W. LARKIN.

CIRCULAR KNITTING MACHINE.

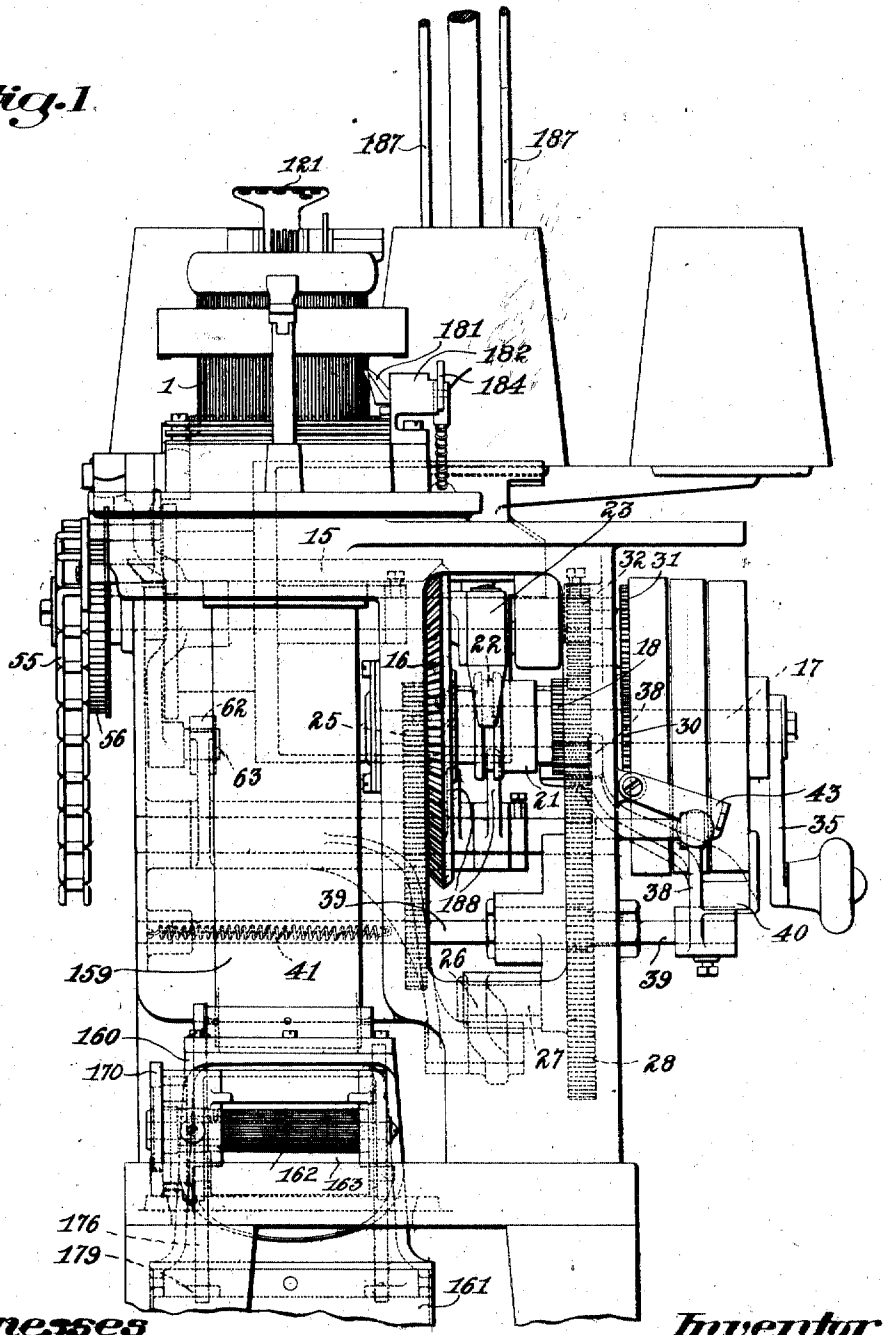
APPLICATION FILED AUG. 13, 1914.

1,244,991.

Patented Oct. 30, 1917.

10 SHEETS—SHEET 1.

Fig. 1.



Witnesses

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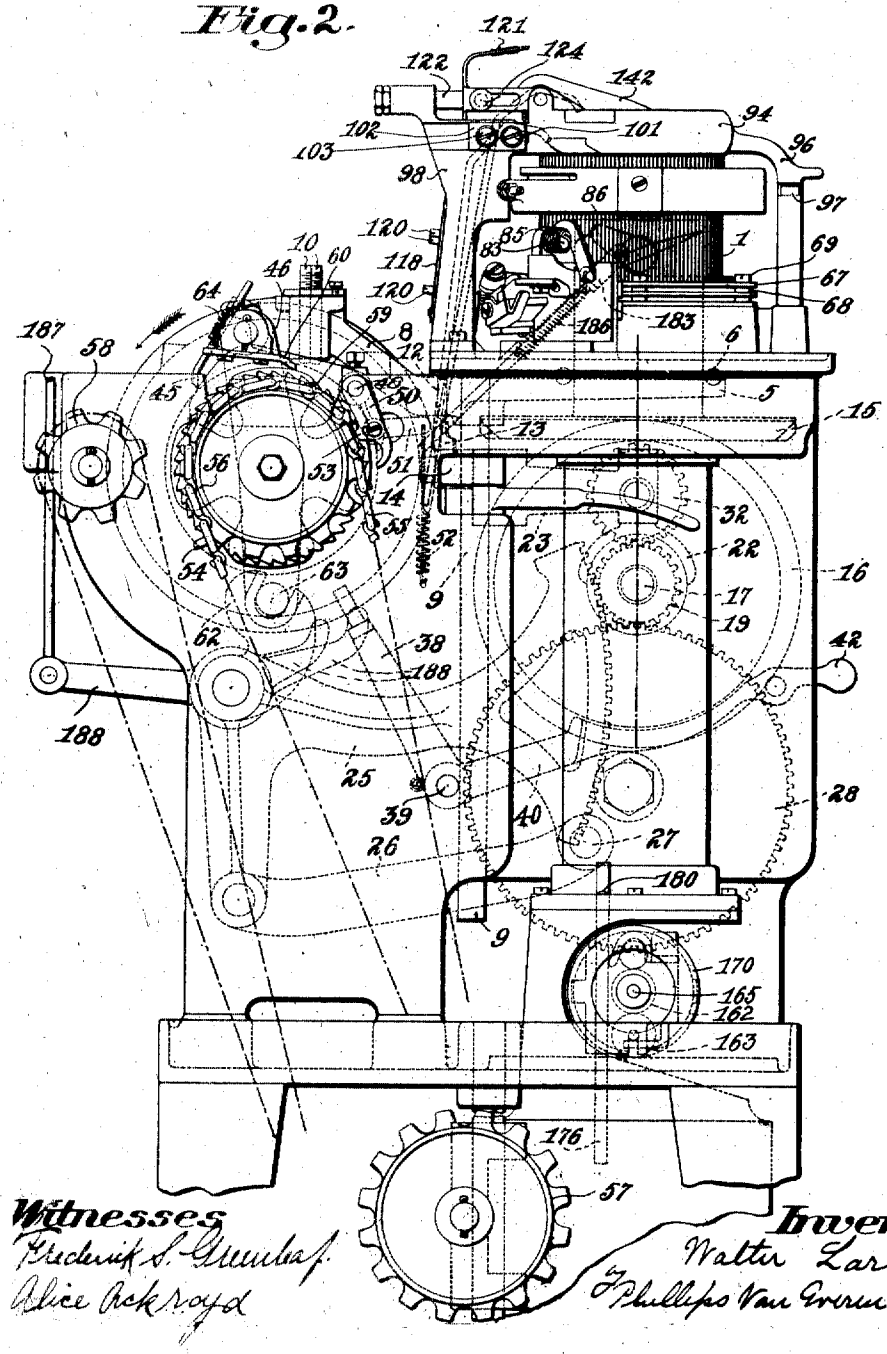
APPLICATION FILED AUG. 13, 1914.

1,244,991.

Patented Oct. 30, 1917.

10 SHEETS—SHEET 2.

Fig. 2.



