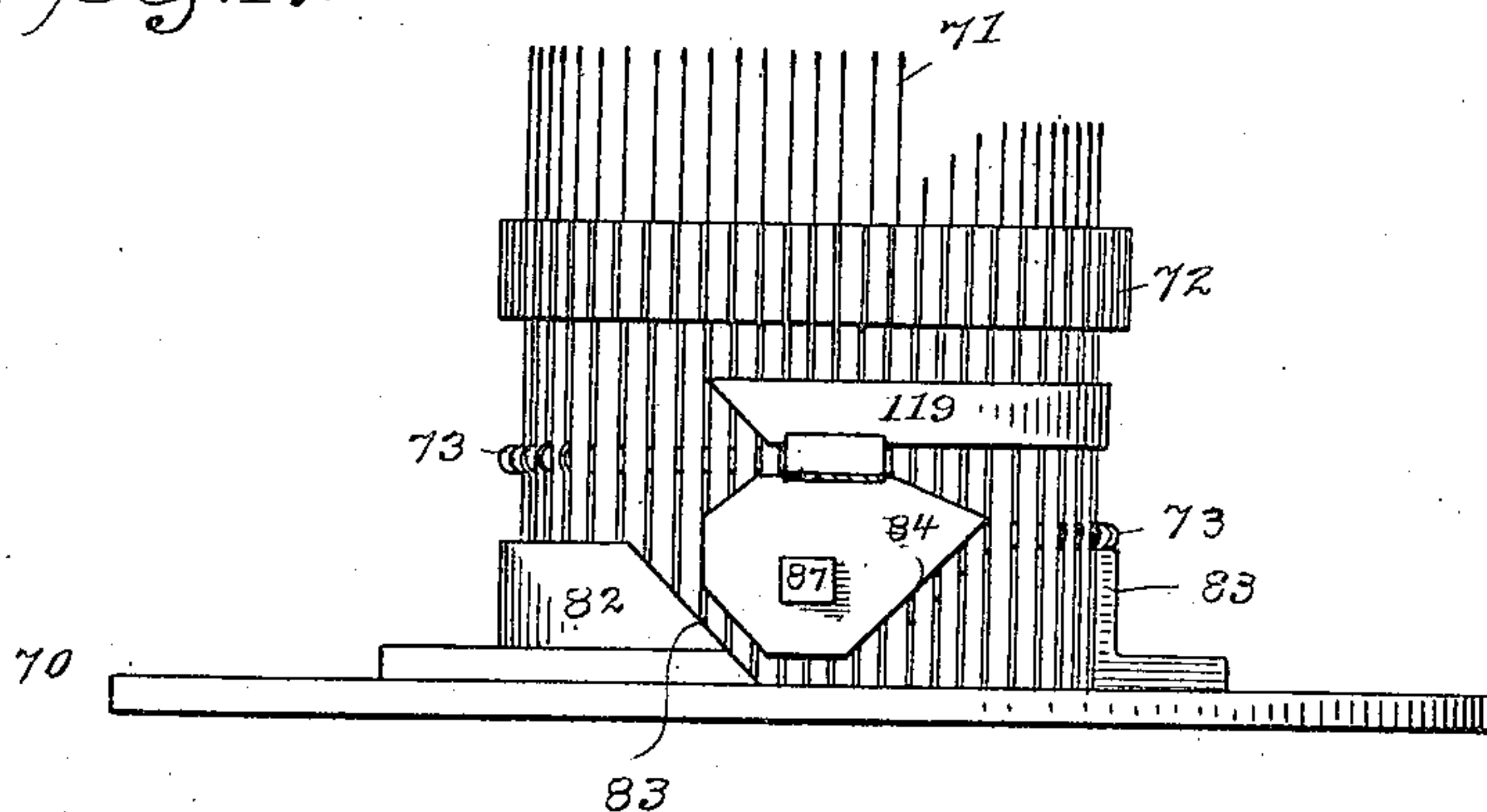
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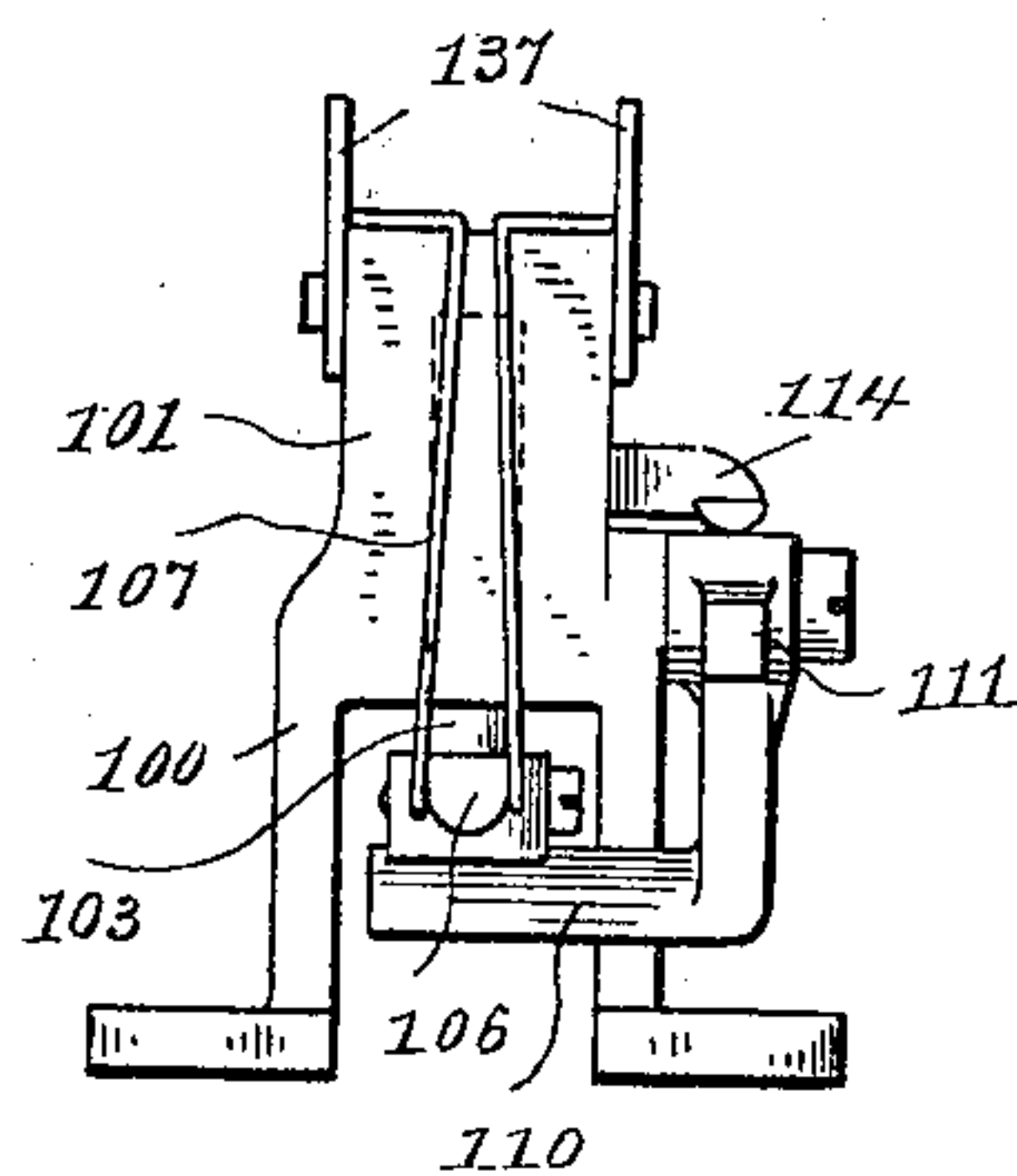
*Fig. 16.*



*Fig. 17.*



*Fig. 18.*



WITNESSES

*H. F. Lundy*  
*A. M. Chittell*

INVENTOR

*Joshua D. Hemphill*  
By *A. M. Wooster*  
*Atty.*



No. 629,503.

