

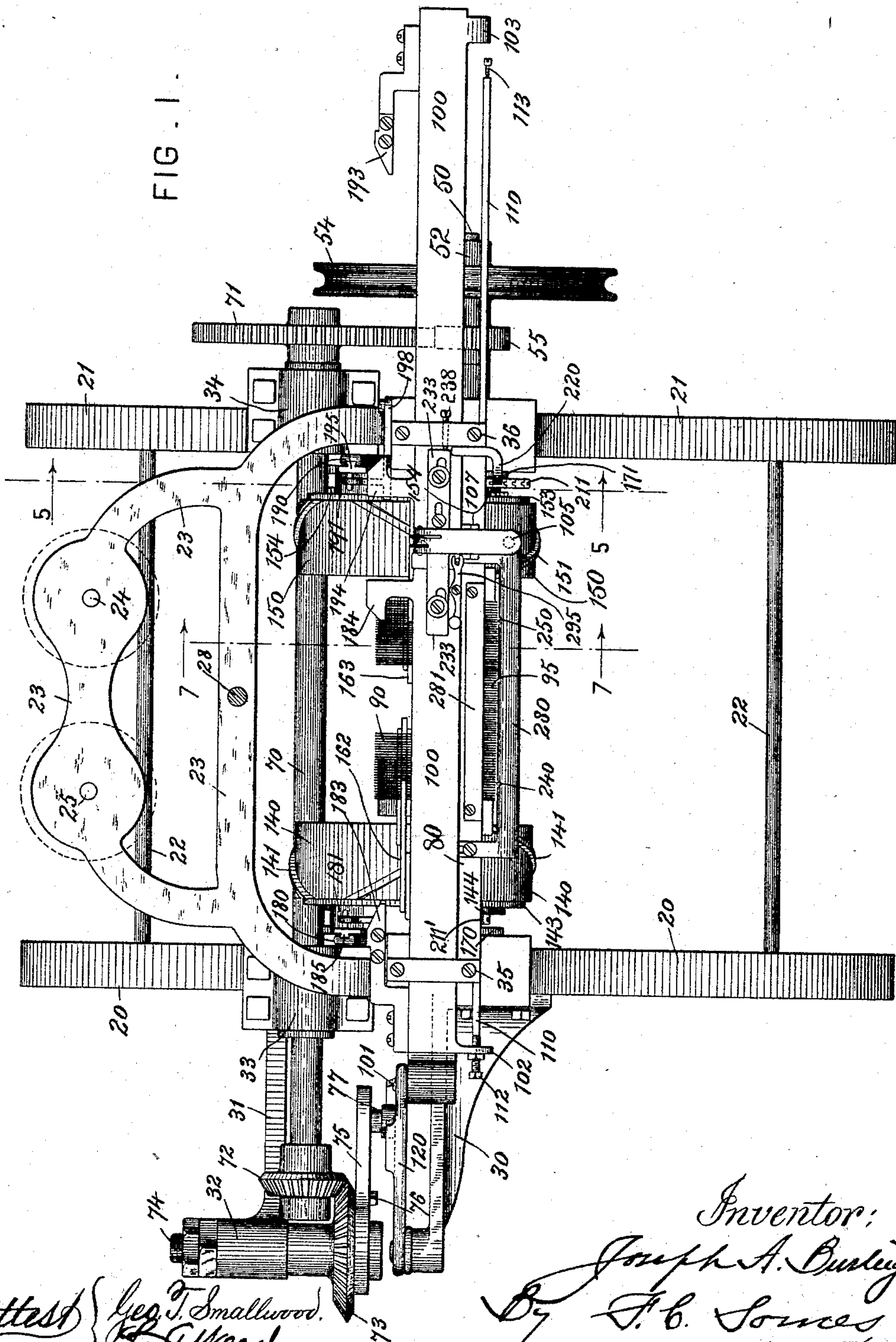
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9 Sheets—Sheet 1.

J. A. BURLEIGH.
KNITTING MACHINE.

No. 497,118.

Patented May 9, 1893.



Attest { Geo. T. Smallwood.
L. Weed

Inventor:
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Attorney.

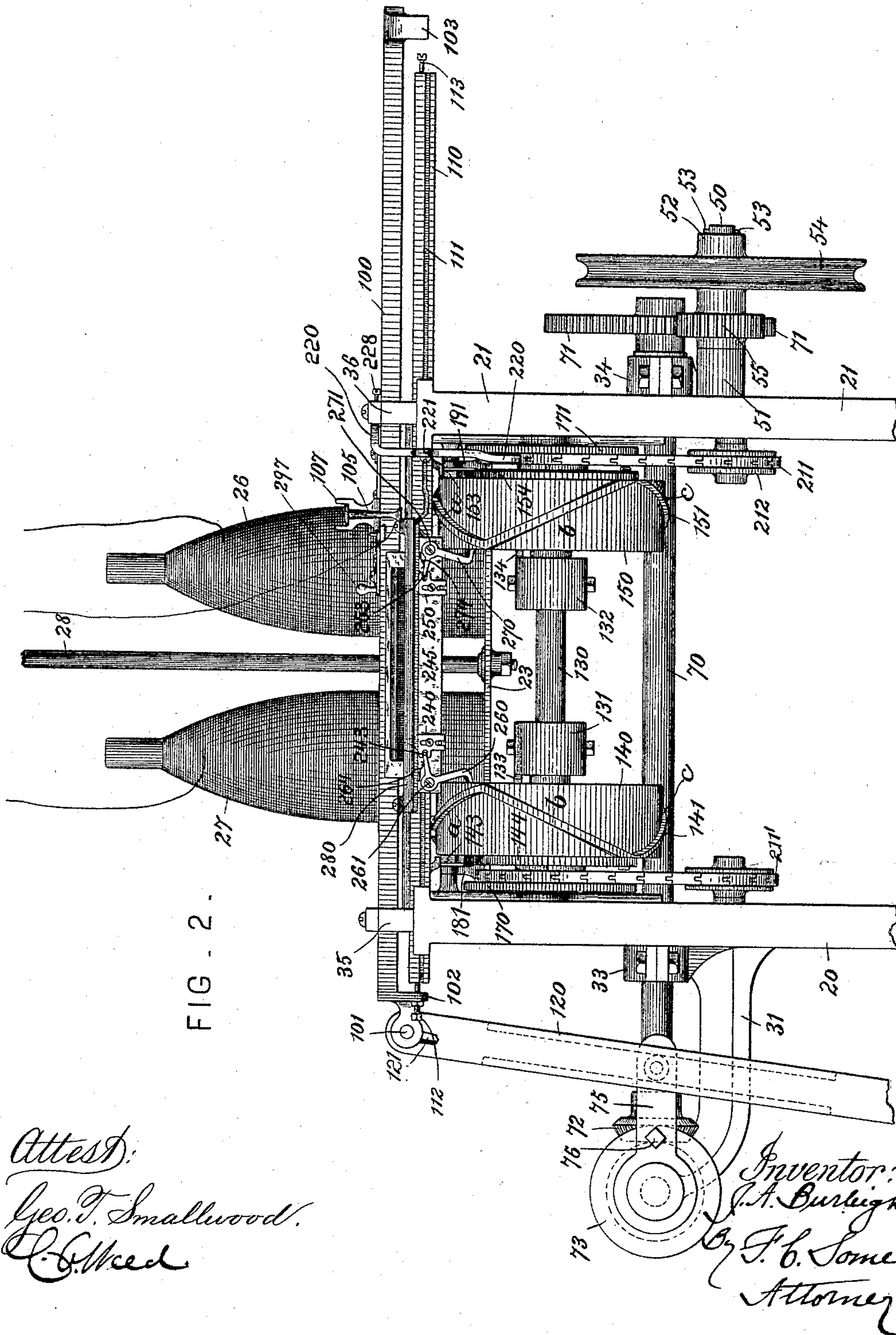
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9 Sheets—Sheet 2.

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Patented May 9, 1893.



THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.)

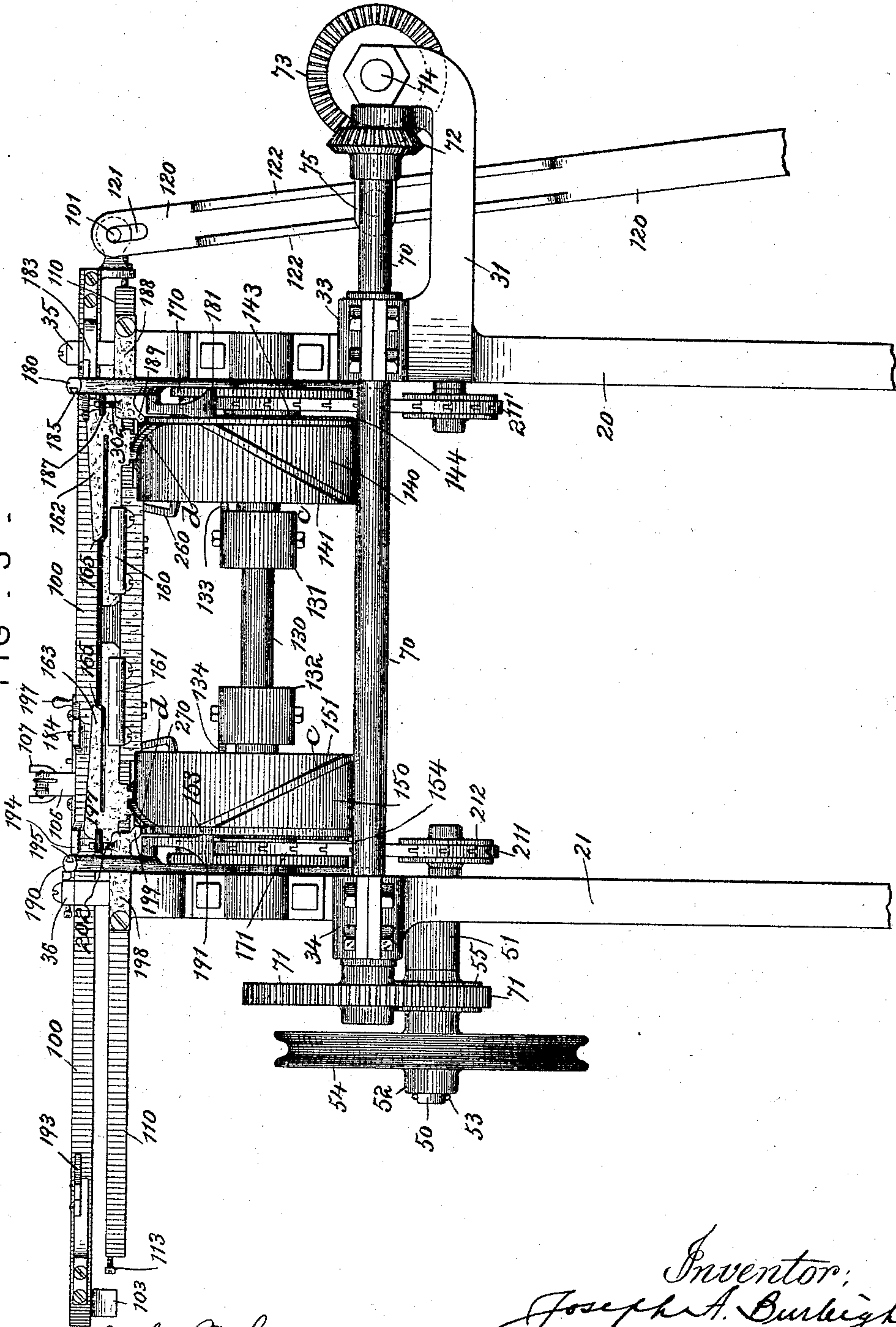
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J. A. BURLEIGH.
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FIG. 3



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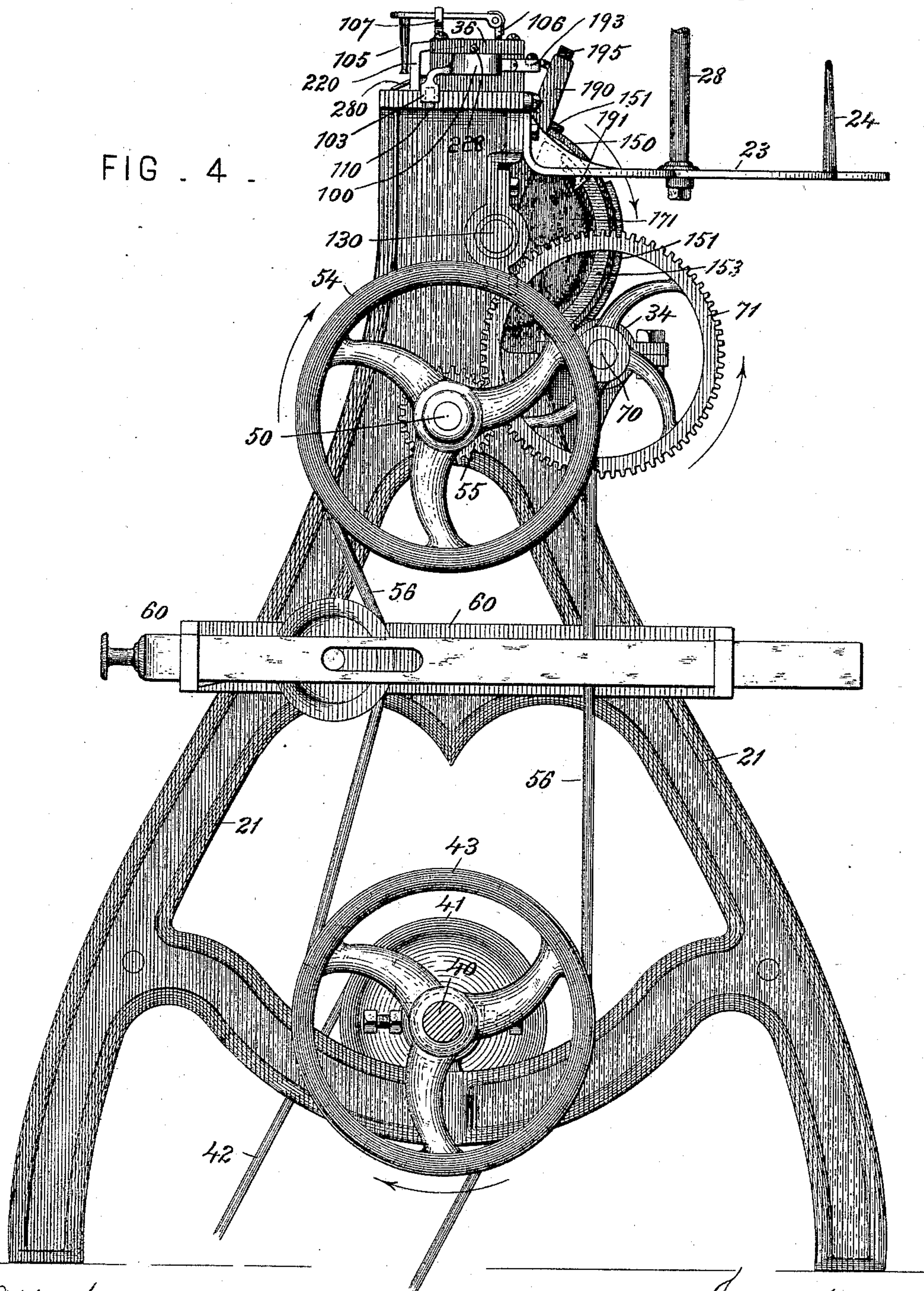
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FIG. 4.



