

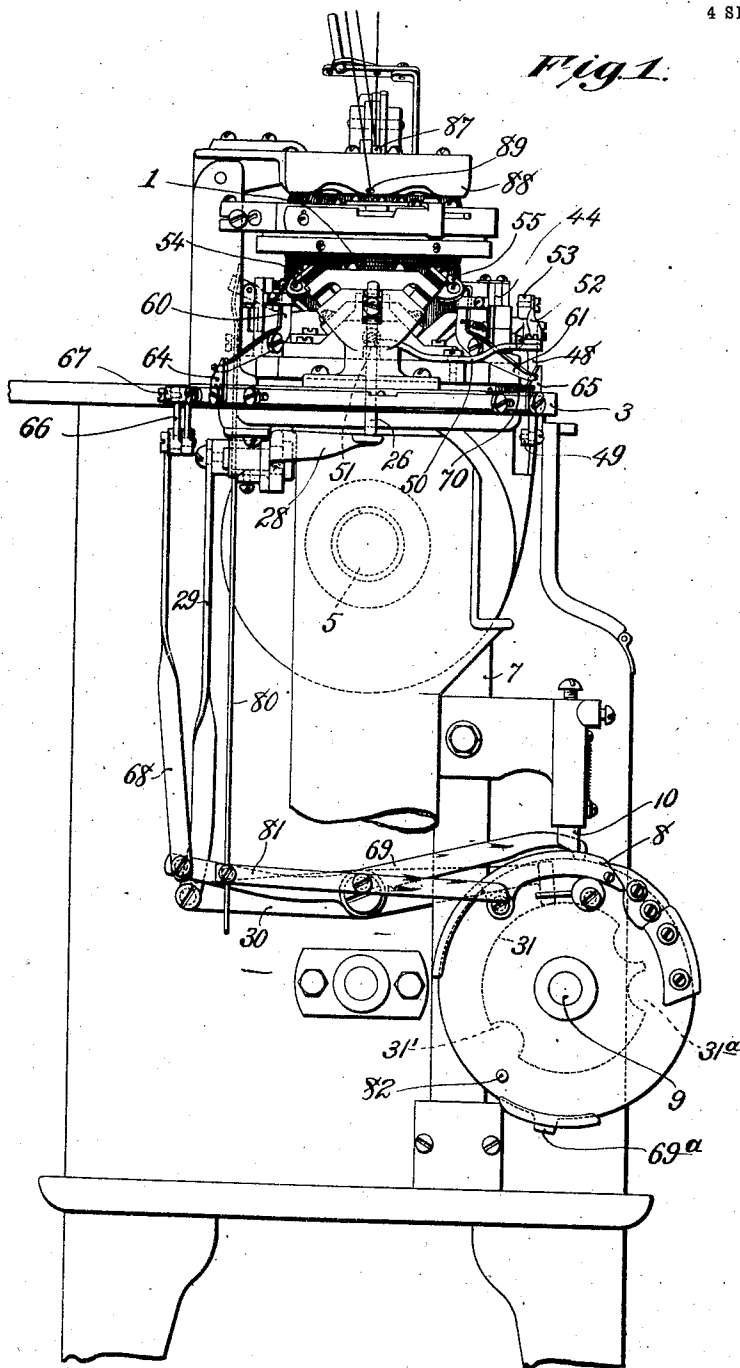
385,927.

E. PAQUETTE.
KNITTING MACHINE.
APPLICATION FILED MAY 16, 1908.

Patented Mar. 7, 1911.

4 SHEETS-SHEET 1.

Fig 1.



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4 SHEETS—SHEET 2.