Witnesses

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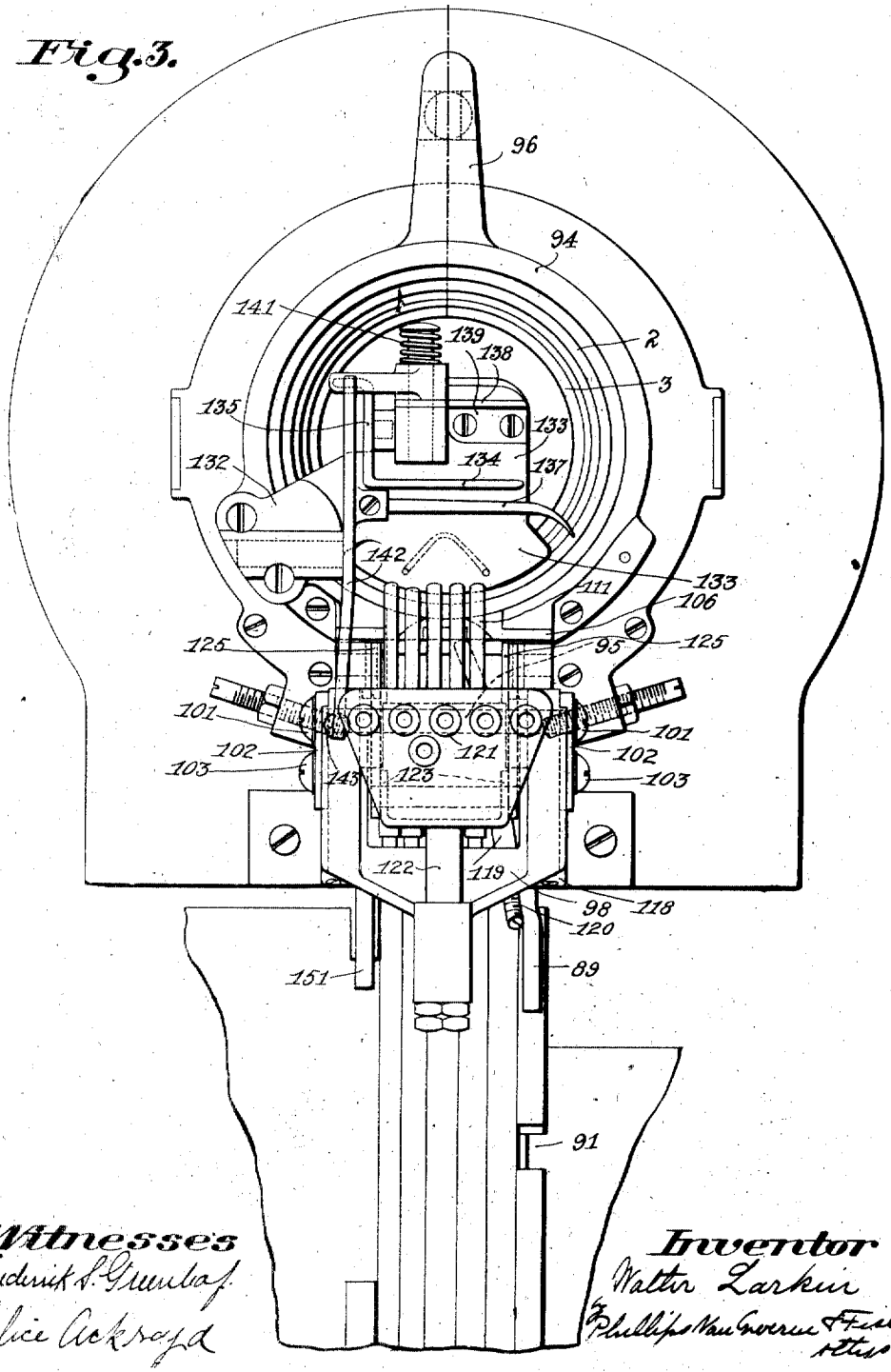
CIRCULAR KNITTING MACHINE.

APPLICATION FILED AUG. 13, 1914.

1,244,991. Patented Oct. 30, 1917.

10 SHEETS—SHEET 3.

Fig. 3.



Witnesses

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1,244,991.

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10 SHEETS—SHEET 4.

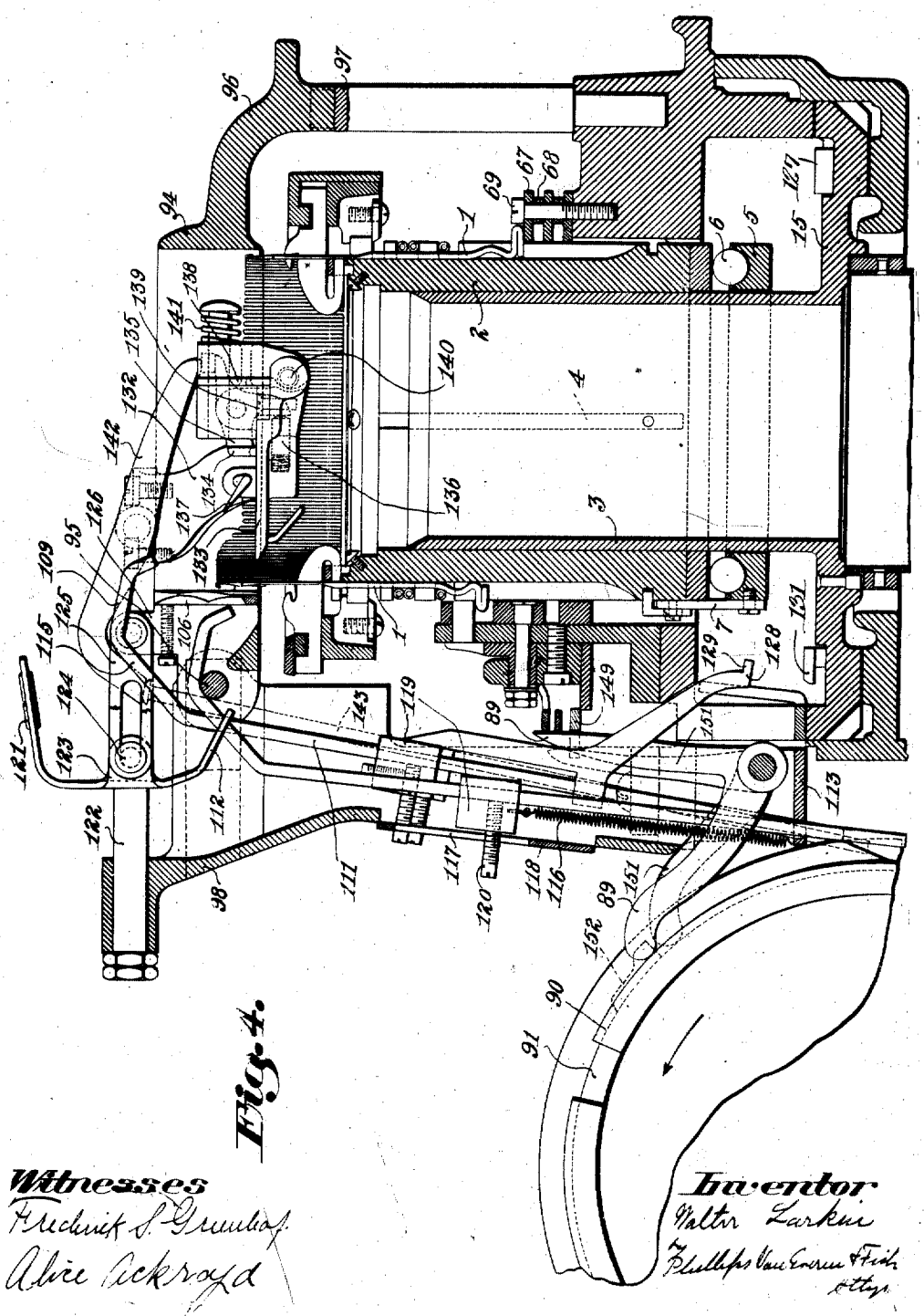


Fig. 4.

Witnesses
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10 SHEETS—SHEET 5.

Fig. 5.

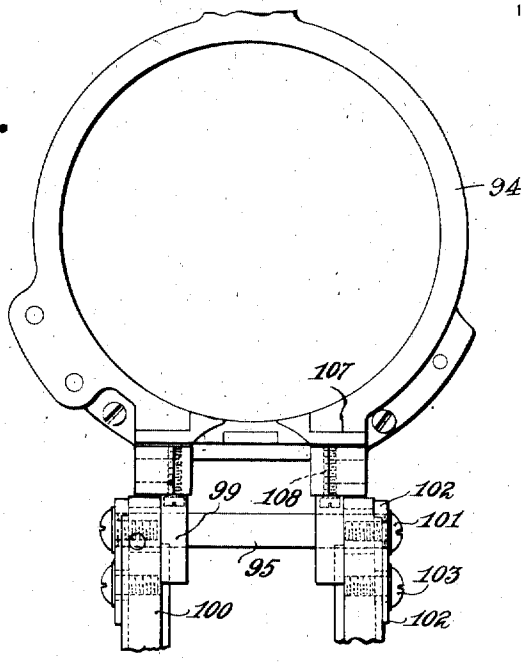


Fig. 6.