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J. A. BURLEIGH.
KNITTING MACHINE.

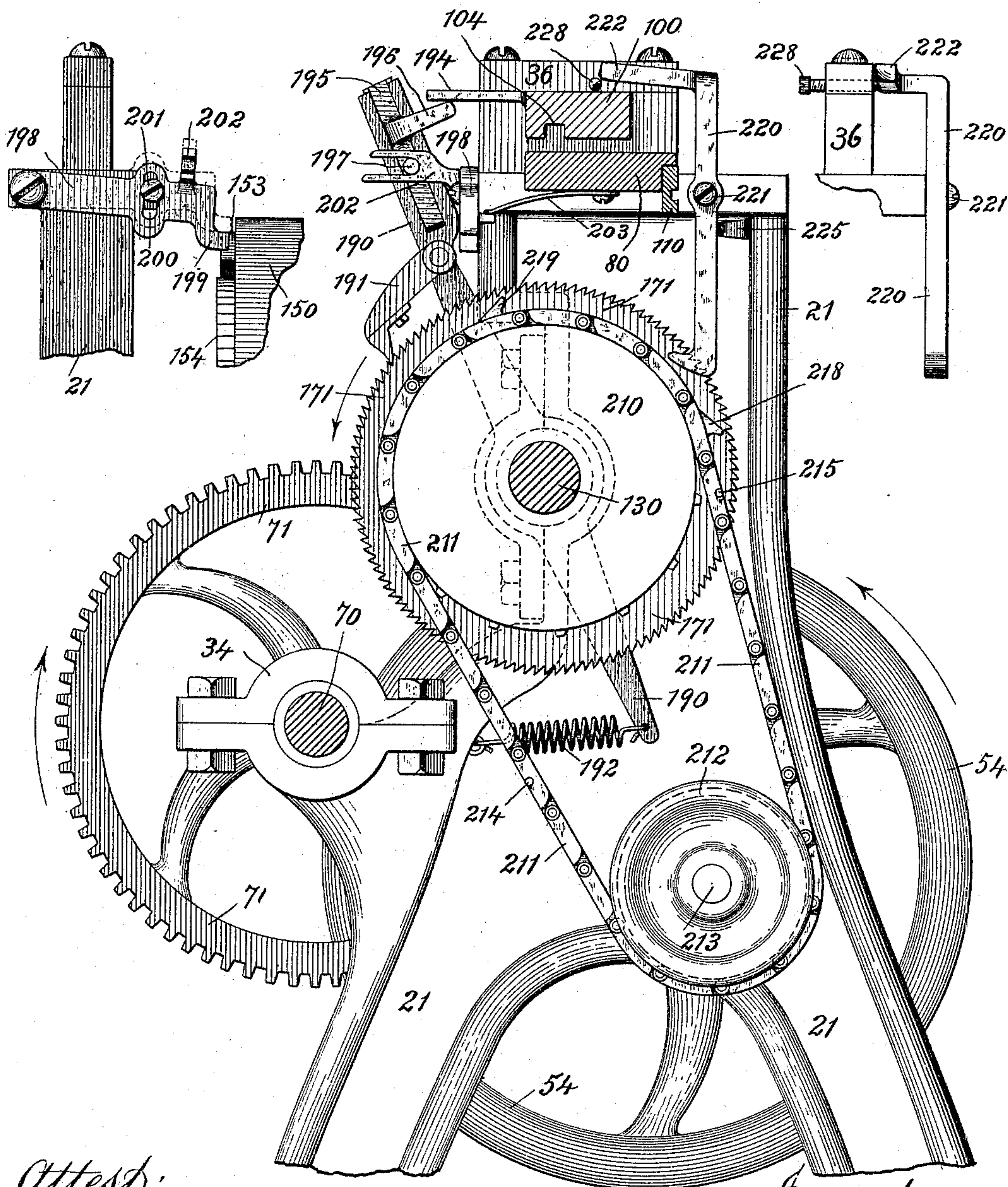
No. 497,118.

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FIG. 6.

FIG. 5.

FIG. 15.



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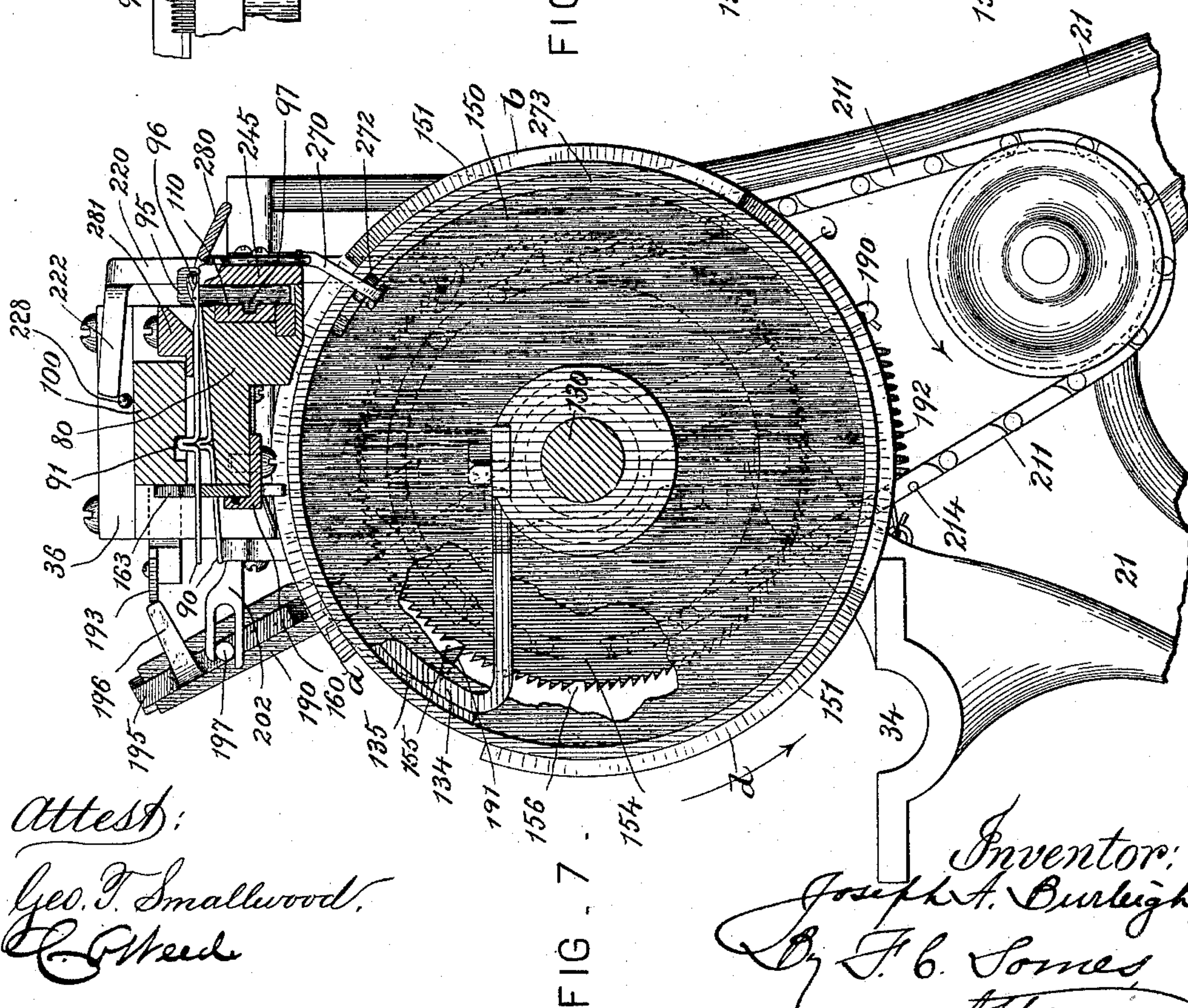
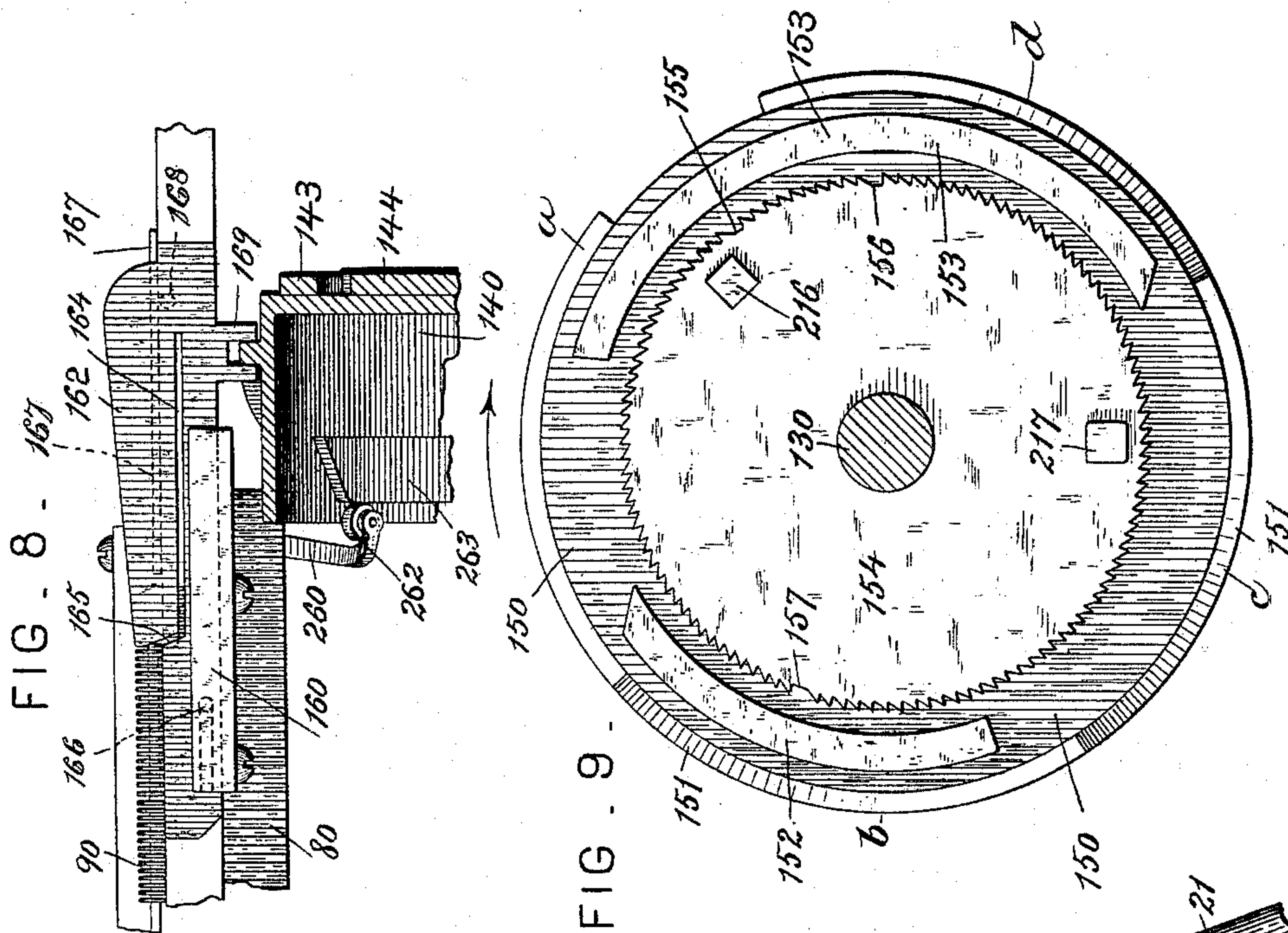
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J. A. BURLEIGH.
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J. A. BURLEIGH.
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FIG. 10.