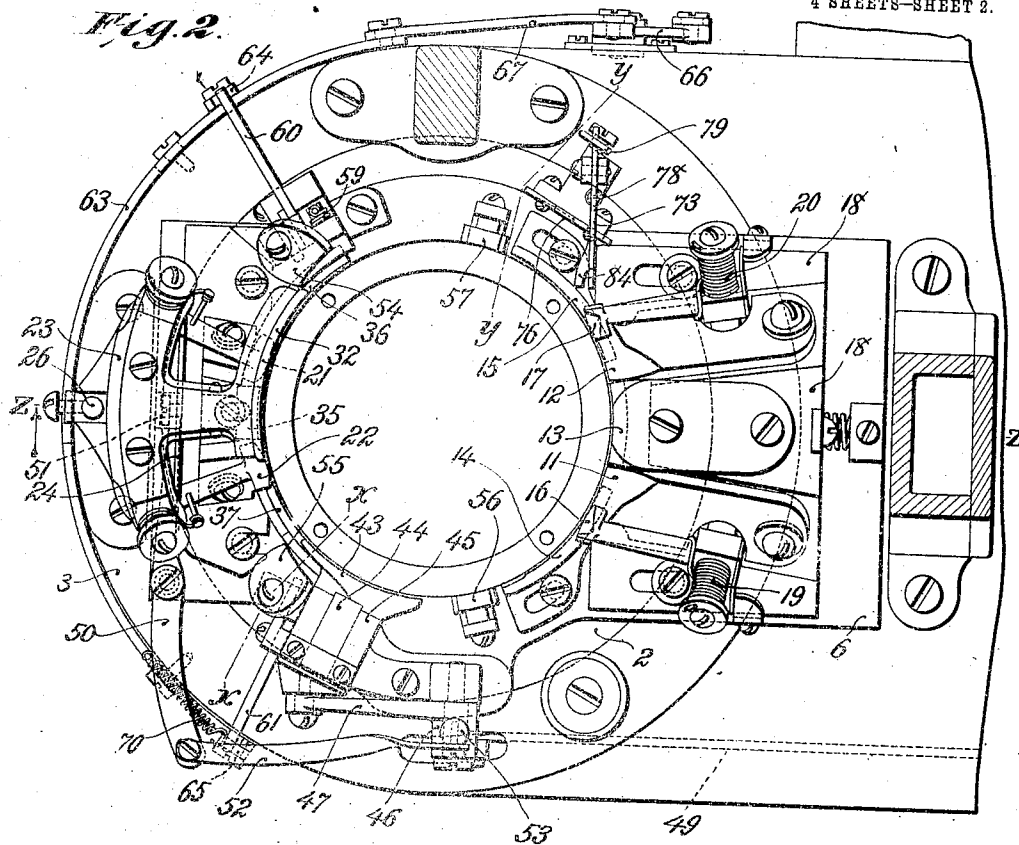
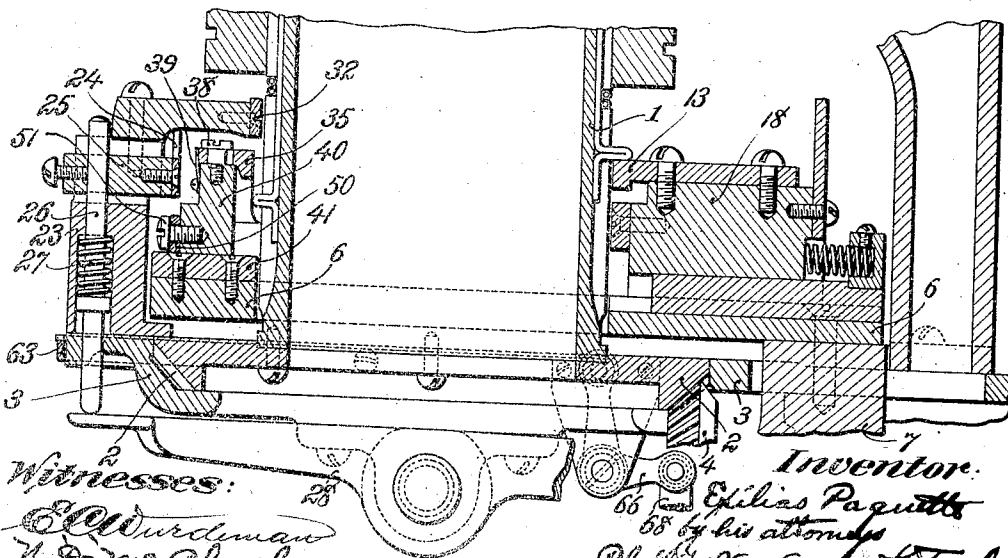


Fig. 3.



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4 SHEETS—SHEET 3.

Fig. 4.

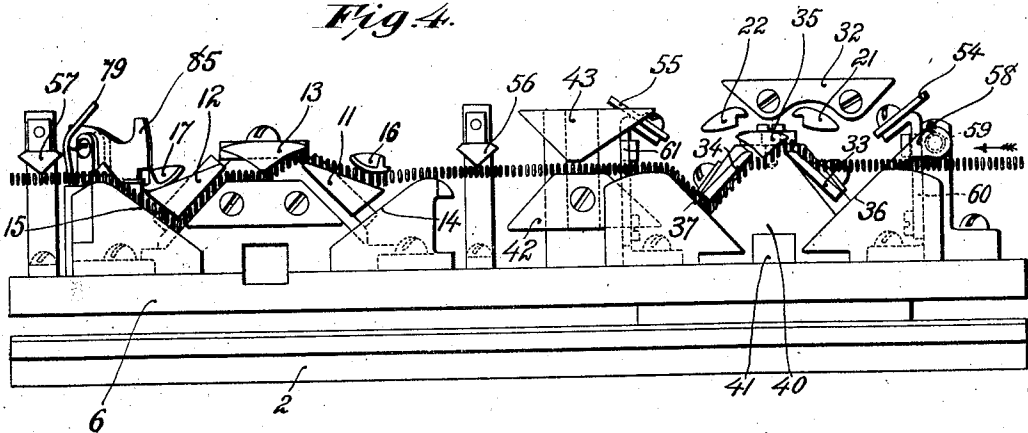


Fig. 5.

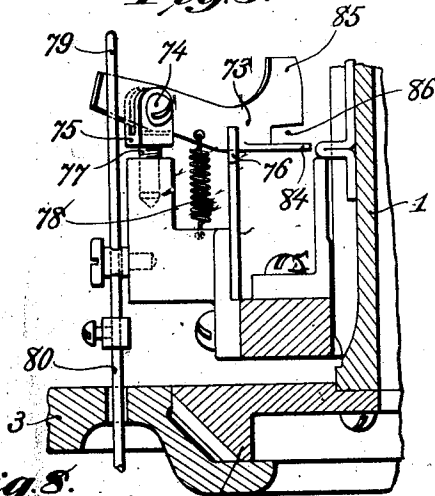


Fig. 6.

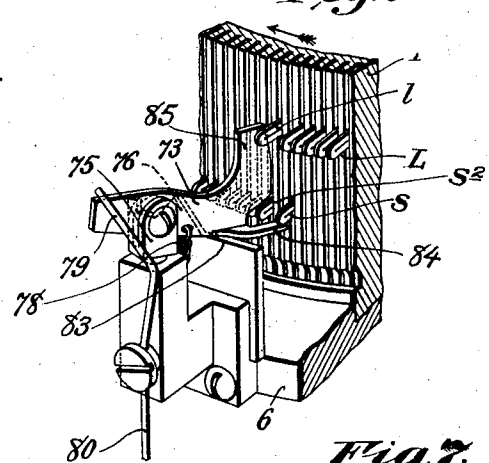


Fig. 8.