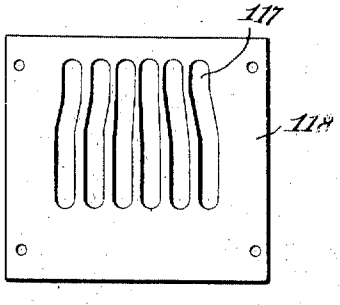


Fig. 7.

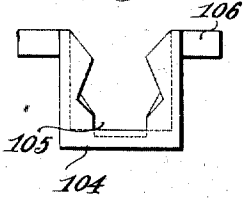


Fig. 9.

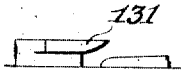


Fig. 8.

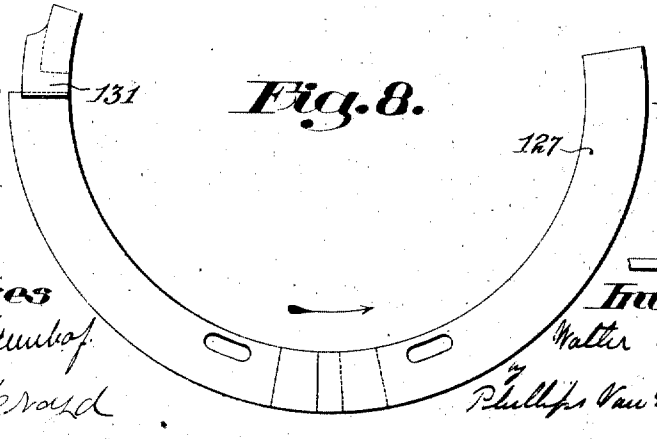
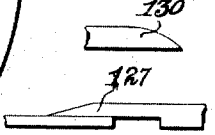


Fig. 10.



Witnesses

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CIRCULAR KNITTING MACHINE.

APPLICATION FILED AUG. 13, 1914.

1,244,991. Patented Oct. 30, 1917.

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Fig. 11.

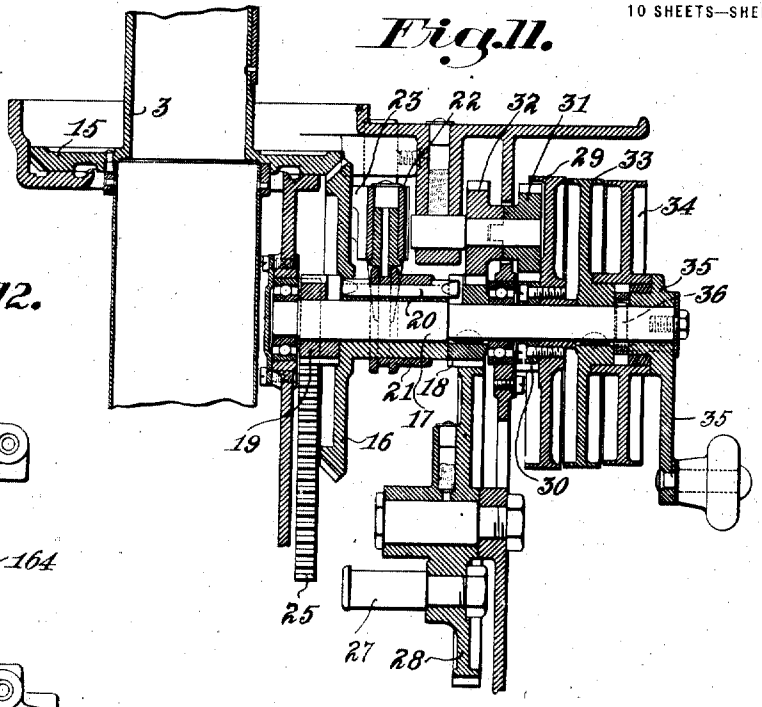


Fig. 12.

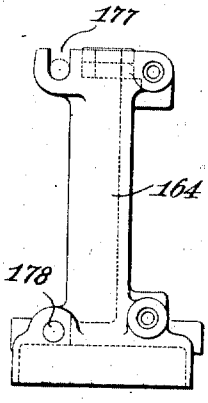


Fig. 13.

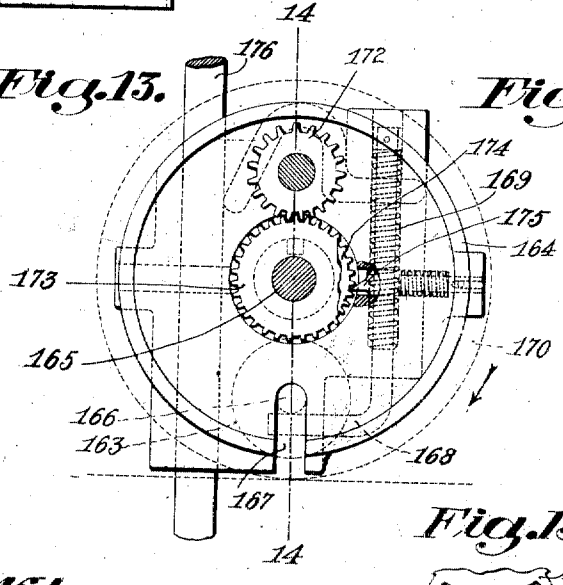


Fig. 14.

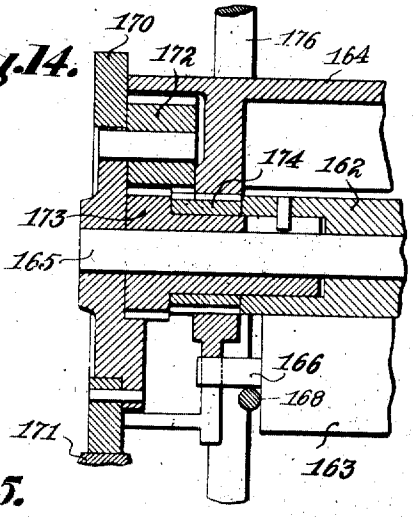
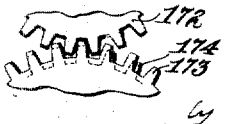


Fig. 15.



Witnesses

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CIRCULAR KNITTING MACHINE.

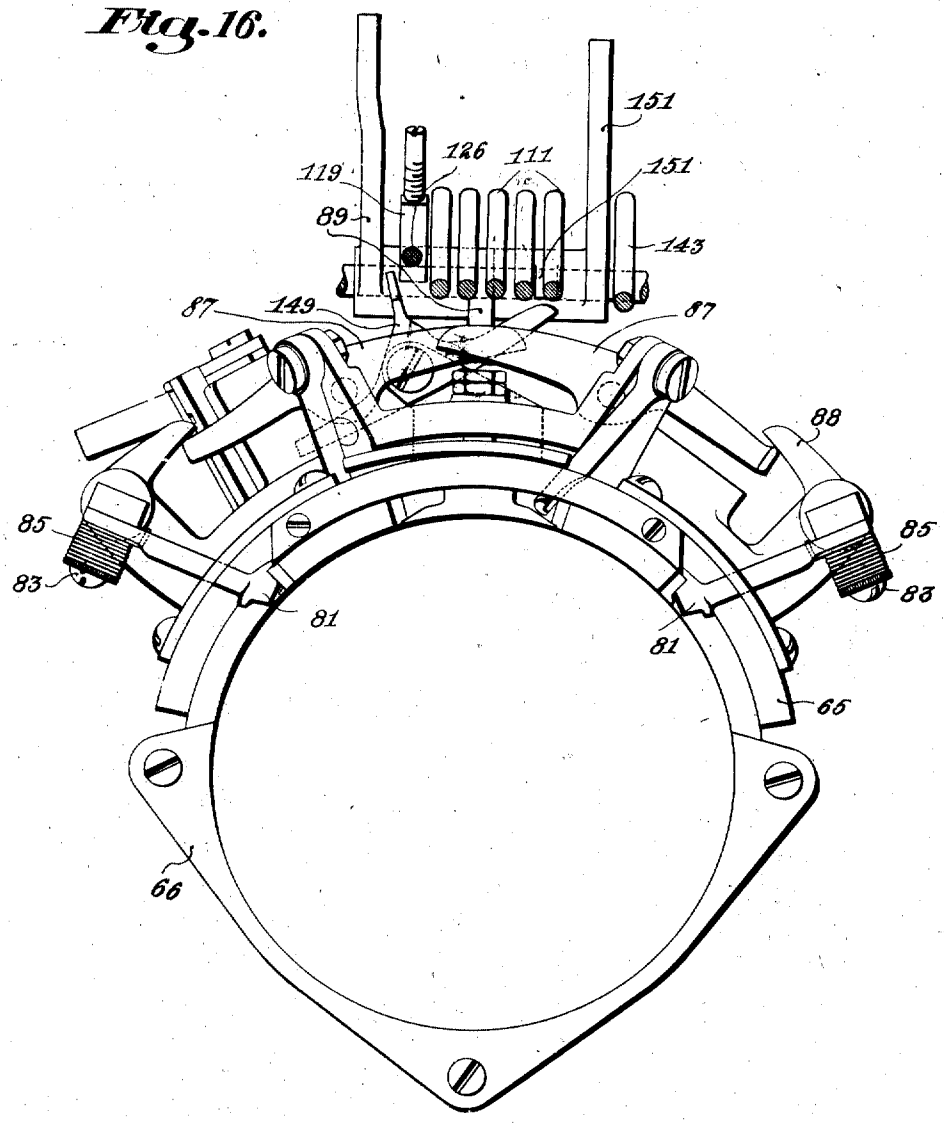
APPLICATION FILED AUG. 13, 1914.

