

E. PAQUETTE.  
CIRCULAR KNITTING MACHINE.  
APPLICATION FILED SEPT. 3, 1910.

999,854.

Patented Aug. 8, 1911.

4 SHEETS—SHEET 1.

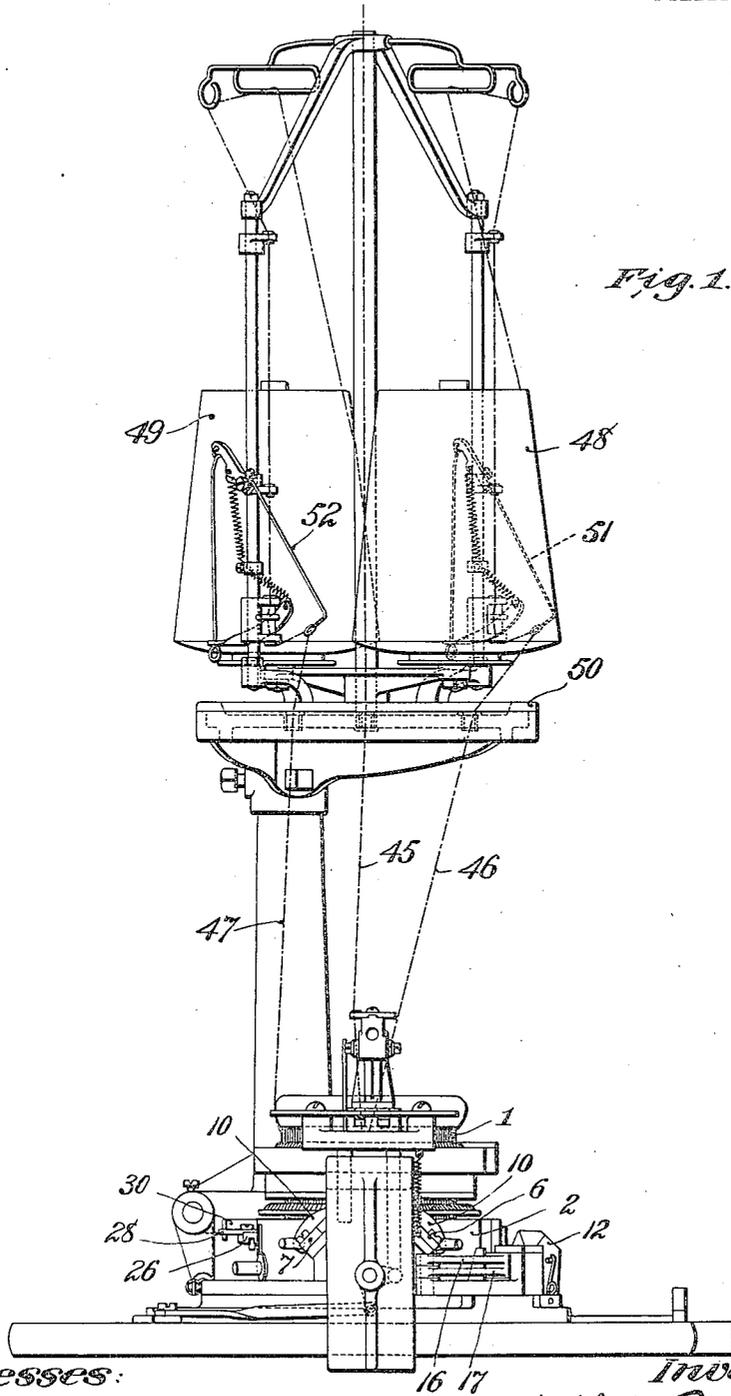


Fig. 1.