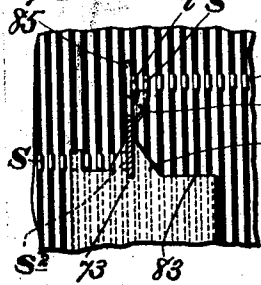


Fig. 9.

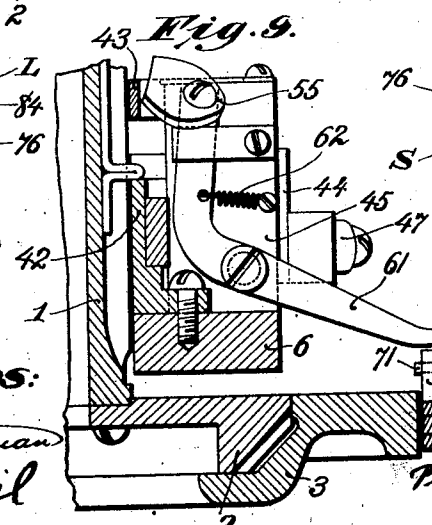
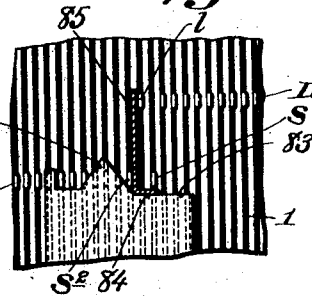


Fig. 7.



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4 SHEETS—SHEET 4.

Fig. 10.

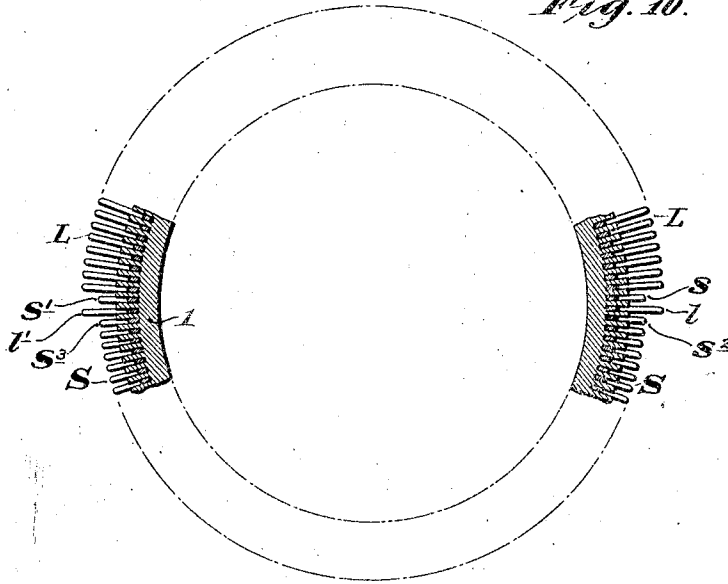
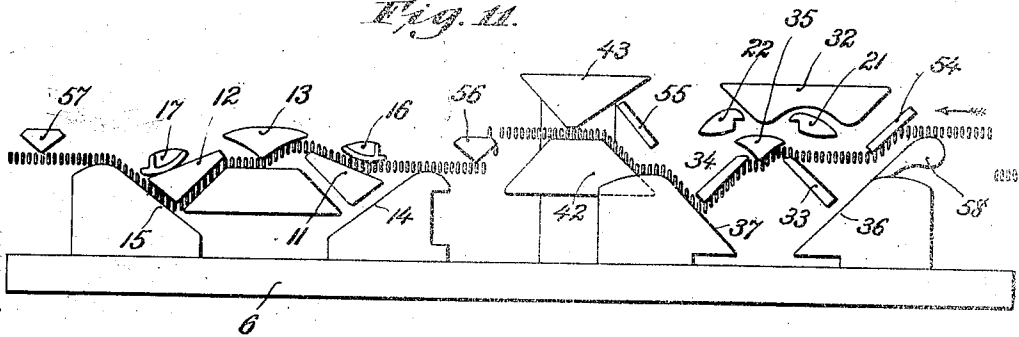


Fig. 11.



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UNITED STATES PATENT OFFICE.

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KNITTING-MACHINE.

985,927.

Specification of Letters Patent.

Patented Mar. 7, 1911.

Application filed May 15, 1908. Serial No. 432,965.

To all whom it may concern:

Be it known that I, EXILIAS PAQUETTE, 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 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 knitting machines in which the needles are mounted in a needle cylinder, and are operated upon by cams and controlling devices arranged about the cylinder, relative movement between the needles and the needle operating cams and devices being produced by rotary and reciprocatory movements of either the needle cylinder or the support or cylinder on which the needle operating cams and devices are mounted.

Certain features of the invention relate more particularly to the provision in a circular knitting machine in which the needle cylinder is given rotary and reciprocatory movements to effect the knitting, of needle operating cams and controlling devices so constructed and arranged that "split foot" stockings may be knit thereon.

Other features of the invention contemplate the further provision in a machine of this character of a construction and arrangement of needle operating cams and controlling devices by which the leg of the stocking may be knit from two yarns in two continuous circular courses, while the foot is knit from continuations of these yarns in courses extending back and forth across the upper part and sole of the foot respectively, the heel and toe being knit from one of the yarns or a continuation thereof.

Further features of the invention relate to the construction and arrangement of the cams and devices by which the needles are operated and controlled in producing a split foot stocking upon a machine in which the relative movements between the needles and the needle operating cams are produced by rotary and reciprocatory movements of either the needle cylinder or the support or cylinder on which the needle operating cams are mounted.

Further features of the invention relate to a novel form of picker for shifting needles

from one plane to another during the relative travel of the needles past the picker.