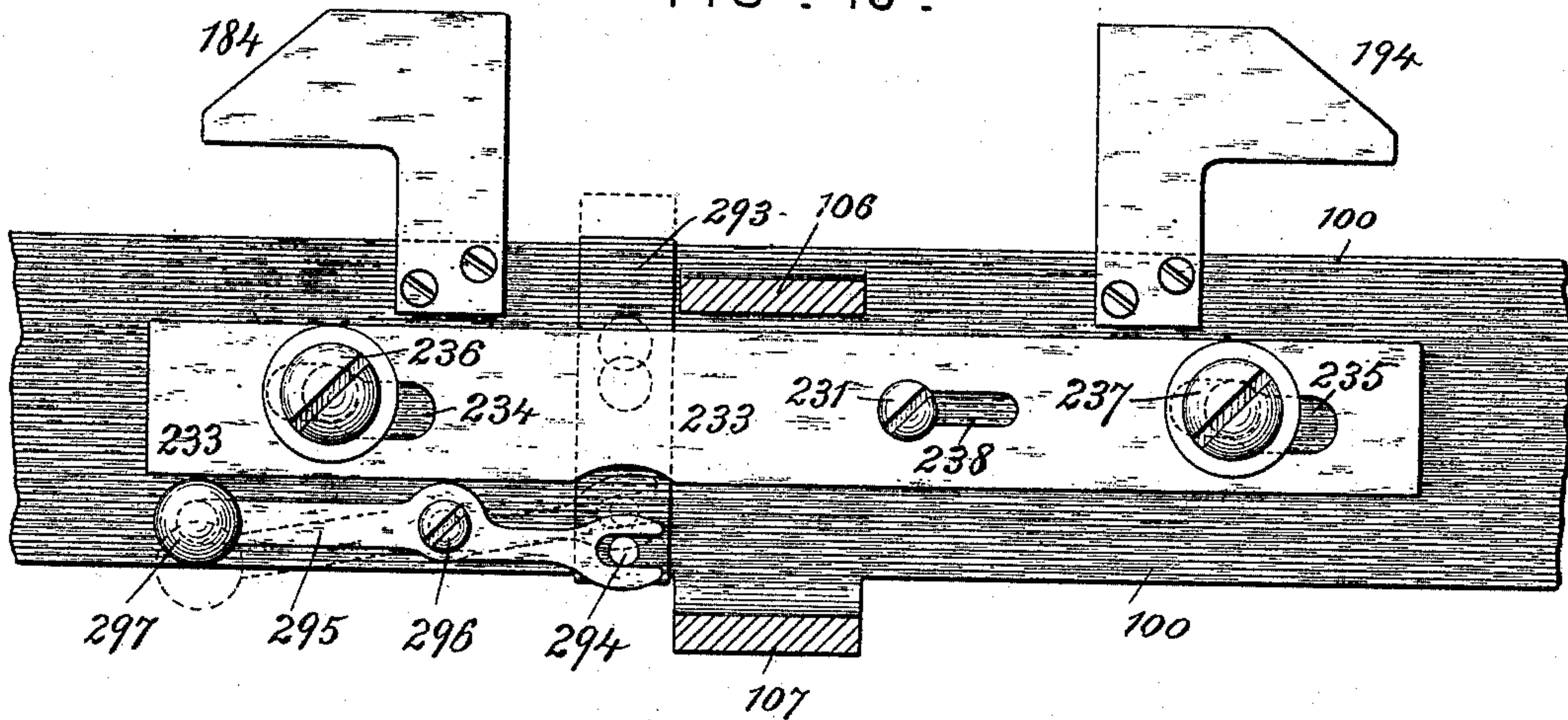


FIG. 11.

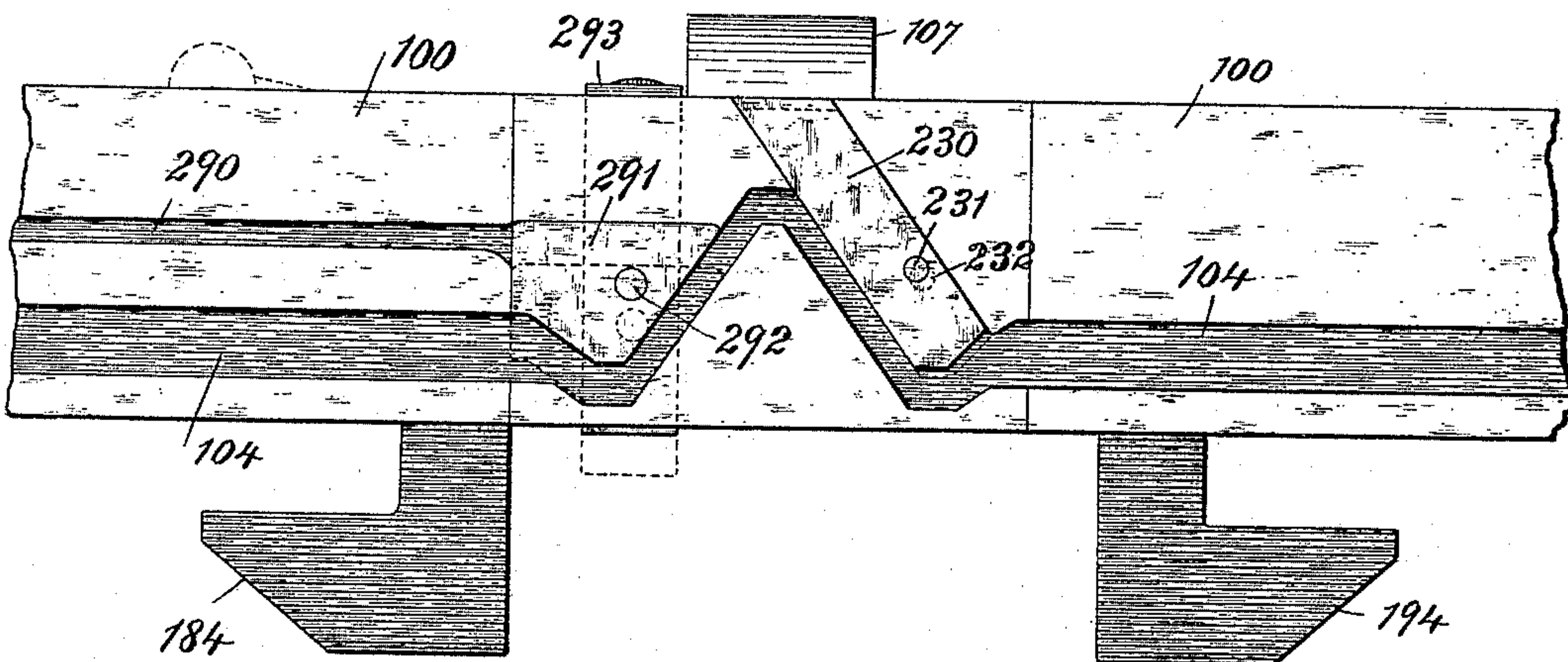


FIG. 12.

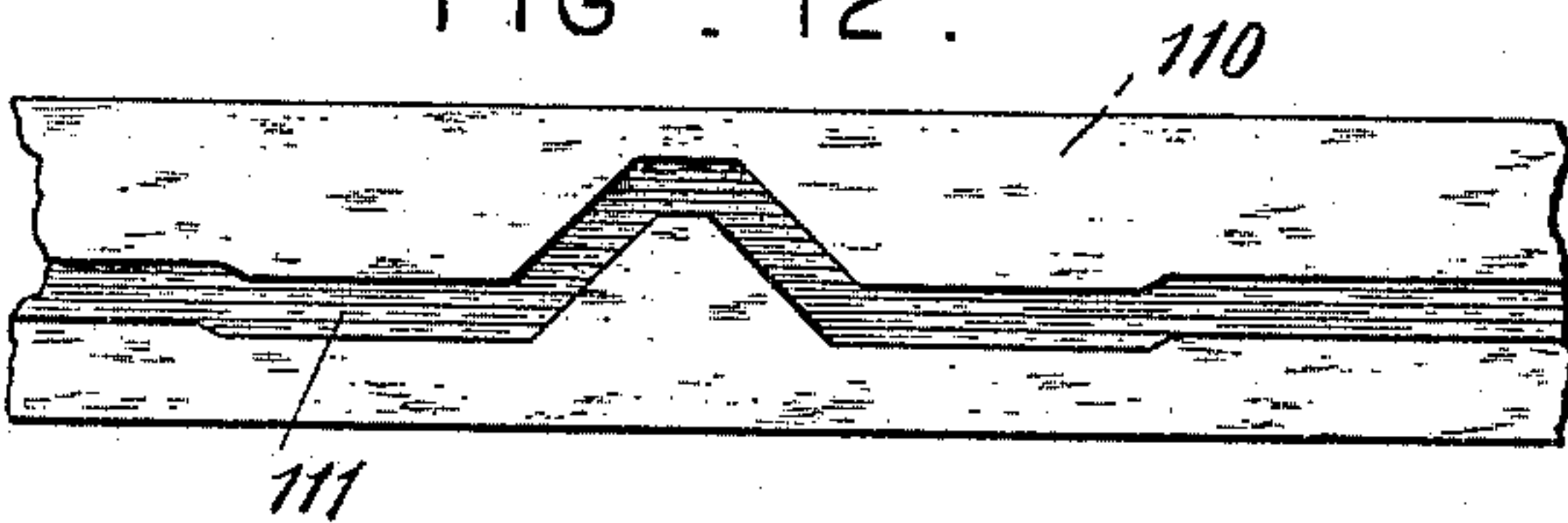


FIG. 13.

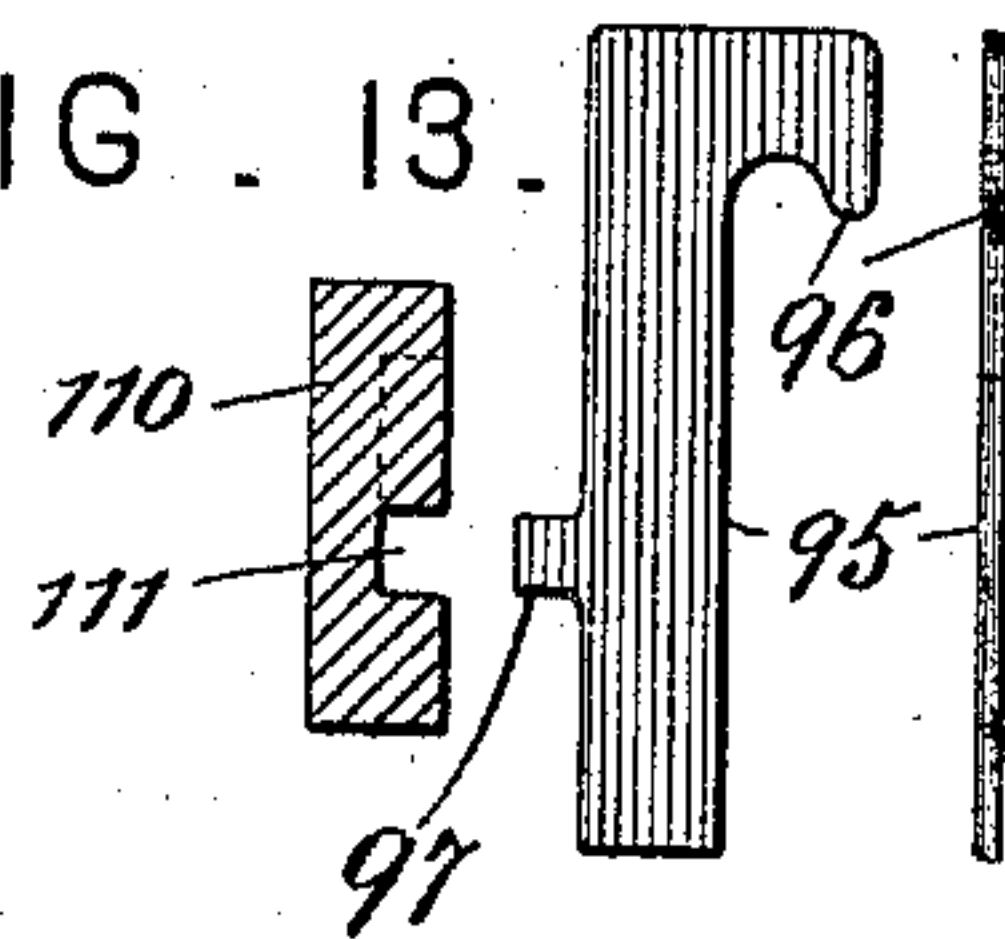
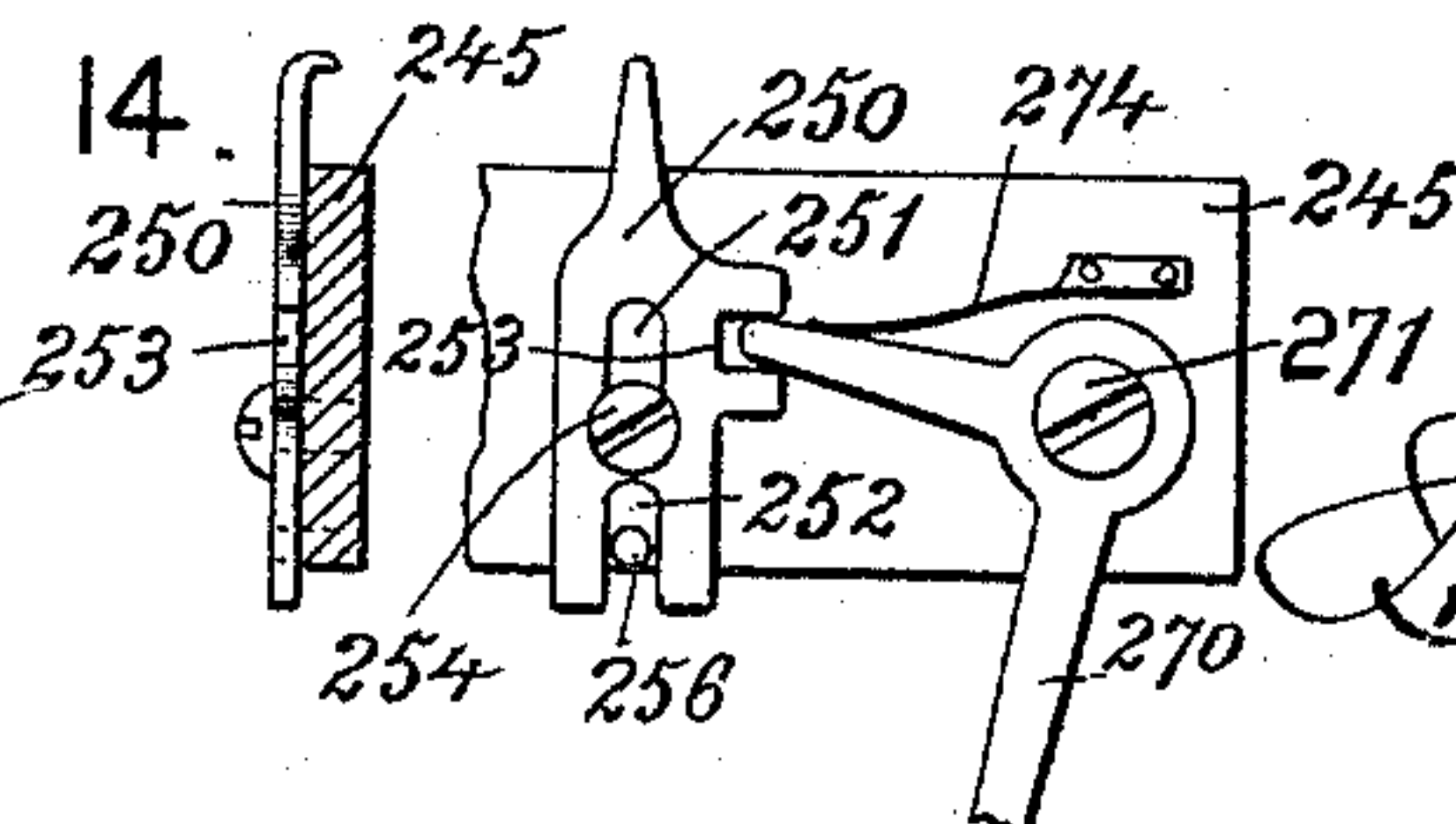