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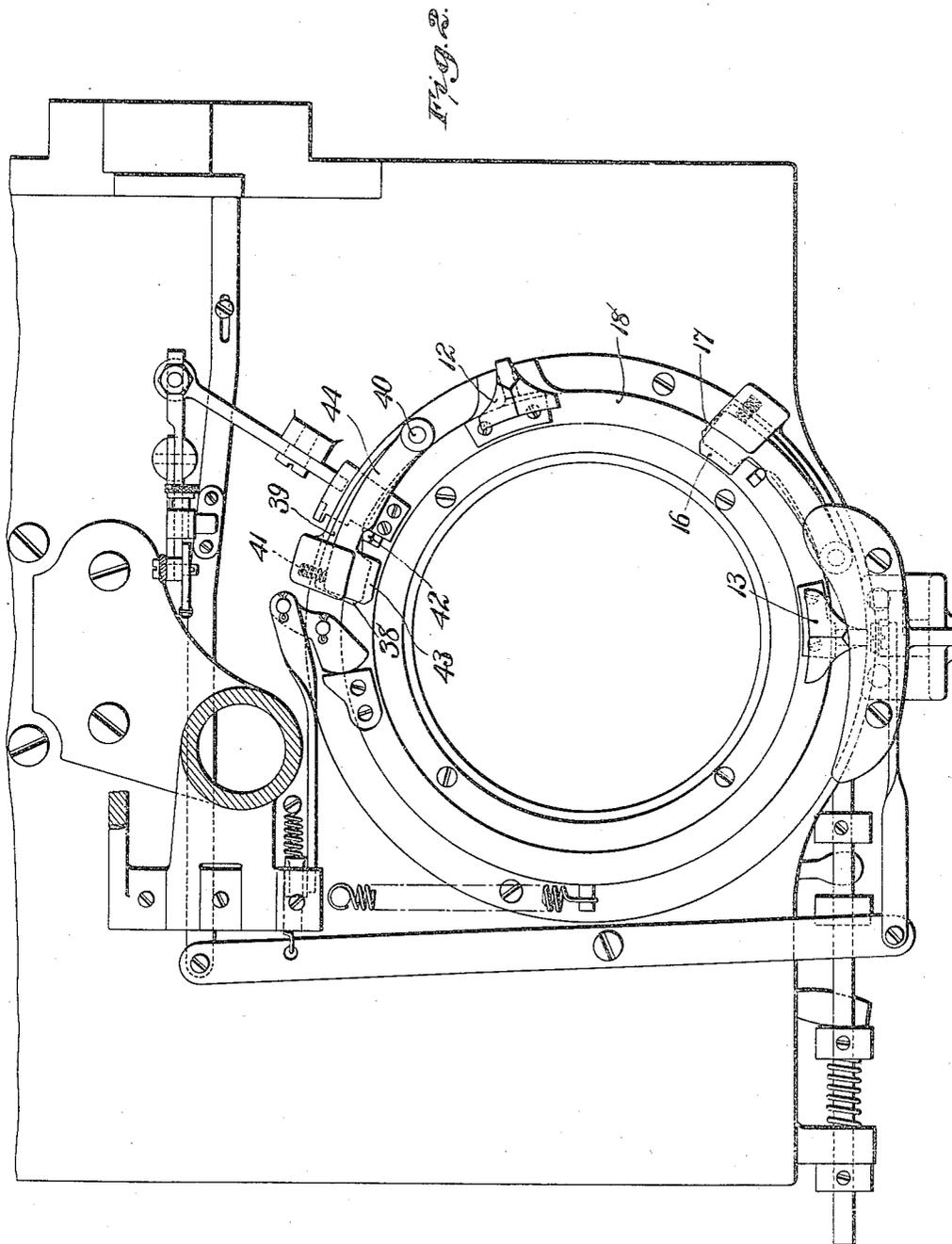
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E. PAQUETTE.  
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4 SHEETS-SHEET 2.