The invention consists in the features and combinations hereinafter described and as defined in the claims.

The various features of the invention will be understood from an inspection of the accompanying drawings, in which—

Figure 1 is a side elevation of a knitting machine embodying the various features of the invention in their preferred form; Fig. 2 is a plan view with the needle cylinder removed; Fig. 3 is a vertical sectional view on line $z-z$, Fig. 2; Fig. 4 is a view showing an interior development of the cams and needle operating devices in position for rotary knitting; Fig. 5 is a sectional view on line $y-y$, Fig. 2; Fig. 6 is a detail perspective view showing the picker illustrated in Fig. 5; Figs. 7 and 8 are views illustrating the operation of the picker shown in Figs. 5 and 6; Fig. 9 is a sectional view on line $x-x$, Fig. 2; Fig. 10 is a diagram illustrating the arrangement of the needles; and Fig. 11 is a view similar to Fig. 4 with the parts in position for reciprocatory knitting on the foot.

In the drawings the various features of the invention are illustrated as embodied in a circular knitting machine having many of its parts constructed and arranged in the manner in which the corresponding parts are constructed and arranged in a machine substantially shown and described in the patent to Hemphill, No. 933,443, September 7, 1909, and known as the "Banner" machine. In this machine the needles are of the type known as latch needles, and are carried in a needle cylinder which is mounted for rotary and reciprocatory movement, and the needles are operated and controlled during the knitting by cams carried by a cam plate which may be moved vertically to control the length or tightness of the stitch drawn by the needles. In embodying the present invention in this machine, I have retained the general construction and arrangement of the operating and controlling devices, and have combined therewith certain additional needle operating and controlling devices so that the mode of operation of the machine is changed and a different product is produced. In illustrating the invention I have shown only so much of the machine as is necessary to an understand-

ing of the invention, it being understood that the motion changing mechanism and the pattern mechanism for controlling the movements of the shaft which carries the controlling cams are substantially the same in construction as in the Hemphill machine. In the present machine, however, the cam for controlling the change of motion is so shaped that the needle cylinder is reciprocated during the knitting of the foot of the stocking as well as during the formation of the heel and toe.

In the machine shown the needles are mounted in vertical slots formed in a needle cylinder 1 which is secured to a plate 2 mounted in the bed plate 3 of the machine, and provided with a beveled gear engaged by a beveled gear 4, through which rotary and reciprocatory movements are imparted to the needle cylinder. The cylinder operating gear 4 is secured to a drive shaft 5, and rotary and reciprocatory movements are imparted to the drive shaft through motion changing mechanism of well known construction such as is embodied in the Hemphill machine. The needles are divided into two substantially semi-circular groups or series L and S, the needles L being provided with long butts, and the needles S with short butts, as is common in this class of machines. Between the two long butt needles at each end of the series L, short butt needles *s s'* are interposed. The needles *s s'* and the end needles *l l'* of the long butt series comprise the suture needles for connecting the fabric knit upon the two groups of needles in knitting the split foot.

The knitting cams are mounted upon a plate 6 secured to the upper end of a sliding bar 7, the vertical position of the plate being controlled by cams 8 carried on a cam shaft 9 and engaged by pins carried by the bar, one of which is shown at 10 in Fig. 1. The shaft 9 is an intermittently operated shaft which carries the various cams for controlling the movements of the needle cylinder, and for controlling the various devices for operating upon the needles. This cam shaft is operated by a pattern mechanism such as is used in the Hemphill machine or in various other circular knitting machines.

The cam carrying plate 6 carries two sets of knitting cams so arranged and controlled that both sets of cams act upon all the needles during rotary knitting, one set of cams acts upon the short butt needles during reciprocatory knitting, and the other set of cams is inactive during the formation of the heel and toe, and is active upon the long butt needles during the continuation of reciprocatory knitting in forming the foot. One set of knitting cams corresponds in construction and arrangement to the knitting cams employed in the Hemphill ma-

chine, and for convenience these cams may be termed the main knitting cams. The narrowing and widening devices for co-operating with these cams in knitting the heel and toe comprise lifting and depressing pickers corresponding in construction and operation to the lifting and depressing pickers of the Hemphill machine. As shown in Fig. 4, the main knitting cams comprise the two stitch cams 11 and 12, the center switch cam 13, and the two elevating cams 14 and 15. The narrowing devices comprise lifting pickers 16 and 17 mounted upon inclined pivot pins carried by the block 18 on which the knitting cams are mounted, and held yieldingly in position above the stitch cams 11 and 12 by springs 19 and 20. The depressing pickers 21 and 22 are pivotally supported upon a standard 23 secured to the base plate 3 of the machine, and are yieldingly forced upward by springs surrounding their pivots. The depressing pickers are moved into and out of active position by means of a plate 24 which is secured to a block 25 and overlies the pickers, as shown in Figs. 2 and 3. The block 25 is secured to the upper end of a rod 26 which is forced downward by a spring 27. The lower end of the rod rests upon one end of the lever 28, the other end of which is connected by a link 29 with a lever 30 (Fig. 1). The front end of the lever 30 rides upon a cam disk 31 secured to the cam shaft 9, and the cam is constructed to raise and lower the rod 26 at proper intervals to move the depressing pickers into and out of active position. The guard cam 32 is arranged over the depressing pickers to return the needle butts into proper relation to the pickers in case they are lifted by the pickers during the back stroke of the needles over the pickers. The mode of operation of the pickers is the same as in the Hemphill machine, and will readily be understood by any one skilled in the art.