1,244,991.

Patented Oct. 30, 1917.

10 SHEETS—SHEET 7.

Fig. 16.



Witnesses

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CIRCULAR KNITTING MACHINE.

APPLICATION FILED AUG. 13, 1914.

1,244,991.

Patented Oct. 30, 1917.

10 SHEETS—SHEET 8.

Fig. 17.

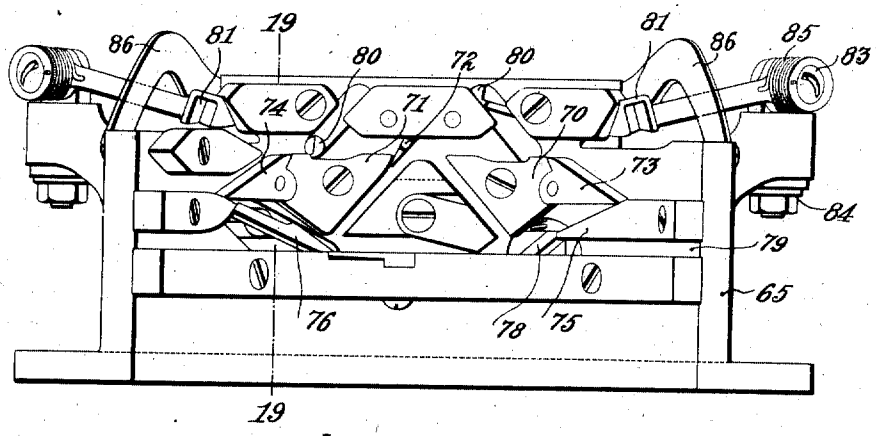


Fig. 18.

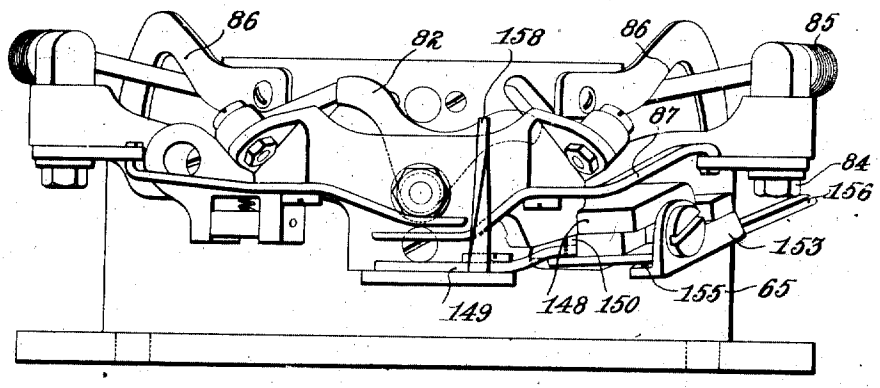


Fig. 21.

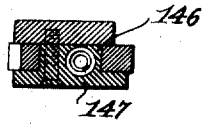


Fig. 19.

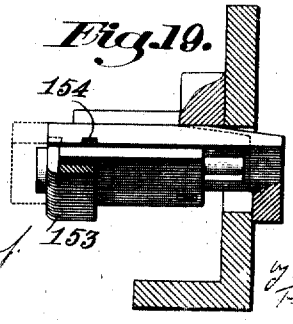
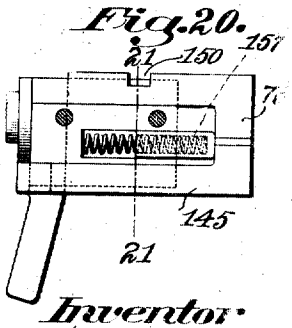


Fig. 20.



Witnesses

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CIRCULAR KNITTING MACHINE.

APPLICATION FILED AUG. 13, 1914.

1,244,991.

Patented Oct. 30, 1917.

10 SHEETS—SHEET 9.

Fig. 22.

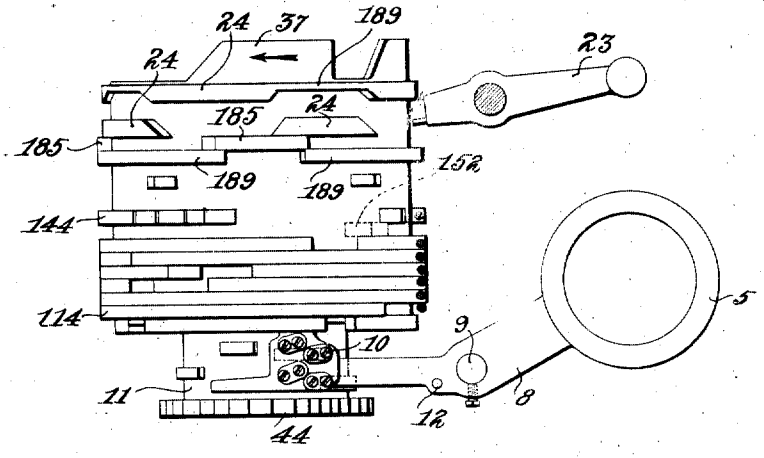


Fig. 23.

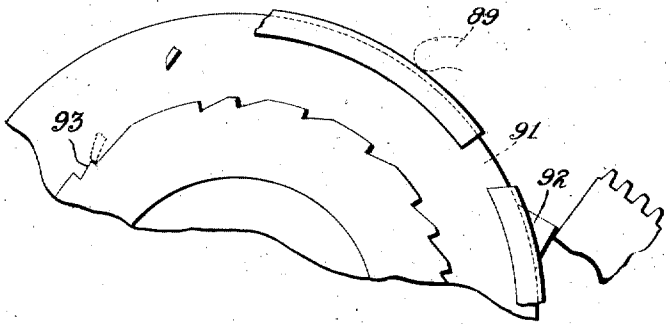
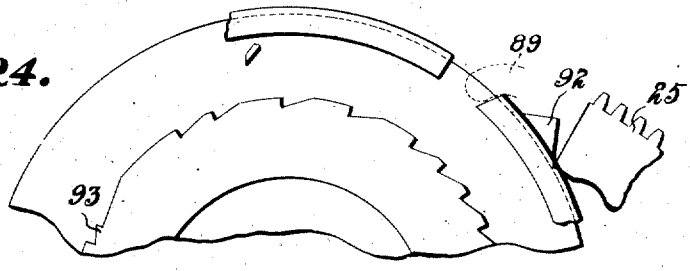


Fig. 24.



Witnesses

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CIRCULAR KNITTING MACHINE.

APPLICATION FILED AUG. 13, 1914.

1,244,991.

Patented Oct. 30, 1917.

10 SHEETS—SHEET 10.

Fig. 25.