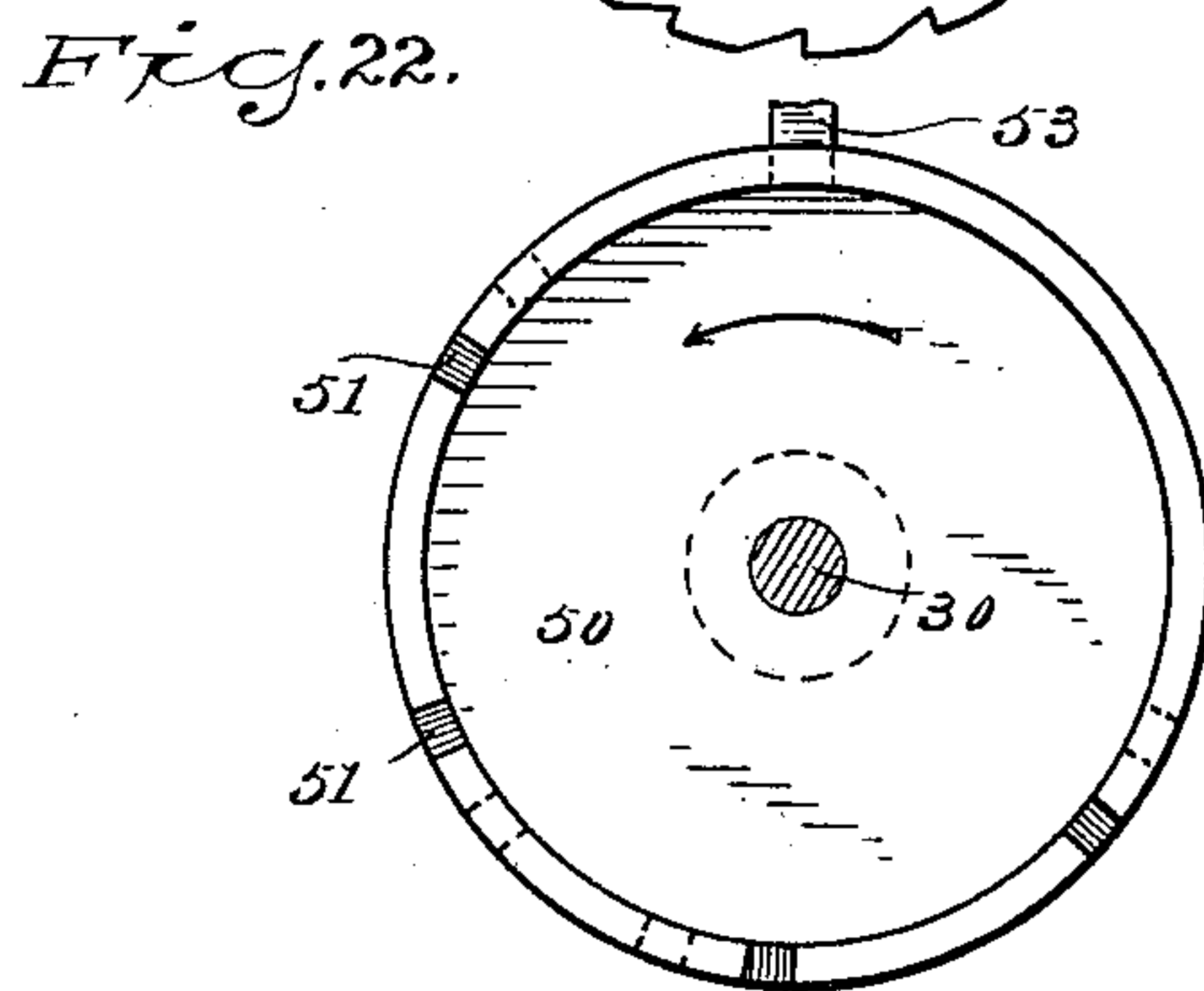
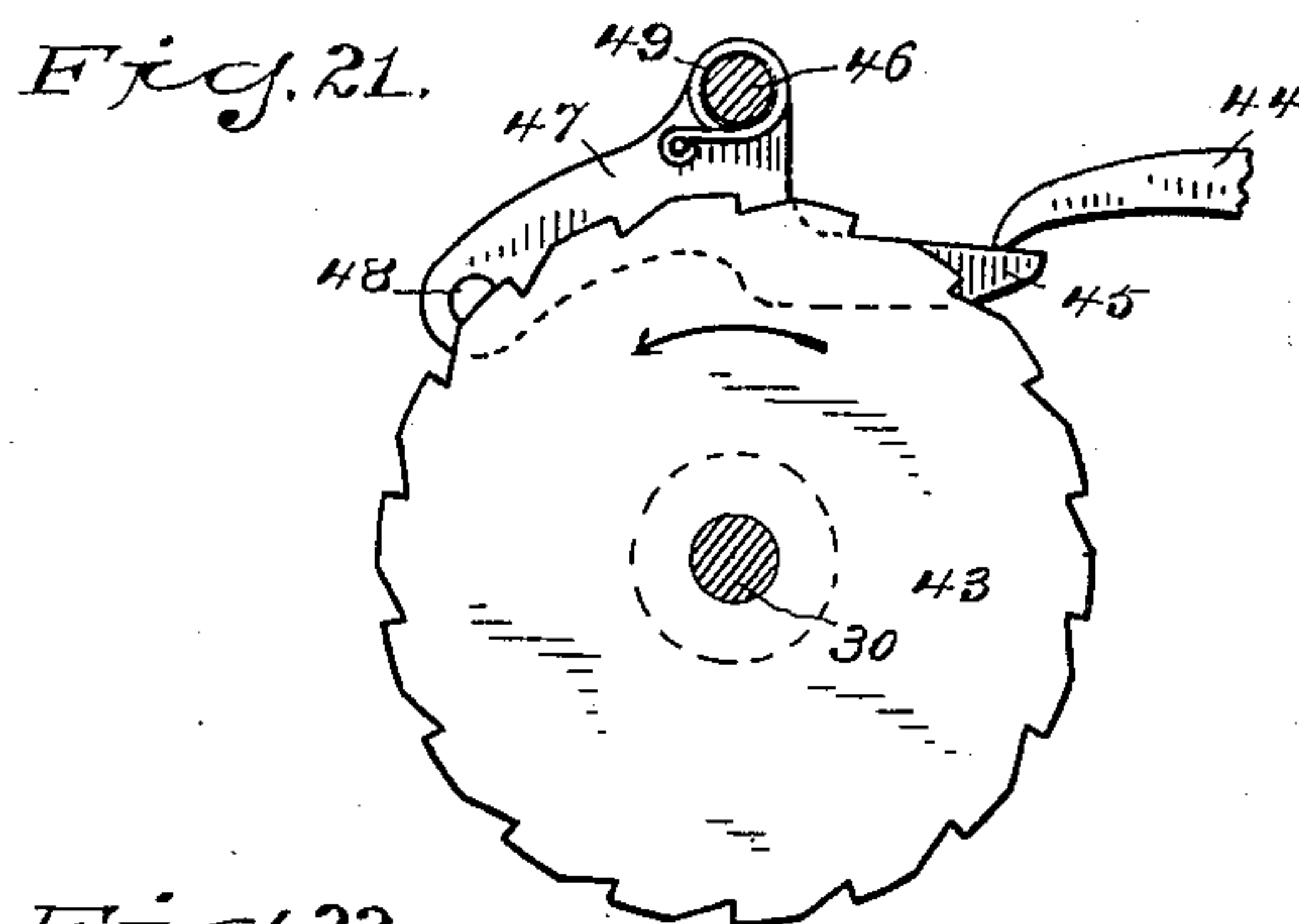
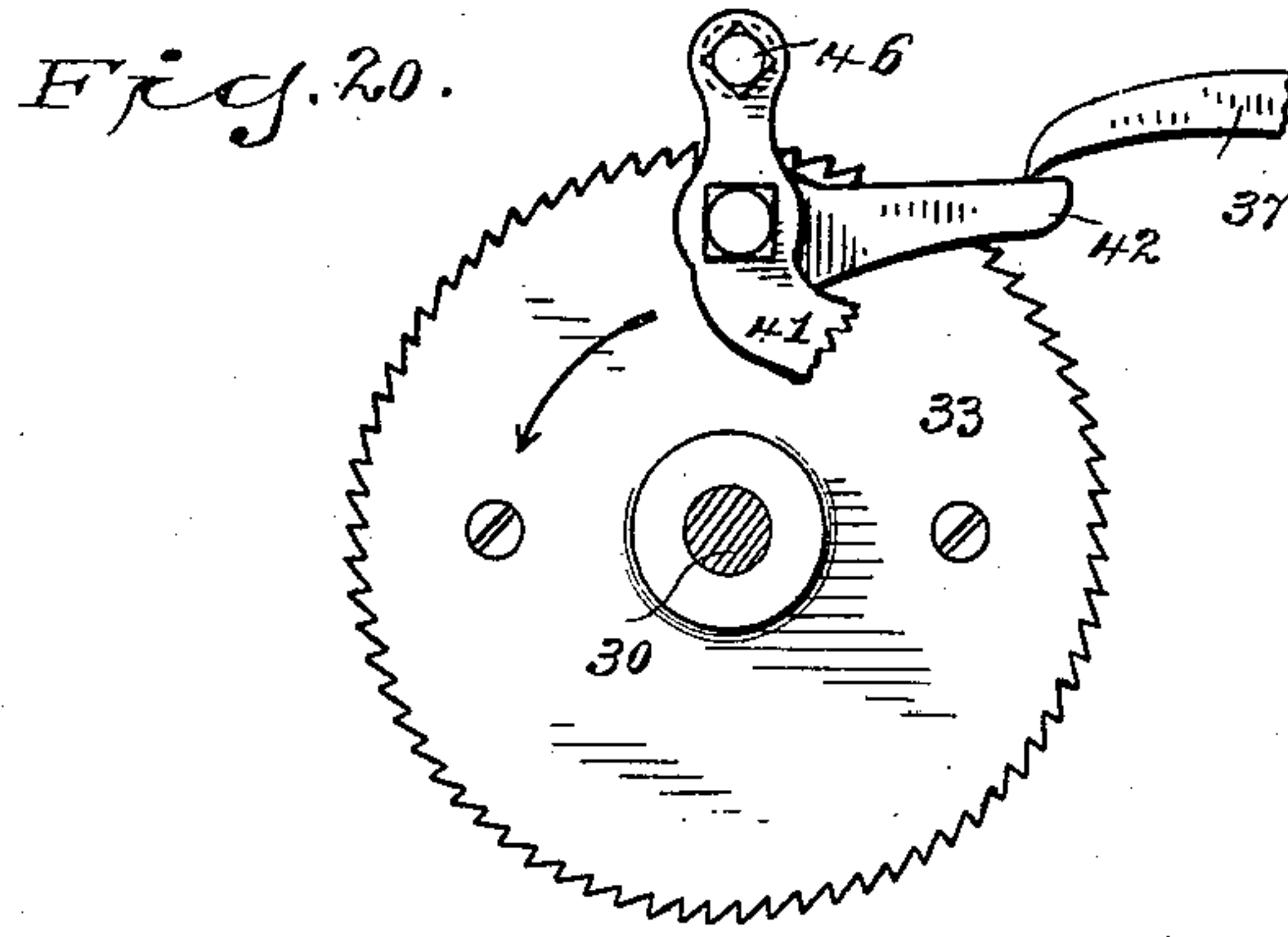
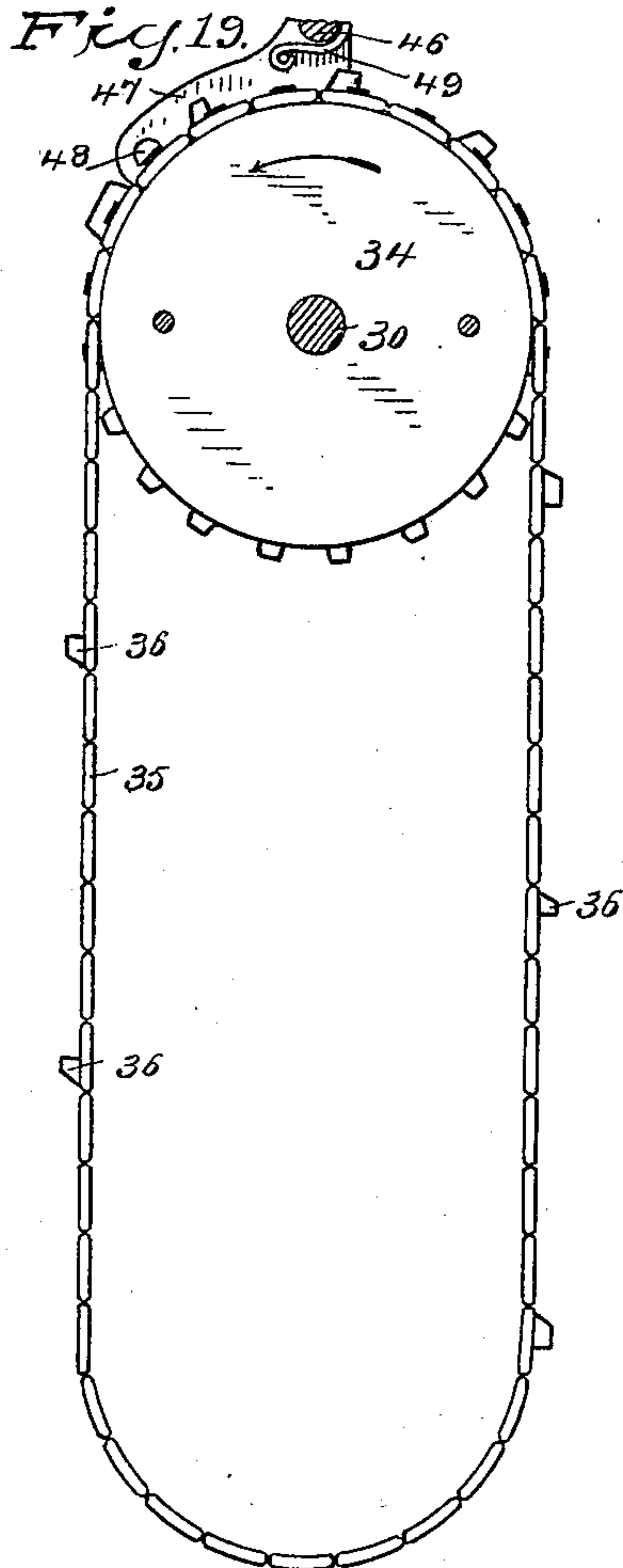
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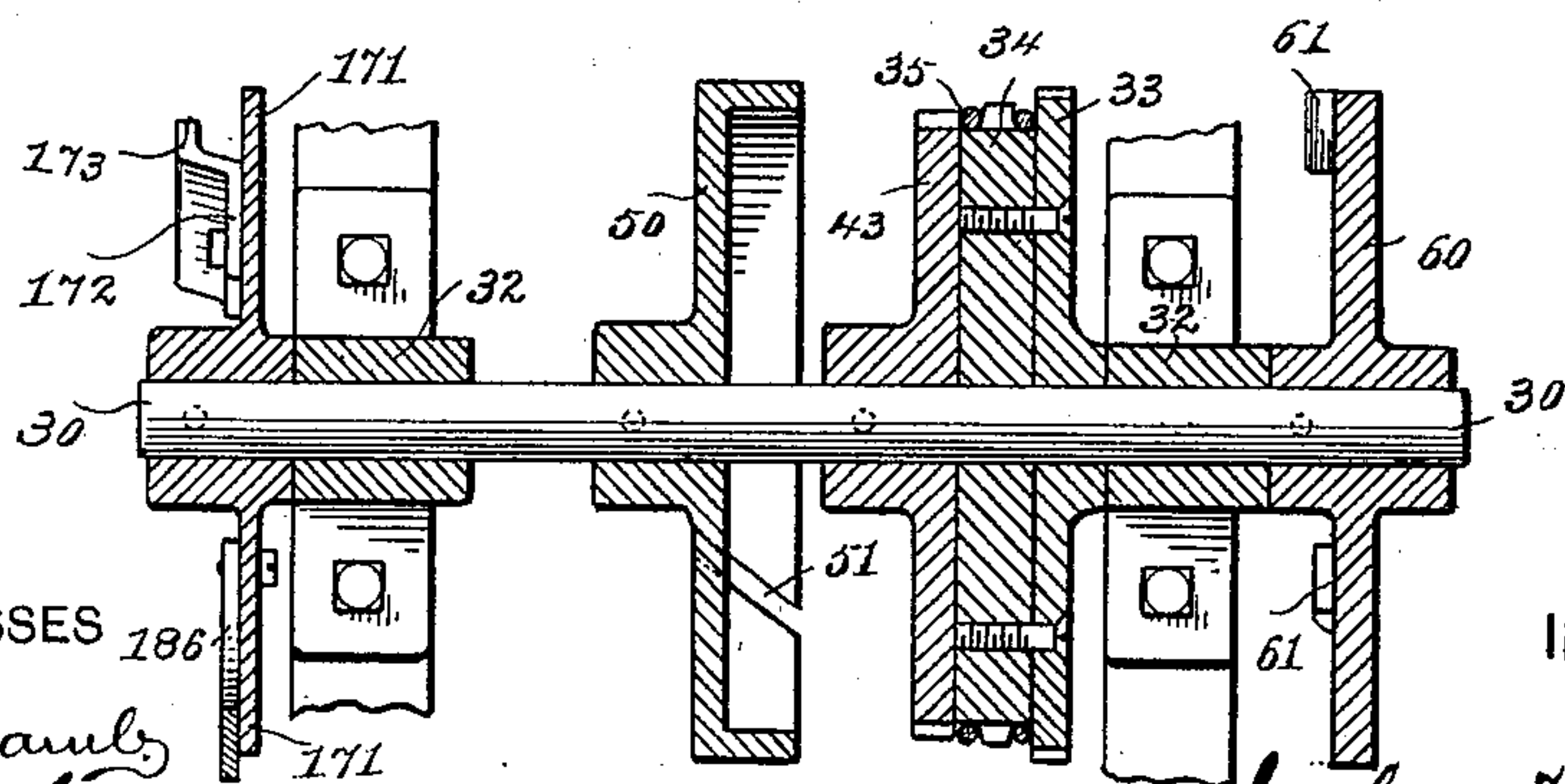
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*Fig. 23.*



WITNESSES

H. A. Lamb  
A. M. Withersell

INVENTOR

Joshua D. Hemphill  
By A. M. Wooster atty.

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J. D. HEMPHILL.  
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Fig. 24.

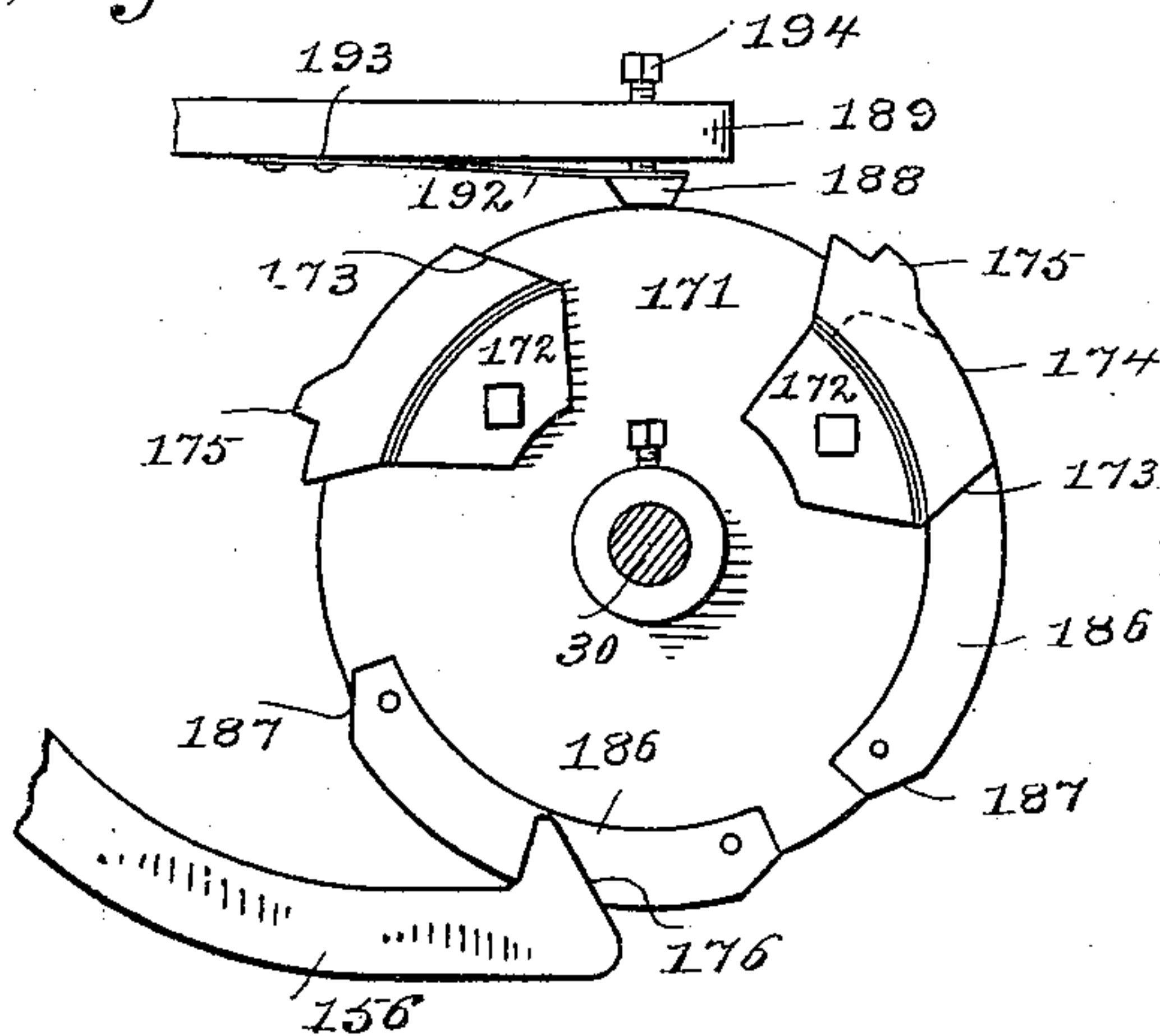


Fig. 25.

