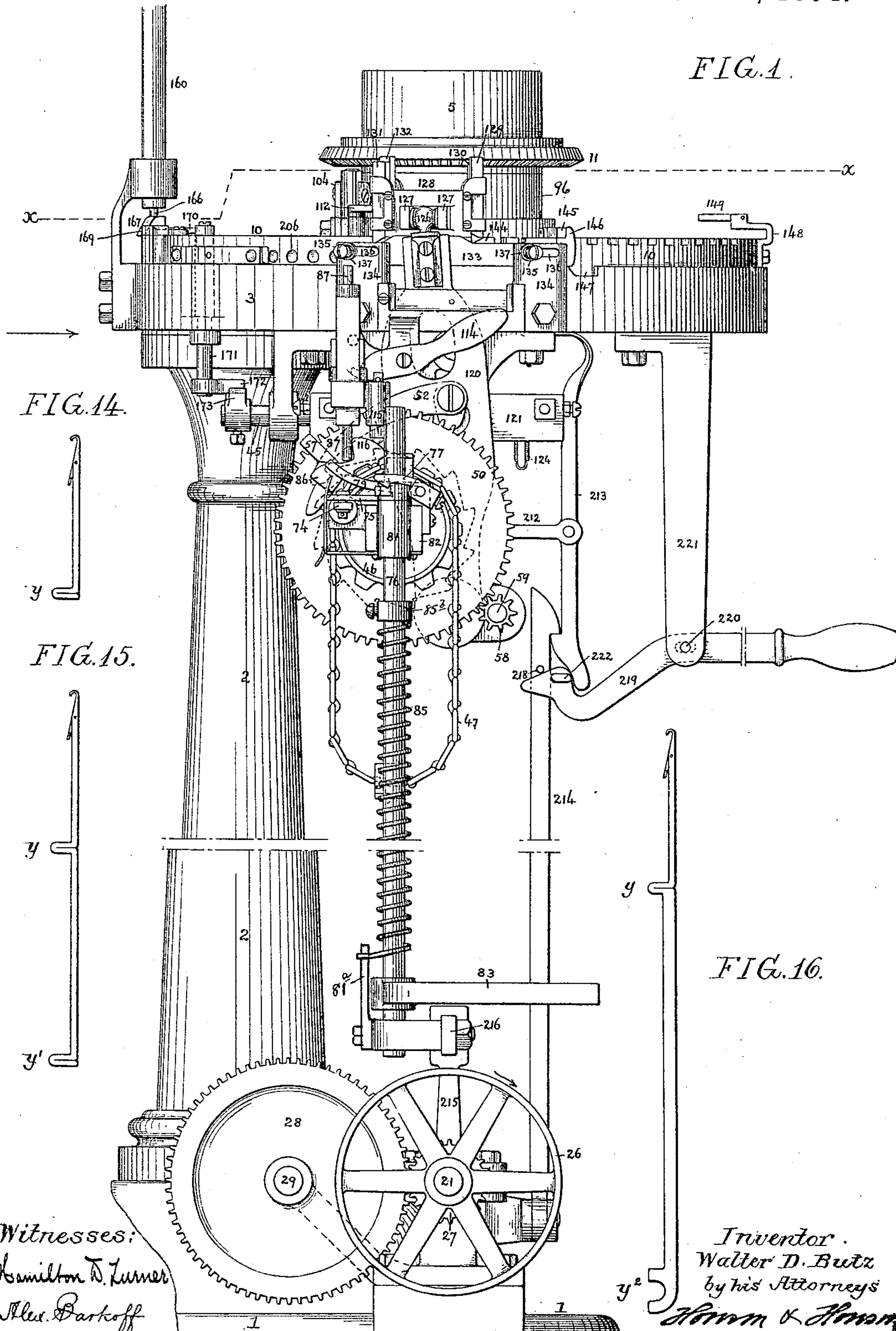


6 Sheets—Sheet 1.

No. 529,362.

Patented Nov. 20, 1894.



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

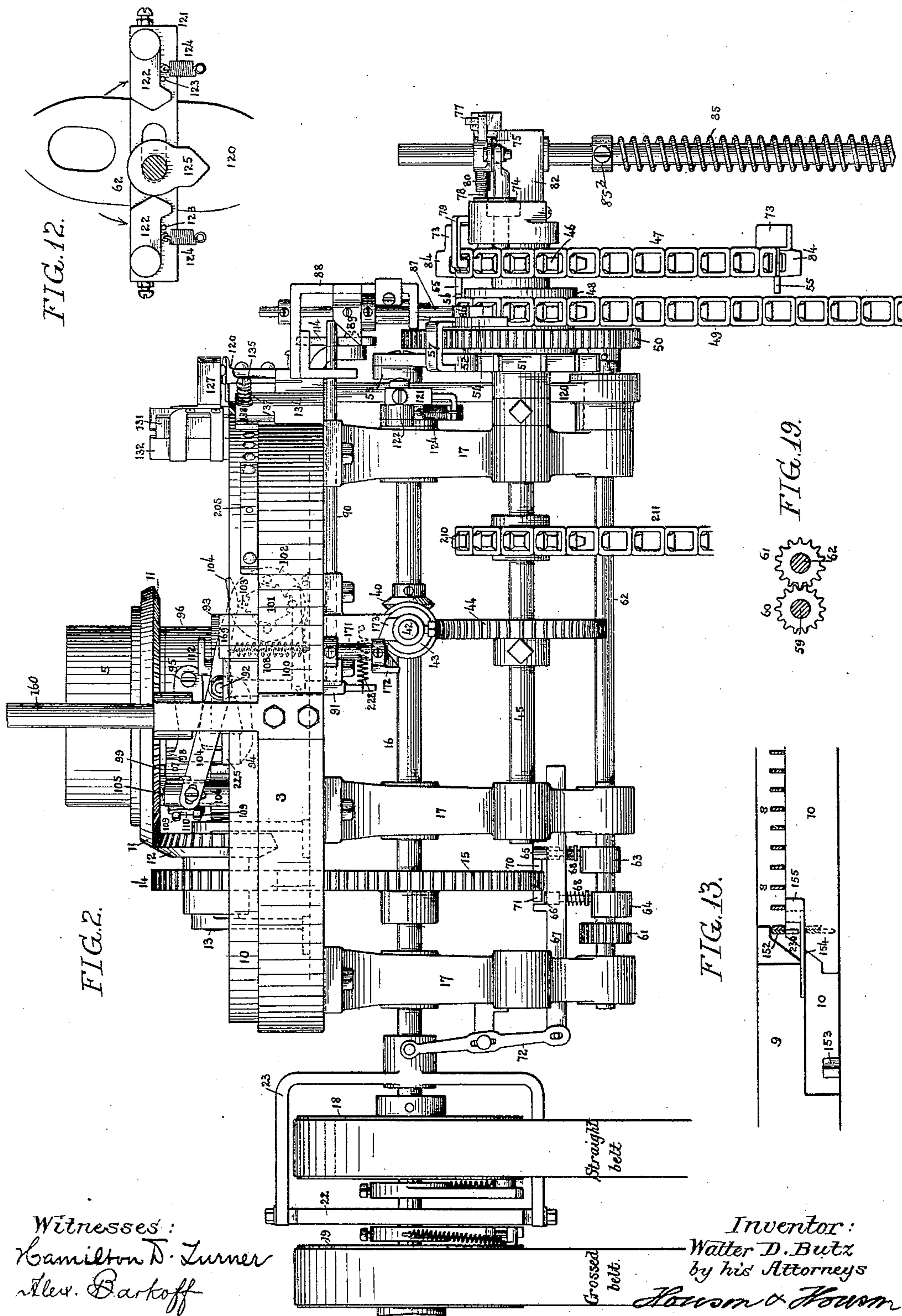
(No Model.)

6 Sheets—Sheet 2.

W. D. BUTZ.
AUTOMATIC KNITTING MACHINE.

No. 529,362.

Patented Nov. 20, 1894.



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(No Model.)

6 Sheets—Sheet 3.

W. D. BUTZ.
AUTOMATIC KNITTING MACHINE.

No. 529,362.

Patented Nov. 20, 1894.

FIG. 10.

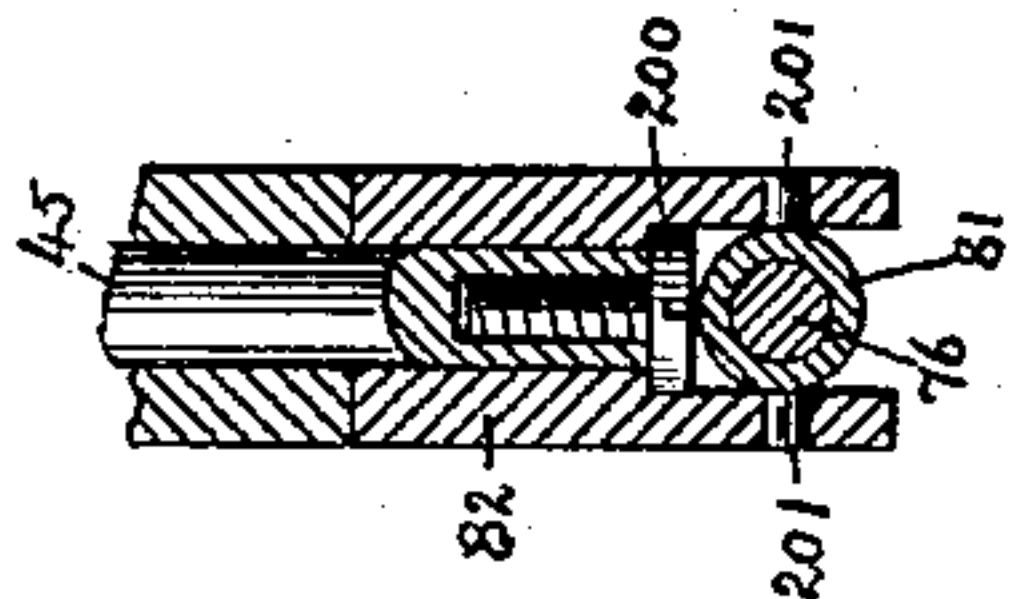


FIG. 3.