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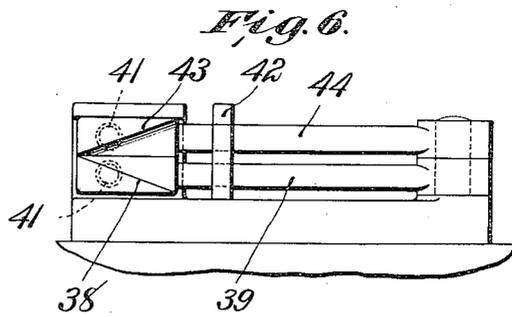
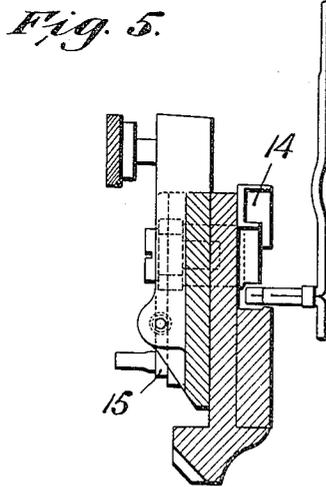
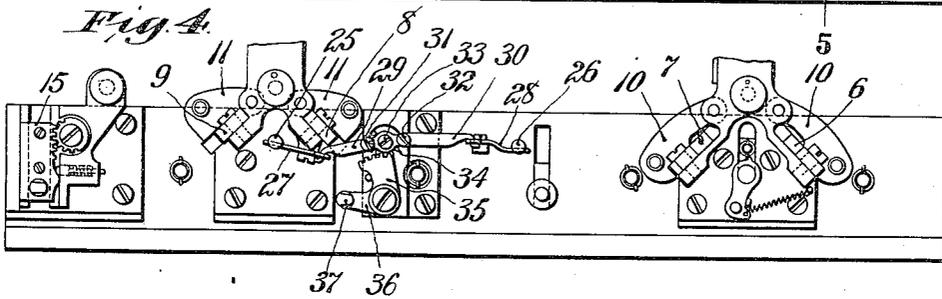
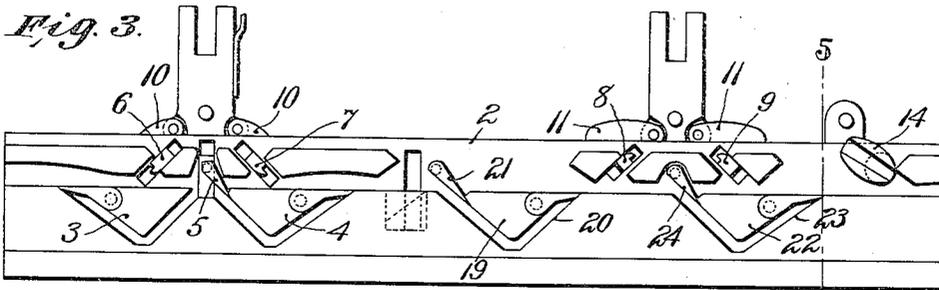
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E. PAQUETTE.  
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4 SHEETS—SHEET 3.



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4 SHEETS—SHEET 4.

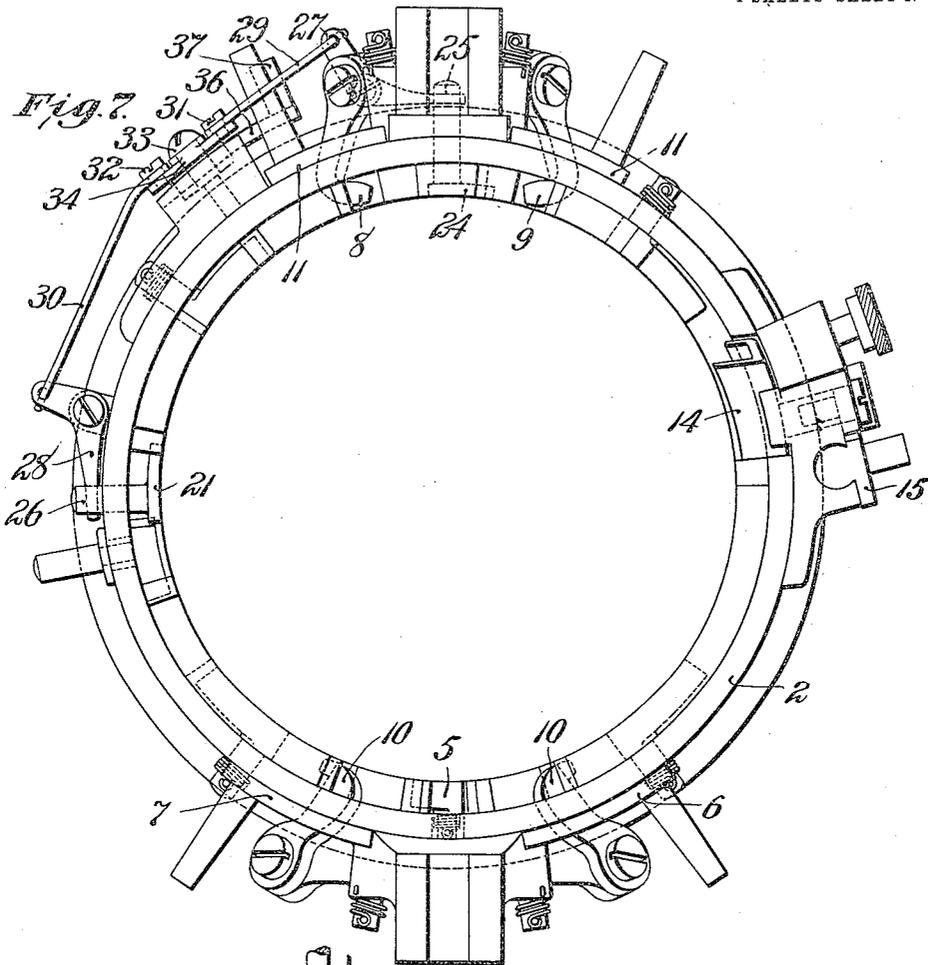
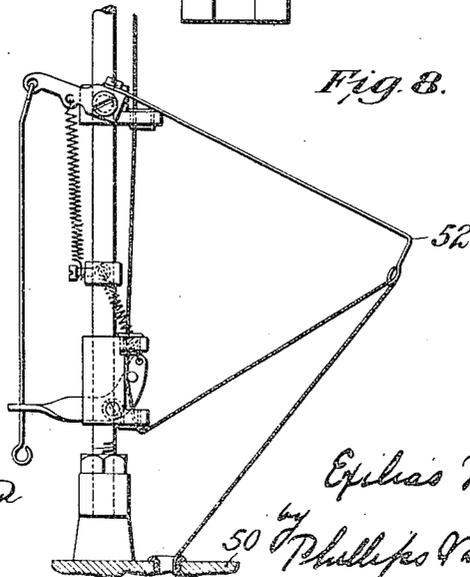