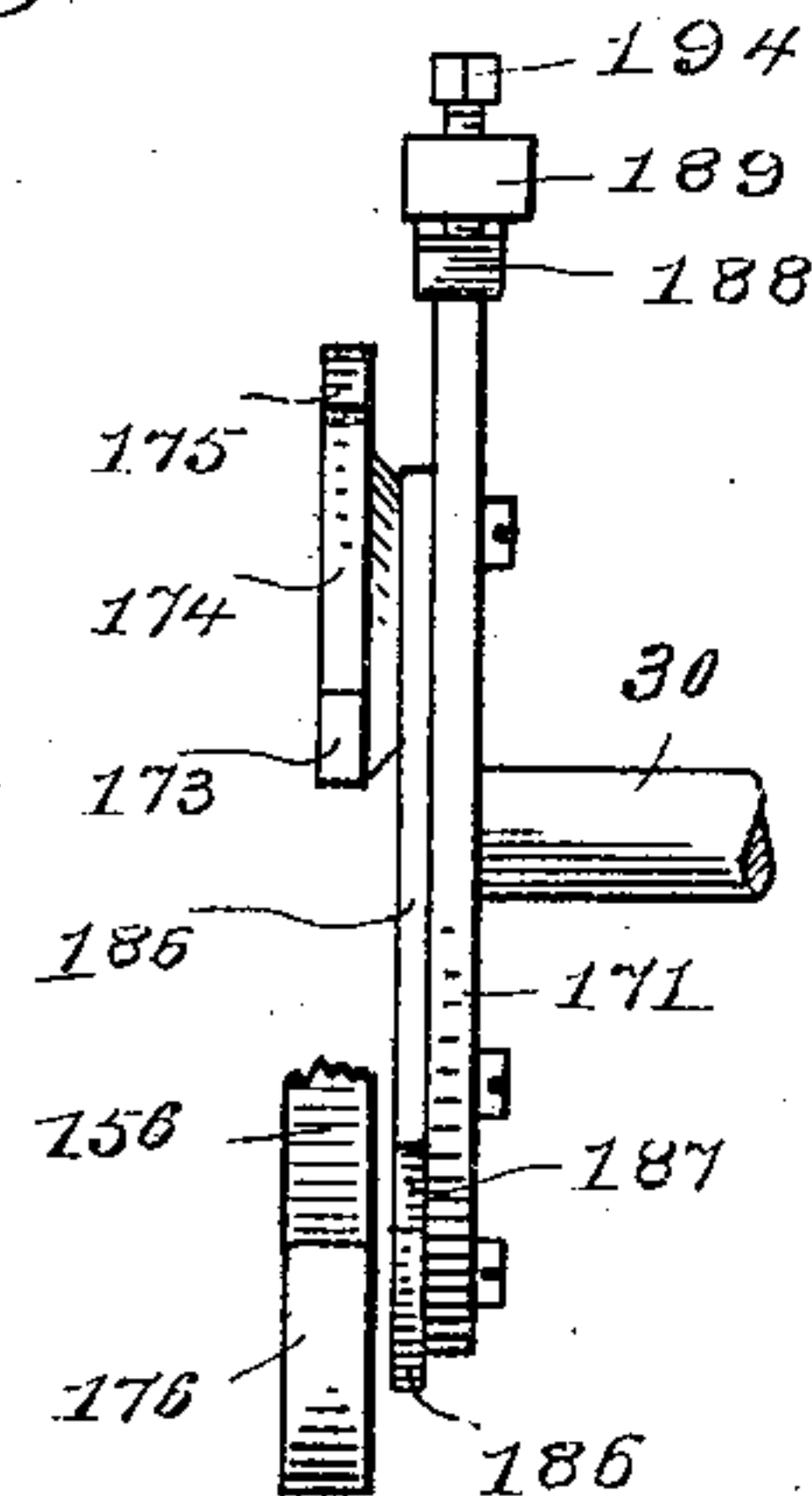


Fig. 26.

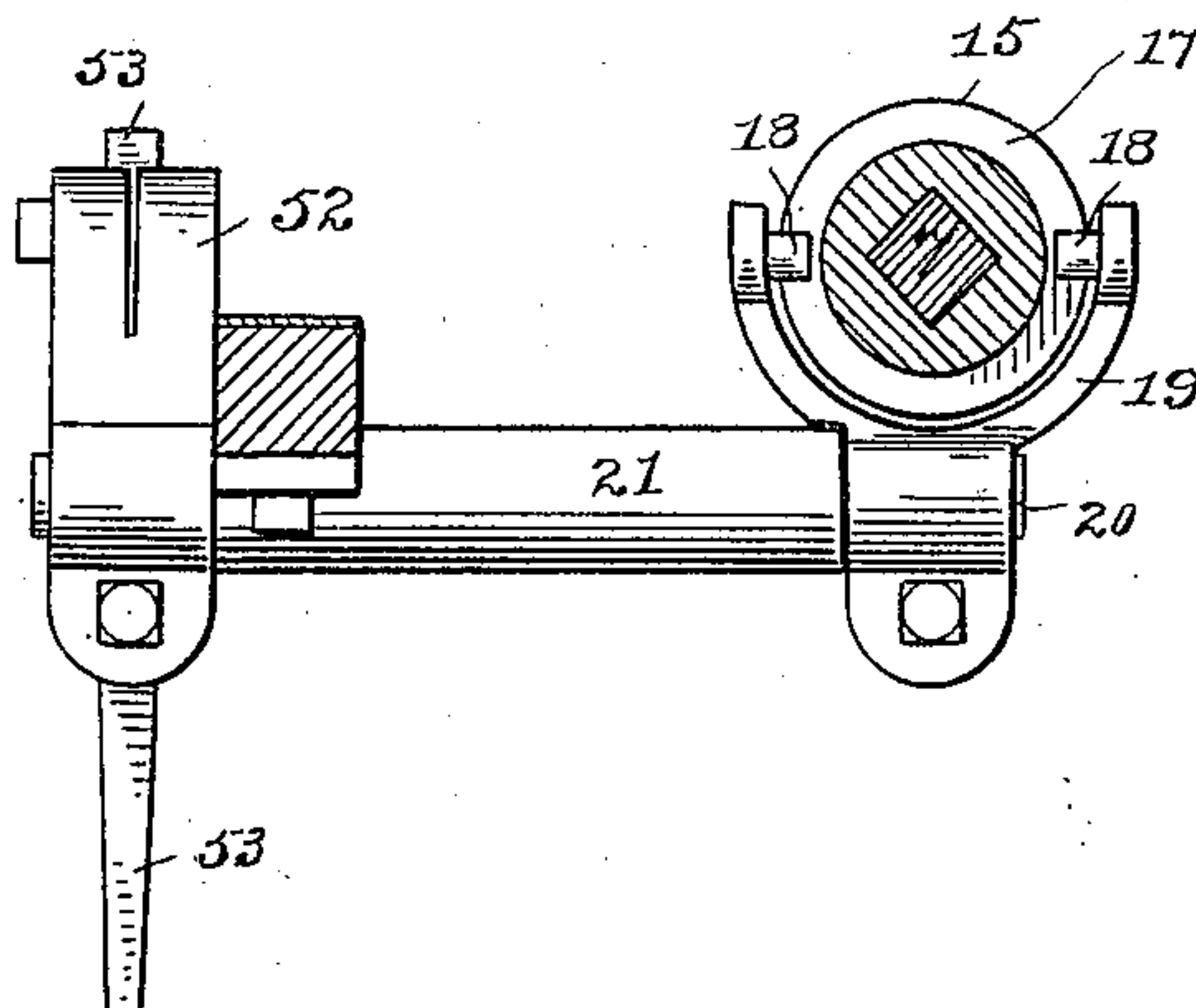


Fig. 27.

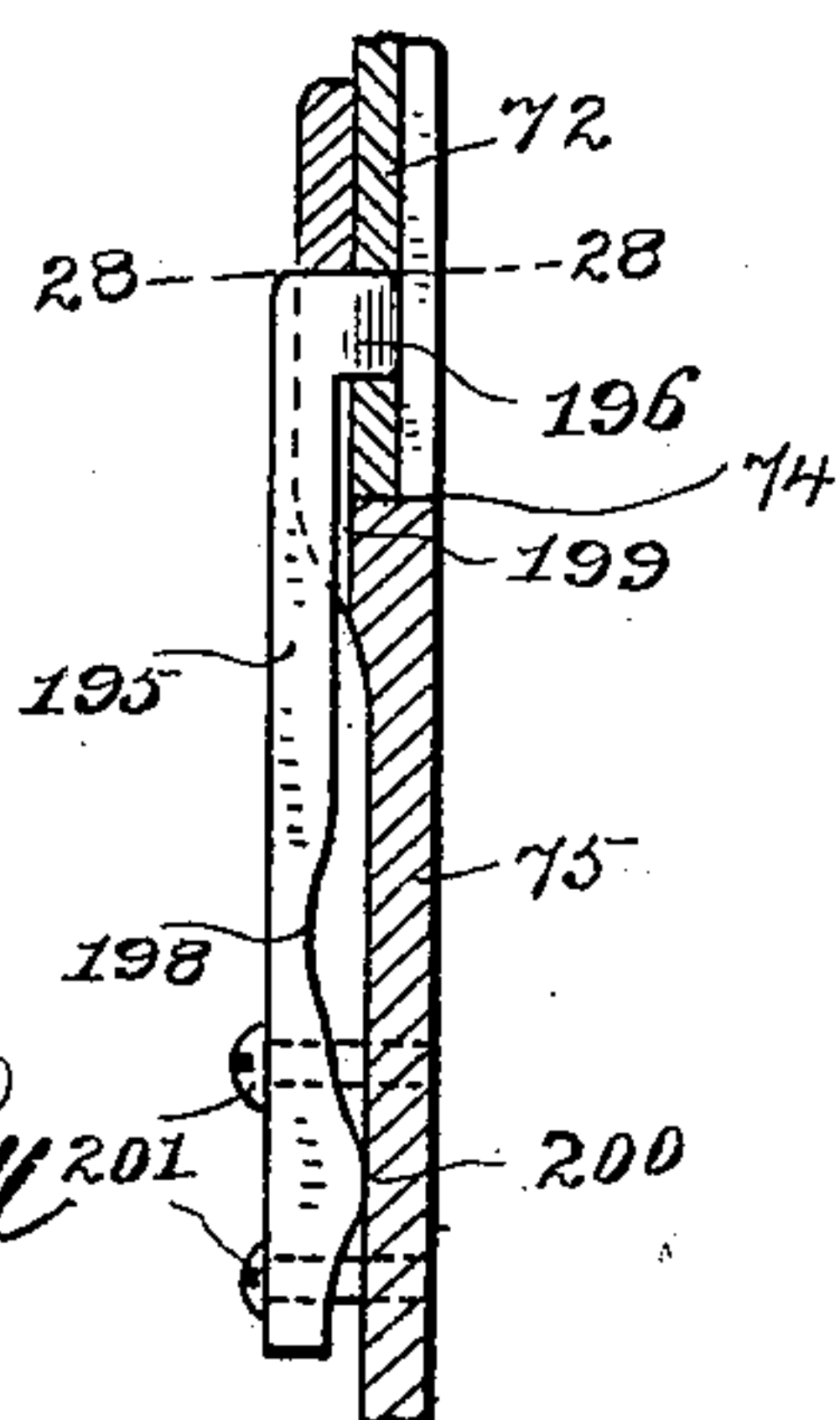
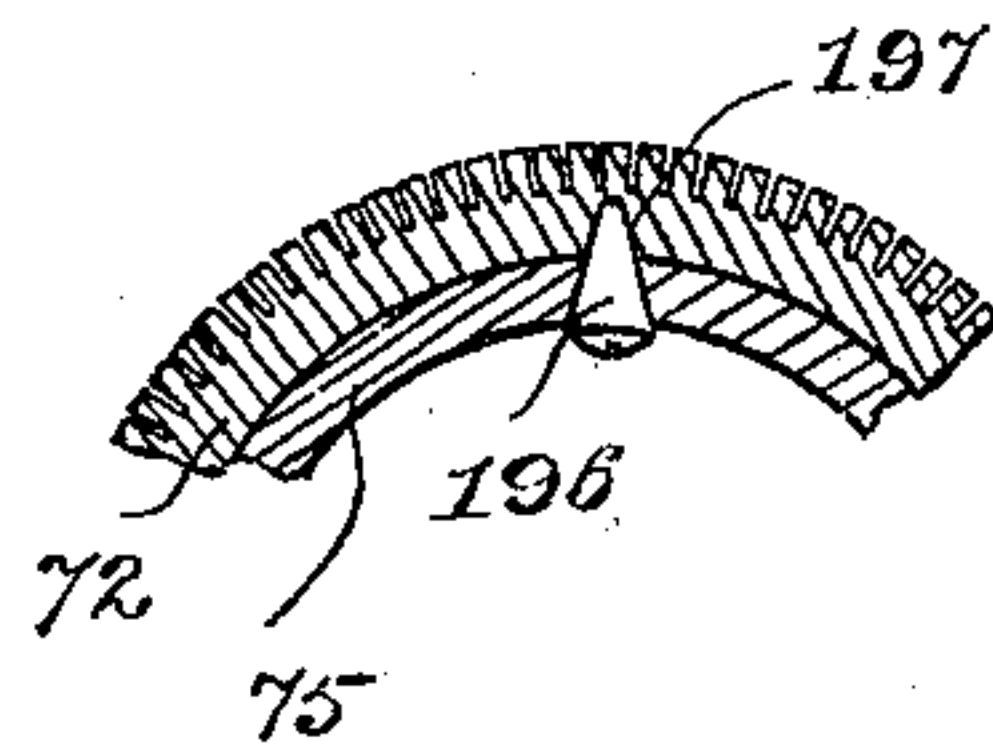


Fig. 28.



WITNESSES

H. F. Lamb  
A. M. Withrill

INVENTOR

Joshua D. Hemphill  
By A. M. Withrill  
att'y



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Fig. 29.

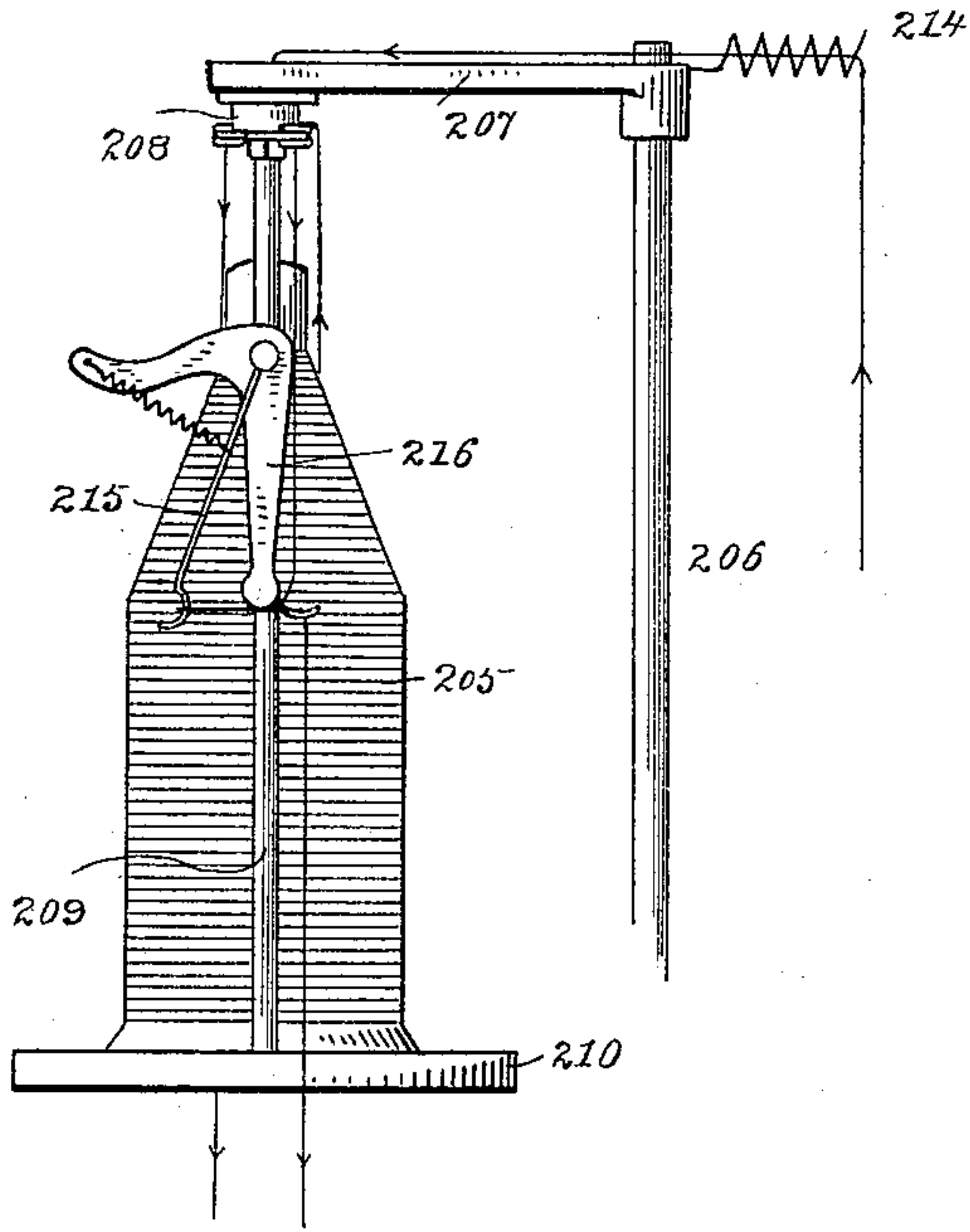


Fig. 31.