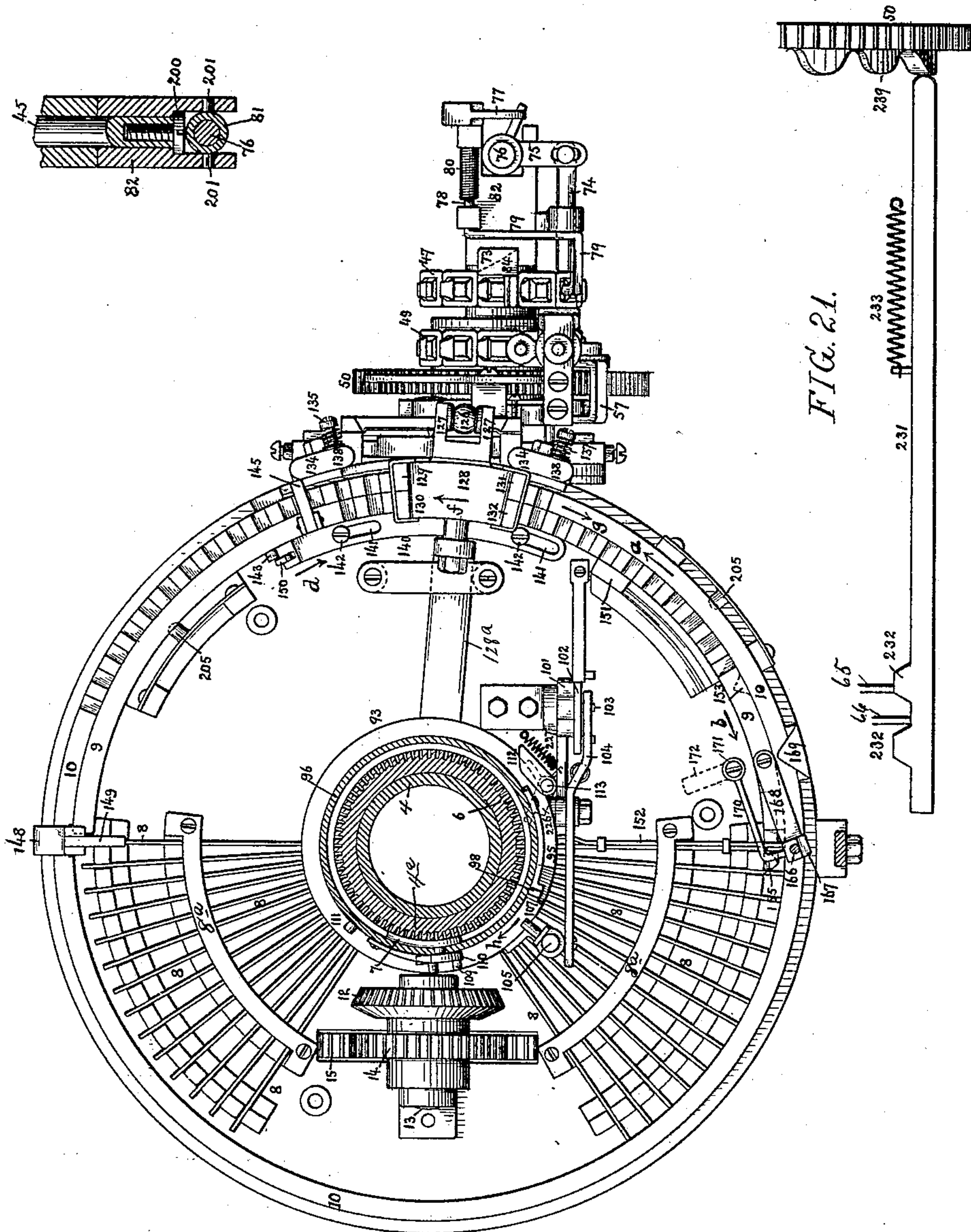


FIG. 21.

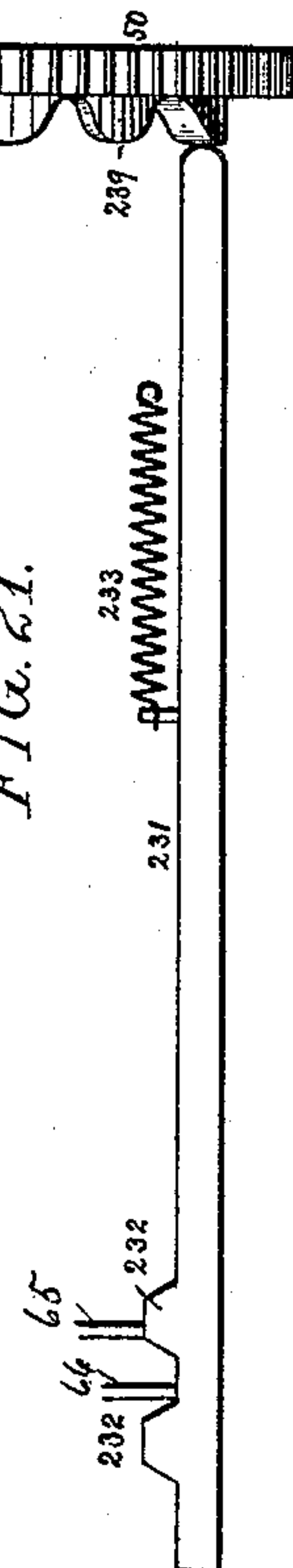
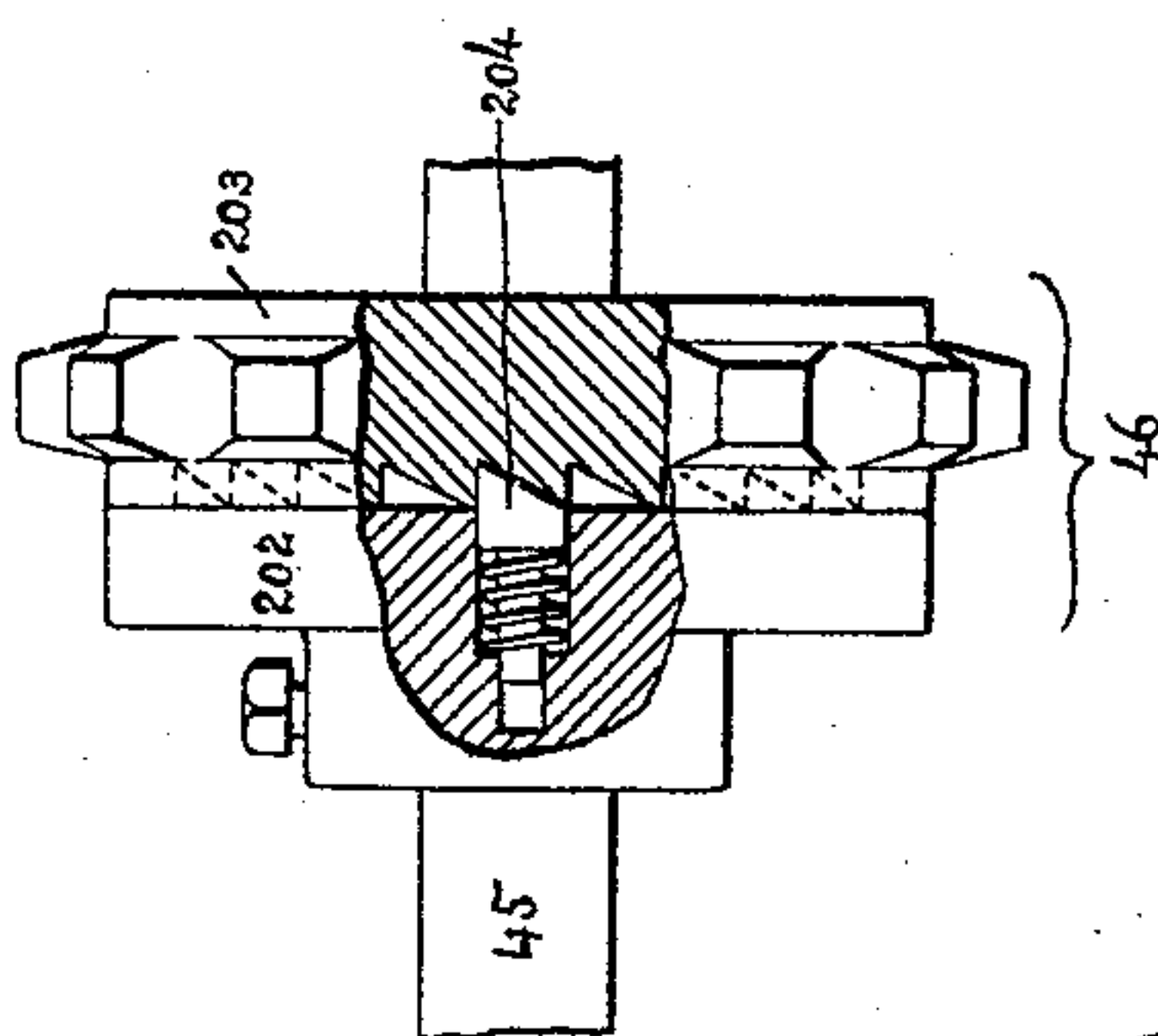


FIG. 11.



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6 Sheets—Sheet 4.

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AUTOMATIC KNITTING MACHINE.

No. 529,362.

Patented Nov. 20, 1894.