In addition to the main knitting cams, the cam plate 6 carries a second set of knitting cams arranged on the plate diametrically opposite to the main knitting cams. These cams, which for convenience may be termed supplemental cams, comprise the stitch cams 33 and 34, the center switch cam 35, and the two elevating cams 36 and 37. The switch cam 35 is pivotally mounted upon a vertical pivot pin 38 and is held normally in the center position by a leaf spring 39 engaging its rear end. This switch cam is moved by the engagement of the butts of the needles therewith against either the end of stitch cam 33 or the end of stitch cam 34, according to the direction in which the needle cylinder is moving. The stitch cams 33 and 34, and the switch cam 35 are mounted upon a block 40 mounted to slide radially on the cam carrying plate 6, and guided

upon a rib 41 secured to the plate. By the radial movement of the block 40 the cams carried by the block including the cam 35 may be moved inward so as to engage the butts of all the needles, or may be moved outward to a position where they will engage only the butts of the long butt needles. The cam carrying plate 6 also carries a cam 42 which acts to elevate the long butt needles into the inactive plane so that the butts will pass above the knitting cams and will not be acted upon by the main or supplemental knitting cams during the formation of the heel and toe. The cam carrying plate also carries a cam 43 for acting upon the butts of all the needles in the upper or inactive plane and returning them to the active plane at the end of reciprocary knitting. The needle elevating cam 42 and needle depressing cam 43 are secured to a vertically movable slide 44 mounted in a standard 45 secured to the cam carrying plate 6, and this slide is moved vertically through a bell crank lever 46 having a horizontal arm 47 connected with the slide 44, and a vertical arm 48, the lower end of which is connected by a link 49 with the clutch of the motion changing mechanism. When the clutch is shifted to change the motion of the needle cylinder from rotary to reciprocating, the bell crank lever 46 is moved to raise the slide 44, thus lifting the cam 42 into position to elevate the long butt needles so that they will pass over the main knitting cams, and will thus be rendered inactive during the narrowing and widening in the formation of the heel or toe. When the motion changing clutch is shifted to change the motion of the needle cylinder back to rotary, the bell crank lever 46 is operated to move the slide 44 downward, thus bringing the needle depressing cam 43 into position so that it will depress all the needles which are in the upper or inactive series, and direct them into the lower or active plane, where they will be acted upon by the knitting cams. The supplemental knitting cams are moved outward so that they will not act upon the short butt needles during reciprocary knitting by means of a lever 50, one end of which is slotted, and is connected with the block 40 which carries the supplemental knitting cams by a screw 51, and the other end of which is connected by a link 52 with an arm 53 which extends upward from the bell crank lever 46. By this connection the supplemental knitting cams will be moved outward so that they will not act upon the short needle butts when the motion changing cam is shifted to change the motion of the needle cylinder from rotary to reciprocating, and will be moved back into position to engage the short butt needles when the motion changing clutch is shifted to change the motion of the needle cylinder back to rotary.

After the formation of the heel or toe, as the case may be, reciprocary movements of the needle cylinder are continued during the knitting of the foot, and at this time the long butt needles are directed through the supplemental knitting cams being elevated after they pass through these cams so that they are not acted upon by the main knitting cams, the main knitting cams acting at this time upon the short butt needles as during the knitting of the heel or toe.

The devices for controlling the long butt needles during the knitting of the foot, so that they will be acted upon by the supplemental knitting cams, and will not be acted upon by the main knitting cams, comprise two needle depressing cams 54 and 55 arranged to be moved radially inward into position to engage the butts of the needles in the upper or inactive plane and direct them down into a lower plane, two fixed depressing cams 56 and 57 for completing the depression of certain of the needles depressed by the cams 54 and 55, as will be more fully explained hereafter, and a needle elevating cam 58 arranged on the side of the supplemental knitting cams opposite to the side on which the needle elevating cam 42 is arranged and constructed to elevate the long butt needles only into the upper or inactive plane. The needle elevating cam 58 is pivotally mounted and is forced yieldingly in a direction to engage the upper side of the cam 36 by a spring 59 coiled about its pivot. The needle depressing cams 54 and 55 are carried on the upper ends of levers 60 and 61, and are held in retracted position out of the path of the needle butts by springs 62. The levers 60 and 61 are operated to move the needle depressing cams into position to engage the butts of the needles, by means of a segmental slide 63 carrying cam fingers 64 and 65 arranged to engage the lower outer ends of the levers 60 and 61. The slide 63 is operated at proper intervals through a bell crank lever 66, one arm of which is connected by a link 67 with the slide 63, and the other arm of which is connected by a link 68 with the rear end of a lever 69, the front end of which is arranged to be operated upon by a cam 69* carried by the cam shaft 9. The slide 63 is operated by the cam on the shaft 9 to move the needle depressing cams 54 and 55 radially inward, after the completion of the narrowing and widening, and at this time the needle butts in the upper or inactive series are in such position with relation to the cam 55 that the cam strikes against the ends of the needle butts. The butts of the needles opposite the cam 54 are in the lower or active series, so that they do not interfere with the inward movement of this cam. In order that the cam 55 may be forced radially inward, and may ride upon

the needle butts in the upper or inactive series until these butts have passed the cam, and may then move inward into position to engage the butts on their return movement, the cam finger 65 which operates the lever 61 carrying the cam 55 is pivotally mounted on the slide 63, and is held yielding in position by a spring 70. When the cam finger 65 strikes the lever 61, it yields so that the cam 55 may ride on the ends of the needle butts, and as soon as the butts have passed the cam 55, the spring 70 draws the cam finger into position with the pin 71 against the stop 72, thus moving the cam 55 forward into position to engage the needle butts on their return stroke, and maintains the cam in this position until the slide 63 is shifted to disengage the cam finger from the cam carrying lever 61.