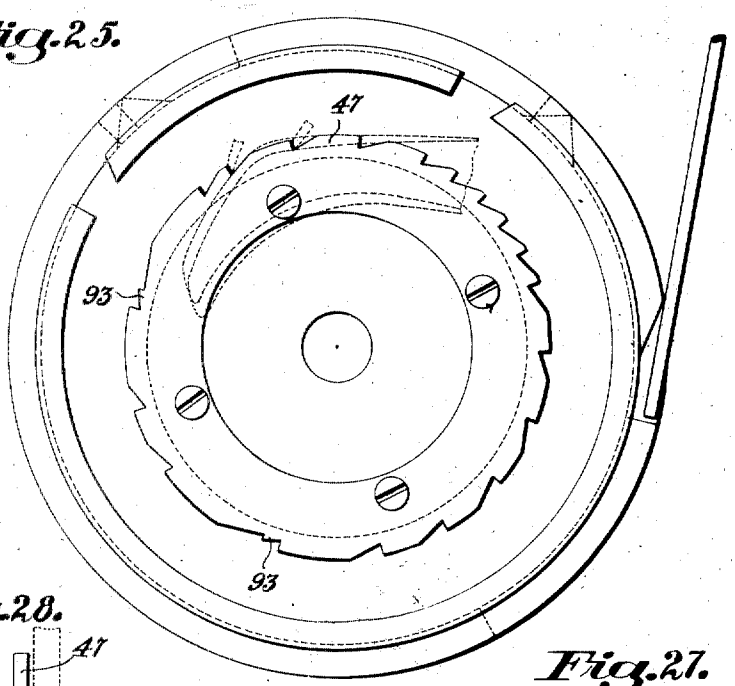


Fig. 28.

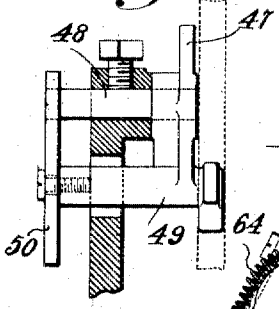


Fig. 27.

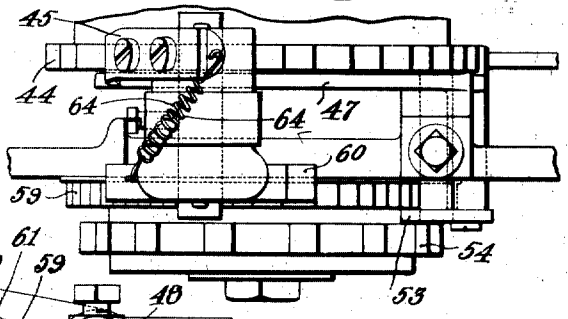
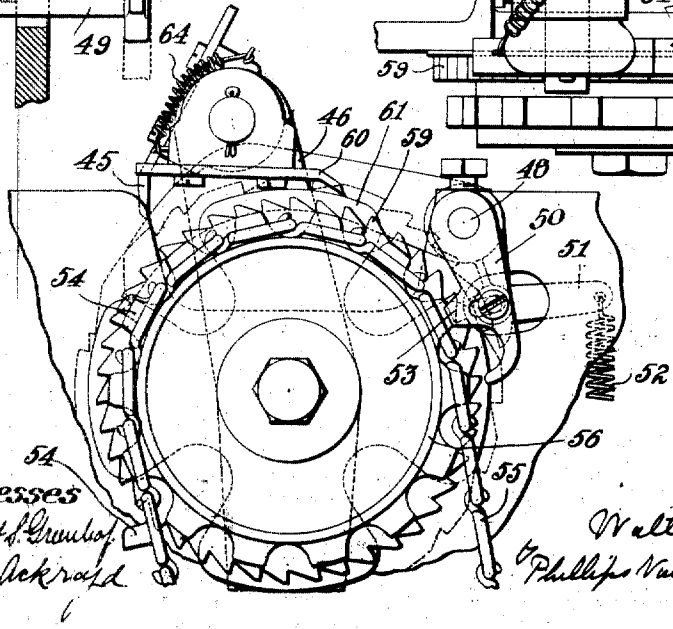


Fig. 26



Witnesses

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UNITED STATES PATENT OFFICE.

WALTER LARKIN, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO JENCKES KNITTING MACHINE COMPANY, OF PAWTUCKET, RHODE ISLAND, A CORPORATION OF RHODE ISLAND.

CIRCULAR-KNITTING MACHINE.

1,244,991. Specification of Letters Patent. Patented Oct. 30, 1917.

Application filed August 13, 1914. Serial No. 856,547.

To all whom it may concern:

Be it known that I, WALTER LARKIN, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Circular-Knitting Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The invention relates to that class of circular knitting machines in which the needles are mounted in a needle cylinder and are operated upon by cams and pickers arranged about the cylinder, the relative movements between the needle cylinder and needle operating cams and pickers requisite for knitting a tubular fabric provided at intervals with heel and toe pockets being produced by rotary and reciprocatory movements of the needle cylinder or cam cylinder.

The object of the invention is to improve and simplify the construction and arrangement of the various parts and mechanisms of a machine of this type, and to that end, the invention comprises the features of constructions and combinations of parts hereinafter described and set forth in the claims.

The various features of the invention will be readily understood from an inspection of the accompanying drawings and the following detailed description of the machine illustrated therein.

In the drawings, Figure 1 is a front elevation of a knitting machine embodying the various features of the invention in their preferred forms; Fig. 2 is a left hand side elevation; Fig. 3 is a plan; Fig. 4 is a vertical sectional view through the knitting head; Fig. 5 is a detail plan view of the latch ring; Fig. 6 is a detailed view of the cam plate for controlling the yarn carrier fingers; Fig. 7 is a detail view of the throat plate; Figs. 8, 9 and 10 are detail views of the high splicer cam; Fig. 11 is a vertical sectional view through the driving mechanism for the needle cylinder; Figs. 12, 13, 14 and 15 are detail views of the fabric take-up; Fig. 16 is a plan view of the cam cylinder; Fig. 17 is a view showing the interior of that section of the cam cylinder which carries the knitting cams and pickers; Fig. 18 is an exterior view of the same; Fig. 19 is a sectional detail on line 19—19 of Fig. 17; Fig. 20 is a detail plan view of the leveling cam and its operating devices; Fig. 21 is a sectional detail on line 21—21, Fig. 20; Fig. 22 is a detail view of the drum which carries the cams for controlling the various mechanisms of the machine; Figs. 23 and 24 are details of the cam drum and a part of its actuating mechanism; Fig. 25 is an end view of the cam drum and the ratchet wheel through which it is actuated; Fig. 26 is a detailed elevation showing the pattern chain and the drum actuating mechanism; Fig. 27 is a plan view of the parts shown in Fig. 26; and Fig. 28 is a detail elevation looking toward the left in Fig. 26, the supporting frame being shown in section.

The machine shown comprises generally a rotary needle cylinder carrying the usual long and short butt needles, a surrounding support or cam cylinder on which the needle operating cams and pickers are mounted, mechanism for rotating and reciprocating the needle cylinder, a series of yarn carrying fingers for delivering yarn to the needles and for changing the yarn during the knitting, and an intermittently revolving cam drum carrying the various cams for automatically operating and controlling the various parts and mechanisms of the machine. The machine is also provided with mechanism for raising and lowering the needle cylinder to vary the length of stitch at different parts of the stocking, and with mechanism for leveling the needles for the purpose of transferring rib tops thereto when the machine is being operated to knit half hose. The machine is also provided with a fabric take-up for taking up the knit fabric as the knitting progresses.

In the construction shown, the needles 1 are mounted in a needle cylinder 2 which is mounted to slide vertically on a sleeve 3 and is connected to rotate therewith by a key 4 (Fig. 4). The needle cylinder is supported on a support 5 and runs on ball bearings 6 interposed between the needle cylinder and the needle cylinder support. The needle cylinder is retained on the support by a bar 7, one end of which is secured to the support and the other end of which is offset to engage a groove formed in the needle cylinder, the bar being made in sections so that it may be adjusted. The needle cylinder support is

formed on an arm 8 secured to the upper end of a rod 9 which is mounted to slide vertically in suitable bearings in the frame of the machine. The rear end of the arm 8 is provided with a series of adjustable screws 10 which are arranged to be engaged by a series of cams carried by the cam drum 11, the cams being properly arranged and formed to raise and lower the needle cylinder to vary the tension or length of stitch at various times in the knitting, as is customary in this type of machine. The arm 8 also carries an adjustable screw 12 arranged to bear on a cam 13 formed on the hub of a lever 14 which is mounted to turn loosely on the rod 9 (Fig. 2). The lever 14 may be turned by the operator to raise and lower the needle cylinder in transferring.