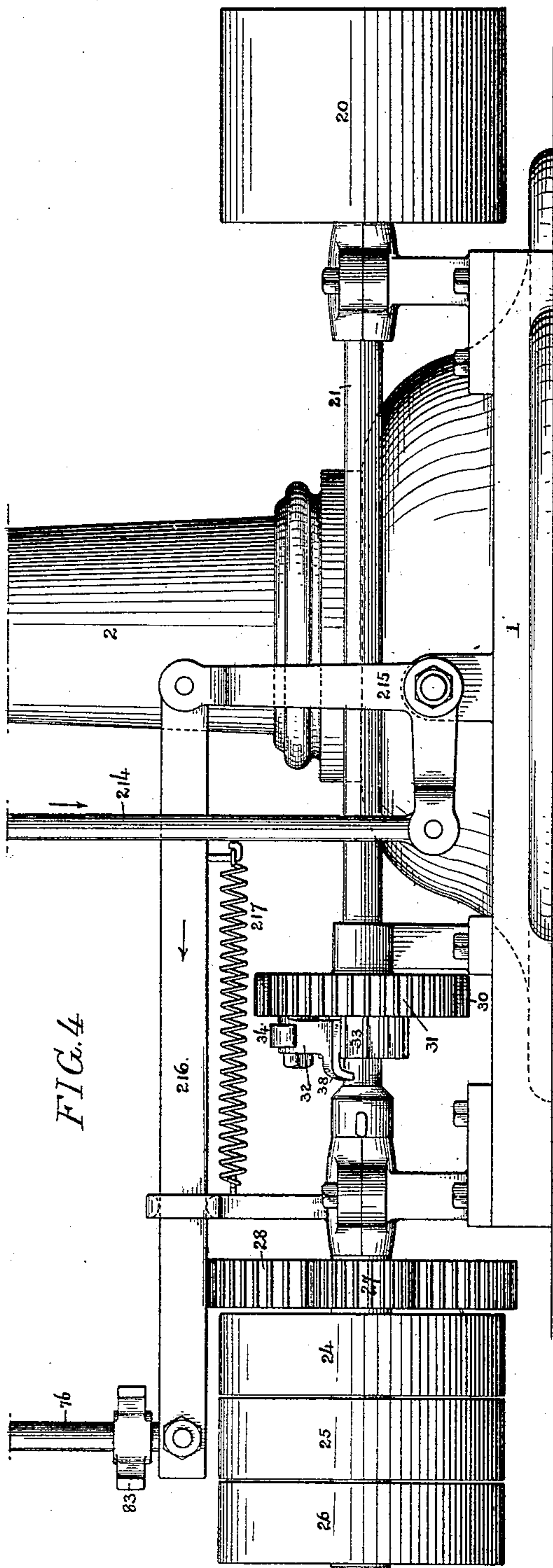


FIG. 4

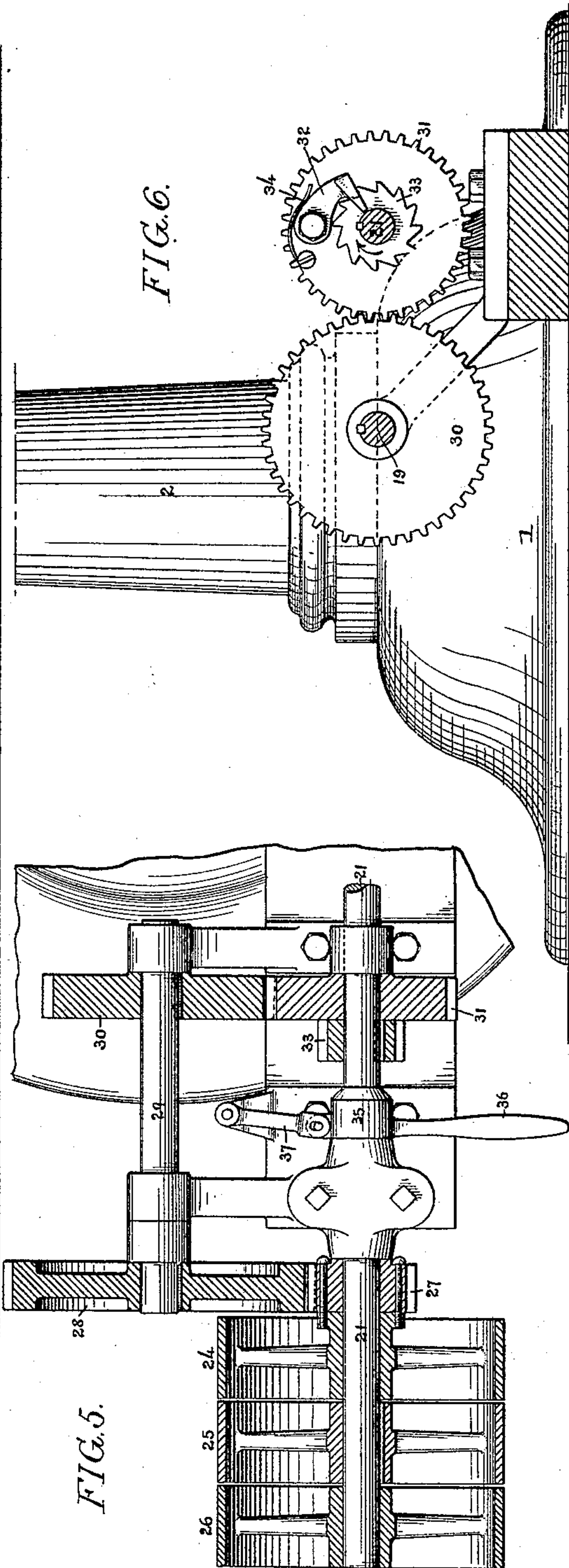


FIG. 6

FIG. 5

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AUTOMATIC KNITTING MACHINE.

No. 529,362.

Patented Nov. 20, 1894.

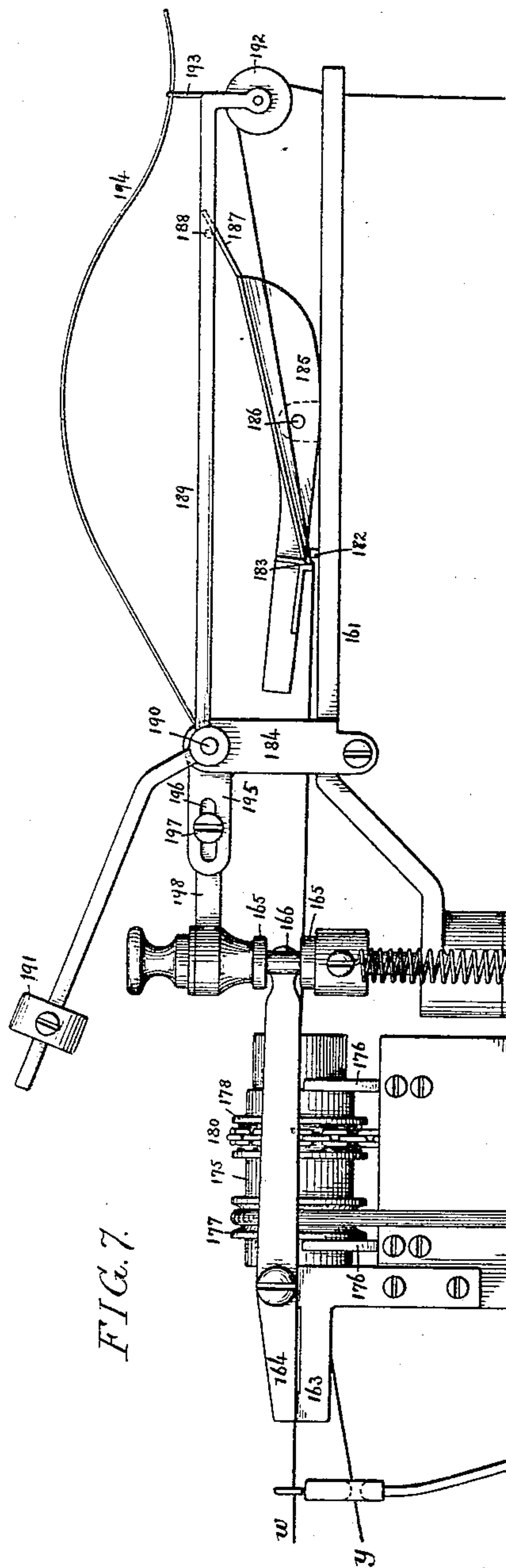


FIG. 7.

FIG. 9.

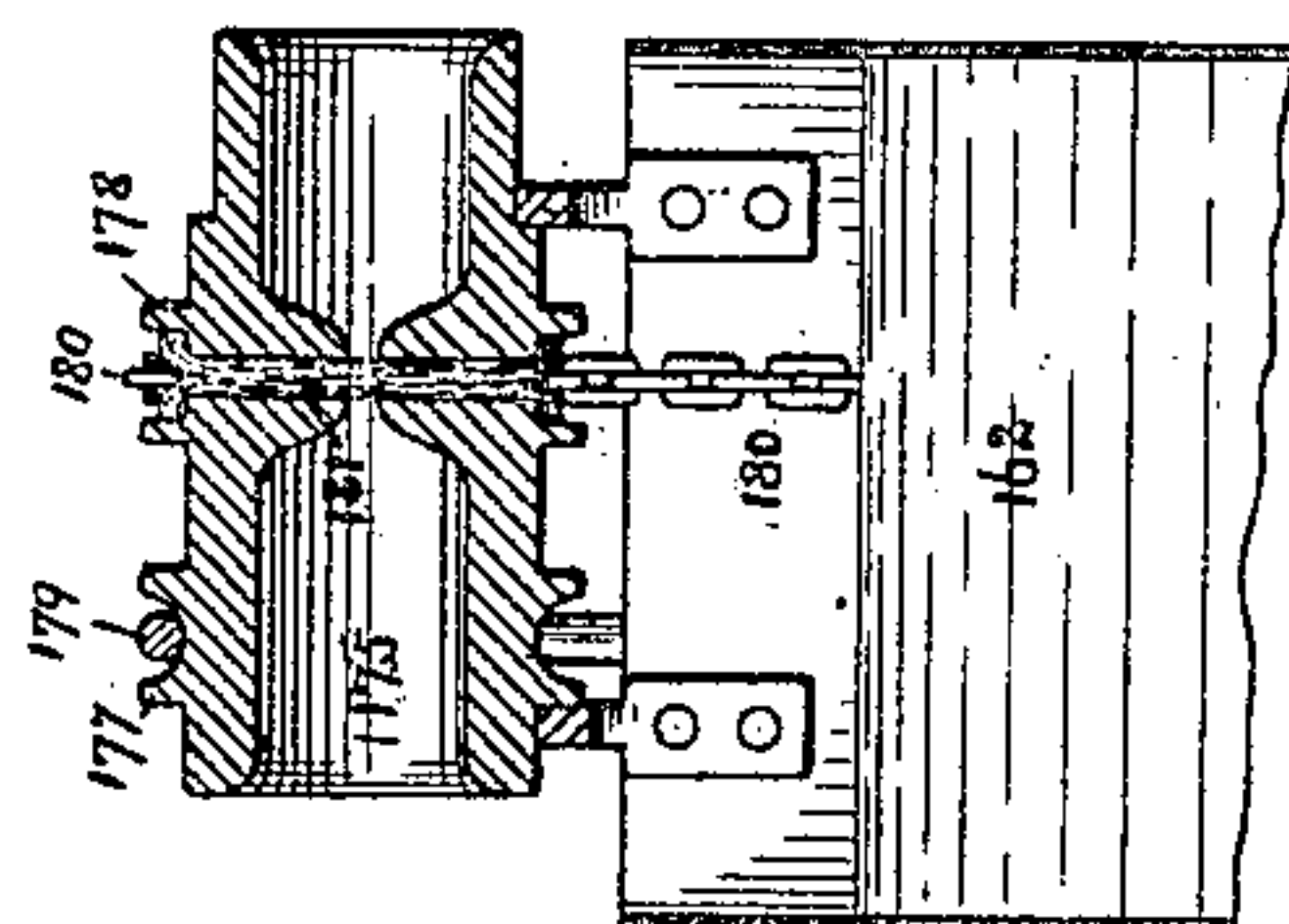


FIG. 8.

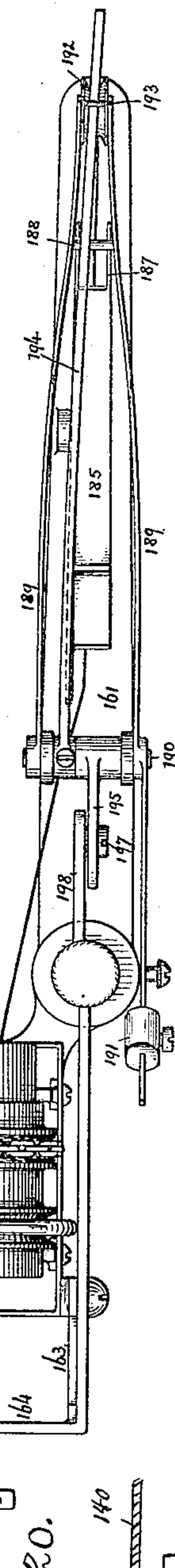
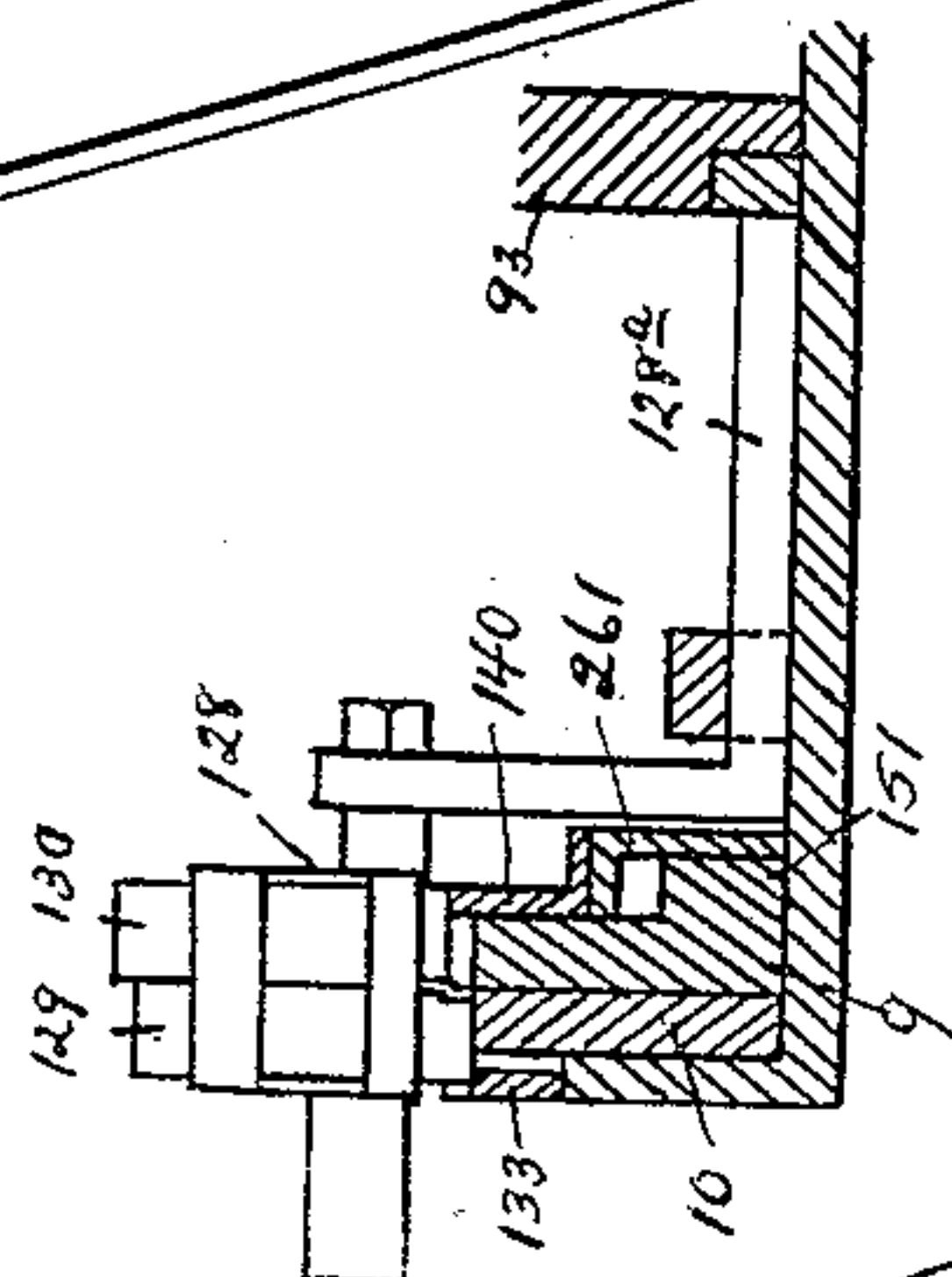


FIG. 20.