FIG. 14.



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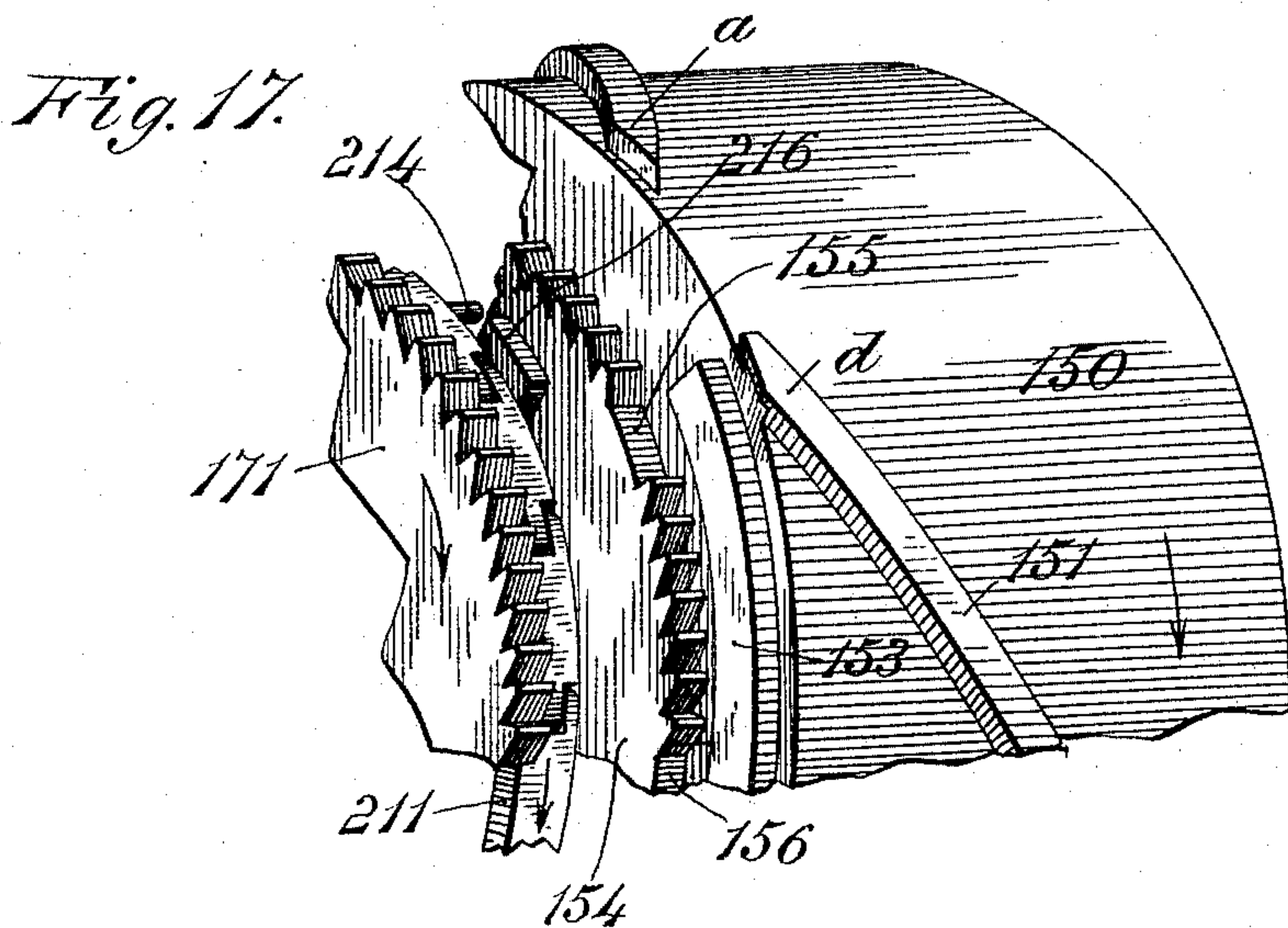
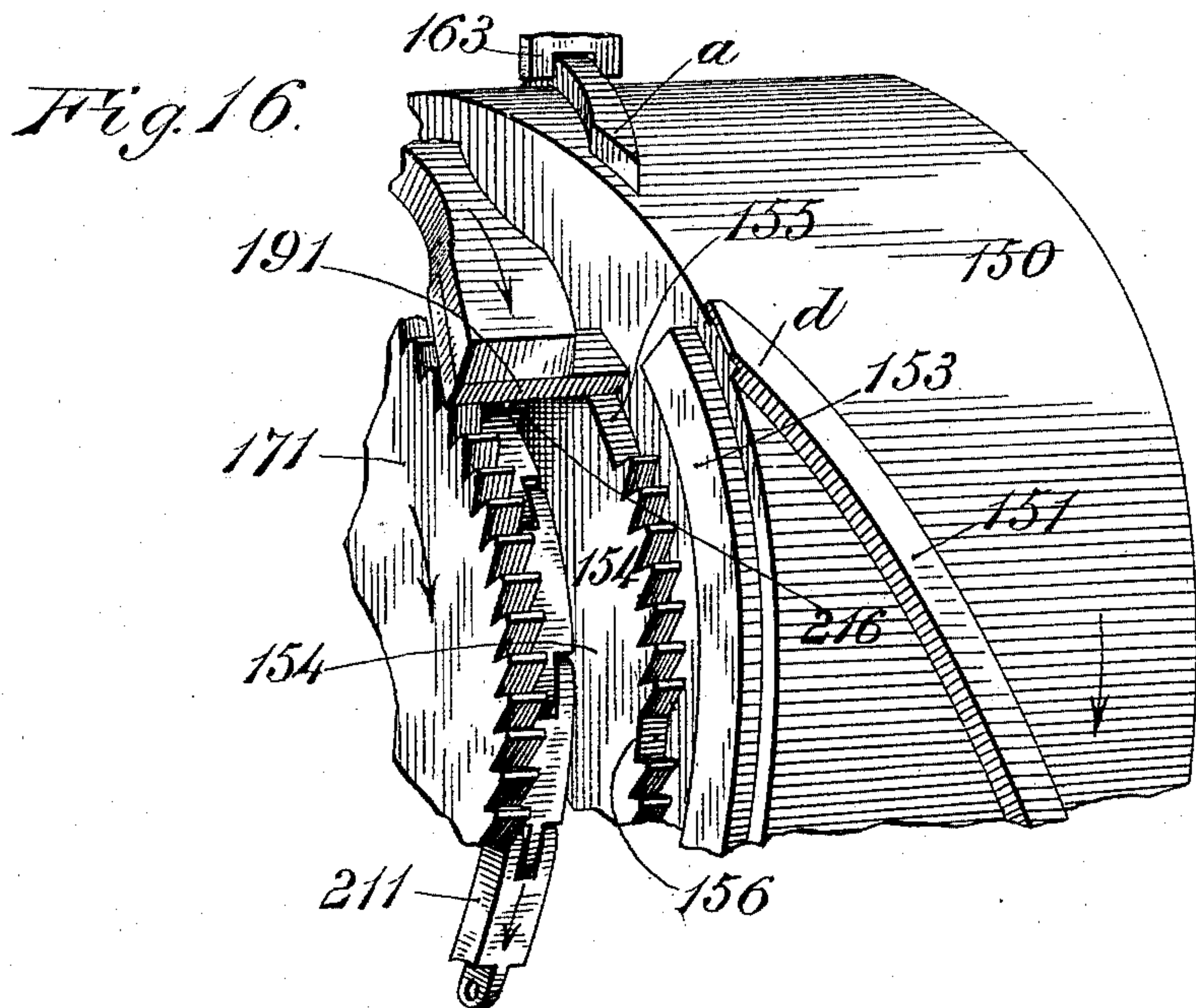
(No Model.)

9 Sheets—Sheet 8.

J. A. BURLEIGH.
KNITTING MACHINE.

No. 497,118.

Patented May 9, 1893.



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(No Model.)