Fig. 8.



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# UNITED STATES PATENT OFFICE.

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## CIRCULAR-KNITTING MACHINE.

999,854.

Specification of Letters Patent.

Patented Aug. 8, 1911.

Application filed September 3, 1910. Serial No. 580,306.

To all whom it may concern:

Be it known that I, EXILIAS PAQUETTE, a citizen of the United States, residing at Lowell, in the county of Middlesex 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 by cams and controlling devices carried by a cam cylinder which is rotated and reciprocated to knit a tubular fabric provided at intervals with heel and toe pockets.

The object of the invention is to provide a novel and improved construction and arrangement of cams and devices for operating the needles, whereby the production of the machine is increased.

The invention is intended primarily as an improvement in the machine known as the "Acme" machine, and illustrated in the patents to Mayo, No. 474,671, May 10, 1892, and No. 745,449, December 1, 1903, although it will be understood that the invention is not limited in its application to this machine, and may be embodied in other constructions and other forms of circular knitting machines for producing seamless hosiery.

The invention consists in the features and combinations hereinafter described and referred to in the claims, the advantages of which will be obvious to those skilled in the art.

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 showing so much of a knitting machine as is necessary to illustrate the application of the present invention thereto; Fig. 2 is a plan view showing the base plate with the cam cylinder and needle cylinder removed; Fig. 3 is a view showing a development of the inside of the cam cylinder; Fig. 4 is a similar view showing the outside of the cam cylinder; Fig. 5 is a detail sectional view on line 5-5, Fig. 3; Fig. 6 is a detail view

showing the cams for throwing the supplemental knitting cams into and out of operation on the short butt needles; Fig. 7 is a plan view of the cam cylinder; and Fig. 8 is a detail view of one of the take-ups.

In the drawings the invention is illustrated as embodied in a machine having many of its parts constructed and arranged and operating in substantially the same manner as the corresponding parts in the "Acme" machine above referred to. The motion changing mechanism, the pattern mechanism for controlling the operation of the various parts of the machine, the main knitting cams which operate the needles during the knitting of the heel and toe, the elevating and depressing pickers for effecting the narrowing and widening, and the cam which raises the long butt or instep needles into the inactive series at the beginning of the narrowing and returns all the needles in the inactive series to the lower or active plane at the end of the widening, are the same in construction, and are operated and controlled in the same manner as in the "Acme" machine. In addition to the knitting cams corresponding to the knitting cams of the "Acme" machine, which for convenience are termed the "main" knitting cams, the machine illustrated in the drawings is also provided with two additional sets of knitting cams which may for convenience be termed "supplemental" knitting cams. The machine is also provided with two additional or supplemental thread guides through which yarn is fed to the knitting waves formed in the needles by the respective sets of supplemental knitting cams, so that during each revolution of the cam cylinder three circular courses of loops are formed, with a corresponding increase in the rapidity with which the leg or leg and foot of the stocking is knit. The supplemental knitting cams are thrown out of action at the beginning of the heel or toe, so that the main knitting cams are the only active knitting cams during the knitting of the heel or toe, and are again thrown into action when the motion of the cam cylinder is changed from reciprocating to rotary.