FIG. 28.



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AUTOMATIC KNITTING MACHINE.

No. 529,362.

Patented Nov. 20, 1894.

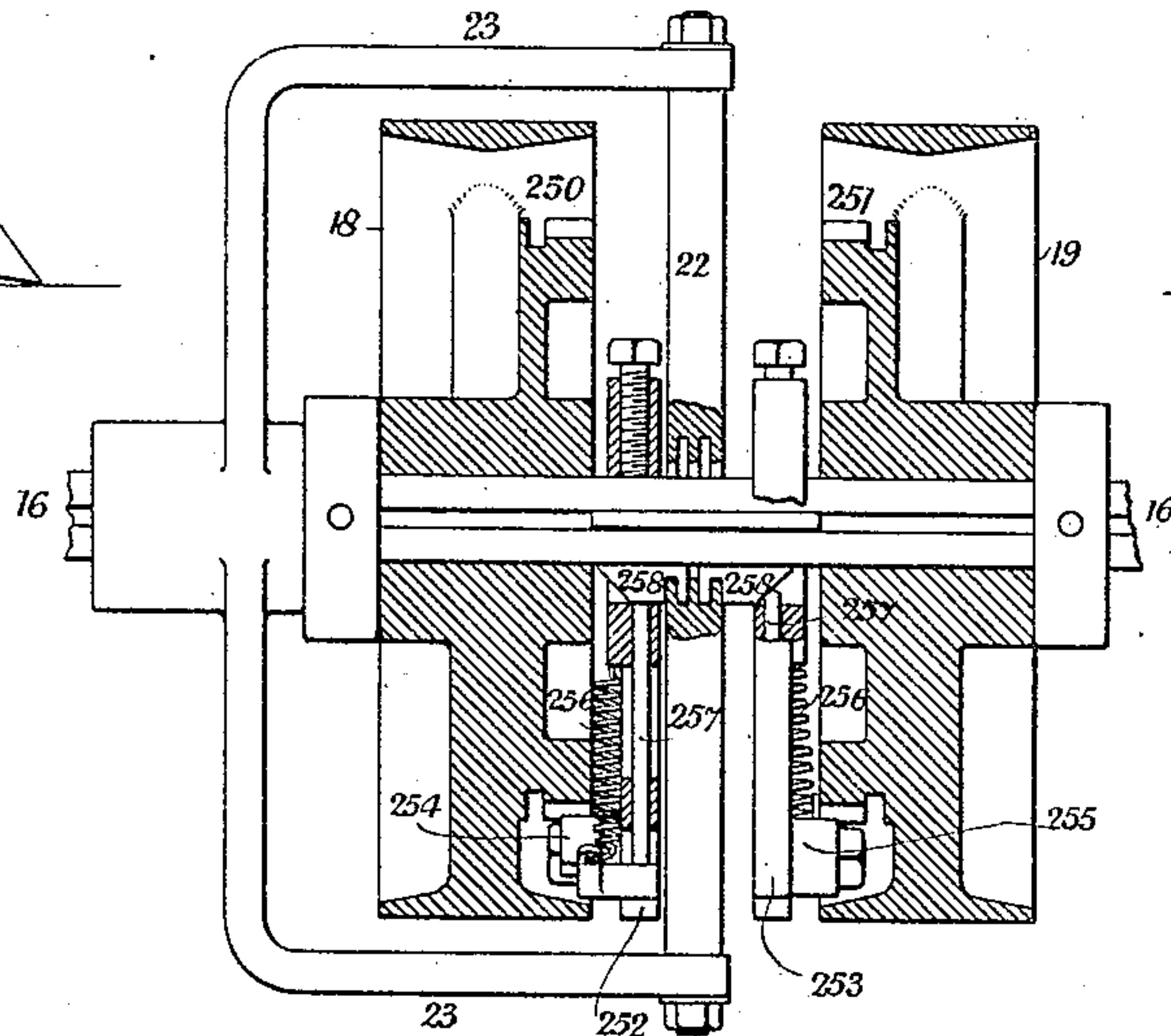
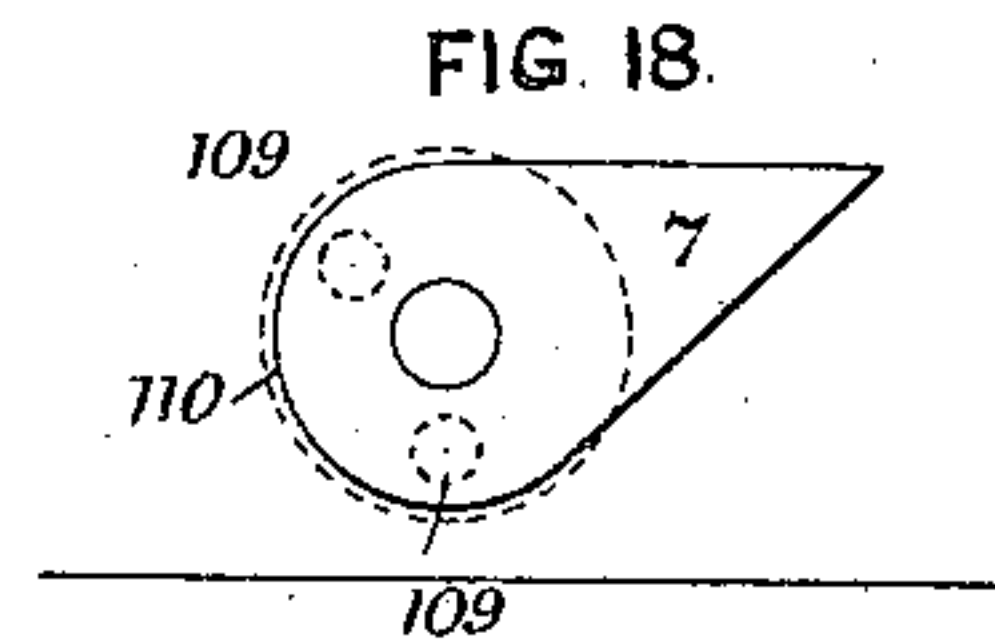
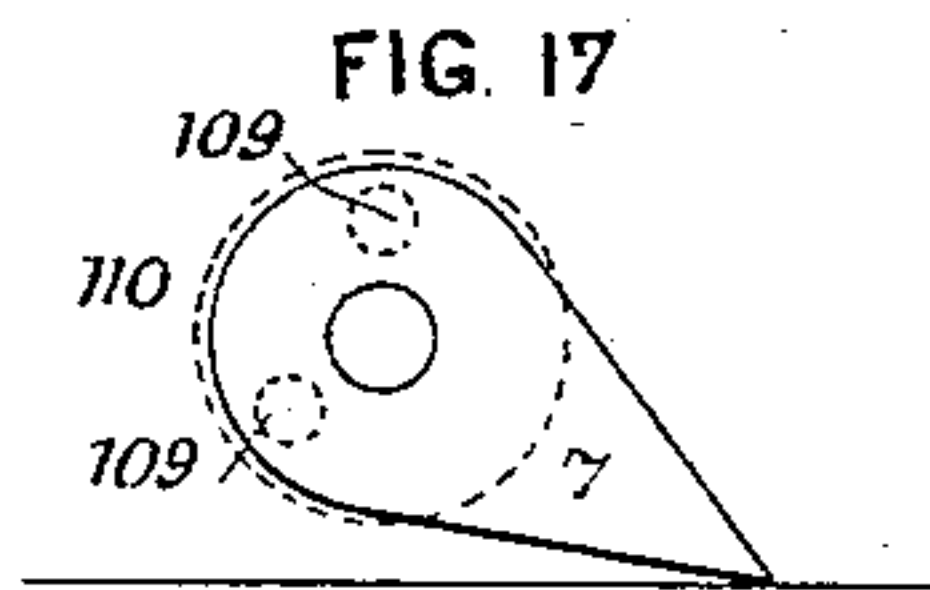