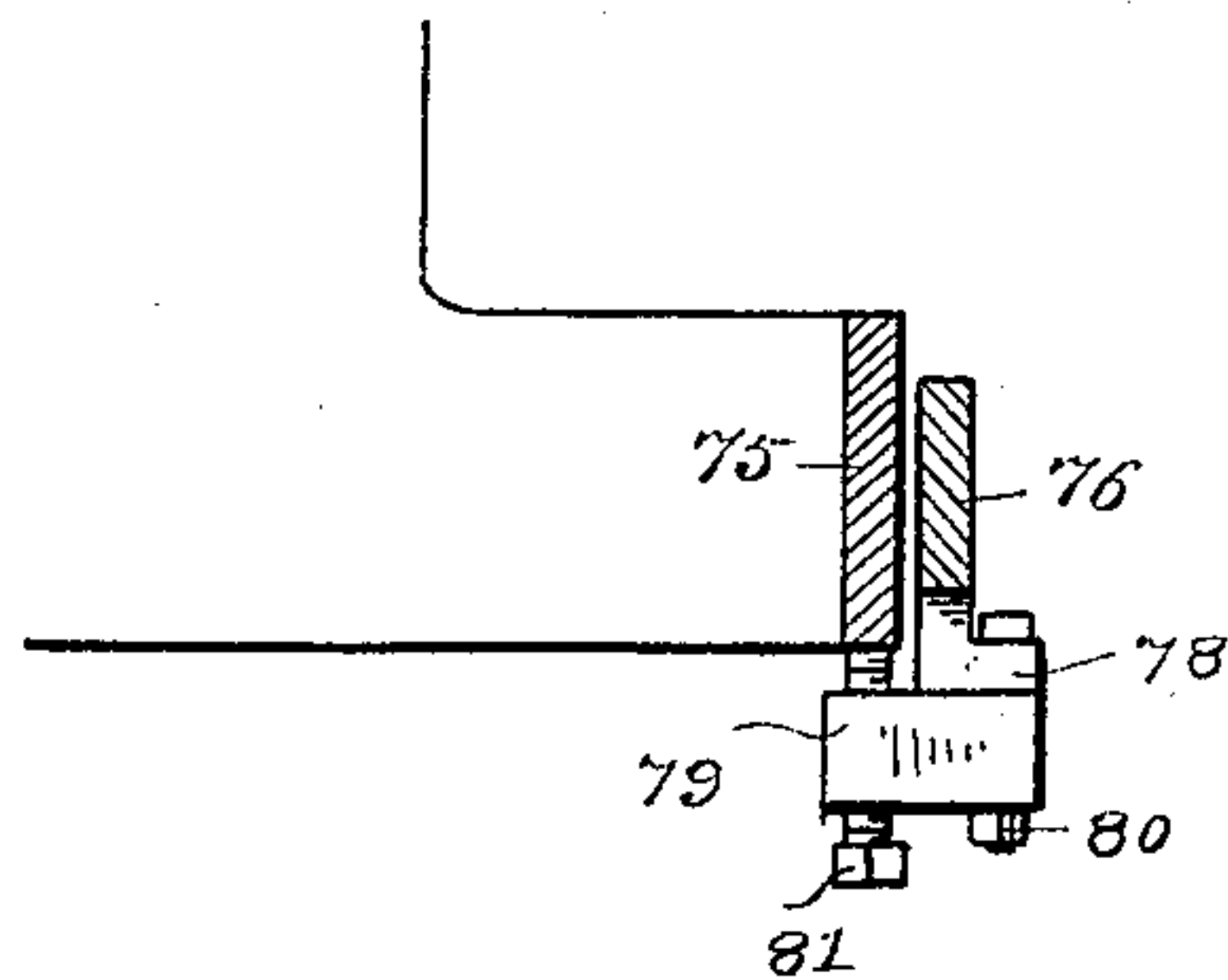


Fig. 30.

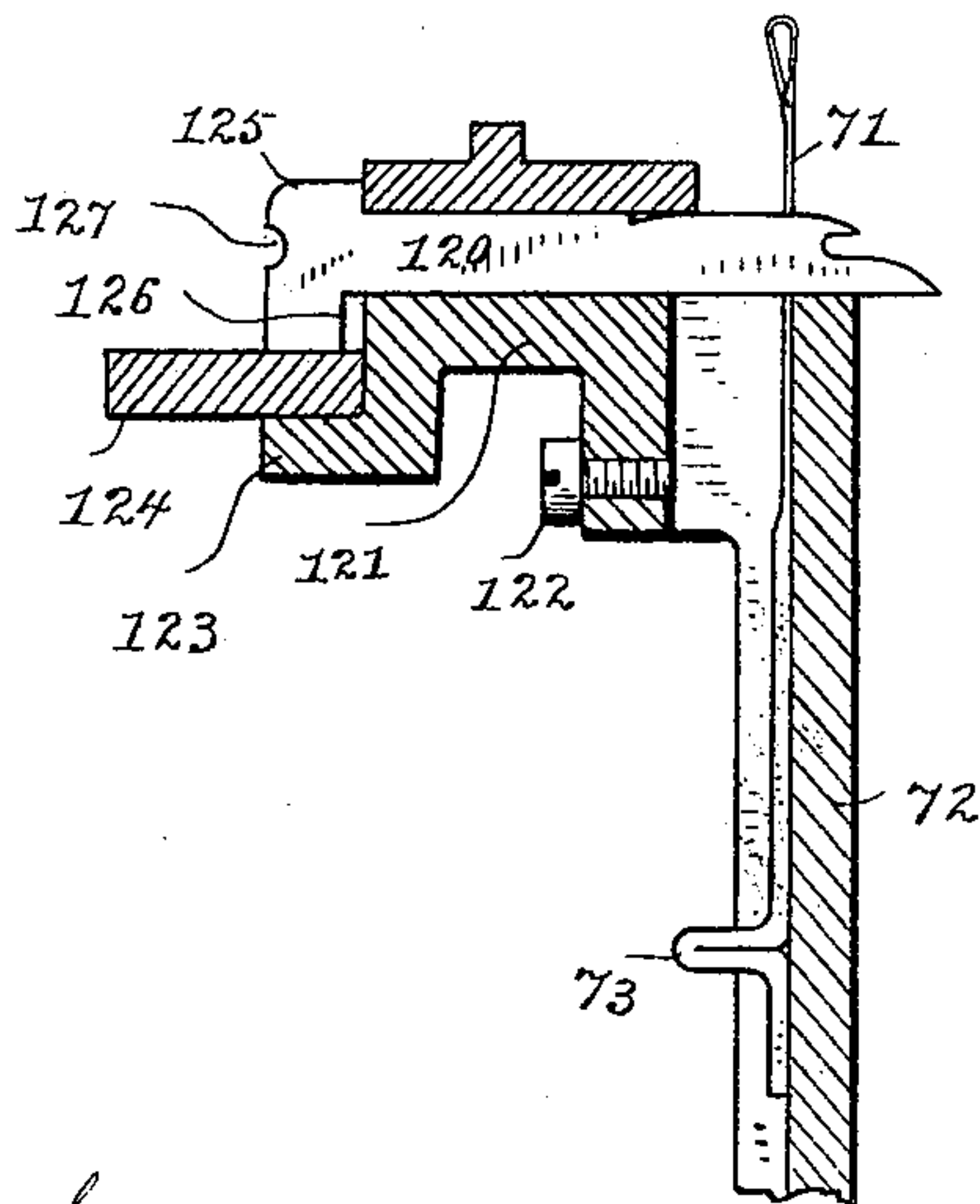
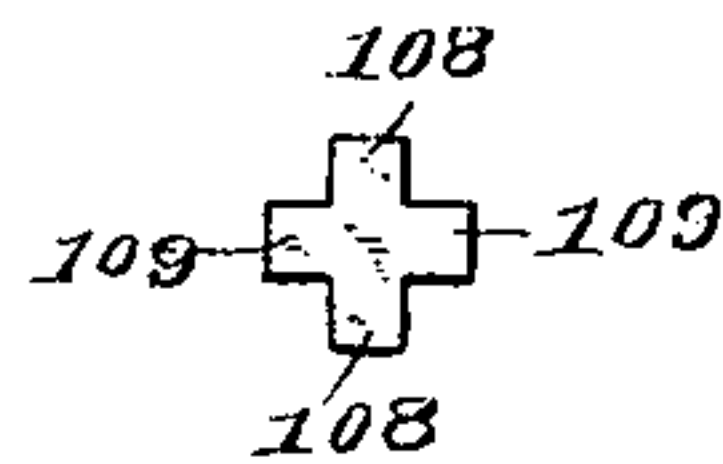


Fig. 32.



WITNESSES

H. D. Lamb  
A. M. Mitchell

INVENTOR

Joshua D. Hemphill  
By A. M. Webster  
att'y.

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J. D. HEMPHILL.  
KNITTING MACHINE.

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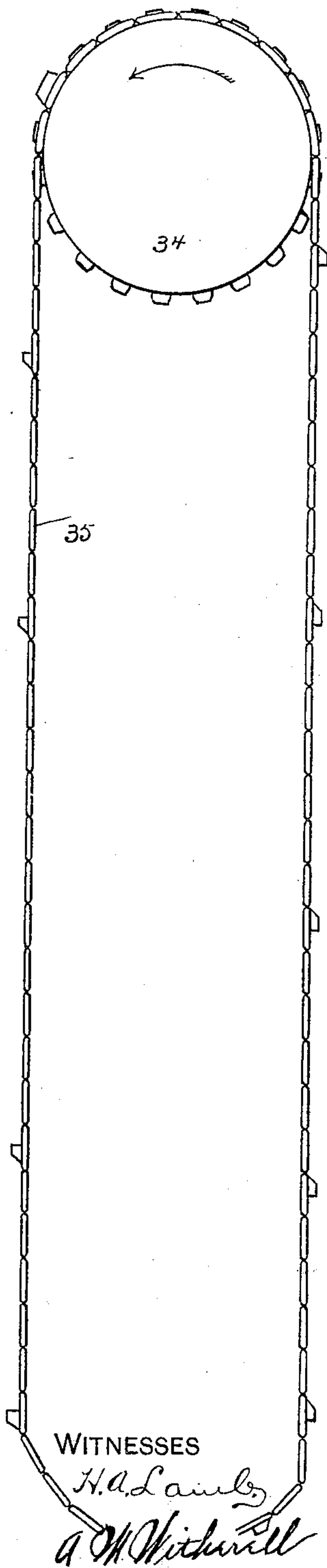


Fig. 33.

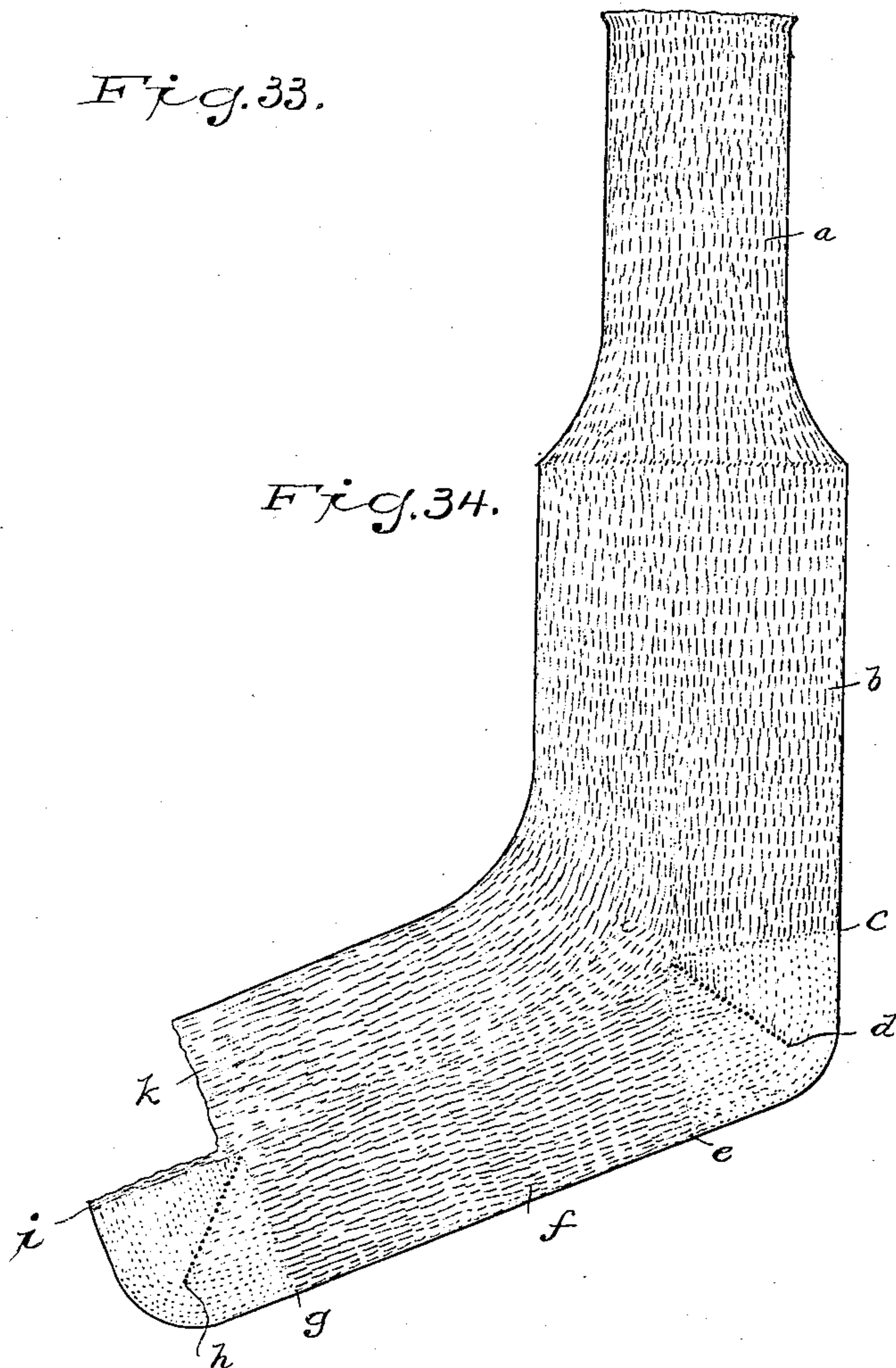


Fig. 34.