In the construction and arrangement shown the knitting cams are so arranged that the needles, after they have been drawn down by the knitting cams to draw the loops, and have been moved up to cast off the previously formed loops, remain in position with the latch of the needle still in the loop on the needle. Just before the knitting point is reached, the needle is raised to clear the latch from the loop. When the needles are in the lower or active level, therefore, the latches of the needles are in the loops on the needles. In the construction and arrangement shown, also, the lifting pickers remain in operation during both the narrowing and widening, and during the knitting of the foot. This manner of manipulating the needles by the knitting cams and lifting pickers has an important bearing upon the manner in which the needles should be manipulated in passing from the heel or toe, as the case may be, on to the foot.

It is important, for reasons which will be more fully explained hereafter, that neither of the short butt suture needles should operate to knit during the first reverse stroke of the needle cylinder in going upon the heel, in case the heel is knit before the foot, or in going upon the toe, in case the toe is knit before knitting the foot. For convenience it will be assumed in further explanation of the operation of the machine that it is arranged to first knit the leg of a stocking, and to knit the foot after the heel has been completed. During the first reverse movement of the needle cylinder in passing from the leg to the heel the suture needle *s* will be lifted up into the inactive series by the lifting picker 17 before it reaches the knitting cams, so that this needle will not knit during this stroke of the needle cylinder in the direction opposite to the arrow Fig. 11. In order that the suture needle *s* shall not knit during this stroke of the needle cylinder, means is provided for raising this

needle into the inactive series before it reaches the knitting cam. This means consists of a picker 73, which is thrown into position to operate upon the butt of the needle *s* when the motion of the needle cylinder is changed from rotary to reciprocating, and acts during the first reverse stroke of the cylinder to lift the suture needle *s* from the active to the inactive series. This picker is in the form of a lever pivoted at 74, so that it may move vertically. The pivot 74 is carried by a block 75 which is pivotally mounted to swing about a vertical axis, so that the picker may move horizontally as well as vertically. Vertical movement is imparted to the picker by a fixed cam 76, over which the picker rides as it is swung about the vertical pivot 77. A spring 78 tends to hold the picker in normal position where it is out of the path of the needle butts. The rear end of the picker is arranged to be engaged by the inclined upper end 79 of a rod 80, the lower end of which is pivotally connected to a lever 81. The front end of the lever 81 is arranged to be engaged by a pin 82 carried by a disk secured to the cam shaft 9. The pin 82 is so arranged that as the cam shaft 9 is rotated to cause the shifting of the motion changing clutch, the pin 82 acts against the end of the lever 81, raising the front end of the lever and immediately releasing it. When the lever 81 is thus operated, the rod 80 is depressed, so that the inclined end 79 acts against the rear end of the picker 73, swinging said picker in a direction to move it from the position indicated in Fig. 5 to the position indicated in Fig. 6. As the picker is swung about its vertical pivot 77, it rides up over the cam 76, so that its lower inner end passes above the short needle butts, and as the inner end of the picker swings toward the right in Fig. 6, the lower part of the picker rides on top of the needle butts until the picker is swung far enough toward the right so that the end of the picker moves radially outward beyond the ends of the butts, where the picker drops down upon the ledge 83 of the cam plate 76. The picker is immediately released by the rod 80, and the spring 78 swings the picker toward the left in Fig. 6, carrying the picker into the position indicated in Fig. 6. The inner end of the picker is provided with a horizontal lip 84 arranged to underlie the butts of the needles in the active plane, and the picker is also provided with a vertical shoulder 85 arranged to extend up into the path of the butts of the needles in the inactive or upper plane. The end of the picker above the lip 84 is cut away or recessed at 86 for the passage of the needle butts in the active series. The vertical shoulder 85 is so located with relation to the lip 84 that the lip 84 will be in position to underlie the butt of the needle *s* when the butt of the needle *z*

strikes the vertical shoulder. When the butt of the needle *l* strikes the picker during the first reverse stroke of the needle cylinder, after the shifting of the motion changing clutch, it acts to swing the inner end of the picker toward the left in Fig. 6, and as the picker is thus moved it rides over the cam 76, and is moved vertically, as indicated in Fig. 8, the lip 84 acting to lift the butt of the needle *s* up from the active into the inactive series. During the continued movement of the needle cylinder the butt of the needle *l* acts to swing the picker into the position indicated in Fig. 5, the spring 78 also tending to return the picker to this position. The picker now remains in this inactive position until the motion of the needle cylinder is changed from rotary to reciprocating, in passing from the leg to the heel of the succeeding stocking.

The machine is provided with a yarn changing mechanism 87 arranged to deliver yarn to the needles at the point where they are operated by the main knitting cams, and operated to change the yarn in passing from the leg to the heel and after the completion of the toe. The latch ring 88 is also provided with a thread guide 89 for feeding yarn to the needles at the point where they are operated by the supplemental knitting cams.

Assuming that a split foot stocking is to be knit, in which the leg and top of the foot are knit from black yarn, and the heel, toe and bottom of the foot are to be knit from white yarn, the operation of the machine is as follows:—During the knitting of the leg of the stocking, black yarn is supplied to the needles by the yarn changing device, and black yarn is supplied to the needles through the thread eye 89. Both the main and supplemental knitting cams act upon the needles, and two knitting waves are formed which follow each other about the needles, so that at each rotation of the cam cylinder two courses of loops are knit, and thus the leg of the stocking is knit in half the number of revolutions of the needle cylinder which would be required if but a single yarn were fed to the needles, and a single knitting wave formed therein. The path of the needles through the cams is indicated in Fig. 4. The butts of the needles pass under the cam 58 in the direction of the arrow, the cam resting on the upper edge of the cam 36 during the passage of the short butts, and riding on the tops of the long butts as they pass under the cam. The needle butts, after passing the cam 58, ride up the upper surface of the cam 33, so that the latches are disengaged from the loops on the needles, and after passing up the cam 33 the butts engage the switch cam 35 and are directed against the under side of the stitch cam 34, down which they ride. They then pass up