FIG. 22

FIG. 24

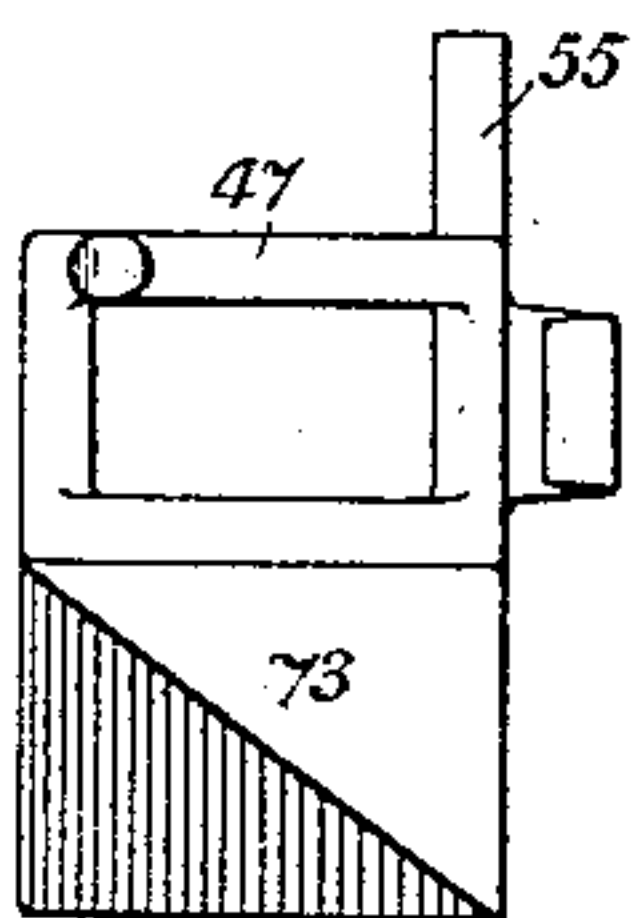


FIG. 23

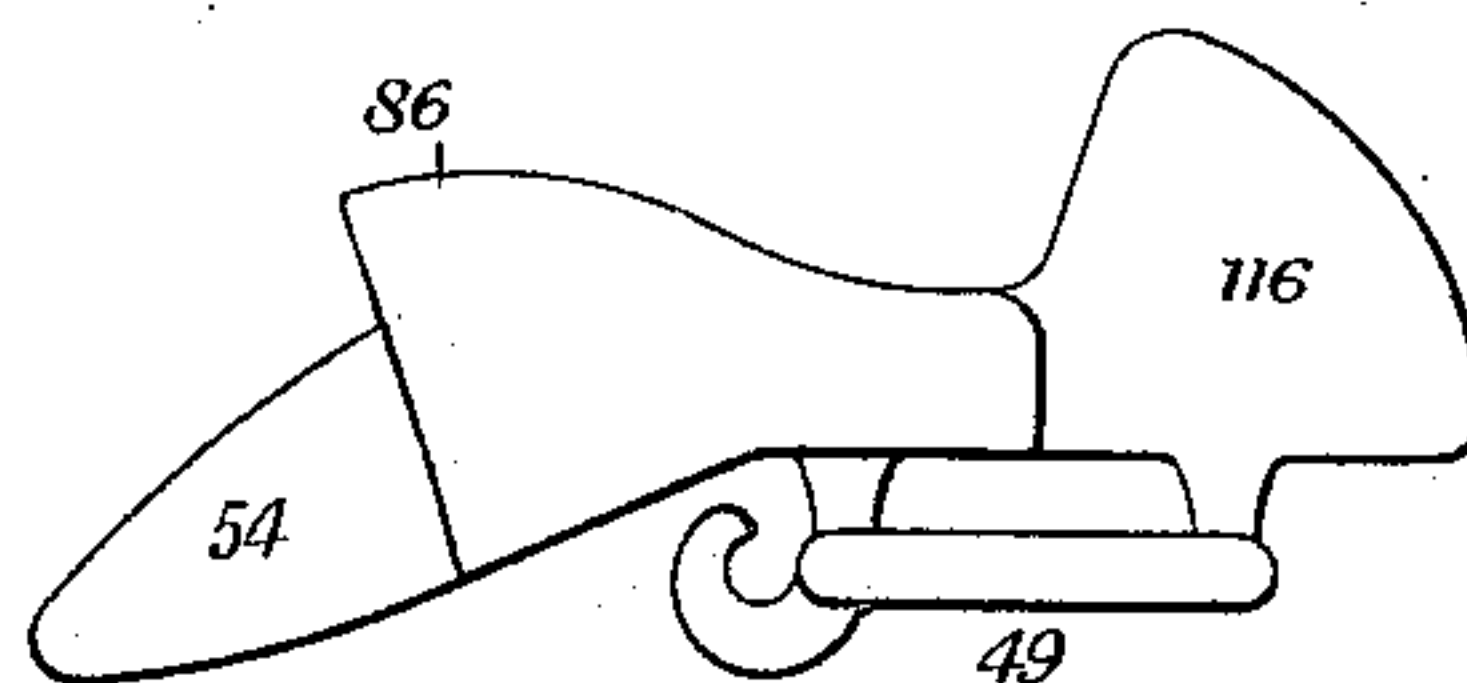


FIG. 25

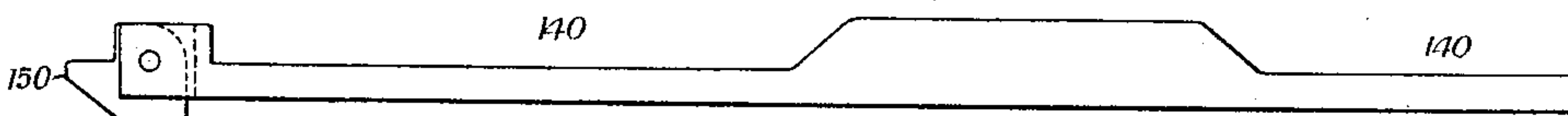


FIG. 26

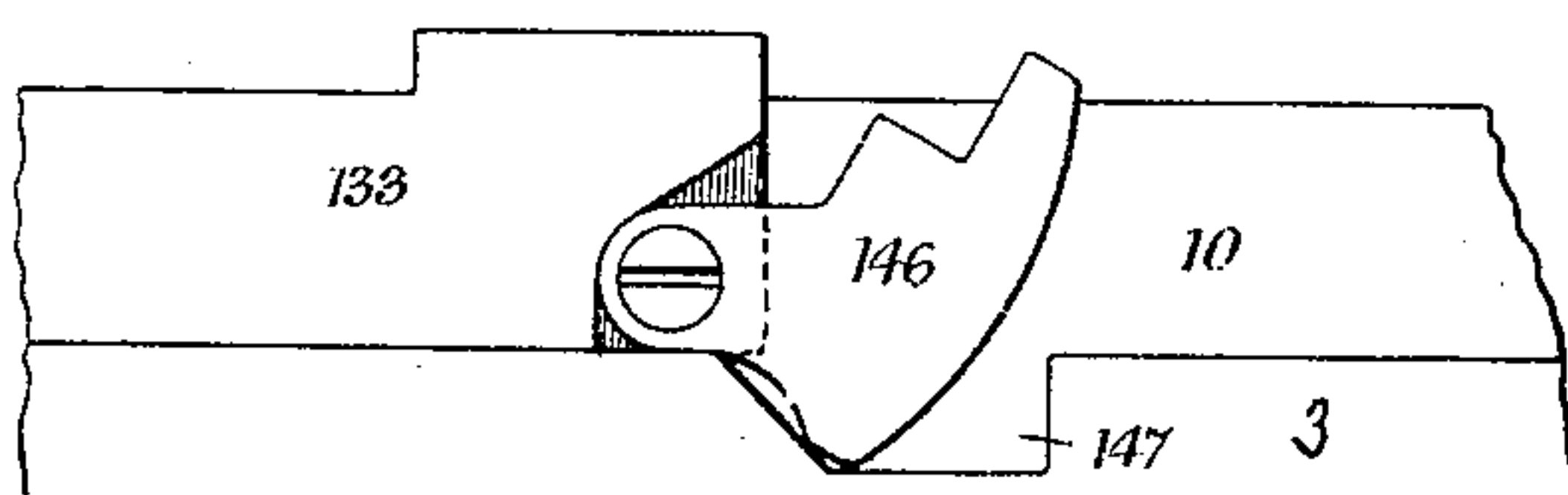
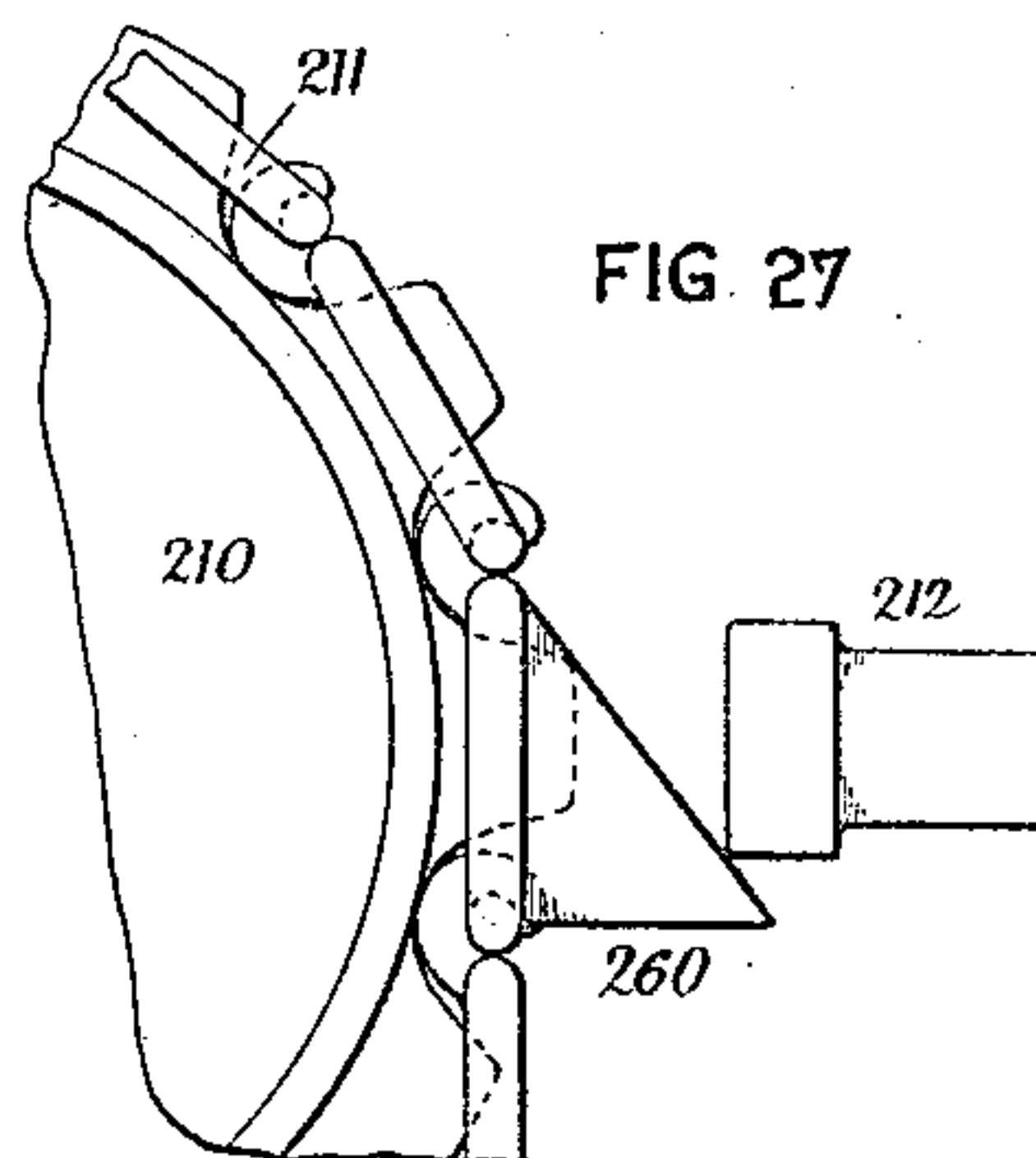


FIG. 27



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UNITED STATES PATENT OFFICE.

WALTER D. BUTZ, OF NORRISTOWN, PENNSYLVANIA.

AUTOMATIC KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 529,362, dated November 20, 1894.

Application filed April 3, 1893. Serial No. 468,882. (No model.)

To all whom it may concern:

Be it known that I, WALTER D. BUTZ, a citizen of the United States, and a resident of Norristown, Montgomery county, Pennsylvania, have invented certain Improvements in Automatic Knitting-Machines, of which the following is a specification.

My invention consists of certain improvements in the knitting machine for which I obtained Letters Patent No. 408,952, dated August 13, 1889, the character and objects of my present improvements being fully set forth and specifically claimed hereinafter.

In the accompanying drawings:—Figure 1 is an end view of my improved knitting machine, the needle cylinder and thread splicing devices being omitted. Fig. 2 is a view of part of the machine, looking in the direction of the arrow, Fig. 1. Fig. 3 is a sectional plan view of the machine on the line $x x$, Fig. 1. Figs. 4, 5, and 6 are enlarged views of part of the driving mechanism of the machine. Figs. 7, 8, and 9 are enlarged views of the thread feeding devices of the machine; and Figs. 10 to 28 are detached views illustrating special features of the invention, or details of construction, hereinafter referred to.