The needles which are out of action during the knitting of the heel and toe, and which for convenience may be termed the "instep" needles, are provided with the

usual long butts, while the needles which are operating during the knitting of the heel and toe are provided with the usual short butts. The needles are mounted in a needle  
 5 cylinder 1, and are surrounded by a cam cylinder 2 to which either rotary or reciprocating movements are imparted through motion changing mechanism like that of the  
 10 "Acme" machine. The main knitting cams, which are active during both rotary and reciprocating knitting, comprise the stitch cams 3 and 4 and the center switch cam 5 which are similar to the knitting cams of the  
 15 "Acme" machine. The cam cylinder is also provided with lifting pickers 6 and 7, and with depressing pickers 8 and 9, which are similar in construction and mode of operation to the pickers of the "Acme" machine,  
 20 and are controlled in the same manner by the latches 10 and 11 and the cam posts 12 and 13. The cam cylinder is also provided with a cam 14 which acts upon the long butt needles to raise them into the inactive plane at the beginning of the heel and toe, and also  
 25 acts to return all the needles which are in the inactive plane at the end of the widening into the lower or active plane. This cam has the same construction as the corresponding cam in the "Acme" machine, and is operated in the same manner through the slide  
 30 15 on the cam cylinder and the cam arms 16 and 17 which are mounted on the base plate of the machine. The movements of the cam posts 12 and 13 which control the operation of the narrowing and widening  
 35 pickers respectively, and the movement of the cam arms 16 and 17 into and out of active position, are controlled by a shifter ring 18 which is constructed and operated in the same manner as the corresponding shifter  
 40 ring of the "Acme" machine.

In addition to the main knitting cams, the cam cylinder is provided with two additional sets of knitting cams which are arranged to operate upon all the needles during the rotation of the cam cylinder, and are rendered inactive upon the short butt needles during the reciprocation of the cam cylinder in knitting the heel or toe. For convenience these two sets of supplemental  
 45 knitting cams will be referred to as the "first" and "second" set respectively. The first set of supplemental knitting cams forms a knitting wave in the needles immediately following the knitting wave formed by the  
 50 stitch cam 4, and comprises the stitch cam 19 for drawing down the needles, the cam 20 for raising them to normal position, and the switch cam 21 for directing the needle butts down into the path of the stitch cam 19.  
 55 The second set of supplemental cams form a knitting wave following the wave formed by the first set, and comprise a stitch cam 22, elevating cam 23, and switch cam 24. The supplemental knitting cams are arranged be-

tween the main knitting cams and the cam 14 which raises the long butt needles into the inactive plane at the beginning of the heel and toe, so that the long butt needles will be acted upon by both sets of supplemental  
 70 cams after they have passed through the main knitting cams, and before they are raised into the inactive plane preparatory to knitting the heel or toe. The cam 14 acts to raise the long butt needles into the inactive  
 75 plane during the last forward or rotary stroke of the cam cylinder in going upon the heel or toe, and during this forward revolution of the cam cylinder the switch cams 21 and 24 are moved radially outward while  
 80 they are acting upon the long butt needles into such position that they will not engage the short butt needles. This radial outward movement of the switch cams renders the two sets of supplemental knitting cams in-  
 85 active upon the short butt needles. The outward movement of the switch cams is not sufficient, however, to free them from the long butt needles, so that they continue to engage the long butt needles during this  
 90 revolution of the cam cylinder. The two supplemental yarns will therefore knit on the long butt needles during the last forward revolution of the cam cylinder, and will knit last on the needle at the end of  
 95 the series of long butt needles. During the knitting of the heel or toe the supplemental yarns will lead from this long butt needle, and will wrap idly about the needles as the cam cylinder reciprocates. At the comple-  
 100 tion of the heel or toe the switch cams 21 and 24 are moved radially inward during the first revolution of the cam cylinder on rotary knitting, while they are passing under the needles which are in the inactive  
 105 series. The supplemental knitting cams therefore resume knitting upon the front end of the series of short butt needles, the supplemental yarns leading from the rear long butt needle to the short butt needle  
 110 which is at the end of the series of active needles. The motion of the cam cylinder is preferably changed so that there will be one or more short butt needles in the inactive series when the supplemental cams resume  
 115 knitting. This causes the supplemental yarns to lie across or be tucked on one or more of the short butt needles, so that they fill or cover the hole which might otherwise appear at the end of the suture between the  
 120 narrowed and widened fabric.

