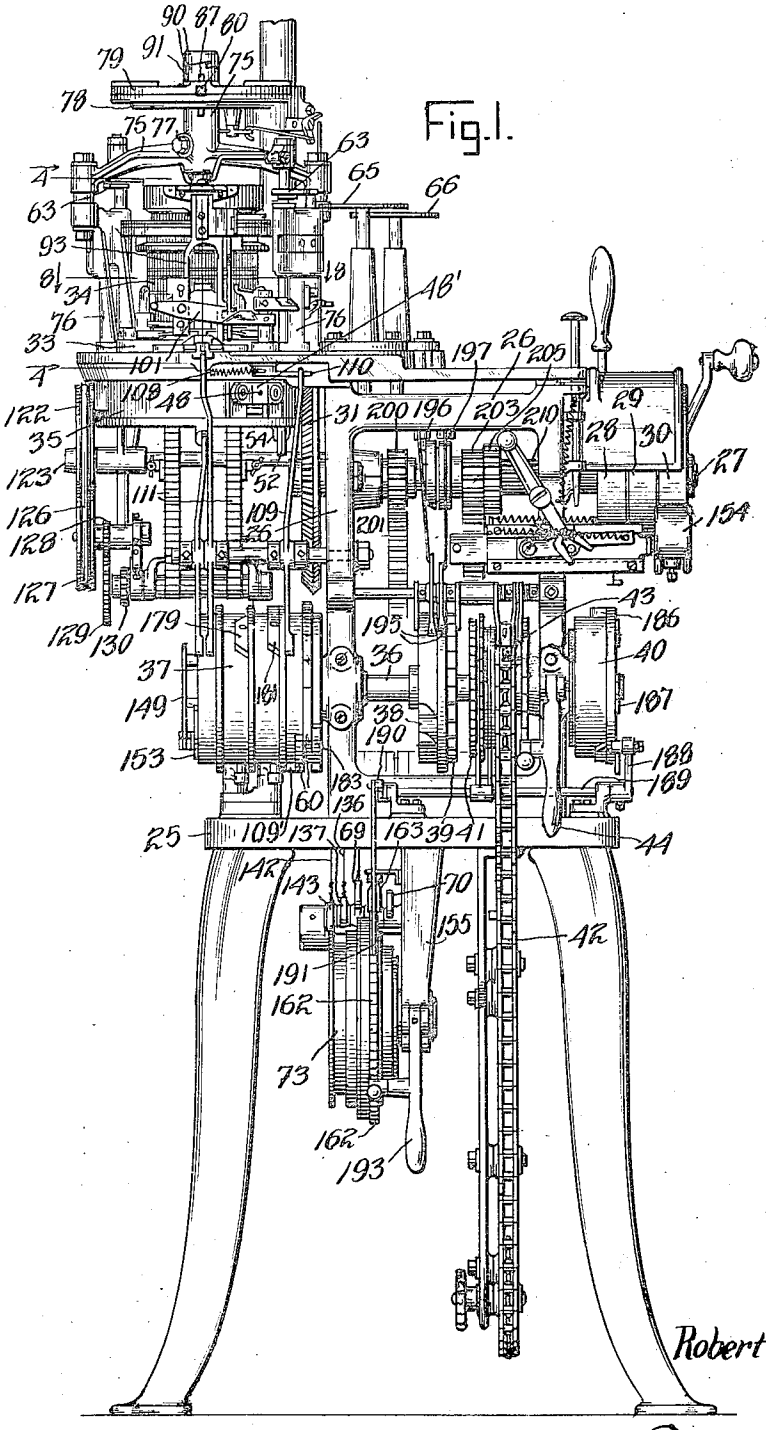
Jan. 2, 1934. R. S. BEAVERS 1,942,322

KNITTING MACHINE

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Fig. 1.



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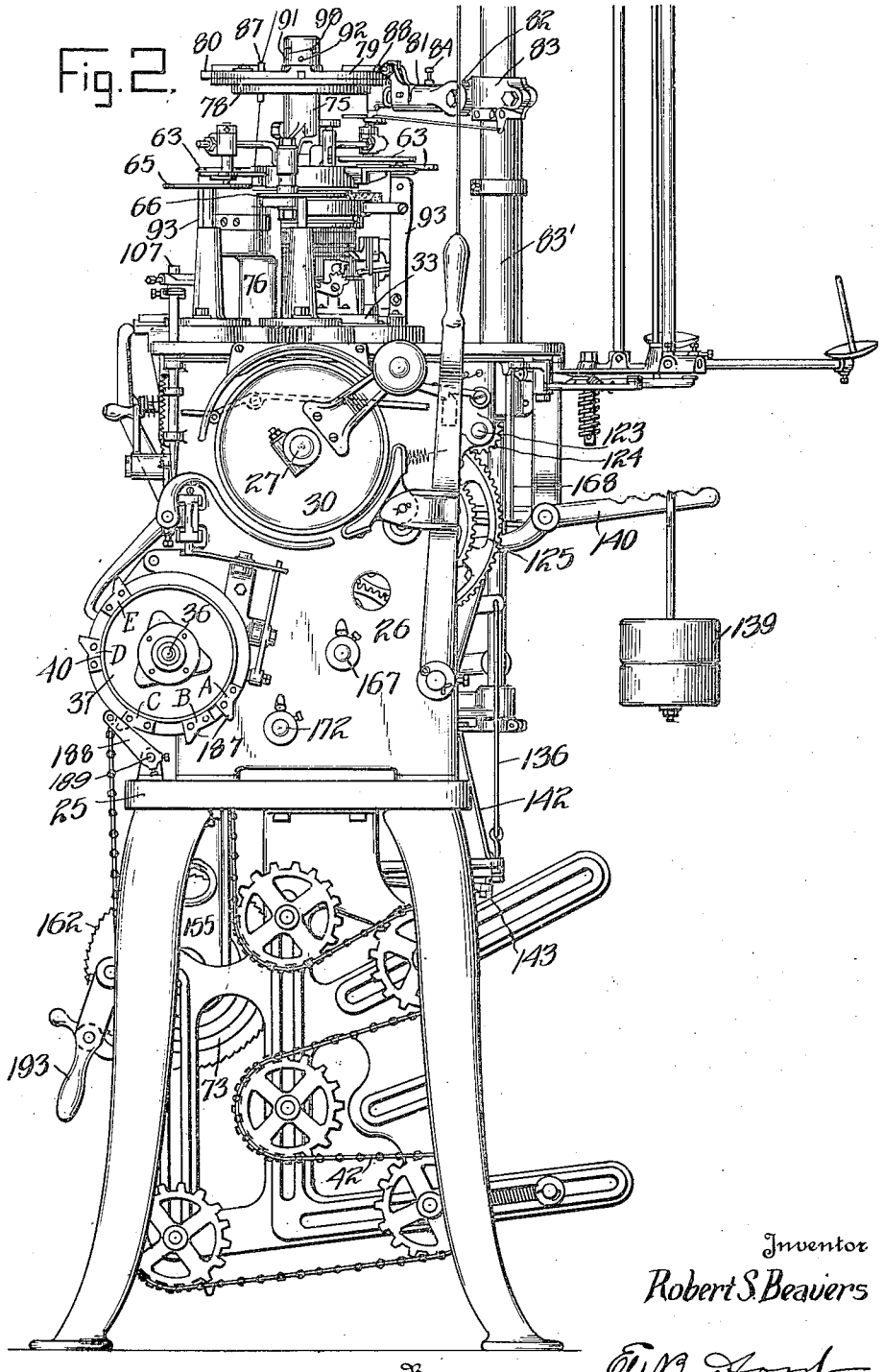
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KNITTING MACHINE

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Fig. 2.