From the base 1 of the machine rises a column or pedestal 2 to the upper end of which is secured a table or bed 3 from which projects upwardly a tubular standard 4 and to the latter is secured the needle cylinder 4^a upon which is mounted, so as to be free to turn, the cam box 5 of the machine, said cam box being provided with cams for actuating the needles of the machine so as to cause the movements of the same necessary to receive the thread, draw new stitches and cast the old stitches, in the usual manner. As in the former machine, all of the needles of the needle cylinder 6 have bits y to be acted upon by said knitting cams and the needles around one-half of the head also have bits y' (Fig. 15) to be acted upon by a switch cam 7 (Figs. 3, 17, and 18) hereinafter referred to, which serves to lift the needles acted upon by it so as to carry the main bits y of the same out of the path of the knitting cams or so as to draw them down again into the path of said knitting cams after they have been lifted. The needles around the other half of the head constitute the fashioning set upon which the

fabric is knitted during the reciprocating motion of the machine for the formation of the toe and heel. The central needles of the fashioning set on which no widening or narrowing is effected have only the bits y as shown in Fig. 14, but the flanking needles of the set, as in the former machine, have supplementary bits y^2 (Fig. 16) to be acted upon by levers 8 which are pivoted to suitable bearings 8^a in the table or bed 3, and are acted upon by cams carried by cam slides 9 and 10 so that the needles under their control will be either raised free from the action of the knitting cams or lowered so as to be brought again under such action.

The cam box 5 has upon it a bevel wheel 11 which meshes with a bevel pinion 12 upon a short shaft 13 mounted in bearings on the table or bed 3, and on said shaft 13 is a spur pinion 14 which meshes with a spur wheel 15 on a shaft 16 adapted to bearings in suitable hangers 17 depending from the table or bed 3.

The shaft 16 has, at the outer end, two pulleys 18 and 19 one of which is driven by a straight belt and the other by a crossed belt from a wide pulley 20 on the primary driving shaft 21 at the base of the machine (see Fig. 4) so that one of said pulleys revolves to the right and the other to the left, both pulleys being loose on the shaft, but each being capable of being clutched to the shaft by means of clutching mechanism such as that set forth in my application for patent, Serial No. 454,880, filed December 12, 1892, the bar 22 which governs the operation of the clutch, being carried by a yoke 23 and the latter being actuated by mechanism such as described hereinafter, so that one pulley may be clutched to the shaft 16 during all of the time that continuous rotary motion of the cam box for the purpose of forming tubular web is required, the clutch being then operated so as to clutch first one pulley and then the other to the shaft 16, in order to impart to the latter the back and forth motion required during reciprocating or to and fro knitting for the purpose of forming the heel or toe pocket.

A general understanding of the construction and operation of the clutches may be had on reference to Fig. 22. The pulleys 18 and 19 both have ratchet wheels formed upon them, as shown at 250 and 251, one of these

wheels being right handed and the other left handed. Secured to the shaft 16 between the pulleys 18, 19, is a pair of arms 252 and 253, one of these arms carrying a pivoted pawl 254 for engaging with the ratchet wheel 250 and the other arm carrying a like pivoted pawl 255 for engaging with the other ratchet wheel 251. Springs 256 tend to keep the pawls in engagement with the ratchet wheels, but in each of the arms 252 and 253 is a sliding rod 257, bearing at its outer end against the pawl of said arm near the free end of the same, and acted upon at the inner end by a wedge 258 adapted to slide in the inner portion of the arm 252 or 253, each wedge being engaged by a flange of the operating bar 22, and the wedges facing in opposite directions, so that when the bar is moved in one direction the pawl of the arm 252 will be pushed out of engagement with the ratchet wheel 250, and the pawl of the arm 253 will be permitted to engage with the ratchet wheel 251, the reverse operation taking place on a reverse movement of the bar 22.

During the time that continuous rotary motion is being imparted to the cam box it is desirable that the speed of the same shall be considerably greater than during the reciprocating or to-and-fro movement. Hence I provide the primary driving shaft 21 with means whereby such change in the speed of the same can be readily effected in changing from one class of knitting to the other, such devices being shown in Figs. 4, 5 and 6, on reference to which it will be seen that the shaft 21 has at its outer end three pulleys 24, 25 and 26. The pulley 25 is keyed to the shaft but the pulleys 24 and 26 are loose thereon and secured to the hub of the pulley 24 is a spur pinion 27 which meshes with a spur wheel 28 on a short countershaft 29, the latter having a spur wheel 30 meshing with a spur pinion 31 loose on the shaft 21, but carrying a pawl 32 which engages with a ratchet wheel 33 keyed to said shaft, the pawl being held in engagement with the teeth of said ratchet wheel by means of a spring 34 (Fig. 6).

When the belt is upon the pulley 25 the shaft 21 is driven directly at high speed by said pulley, the direction of movement being that indicated by the arrow in Fig. 6, the teeth of the ratchet wheel 33 slipping past the pawl 32 so that the pulley 24 and the train of gears connected therewith can remain at rest. When, however, the belt is shifted onto the pulley 24 the latter drives the shaft 21 through the medium of the train of gears, the pawl and the ratchet, the movement being materially slower than that derived directly from the pulley 25 owing to the character of the gearing.

It may be advisable to stop the machine quickly during the time that the shaft 21 is being driven by the pawl 32 and the ratchet wheel 33. Hence I mount upon the shaft 21 a cone sleeve 35 having a handle 36 and connected by a link 37 to a stud on the base frame, this cone sleeve when thrust toward

the pinion 33 acting upon a toe 38 projecting from the pawl 32 and lifting the latter free from engagement with the teeth of the pinion.

The shaft 16 has a bevel wheel 40 meshing with a suitable bevel pinion upon a shaft 42 at right angles to the shaft 16 and said shaft 42 carries a worm 43 which engages with a worm wheel 44 upon a shaft 45 parallel with the shaft 16, and said shaft 45 carries at its outer end a sprocket wheel 46 to which is adapted a pattern chain 47, another sprocket wheel 48 turning loosely on the shaft and carrying a pattern chain 49, said sprocket wheel 48 being secured to or forming part of a spur wheel 50 to which is also connected a ratchet wheel 51, the operation of the latter, at the proper times, being effected by a pawl 52 hung to a crank arm 53 at the end of the shaft 16.

During the formation of round-and-round work the wheel 48 and its pattern chain are stationary and the pawl 52 is held out of engagement with the ratchet wheel 51 by means of a beveled cam 54 (Fig. 23) on said pattern chain, the chain 47 moving slowly with the shaft 45 during this time. Projecting from the chain 47 are pins 55, and when the proper length of tubular work has been produced, one of these pins comes into contact with a pin 56 on the pattern chain 49 and moves the same so as to withdraw the supporting cam 54 from beneath the arm 57 on the pawl 52 and thus permit the latter to drop into engagement with the ratchet wheel 51 so that motion is imparted to the latter and to the spur wheel 50 and pattern chain 49. The spur wheel 50 meshes with a pinion 58 on a short shaft 59 which is also geared by pinions 60 and 61 (Fig. 19) to a shaft 62 and the latter is provided with two oppositely set cams 63 and 64 which act upon the stems of sliding toes 65 and 66 guided in a slide bar 67 mounted in bearings in the hangers 17, springs 68 serving to depress the toes when the latter are not lifted by the cams. When either toe is lifted it is acted upon by a beveled cam on the spur wheel 15, the cam which acts upon the toe 65 being represented at 70 and that which acts upon the toe 66 being represented at 71. Hence, as the toes are alternately lifted they are alternately acted upon and the slide 67 is moved first in one direction and then in the opposite direction, this motion being transmitted by means of a lever 72 to the yoke 23 which controls the clutch shifting bar 22. Hence as soon as the operation of the spur wheel 50 begins, a reciprocating or to-and-fro motion takes the place of the rotating motion of the shaft 16 owing to the fact that said shaft is clutched to the pulleys 18 and 19 alternately. During this to and fro motion there is no forward movement of the pattern chain 47, as the movement of the shaft 16 is only sufficient to impart a very slight backward and forward movement of the shaft 45, but the same movement of the pattern chain 47 which starts the pattern chain 49 causes a beveled cam

73 (Fig. 24) on said pattern chain 47 to thrust outward a sliding bolt 74 connected to one arm of a lever 75 mounted upon a vertical rod 76 and having another arm which by this movement is brought under control of a catch 77 (Fig. 1) hung to a shaft 78 which has an arm 79 overhanging the pattern chain 47, a spring 80 on the shaft 78 tending to turn said shaft so as to depress the catch 77 and arm 79.

10 The vertical shaft 76 is free to turn in a swinging block 81 (Fig. 10) hung to a bearing 82 which is mounted in the manner described hereinafter upon the outer end of the shaft 45, and the vertical shaft 76 has at its lower end a forked guide 83 for the reception of the driving belt. During round and round knitting this belt is adapted to the fixed pulley 25 on the shaft 21, but the movement of the shaft 76 above described serves to shift the driving belt from the pulley 25 onto the pulley 24 which is connected with the slow speed gearing for the shaft 21. Hence at the same time that the movement of the shaft 16 is changed from a rotating to a to-and-fro motion, the speed of said shaft and the parts operated thereby, is diminished, it being always advisable to run the machine at a lower rate of speed during the formation of the heel or toe pocket than during the formation of continuous tubular work. As soon as the completion of a heel or toe pocket is effected the movement of the pattern chain 49 brings the cam 54 again under the toe 57 of the pawl 52 and lifts the latter out of engagement with the ratchet wheel 51 so that there is no further operation of the clutch shifter and the shaft 16 continues to rotate in the direction determined by the last position of the clutch. This again starts the pattern chain 47 and, as the first effect of this movement, one of a pair of cams 84 on said chain acts upon the arm 79 of the shaft 78 and lifts the catch 77 so as to release the lever 75, a coiled spring 85 connected at the upper end to a collar, 85^b, on the shaft, 76, and at the lower end to the arm, 81^a, on the bar, 216, then acting upon the shaft 76 so as to restore the same to its original position and shift the driving belt back on to the pulley 25 in order to increase the speed of rotation of the machine.

It will be seen that the chain 47 moves at a slow speed during the formation of tubular work and its pins 55 serve to throw into action the chain 49 when the heel and toe are to be produced, and at the same time to effect the change of speed of the machine desirable in changing from round and round knitting to to-and-fro knitting or back again. Upon the pattern chain 49 is a cam 86 and one of the first results of the movement of said chain 49 by contact of the pins 55 and 56 is to cause said cam 86 to lift a rod 87 guided in a suitable frame 88 secured to the fixed frame of the machine. Secured to the rod 87 is a cam 89 which when said rod 87 is lifted acts upon and pushes inward a rod 90 guided in suitable bearings on the under side of the table

or bed 3, the inner end of this rod acting upon an arm 91 hung to a pin 92 projecting from the fixed central portion 93 of the table or bed, another arm 94 connected to the arm 91 acting upon a lifter block 225, which is guided in a recess in the portion 93 of the bed, and supports an arm 95 hung to a ring 96 which surrounds the needle cylinder of the machine below the main cam box 5. The raising of the arm 95 brings a lug 98 on the same into range of a lug 99 on the cam box, and the last rotating movement of the cam box is thereby imparted to the ring 96, the arm 95 being supported upon the top of the projection 93 during such movement. The arm 91 carries a pawl 100 engaging with a ratchet wheel 101 upon a disk 102 which carries a series of projecting pins 103, these pins acting upon one arm of a lever 104 which is hung upon the pin 92, the other arm of said lever acting upon a sliding rod 105 guided in a bearing 106 on the central projection 93. From the sliding rod 105 projects a pin 107 (Fig. 3) and when the arm 91 is moved inward by the rod 90 the disk 102 is turned to such an extent as to carry one of its pins from beneath the lever 104 which is thereupon lowered by the action of a spring 108 so as to raise the rod 105 and its pin 107. This movement brings said pin into range of the upper of two pins 109 carried by a disk 110 mounted upon the ring 96, the shaft or spindle of this disk carrying at its inner end the cam 7 whereby the needles around one-half of the machine are thrown into and out of action. During the formation of tubular work the free end or point of this cam is down, as shown in Fig. 17. Hence when the ring 96 begins to move, said cam will act upon the supplementary bits of the needles around one-half of the head and will raise the same so that their main bits are out of range of the main knitting cams. Before the ring 96 has completed its rotation, a pin 111 on said ring strikes a toe 112 carried by a spindle 113 mounted in bearings on the central projection 93, the lower end of this spindle having a catch 226, which engages with the arm 91 on the inward movement of the rod 90 and retains said arm in its inward position after the cam 89 and rod 87 have been dropped by the withdrawal from beneath the same of the cam 86, a spring 227 acting on a pin on the spindle 113, to hold the catch 226 in retaining position. As soon as the arm 91 is released, therefore, it is moved by a spring 228 so as to cause the arm 94 to drop and lower the block 225 in the recess in the projection 93 so as to open said recess for the reception of the end of the arm 95 when the ring 96 has completed its rotation. Before this time, however, the upper pin 109 of the disk 110, strikes the pin 107 of the rod 105, and the disk 110 is thereby turned so as to raise the point of the cam 7, as shown in Fig. 18. On the completion of the heel or toe, the rod 90 is again operated so as to lift the arm 98 again into engagement with the stud 99 on

the cam box, and the ring 96 is again rotated, so that the cam 7 again draws down into operative position the needles which were inoperative during to-and-fro knitting. At the same time the rod 105 is lowered so that its pin strikes the lower pin of the disk 110 just before the ring 96 completes its turn, and thus restores the cam 7 to its original position, as shown in Fig. 17.