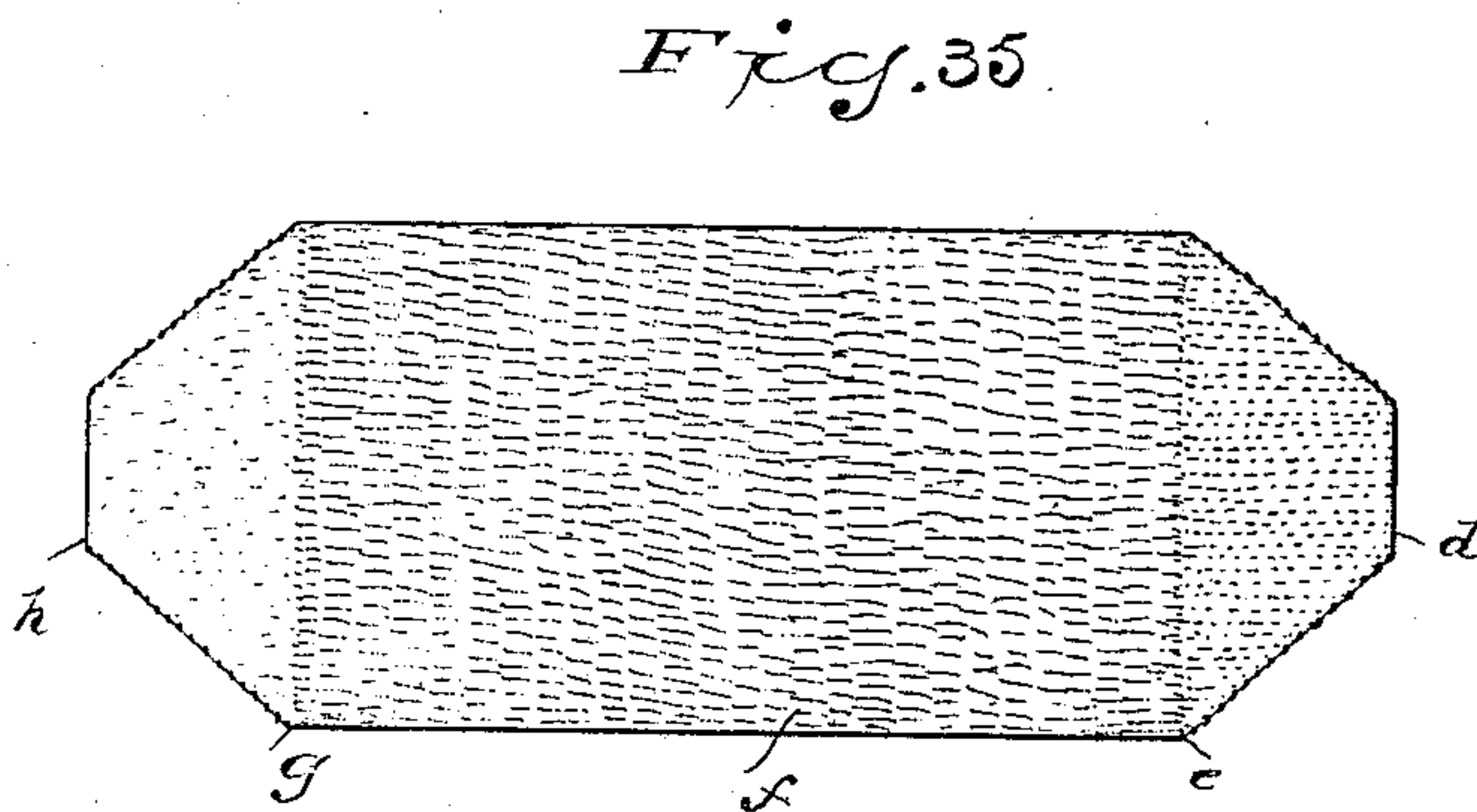


Fig. 35.

WITNESSES

H. A. Lamb  
A. M. Withwell

INVENTOR

Joshua D. Hemphill  
By A. M. Wooster  
Atty.



# UNITED STATES PATENT OFFICE.

JOSHUA D. HEMPHILL, OF SHELTON, CONNECTICUT, ASSIGNOR OF ONE-HALF TO WALTER W. RADCLIFFE AND FREDERICK W. RADCLIFFE, OF SAME PLACE.

## KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 629,503, dated July 25, 1899.

Application filed September 24, 1898. Serial No. 691,792. (No model.)

*To all whom it may concern.*

Be it known that I, JOSHUA D. HEMPHILL, a citizen of the United States, residing at Shelton, county of Fairfield, State of Connecticut, have invented a new and useful Knitting-Machine, of which the following is a specification.

This invention relates to that type or class of circular-knitting machines in which web holders or sinkers are employed cooperating with latch-needles in forming the knitted articles, particularly stockings and half-hose; and the invention has special reference to that type or class which is adapted to knit complete seamless stockings, with heel and toe portions composed of a different yarn, and in which all of the operations are accomplished automatically.

Among the objects of my invention are the dispensing with the usual plurality of picker-cams for rendering the needles inoperative and again active one by one during narrowing and widening and substituting therefor a single picker capable of producing these results, the provision of improved yarn-changing mechanism, the production of means for lengthening the stitch by raising the needle-cylinder, the provision of means whereby the web holders or sinkers may be readily removed and replaced and changed from one side of the machine to the other, the provision of means whereby the needles may be readily removed and replaced, and in general the simplification and reduction of cost of machines of this type and to increase their durability and certainty and rapidity of action.

To these ends the invention consists in the construction and combination of parts substantially as hereinafter described and claimed, referring to the accompanying drawings, in which similar reference characters designate the same or similar parts in all the views.

Figure 1 represents a side elevation of the machine complete. Fig. 1<sup>a</sup> is a detail view of the pinion and segment gear for imparting reciprocating rotary movement to the cam-ring. Fig. 2 represents a front elevation of the parts of the machine below the bed. Fig. 3 represents a side elevation from the left of

Fig. 2. Fig. 4 represents an enlarged plan view of the knitting mechanism. Fig. 5 represents a side elevation, partly in section, on line 5 5 of Fig. 4. Fig. 5<sup>a</sup> is a detail rear elevation of one of the cams shown in Fig. 5. Fig. 6 represents a horizontal section on line 6 6 of Fig. 5. Fig. 7 represents a vertical section through the cylinder, bed-plate, and main shaft. Fig. 8 represents a detail side elevation of the cylinder and needles and one of the knitting-cams when doing continuous or round-and-round work. Fig. 9 represents a view of the cylinder and needles and parts operating in connection therewith when on heel-and-toe work. Fig. 10 represents a plan view of the ring-cam for raising the needles. Fig. 11 represents a detail elevation of the cams for operating the yarn-changing devices and for shifting the fulcrum of the picking-finger. Fig. 12 represents an elevation from the right of Fig. 11. Fig. 13 represents a detail elevation of the needle-cylinder and the picking-finger. Fig. 14 represents a similar view, but with the picking-finger moved to another position and parts being indicated in section. Fig. 15 represents a detail elevation of the cam for oscillating the picking-finger. Fig. 16 represents a horizontal section of the needle-cylinder and plan of the picking-finger, the dotted lines indicating the change in position of the picking-finger as it throws one needle up or down in narrowing or widening for heel or toe. Fig. 17 represents a view similar to Fig. 8, but with the parts in position when knitting heel or toe. Fig. 18 represents a detail elevation from the left of Fig. 13 of the picking-finger and its adjuncts. Fig. 19 represents a detail view of the pattern-chain for half-hose and its pulley. Fig. 20 represents a detail view of the ratchet which carries the chain-pulley. Fig. 21 represents a detail view of the intermittently-operated ratchet attached to the cam-shaft and the pawl and pawl-shield. Fig. 22 represents a side elevation of the clutch-shifting cam. Fig. 23 represents the cam-shaft, the cams, ratchets, and chain-pulley thereon being shown in section. Fig. 24 represents a detail side elevation of the cam-disk for controlling the elevation of the cylinder and the eleva-



tion of the cams shown in Figs. 11 and 12. Fig. 25 represents an edge view of said cam-disk. Fig. 26 represents a detail view of the clutch-shifting mechanism. Fig. 27 represents in detail the automatic lock and release for securing the needle-cylinder in its bearing or permitting its release therefrom to prevent breakage of needles or when it is desired to rotate the cylinder in its bearing. Fig. 28 represents a detail section on line 28 28 of Fig. 27. Fig. 29 represents a detail elevation of one of the bobbins and the yarn-tension. Fig. 30 represents a detail section through one side of the needle-cylinder and web holder or sinker ring. Fig. 31 represents a detail section, enlarged, on line 31 31 of Fig. 2, looking toward the right. Fig. 32 represents a detail end view of the picking-finger. Fig. 33 represents a detail of a pattern-chain employed when knitting long hose or ladies' stockings, the chain having differently-spaced lugs or cams for the increased length of hose and additional ones for changing the length of stitch in some portions of the hose. Fig. 34 represents the stocking produced by the machine when the pattern-chain shown in Fig. 19 is employed. Fig. 35 represents a view of the sole of the hose before boarding.

The bed 1 of the machine is supported by a suitable frame 2, mounted on legs 3, a cup-shaped bearing 4 being formed below said bed, as shown most clearly in Fig. 7 and to which reference will be made hereinafter.

The main shaft of the machine is represented at 7 and is provided with the large bevel-gear 8, secured thereto at one end, while the other end is mounted in a sleeve 9, to which is secured a single driving-pulley 10, having a crank-handle 11, as is usual for hand working of the machine. A single loose pulley 12 is mounted on an extension of the hub of the driving-pulley. Loosely mounted on the shaft adjacent to the gear 8 is a pinion 13, while the inner end of the sleeve 9 is formed as a pinion 14. Between the pinions 13 and 14 the shaft is provided with a clutch-hub 15, the said shaft being formed angular or provided with a feather to permit the hub to slide thereon while held from independent rotation thereon. The said clutch-hub is shown in Fig. 7 as provided with two projections or teeth 16 to engage a groove in one or the other of the pinions 13 14 and is also provided with an angular groove 17 to receive pins or rollers 18, carried by a shifting yoke 19, said yoke being secured to one end of a rock-shaft 20, (see Figs. 2 and 26,) mounted in a bearing 21 and oscillated by mechanism described hereinafter.

A gear 22 (see Figs. 1 and 2) is mounted in a suitable bearing supported by the frame and meshes with pinion 14 and is constantly driven thereby during the operation of both the round-and-round work and heel-and-toe-knitting operation. Said gear 22 is provided with a crank-pin 23, (see Fig. 1,) to which is connected one end of a pitman 24, the other

end of said pitman being connected with one end of an elbow-lever 25, mounted on a shaft 26, supported in standards 27. The other end of the lever 25 is provided with a segmental gear 29, which meshes with pinion 13 on the main shaft. (See Figs. 1, 1<sup>a</sup>, 2, and 7.)

It will now be understood that when the clutch-hub is in engagement with the pinion 14, which is constantly driven, the gear 8 will be rotated continuously in one direction, since both the gear 8 and the clutch hub are non-rotatable on the shaft. During this time the segmental gear is imparting a rotary reciprocating motion to the pinion 13, which is loose on the shaft; but when the clutch-hub is shifted to engage the pinion 13 it is disengaged from pinion 14, which latter then through gear 22, pitman 24, lever 25, segmental gear 29, pinion 13, and clutch-hub 15 imparts to the shaft and to the gear 8 a rotary reciprocating motion. The motion of the elbow-lever imparts movement to the pattern-chain and to certain cams through the medium of pawls by the mechanism now to be described.

Referring to Figs. 1, 2, 3, and 19 to 25, inclusive, a shaft 30 is shown as mounted in bearings 32, supported by the frame. Loosely mounted on this shaft is a ratchet 33, to one side of which is secured the pattern-chain pulley 34, said pulley having the usual teeth to engage the links of the pattern-chain 35, some of said links having the lugs or cams 36. The ratchet 33 and pulley 34 are driven in the direction of the arrow shown in Figs. 19 and 20 by means of a pawl 37, pivotally connected with one end of an elbow-arm 38, (see Fig. 1,) mounted on shaft 26, the other end of said arm 38 being secured to the side of the elbow-lever 25 by means of a bolt 39, passing through a slot 40 in the arm 38. A bracket 41 is secured to the frame of the machine, (see particularly Fig. 2,) and bolted to this bracket is a shield 42, on which the pawl 37 rides during a portion of its stroke. The shield is secured firmly to the bracket by means of a single bolt, by means of which said shield may be readily raised or lowered to permit the pawl to engage a tooth of the ratchet at a point more or less remote from its extreme forward limit of motion, and thus adjust the amount of feed imparted to the pattern-chain. A ratchet 43 (see Figs. 2, 21, and 23) is secured to the shaft 30 on the opposite side of the pulley 34, and this ratchet, which may be termed the "cam-driving" ratchet since it rotates the cam-carrying shaft 30, is adapted to be intermittently rotated by means of a pawl 44 when permitted by the lugs of the chain. The pawl 44, like the pawl 37, is also pivotally connected with the elbow-lever 25 and is reciprocated thereby, said pawl 44 normally riding on a shield 45. The said shield is pivoted on a pin 46, carried by the bracket 41 and extending over both ratchets and the chain-pulley, and the shield is provided with an arm 47, having a pin 48, which projects into the path of movement of



the chain-lugs. A spring 49 is coiled about the pin 46 and tends to hold the arm and shield in the position shown in Fig. 21; but when a chain-lug raises the pin 48 the shield 45 is depressed and the constantly-reciprocating pawl 44 engages a tooth of the ratchet 43 and advances the latter; and consequently partially rotates the shaft 30 and the cam-disks carried thereby, which are yet to be described.

Adjacent to the ratchet 43 a clutch-operating cam-disk 50 is secured to the shaft 30. This disk is shown in Figs. 22 and 23 as cut away at one side for lightness. It is provided with four grooves 51 in its periphery, these grooves being formed in alternately opposite directions, as shown in Fig. 2 and as indicated by the dotted lines in Fig. 22. The rock-shaft 20, heretofore described in connection with the clutch-hub 15, (see Fig. 26 in connection with Figs. 1, 2, and 7,) is provided with an upwardly-extending arm 52 at its front end, to the side of which is secured a spring-arm 53, the lower end of which extends below the rock-shaft and engages the cam-disk 50. The width of the periphery of the disk 50 is greater than the arc of movement that would be naturally given to the lower end of the arm while the clutch-hub 15 is moving from one of the pinions 13 or 14 to the other. Hence the arm 53 is made somewhat elastic and its lower end bears with considerable pressure against one side or the other of the periphery of the disk 50. This elasticity of the arm causes it to enter the grooves 51 alternately as the disk is rotated, the further rotation of the disk immediately causing the inclined side of the groove into which the arm has sprung to force the arm over to the other side of the disk, thus shifting the clutch-hub.