The needle cylinder is rotated or reciprocated through a bevel gear 15 formed on the lower end of the sleeve 3 and engaged by a bevel gear 16 loosely mounted on the drive shaft 17 and adapted to be connected with a rotary pinion 18 which is secured to the shaft or to an oscillating pinion 19 which is loosely mounted on the shaft. The means for connecting the driving gear 16 with one or another of the pinions comprises a clutch bolt 20 mounted to slide in the hub of the gear and arranged to be shifted into engagement with notches or recesses in the pinions. The clutch bolt is connected to a sleeve 21 mounted to slide on the hub of the gear 16 and provided with an annular groove which is engaged by a yoke 22 mounted on the forward end of a lever 23 (Figs. 1, 2 and 22). The rear end of the lever 23 is arranged to be engaged by cams 24 on the cam drum 11 which operate the lever to shift the bolt from one pinion to the other at the proper intervals to change the motion of the needle cylinder. The shaft and therefore the pinion 18 are continuously driven during the knitting either at a high or a low speed and the pinion 19 is oscillated through a segment 25 which is connected through a link 26 with a crank pin 27 carried by a gear 28 which meshes with the pinion 18. The pinion 18 is driven at a high speed through a pulley 29 loosely mounted on the shaft and carrying a gear 30 meshing with a gear 31, the hub of which is connected with the hub of a gear 32 meshing with the pinion 18. The pinion 18 is driven at a slower speed through a pulley 33 secured to the shaft 17 and arranged at the side of the pulley 29. The loose pulley 34 on to which the belt is shifted when the machine is to be stopped runs loosely on the hub of the slow speed pulley 33. A crank handle 35 is connected with the end of the driving shaft through a ratchet mechanism indicated at 36 so that the machine may be turned by hand when desired. This construction of driving mechanism for the needle cylinder is simple and compact and does not involve the use of comparatively long sleeves for securing connections between the different pulleys and gears. It also enables the driving shaft to be readily mounted in ball bearings with a resulting reduction in the friction and wear.

During rotary knitting, the driving belt runs upon the high speed pulley 29 and is shifted on to the low speed pulley 33 during reciprocatory knitting. The belt is automatically shifted at proper intervals by cams 37 formed on the cam drum 11 and arranged to engage the upper end of an arm 38 secured to the belt shipper rod 39. The rod 39 carries a belt shipper 40 and is forced in a direction to shift the belt on to the high speed pulley 29 by a spring 41. The belt may be shifted on to the loose pulley automatically by a cam secured to the cam drum and arranged to engage the arm 38, or it may be shifted manually by the operator through a handle 42 projecting from the belt shipper. The belt shipper may be latched in position with the belt on the loose pulley by a latch 43 engaging the handle 42. The latch may be thrown up by the operator to release the belt shipper and thus shift the belt on to the high speed pulley.

The cam drum 11 is moved at proper intervals through a ratchet wheel 44 secured to the end of the drum and engaged by a pawl 45 pivotally mounted on the upper end of a pawl carrying lever 46 (Figs. 2, 11, 25 and 28). The engagement of the pawl with the ratchet is normally prevented by a guard 47 arranged to underlie the pawl. The guard is in the form of a lever pivotally mounted on a stud 48 and is provided with a laterally projecting boss 49 to which an arm 50 is secured. The arm 50 also pivotally engages the stud 48. The guard lever is also provided with a rearward projection connected with a spring 52 which normally holds the guard lever in a position to prevent the engagement of the pawl 45 with the ratchet 44. The arm 50 of the guard lever is provided with a finger 53 adapted to be engaged by a series of lugs 54 on the pattern chain 55. When one of the lugs rides under the finger 53, the pawl guard is lowered, as indicated in dotted lines in Fig. 25, to permit the pawl 45 to engage one of the teeth of the ratchet 44 and thus advance the cam drum. The teeth on the ratchet 44 are of different lengths and the lugs 54 on the pattern chain are of different heights so that the guard lever may be lowered the proper distance in accordance with the length of the tooth which is to be engaged by the pawl. The pattern chain which controls the feeding movements of the cam drum passes over a sprocket wheel 56 loosely mounted on the stud which carries the cam drum and also passes over the guide sprock-

ets 57 and 58. The pattern chain is intermittently advanced during the running of the machine through a ratchet wheel 59 secured to the rear side of the sprocket wheel and arranged to be engaged by a pawl 60 pivotally mounted on the upper end of the pawl carrying lever 46. The pawl 60 rides over a guard 61 so arranged that the pawl will advance the ratchet wheel one tooth at each reciprocation of the pawl carrying lever. The pawl carrying lever is oscillated from the segment lever 25 through an arm 62 projecting upwardly from the hub of the segment and provided with a slot engaging a pin 63 on the lower end of the pawl carrying lever. The pawls 45 and 60 are forced in a direction to engage their respective ratchet wheels by a spring 64 connecting the pawls.

The knitting cams for forming the knitting waves in the needles and the pickers for effecting the narrowing and widening are mounted on a semi-cylindrical support 65 which is secured to the base plate of the machine and forms one section of the stationary cam cylinder. This section of the cam cylinder embraces substantially one-half of the needle cylinder while the other half is surrounded by a cam cylinder section 66 formed of a series of plates 67 separated by the spacing collars 68 which surround the retaining bolts 69 by which the section is secured to the base plate and which are interposed between the plates 67. The upper plate of the skeleton section forms a continuation of the supporting ledge for the needle butts when the needles are on the knitting level while the space between the lower and middle plates forms a continuation of the leveling groove into which the needle butts are directed in leveling the needles for transferring work. This construction enables the cam supporting cylinder to be economically and conveniently constructed and also enables the cam carrying segment to be readily removed for repair.

The support 65 carries the usual stitch cams 70 and 71, the switch cams 72, 73 and 74, and the elevating cams 75 and 76. The lower end of the elevating cam 75 is in the form of a yielding cam 78 so mounted that it will yield to allow the passage of the needle butts in the direction from right to left in Fig. 17 when the needle butts are in the leveling groove 79. The needle elevating cam 76 is so mounted that it may be withdrawn radially from the path of the needle butts, so that the needle butts will pass down into the leveling groove 79 when the needles are to be leveled for transfer work. The means for withdrawing this cam will be described later. The support 65 also carries the two lifting pickers 80 and the two depressing pickers 81. The lifting pickers are arranged above the stitch cams 70 and 71 and are mounted to swing about inclined axes, as indicated in Fig. 18. These pickers are frictionally held in the position into which they are moved by the action of the needle butts thereon. When one picker is raised by its engagement with the needle butt, the other picker is moved down into active position by a lever 82 pivoted on the outside of the support 61 and having its ends arranged to engage the pickers and transmit motion from one picker to the other. The needle depressing pickers 81 are mounted on horizontal pivots 83 carried by vertical pivot studs 84. Springs 85 mounted on the pivots 83 act to force the pickers yieldingly upward. The pickers are caused to swing downward when engaged by the needle butts by the guide cams 86. The pickers are normally held down in inactive position, as indicated in Fig. 17, through levers 87. One end of each lever engages an arm 88 projecting from one of the pivot studs 84, and the other end of each lever is engaged by the vertical arm of a bell crank lever 89, the horizontal arm of which rides on a cam 90 on the cam drum 11. The cam 90 is provided with openings or depressions 91 which are brought into register with the bell crank lever 89 and allow the pickers to move up into active position when the widening of the fabric on the heel or toe is to begin.

It will be noted that in the construction shown the depressing pickers 81 are arranged on the same side of the needle cylinder as the lifting pickers and stitch cams. This arrangement of the pickers in a machine in which the needle cylinder is rotated and reciprocated makes it necessary, in order that the depressing pickers may be thrown into action at the proper time in the reciprocation of the needle cylinder, that the movement of the cam drum 11, which brings the depression 91 into register with the lever 89 and thus throws the pickers into operation, should take place at a different time from the timing of the movements which are imparted to the drum by its actuating pawl 45. An independent actuating mechanism is therefore provided for actuating the cam drum to throw the needle depressing pickers into operation. In the construction shown, this actuating mechanism comprises two lugs 92 on the cam drum which are so arranged that they may be engaged by the upper end of the segment 25 when brought into the path of the segment. When the depressing pickers are to be thrown into operation, a lug on the pattern chain lowers the pawl guard 47 so that the pawl 45 will engage one of the short teeth 93 on the ratchet 44 and advance the cam drum sufficiently to bring one of the lugs 92 into the path of the segment 25. (Figs. 22 to 25.) This occurs when the seg-

ment is at the lower end of its stroke. Now, as the segment completes its upward stroke, the end of the segment strikes the lug 92, as indicated in Fig. 23, and moves the cam drum forward from the position indicated in Fig. 23 to the position indicated in Fig. 24, this movement of the cam drum bringing the depression 91 into register with the end of the lever 89 and throwing the depressing pickers into operation.