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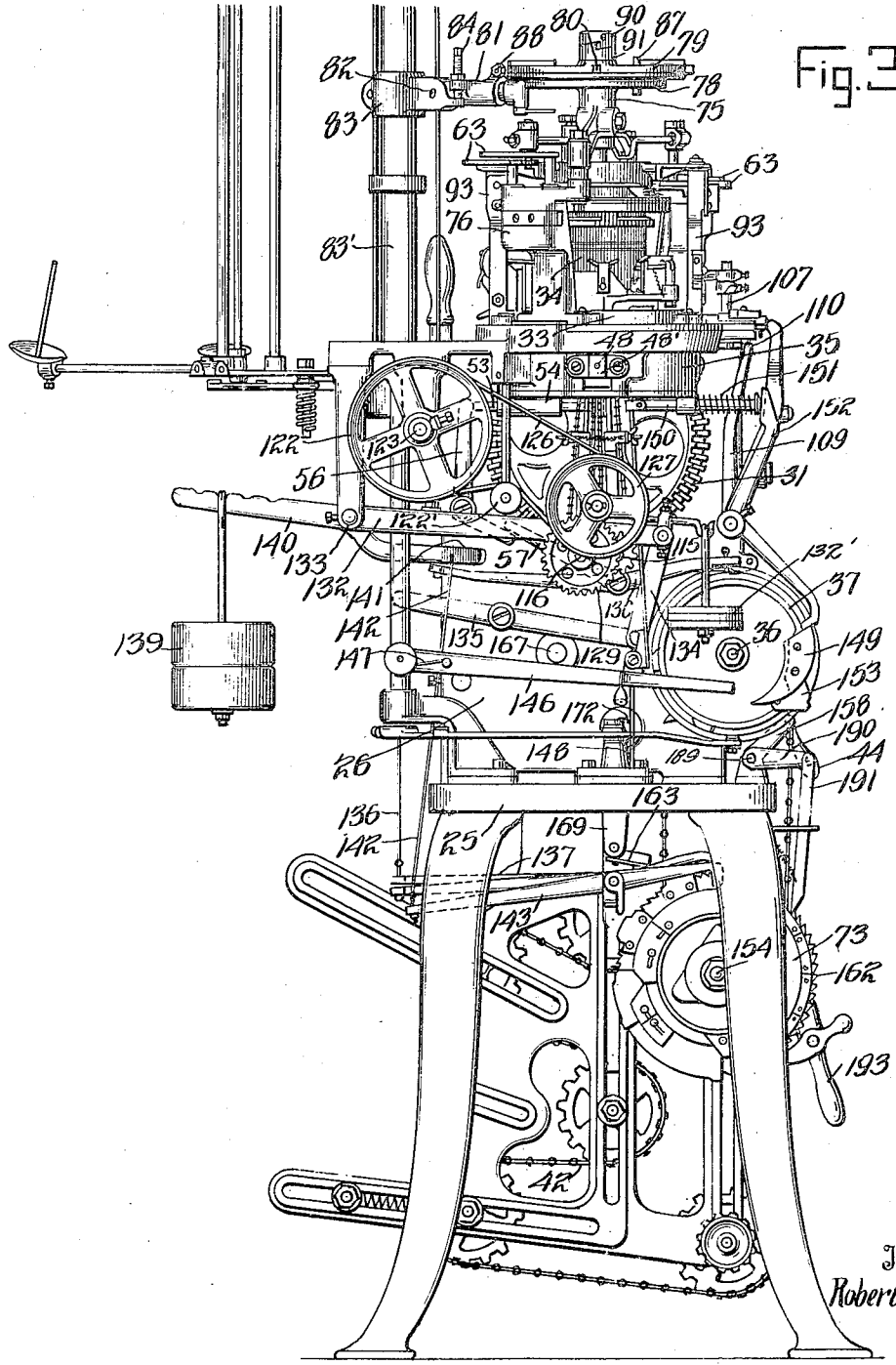
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Fig. 3.



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Fig. 4.

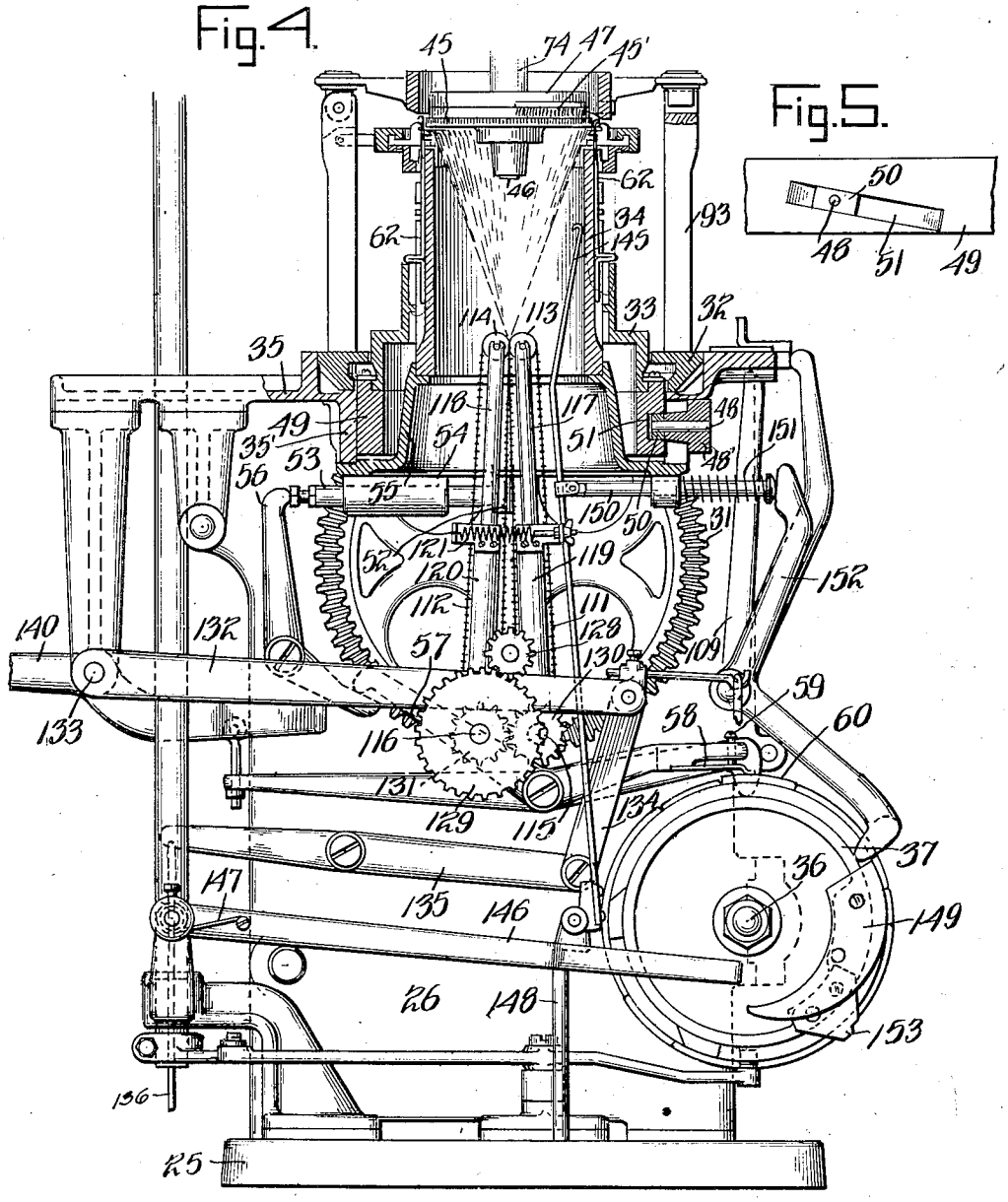


Fig. 5.

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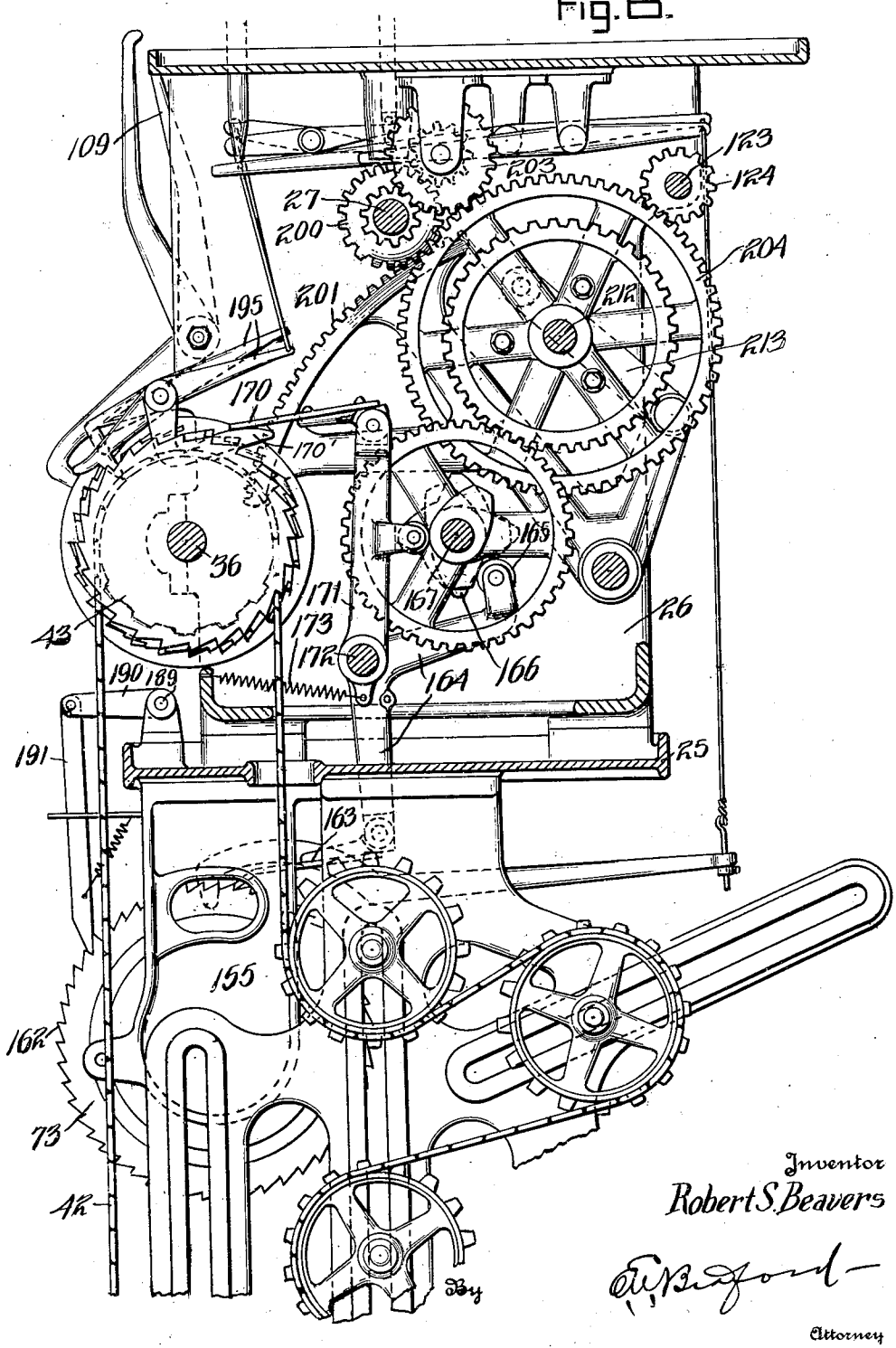
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Fig. 6.