It is to be understood, of course, that one complete rotation of the shaft 30 and its cams takes place during the knitting of one stocking, the length of the article and its shape being controlled by the length of the chain employed and the spacing and number of the lugs carried by said chain. The knitting operation itself continues uninterruptedly without regard to the rotation of said shaft and cams and will be described hereinafter; but when a stocking is finished, however, the rotation of said shaft effects the automatic stoppage of the entire knitting operation, and during the single rotation of the shaft it also effects two temporary shifts of the driving-belt to slow down or ease off the machine when the clutch-hub is moved into engagement with the pinion 13. This movement of the hub changes the knitting from circular or round-and-round work to the narrowing or widening at heel or toe, one-half of the needles being thrown out of action, as hereinafter described. During the narrowing or widening the knitting-cams have a reciprocating rotary motion through the segment and other gearing hereinbefore de-

scribed, and the change to this motion from the continuous rotary motion causes a resistance, which renders it desirable to provide for slowing down or easing off the machine, as mentioned. The means for doing this will now be described.

At one end of the shaft 30—the right-hand end in Fig. 23 (see also Figs. 1 and 2)—there is secured a disk 60, having three cam-lugs 61 on its side near the edge. These are adapted to operate successively against a pin or roller 62, carried by a lever 63, pivoted at 64 to the frame of the machine, the lower end of the lever being acted on by a spring 65 to keep the pin or roller in engagement with the cam-disk. The upper end of the lever 63 carries a belt-guide 66 of the usual type for shifting a belt, curved partly around the belt-pulley and adapted to shift a belt (not shown) from the fast pulley 10 (see Fig. 7) to the loose pulley 12 when a cam 61 acts on the shipping-lever, and vice versa when the cam 61 leaves the pin of said lever, the spring 65 causing the return of the lever.

The lever 63 is provided with a handle 67 and with an upwardly-extending finger 68, which is adapted to move under and be held by a spring-latch 69, secured to the frame, (see Fig. 2,) whenever the lever 63 is moved to its limit of motion for throwing the belt off from the fast pulley. One of the cams 61 on the disk 60 is of a height sufficient to throw the lever to this limit of movement, so that the lever will be retained by the spring-latch and the driving-belt held on the loose pulley, thus stopping the machine. To start the machine, it is only necessary to lift the spring-latch and permit the spring 65 to cause the belt-shipping lever 63 to restore the belt to the fast pulley, it being understood that the movement of the disk 60 which caused the lever to be caught by the spring-latch was sufficient to carry the cam-lug just beyond the roller 62 of the lever. The other two cam-lugs 61 are of a thickness sufficient to cause the lever to shift the belt onto the loose pulley, but not to cause the lever to be engaged by the spring-latch, and hence the power is thrown off the machine but momentarily, and these two last-mentioned cams are so located on the disk 60 that the power is thrown off only at the moment when the change in the knitting above described is taking place. The cam-lugs are of a length to be brought under the roller 62 to operate the lever 63 and to pass beyond it during the time that the pawl 44 (see Fig. 21) is making one stroke to partly turn the shaft 30 and its cams, the belt barely passing off the fast pulley before it is shifted back again. The cup-shaped bearing 4 supports the cam-ring 70, which is provided with bevel-teeth that are engaged by the teeth of the gear 8. This cam-ring, as has been hereinbefore mentioned, is revolved continuously to produce circular or round-and-round work or is given a rotary reciprocating motion to produce heel-and-toe work. While



doing the latter substantially one-half of the needles are first thrown out of action, and a portion of the remaining needles are then thrown out of action one by one to narrow and then restored in the reverse order to widen. Before describing the mechanism for doing this, however, I will first refer to the support and construction of the needle-cylinder 72, in the vertical grooves of which the needles 71 are fitted to reciprocate, each of said needles having a heel 73 to be operated upon by the knitting-cams, the picking-finger, and the cams for throwing part of the series of needles out of action and back again. As has been mentioned, the cup-shaped bearing 4 is supported by and below the bed 1 by the frame. The needle-cylinder extends through a central opening in the cam-ring (see Fig. 7) and rests upon an annular shoulder 74, formed upon a web-guide 75, which has a portion of one side cut away, as shown. The upper end of the said web-guide, which is cylindrical, extends within the needle-cylinder, and the lower end, which is also cylindrical, is steadied within a ring 76, secured to and supported by two rods or bars 77, which are bolted to and depend from the bottom of the cup-shaped bearing 4. The ring 76 is provided with a projecting lug or ear 78, (see Fig. 31 in connection with Figs. 2 and 3,) to which a block 79 is secured by means of a bolt 80. A stop consisting of a bolt 81 extends vertically through the inner end of the block and projects above the same. The web-guide 75 normally rests on the stop except when raised for lengthening the stitch, as will be described hereinafter, and said web-guide in turn supports the needle-cylinder by means of the shoulder 74. Owing to the stop 81 being adjustable in the block 79 the normal elevation of the needle-cylinder may be adjusted to alter the length of stitch.

The construction and operation of the knitting-cams will next be described.

A cam-web 82, which forms about three-fourths of a circle, (see Fig. 10 in connection with Figs. 5 to 9 and 13 to 16,) is formed at each end with an incline or cam 83 and is secured to the ring 70. The cams 83 act on the heels of the needles to raise them during the knitting operation, the said heels riding on the top of the web after being raised until acted on by one of the draw-cams, presently described. During straight or round-and-round knitting but one of the cams 83 acts, but on heel-and-toe work, when the cams are all given a rotary reciprocating movement, as before described, the two inclines or cams 83 act alternately to raise the needles. The two draw-cams 84 to lower the needles and draw the loops of yarn are substantially the same in construction (see Fig. 6 in connection with Figs. 5, 8, and 17) except that their cam-surfaces face in opposite directions toward each other. In Fig. 8 one of these cams is shown in the act of drawing down the needles at the right. Each cam 84

is formed on the end of a block 85, which is secured to a plate 86 on the inner end of a slide 87, said slide being fitted to reciprocate in a direction radial to the needle-cylinder in a guide-block 88, secured to the ring 70. A spring 89 is confined between the outer closed end of the block 88 and the slide, the latter being preferably hollow to permit a longer spring to be employed, as indicated by dotted lines in Fig. 6. The upper surfaces as well as the lower surfaces of the cams 84 are shown as inclined, the function of the upper inclines being to complete the raising of the needles after they have been acted upon by the picking-finger in heel-and-toe work. The faces of the blocks are substantially flat, (see Fig. 6,) and hence when one of the cams is traveling backward around the needle-cylinder it rides over the outer ends of the heels of needles, the spring 89 permitting the entire block and cam to be moved outward. In Fig. 6 one of the draw-cams is shown as pushed away from the needle-cylinder by this action, while the other cam is pushed toward the cylinder by its spring and the point of the cam is in position to engage the tops of the needle-heels and move them down. This is during round-and-round work. During heel-and-toe work the rotary reciprocating motion of the cam-ring causes first one cam 84 to operate, the other being pushed away as described, and then on the reverse movement the activity of the two cams 84 is reversed.

Having now described the knitting-cams and their operation, I will next refer to the means for rendering a series of the needles inactive when heel-and-toe work is to be commenced.

As indicated in Figs. 6, 7, and 16, substantially one-half of the needles are provided with heels longer than those of the other needles. The long-heel needles are the ones that are to be rendered inactive at the commencement of the heel-and-toe work and to remain so during said work. To do this, I provide a cam 90, (see Figs. 5 and 6 in connection with Figs. 7, 9, 10, and 16,) which travels in a plane entirely below the needle-heels during circular or round-and-round knitting, but which is adapted to be raised from that plane when the change to heel-and-toe work begins. Said cam 90 is secured to a block 91, rising from a segmental plate 92, which normally fits in a correspondingly-shaped space in the flange of the cam-web 82 and which is provided with a pin 93, extending down through the cam-ring 70 and through a long tubular bearing 94, depending from said ring 70. The lower end of the pin 93 is adapted to be acted upon in a vertical direction by a circular plate 95 within the cup-shaped bearing 4, the means for raising and lowering which at the commencement and end of heel-and-toe work, respectively, will be described hereinafter.

The block 91 and cam 90 are prevented from rotating on the axis of the pin 93 by the



inner edge of the segmental plate 92, which at all times is in contact with the outer side of the cam-web 82. (See Fig. 10.) By referring to Fig. 6 it will be seen that the cam 90 is at a distance from the cylinder sufficient to prevent its operating upon any of the short heels; but when said cam is elevated to the position shown in Fig. 9 it will elevate the long-heel needles from the position shown at the right of that figure to the position shown at the left of said figure, thus carrying them out of position to be operated by the draw-cams. The block 91 has also secured to it an arm 96, having the throwing-in cam 97 at the end thereof located to move in a path close to the cylinder, the acting face of this cam being indicated in Fig. 5<sup>a</sup> and by dotted lines in Fig. 5. This cam 97 when lowered engages the tops of the long heels and one short heel, as will be hereinafter described, and said cam when the block 91 is lowered at the end of the heel-and-toe work sweeps over the long heels and the single short heel and lowers the needles to position for circular work—that is, from the position shown at the left of Fig. 9 to the position shown at the right of that figure. A pin 98 projects from the cam 90 and is engaged by the outer end of a spring 99, the other end of which is secured to the flange of the cam-web 82. Said spring acts to depress the block 91 and cams when permitted by the descent of plate 95, as hereinafter described.

The mechanism for picking out the needles one by one and restoring them to activity in reverse order during the narrowing and widening in heel-and-toe work will next be described, reference being had particularly to Figs. 5, 6, 11 to 16, inclusive, and 18.

Mounted on the cam-ring 70 and rotating therewith is an arched standard 100, provided with an offset 101, in which is a vertical bore or recess 102, closed at the top, as shown in Fig. 14. A plunger 103 is fitted to slide and oscillate on its axis within said recess and is pressed downward by a spring 104, confined between the plunger and the top of the recess. To the lower end of this plunger the picking-finger 105 is pivoted, said plunger affording a support for the picking-finger and yielding vertically against the pressure of the spring 104, and the outer short end or heel 106 of the finger is held between two springs 107, secured to the standard or offset. (See Fig. 18.) These springs have a tendency to hold the picking-finger and the plunger in such position that the finger is radial to the needle-cylinder, but permit these parts to swing to either side of that position. The acting end of the picking-finger is formed somewhat in the form of an equal-armed cross, (see Fig. 32,) with two vertical lugs 108 and two horizontal lugs 109, which are adapted to act on the heels of the needles, as presently described. In order that the spring 104 may act to press the picking end of the finger upward, as shown in Figs. 5 and 14, or downward, as shown in Fig. 13, I provide a mov-

able support or fulcrum therefor, as at 110. This fulcrum 110 consists of a horizontal arm, having a sharp upper edge projecting from an elbow-lever 111, pivoted to the side of the standard-offset 101. The upper arm of the elbow-lever 111 is adapted to be acted upon by either one of the cams 112, fixed to a block 113, that is vertically movable at one side of the bed, as hereinafter described. The cams 112 have no movement other than a vertical one, and hence as the outer end of lever 111 sweeps around between them it may come in contact with one or the other, according to the elevation of the block 113 and the cams, and so cause the knife-edge fulcrum-arm to shift from the position shown in Fig. 13 to that shown in Fig. 14, or vice versa. The limit of movement of the fulcrum in one direction is imposed by its coming in contact with the outer side of the standard 100 and in the other direction by a stop 114, secured to one side of the offset 101, as shown in Figs. 5 and 18. To the feet of the standard 100 is secured a curved plate 115, (see Figs. 6, 13, 14, and 15,) having an opening through which the picker extends. This opening has two upper oppositely-inclined sides or cams 116 and two lower oppositely-inclined sides or slots 118, being formed as horizontal continuations of the opening at the ends of the cams. The operation of this portion of the machine is as follows: When narrowing is to be commenced at the heel or toe and after the cam 90 has raised all of the long-heel needles out of action, the block 113 is raised by mechanism hereinafter described and the lower cam 112 throws the elbow-lever 111, and consequently the picking-finger 105, into the position shown in Fig. 13. At the same time the motion of the cam-ring is changed from a continuous rotary to a rotary reciprocating movement by the means hereinbefore described and during which movement neither cam 90 nor cam 97 performs any function. As one side of the upper lug 108 of the picker comes in contact with the side of the butt of the first needle of the remaining series of needles, the end of the picker is stopped, (see Fig. 16;) but since the cam-ring continues to move, and with it the standard 100 and cam-plate 115, one of the lower cams 117 of the plate rides under the finger and elevates it, thus causing the upper surface of one of the lugs 109 of the picker to throw that needle up out of action. As the finger finally rides into the slot 118 of the plate 115, the swinging of the finger from a radial to a tangential position (see dotted lines in Fig. 16) causes the lugs of the finger to leave the butt of that needle and in the plane insured by the height of the slot 118. As soon as the finger leaves said needle the springs 104 and 107 cause it to assume the position indicated in Fig. 13 and by the full lines in Fig. 16, ready to engage and elevate a needle at the other end of the series. To prevent the finger from throwing a needle too high, a guard



119 (see Figs. 8, 13, and 17) is attached to one of the guide-blocks 88 and is curved in a horizontal plane across the space within which the picking-finger operates, said guard being sufficiently close to the needle-cylinder to act as a stop for the heels of the needles. When the needles are to be brought back again into action one by one for widening, the block 113 is lowered by mechanism hereinafter described and the upper cam reverses the position of the elbow-lever 111, resulting in moving the picker to the position shown in Figs. 5 and 14. Then the lower lug 108 of the picker and the under surfaces of the lugs 109 act on the butts of the needles one by one to depress them under the influence of the upper cams 116 of the plate 115 in the same manner as has been described in connection with the operation of elevating the needles. When all of the short-heel needles except one at each end of the series have been rendered active, the block 91 is lowered and the first complete rotation of ring 70 causes the cam 97 to throw in all of the elevated needles, which are the long-heel needles, and the two remaining short-heel needles, and round-and-round work is automatically resumed. The reason for throwing in the last two fashioning-needles simultaneously with the long-heel needles is to avoid leaving a small hole in the fabric each side of the heel. When all of the needles are down, the picking-finger engages none of the heels, for said finger is then in the position shown in Fig. 5, the block 113 and cams 112 being lowered at this time, as hereinafter described.

The web-holders or "sinkers," as they are sometimes termed, which cooperate with the needles and prevent the lifting of the web by the upward movement of the needles and help to draw the stitch, are indicated at 120. (See Figs. 7 and 30 in connection with Figs. 1, 4, and 5.) They are supported in radial grooves in a bed 121, which is secured to the needle-cylinder, as by screws 122, said bed having a horizontal flange 123, which forms the bearing for a ring 124, carrying the cams for reciprocating the web-holders. Said web-holders are or may be of the usual form at the inner ends; but their outer ends are formed as follows: Each web-holder has an upper shoulder 125, adapted to limit the inward movement thereof by abutting against the outer wall of the bed 121, and a lower shoulder 126, which is at a greater distance from the point of the web-holder than the shoulder 125 in order to leave a slight space between said shoulder 126 and the outer wall of the bed. This permits the cams which are carried by the ring 124 to enter said space easily to withdraw the holder. The outer ends of the web-holders are notched, as at 127, to receive an elastic band 128, which acts on all the web-holders to hold them inward and prevent their being thrown out by centrifugal force. Said band preferably consists of an endless coil of fine steel wire.