the cam 37, and under the lifting picker 16, which rides on the tops of the needle butts. The butts pass up the upper surface of the stitch cam 11, which elevates the needles so as to disengage the latches from the loops on the needles, and then pass against the switch cam 13 which directs them down against the under surface of the stitch cam 12. From the stitch cam 12 the needle butts pass up the cam 15, and thence pass the cam 58 again. During rotary knitting the depressing pickers 21 and 22 are in their upper position, as indicated in Fig. 4. When the heel is reached, the cam shaft 9 is given a movement which shifts the motion changing clutch, carries the pin 82 past the end of the lever 81, and brings the depression 31' in the cam 31 under the end of the lever 30. This movement of the cam shaft 9 through the connections heretofore described thus changes the motion of the needle cylinder, causes the needle elevating cam 42 to be raised into position to deflect the long butt needles up into the inactive plane, draws the depressing pickers 21 and 22 down out of active position, throws the picker 73 into the position indicated in Fig. 6, and shifts the block 40 radially outward so that the supplemental knitting cams are out of the path of the butts of the short butt needles but are in position to act on the long butts when the long butt needles are deflected down into the active plane. During the knitting of the heel (or toe), however, the long butts remain in the inactive plane and pass above these cams. The yarn changing device is also operated at this time to change the yarn, so that white yarn is delivered to the needles at the point where they are operated on by the main knitting cams. The shifting of the parts occurs while the needle cylinder is moving in its forward direction *i. e.* the direction of the arrow Figs. 4 and 11. During the completion of the movement of the needle cylinder in this direction, the cam 42 raises the long needle butts into the inactive plane, and during this forward movement of the needle cylinder the needle *l* is the last needle to knit with the black yarn fed through the thread eye 89. During the formation of the heel the black thread leading through the thread eye 89 therefore draws idly back and forth through the thread eye 89 as the needle cylinder reciprocates, being laid about the needles as the needle *l* passes away from the thread eye in either direction, and being drawn back through the thread eye as the needle *l* approaches the thread eye. The thread is held taut during this time by a takeup of usual construction. The purpose of throwing the suture needle *s* up into the inactive series on the first return stroke of the needle cylinder in forming the heel can best be explained at this point. If the needle *s* were allowed

to knit on the return stroke of the needle cylinder, the black thread leading from the needle *l* to the thread eye 89 would lie across the needle *s* at the time this needle drew a loop of the white yarn, and the black yarn would therefore be connected with the fabric at the needle *s*. If this should occur, the black thread, instead of leading from the needle *l* during the knitting of the heel, would lead from the needle *s*, and when knitting with the black thread was resumed in going from the heel on to the foot, the black thread would not be properly presented to the needle *l*, and a stitch would be dropped at this point, thus forming a hole and imperfection in the fabric. During the first return stroke of the needle cylinder, however, the short butt suture needle *s* is raised to the inactive series by the picker 73 in the manner heretofore described, so that the needle *s*² is the last needle to knit with the white yarn during this stroke of the needle cylinder, and the black yarn therefore leads from the needle *l* during the knitting of the heel, and is properly presented to the needle when this needle is operated during the formation of the first course on the foot. During the knitting of the heel the lifting pickers operate to effect the narrowing, and after the narrowing has been completed the cam shaft 9 is given an advance movement to bring the concentric part of the cam 31 under the end of the lever 30, so that the depressing pickers 21 and 22 are moved up into active position. During the widening the depressing pickers act to move two needles down into the active series at each stroke of the needle cylinder, while the lifting pickers remain in action and move a single needle into the inactive series during each stroke of the needle cylinder.

When the heel has been completed the cam shaft 9 is given an advance movement to bring the cam 69^a under the end of the lever 69, and thus operate the slide 63, which throws into operation the needle depressing cams 54 and 55. At this time the needle cylinder is moving on its last forward stroke upon the heel, and the lifting picker 16 lifts the needle *s*² of the short butt series up into the inactive series. On the return stroke of the needle cylinder, which is the first reverse stroke of the cylinder on the foot, the lifting picker 17 moves the needle *s*³ of the short butt series up into the inactive series. During the first stroke of the needle cylinder in each direction on the foot, therefore, the needles *s*, *s*¹, *s*² and *s*³ of the short butt series are in the upper or inactive series with the long butt needles. It is for this reason that the depressing cams 54 and 55 are so arranged that they do not direct the needles down into the lower plane of the short butt needles, and that the cams 56 and