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Fig. 7.

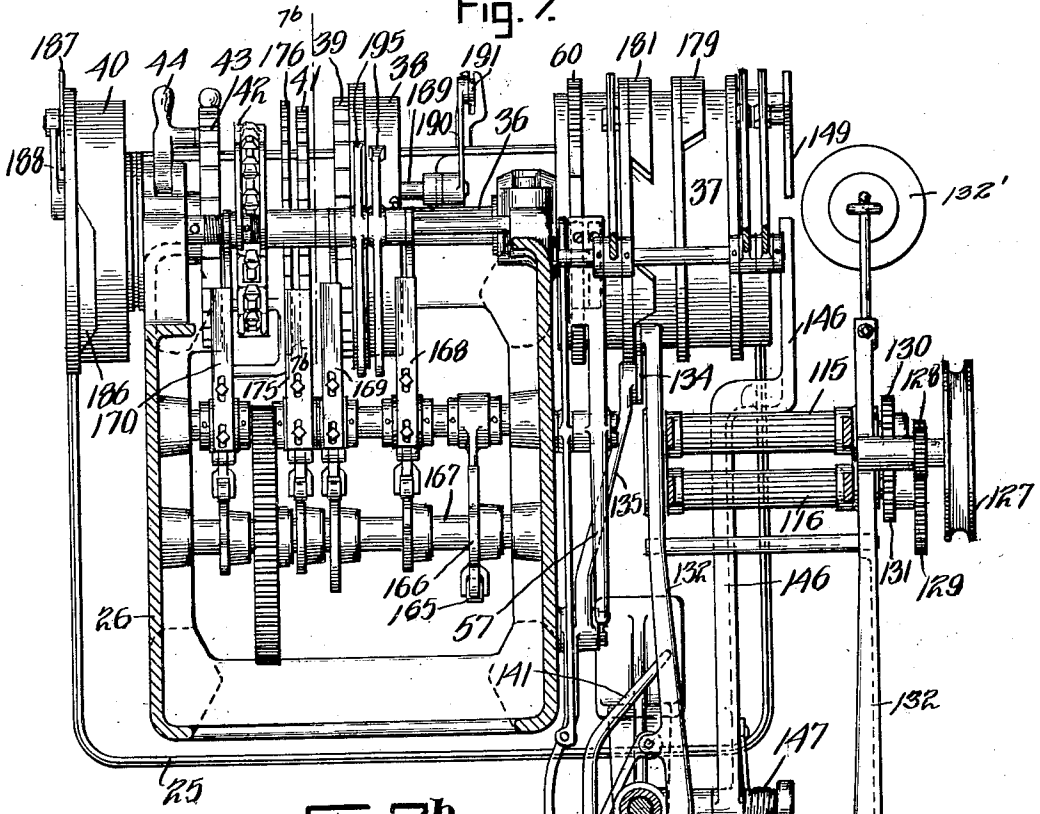


Fig. 7b

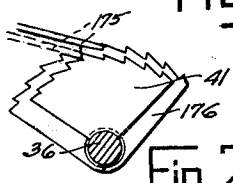
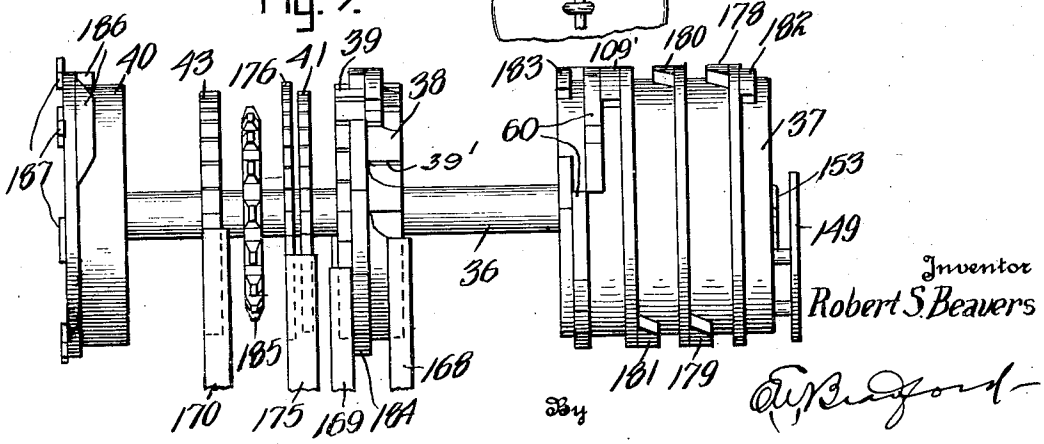


Fig. 7a



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Fig. 8.

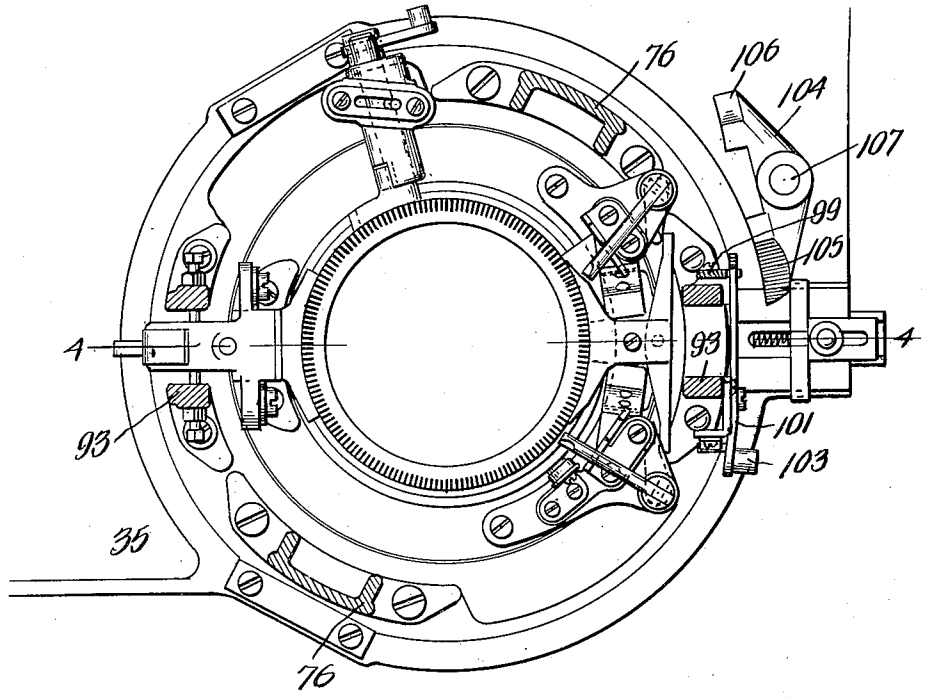


Fig. 9.

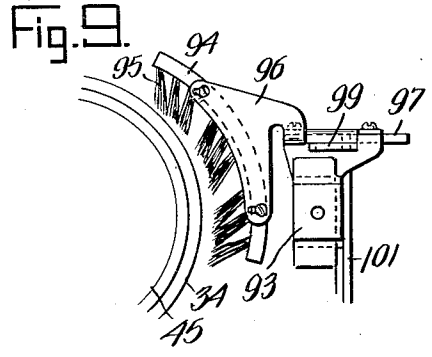
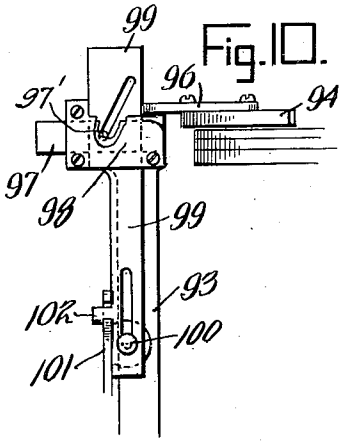


Fig. 10.



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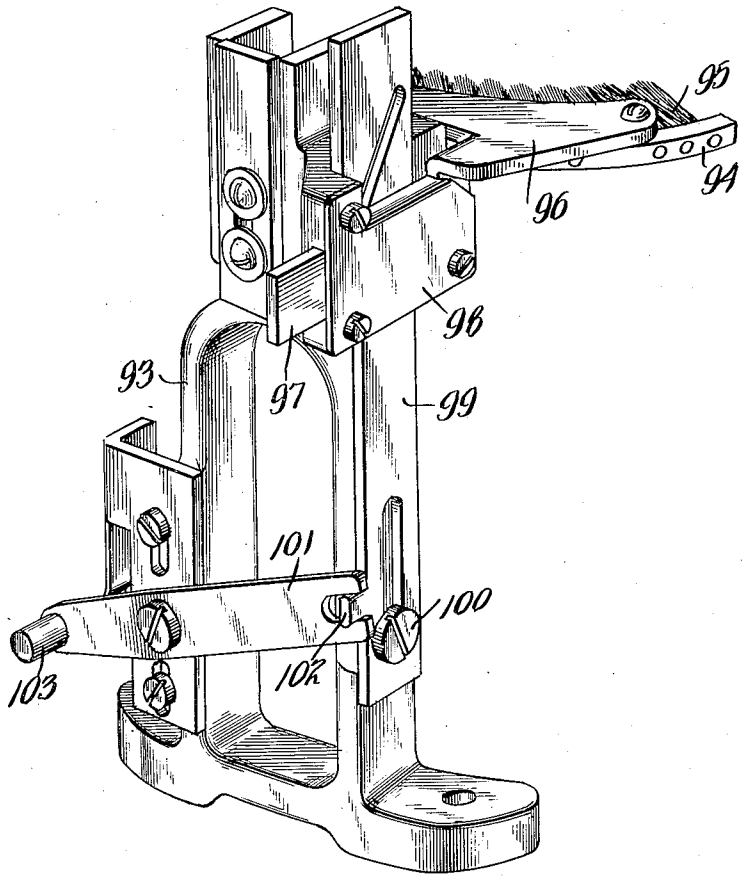
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Fig. 11.