The cams which are carried by the ring 124 are shown in Fig. 4, in which 129 represents the double-ended cam for engaging the inner sides of the shoulders 126 for moving the web-holders outward during either direction of movement of the ring, and 130 represents the two cams also carried by the ring 124 for engaging the outer ends of the web-holders to retract them, aided by the action of the endless spring 128. Secured to the under side of the ring 124 are two blocks 131, the positions of which are indicated by dotted lines in Fig. 4 and between which a striker 132 extends, said striker projecting from a standard 133, (see Fig. 5,) which rises from and rotates or oscillates with the cam-ring 70. When the cam-ring 70 is revolving continuously, the striker engages but one of the blocks 131; but when oscillating the striker engages the two blocks alternately and reciprocates the ring. The space between the two blocks 131 corresponds somewhat with the space between the knitting-cams and permits of the web-holders and needles remaining at rest while the picking-finger is changing its position, as heretofore described. By pulling away the spring-band 128 either entirely or for portions at a time the web-holders may be easily withdrawn and replaced by others, if desired, or those which are used most continuously may replace those which are less worn on the other side of the machine, and vice versa.

The latch-guard ring 134 (see Figs. 4 and 5) is adapted to be swung up out of the way whenever desired, as when placing a new cuff on the needles or to enable the needles to be more readily examined without removing it from its support by the cam-ring 70. Said guard-ring 134 is formed as the central portion of an arm or lever 135, pivoted at 136 to the top of the standard 133, any suitable means being employed to retain the arm in a substantially upright position when raised. The front end of the arm 135 is adapted to rest when in operative position on the top of the offset portion of the standard 100, which is provided with two upwardly-extending plates 137, (see Figs. 5 and 18,) between which the arm 135 is confined. These two plates 137, in conjunction with the pivotal connection with standard 133, insure the retention of the lever or arm 135 and guard-ring 134 in proper position during the operation of the machine.

The yarn-changing devices are carried by the lever 135 and are particularly simple and efficient in construction and operation. The upper surface of the outer end of the lever or arm 135 is formed with suitable guideways for two slides 138 and 139, one having a yarn-guide eye 140 at its inner end and an upwardly-projecting pin having a roller 141 at its outer end and the other slide having a yarn-guide eye 142 at its inner end and a downwardly-projecting pin having a roller 143 at its outer end. Each slide is provided with a rigid outwardly or laterally projecting arm



144, against which the ends of a lever 145 bear. Said lever 145 is pivoted to the guard-ring arm between the two slides, and hence when one slide is pushed in its arm 144 acts through the lever 145 and the other arm 144 to push the other slide out. The inner ends of the slides are provided each with a raised portion or stop 146, adapted to abut against a fixed stop 147 between the slides to limit the outward movement of said slides. Stops 148 are also affixed to the guard-ring arm and project laterally or in opposite directions from the slides to limit the movements of the lever 145. The means for automatically reversing the positions of the two guide-eyes to change the yarn when changing from circular to heel-and-toe work will be described presently.

By having the arms 144 and the stops 148 project laterally away from the slides the ends of said arms and stops are located at sufficient distances from said slides to enable a lever 145 of considerable length to be employed, the slides themselves being located very close together, so as to bring the guide-eyes 140 as near to each other as possible. This construction, including the lever of extended length, enables the alternate positions of the slides and guide-eyes to be fixed with accuracy.

The curved web-guide 149 (see Fig. 4) is formed at the outer end of a spring-arm 150, secured to the arm 135 back of the latch-ring, as indicated at 151 in Fig. 5. A recess 152 is formed in the edge of the web-guide, said recess having hooked ends to retain the yarn which is not being knitted in position for use again when the next change is made.

Referring now to Figs. 4, 11, and 12, I will describe the means for causing the yarn-guide eyes to change position. A plate 153 is secured to the bed 1 of the machine and has a vertical sleeve-bearing 154 extending over and below said bed. (See Fig. 1.) Said bearing is for a lift-rod 155, the lower end of which bears upon and is operated by a lever 156, the control of which will be hereinafter described. To the upper end of the lift-rod is secured a sleeve 157, having an arm 158, carrying a block 159, to the upper and lower surfaces of which are secured plates having cam-shaped edges 160. Said cams 160 are so spaced that one or the other of the rollers 141 and 143 of the yarn-changing slides may sweep between them when no change in the yarn is to be effected; but when the yarn-guide slides are to be shifted from the positions shown in Figs. 4 and 5 the lift-rod 155 is acted upon by the lever 156 to raise the block 159 and bring the lower cam 160 into the path of movement of the roller 143, which, moving over the edge of said cam, reverses the positions of the guide-eyes hereinbefore described. A guide-pin 161 rises from the plate 153 and extends through the block 159 to hold said block and the cams 160 against lateral movement. When the yarn-guides are to be shifted back again, the rod 155 is lowered to nor-

mal position and brings the upper cam 160 into the path of movement of the roller 141 of the now-projected slide 138, and thus again effect the change of yarn.

The figures of the drawings which have just been referred to also illustrate the means for shifting the cams 112, which change the operation of the picking-finger 105, heretofore described. The block 113, carrying the cams 112, is supported by an arm 162, projecting from a sleeve 163, loosely mounted on the lift-rod 155. The guide-pin 161 passes through the arm 162 to steady it, as well as the block 159. A pin 164, projecting from the arm 162, is normally engaged by a lug 165, carried by a spring 166, the upper end of which is secured to a lug 167, projecting from the arm 158. The side of lug 165 is inclined, as at 168, and below this incline the lower end of the spring 166 is curved or inclined, as at 169, under the end of a finger 170, fixed to the plate 153. To render the operation of this part of the mechanism more clear, it is necessary to state here what will be more fully described hereinafter—viz., that the cams which act on the lift-rod 155 impart two elevations to it for each narrowing and widening operation, during which time the yarn is changed. The first lift of the rod 155 elevates the block 159 and cams 160 and changes the yarn as above described. At the same time through the medium of the spring 166, its lug 165, and the pin 164 the block 113 is elevated, and this brings the picking-finger into operation for narrowing, as has been hereinbefore described. Of course the timing of the operation of other parts is such that simultaneously the needles having the long heels are thrown out of action and the rotary reciprocating motion of the knitting-cams takes the place of the continuous motion. When the narrowing is completed, the lift-rod 155 is given a short elevation above the plane of the first, giving to the arm 158 what may be termed a "hitch." This is but momentary, but it serves to draw the curved lower end 169 of the spring 166 upward over, but not entirely above, the end of the fixed finger 170, which pushes the spring outward sufficiently to carry the lug 165 out from under the pin 164 of the arm 162. The arm 162 and its block and cams 112 immediately drop and cause the operation of the picking-finger to begin restoring the needles for widening, as has been hereinbefore described. The second elevation or hitch of the lift-rod is for this purpose only, and the position of the cams 160 is not so changed as to shift the yarn-guides, for the same yarn is used in widening as in narrowing. Simultaneously, however, with the resumption of continuous rotary motion of the knitting-cams and the restoration of all the needles to positions of activity the lift-rod descends to its normal position and the upper cam 160 effects the change of the yarn to the color and quality preferred for the round-and-round work and the inclined lower side 168 of the lug 165 rides



down over the pin 164 and then the lug snaps under said pin, ready for the next operation. The picking-finger is left turned upward, as indicated in Fig. 5; but there being no needles with their heels in a plane to be engaged by the said finger the latter remains out of operation until the next change, as described.

The means for effecting the elevation of the lift-rod and of the plate 95 and of the needle-cylinder will next be described.

Secured to the shaft 30 at the opposite end thereof from the belt-shipping disk 60 is a disk 171, to which two sets of cams are attached. (See Figs. 2, 3, 23, 24, and 25.) To this disk are attached two similar plates or ears 172, the operative edges or surfaces of which are offset, so as to stand some little distance away from the disk itself. (See Fig. 25.) Each of these plates or ears is formed with a cam-surface 173, a portion 174, which is concentric with the axis of shaft 30, and a cam-lug 175 near the rear end of the plate.

The lever 156 hereinbefore described and which operates the lift-rod is pivoted on the shaft 26 and has its front beveled end 176 in the path of movement of the cams 173 and 175. The cam 173 imparts the first elevation to the lift-rod, while the cam 175 gives it the second elevation or hitch before referred to, after which the end 176 of the lever passes to the short section of plate 172 behind the cam 175 and at the next advance of the disk it passes off the plate 172 and to the position shown in Fig. 3.

Rigidly connected with the lever 156, so as to oscillate therewith, is an upwardly-projecting arm 177, having its end formed with two steps 178 180, connected by an incline or cam 179. (See Fig. 3.) A spring 181, secured to the bearing for the lever 156 and arm 177, bears against a pin 182, projecting from the arm 177, and tends to hold said arm and the lever 156 in the position shown in Fig. 3, a stop 183, projecting from the ring 76, serving to limit the movement of said lever and arm toward the left in said figure.

The circular plate 95, which, as hereinbefore stated, rises and falls to control the action of the cams 90 and 97, is secured to a rod 184, which is adapted to slide vertically through an opening in the cup-shaped bearing 4 and in a guide 185, carried by one of the bars 77. The lower end of the slide-rod 184 rests on the upper end of the arm 177, and as the latter oscillates passes from step 178 to step 180 over the incline 179, or vice versa. The action of these parts is so timed that the circular plate 95 is elevated to render inactive the needles having the long heels simultaneously with the first elevation of the lift-rod 155 by cam 173, which, as before stated, causes the change of yarn and the commencement of operation of the picker-finger; but when the lift-rod is given its second elevation or hitch by means of cam-lug 175 the step 178 simply moves slightly across the lower end of the slide-rod 184 without af-

fecting the elevation of the circular plate 95. The disk 171 carries also two segments 186, each having a cam-surface 187 at one end adapted to act upon a block 188, carried by a lever 189, pivoted at 190 to the frame of the machine and having a lug 191, adapted to bear against the lower edge of the web-guide 75 when the latter is to be lifted to elevate the needle-cylinder, as hereinbefore mentioned. In order to adjust the amount of elevation that may be imparted to the web-holder and needle-cylinder by the cams, the block 188 is adjustably connected with the lever 189. As shown in Fig. 3, said block is carried by a plate-spring 192, attached at 193 to the under side of the lever, a screw 194 being tapped through the lever and bearing on the free end of said plate-spring. As indicated in Figs. 2 and 25, the cam-segments 186 are secured close to the disk 171, so that when the block 188 is not being acted on by said segments it will ride along the edge of said disk.

The needle-cylinder 72, as has been stated, rests upon the shoulder 74 of the web-guide 75. (See Fig. 7.) The upper end of the latter is surrounded by the needle-cylinder, and the fit is such that the cylinder could be rotated upon its seat if not locked. In order to prevent accidents from arising from any disarrangement of the cams carried by the ring 70 relatively to the needles, I provide a yielding lock for securing the needle-cylinder to the upper end of the web-guide. This lock, as shown in Figs. 7, 27, and 28, consists of a spring-bar 195, secured to the inner wall of the web-guide and having a wedge-shaped lug 196 at its upper end, which lug extends through an opening in the web-guide and into a tapered recess 197 in the inner wall of the needle-cylinder. The bar 195 may be yielding throughout its length, but preferably its point of chief elasticity is near the lower end, as at 198. The upper end of the bar 195 rests in a vertical groove 199 in the inner wall of the web-guide 75, and said bar and its lug 196 form a lock to prevent rotation of the needle-cylinder on the web-guide; but should a needle offer an obstruction to the passage of a cam or if for that or any other reason such an obstruction is caused as might break a cam or break away the ribs of the cylinder between the needles the inclined side of the recess 197 will act on the side of the lug 196 and force it inward, thus unlocking the cylinder from its support and permitting it to rotate. In order that the wedge-shaped lug may be held in its recess with greater or less force, the lower end of the bar 195 is formed with a shoulder or lug 200, and screws 201 pass through the bar above and below said lug. By loosening one screw and turning in the other the bar is rocked on its lug 200 as a fulcrum, and thus forces the lug 196 more or less into the recess of the needle-cylinder. This automatic or self-releasing lock permits the needle-cylinder to be turned readily by



hand whenever it may be desired to remove any needles or sinkers or replace them in a portion of the cylinder that would otherwise be difficult of access, and this can be done by simply using a little force with the hands in starting the cylinder around without removing or replacing any part or pieces of the machine or frame. It will be observed also that my construction of the needle-cylinder and cams is such that no casing or other parts require removal in order to give access to needles or sinkers. It has already been described how the sinkers may be removed, and it need only be added that any needle may be removed by first pulling it up until its lower end is above the cam-rib 82 and then taking hold of the heel of that needle and drawing it outward and downward.

One of the yarn-bobbins 202 is shown in Fig. 1 as supported on a shelf or plate 203, carried by a bracket 204, attached to the frame of the machine. The other yarn-bobbin 205 is supported in a rotary manner above the needle-cylinder by the following means: A standard 206 is suitably attached to the frame and is provided with an arm 207 at its upper end, to the outer end of which arm a bar 208 is pivotally connected in any suitable manner. From the ends of this bar two rods 209 depend and are connected to a circular plate or table 210 at their lower ends. This table supports the upper bobbin. To steady it, a ring 211 surrounds the table, said ring being supported at one edge by a sleeve 212, connected to the standard 206. A leg 213, rising from the ring 70, is connected with the table 210 to rotate the latter and the bobbin thereon during knitting. The two yarns pass through suitable guides and take-up devices. In Fig. 29 a guide 214 is shown for the yarn from the lower bobbin, another guide (not shown) being carried at the end of the arm 207. In said Fig. 29 one form of take-up is shown connected to one of the rods 209, said take-up consisting of a spring-operated arm 215, having a suitable eye for the yarn, other eyes for the yarn being carried by the lower end of an arm 216, carried by said rod 209. The take-up, however, forms no part of my present invention and may be of any well-known or preferred type.

Having described the operation of the several parts of my machine in connection with the detailed description of the construction thereof, reference to the general operation will be unnecessary further than to mention in connection with Figs. 34 and 35 that the cuff *a*, which, as usual, is knitted on a cuff-knitting machine, is placed on the needles by means of a transferrer and circular knitting at *b* proceeds to the point *c*. Then narrowing begins and continues to the point *d*, and from there the knitting widens to the point *e*, when circular knitting is continued to form the foot portion *f*. At *g* narrowing again begins and continues to the point *h*, from whence it again widens to the point *i*, when after knitting a

few courses the machine automatically stops. The operator then breaks off the yarn and by means of the crank 11 turns cam-ring 70 one revolution forward, which disengages the needles from the stocking, so that it may be removed, and then moves the crank backward slightly, which through the engagement of the heels of the needles with the inner face of the block 85 last in operation forces said block out of operative position and permits the corresponding cam 83 to raise the needles so that their upper ends will be on a level or in a single plane corresponding with the upper extreme or limit of reciprocations of the needles when knitting and in position to receive another cuff. In other words, the needles are leveled in the upper knitting-path. After the stocking has been removed from the machine the edges *i* and *k* may be united in the usual or any preferred manner.

Having now described my invention, I claim—

1. A knitting-machine comprising in its construction needles, mechanism for reciprocating them, a single picker, a vertically-yielding support therefor, and a pivotal connection between the picker and support.

2. A knitting-machine comprising in its construction needles, mechanism for reciprocating them, a single picker mounted on an adjustable fulcrum and adapted to render them inactive one by one and to restore them to activity, and means for shifting said fulcrum to reverse the operation of the picker.