9 Sheets—Sheet 9.

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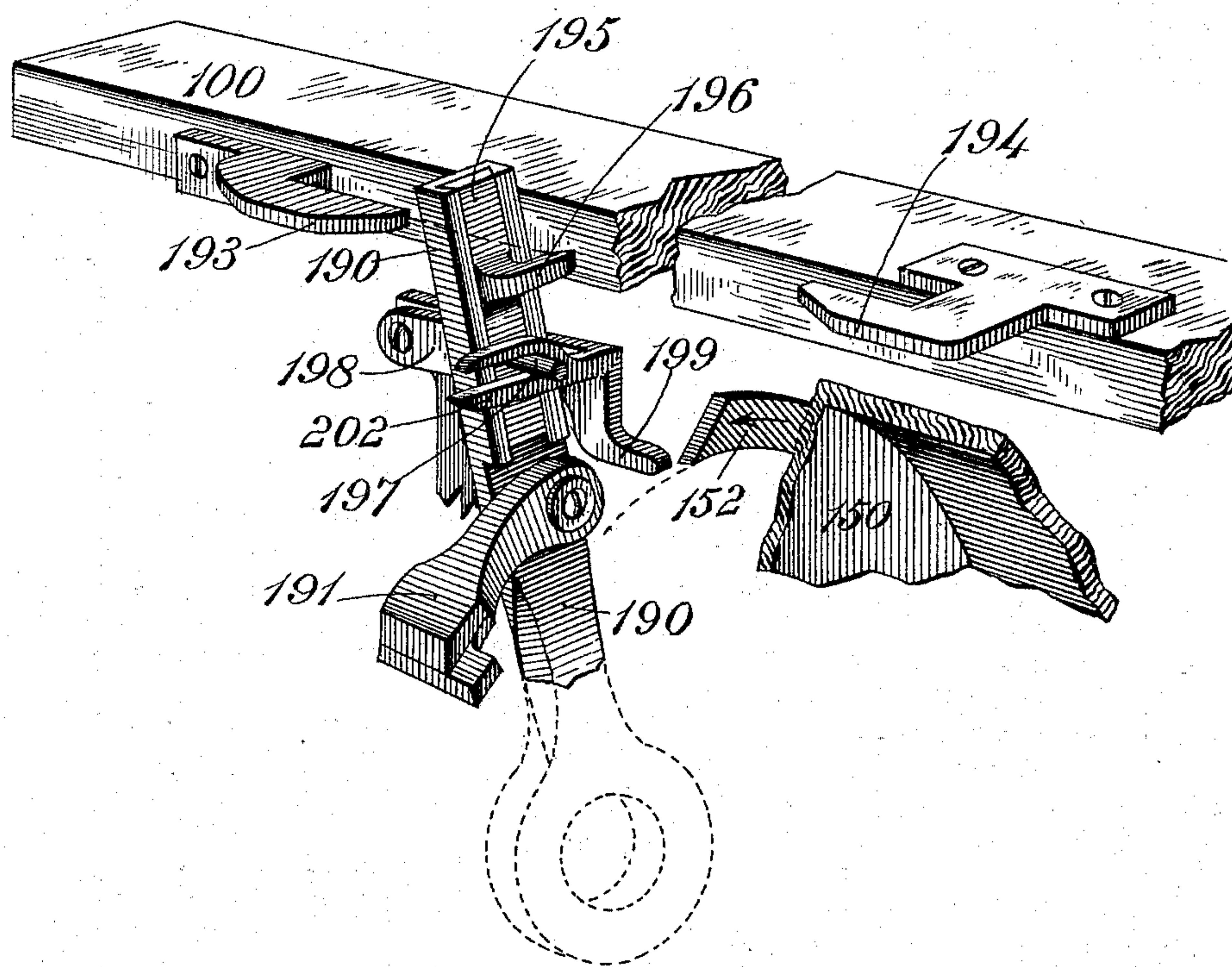
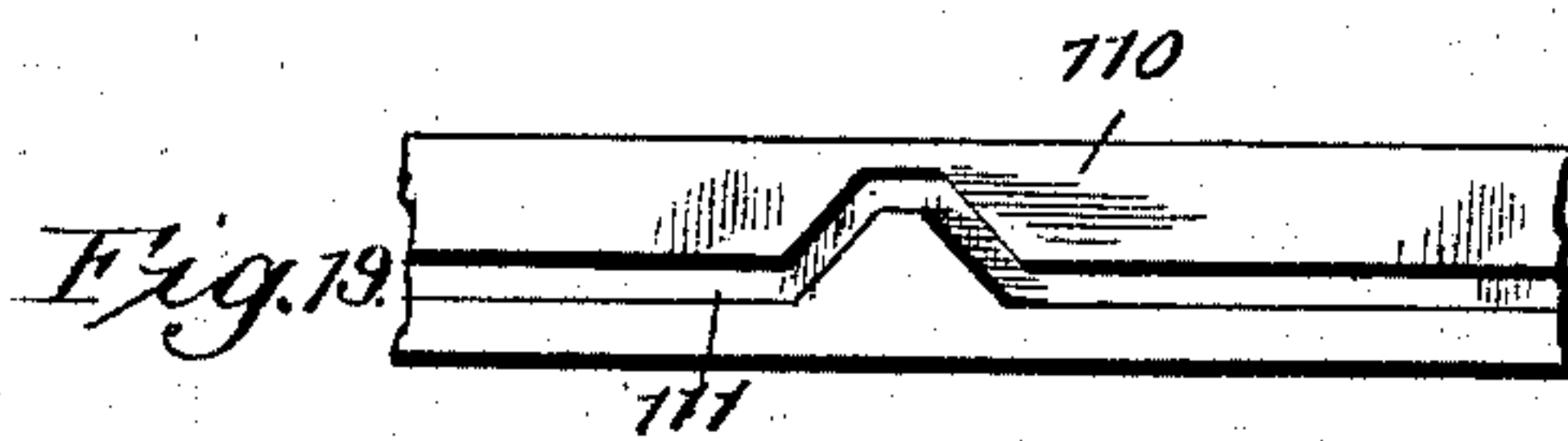


Fig. 18.



WITNESSES

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UNITED STATES PATENT OFFICE.

JOSEPH A. BURLEIGH, OF LAKEPORT, NEW HAMPSHIRE, ASSIGNOR OF ONE-HALF TO JOSEPH CLIFFORD MOORE, OF SAME PLACE.

KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 497,118, dated May 9, 1893.

Application filed November 14, 1891. Serial No. 411,875. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH ALBERT BURLEIGH, a citizen of the United States of America, residing at Lakeport, in the county of Belknap, in the State of New Hampshire, have invented certain new and useful Improvements in Knitting-Machines, of which the following is a specification.

This invention relates to a straight-bed knitting machine especially adapted for knitting fashioned feet of stockings to which the legs are afterward knit on as described in my patent No. 475,263, dated May 17, 1892.

The object of the invention is to provide a knitting machine which will knit the upper foot portion in a continuous flat web, then narrow and widen automatically to form a seamless toe, then shift its mechanism automatically and knit a straight web to form the lower foot portion, then widen automatically to form a gusset for the enlargement of the instep portion, then narrow and widen automatically to form a seamless heel.

The machine illustrated will stop automatically when the knitting of the foot is finished.

Figure 1 of the accompanying seven sheets of drawings represents a plan of this improved knitting machine, the yarn tension mechanism being omitted. Fig. 2 represents a front elevation thereof, the yarn tension mechanism, the lower portion of the frame and a portion of the driving mechanism carried thereby being omitted. Fig. 3 represents a rear elevation thereof, the same parts being omitted. Fig. 4 represents an end elevation of the right hand end of the machine as illustrated in Figs. 1 and 2, omitting only the yarn tension mechanism. Fig. 5 represents an enlarged transverse section of this improved knitting machine on line 5—5 of Fig. 1. Fig. 6 represents a rear view in detail of one of the levers for controlling the pawl which causes the movement of one of the cam drums for narrowing and widening. Fig. 7 represents an enlarged transverse section of this improved knitting machine on line 7—7 of Fig. 1. Fig. 8 represents in detail a rear elevation of the narrowing and widening mechanism. Fig. 9 represents on an enlarged scale the outer face of one of the cam drums. Fig. 10 represents an

enlarged plan of the central portion of the needle actuating cam bar with its attachments. Fig. 11 represents on an enlarged scale the under side thereof. Fig. 12 represents on an enlarged scale, a rear elevation of the jack bar for elevating and depressing the sinkers. Fig. 13 represents on an enlarged scale a sinker in front and side elevation and its actuating jack bar in cross-section. Fig. 14 represents enlarged front and sectional elevations of one of the selvage loopers and its actuating mechanism. Fig. 15 represents an enlarged side elevation of the actuating lever for the adjusting mechanism for the loose course and the adjustable stop therefor. Fig. 16 represents a perspective view of the mechanism for actuating one of the needle slides for narrowing and widening. Fig. 17 represents a similar view of the mechanism, the pawl being omitted and the stud and lug for starting the drum out of the dwells being shown. Fig. 18 represents in perspective a grouping of the mechanism for actuating the pawl which drives one of the cam drums for moving one of the needle slides in narrowing and widening, showing portions of the needle bar with one set of its actuating cams, this figure being designed to more clearly illustrate the means for shifting from one actuating cam to the other. Fig. 19 represents on an enlarged scale an elevation of the rear face of the sinker actuating bar provided with an ordinary cam track slightly different in form from the track shown in Fig. 12.

Similar numerals and letters of reference indicate corresponding parts in the different figures.

The frame of this machine is of any suitable construction adapted to support the working parts. As shown it consists of two end frames or legged standards 20 and 21, which are connected in an ordinary manner by longitudinal rods 22. A horizontal skeleton shelf 23 is attached to the end frames on the rear side near the tops thereof. This shelf is provided with upright rods or spindles 24 and 25 for supporting the bobbins 26 and 27 for containing the yarn. A standard 28 shown in the drawings as broken off is attached to this shelf and supports the yarn tension de-

vices which are of any suitable construction and need not be herein illustrated or described.

The end frame 20 is provided with a bracket 30, see Fig. 1, attached thereto near the floor and with a bracket 31 disposed at a higher elevation. The latter has a transverse shaft bearing 32 at its outer end. The end frame 20 is provided with a shaft bearing 33 and the end frame 21 with a shaft bearing 34.

A driving shaft 40 which may connect with and impart motion to a series of these machines has its bearings in the end frames near the floor. This shaft is driven in any suitable manner, as by a pulley 41 and belt 42 connected with the source of power, and is provided with a pulley 43 which is shown as grooved. A fixed stud 50 provided with a boss 51 at its inner end projects from the end standard 21 above the driving shaft and a rotary sleeve 52 is disposed on said shaft. The inner end of this sleeve rests against the boss and a locking pin 53 is passed through the outer end of the stud to hold the sleeve therein. This sleeve is provided with a grooved pulley 54 and with a pinion 55. A belt 56 passing over pulleys 43 and 54 imparts motion from the former to the latter. An ordinary belt tightener 60, the details of which need not be herein described, is supported in the end frame 21 and is actuated to tighten or loosen the belt for starting and stopping the machine.

Any suitable or equivalent means may be used for connecting and disconnecting the driving shaft and the operative parts of the machine.

A shaft 70 is supported in the bearings 33 and 34 on the rear side of the frame and extends at one end beyond the end frame 20, being provided at one end with a gear wheel 71 which meshes with the pinion 55 on the sleeve 52. The shaft 70 is provided at its opposite end with a beveled pinion 72 which meshes with a beveled pinion 73 on a stub shaft 74 supported in the transverse shaft bearing 32 of the bracket 31.

This machine has an ordinary needle bed 80 and a straight bank of horizontal latch needles 90 adapted to reciprocate in said bed, said needles being provided with lateral heels 91 on their shanks. About one third of the needles at each end of the bank are provided with elongated butts or shanks and are adapted to tilt in the bed to throw them out of and bring them into action. A bank of sinkers 95 is disposed in the front face of the needle bed in proper relation to the needles for holding the loops of the work, said sinkers being adapted to reciprocate vertically and being provided with hooks 96 at their upper ends and with heels 97 on their shanks. A reciprocating needle actuating cam bar 100 is guided in blocks 35 and 36 at the tops of the end frames, and provided on its lower face with cam grooves hereinafter described, into which the heels of the needles project. A

sinker actuating bar 110 for actuating the sinkers is guided in recesses at the ends of the needle bed and provided with an ordinary cam groove 111 on its inner face into which the heels 97 of the sinkers project.

The needle-actuating cam bar 100 is provided at one end with a lateral stud 101. A lever 120 is pivoted at its lower end to the bracket 30 and provided at its upper end with a slot 121 which engages the stud 101. This lever is provided with flanges 122 which form a guide-way extending longitudinally thereof. A crank arm 75 is fixed by a screw 76 to the outer face of the beveled pinion 73 and carries at its outer end a crank pin 77 which is preferably provided with an anti-friction roller. This crank pin engages the lever 120 between the flanges 122 thereof and plays in the way formed thereby, causing said lever to oscillate and the needle actuating bar to reciprocate.

The needle actuating cam bar is provided at its opposite ends with dependent lugs 102 and 103 for engaging the ends of the sinker bar 110 to actuate the latter. Adjustable bunters 112 and 113 are placed on the ends of the sinker bar or in the lugs of the needle actuating bar, being shown in the form of screws which may be turned in or out more or less to increase or diminish the throw of the sinker bar.

The needle actuating cam bar 100 is provided on its under side with a cam groove engaging the studs of the needles for thrusting and retracting said needles.

Any suitable thread carrying mechanism may be employed. The drawings show a thread-carrier 105 mounted on the needle actuating bar being hinged to a standard 106 and supported by a rest 107.

A rod 130 is supported in the end frames and two cam drums 140 and 150 are mounted and adapted to rotate on said rod for actuating the widening and narrowing mechanism hereinafter described.

The cam drum 150 is provided on its periphery with a zigzag cam track 151 and on its outer end with segmental cams 152 and 153. The cam drum 140 is provided with a similar peripheral zigzag cam track 141 and with like segmental end cams.

The cam tracks 141 and 151 on the cam drums 140 and 150 are each composed of four parts *a b c* and *d*. The parts *a* which are used in narrowing the fabric knitted to form the upper portion of the toe incline from the outer edges of the periphery of the cam drums toward the inner edges thereof and the parts *b* which are used in widening the fabric in the formation of the lower part of the toe and in widening for the gussets near the heel are inclined from the lower terminals of the parts *a* toward the outer edges of the peripheries. The parts *c* come into use in narrowing for the heel and incline from the lower terminals of the parts *b* toward the inner edges of the peripheries of the drums; and the parts *d*

which are employed in widening for the heel incline outward on the peripheries. These parts may vary in length to suit the requirements of the work.

5 The rod 130 is provided with two bosses 131 and 132 fixed thereto near said cam drums and brake arms 133 and 134 are fastened in recesses in said bosses. These brake arms have brake shoes, as 135, (see Fig. 7) which
10 press against the inner peripheries of the drums 140 and 150 and hold said drums stationary when they are not actuated by their driving mechanisms and permit them to turn under the action of said mechanisms.

15 The cam drum 150 has fixed to its outer end a toothed disk 154 from which three teeth are omitted forming rests or dwells 155, 156 and 157 and the cam drum 140 has fixed to its outer end a toothed disk 144, from which three
20 teeth are also omitted forming corresponding rests or dwells. These cam drums are duplicates of each other.

The widening and narrowing mechanism will now be described. A flanged guide plate
25 160 is attached to the under side of the needle bed at the rear thereof and near one end thereof, and a similar flanged guide plate 161 is attached to the under side of the needle bed near the other end thereof. These guide
30 plates form guide-ways between their up-turned flanges and the rear edge of the needle bed. A forked needleslide 162 plays back and forth in the guide-ways formed by the flanged guide 160 and another cam slide 163
35 plays back and forth in the guide-way formed by the flanged guide 161. These slides have longitudinal slots 164 provided with an oblique mouth 165. Each of these slides has a step-by-step-motion when in operation, and
40 engages a needle at each inward step, and releases a needle at each outward step in the usual manner. The lower longer arm of each of said slides is provided near its forward end on its outer face with a pin 166
45 which engages a slot or groove in the inner face of the flange of one of the guide plates for the purpose of holding said end against vertical play, and a cap plate 167, (see Fig. 8) attached to the needle bed and projecting over
50 a pin 168 on the front face of said slide near its rear end serves to hold said end against vertical play. Each of these needle slides is provided with a recessed lug 169 which engages the zigzag peripheral cam of one of the
55 cam drums.