The rod 87 and its cam 89 can be lifted by hand at any time when desired by means of a lever 114 hung to a bracket on the main frame and engaging with said cam 89. Accidental forward movement of the pattern chain 49 is prevented by means of a friction bolt 115 acting on a beveled cam 116 on said pattern chain, as shown in Fig. 1, the bolt yielding to permit the passage of the cam 116, however, when the chain 49 is positively moved by the action of the pins 55 of the chain 47.

Hung upon the end of the shaft 62 is a lever 120 to which is secured a transversely projecting bar 121, both lever and bar having formed therein an opening for the passage of the shaft 16, said opening being large enough to permit the desired vibration of the lever without bringing the same into contact with the shaft. The bar 121 has opposite pawls 122 resting on pins 123 and held in contact with said pins by means of springs 124, as shown in Fig. 12, and on the shaft 16 is a cam 125 which, when said shaft has a to-and-fro motion imparted to it, acts alternately upon the pawls 122, the cam acting in the direction of the arrows in Fig. 12 in which direction the pawls are unyielding. Hence the bar 121 and lever 120 will by the action of the cam be moved first in one direction and then in the other direction, but when the shaft 16 rotates, the bar and lever will remain in position at one limit of movement, and one of the pawls will be tripped by the cam as it rotates. The lever 120 has at the upper end a spherical head 126 which has a bearing between semi-spherical jaws 127 on a reciprocating pawl carrier 128, said carrier being secured to the outer end of a radius arm 128^a and having at one end two vertically guided pawls 129 and 130 and at the other end two pawls 131 and 132 similar to the pawls 129 and 130 but facing in the opposite direction. The pawls 129 and 131 serve by engagement with the teeth around the upper edge of the outer cam slide 10 to move said slide in one direction or the other and the pawls 130 and 132 perform a like office for the inner cam slide 9, it being understood, of course, that one pawl only of each slide is in action at one time. In order to provide for tripping the pawls so that they will be in action alternately, a tripping plate 133 with cams for acting upon the outer pawls 129 and 131 is mounted and guided in suitable lugs 134 on the bed 3, as shown in Fig. 1, set screws 135 projecting from the tripper plate through slots 136 in the lugs 134, springs 137 being interposed between the heads of these set

screws and washers 138 bearing on the faces of the lugs so as to serve as friction brakes to prevent accidental movement of the tripper plate in either direction. A like tripper plate 140 (Figs. 3 and 25) is employed in connection with the pawls 130 and 132 which act in conjunction with the inner cam slide, said tripper plate 140 having slots 141 for the reception of set screws 142 secured each to a support 261 on the table or bed 3, this support being recessed as shown in Fig. 28 for the passage of a lug 151 carried by the inner cam slide 9 and referred to hereinafter. As shown in the drawings, the outer cam slide has just reached the limit of its movement in the direction of the arrow *a*, Fig. 3, under the influence of the pawl 129, and the inner cam slide has reached the limit of its movement in the direction of the arrow *b* under the action of the pawl 132. In completing its movement in the direction of the arrow *b* a pin 143 upon the inner slide 9 strikes the trip plate 140 and moves the same in the direction of the arrow *d* (Fig. 3) so as to raise the pawl 132 out of action and drop the pawl 130 into action so that on the next forward movement of the pawl carrier 128 in the direction of the arrow *f* (Fig. 3) there will be a like movement of the inner slide 9. As there must not be any movement of the outer slide 10 in this direction, however, and as the slide 133 has not yet been shifted so as to lift the pawl 129 out of action, said pawl rests upon an inclined tooth 144 of the said slide 10 (Fig. 1) so that the first movement of the carrier 128 in the direction of the arrow *f* does not cause any movement to be imparted to the outer cam slide 10. A pivoted finger 145 on the inner cam slide 9, however, engages with a hooked catch 146 pivoted to the trip plate 133 when the rings are in the position shown in Figs. 1 and 3. Hence the first movement of the slide 9 in the direction of the arrow *f* causes a movement of the trip plate 133 in the same direction owing to this engagement of the finger 145 and hooked catch 146, thus throwing the pawl 129 out of action and allowing the pawl 131 to drop into action. The pivoted catch 146 then drops into a recess 147 in the table or bed 3 as shown in Fig. 26 so that the toe 145 is permitted to pass over the same on the continued movement of the cam slide 9. When the slides 9 and 10 reach their limit of movement in the opposite direction the trip plate 133 is moved back to its original position by contact of a bracket 148 on the slide 10 with the end of the catch 146, said catch and recess being suitably beveled so as to permit the catch to rise out of the recess. Just before the inner slide 9 reaches the limit of its movement in a direction the reverse of that indicated by the arrow *d*, Fig. 3, a lug 151 projecting inward from said slide acts upon and moves to the position shown in Fig. 20, a pivoted catch 150 at the end of the trip plate 140, and just before the outer slide 10 reaches the limit of its move-

ment in the direction of the arrow *g*, a pivoted finger 149 carried by the bracket 148 passes over said pivoted catch 150 and engages with the other side of the same. When the outer slide 10 again commences to move in the direction of the arrow *a*, therefore, it will carry the trip plate 140 with it until the catch 150 drops from the end of the lug 151, thus moving the trip plate 140 sufficiently to throw out of action the pawl 130 and permit the pawl 132 to drop into action again.

The levers 8 are acted upon successively by cams on the cam slides 9 and 10 as in my former machine so as to throw out of action successively the needles of the acting set and then bring these needles into action again successively, but in reverse order, and when the cam box is making its last reciprocation in the direction of the arrow *h* (Fig. 3) I find it advisable to bring into action not only the last needle of the fashioning set on that side, but also the adjoining needle of the inactive set, for I find that by this means the formation of an objectionable opening in the web is prevented. In order, therefore, to provide for thus bringing into action one of the inactive needles the outermost lever 8 of the set at one side of the machine has mounted upon it so as to be free to slide longitudinally a bar 152, and sometime before the cam of the slide 10 is in position to act upon said end lever 8, this bar has been thrust inward by means of a cam 153 on said slide 10 (see Fig. 13) so that its inner end will engage with a supplementary bit y^2 formed upon the end needle of the inactive set, and similar to the supplementary bits formed upon the fashioning needles for the action of the lever 8. Hence, when said end levers is actuated by the cam of the slide 10 the bar 152 will be likewise actuated and the needle of the inactive set adjacent to the end needle of said fashioning set will be drawn down into action with the latter. In order to again withdraw the bar 152 so that it will not interfere with the lifting of the inactive needle out of action by the cam 7 the inner cam slide 9 has a projecting finger 154 with cam 155 which acts upon a lug 230 at the outer end of the bar 152 as said inner cam slide 9 begins its movement in the direction the reverse of that indicated by the arrow *b*. (See Fig. 13.)

In changing from round-and-round to to-and-fro knitting it is advisable to feed into the machine along with the main knitting thread a supplementary or reinforcing thread so that the heel and toe portions of the stocking will be heavier than the leg and foot portions. In order that this may be done I provide the table or bed 3 at one side with an upwardly projecting tubular spindle 160 which carries at its upper end an arm 161 and a box or receptacle 162, and upon the latter is mounted a nipping device consisting of a fixed lower jaw 163 and a pivoted upper jaw 164, the reinforcing thread *w* being fed between these jaws but the main knitting thread *y* passing under the fixed jaw 163 so that it

is not affected by the action of said jaws, both threads following the same course after leaving the jaws, as shown in Fig. 7. The pivoted upper jaw has a rearwardly extending arm engaged by collars 165 on a rod 166 which passes down through the hollow standard 160, the lower end of said rod being adapted to be acted upon by a cam 167 which acts as a lifter for said rod and is carried by an arm 168 hung to the inner cam slide 9. On the first movement of the cam slides 9 and 10, a cam 169 on the outer slide 10 acts upon said arm 168 and pushes the same inward so as to withdraw the cam 167 from beneath the rod 166 and permit the latter to drop, thereby raising the jaw 164. At the same time the cam 167 acts upon the bent end of an arm 170 on a rocker spindle 171, which has, beneath the table or bed, an arm 172, and this movement brings said arm into the path of a cam 173 on the right angled shaft 42. (See Fig. 2.) During the reciprocating motion of the machine this cam has no effect upon the arm 172, but as soon as the machine commences to rotate, said cam will act upon the arm 172 and rock the spindle 171 so as to cause its arm 170 to again thrust the cam 167 under the rod 166 and thereby raise the same so as to cause the jaw 164 to again nip and hold the supplementary knitting thread.

The object of using the cam 173 and the rocker spindle with its arms for the purpose of restoring the cam 167, is to defer the breaking off of the supplementary thread until such time as the heel or toe is fully completed and round-and-round knitting has actually been resumed.

Both the main and supplementary knitting threads pass through a tube 175 which is mounted in lugs 176 on the box 162 and has two grooved collars or flanges 177 and 178. The first of these receives a belt 179 which can be adapted to any convenient rotating shaft of the machine so as to impart rotating movement to the tube 175, the other grooved collar 178 carrying a chain 180 which hangs down within the box or receptacle 162.

The grooved collar 178 is partially filled with absorbent material upon which the chain 180 has its bearing, and strands of this absorbent material pass through openings 181 in the tube 175 and extend to or almost to the center of said tube so that the threads passing through the tube are compelled to pass between and in contact with the inner ends of these strands.

The box or receptacle 162 contains oil, and as the tube 175 is rotated the chain 180 carries up small portions of this oil and the textile lining or filling of the grooved collar 178 and its inwardly extending strands become saturated with the oil, which is transferred to the threads passing through the tube. The threads pass between lugs 182 and 183, said lug 182 being carried by the arm 161 secured to the upper end of the hollow standard 160 and the lug 183 being carried by the long arm

of a lever 185 which is hung to a pin 186 carried by brackets on the arm 161, the short arm of the lever having a projection 187 adapted to be acted upon by a pin 188 on a forked lever 189 mounted upon a rock shaft 190 which can turn in bearings in arms 184 projecting upward from the arm 161.