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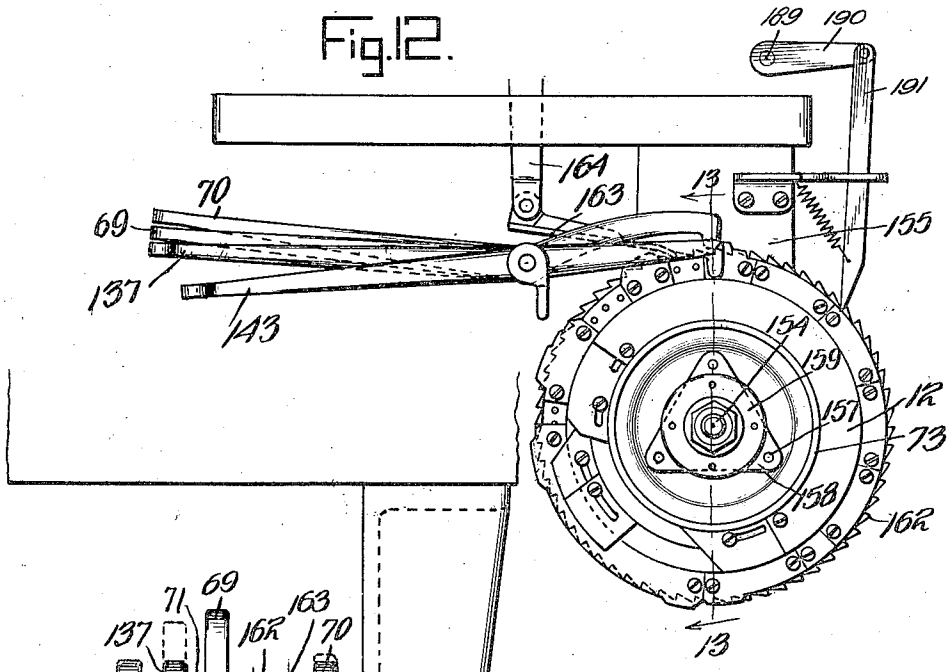
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Fig.12.



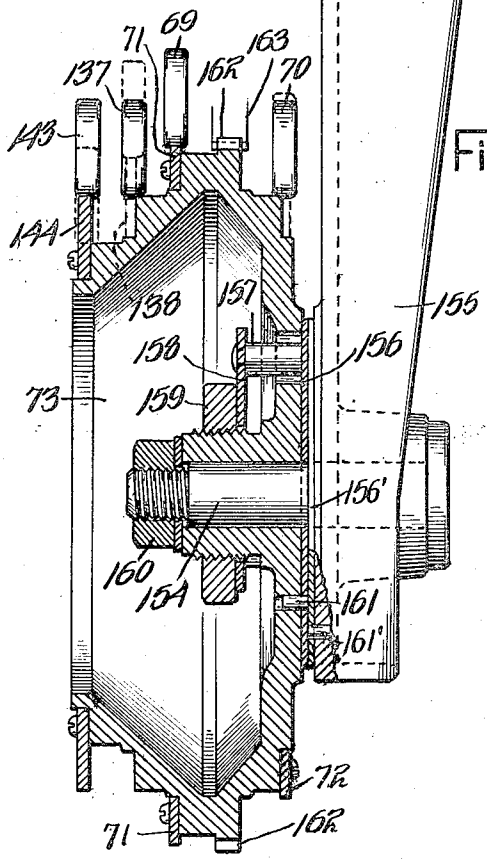


Fig.13.

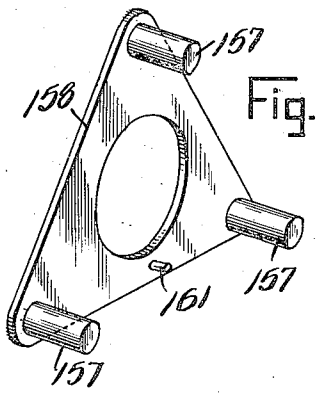


Fig.14.

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Fig. 15.

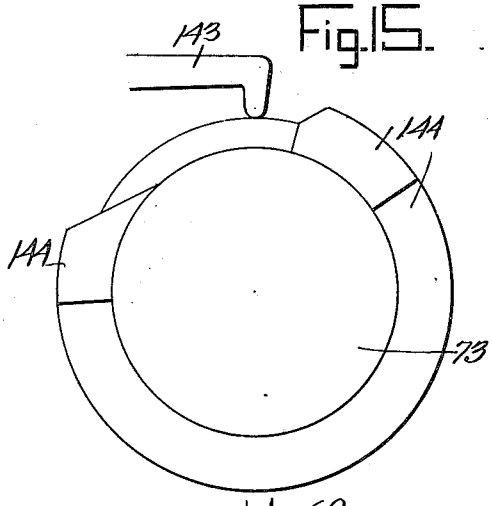


Fig. 16.

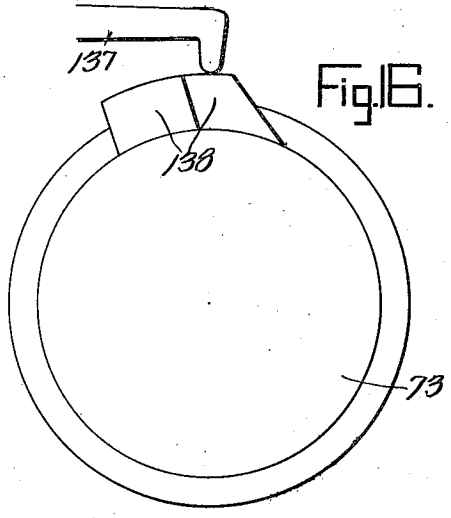


Fig. 17.

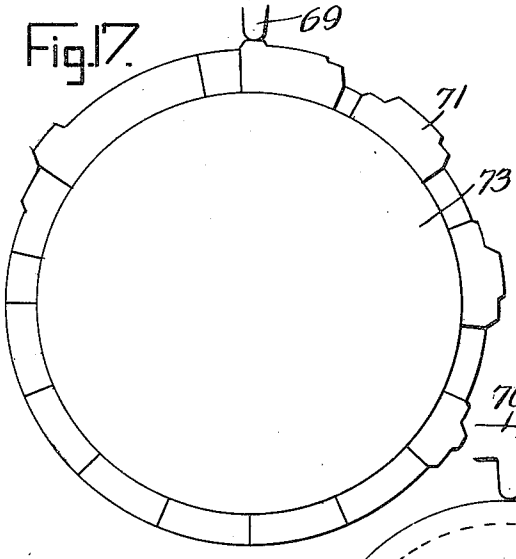


Fig. 18.

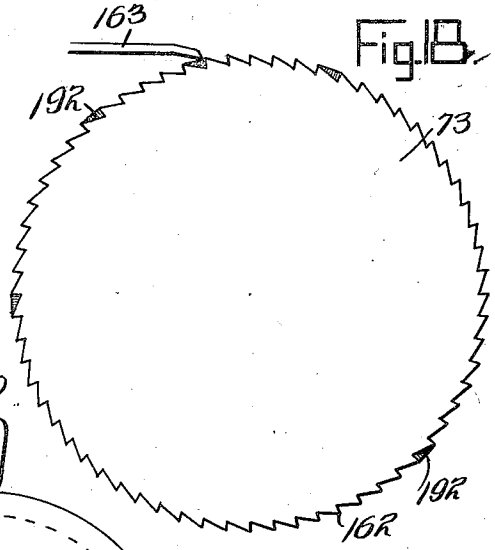
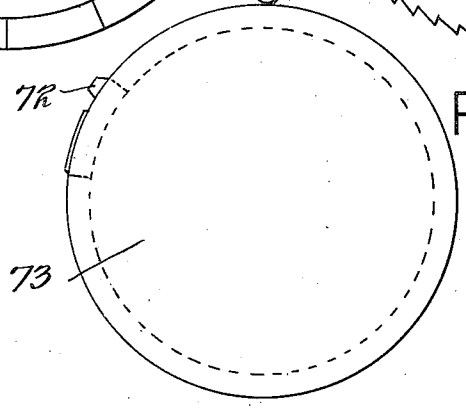


Fig. 19.



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Fig.20.