Ratchet wheels 170 and 171 are disposed on the fixed cam rod 130 outside the cam drums 140 and 150 and a short distance from the toothed disks 144 and 154 respectively at-
60 tached to said drums. Levers 180 and 190 are disposed on said rod adjacent to and outside of said ratchet wheels and project beyond the peripheries thereof. A pawl 181 is pivoted to the lever 180 and engages the teeth
65 of both the disk 144 and the ratchet wheel 170 spanning the space between said disk and ratchet wheel. A pawl 191 is pivoted to the

lever 190 and engages the teeth of both the disk 154 and the ratchet wheel 171, spanning
70 the space between them. These pawls serve to impart a step by step motion to said disks and ratchet wheels at certain periods during the knitting operation. Springs as 192 connect the lower ends of levers 180 and 190 with
75 the frame and operate to swing said levers toward the front side of the machine, retracting their pawls and causing said pawls to engage fresh teeth of the ratchet wheels and disks. The lever 180 is actuated by cams 183
80 and 184 secured to the reciprocating needle actuating bar 100, and the lever 190 is actuated in a similar manner by cams 193 and 194 on said bar. The cam 193 near the right hand
85 end of said bar comes in contact when required with a shifting arm 196 connected with said lever 190 on the out stroke of the needle bar from right to left and swings said lever backward causing its pawl 191 to move the ratchet wheel
90 171 the distance of one tooth and likewise to move the ratchet disk 154 a corresponding distance when in engagement with the teeth of the latter; and the cam 194 attached to the needle actuating bar a little to the right
95 of the center thereof comes in contact when required with said shifting arm 196 on the in stroke of said bar from left to right. The cam 194 is disposed in a plane above the cam 193, and the arm 196 is shifted into position to be actuated by either of said cams at the
100 proper time by the mechanism now to be described, being elevated out of the path of the cam 193 and into the path of the cam 194 when it is to be actuated by the latter, and being depressed into the path of the cam 193
105 and out of the path of the cam 194 when it is to be actuated by the former. This lever 190 is provided at its upper end with a dove-tailed recess in which a dove-tailed slide 195 plays. The shifting arm 196 is attached to this slide, and said slide is provided with a
110 stud 197.

In order to effect the raising and depressing of the slide to bring the shifting arm 196 in position to be actuated by cam 194, or into
115 position to be engaged by cam 193, a lever 198 is pivoted at its outer end to the needle bed and provided at its inner end with a foot 199 which is engaged by the end cams 152 and 153 of the cam drum 150. The inner end of this lever is provided with a rearwardly
120 extending forked arm 202 which engages the stud 197 on the slide 195, and serves to lift and depress said slide to shift said arm 196 as aforesaid. The end cams 152 and 153 serve to raise said slide, and a spring 203 at-
125 tached to the underside of the needle bed operates to depress the lever 198 when said cams pass out of contact therewith, said spring thus serving to shift the arm 196 into its lower position. The lever 198 has a trans-
130 verse slot 200 and a pin 201 extending through said slot into the needle bed serves to hold said lever in place and limits the oscillation thereof.

Corresponding mechanism is connected with the lever 180 whereby it is actuated by cams 183 and 184.

The inner face of the ratchet wheel 171 is provided with a sprocket flange 210 and an endless pattern chain 211 passes over said sprocket flange and over a grooved guide pulley 212 disposed on a stud 213 on the end frame 21. This pattern chain is provided with pins 214 and 215 which engage lugs 216 and 217 on the adjacent face of the toothed disk 154 for starting said disk at the proper time when the pawl 191 rests in one of the dwells or blank spaces 155, 156 or 157 of said disk. When once started the pawl will turn the wheel step-by-step until the next dwell is reached. The ratchet wheel 170 has a similar sprocket flange, and a corresponding sprocket chain 211' passing over said flange and provided with similar pins serves to engage similar lugs on the adjacent face of the toothed disk 144 for starting said disk at the proper time when the pawl 181 rests in one of the dwells or blank spaces of said disk.

The sprocket chain 211 is provided with two trippers 218 and 219 for actuating a lever 220 which is supported on a pivot 221.

The needle actuating bar 100 is provided on its under side with a slide plate 230 which has a movement indicated in dotted lines in Fig. 11. This plate is provided with a stud 231 which passes through a diagonal slot 232 in said needle bar. A slide plate 233 provided with oblique slots 234 and 235 is mounted on the upper side of the needle bar and secured thereto by screws 236 and 237 passing through said slots into said bar. This upper slide plate is provided with a straight longitudinal slot 238 through which the stud 231 attached to the under slide plate 230 passes.

The lever 220 is provided with an arm 222 and when the lower end of the lever is engaged by one of the trippers 218 or 219 on the sprocket chain 211 the arm 222 is thrown down onto the top of the needle bar just before the needle bar finishes the outstroke. The end of the top plate 233 then comes in contact with said arm and said plate is arrested in its movement. The needle bar continues to the finish of the stroke and said plate is thereby shifted slightly rearward by the action of the studs 236 and 237 in the oblique slots 234 and 235. This shifting of the top plate causes a corresponding backward movement of the bottom plate 230 whereby its beveled end is projected farther into the cam groove 104 and the needles are caused to move farther backward making longer loops to constitute the loose course in the work. An adjustable stop or screw 228 provided with a tapered end passes through the cap plate 36 and is engaged by the inner end of the arm 222, said arm being beveled as shown in Fig. 15. The lever to which the arm is attached is supported loosely on its pivot 221, and when the arm is swung down its beveled end comes in contact with the end of said stop and is forced toward the left a

greater or less extent according to the distance the screw projects. This adjustable stop serves to regulate the position of the lever arm and control the length of the loops of the loose course inasmuch as the position of the arm determines the length of the stroke of the shifting top plate 233.

In knitting a straight portion of fabric of less width than the bank of needles, selvage loopers 240 and 250 are employed which are brought into and thrown out of action automatically for forming selvages on such widths of fabric. Each of these loopers has a broad shank provided with a central closed vertical slot, as 251, (see Fig. 14) a vertical slot as 252 at its lower end and a lateral notch, as 253. An attaching screw as 254 passes through the slot 251 into a plate 245 disposed at the front edge of the needle bed and serves to secure the looper thereto and permit it to play vertically thereon. A guide pin, as 256, passes through the slot 252 into said plate 245 and serves to guide and steady the looper in its vertical movements and prevent lateral play thereof. These loopers are operated by bell-crank levers 260 and 270 respectively, one of which will now be described.

The bell-crank lever 270 is swiveled on a pivot 271 on the plate 245 adjacent to the selvage looper 250. The upper end of this lever engages the notch 253 in the shank of the looper as shown in Figs. 2 and 14. The lower portion of this lever is bent downwardly and rearwardly and preferably provided with an anti-friction roller 272 which is engaged by the cam 273 on the face of the cam drum 150, as shown in Fig. 7, and a spring 274, shown in Figs. 2 and 14, tends to throw said lever into position to be engaged by said cam. The bell-crank lever 260 for actuating the selvage looper 240 at the left of the machine is correspondingly operated by a similar cam 263 on the inner face of the cam drum 140, said lever having a rearwardly extending bent arm preferably provided with a roller 262 engaging said cam, as shown in Fig. 8. When the width of the fabric being knit is to be increased beyond the selvage loopers, the bell-crank levers are released by the cams on the inner faces of the cam drums 140 and 150 and the springs, as 274, will then depress the loopers and throw them out of action. After the selvage loopers are thrown out, the needle next in advance of the one on which the selvage loop is formed moves forward and acts as a looper, and also in narrowing, the needles act as loopers. As the narrowing and widening needles either take on or throw off a loop whenever they act as selvage loopers there is no such drawing of the fabric and breakage of selvage stitches as would occur if the same needles acted repeatedly as selvage loopers and held the margin of the fabric.

Any equivalent actuating mechanism may be employed for rendering the loopers automatic.

A delivery plate 280 over which the work

falls is attached to the needle bed in front of the needles, and a guard 281 surmounts the bank of needles.

The needle actuating bar 100 is provided on its under side with a supplemental cam groove 290 and with a switch plate 291 which serves to close the cam groove 104 on one side of the center of said bar and open said supplemental groove 290, as shown in dotted lines, in Fig. 11. This switch plate is connected by a pin 292 passing through a slot in the needle bar with a slide plate 293 disposed in a recess on the top of said bar, and confined therein by the slide 233. The plate 293 is provided with a stud 294 and an actuating lever 295 fulcrumed on a pivot 296, engages said stud. The outer end of the lever is provided with a knob 297. On swinging the lever the switch plate is shifted. When the work is completed, the switch is used to throw all the needles into the supplemental groove whereby they are taken out of action and the work removed from the machine.

In the use of this machine a blank for the foot of a stocking is knit. In the usual way of operating the machine, the knitting begins at a point a little above the instep portion of the foot, and a flat web is knit for a few courses which constitutes a margin for the attachment of the foot blank when completed to a circular knitting machine for knitting on the leg. At a point a few courses from the beginning of the knitting a loose course is formed in the fabric to serve as a guide in the subsequent transfer to the circular machine. Then a straight web of a width and length suitable for the upper half of the foot is produced. Then the thread may be shifted, if desired, in the common way of forming stockings, to a thread of a different color or character to produce the toe. Then a gradually narrowing portion is produced, then a gradually widening web is formed and united with the narrowed portion, the narrowed and widened portions forming a seamless toe. Then the toe thread is thrown out and the original thread brought into use and a flat web of uniform width is knit from the toe to a point near the heel to constitute the lower foot portion or bottom of the foot. Then a gradually widened portion is knit for a few courses forming gussets on opposite sides to constitute an enlargement for the instep of the foot. Then the thread is again changed, if a heel of a different color or character is desired. Then a gradually narrowed portion is formed to constitute the front portion of the heel, and then a gradually widened portion to constitute the rear portion of the heel, said narrowed and widened portions being knit together to form a seamless heel. This narrowing and widening operation includes more courses than that for the toe which makes the heel larger than the toe. Then the original thread is fed to the needles and a few courses are knit in a straight web above the top of the heel to form a margin for at-

tachment to the circular machine. If the heel be composed of a thread of a different color from that of the body of the stocking, the top of the heel forms a guide line for the attachment. If of a thread of the same color, a loose course may be knit at the top of the heel corresponding to that at the top of the instep. The foot blank is then removed from the straight knitting machine and its two opposite ends are run onto a circular knitting machine, the slack or loose course of the top of the instep and the similar loose course or the color line at the top of the heel, serving as guide lines on which the needles of the circular machine are made to pierce the fabric.

The operation of this machine is as follows: The parts being in the position shown in Figs. 1, 2 and 3 wherein the adjustable loopers 240 and 250 are in operative position and the needles at the opposite ends of the needle bed outside said loopers out of operative position, the machine is started by moving the belt tightener. The belt 56 then imparts motion from the main driving shaft 40 to the pulley 54 on the sleeve 52 carrying the pinion 55 which transmits motion to gear wheel 71 on shaft 70; thence to bevel pinion 72 on the opposite end of said shaft; thence to the bevel gear 73 on the transverse shaft 74; thence to the crank arm 75 on said shaft; thence to the lever 120 to which the needle bar 100 is secured. The needle bar is thus moved from right to left and engages and moves the sinker bar 110. The needle cam on said needle bar throws forward and retracts all the needles between the adjustable selvage loopers 240 and 250 in its strokes from right to left and left to right. In its first stroke from right to left at the beginning of the knitting the first needle to the left of the selvage looper 250 receives the yarn from the thread carrier and forms a stitch, and all of the needles between said loopers successively form stitches in the usual manner. In this stroke the yarn passes the selvage looper 250 without looping therein. When the needle bar 100 has nearly completed its stroke from right to left the right hand end cam 193 thereon comes in contact with the shifting arm 196 connected with the lever 190 carrying the pawl 191 and said pawl moves the ratchet wheel 171 in the direction of the arrow, Fig. 5, a distance of one tooth, without however, moving the ratchet disk 154 attached to the cam drum 150, the pawl 191 being in the dwell 155 of said disk. This movement of the ratchet wheel causes the pattern chain 211 at the right of the machine to move one step, and thereby brings the pin 215 thereof one step nearer the lug 216 on said disk. During this stroke from right to left of the needle bar all the needles between the two selvage loopers are brought into action by the needle cam groove 104, and the first course of the work is knit. The crank arm 75 then reverses the needle bar 100 and said bar moving from left to right causes the reversing of the sinker bar