The switch cams 21 and 24 are secured upon pins 25 and 26 respectively, which are mounted to slide radially through the wall  
 125 of the cam cylinder to shift the switch cams into position to engage the butts of all the needles, or to engage the long butt needles. The pins are advanced and retracted at the proper times through bell crank levers 27 and  
 130 28 which are connected through links 29 and

30 with two crank pins 31 and 32 arranged on diametrically opposite sides of a rock shaft 33. The rock shaft is provided with a segmental pinion 34 which is engaged by a gear segment 35 formed on one arm of a bell crank lever 36. The bell crank lever is pivoted on the cam cylinder, and the horizontal arm of the lever is provided with a radially projecting pin 37 adapted to engage and be operated by cams mounted on the base plate of the machine. The cam 38 for raising the pin 37 and thus rocking the shaft 33 to move the stitch cams radially outward is formed on the free end of an arm 39 which is pivoted at 40 to the base plate of the machine. The arm 39 is forced forward toward the cam cylinder by a spring 41, and is held normally in position with the cam 38 out of the path of the pin 37 by a lug 42 on the shifter ring 18. The cam 43 for depressing the pin 37, and thus returning the rock shaft 33 and switch cams 21 and 24 to normal position, with the switch cams in the path of both the long and short butt needles, is formed on the free end of an arm 44 similar to the arm 39 and also pivoted on the stud 40. This arm is also pressed forward by a spring against the lug 42 on the shifter ring. When the shifter ring is shifted, preparatory to knitting the heel or toe, the lug 42 forces the arm 44 back, to remove the cam 43 from the path of the pin 37, and also allows the arm 39 to move forward and bring the cam 38 into the path of the pin. This movement takes place after the pin 37 has passed the cam arms 16 and 17, and before it reaches the cam 38. Now during the forward rotation of the cam cylinder the pin 37 rides up the cam 38, thus rocking the shaft 33 and withdrawing the switch cams 21 and 24. The cam 38 is so located that the switch cams 21 and 24 are at this time operating upon the long butt needles. When the motion of the cam cylinder is changed from reciprocatory to rotary after the completion of the heel or toe, the shifter ring 18 is returned to normal position, and during this movement of the shifter ring the lug 42 moves the arm 39 back and withdraws the cam 38 from the path of the pin 37, and also allows the arm 44 to move forward, thus bringing the cam 43 into the path of the pin. This movement takes place after the pin 37 has passed the cam arm 16 and before it reaches the cam 43. Now during the forward rotary movement of the cam cylinder, the pin 37 rides down the cam 43, operating the rock shaft 33 to move the switch cams 21 and 24 back into position to operate upon the butts of all the needles. At this time the switch cams 21 and 24 are passing under the long butt needles, which are still in the inactive series, since they have not yet been acted upon by the cam 14 and returned to the active plane.

The main yarn 45 which is fed to the knitting waves formed by the cams 3 and 4 may lead from a bobbin held upon a stationary support, while the yarns 46 and 47 which are fed to the knitting waves formed by the supplemental knitting cams are led from cops 48 and 49 mounted upon a rotary support 50. The rotary support 50 is arranged above the cam cylinder, and is rotated and reciprocated in unison therewith, by suitable gearing connected with the gearing for driving the cam cylinder. The yarns 46 and 47 may be held taut as they are wrapped back and forth around the needles during the knitting of the heel or toe, by spring take-ups 51 and 52 which may be of any usual construction. During rotary knitting the take-ups are held in the position indicated in Fig. 1 by the tension on the yarns, and during the knitting of the heel or toe the take-ups swing back and forth from this position and the position indicated in Fig. 8 as the yarns wrap about the needles or unwrap from the needles.

The web holder or sinker cam ring is the same in construction as the sinker cam ring of the "Acme" machine, and is provided with two additional or supplemental cams for forming waves in the web holding sinkers corresponding to the waves formed in the needles by the supplemental stitch cams.