The short arm of the lever 189 has an adjustable counter-balance weight 191 and the outer end of the long arm of said lever has a guide pulley 192 and a loop 193 with which engages a spring 194 secured at its inner end to a collar on the rock shaft 190. Secured to said shaft is an arm 195 having a slot 196 for the reception of a pin 197 on an arm 198 projecting from the upper end of the rod 166. When, therefore, said rod 166 is lifted so as to close the nipping jaws 163 and 164 the outer end of the spring 194 will be lowered so as to permit the long arm of the lever 189 to drop to the position shown in Fig. 7, the pin 188 acting upon the projection 187 of the lever 185 so as to lift the lug 183 and subject the main knitting thread to but a moderate amount of tension. When, however, the rod 166 is depressed so as to open the jaw 164 and thus permit the supplementary knitting thread *w* to be drawn forward along with the knitting thread *y* the outer end of the spring 194 is lifted so as to carry with it the outer end of the lever 189, thus permitting the long arm of the lever 185 to drop and cause the lugs 182 and 183 to impart increased tension to the threads passing between them so as to knit the heel or toe portion of the stocking stiffer than the leg and foot, the lever 189 being free to yield under the action of the spring 194 so as to serve as a take-up for the slack thread during to-and-fro knitting.

In carrying out my invention various modifications in detail may be adopted without departing from the main principles of the invention. For instance, instead of using the cam shaft for operating the sliding blocks of the belt shifter, a sliding rod 231 having cams 232 for operating said blocks may be employed, as shown in Fig. 21, for instance, this rod being actuated in one direction by a spring 233 and in the other direction by cams 234 upon the back of the spur wheel 50, or such slide rod might be connected directly to the belt shifter if desired.

The method of hanging the box 82 upon the end of the shaft 45 is shown in Fig. 10, on reference to which it will be seen that the box is confined longitudinally to the shaft by means of a screw 200 and has projecting ears for the reception of the pivot pin 201 whereby the swinging box 81 for the shaft 76 is secured to the block 82.

The sprocket wheels 46 and 48 are not rigidly secured to the shaft 45 but are each composed of two parts, namely, a disk 202 secured to the shaft, and a disk 203 loose on the shaft and carrying the sprocket teeth, that face of this disk which is adjacent to the disk 202 having ratchet teeth for engagement with a

spring actuated pawl 204 contained in a recess in the disk 202 as shown in Fig. 11, so that while the disk 203 is caused to move forward with the disk 202 the chain can be moved forward by hand to any desired extent without imparting movement to said disk 202 so that in case of any defect in the work, the defect can be remedied and the chain re-set by hand without necessitating a slow rotation of the chain to the desired point by means of the shaft 45.

Undue movement of either of the cam slides 9 or 10 is prevented by means of a spring bolt 205 engaging with openings 206 in the face of the slide, as shown in Fig. 1, these openings being spaced to accord with the teeth of the racks formed upon said slide.

The mechanism for stopping the machine when the stocking has been completed is best shown in Figs. 1, 2 and 4, and is as follows: On the shaft 45 is a sprocket wheel 210 which carries a chain 211 and on the latter, as in the former machine, is a cam 260 (Fig. 27) for acting upon an arm 212 carried by a spring catch 213 depending from the table or bed 3 of the machine, this catch engaging with a rod 214, the lower end of which is connected to one arm of a bell crank lever 215 hung to a stud on the base of the machine, as shown in Fig. 4, the other arm of said lever being connected by a bar 216 to the lower end of the shaft 76 which carries the belt shipper, a spring 217 tending to draw the rod 216 in the direction of the arrow (Fig. 4) so as to throw the belt onto the loose pulley 26 and to impart a constant downward pressure to the rod 214. When, therefore, the cam on the chain 211 pushes outward the spring catch 213, the rod 214 is released and the belt is shifted on to the loose pulley 26 in order to stop the machine. The rod 214 has a pin 218 which is acted on by the end of a lever 219 having a slot for the reception of a pivot pin 220 carried by a bracket 221 depending from the table or bed 3, this lever also having a lug 222 for acting upon the lower end of the spring catch 213. The lever can thus be swung upon its pivot so as to lift the rod 214 into position to engage with the catch 213 in order to start the machine, or when it is desired to stop the machine by hand the lever can be pulled outward so as to withdraw the catch 222 from engagement with the rod 214 and thus permit the shifting of the belt on to the loose pulley.

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

1. The combination of the cam cylinder, a shaft geared thereto and having two pulleys, one rotated in one direction and the other in the opposite direction, a duplex clutch whereby either of said pulleys may be clutched to the shaft simultaneously with the release of the other pulley, a clutch shifting rod or bar, a wheel having cams on its opposite sides, movable toes on the clutch shifter, and means for moving one of said toes into

the path of one of the cams of the cam wheel simultaneously with the movement of the other toe out of the path of the other cam, substantially as specified.

5 2. The combination of the driving shaft of the machine having two belt pulleys, one connected directly to said shaft, a system of reducing gears whereby the other pulley is geared to the shaft, a belt shipper, a lever for
10 moving the same in one direction, a spring for moving it in the opposite direction, a catch for retaining the lever in one of its positions, a pattern chain having two cams, means for actuating said chain, and devices whereby one
15 of the cams is caused to operate the lever of the belt shipper and the other to trip the retaining catch, substantially as specified.

3. The combination of the driving shaft of the machine having two pulleys, one secured
20 to said shaft and the other loose thereon, a ratchet wheel secured to the shaft, and a system of reducing gears, that at one end of the system being secured to the loose pulley and that at the other end having a pawl for en-
25 gagement with the ratchet wheel, substantially as specified.

4. The combination of the driving shaft of the machine, a pair of belt pulleys, one se-
30 cured to said shaft, and the other loose thereon, a ratchet wheel secured to the shaft, a system of reducing gears, that at one end of the system being secured to the loose pulley, and that at the other end having a pawl for en-
35 gagement with the ratchet wheel, a sliding cone for throwing said pawls out of engagement with the ratchet wheel, and means for operating said cone, substantially as specified.

5. The combination of the driving shaft of the machine, a belt pulley secured to said
40 shaft, a loose pulley connected to the shaft by a system of reducing gears, a pulley disconnected from the shaft, a belt shipper free to turn in a swinging block, means for turning
45 said belt shipper so as to shift the belt from one to the other of the two driving pulleys, and mechanism for causing the swinging of the belt shipper on its pivots in order to transfer the belt to the disconnected pulley, substantially as specified.

50 6. The combination of the cam box of the machine, the ring having a cam for shifting certain of the needles into and out of operative position, a projection on the cam box, a clutch arm on the shifter cam ring, a pattern
55 chain and means whereby said chain is caused to operate said clutch arm at intervals so as to clutch the shifter cam ring to the cam box and cause simultaneous rotation of the two, substantially as specified.

60 7. The combination of the cam box of the machine, the cam ring having a shifter cam for moving certain of the needles into and out of operative position, a projection on the cam box, a clutch arm on the cam ring for
65 engaging with said projection, a fixed and recessed support serving as a bearing for said clutch arm during the time that it is in en-

gagement with the projection on the cam box, a block acting upon the free end of the arm and working in the recess in said support, a
70 pattern chain, and means whereby said chain is caused to operate the block so as to lift the arm or permit it to drop into the recess in the support, substantially as specified.

8. The combination of the cam box, the
75 ring having a cam for shifting certain of the needles into and out of operative position, a projection on the cam box, a clutch arm on the shifter cam ring adapted to engage with
80 said projection, a support serving as a bearing for said arm during the time that it is rotated with the cam ring, mechanism for lifting said clutch arm into operative connection with the cam box, a catch for retaining said mechanism in such position, and a projection
85 on the shifter cam ring for tripping said catch, substantially as specified.

9. The combination of the cam box, a ring having a cam for shifting certain of the nee-
90 dles into and out of operative position, a projection on the cam box, a clutch arm on the ring for engaging with said projection, a reversing device for the needle shifting cam of the cam ring whereby said cam is moved into
95 position either to raise or lower the needles, and means for operating said clutch arm and reversing device, substantially as specified.

10. The combination of the cam box of the machine, a ring having a cam for shifting cer-
100 tain needles of the machine into and out of operative position, a projection on the cam box, a clutch arm on the shifter cam ring for engaging with said projection, a reversing device for the needle shifting cam having as one
105 of its elements a ratchet wheel, mechanism for operating the clutch arm, and means whereby the movement of one of the arms of said mechanism is imparted to the ratchet wheel, substantially as specified.

11. The combination of the needle cylinder
110 and its needles, the cam box, the radiating levers for operating the needles, the cam slides for actuating said levers, a reciprocated pawl carrier having two pairs of pawls, one pair for each cam slide, and pawl tripping plates
115 whereby one pawl of each pair is thrown out of action simultaneously with the throwing into action of the other pawl of the pair, substantially as specified.

12. The combination of the needle cylinder
120 of the machine, and its needles, the cam box, the radiating levers, cam slides for actuating the same, a reciprocated pawl carrier having two pairs of pawls, one pair for each cam slide, pawl tripping plates, projections on the
125 cam slides for moving these tripping plates positively in one direction, and trip catches whereby the cam slides move the pawl tripping plates in the other direction and then release the same, substantially as specified. 130

13. The combination of the cam slides hav-
ing racks, the reciprocated pawl carrier hav-
ing two pairs of pawls, one pair for each cam slide, pawl tripping plates, and means for op-

erating the same, one of the teeth in the rack of one cam slide being beveled and the others abrupt, substantially as specified.

14. The combination of the needle cylinder of the machine and its needles, the radiating levers acting on said needles, the cam slides for actuating said levers, the pawl carrier having two pairs of pawls, one pair for each cam slide, a lever connected to said pawl carrier, pawls carried by said lever, and each free to yield in one direction, and a cam for acting upon said pawls so as to vibrate the lever, substantially as specified.

15. The combination of the cam slides of the machine, means for moving the same, nipping jaws for the supplementary knitting thread, an operating rod for said nippers, a lifter for said rod carried by one of the cam slides, an arm for acting upon said lifter, and a cam with intermediate mechanism for moving said arm when the lifter is in position to be acted upon thereby to raise the operating rod, and means for moving said lifter to drop said rod, substantially as described.

16. The combination of the tube through which the thread passes, absorbent material carried by said tube and projecting into contact with the thread, means for rotating the tube, and means for supplying oil to said absorbent material, substantially as specified.

17. The combination of an oil reservoir, a tube mounted above the same and serving as a thread passage, means for rotating said tube, a grooved wheel or flange formed on the tube and having a lining of absorbent material with portions projecting inwardly into contact with the thread, and a chain adapted to said grooved wheel or flange, and depending into the oil reservoir, substantially as specified.

18. The combination of the nipper for the supplementary knitting thread, a rod for op-

erating said nipper, a lever having a guide for the threads at its outer end, a spring acting upon said lever so as to lift the outer end of the same, and a connection between the spring-actuated lever and the nipper operating rod, whereby the outer end of the lever is raised by the spring on the opening of the nippers, but is lowered on the closing of the same.

19. The combination of the nippers for engaging with the supplementary knitting thread, a rod for operating said nippers, a lever having a guide for the threads, means for raising and lowering said lever, and a lever having a bearing for the threads and a projection for engagement with the thread guiding lever, whereby tension upon the threads is changed as said lever rises and falls, substantially as specified.

20. The combination of the nippers for the supplementary knitting thread, a rod for operating said nippers, a lever having a guide for the knitting threads, and a spring acting on said lever and connected to the nipper operating rod, substantially as specified.

21. The combination of the needle cylinder and its needles, the levers for moving said needles into and out of operative position, cam slides for acting upon said levers, a slide carried by the end lever of one set and adapted to engage the first needle of the inactive set, and cams carried by the cam slides and serving to move this slide into and out of operative position, substantially as specified.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WALTER D. BUTZ.

Witnesses:

JOSEPH H. KLEIN,
HARRY SMITH.