110. In the passage from right to left the yarn passes under the selvage looper 240 and on the return stroke from left to right the yarn is looped over said looper to form the selvage stitch at that side of the fabric. When the first needle to the right of said looper recedes it pulls off the loop from said selvage looper and the succeeding needles to the right continue the knitting, and another course is knit on the fabric on the return stroke. Near the end of said stroke the yarn passes under the selvage looper 250, and on the next outward stroke a loop is formed on said looper and taken off by the first needle to the left of said looper in the manner described as regards the looper 240. When the needle bar 100 has nearly completed its stroke from left to right the end cam 183 on said bar actuates the lever 180 carrying the pawl 181 at the left hand end of the machine and said pawl turns the ratchet wheel 170 the distance of one tooth, moving the pattern chain 211 one step and leaving the ratchet disk 144 on the cam drum 140 stationary, the pawl 181 being in the dwell of said disk corresponding to the dwell 155 of the disk 150. The needle bar and sinker bar are reciprocated four times more or less making eight courses more or less of knitting, which constitute the upper or attaching margin at the top of the instep for attaching the foot to the circular knitting machine where the leg is to be formed. After the eighth stroke of the needle bar is begun, being a stroke from left to right, the trip 218 on the pattern chain 211 at the right hand end of the machine comes in contact with the lower end of the bent lever 220 pivoted on the lug 221 on the inside of the end frame 21, and causes its horizontal arm 222 to swing downward into contact or nearly so with the top of the needle bar. Just before completion of the eighth stroke of the needle bar, the right hand end of the slide plate 233 thereon comes in contact with the horizontal arm 222 of said lever and is held stationary, while the needle bar continues to move, whereby the position of said plate on said bar is shifted rearwardly under the action of the pins 236 and 237 on said needle bar acting on the oblique slots 234 and 235 in said plate. This shifting of the plate 233 causes the slide plate 230 which is connected thereto by the stud 231 and disposed on the under side of the needle bar, to shift into the position shown in dotted lines in Fig. 11, whereby the cam track 104 of the needle bar is changed so as to increase the backward stroke of the needles on the next course, a distance of about a thirty-second of an inch, whereby the loops are elongated and a loose or slack course is formed in the web of fabric, which serves as a guide in transferring it to the circular machine. When the ninth stroke, an outstroke, of the needle bar is nearly completed, the left hand end of the slide plate 233 comes in contact with the cap plate 35 at the left hand end of the machine. The needle bar continues to

move, and the plate 230 is shifted back to its first position, and the needle cam groove 104 restored to its normal form, so that the loops of the next course will be of ordinary length. The normal position of the plate 233 on the needle bar 100 is a little to the left of the center so that the right hand end thereof does not come in contact with the cap plate 36 at the right hand end of the machine when said bar makes a stroke in that direction. The trip 218 then releases the lever 220, which is immediately acted upon by a spring 225 and its horizontal arm 222 lifted out of the path of the slide plate 233. The machine continues to work without change until a sufficient number of courses are knit to form the top of the foot, say from one hundred to one hundred and twenty courses more or less, according to the size of the stocking to be produced, the size of the yarn used and the gage of the machine, that is the distance between the needles. Up to this point the yarn loops over the selvage loopers 240 and 250 in forming the selvage. Then the thread may be shifted if desired, to a thread of a different color or character to produce the toe.

To start the narrowing and widening mechanism for forming the toe, the pin 215 on the pattern chain 211 at this point of the knitting comes in contact with the lug 216 on the ratchet disk 154 of the cam drum 150, see Figs. 5, 9 and 17, and moves said ratchet disk the distance of one tooth, so that the pawl 191 will in its next operation be withdrawn from the dwell 155 therein and made to engage the teeth of said disk, the said pawl having rested in said dwell since the beginning of the knitting operation at the top of the foot. The cam drum 150 is thus brought under control of the pawl 191 and turned the distance of one tooth at each complete reciprocation of the needle bar. The cam drum 140 is actuated in a similar manner. Each alternative movement of the cam drums 140 and 150 moves by the parts *a* of the zigzag cams 141 and 151 one of the needle slides 162 and 163 a sufficient distance toward the center to depress the shank of one needle at the outer end of the bank of needles and throw said needle out of action, thus narrowing the fabric one stitch. This narrowing operation is repeated at each stroke of the needle bar until the point of the toe is reached, the narrowing including about twenty-six courses more or less. Then the lever 198 at the rear of the end frame 21, see Figs. 3, 5 and 6, is lifted by the end cam 152 of the cam drum 150 and the rearwardly projecting finger 202 of said lever is raised thus lifting the dove-tailed slide 195 to bring its arm 196 into position to be operated upon by the right hand center cam 194. The lever 188 at the rear of the end frame 20, is lifted by the end cam of the cam drum 140 corresponding to the cam 152, and the rearwardly projecting finger 302 of said lever which is like the finger 202 of lever 198, is raised, thus lifting the dove-tailed slide 185

and bringing its arm which corresponds to arm 196 into position to be operated upon by the left hand center cam 184. At this time the drums 140 and 150 have turned sufficiently to bring the corresponding inner angles of the cam tracks 141 and 151 at the points of engagement with the recessed lugs as 169 of the forked needle slides 162 and 163 and on the further rotation of the cam drums 140 and 150 the parts *b* of the zigzag cams 141 and 151 will act upon said slides and the movements thereof will be reversed, and said slides will thence move in outward direction step by step so that on each succeeding stroke of the needle bar 100, a needle is restored to action from the inner end of the groups of shifting needles until the widest part of the toe is reached. The shifting from the end actuating cams 193 and 183 to the center actuating cams 194 and 184 is done in order that the needles which have been thrown out of action in narrowing may be brought into action in widening in proper time with relation to the movements of the needle actuating bar. If the end cams 193 and 183 were solely relied on, two courses of the same length would be knit at the extremity of the toe, as said cams 193 and 183 would not actuate the pawl levers 190 and 180 in season to throw into action the first needle in widening at either end of the bank of needles before the thread carrier had passed said needle on the outward or inward stroke of the needle actuating bar. The right center cam 194 being brought into action near the end of the return stroke of the needle actuating bar in knitting the last course at the extremity of the toe, causes the pawl lever 190 and its pawl 191 to actuate the toothed disk 154 and moves the slide 163, releasing a needle before the completion of said return stroke so that said needle is in position to receive the yarn on the first outward stroke of the needle actuating bar in the widening operation. The pawl carrying arm 180 is likewise thrown out of operative connection with the end cam 183 at the opposite end of the needle actuating cam bar 100, and the left center cam 184 is brought into operative connection therewith, so that the same movements of corresponding parts occur at the left hand end of the machine alternately with those at the right hand end thereof.

During the narrowing and widening operations the selvage loops are formed by the needles at opposite ends of the bank next adjacent the active stitch-forming needles, the yarn thread passing outside the selvage loopers 240 and 250 without engaging them; since the needles adjacent said loopers being inoperative do not draw in the yarn at that point so as to cause it to pass behind the loopers. When the knitting of the toe is finished the toe thread is thrown out and the original thread restored. At this time the pawls 181 and 191 fall into the dwells as 157 of the

toothed disks 144 and 154 attached to the cam drums 140 and 150 and said drums remain stationary. A sufficient number of courses are then knit to form a strip of uniform width to constitute the bottom of the foot, being the same number of courses as knit for the top of the foot less the widened courses for the instep. During the knitting of the lower foot portion the selvage loopers take the thread and form loops for the selvage and the pawls 181 and 191 remain in the dwells as 157 of the toothed disks 144 and 154 and the cam drums 140 and 150 remain stationary. The point is then reached where widening to form the gussets for the instep enlargement becomes necessary and the pins as 214 on the pattern chains as 211, come in contact successively with the lugs as 217 on the ratchet disks 144 and 154 of the cam drums 140 and 150 and move said drums a sufficient distance so that the pawls 181 and 191 are removed from the dwells as 157 into which they fell on completion of the toe. At this point the cams 263 and 273 on the inner faces of the cam drums 140 and 150 successively release the bell-crank levers 260 and 270 and the springs 264 and 274, being thus permitted to act, depress the selvage loopers 240 and 250 and take them out of action. The pawls 181 and 191 then continue to move said drums the distance of one tooth, at each reciprocation of the needle bar. Then the needle slides 162 and 163, which are still engaged by the parts *b* of the zigzag cams 141 and 151 of the cam drums, again move step by step in outward direction releasing and throwing into action successively the needles outside the selvage loopers at the outer ends of the bank of needles, which heretofore remained out of action. In widening beyond the selvage loopers 240 and 250, the succeeding needles beyond the stitch-forming needles serve as selvage loopers. When all the needles have thus been brought into action, a few courses are knit over the entire bank while the needle slides are at the outer angles between the parts *b* and *c* of the zigzag cams 141 and 151 of the cam drums 140 and 150. Then the point is reached where the heel is to be knit, and the thread is again shifted. The inwardly inclined parts *c* of the cams 141 and 151 then act, throwing the needle slides 162 and 163 inward the distance of one needle at each stroke of the needle bar, and narrowing for the heel occurs, the slides 195 and 185 falling and being engaged respectively by the end cams 193 and 183 of the needle bar during the narrowing instead of by the center cams 194 and 184. This dropping of the slides 185 and 195 is effected by springs as 203, the levers as 198 pivoted to the rear side of the end frames being released from contact with the end cams, as 152, of the cam drums. The slides 185 and 195 remained in position to be acted on by the center cams 184 and 194, after the widening for the toe was completed in order that they might be ready for use when

the knitting of the gussets for the instep enlargement began. The change from the center cams 184 and 194 to the end cams 183 and 193, which occurs on completion of the lower foot portion, including the instep gussets, is made in order to cause the needles for narrowing to be thrown out of operation in proper time with relation to the movements of the needle actuating cam bar, so as to avoid the formation of holes during the narrowing operation. As soon as the heel narrowing is completed the heel widening commences, the slides as 195, being elevated by means of the cams as 153, out of the path of the end cams as 193 and into the path of the center cams as 194, as before, to throw in the needles in proper time and avoid the formation of holes in the widenings. The widening for the heel is effected under the action of the parts *d* of the zigzag cams 141 and 151. The pawls 191 and 181 then fall into dwells as 156, on the ratchet disks 144 and 154. After the heel is completed the trip 219 comes in contact with the bent lever 220 and again brings its horizontal arm 222 in position to be engaged by slide 233 for knitting a second loose course to serve as a guide in transferring the heel end of the fabric to a circular machine. The trip 219 passes the lever 220 allowing the spring 225 to return said lever to its normal position and then a few straight courses are knit to form the attaching margin at the heel end of the fabric. The foot thus completed is then taken off the machine and transferred to a circular machine for knitting on the leg. During the described operation the cam drums make a nearly complete rotation, and on completing a foot the machine stops automatically, the belt tightener or belt shifter being actuated for this purpose in any suitable manner, as by a spring released by a projection on the sprocket chain. When as in the particular machine illustrated, the proportions of the cam drums 140 and 150 happen to be such as to exceed the requirements for forming a complete foot, said drums are turned by hand or otherwise until the pawls 181 and 191 again fall into the dwells 155, before another foot is begun. This may be effected by swinging the pawl levers 180 and 190 forward and back a few times, their pawls catching in the teeth of the disks attached to the drums and turning the latter at each backward stroke. In this movement of the drums, the parts *a* of the zigzag cams 141 and 151 again engage the needle slides 162 and 163 and the needles outside the selvage loopers 240 and 250 are thrown out of action and the cams 263 and 273 again engage the actuating mechanism of said loopers and they are swung into operative position. The machine is then ready to knit another foot.

The details of the several mechanisms may be changed without a departure from the scope of this invention.

I claim as my invention—

1. In a knitting machine for knitting the foot of a stocking, the combination of a single straight needle bed, needles disposed therein, a rectilinear reciprocating cam bar provided with means for actuating the needles at each stroke in each direction, sinkers, actuating devices therefor, mechanism consisting of devices at opposite ends of said bed each adapted to act upon certain adjacent needles to throw them successively out of and into operative connection with said cam bar, means for automatically operating said mechanism to narrow and widen for the toe, means for automatically throwing said mechanism out of action on completion of the toe, and means for automatically actuating said mechanism to narrow and widen for the heel, the several moving parts of the organization being connected with the driving shaft to operate in unison or at intervals in one continuous operation from the beginning to the completion of the knitting of a foot, substantially as set forth.

2. In a knitting machine for knitting the foot of a stocking, the combination of a single straight needle bed, needles disposed therein, a rectilinear reciprocating cam bar provided with means for actuating the needles at each stroke thereof in each direction, sinkers, actuating devices therefor, mechanism consisting of devices at opposite ends of said bed each adapted to act upon certain adjacent needles to throw them successively out of and into operative connection with said cam bar, means for automatically actuating said mechanism to narrow and widen for the toe, means for automatically throwing said mechanism out of action on completion of the toe, means for automatically actuating said mechanism to narrow and widen for the heel, and means for automatically throwing said mechanism out of action on completion of the heel, the several moving parts of the organization being connected with the driving shaft to operate in unison or at intervals in one continuous operation from the beginning to the completion of the knitting of a foot, substantially as set forth.

3. In a knitting machine for knitting the foot of a stocking, the combination of a single straight needle bed, needles disposed therein, a rectilinear reciprocating cam bar provided with means for actuating the needles at each stroke in each direction, sinkers, actuating devices therefor, mechanism for automatically throwing certain needles at opposite ends of said bed into and out of action, means for automatically actuating said mechanism to narrow and widen for the toe, means for automatically throwing said mechanism out of action on completion of the toe, means for automatically bringing said mechanism into action to widen for the instep enlargement, and means for automatically actuating said mechanism to narrow and widen for the heel; the several parts of the organiza-

tion being connected with the driving shaft to operate in unison or at intervals in one continuous operation from the beginning to the completion of the knitting of a foot, substantially as set forth.