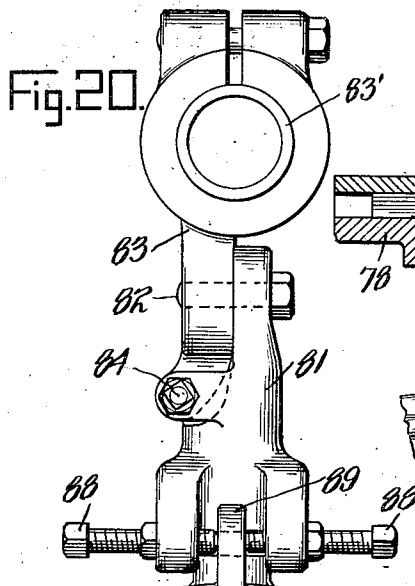
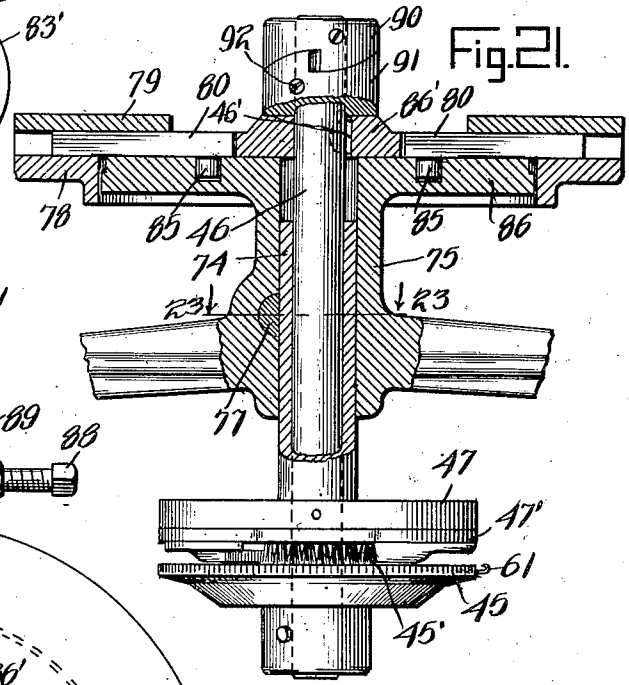


Fig.21.



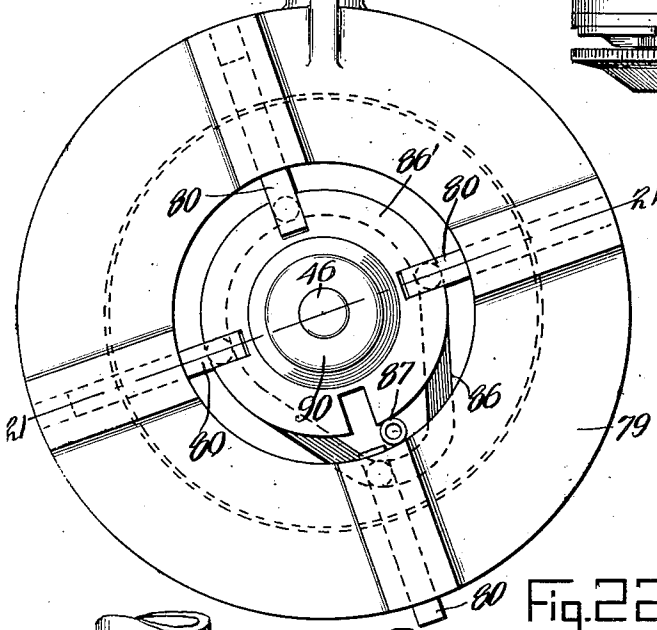


Fig.23.

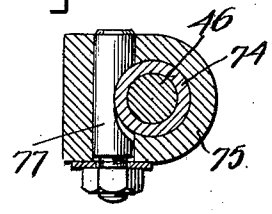
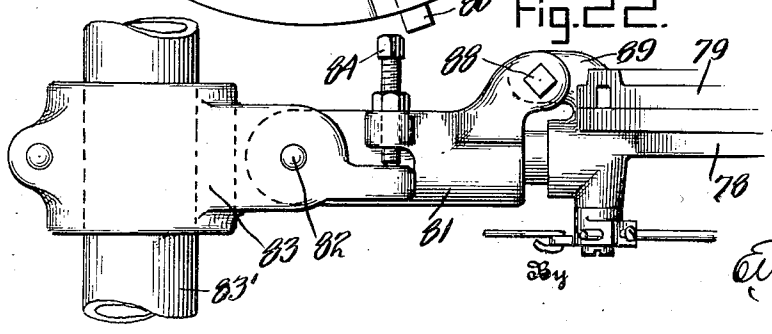


Fig.22.



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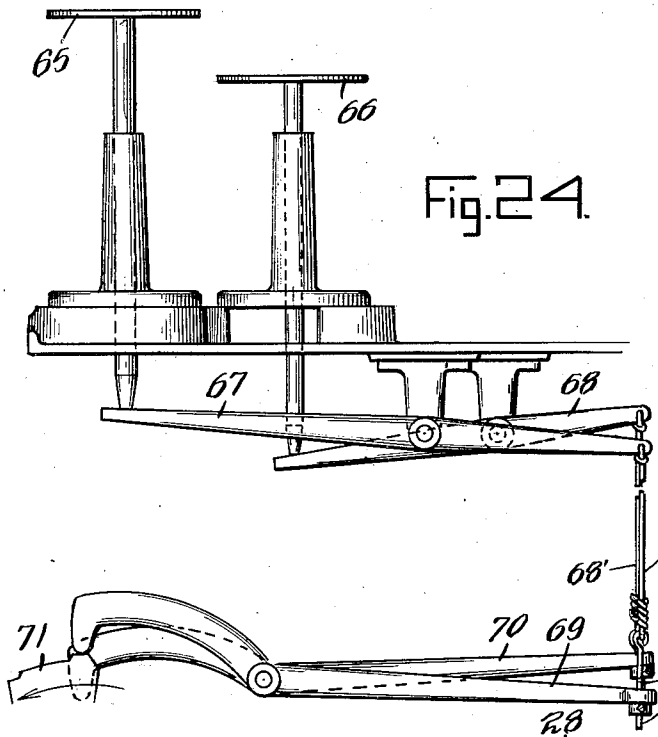


Fig. 24.

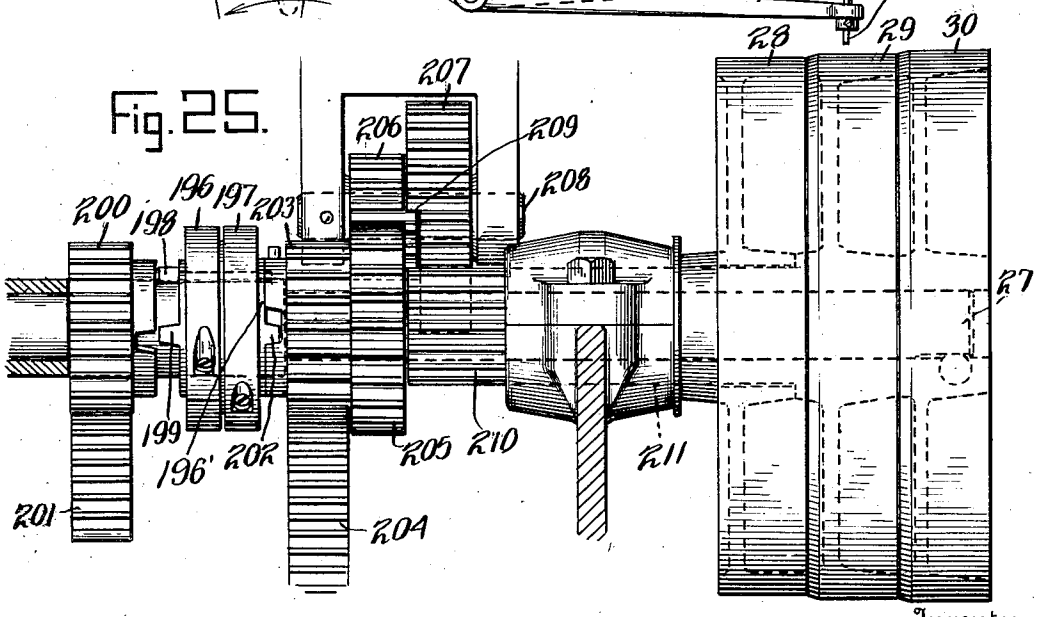


Fig. 25.

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Patented Jan. 2, 1934 1,942,322

UNITED STATES PATENT OFFICE

1,942,322

KNITTING MACHINE

Robert S. Beavers, Providence, R. I., assignor to May Hosiery Mills, Nashville, Tenn., a corporation of Tennessee

Application December 31, 1927
Serial No. 243,912

2 Claims. (Cl. 66—54)

My said invention relates to a machine for knitting rib fabric in alternation with plain fabric having pouch-like enlargements at intervals and is concerned particularly with the knitting of stockings having ribbed legs and plain foot portions with heel and toe pockets, such stockings being knitted from toe to top. The fabric referred to is made on a circular machine with a stationary needle cylinder and a revolving cam ring. It is an object of my invention to provide an improved dogless device.

Another object of the invention is to provide an improved take-up for the fabric.

Another object is to provide improved means for controlling the stitch length.

Another object is to provide improved latch-opening means.

Still another object is to provide an improved stop motion.

A further object is to provide improved pattern controlling mechanism for the machine.

Another object is to provide improved friction braking means for the pattern drums.