While it is preferred to employ the construction and arrangement of parts shown and described in embodying the invention in a machine having the general construction and mode of operation of the "Acme" machine above referred to, it will be understood that this construction and arrangement is not essential, and may be varied and modified as best suited to the construction of machine in which it is to be embodied.

Having explained the nature and object of the invention, and specifically described one form of mechanism in which it may be embodied, what I claim is:—

1. A circular knitting machine, having, in combination, a needle cylinder provided with long and short butt needles, a rotary and reciprocatory cam cylinder provided with narrowing and widening devices, a needle elevating cam for raising the long butt needles at the beginning of the heel or toe and two sets of supplemental knitting cams, means for rotating the cam cylinder and for reciprocating it during the narrowing and widening to form the heel or toe, and devices for rendering the supplemental knitting cams inactive on the short butt needles while they are acting on the long butt needles during the last forward stroke of the cam cylinder before the narrowing, and active on all the needles while they are passing under the butts of the long butt needles during the first forward revolution of the cam cylinder at the com-

pletion of the heel or toe, substantially as described.

2. A circular knitting machine, having, in combination, a needle cylinder, a rotary and reciprocatory cam cylinder provided with main knitting cams, narrowing and widening devices, devices for throwing the instep needles out of operation at the beginning of the narrowing and widening, two sets of supplemental knitting cams arranged to operate upon all the needles during the rotary motion of the cam cylinder, and devices for causing said cams to operate only upon the instep needles during the last rotary stroke of the cam cylinder and to become inactive during the reciprocatory motion of the cam cylinder upon the needles which are in operation during the knitting of the heel or toe, and means for rotating the cam cylinder and for reciprocating it during the narrowing and widening to form the heel or toe, substantially as described.

3. A circular knitting machine, having, in combination, a needle cylinder provided with long and short butt needles, a rotary and reciprocatory cam cylinder provided with main knitting cams, narrowing and widening devices, a needle elevating cam for raising the long butt needles at the beginning of the heel or toe and two sets of supplemental knitting cams arranged to follow the main knitting cams and to precede the needle elevating cams, devices for throwing the supplemental knitting cams out of operation upon the short butt needles while they are acting on the long butt needles during the last forward stroke of the cam cylinder preceding the narrowing, and into action upon all the needles while they are passing under the butts of the needles in the inactive plane when the motion of the cam cylinder is changed from reciprocatory to rotary at the completion of the heel or toe, and means for rotating the cam cylinder and for reciprocating it during the narrowing and widening to form the heel or toe, substantially as described.

4. A circular knitting machine, having, in combination, a needle cylinder provided with long and short butt needles, a rotary and reciprocatory cam cylinder provided with main knitting cams, a needle elevating cam for raising the long butt needles into

the inactive series and two sets of supplemental knitting cams, devices for operating the needle elevating cam comprising cam arms 16 and 17, devices for throwing the supplemental knitting cams out of action on the short butt needles and into action on all the needles comprising the cam arms 39 and 44, and a shifter ring for rendering the cam arms active or inactive, substantially as described.

5. A circular knitting machine, having, in combination, a needle cylinder provided with long and short butt needles, a rotary and reciprocatory cam cylinder provided with main knitting cams, a needle elevating cam for raising the long butt needles into the inactive series, two sets of supplemental knitting cams comprising stitch and elevating cams and the switch cams 21 and 24, means for moving the switch cams radially outward beyond the ends of the short butts and radially inward to engage both the long and short butts comprising relatively stationary cams and means for moving the cams into and out of active position, substantially as described.

6. A circular knitting machine, having, in combination, a needle cylinder provided with long and short butt needles, a rotary and reciprocatory cam cylinder provided with main knitting cams, a needle elevating cam for raising the long butt needles into the inactive series, two sets of supplemental knitting cams arranged to follow the main knitting cams and precede the needle elevating cams comprising stitch and elevating cams and switch cams, relatively stationary cam arms 16 and 17 for operating the needle elevating cams, relatively stationary cam arms 39 and 44 for moving the switch cams radially in and out, actuating devices for the switch cams mounted on the cam cylinder and projecting into position to engage the cam arms 39 and 44, and means for moving the cam arms alternately into and out of the path of the actuating devices after said devices have passed the cam arms 16 and before they reach the cam arms 39 and 44, substantially as described.

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