3. A knitting-machine comprising in its construction a circular series of needles a portion of which have heels longer than the others, means for simultaneously rendering all of the long-heel needles inactive, and means for successively retiring some of the short-heel needles from and restoring them to activity, said means comprising a single picker, a vertically-yielding support therefor, a pivotal connection between the picker and support, and an adjustable fulcrum for the picker.

4. A knitting-machine comprising in its construction a circular series of needles a portion of which have heels longer than the others, means for simultaneously rendering all of the long-heel needles inactive, a single picker adapted to render some of the short-heel needles successively inactive and to restore them to activity, a vertically-yielding support for the picker, a pivotal connection between the picker and support, and an adjustable fulcrum for the picker.

5. A knitting-machine comprising in its construction a rotary cam-ring having a vertically-movable cam mounted thereon, a cup-shaped bearing for said ring, and a vertically-movable plate inclosed within said bearing and adapted to control the elevation of said cam.

6. In a knitting-machine, the combination with the cup-shaped bearing supported by the frame, of the ring 70 supported by said



bearing and carrying independently-movable cams, and cam-operating mechanism inclosed in said bearing below the ring 70.

7. A knitting-machine comprising in its construction a main shaft having a single driving or fast pulley and a single loose pulley adjacent thereto, a shipper for shifting a driving-belt from one to the other, and a disk having a plurality of cam-lugs of different thickness for automatically operating the shipper temporarily during the operation of the machine and for completely operating the shipper at the completion of the knitting.

8. In a knitting-machine, the combination with shaft 30, and means for rotating it, of the disk 50 secured thereon and having a series of grooves 51 formed across its periphery in alternately opposite directions, a clutch and gearing for controlling the operation of parts of the machine, a yielding pivoted arm 53 having connections for operating the clutch, and having its lower end adapted to successively pass through the grooves in the disk 50, said arm normally tending in a direction toward the center of the face of the disk.

9. In a knitting-machine, the combination with shaft 30 and means for rotating it, of the disk 50 secured thereon and having a series of grooves 51 formed across its periphery in alternately opposite directions, a clutch and gearing for controlling the operation of parts of the machine, a rock-shaft having a yoke for operating the clutch, and a spring-arm 53 connected with said rock-shaft and having its lower end engaging the sides or grooves of the disk 50.

10. In a knitting-machine, the combination with the main shaft having fast and loose pulleys 10 and 12, of a belt-shifting lever 63 having a pin or roller 62, the intermittently-rotated shaft 30 having disk 60, a plurality of cams 61 on said disk for engaging the pin or roller 62, one of said cams being thicker than the others, and a spring-catch to engage and hold the lever when operated by the thickest cam.

11. In a knitting-machine, the combination with the ring 76 supported by the frame of the machine and carrying an adjustable stop 81, of the web-guide 75 supporting the needle-cylinder and adapted to rest on said stop, a lever for engaging the web-guide to elevate it and the needle-cylinder, and means for operating said lever.

12. A knitting-machine comprising in its construction a cam-ring carrying needle-elevating and draw cams, the latter being adapted to yield in a radial direction to ride over the ends of the needle-heels when moving backward.

13. A knitting-machine comprising in its construction a cam-ring carrying a curved web having inclined ends for raising the needles, and a pair of draw-cams yieldingly mounted on the ring and having surfaces adapted to be acted on by the ends of the needle-heels to

move said draw-cams away from the needle-cylinder when rotating backward.

14. In a knitting-machine, the combination with the cam-ring 70 carrying the web 82 having cams 83, of the draw-cams 84 mounted on slides 87 guided by the ring, and springs adapted to yieldingly press said cams toward the needle-cylinder.

15. In a knitting-machine, the combination with the cam-ring 70 carrying the web 82 having cams 83, of the guides 88 mounted on the ring, the spring-pressed slides 87 in said guides, and draw-cams carried by said slides.

16. In a knitting-machine, the combination with the cam-ring 70 carrying the web 82 having cams 83, of the guides 88 mounted on the ring, the spring-pressed slides 87 in said guides, and flat-faced blocks 85 carried by said slides and adapted to ride over the ends of the needle-heels when moving in one direction, each of said blocks 85 having a portion 84 provided with a cam-surface to act on the tops of the needle-heels when moving in the other direction.

17. A knitting-machine comprising in its construction a needle-cylinder and a series of needles a portion of which have heels longer than those of the remaining needles, and a cam adapted to rotate about the cylinder in a plane below the needle-heels and to be moved to a higher plane of rotation, said cam being arranged at a distance from the cylinder to escape the short-heel needles but to engage and elevate the long-heel needles out of action, said cam carrying with it another cam adapted to engage the long heels to return them to their lower positions.

18. In a knitting-machine, the combination with the cylinder having needles with long and short heels, of the cam-ring 70, a cam 90 mounted on a vertically-movable support carried by said ring, and means for raising and lowering said support.

19. In a knitting-machine, the combination with the cylinder having needles with long and short heels, of the cam-ring 70, a cam 90 mounted on a vertically-movable support carried by said ring, and a cam 97 also carried by said support.

20. In a knitting-machine, the combination with the cylinder having needles with long and short heels, of the cam-ring 70, a plate 92 having a pin 93 projecting through and below the ring, a cam 90 carried by the plate 92, and a circular plate 95 below the path of movement of the pin 93 and means for raising and lowering said plate.

21. In a knitting-machine, the combination with the cylinder having needles with long and short heels, of the cam-ring 70, a plate 92 having a pin 93 projecting through and below the ring, a cam 90 carried by the plate 92, an arm 96 having a cam 97 also carried by the plate 92, and a circular plate 95 below the path of movement of the pin 93 and means for raising and lowering said plate.



22. A knitting-machine comprising in its construction a series of needles some of which have longer heels than the others, a picker having a yielding universal-joint connection with a non-reversible support movable past the needles, said picker having horizontal lugs or shoulders at its end and a vertical lug or shoulder above and below the horizontal lugs to engage the needle-heels and means for causing said picker to swing in an inclined direction.

23. In a knitting-machine, the combination with the needles some of which have shorter heels than the others, of the ring 70, a standard carried thereby, the picking-finger 105 having a yielding universal-joint connection with the standard and having its face provided with two vertical and two horizontal lugs, and the cam-plate 115 having a plurality of cam-surfaces to guide the finger in its swinging movements.

24. In a knitting-machine, the combination with the needles some of which have shorter heels than the others, of the ring 70, a standard carried thereby and having a vertical recess, the spring-depressed plunger 103 in said recess, the picker 105 pivoted to said plunger, a fulcrum for said picker, spring connections for normally holding the picker in intermediate lateral position, and the cam-plate 115 having a plurality of cam-surfaces to guide the finger in its swinging movements.

25. In a knitting-machine, the combination with the needles some of which have shorter heels than the others, of the ring 70, a standard carried thereby and having a vertical recess, the spring-depressed plunger 103 in said recess, the picker 105 pivoted to said plunger, a movable fulcrum for said picker, spring connections for normally holding the picker in intermediate lateral position, and the cam-plate 115 having a plurality of cam-surfaces to guide the finger in its swinging movements.

26. In a knitting-machine, the combination with the needles some of which have shorter heels than the others, of the ring 70, a standard carried thereby and having a vertical recess, the spring-depressed plunger 103 in said recess, the picker 105 pivoted to said plunger, a lever 111 pivoted to the standard and having a fulcrum 110 for the picker, means for automatically changing the position of the lever 111 and the fulcrum, springs for holding the picker in intermediate lateral position, and the cam-plate 115 having a plurality of cam-surfaces to guide the finger in its swinging movements.

27. In a knitting-machine, the combination with the needles some of which have shorter heels than the others, of the ring 70, carrying the plate 115 having an opening formed with upper and lower inclined edges 116 and 117 and horizontal slots 118, and a picker 105 having a yielding universal-joint connection with the ring and extending through the opening in plate 115 and provided with faces at its

end to act on the sides and upper and lower edges of the heels of the needles.

28. In a knitting-machine, the combination with the needles some of which have shorter heels than the others, of the ring 70, a standard carried thereby, the picking-finger 105 having a yielding universal-joint connection with the standard and having its face provided with two vertical and two horizontal lugs, a cam-plate for guiding the finger in an inclined direction, and a guard 119 for limiting the upward movement of the needles under the impulse of the picking-finger.

29. In a knitting-machine, the combination with the sinker-bed 121 secured to the needle-cylinder and having flange 123 of the cam-ring 124 mounted on said flange, means for rotating said ring, sinkers guided in the bed 121 and having upper and lower shoulders at different distances from their ends, the upper shoulders being adapted to limit the inward movements of the sinkers, a double cam 129 carried by ring 124 and adapted to act on the lower shoulders of the sinkers to move them outward and cams 130 carried by the ring to move them inward.

30. A knitting-machine comprising in its construction a needle-cylinder and latch-needles mounted therein, and a pivoted latch-guard ring and yarn-changing-device support adapted to be swung out of position.

31. In a knitting-machine, the combination with the needle-cylinder and latch-needles carried thereby, of a standard mounted to rotate around the cylinder, the arm 135 carrying yarn-changing devices and the latch-guard ring 134 and pivoted to said standard, and means for supporting the other end of the arm 135.

32. In a knitting-machine, the combination with the needle-cylinder and latch-needles carried thereby, of a standard mounted to rotate around the cylinder, the arm 135 carrying yarn-changing devices and the latch-guard ring 134 and pivoted to said standard, the standard 101 opposite the first-mentioned standard, and guide-plates for the end of the arm on the standard 101.

33. In a knitting-machine, the combination with the slides 138 and 139 having yarn-guide eyes at one end and laterally-projecting arms 144 near their outer ends, a support for said slides, the lever 145 pivoted to said support and extending between the arms 144, means for directly moving one or the other of said slides inward, and laterally-projecting stops for limiting the movement of the lever 145 and the slides.

34. In a knitting-machine, the combination with the slides 138 and 139 having yarn-guide eyes at one end and laterally-projecting arms 144 near their outer ends, a support for said slides, the lever 145 pivoted to said support and extending between the arms 144, means for directly moving one or the other of said slides inward, stops 146 carried by the slides,



a fixed stop 147, and laterally-projecting fixed stops 148 for the ends of the lever 145.

35. In a knitting-machine, the combination with the needle-cylinder and needles and yarn-changing devices, of the hinged arm 135 and a curved web-guide 149 carried by said arm and having a recess 152 in its outer edge to hold one of the yarns when not in use.

36. In a knitting-machine, the combination with the needle-cylinder and needles and yarn-changing devices, of the hinged arm 135 and a curved web-guide 149 carried by said arm and having a recess 152 in its outer edge, said recess having hooked ends to prevent the escape from said recess of the yarn which is not in use.

37. In a knitting-machine, the combination with the yarn-changing slides 138 and 139, having rolls projecting upward and downward respectively, of a pair of cam-plates 160 adapted to be moved into and out of the path of movement of the outer ends of the slides, and means for automatically shifting the position of said cam-plates.

38. In a knitting-machine, the combination with the yarn-changing slides 138 and 139, having rolls projecting upward and downward respectively, of a pair of cam-plates 160, a vertically-movable rod 155 for lifting and lowering the cam-plates, and an automatically-controlled lever for elevating the rod 155.

39. In a knitting-machine, the combination with the rod 155 and means for moving it vertically, of the cam-plates 160 carried thereby, the cams 113 having a sleeved connection with said rod and adapted to be elevated thereby, and yarn-changing and needle-operating devices controlled by said cams.

40. In a knitting-machine, the combination with the rod 155 and means for moving it vertically, of the cam-plates 160 carried thereby, the cams 113 having a sleeved connection with said rod, a yielding connection whereby the elevation of the cams 160 first elevates the cams 113 and then permits the latter to drop, and yarn-changing and needle-operating devices controlled by said cams.

41. In a knitting-machine, the combination with the vertically-movable rod 155, of the arm 158 secured thereto and carrying cams 160, the arm 162 carrying cams 112 and sleeved on the rod, connections whereby the latter is elevated by the movement of the arm 158, and a guide-pin 161 for preventing rotary movement of the arms and their cams.

42. In a knitting-machine, the combination with the vertically-movable rod 155 and means for giving it two elevations, of the cam-carrying arms 158 and 162, respectively secured to and sleeved on the rod, and a separable connection between the two arms whereby the first elevation of the rod lifts both arms together and the second elevation separates the connection and permits the lower arm to descend.

43. In a knitting-machine, the combination with the vertically-movable rod 155 and means

for giving it two elevations, of the cam-carrying arms 158 and 162, respectively secured to and sleeved on the rod, a pin 164 projecting from the arm 162, a spring 166 connected with the arm 158 and having a lug 165 adapted to engage the pin 164 and having an inclined lower side 168, and means for automatically releasing the lug from the pin after it has been raised a predetermined distance.

44. In a knitting-machine, the combination with the vertically-movable rod 155 and means for giving it two elevations, of the cam-carrying arms 158 and 162, respectively secured to and sleeved on the rod, a pin 164 projecting from the arm 162, a spring 166 connected with the arm 158 and having a lug 165 adapted to engage the pin 164 and having an inclined lower side 168, the said spring having a curved lower end 169, and a finger 170 over which the end 169 moves to release the lug 165 from the pin 164.

45. In a knitting-machine, the combination with the shaft 30 carrying cams 173, 175, of the lever 156 having an arm 177 provided with steps 178 and 180, a throwing-out cam 90 vertically movable by means of a downwardly-projecting pin 93, and the plate 95 having a rod 184 resting on the upper end of the arm 177.

46. In a knitting-machine, the combination with the shaft 30 carrying cams 173, 175, of the lever 156 extending rearwardly, the sliding rod 155 resting on said lever, vertically-movable cams connected with said rod for controlling the operation of parts of the machine, an arm 177 of the lever 156 provided with steps 178 and 180 at its upper end, and a throwing-out cam controlled by the movements of said arm 177.

47. In a knitting-machine, the combination with the needle-cylinder and a support therefor, the former having a recess with tapering sides, of a yielding bar secured to the support and having a tapered lug extending through an opening in the support into the recess of the cylinder, the said bar having a lug or projection 200 near its end resting against the inner wall of the support, and screws 201 for adjusting the pressure exerted by said bar and lug.

48. A knitting-machine comprising in its construction needles, mechanism for reciprocating them, and a cam for leveling all the needles in a single plane corresponding with one of the two extremes of reciprocation of the needles when knitting.

49. A knitting-machine comprising in its construction needles, mechanism for reciprocating them, automatic stop devices for stopping the machine when a stocking is completed, and cam mechanism for leveling all the needles after their disengagement from the stocking in a single plane corresponding with the upper limit of reciprocations of the needles when knitting.

50. A knitting-machine comprising in its construction a circular series of needles, cams for reciprocating them, means for automat-



ically stopping the machine when a stocking  
is completed, and means for operating the  
cams by hand after the completion of a stock-  
ing to first permit the needles to be disengaged  
5 from the stocking and then arrange them  
in a uniform plane, corresponding with the  
upper limit of reciprocations of the needles  
when knitting, to receive the cuff of the next  
stocking.

10 51. A knitting-machine comprising in its  
construction a circular series of needles, and

cams for reciprocating them, the draw-cams  
being mounted to yield outwardly from the  
needles and having flattened inner faces  
adapted to ride over the outer ends of the 15  
heels of the needles when traveling backward.

In testimony whereof I affix my signature  
in presence of two witnesses.

JOSHUA D. HEMPHILL

Witnesses:

A. M. WOOSTER,

A. M. WITHERELL.