Referring to the drawings, which are made a part hereof and in which similar reference characters indicate similar parts:

Figure 1 is a front elevation of the machine,

Figure 2, an elevation of the same viewed from the right,

Figure 3, an elevation viewed from the left,

Figure 4, a vertical section on line 4—4 of Fig. 8,

Figure 5, a detail of the means for varying the elevation of the cam ring shown in Fig. 4,

Figure 6, a diagrammatic view of controlling means viewed from the right and shown on an enlarged scale,

Figure 7, a plan view corresponding to Fig. 6,

Figure 7*a*, a detail of the main pattern shaft viewed from the back of the machine,

Fig. 7*b*, a section on line 7*b*—7*b* of Fig. 7,

Figure 8, a section on line 8—8 of Fig. 1 looking downward,

Figures 9, 10 and 11, details of latch-opening means,

Figure 12, a detail of the rib pattern drum and adjacent parts,

Figure 13, a section on line 13—13 of Fig. 12,

Figure 14, a detail of the friction device to prevent over running of the rib pattern drum shown in Fig. 13,

Figures 15 to 19, details of successive sections of the rib pattern drum viewed from the left in Fig. 13,

Figure 20, a plan of a dogless device forming part of my machine,

Figure 21, an elevation, partly in section, on line 21—21 of Fig. 20,

Figure 22, a view of part of the supporting means for the dogless device as viewed from the left in Fig. 20,

Figure 23, a section on line 23—23 of Fig. 21,

Figure 24, a diagrammatic elevation of adjusting means for the dial cams and connections therefrom to the pattern mechanism, and

Figure 25, an elevation of speed changing gearing.

In the drawings reference character 25 indicates the base-plate of a plain machine of known type which forms the foundation of the device of my invention. A frame member 26 extends upward from the base-plate, said frame member forming a support for a main driving shaft 27 carrying the pulleys 28, 29 and 39 of which pulley 28 is loose, 29 is a low speed pulley and 30 is a high speed pulley. These parts, through gearing hereinafter described, drive a bevel-gear 31 having teeth meshing with teeth on the revolving ring-gear 32 operating the cam ring 33, by which the needles in the cylinder 34 are actuated. The ring-gear, the cam ring, and the needle cylinder and parts cooperating therewith are supported by a bed-plate 35 (Fig. 4). A main pattern drum shaft 36 is journalled in bearings on the frame 26. A pattern drum 37 on the shaft 36 controls yarn feed means for splicing heels and toes, needle pickers, a switch cam, etc., as in plain machines of known type. It also controls stitch adjusting means and an auxiliary take-up hereinafter described. The pattern drum 38 controls the means for changing the direction of movement of the cam ring and also includes ratchets 39 and 39′ for driving the shaft 36. A drum 40 controls the speed changing means and the means for initiating movement of the rib pattern drum. The ratchet 41 on the shaft serves for driving the ordinary pattern chain 42. The ratchet 43, normally operated by pawl 170, may also be operated by a pawl lever 44 to turn the shaft 36 by hand.

A dial 45 is located concentrically with the cylinder (Figs. 4, 21) on a dial post 46 extending through the cam cap 47, the cam cap being driven from the cam ring in conventional manner and the dial and dial post being held against rotation by a dogless device hereinafter described. A brush 45′ on the cam cap 47 serves to sweep dust and lint off the dial.

Stitch length mechanism

Figures 3, 4 and 5 show means for controlling the length of stitch by varying the elevation of the cam ring. For this purpose I have provided three plates 48' evenly spaced about the depending sleeve 35' of the bed-plate 35. Each of the plates 48' has a pin 48 carrying at its inner end a block 50 entering a spiral slot at 51 in a cup 49 (Fig. 5) secured to the lower end of the cam ring 33 in a manner to permit circumferential movement relatively thereto. A stud 52 (Figures 1, 4 and 5) depending from the cup and through a slot in the cone 55 is engaged by a plunger 53 slidably mounted in a guide 54 located at the lower end of a supporting cone 55 for the needle cylinder. The cup 49 and connected parts move downward by gravity and are moved upward by means comprising a bent lever 56 (Figs. 3 and 4) having an arm engaging slidably with another bent lever 57. At its free end the lever 57 has attached thereto a leaf spring 58 movable by means of an adjusting screw 59 toward cams 60 on the drum 37 (Figs. 1, 4 and 7), whereby the height of said cams determines the degree of elevation of the cam ring and therefore the length of the stitches by varying the extent to which the needles are drawn down in the rotation of said ring.

There are two rows of stitch adjustment cams 60 on the machine pattern drum. On the left side the heel and toe and foot adjustments are obtained and on the right side all other stitch adjustments are obtained.

Dial and dial cams

The dial 45 (Fig. 21) is provided with needles 61 co-acting with the cylinder needles 62 (Fig. 4) for knitting a rib fabric at times. The dial cams are moved into idle, tuck and knitting positions as required, by means which may be similar to those shown in copending application Serial No. 26,453, filled April 28, 1925, Patent No. 1,853,783, said means including rock-arms 63 (Figs. 1 to 3) actuated by abutments here shown as bob-cams 65 and 66, (Figs. 1, 2 and 24), said bob-cams having stems resting at their lower ends on levers 67 and 68 respectively, which are connected by links 67' and 68' to levers 69 (Figs. 1, 17 and 24) and 70 (Figs. 1, 19 and 24) bearing at their free ends on cams 71 and 72 of a rib pattern drum 73 (Figs. 13, 17 and 19).

An adjustment is provided in the train of connections from the bob-cams to the pattern means, such adjustment being preferably as shown in Fig. 24, where the lower end of each link 67' and 68' is formed as a threaded bolt 69' with a nut thereon which can be turned to shorten or lengthen the link according to the adjustment required. It will be understood that the adjustment could be on the levers instead of on the links, if preferred.

The sleeve 74 of the dial cam cap (Figs. 4, 21 and 23) passes up through a bracket 75 carried on the ring gear 32 by posts 76 (Figs. 1, 2, 3 and 8), the sleeve being clamped in a vertical bearing of the bracket 75 by means of a bolt 77 (Fig. 23). The underneath frame member 78 of the dogless device and the upper member 79 in which the plungers 80 are housed are fastened together and carried by a bracket 81 pivoted at 82 by a screw which normally clamps the bracket 81 against a fixed bracket 83 (Figs. 1, 2, 3, 20, 21 and 22), on a stationary post 83'. When the screw 82 is backed off, the bracket 81 may be moved by means of a set screw 84 to level the frame member 78 so as to permit free rotation of the bracket 75. The plungers 80 are moved in and out in ordinary manner to engage with or disengage a collar 86' splined to the dial post by a key 46', thus permitting passage of a yarn guide 87 carried by the cam 86. The movement of the plungers 80 is effected by means of downwardly extending projections 85 (Fig. 21) actuated by a cam 86. For adjusting the dial circumferentially to locate the dial needles properly between the cylinder needles, the usual screws 88 are provided, said screws passing through forks of the bracket 81 and bearing against a rearwardly projecting lug 89 on the top member 79 of the dogless device. For adjusting the dial vertically, the dial post is provided at its upper end with spiral inclines on collar 90 (Figs. 1, 2, 3 and 21) bearing against coacting faces on a similar collar 91 adjustably held by set screw 92. On loosening the set screw, the collar 91 may be rotated to raise the dial or permit it to be moved downward by gravity. It will be noted that the dial and dial cams are supported by the posts 76 on the ring gear instead of being supported by the dogless device, as usual.

The dogless attachment is so designed that there is no vertical bearing connection between the stationary part and the revolving part. The stationary part is designed so that it can be taken off as a unit without disturbing the proper adjustments for aligning the dial needles midway between the cylinder needles. The stationary part is also designed so as to be adjustable for centralizing the revolving part in relation to the stationary part either up or down or for circumferential adjustment; also for adjusting the dial needles to position midway between adjacent cylinder needles, as above described.

Latch opener

A latch-opening means (Figs. 8, 9, 10, 11) for opening the latches of the dial needles is mounted on the front latch-ring support 93 (Figs. 1, 3, 8). The latch-opening means consists of a segmental holder 94 in which are mounted tufts of bristles 95 extending at an angle of from 30° to 45° with relation to the dial needles. The holder is located on a plate 96 having an outward extension 97 in a slot on the support 93 closed at the outside by plate 98. A flat bar 99 is mounted for vertical reciprocation behind the outward extension 97, the member 97 having a pin 97' (Fig. 10) engaging in a slot in the member 99, whereby upward movement of the member 99 retracts the latch-opener and downward movement forces the latch-opener toward the dial. The bar 99 is guided at its lower end on the post 93 by a screw 100 passing through a slot in the bar and a lever 101 engages a projection 102 on the bar for reciprocating the same. Lever 101 has a stud 103 operated by means shown in Figs. 1 and 8 comprising a switch cam control 104 having a cam 105 for lifting the stud 103 to move the latch-opener into operative position during round and round knitting and a cam 106 acting on said stud for moving the latch-opener out of operative position during reciprocating knitting. The switch cam control 104 is moved in the ordinary manner about a shaft 107 by a spring 108 tending to turn it in one direction, and in the other direction by a lever 109 pressing at its upper end against a finger 110 and bearing at its lower end against cams 109' on the pattern drum 37. The latch opener is intended for opening the latches on

the dial needles to cause them to receive the first course of yarn when beginning to knit rib work and to hold open the latches on the dial needles when coming out of tuck position for regular knitting. The brush is moved away from the needles when the machine goes into reciprocating knitting, in order to keep the bristles from passing beyond the backs of the cylinder needles on the reverse movement of the machine. The usual stationary brush, not shown, is provided at the casting-off side.