4. In a knitting machine for knitting the foot of a stocking, the combination of the needles, the sinkers, the actuating devices therefor, selvage loopers, a narrowing and widening mechanism, means for automatically actuating said mechanism to narrow and widen for the toe, means for automatically throwing said mechanism out of action on the completion of the toe, means for automatically bringing said mechanism into action to widen for the instep enlargement, means for automatically throwing said selvage loopers into and out of action, and means for automatically actuating said narrowing and widening mechanism to narrow and widen for the heel, substantially as set forth.

5. In a knitting machine, the combination with the needle bed, of a narrowing and widening mechanism consisting of two needle slides for engaging the butts of the needles, cam drums provided with peripheral cam tracks engaging said needle slides, and means for imparting intermittent motion to said drums, substantially as set forth.

6. In a knitting machine, the combination with the needle bed and the needles, of a narrowing and widening mechanism consisting of two needle slides for engaging the butts of the needles, cam drums provided with peripheral cam tracks engaging said needle slides, means for imparting intermittent motion to said drums, and brakes for holding said drums stationary between their intermittent movements, substantially as set forth.

7. In a knitting machine, the combination of the needle bed, the needles, the sinkers, the needle actuating cam bar, the sinker actuating cam bar, two forked needle slides for engaging the butts of the needles, two cam drums provided with cam tracks for engaging said needle slides, toothed disks connected with said drums, ratchet wheels disposed near said disks, pivoted levers provided with pawls each engaging a ratchet wheel and a disk, cams on the needle actuating bar for swinging said levers to actuate said wheels and disks, and means for returning said levers, substantially as set forth.

8. In a knitting machine, the combination of a needle bed, the needles, the sinkers, the needle actuating cam bar, the sinker actuating cam bar, two forked needle slides for engaging the butts of the needles, two cam drums provided with cam tracks for engaging said needle slides, toothed disks connected with said drums and provided with dwells on their peripheries, ratchet wheels disposed near said disks, pivoted levers provided with pawls each engaging a ratchet wheel and a disk, cams on the needle actuating bar for actuating said levers, means for retracting

said levers, and means for actuating said toothed disks when the pawls are in dwells thereof, substantially as set forth.

9. In a knitting machine, the combination of the needle bed, the needles, the sinkers, the needle actuating cam bar, the sinker actuating cam bar, two forked needle slides for engaging the butts of the needles, two cam drums provided with cam tracks for engaging said needle slides, toothed disks connected with said drums, ratchet wheels disposed near said disks, pivoted levers provided with pawls each engaging a ratchet wheel and a disk, adjustable slides on said levers, two sets of cams on the needle actuating bar for engaging said slides for actuating said levers, means for retracting said levers, and means for shifting said slides into position to be engaged by either cam of the corresponding set, substantially as set forth.

10. In a knitting machine, the combination of the needle bed, the needles, the sinkers, the needle actuating cam bar, the sinker actuating cam bar, two needle slides for engaging the shanks of the needles, two cam drums provided with cam tracks for engaging said needle slides, toothed disks connected with said drums and provided with dwells on their peripheries, ratchet wheels disposed near said disks, pivoted levers provided with pawls each engaging a ratchet wheel and a disk, adjustable slides on said levers, two sets of cams on the needle actuating bar for engaging said slides for swinging said levers to actuate said wheels and disks, means for returning said levers, means for shifting the position of the slides so as to be engaged by either cam of the corresponding set, and means for actuating said toothed disks when the pawls are in dwells thereof, substantially as set forth.

11. In a knitting machine, the combination of the needle bed, the needles, the sinkers, the needle actuating cam bar, the sinker actuating cam bar, two forked needle slides for engaging the butts of the needles, two cam drums provided with cam tracks for engaging said needle slides, toothed disks connected with said drums and provided with dwells on their peripheries, and lugs on their faces, ratchet wheels disposed near said disks, sprocket flanges on said ratchet wheels, pivoted levers provided with pawls, each engaging a ratchet wheel and a disk, cams on the needle actuating bar for actuating said levers, means for returning said levers, sprocket wheels, sprocket chains passing over said sprocket wheels and sprocket flanges, and provided with lateral pins engaging the lugs on the faces of said disks for starting them when the pawls are in dwells thereof, substantially as set forth.

12. In a knitting machine, the combination of a straight needle bed, needles, sinkers, a rectilinear reciprocating needle actuating bar, a sinker actuating cam bar, a slide plate on said needle bar provided with oblique slots engaged by studs on said bar, a slide plate

on the under side of said needle bar extending into the cam track thereof, and connected with the upper slide plate, and means for shifting said slide plate to form a loose course, substantially as set forth.

13. In a knitting machine, the combination of the needle bed, the needles, the sinkers, the needle actuating cam bar, the sinker actuating cam bar, a slide plate on said needle bar provided with oblique slots engaged by studs on said bar, a slide plate on the under side of said needle bar extending into the cam track thereof, and connected with the upper slide plate, a lever pivoted adjacent to said needle bar and having an arm adapted to be swung into the path of said slide plate carried by said needle bar, and means for actuating said lever at the proper time for forming a loose course.

14. In a knitting machine, the combination of the needle bed, the needles, the sinkers, the needle actuating cam bar, the sinker actuating cam bar, two forked needle slides for engaging the shanks of the needles, two cam drums provided with cam tracks on their peripheries for engaging said needle slides, selvage loopers, mechanism for shifting said loopers into and out of position, cams on the faces of said cam drums for actuating said mechanism and means for actuating said cam drums, substantially as set forth.

15. In a knitting machine, the combination of the needle bed, the needles, the sinkers, the needle actuating cam bar, the sinker actuating cam bar, two forked needle slides for engaging the shanks of the needles, two cam drums provided with cam tracks on their peripheries for engaging said needle slides, selvage loopers, mechanism for shifting said loopers into and out of position, cams on the faces of said cam drums for actuating said mechanism, toothed disks connected with said drums, ratchet wheels disposed near said disks, pivoted levers provided with pawls each engaging a ratchet wheel and a disk, cams on the needle actuating bar for actuating said levers, and means for returning said levers, substantially as set forth.

16. In a knitting machine for knitting the foot of a stocking, the combination of a straight needle bed, needles disposed therein, sinkers, actuating devices therefor, mechanism for automatically throwing certain needles at opposite ends of said bed into and out of action, selvage loopers, means for automatically actuating said mechanism to narrow and widen for the toe, means for automatically throwing said mechanism out of action on completion of the toe, means for automatically bringing said mechanism into action to widen for the instep enlargement, means for automatically throwing said selvage loopers into and out of action, and means for automatically actuating said needle throwing mechanism to narrow and widen for the heel, substantially as set forth.

17. In a knitting machine, the combination of a single straight needle bed, needles disposed therein, a horizontally reciprocating needle actuating cam bar, mechanism for automatically throwing certain needles at opposite ends of said bed into and out of action, means for automatically actuating said mechanism to narrow and widen for the toe, means for automatically throwing said mechanism out of action on completion of the toe, means for automatically bringing said mechanism into action to widen for the instep enlargement, and means for automatically actuating said mechanism to narrow and widen for the heel.

18. In a knitting machine, the combination of a single straight needle bed, needles disposed therein, a rectilinear reciprocating needle actuating cam bar, mechanism consisting of devices at opposite ends of said bed, each adapted to act upon certain adjacent needles to throw them out of and into operative connection with said cam bar, means for automatically actuating said mechanism to narrow and widen for the toe, means for automatically throwing said mechanism out of action on completion of the toe, means for automatically actuating said mechanism to narrow and widen for the heel, and means for automatically throwing said mechanism out of action on completion of the heel, the several moving parts of the organization being connected with a driving-shaft to operate in unison or at intervals in one continuous operation from the beginning to the completion of the knitting of a foot.

19. In a knitting machine, the combination of a needle bed, needles movable in said bed, actuating devices therefor, selvage loopers, a narrowing and widening mechanism, means for automatically actuating said mechanism to narrow and widen for the toe, means for automatically throwing said mechanism out of action on the completion of the toe, means for automatically bringing said mechanism into action to widen for the instep enlargement, means for automatically throwing said selvage loopers into and out of action, and means for automatically actuating said widening and narrowing mechanism to narrow and widen for the heel.

20. In a knitting machine, the combination of a needle bed, needles, actuating devices therefor, devices for throwing certain needles out of and into action, cam drums provided with cam tracks for actuating said devices, disks connected with said drums, ratchet wheels disposed near said disks, pivoted levers provided with pawls each engaging a ratchet wheel and a disk, and means for swinging said levers to actuate said wheels and disks.

21. In a knitting machine, the combination of a knitting mechanism, cam drums provided with cam tracks for actuating parts connected with said mechanism, disks connected with

said drums, ratchet wheels disposed near said disks, pivoted levers provided with pawls each engaging a ratchet wheel and a disk, and means for swinging said pivoted levers.

22. In a knitting machine, the combination of a needle bed, needles therein, a needle actuating cam bar, two forked needle slides for engaging the butts of the needles, two cam drums provided with cam tracks for engaging said needle slides, two disks connected with said drums and provided with dwells on their peripheries, ratchet wheels disposed near said disks, pivoted levers provided with pawls each engaging a ratchet wheel and a disk, 15 cams on the needle actuating bar for actuating said levers, means for retracting said levers, and means for actuating said toothed disks when the pawls are in dwells thereof.

23. In a knitting machine, the combination of a knitting mechanism a drum provided with cams for actuating certain parts of said mechanism, a toothed disk connected with said drum and provided with dwells on its periphery, a ratchet wheel disposed near said disk, a pivoted lever provided with a pawl 25 engaging said ratchet wheel and disk, means for actuating said lever, and means for actuating said toothed disk when the pawl is in a dwell thereof.

24. In a knitting machine, the combination of a needle bed, needles movable therein, a needle actuating cam bar, devices for throwing certain needles at opposite ends of said bed into and out of action, cam drums provided with cam tracks for engaging said devices, toothed disks connected with said drums and provided with dwells on their peripheries, ratchet wheels disposed near said disks, pivoted levers provided with pawls each engaging a ratchet wheel and a disk, means 40 for actuating said levers, means for retracting said levers, and means for actuating said toothed disks when the pawls are in dwells thereof.

25. In a knitting machine, the combination of a needle bed, needles therein, narrowing and widening mechanisms at opposite ends of said bed, selvage loopers, and intermittent rotary drums each provided with a cam for controlling a selvage looper and with a cam for controlling a narrowing and widening mechanism.

26. In a knitting machine, the combination of a knitting mechanism, narrowing and widening mechanisms, adjustable selvage loopers, means for elongating the loops to form a loose course, and rotary drums each provided with a cam for controlling a selvage looper, with a cam for controlling a narrowing and 60 widening mechanism and with a cam for controlling a loose course mechanism.

27. In a knitting machine, the combination of a needle bed, needles disposed therein, a needle actuating cam bar, two forked needle slides for engaging the butts of the needles, 65 two cam drums provided with cam tracks for

engaging said needle slides, two disks connected with said drums, ratchet wheels disposed near said disks, pivoted levers provided with pawls each engaging a ratchet wheel and a disk, adjustable slides on said levers, two sets of cams on the needle actuating cam bar for engaging said slides for actuating said levers, means for retracting said levers, and means for shifting said slides into position to be engaged by either cam of the corresponding set. 70 75

28. In a knitting machine, the combination of a needle bed, needles movable therein, a needle actuating cam bar, narrowing and widening mechanisms, two sets of cams on the needle actuating cam bar for operating said mechanisms, and means whereby said mechanisms are respectively caused to be actuated by either cam of the corresponding set. 80 85

29. In a knitting machine, the combination of the needle bed, the needles, the needle actuating cam bar, two needle slides for engaging the shanks of the needles, two cam drums provided with cam tracks for engaging said needle slides, toothed disks connected with said drums and provided with dwells on their peripheries, ratchet wheels disposed near said disks, pivoted levers provided with pawls each engaging a ratchet wheel and a disk, adjustable slides on said levers, two sets of cams on the needle actuating bar for engaging said slides for swinging said levers to actuate said wheels and disks, means for returning said levers, means for shifting the position of the slides so as to be engaged by either cam of the corresponding set and means for actuating said levers when the pawls are in dwells of said disks, substantially as set forth. 90 95 100

30. In a knitting machine, the combination of two cam drums, disks connected with said drums and provided with dwells on their peripheries and lugs on their faces, ratchet wheels disposed near said disks, sprocket flanges on said ratchet wheels, pivoted levers provided with pawls each engaging a ratchet wheel and a disk, means for operating said levers, sprocket wheels, and sprocket chains passing over said sprocket wheels and sprocket flanges, said chains being provided with lateral pins engaging the lugs on the faces of the said disks for starting them when the pawls are in dwells thereof. 105 110 115

31. In a knitting machine, the combination of a needle bed, needles movable in said bed, actuating devices therefor, selvage loopers, a narrowing and widening mechanism, means for automatically actuating said mechanism to narrow and widen the toe, means for automatically throwing said mechanism out of action on the completion of the toe, means for automatically throwing said selvage loopers into and out of action, and means for automatically actuating said widening and narrowing mechanism to narrow and widen for the heel. 120 125 130

32. In a knitting machine, the combination

of a needle bed, needles movable in said bed,
actuating devices therefor, selvage loopers, a
narrowing and widening mechanism, a loose
course mechanism, and means for automati-
5 cally throwing into and out of operation said
narrowing and widening mechanism, selvage
loopers and loose course mechanism.

In testimony that I claim the invention
above set forth I affix my signature in pres-
ence of two witnesses.

JOSEPH A. BURLEIGH.

Witnesses:

E. H. BLAISDELL,
JAS. P. F. SMITH.