A latch ring 94 surrounds the upper ends of the needles and is mounted upon a pivot stud 95 so that it may be swung up out of the way for transfer work or inspection. The latch ring is provided with an arm 96 on the side opposite the pivot stud 95 which rests in a notch formed on the upper end of the support post 97. (Fig. 4.) The pivot stud for the latch ring is so mounted in a support 98 that it may be adjusted toward or from the needles to bring the latch ring into proper position with relation to the needles. As shown in Fig. 5, the latch ring is provided with two rearwardly projecting lugs 99 which fit between the two side plates 100 of the support 98. The pivot stud 95 passes through the lugs 99 and into enlarged holes in the side plate 100. The pivot stud is secured in position by screws 101 which pass through adjusting plates 102 and into the ends of the pivot stud. The plates 102 are mounted in guideways formed in the outer surfaces of the plates 100 and are clamped in adjusted position by the clamping screws 103 which pass through slots in the plates 102 and are screwed into the side plates 100. The adjusting plates 102 may be adjusted in their guideways to move the pivot stud forward or back, and after the adjustment is made, the plates may be firmly secured in position by the clamping screws 103. The screws 101 may be tightened to spring the side plates 100 inward so that they will frictionally engage the lugs 99 and frictionally hold the latch ring in any position into which it may be moved by the operator.

The latch ring carries a throat plate 104 through which the yarns are fed to the needles, the lower corners 105 of the opening in the throat plate forming guides over which the knitting yarn passes. The sides of the opening in the throat plate are inclined, as indicated in Fig. 7, to act as cams for turning down any needle latches which may swing outward into the opening in the throat plate as the inactive needles are passing during the reciprocatory knitting. The throat plate is so mounted in the latch ring that it may be adjusted vertically to bring its guiding surfaces into proper relation to the needle. As shown, the throat plate is provided with lateral projecting lugs 106 which fit within grooves 107 formed in the latch ring, and the throat plate is held in position in the latch ring by clamping screws 108 engaging the lugs.

The yarn is delivered to the needles by a series of yarn carrying fingers 109 which are provided at their inner free ends with eyes through which the various yarns used during the knitting of a stocking pass. The yarn carrying fingers are formed on the upper ends of rods 111 which are mounted to slide longitudinally through holes formed in the guide plates 112 and 113. The lower ends of the rods are arranged to directly engage a series of cam ribs 114 secured to the cam drum 11 and constructed to raise and lower the rods at the desired times and in the desired sequence. The yarn carrier rods are provided near their upper ends with inclined portions 115 which, in sliding through the guide plate 112, act as cams for giving the yarn fingers a radial movement across the tops of the needles when the rods are raised or lowered to withdraw or insert their yarns. The yarn carrier rods are pulled downward by springs 116, and when in position to deliver yarn to the needles, the yarn carrying fingers at the upper ends of the rods rest on the pivot 95 of the latch ring, as indicated in Fig. 4. In the construction shown, there are six yarn carrying fingers, and in order that the outer fingers may move in the proper direction to carry their yarns into proper relation with the opening in the throat plate, means are provided for swinging the yarn fingers laterally as they are moved vertically to insert or withdraw the yarn. In the construction shown, this means comprises a series of cam slots 117 formed in a cam plate 118 which is secured to the rear side of the support 98. The yarn carrier rods are provided with blocks 119 adjustably secured thereon by screws 120 which also pass through the slots 117 and coöperate therewith in guiding and swinging the yarn carrier rods.

The different yarns are led to the yarn carrying fingers through guide eyes 121 secured in an upper extension of the guide plate 112. (Figs. 3 and 4.) In order that the yarn guides 121 and the yarn carrying fingers 109, which are mounted independently of the latch ring, may be moved back out of the way when the latch ring is raised and thus avoid danger of tangling the yarns, the guide plate 112 is so connected with the latch ring that the final upward movement of the latch ring will move the guide plate radially away from the needles. As shown, the guide plate is mounted upon a rod 122 mounted to slide in a bearing in the support 98, and the plate is provided with ears 123 carrying a rod 124 which passes through the ears and through slots formed in links 125 the forward ends of which are pivotally connected with lug 126 on the latch ring. When the latch ring is swung up the links

125 first slide idly back on the rod 124 until the front ends of the slots 124 engage the rod, when the further upward movement of the latch ring causes the guide plate 112 to be moved rearwardly. This moves the yarn carrying fingers back away from the needles. When the latch ring is returned to normal position, the links 125 act to return the yarn carrier fingers to their normal position, indicated in Fig. 4.

One of the yarn carrier fingers is designed to carry the splicing yarn, which is usually inserted and withdrawn during each course in knitting certain parts of a stocking. In the construction shown, the means for operating the splicing yarn carrier finger, when it is lowered into active position by its cam 114, comprises a cam secured to the cylinder operating gear 15 and constructed to positively raise and lower the yarn carrier finger at predetermined points during each rotation of the needle cylinder. As shown, the splicing cam is in the form of a cam rib 127 secured to the upper face of the gear 15 and is formed in sections, the ends of which overlap so that the length of the cam rib may be adjusted, as indicated in Figs. 8, 9 and 10. This cam coöperates with an arm 128 secured to the rod of the splicing yarn finger and provided with a laterally projecting finger 129 adapted to ride on the cam 127 (Fig. 4). The leading end 130 of the cam 127 is inclined to ride under the end of the arm 128 and lift the yarn finger sufficiently to withdraw the yarn. The yarn finger remains in inactive position until the cam 127 passes from under the arm 128. As this occurs, the finger 129 rides under the inclined end of a cam 131 arranged at the end of the cam 127, and the yarn carrier finger is positively drawn down into active position to insert and feed the yarn to the needles.

When the yarns are changed, the yarn which is withdrawn is severed and the ends of the inactive yarns are held by a clamp mounted upon the latch ring and arranged within the needles. As shown, the yarn cutter and yarn clamp are mounted on a support 132 secured to the latch ring and carrying a plate 133 located within the needles. The clamp 134 projects laterally from a clamp lever 135 pivoted upon a bracket carried by the plate 133. (Figs. 3 and 4.) The clamp is forced in a direction to clamp the yarns upon the plate 133 by a spring-pressed pin 136 engaging an arm depending from the lever 135. The yarns are guided under the clamp by a guide finger 137. The cutter 138 is pivotally supported on the plate 133 and is arranged to coöperate with a shear blade 139 secured to the rear edge of the plate. The rear end of the cutter lever overlies the rear end of the clamp lever 135 so that when the cutter lever is operated to raise the cutter the clamp is also raised, and when the cutter is released to sever the yarn the clamp is also released to clamp the severed end. The cutter is held closed by a spring-pressed pin, indicated at 140, similar to the pin 136. A spring 141 on the pivot stud of the cutter holds the cutter in position to coöperate with the shear blade 139. The means for operating the clamp and cutter comprises a lever 142 the front end of which engages the rear end of the cutter lever and the rear end of which is engaged by a vertically sliding rod 143. The lower end of the rod is engaged by a series of cams 144 secured to the cam drum 11 and arranged to operate the cutter and clamp at the proper intervals.