Fabric take-up

The fabric take-up shown in Fig. 4 is similar in its essential features to what is shown in copending application Serial No. 190,919, filed May 12, 1927, Patent No. 1,825,370, and comprises two pairs of belts 111 and 112 passing at their upper ends about pulleys 113 and 114 within the needle cylinder and at their lower ends about the pulleys on shafts 115 and 116 (Figs. 3 and 4). The upper pulleys are supported by rods 117 and 118 slidably mounted in casings 119 and 120 containing springs (not shown) for forcing the rods up to hold the belts taut. The pulleys are held together by means of springs 121 located at the upper ends of casings 119 and 120 and serving to draw the casings toward one another. The belts are driven by means comprising a pulley 122 (Figs. 1 and 3) on a shaft 123 provided with a gear 124 (Figs. 2 and 6) meshing with the gear 125, which drives the usual segment 201 for causing reciprocation of the needle cylinder. A belt 126 (Figs. 1 and 3) is trained over pulley 122, an idler 122' and a pulley 127. The shaft of pulley 127 carries a gear 128 (Fig. 4 and 7) meshing with a gear 129 on shaft 116, which gear in turn drives a gear 130 on shaft 115, by means of a gear 131 on shaft 116. A pattern controlled means is provided in connection with said take-up for lifting it at times to remove the tension from the fabric in whole or in part, said means comprising a frame 132 pivoted at 133 and connected at its forward end by a link 134 to a lever 135 connected at its rear end by a link 136 to a lever 137 (Figs. 1, 3 and 4), resting at its free end on a surface of the rib pattern drum, including a cam 138 (Figs. 13 and 16). The forward end of the frame 132 has a weight 132' suspended therefrom. A counterweight 139 (Figs. 2, 3 and 7) for the take-up is supported by a lever 140 at the back of the machine, said lever having a forwardly projecting arm bent at 141 to engage the under side of the frame member 132. A link 142 connects this arm to a lever 143 (Figs. 1, 3, 12, 13 and 15) bearing at its free end on cams 144 on the rib pattern drum 73. Normally, the weight 139 has no effect on the take-up frame, but when the rib pattern drum is turned to present a low surface to the finger at the end of lever 143, the bent end 141 of lever 140 is permitted to rise and the weight 139 therefore will tend to force the take-up frame 132 upward at its free end to relieve the strain on the fabric. When the take-up frame is lifted, whether by the pull of the fabric or otherwise, the lower run of the belt 126 is straightened out by reason of the stationary position of the idler 122', hence the belt is slackened and slips on the driven pulley so that the take-up drive is wholly or partially discontinued. As the fabric runs down, the driven pulley is lowered until the belt becomes tight enough to drive the driven pulley again.

The control for the fabric take-up is taken from the rib pattern drum underneath the machine. This is done because the drum underneath the machine can be racked on any revolution of the head. The fabric take-up has a counterweight 139 at the rear. As soon as the rib part of the stocking is finished, and at the exact time that the dial needles are being cleared of their stitches, the counter-balance weight 139 is allowed to exert its pressure against the fabric take-up. This tends to make the fabric take up lighter. Putting the counter-balance weight in action at this time prevents holes being cut in the fabric at the time of cast off from the dial needles.

After the casting off operation is completed the fabric take-up itself is lifted up out of action by a cam 138 on the rib pattern drum through a train of levers and links 137, 136, 135 and 134, connecting the rib pattern drum with the fabric take-up, as above described. The fabric take-up remains in this position and does not pull the fabric at all until after the heel pocket of the stocking is finished, whereupon the fabric take-up is allowed to move downward so that the fabric take-up belt will cause the said take-up to pull down all of the slack fabric which has been knit between the point of cast-off and the point of transfer which includes the loopers margin, the toe pocket, the foot, the heel pocket and the small amount of plain knit fabric between the heel pocket and the transfers which we call the ankle. The counter-balance weight remains in action from the time of cast-off until one or more revolutions after the transfer.

The reason for having this counter-balance weight is to prevent the take-up from being too heavy at the time of transfer, also at the time of cast-off. If the counter-balance weight were not on the fabric take-up at the time of transfer, the excessive pull on the fabric would tend to stretch the transfer stitches and make an unsightly transfer. In addition to this, there would be many holes cut at the line of transfer due to the excessive pull on the fabric.

One or more revolutions after the transfer is made, the counter-balance weight is taken out of action thereby allowing the full weight of the fabric take-up to act on the rib fabric and the counter-balance weight remains out of action until the point of cast-off is again reached.

The timing of this fabric take-up has to be so set that at the time the dial needles take the thread and start knitting the full weight can be exerted on the fabric. This weight remains on the fabric throughout the rib part of the stocking. At the moment of casting off the rib fabric from the dial needles, the fabric take-up weight must be completely taken away from the fabric; otherwise the stitches will ravel down the stocking. These settings are all adjustable to the right position on the pattern drum 73 beneath the machine.

Auxiliary fabric take-up

A grab hook 145 is shown in Fig. 4, the purpose of this grab being to engage the fabric tube at one side, in connection with the knitting of heels and toes, to maintain uniform tension about the entire circumference. The hook is at the upper end of a long rod, pivotally attached at its lower end to a lever 146. A spring 147 (Figs. 3, 4 and 7) is coiled about the pivot of the lever 146 to aid in moving it down against the tension of the fabric and a stop 148 limits the downward movement. A cam 149 on the main pattern drum serves to move the lever 146 upward until the end of the

cam is reached when the lever is released to permit the auxiliary take-up to pull down on the fabric. It is necessary to have this hook 145 in the up position and above the heel pocket at the time the rib knitting is started. Just as the fabric take-up begins to pull with its full weight, the machine pattern drum 37 operates a lever 152 that moves a plunger 150 which in turn moves the grab hook 145 toward the center of the machine, coming in contact with the fabric between the heel pocket and the beginning of the rib knitting. At the same time the machine drum 37 moves, releasing the hook 145, which in turn is pulled down by the adjustable spring 147 to put the right amount of tension on the fabric at the front side of the machine above the heel pocket, so as to cause the dial needles to form their stitches properly. This spring grab hook continues to pull until it comes to rest, by which time the heel pocket has passed into the top rolls of the fabric take-up allowing an even pull on the dial needles. The grab when at its top position is moved toward the fabric by means comprising a plunger 150 (Fig. 4) impelled by a spring 151 in a direction to take the grab away from the fabric, such movement being ended by the inner wall of the needle cylinder. A bent lever 152 has one arm engaging a plunger 150 and the other arm engaging a cam 153 on the main pattern drum 37.

Pattern mechanism

The pattern mechanism includes a main pattern drum 37 and a rib pattern drum 73 (Figs. 1, 2, 3, 12 and 13), the rib pattern drum being journalled on a stud 154 fixed in a bracket 155. The rib pattern drum is provided with a friction device to prevent over-running, said friction device comprising two friction elements 156 and 156' bearing against a face on the bracket 155, one of said elements being pinned to the face of bracket 155 and the other friction element being pinned to the face of the drum 73. A spider 158 is provided with pins 157 which pass through openings in drum 73. A nut 159 on the drum forces the spider toward the bracket to hold the pins with adjustable pressure against plate 156 and so presses the face of plate 156 against the coacting friction face of plate 156'. The drum is held on the stud 154 by a nut 160. The pins 157 enter relatively large openings in the hub of the drum and a pin 161 on the plate 156 fits in an opening in said hub to insure rotation of the plate 156 with the rib pattern drum. The friction element 156' also has a pin 161' which fits in an opening in the bracket 155 which acts to prevent rotation of the plate 156'. The rib pattern drum carries cams shown in Figs. 12, 15, 16, 17 and 19 and is provided with ratchet teeth 162 engaged by a pawl 163 (Figs. 6, 12, 13 and 18) for driving the drum. The pawl is pivotally mounted at the lower end of a bent lever 164 having a follower 165 (Fig. 6) bearing against cams 166 on a shaft 167 which drives the rib pattern drum.