When using the machine to knit half hose, the yarn carrier finger which carries the toe yarn is automatically raised to run off the stocking, the needles are automatically leveled preparatory to the transfer of a ribbed top thereto, the yarn carrier finger which carries the yarn to be used at the beginning of the knitting is released by the operating cam on the cam drum, and the belt shifter is operated to shift the belt on to the loose pulley and stop the machine. These operations all take place during the last feeding movement imparted to the cam drum. In order to effect the leveling of the needles, the needle lifting cam 76 is partially withdrawn at the time when the long-butt needles are passing the cam. The butts of the short-butt needles then pass down into the leveling groove 79, and while the short-butt butts are passing the cam 76 it is completely withdrawn so that the butts of the long-butt needles also pass down into the leveling groove. In the construction shown, the cam 76 is formed on the inner end of a U-shaped slide 145, the arms of which embrace a guiding rib 146 formed on the guide plate 147 which is secured to a lug 148 projecting from the cam support 65. (Figs. 16 to 21.) The means for withdrawing the slide 145 and cam 76 comprises a lever 149 one end of which engages a notch 150 in the side of the slide 145 and the other end of which is arranged to be engaged by one arm of a bell crank lever 151. The other arm of the bell crank lever is arranged to engage a cam 152 which is secured to the cam drum when the machine is to be used for transfer work. During the last feeding movement of the cam drum, the low part of the cam 152 first rides under the bell crank lever 151 and partially withdraws the cam 76, as above described. After the long-butt needles have passed the cam 76, the continued movement of the cam drum brings the high part of the cam 152 under the bell crank lever 151, thus completing the withdrawal of the cam 76. When the cam is thus completely withdrawn, it is retained in position by a latch

153 arranged to engage a notch 154 in the underside of the long arm of the U-shaped slide 145. The latch is forced in a direction to engage the notch by a spring 155. The latch is provided with a projecting finger 156, by which the operator may operate the latch to release the cam carrying slide 145. When the cam slide is thus released, the spring-pressed pin 157 forces the cam slide radially inward and the cam rides against the ends of the needle butts until the short-butt needles have passed the cam, when the first long-butt needle will ride upon the cam and be brought into position to knit. As soon as the short-butt needles have passed the cam, it will move into its normal position, so that all the needle butts will ride upon the cam and the needles will be brought into knitting relation to the knitting cams. The operator thus releases the cam 76 after the transfer of the ribbed top to the needles has been effected, in the usual manner. When the lever 149 is operated to withdraw the cam 76 from the path of the needle butts, a vertical stop finger 158 formed on the lever is brought into position under the block 119 on the yarn carrier rod which carries the yarn to be used at the beginning of the knitting, so that the yarn carrier is retained in inactive position until after the transfer has been effected. When the operator releases the cam 76 preparatory to beginning the knitting, the stop finger 158 moves out of active position, thus releasing the yarn carrier rod, so that the yarn carrier drops down into active position and presents the yarn to the first active needle. The cam 152 is removed from the cam drum when ladies' stockings are to be knit.

The knit fabric passes down through a fabric tube 159, the upper end of which is connected with the gear 15 through which motion is imparted by the needle cylinder. The lower end of the fabric tube carries a head 160 which is open on one side and which supports the fabric take-up. A can or receptacle 161 is secured to the lower end of the head 160 and receives the finished fabric. The fabric take-up mechanism comprises two take-up rolls 162 and 163 which are mounted in a supporting bracket 164. The upper take-up roll 162 is mounted on a shaft 165, while the lower roll is provided with trunnions 166 running in grooves 167 formed in the end plates of the bracket 164. The trunnions are supported upon rods 168 which underlie the trunnions and are provided with vertical extensions acted upon by springs 169 which tend to force the lower roll firmly against the upper roll. The mechanism for driving the upper roll 162 comprises a friction disk 170 loosely mounted on the end of the shaft 165 and arranged to rest on a circular stationary track 171. The disk 170 carries a planet pinion 172 which engages a gear 173 connected with the roll 162 and also engages a gear 174 which surrounds the hub of the gear 173 and is held against rotation in one direction by a spring-pressed pawl 175. The gear 173 has one more tooth than the gear 174 so that the roll 162 is slowly rotated in a direction to draw the fabric downward as the disk 170 travels around the stationary track 171. The bracket 164 carrying the take-up mechanism is mounted to slide freely on guide rods 176 so that the take-up mechanism is free to climb up the fabric and relieve the frictional engagement of the disk 170 with the track 171 and thus maintain a practically uniform tension on the fabric. In order that the take-up mechanism may be readily inserted in the head 160 or removed therefrom, the bracket 164 is provided with an open slot 177 for engaging one of the guide rods 176 while the other guide rod passes through a hole 178 in the bracket and is so supported in the head 160 that it may be readily removed. As shown, the removable rod 176 passes loosely through guide holes formed in the uper flange of the head 160 and in a lug 179 near the lower end of the head, and the rod is supported in position by a pin 180 which rests on the flange at the upper end of the head.

The cam 181 for raising the long-butt or instep needles into the inactive plane at the beginning of the heel or toe and for returning the needles to the active plane at the completion of the heel or toe, is pivotally mounted in a bracket 182 secured to the base plate of the machine and is operated through a rod 183 one end of which is pivoted to an arm 184 connected with the cam and the other end of which directly engages the cams 185 on the cam drum. (Figs. 2 and 22.) The cam 181 is held in normal position, indicated in Fig. 2, by a spring 186.

The take-ups for the heel and toe yarns are thrown into and out of action through rods 187 the lower ends of which are connected to the rear ends of the levers 188 and the forward ends of which are arranged to engage cam ribs 189 on the cam drum 11.

While it is preferred to employ the construction and arrangement of parts shown and described in embodying all the features of the invention in an automatic knitting machine adapted to knit either fashion stockings or half hose, it is to be understood that this construction and arrangement are not essential to the broader features of the invention and may be varied or modified without departing therefrom.

Having explained the nature of the invention and specifically described one form

of mechanism in which it may be embodied, what is claimed is:—

1. A circular knitting machine having, in combination, a rotary needle cylinder, independently movable needles mounted therein, needle operating cams, a series of rods having yarn carrier fingers at their upper ends, inclined portions below the fingers, a guide plate having holes through which the inclined portions of the rods slide as the rods are raised and lowered, and means for raising and lowering the rods.

2. A circular knitting machine having, in combination, a rotary needle cylinder, independently movable needles mounted therein, needle operating cams, a series of vertically sliding rods provided with laterally projecting yarn carrier fingers, and means for raising and lowering and for swinging the rods.

3. A circular knitting machine having, in combination, a rotary needle cylinder, independently movable needles mounted therein, needle operating cams, a series of vertically sliding rods provided with laterally projecting yarn carrier fingers, a plate having cam slots, pins projecting laterally from the rods into the slots, and means for raising and lowering the rods.

4. A circular knitting machine having, in combination, a rotary needle cylinder, independently movable needles mounted therein, needle operating cams, a throat plate through which yarn is directed to the needles, a series of yarn carrier fingers, and means for raising and lowering the fingers and for swinging them laterally.

5. A circular knitting machine having, in combination, a needle cylinder, independently movable needles mounted therein, needle operating cams, a latch ring, and a throat plate through which yarn is directed to the needles vertically adjustable in the latch ring.

6. A circular knitting machine having, in combination, a needle cylinder, independently movable needles mounted therein, needle operating cams, a latch ring, a throat plate through which yarn is directed to the needles, vertical guides in the latch ring for receiving the throat plate, and clamping screws for adjustably securing the throat plate in the guides.

7. A circular knitting machine having, in combination, a needle cylinder, independently movable needles mounted therein, needle operating cams, a pivoted latch ring, a throat plate in the ring through which yarn is directed to the needles, yarn carrier fingers mounted independently of the latch ring, and devices operated by the raising and lowering of the latch ring for moving the fingers back and for returning them to normal position.

8. A circular knitting machine having, in combination, a needle cylinder, independently movable needles mounted therein, needle operating cams, a pivoted latch ring, a throat plate in the ring through which yarn is directed to the needles, a series of vertically movable rods provided with yarn carrier fingers, a guide plate through which the rods slide, and connections between the plate and latch ring for moving the plate away from the needles during the final upward movement of the latch ring.

9. A circular knitting machine having, in combination, a rotary needle cylinder, independently movable needles mounted therein, needle operating cams, a yarn carrier for splicing yarn, a concentric driving gear for the needle cylinder, and a cam on the gear for raising and lowering the yarn carrier to withdraw and insert the splicing yarn.

10. A circular knitting machine having, in combination, a rotary needle cylinder, independently movable needles mounted therein, needle operating cams, a yarn carrier for splicing yarn, a cam for raising and supporting the yarn carrier to withdraw the yarn from the needles, and a cam at the end of the supporting cam for drawing down the yarn carrier to insert the yarn.

11. A circular knitting machine having, in combination, a rotary needle cylinder, independently movable needles mounted therein, needle operating cams, a vertically movable rod provided with a yarn carrier finger, a cam for supporting and releasing the rod, an arm on the rod, and a segmental cam traveling with the needle cylinder arranged to act on the arm to raise and lower the yarn carrier finger when the rod is released by its supporting cam.

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