The main pattern drum 37 is driven by three pawls 168, 169 and 170 (Fig. 7) engaging respectively with ratchet teeth 39' and 39 at opposite ends of drum 38 and with a ratchet 43. The pawls are mounted at the upper ends of rockers, one of which is shown at 171 (Fig. 6), and are actuated by cams on shaft 167 which may be similar to the cams 166 and arranged in suitable number and sequence about said shaft. Engagement of the pawls with their respective ratchet teeth is controlled by the pattern chain 42 so as to impart the correct movements to the drum. These pawls are all pivoted at 172 and springs, as 173 (Fig. 6), serve to retract them. The pawls 168, 169 and 170 are moved to engage and disengage their respective ratchet wheels 39', 39 and 43 by lugs on the pattern chain, these lugs operating through bent levers, one of which is shown at 170' in Figure 6. The pawls are held out of engagement with the ratchets by the lugs on the pattern chain except at such times as it is necessary to have the pawls drive the ratchets. The pawls are mounted on levers, one of which is shown at 171, which levers are pivoted on the shaft 172 and the levers are operated by rollers which engage cams similar to cam 166, such cam being shown in dotted lines in Figure 6. The several cams on the shaft 167 drive the pawls in the proper relation with each other to give the desired step-by-step movement to the pattern drum shaft 36. The chain 42 is trained over a sprocket 185 (Fig. 7*a*) on the shaft 36 and over various idle sprockets shown in Fig. 3. A pawl 175 drives this chain by means of the ratchet 41. A multiplier shown in detail in Figure 7*b* consists of a pawl 175 driving ratchet wheels 176 and 41. The ratchet wheel 176 is loosely mounted on the shaft 36 but the ratchet 41 is keyed to the shaft. The ratchet 176 is racked a notch at a time by the pawl 175 until the pawl reaches a notch which is deeper than the others which permits the pawl to drop down and engage a tooth on the ratchet wheel 41. A movement of the pawl at this time rotates the ratchet wheel 41 through a distance of one tooth after which the pawl rides out of the deep notch and engages a tooth on the ratchet wheel 176 to begin rotation of the ratchet 176 until it has made another complete revolution. The shaft 36 carries a main pattern drum 37 having cams 60 and 149, hereinbefore described, and also having cams 178, 179, 180 and 181 for operating twisters of a yarn feed mechanism, (not claimed in this application and therefore not further shown or described), cam 182 for the conventional needle dropper control and cams 183 for a yarn tension arm forming a part of the yarn feed mechanism. The shaft also carries a ratchet drum 38 with two sets of teeth 39 and 39' operated by the pawls 168 and 169, and with cams 184 for the clutch shifting mechanism, and multiplier mechanism with ratchets 41 and 176 operated by pawl 175, the sprocket 185 for the pattern chain, the ratchet 43 actuated by pawl 170 and a drum 40 having belt shifting cams 186 thereon. The drum 40 also carries cams 187, marked A, B, C, D, E in Fig. 2 for convenient reference, for actuating an arm 188 (Fig. 1) on a rock shaft 189 carrying at its other end an arm 190 from which a pawl 191 (Fig. 3) depends, which pawl when operated starts the rib pattern drum from a position of rest. Such position of rest occurs whenever the pawl 163 rides up on one of the five idlers 192 shown in Fig. 18. The rib pattern drum may also be rotated manually by a hand lever 193 carrying a pawl engaging the ratchet 162. Clutch mechanism indicated at 196 and 197 in Fig. 1 is controlled from the main pattern drum by means of a pair of clutch levers 195 (Figs. 1, 6 and 7), such clutch mechanism and the controlling means not being claimed in this application.

Change speed mechanism

The means for changing the speed of the machine and the direction of rotation comprises

pulleys 28, 29 and 30 (Figs. 1 and 25) on the shaft 27. The pulley 30 is the high speed pulley and is fixed directly to the shaft 27. A slidable clutch element is splined to the shaft, said clutch comprising members 196 and 197 secured on a sleeve 196' which is connected to the shaft by spline 198. Sleeve member 196' has a tooth 199 for engagement with a notch in a flange of the gear 200 meshing with segment 201 (Figs. 1, 6 and 25), which segment is driven in known manner from the gear 126. A tooth 202 on sleeve member 196' is adapted for engagement with a notch on an annular flange on a gear 203 fast to the shaft 27 and meshing with a gear 204. A gear 205 is also fixed to shaft 27, the gears 203 and 205 being preferably pinned together and the gear 205 meshing with a gear 206. A gear 207 is mounted on the stationary shaft 208 which also supports gear 206 and each of these gears is faced off to provide diametrical shoulders 209 whereby they are made to move in unison. A gear 210 loose on shaft 27 is or may be formed as an integral part of a sleeve 211 to which the pulley 29 is fixed. The pulley 28 is loose on sleeve 211 so that the driving belt when on this pulley does not operate the machine.

Details of the clutch form no part of this invention and are not claimed herein. The belt shifter is or may be of the type shown in the patent to Mayo 726,178 and it is, therefore, not believed to be necessary to describe it further.

By the use of gearing as described, it is possible to drive the machine at high speed during round and round knitting, the parts being then in the position shown in Fig. 25 and the drive being from the pulley 30 through shaft 27 and gear 31 which drives the ring gear 32 of the cam ring 33. For reciprocating knitting, the clutch is shifted and the drive is from pulley 30 through shaft 27, gear 203, sleeve 204 and link 213, and the segment 201 which drives the gear 200. The gear 204 on shaft 212 is driven by gear 203 fixed to shaft 27 and so oscillates the ring gear and the cam ring at an intermediate speed through link 213, segment 201 and gear 200. For driving the cam ring round and round at a low speed during the transfer from plain to rib, and also for making the welts, and for casting off all of the rib stitches at the completion of a stocking, the belt is shifted to pulley 29 whereupon the drive is through sleeve 211, gears 210, 207, 206 and 205 to the shaft 27 and so to the ring gear 32 and the cam ring 33.

Operation

At the beginning of a new stocking all the cylinder needles have fabric on them, the dial needles being out of action and holding no loops. There is about a half inch of fabric knit on the cylinder needles which we call hereafter "plain fabric". This half inch is made for the loopers to hold to while looping. After this half inch of plain fabric is knit the machine goes into the toe, raising all of the long butt needles with the instep cam, when the long butt needles are thrown up out of action. This leaves all of the short butt needles in action, the short butt needles being just half the number of needles in the cylinder. At the same time that these long butt needles are raised out of action the clutch is thrown in the proper direction for causing the machine to reciprocate. Thus the toe is completed and the machine proceeds to make the foot.

At the end of the foot the machine again goes into reciprocatory movement, the instep cam lifting the long butt needles; the procedure is the same as in making the toe. At the end of the heel there is about one inch of plain fabric knit on the cylinder needles. After this fabric has been knit a link in the chain uncovers the ratchet 43 allowing the pawl to rack the machine drum 37. At the same time a cam 187 on the machine drum 40 on the belt shifter side racks the rib pattern drum 73 one tooth, after which time the rib pattern drum racking pawl 163 proceeds to rack the drum 73 and the cams 71 on said drum provided for that purpose move the bob cam disk 65 into the right position to control the dial needles. At this time the dial needles are drawn out into action on the opposite side to the thread feeding side of the latch ring. A few rotations of the machine at this time will allow the brushes 95 mounted on the sinker cam ring to open the dial needle latches for the reception of the first course of yarn for making rib work. After a few turns have been made and the latches are open, the bob cam 65 again moves, putting these dial needles back out of action. The rib pattern drum 73, being started again by the machine pattern drum 37, moves the bob cam 65 into another position which brings the dial needles out into action on the yarn feeding side. At this time the dial needles are brought into tuck position or about half way out, allowing the hooks of the dial needles to take one course of yarn when they are again moved back out of action into the dial by the bob cam 65. One course is then knit on the cylinder needles only and the bob cam 66 again brings the dial needles clear out and into full action taking yarn and continuing to knit through the rib fabric. The reason the dial needles take yarn and go out of action allowing one course to be knit on the cylinder needles is to close the holes that would otherwise be made where the rib knitting is started.

At the end of the rib fabric welts are formed by laying one, two or three courses of yarn on the dial needles. As many courses as desired can be made in these welts, also as many welts as desired may be made. This is controlled by the rib pattern drum 73 and the bob cam 65. After the welts are completed about three-fourths of an inch of rib fabric is knit at which time the rib pattern drum 73 is again put in action, causing the bob cam 65 to throw the dial needles out of action on the knitting side or yarn feeding side and at the same time throwing the dial needles into action on the opposite side, thus causing the dial needles to cast off the stitches thereon. This completes one stocking. At the same time that these dial needles cast off their rib stitches the fabric take-up (Fig. 4) is lifted out of action thereby taking the weight off the fabric. This fabric take-up is controlled by the rib pattern drum 73. There will be one or two courses of long stitches or ravel stitches at the point where the dial needles cast off stitches. Owing to the weight of the take-up being taken off the fabric there will only be one or two courses of ravel of rib stitch. There is no more pull or weight put on the fabric again until after the heel is knit.

After the heel is knit, owing to the counterbalance weight on the back of the fabric take-up, there will be a slight pull put on the fabric which allows the rolls to pass the fabric through and get the point of dial needle press off below the rolls before there is any weight put on the fabric. On the left-hand end of the drum there are two

cams 149 and 153 mounted, one of which cams 149 controls the grab hook 145. This grab hook is used to give an even pull on the fabric to start the knitting of rib work owing to the heel which is on the front side of the fabric and the machine, the heel pocket not having passed through the rolls at this time. This hook 145 must go above the heel pocket and right underneath the dial. At the time the rib fabric is being started the hook 145 has been raised to its highest point by the cam 149 on the left-hand end of the drum and at the right moment the other cam 153 on the end of the drum moves a lever 152 which in turn moves a push rod 150 and this push rod advances the grab hook 145 toward the center of the machine, the hooks piercing the fabric and at the same time dropping off the grab hook control cam 153. The amount of pull put on this grab hook is regulated by an adjustable spring on the grab hook lever 146. By means of this grab hook 145 a pull is put on to the fabric above the heel pocket and continues to pull until the heel pocket has entered the top set of rolls on the fabric take-up.

It will be obvious to those skilled in the art that various changes may be made in my device without departing from the spirit of the invention, and I, therefore, do not limit myself to what is shown in the drawings and described in the specification, but only as set forth in the appended claims.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A knitting machine comprising a stationary needle cylinder, a revolving cam ring, means for changing the stitch length including a cup on which the cam ring is supported, a series of pins engaging spiral grooves in the cup and means on the cup engageable by pattern operated means for rotating the cup to move it vertically of the said pins, substantially as set forth.

2. A knitting machine comprising a stationary needle cylinder, a revolving cam ring, means for changing the stitch length including a cup on which the cam ring is supported, a series of pins engaging spiral grooves in the cup, a stud on the cup, a plunger engageable with the stud, pattern mechanism, and connections from the pattern mechanism for engaging said plunger and pressing it against the stud to rotate the cup, substantially as set forth.

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