57 are provided for completing the downward movement of the short butts into the lower active series. If the cams 54 and 55 directed the butts of the needles down into the plane of the active series, the latches of the needles *s*² and *s*³ would be swung out by engagement with the loops on the needles at the time that these needles were passing the supplementary knitting cams, and would catch the black thread being fed to the long butt needles, and would prevent the proper engagement of the thread with the long butt needles *l*, *l*¹, and thus cause imperfections in the fabric. The cams 54 and 55, however, are so arranged that they deflect the butts of all the needles which are in the upper inactive series down into a plane where the long butts will strike the switch cam 35 and be directed against the stitch cams, but do not direct them down far enough to cause the latches to be acted upon by the loops on the needles. The short butt needles *s*, *s*¹, *s*² and *s*³, which are deflected down by the cams 54 and 55 during the first strike of the needle cylinder in each direction when passing from the heel on to the foot, pass idly by the supplemental cams. The cams 56 and 57 direct the butts of these needles down into the plane of the butts of the short butt needles, so that they will pass under the lifting pickers 16 and 17 with the short butt needles, and will pass through the main knitting cams. During the continued knitting of the foot the suture needles *s*, *s*¹ are raised by the lifting pickers 16 and 17 respectively, so that only the suture needle which is the last needle in the series to knit is actuated by the main knitting cams at each stroke of the needle cylinder, and these needles, which are raised by the lifting pickers, are returned to the active series of short butt needles by the cams 54 and 55 and the supplemental depressing cams 56 and 57. After the foot has been completed and the toe is to be formed, the cam shaft 9 is given an advance movement, carrying the cam 69^a from under the lever 69, and bringing the depression 31^a on the cam 31 under the end of the lever 30. This causes the depressing pickers to be moved down into inactive position, where they remain during the narrowing operation, and also moves the cams 54 and 55 back out of active position, so that the long butt needles are not directed through the supplemental knitting cams. At the end of the narrowing, the widening cams are thrown into action by another advance movement of the cam shaft 9. After the toe has been completed, the cam shaft 9 is advanced to cause a shifting of the motion reversing clutch, which changes the motion of the needle cylinder from reciprocating to rotary, shifts the cams 42 and 43 into the position indicated in Fig. 4, so that the cam 43 returns the butts of all the needles in the in-

active series to the lower or active plane, and moves the block 40 inward so that the supplemental knitting cams will act upon the short butt as well as the long butt needles during rotary knitting. Before the leg of the next stocking is started, the yarn changer is operated to deliver the black yarn to the needles at the point where they are operated by the main knitting cams.

10 While I prefer to employ the specific construction and arrangement of parts shown and described in practicing the invention, it will be understood that this specific construction and arrangements of parts is not essential to the invention in its broader aspects, and may be varied without departing from the invention.

20 Having set forth the nature and object of the invention, and specifically described one form of apparatus 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, main knitting cams, supplemental knitting cams, needle elevating cams on opposite sides of the supplemental knitting cams arranged to engage the butts of the long butt needles only, one of said cams being mounted to ride over the long butt needles during rotary knitting, and to automatically return to normal position when the long butt needles have passed, substantially as described.

2. A circular knitting machine, having, in combination, a needle cylinder provided with long and short butt needles, main knitting cams, supplemental knitting cams, means for relatively reciprocating the cams and needle cylinder, a needle elevating cam arranged on one side of the supplemental cams, means for moving the cam into position to elevate the long butt needles during the relative forward travel of the needles, a needle elevating cam arranged on the opposite side of the supplemental cams and mounted to ride over the butts of the long butt needles during the relative forward travel of the needles and to automatically move into position to elevate the long butt needles during the relative return travel of the needles, substantially as described.

3. A circular knitting machine, having, in combination, a needle cylinder provided with long and short butt needles, main knitting cams, supplemental knitting cams, needle elevating cams arranged on opposite sides of the supplemental knitting cams, needle depressing cams arranged to direct the needles in the upper series into the supplemental knitting cams during reciprocatory knitting, and cams to complete the depressing of the needles not acted on by the supplemental knitting cams after they have passed the supplemental knitting cams, substantially as described.

4. A circular knitting machine, having, in combination, a needle cylinder provided with long and short butt needles, main knitting cams, supplemental knitting cams, needle elevating cams arranged on opposite sides of the supplemental knitting cams to act upon the long butt needles during reciprocatory knitting, needle lifting pickers, needle depressing cams acting on long and short butt needles arranged on opposite sides of the supplemental knitting cams to direct the long butt needles into the knitting cams, and cams to complete the depressing of the short butt needles after they have passed the supplemental knitting cams, substantially as described.

5. A circular knitting machine, having, in combination, a needle cylinder provided with long and short butt needles, a picker having a needle shifting lip adapted to operate on the butt of a short butt needle, and a shoulder arranged to be engaged by the butt of a long butt needle, substantially as described.

6. A circular knitting machine, having, in combination, a needle cylinder provided with a series of needles, a needle picker, and means for operating the picker to shift a needle at the rear end of the relatively traveling series of needles in the needle cylinder, substantially as described.

7. A circular knitting machine, having, in combination, a needle cylinder provided with long and short butt needles, and a needle picker constructed to shift a short butt needle and to be actuated by engagement with a long butt needle, substantially as described.

8. A circular knitting machine, having, in combination, a needle cylinder provided with long and short butt needles, a picker provided with a lip to engage and shift the butt of a short butt needle and with a shoulder arranged to be engaged by the butt of a long butt needle, and means for operating the picker to bring the lip under a series of short butt needles and the shoulder into the path of the butt of a long butt needle, substantially as described.

9. A circular knitting machine, having, in combination, a needle cylinder provided with long and short butt needles, a needle picker provided with a horizontal butt engaging lip and with a vertical shoulder arranged out of the path of the short butt needles and in the path of a long butt needle, substantially as described.

10. A picker for a knitting machine provided with a horizontal lip for engaging and shifting a needle butt, a vertical shoulder to be engaged by a needle butt for operating the picker, the shoulder being arranged to allow the passage of short butts over the lip and to be engaged by a long butt, substantially as described.

11. A picker for a knitting machine comprising a lever mounted to move vertically and swing laterally, a cam for moving the picker vertically as it swings laterally, a horizontal lip on the free end of the picker for engaging and shifting needle butts, and a vertical shoulder through which the picker is swung laterally by engagement with a needle butt, the shoulder being arranged to allow the passage of short butts over the lip and to be engaged by long butts, substantially as described.

12. A circular knitting machine, having, in combination, a needle cylinder, needles therein comprising two substantially semi-circular groups, suture needles interposed between the needles at the end of one group, cams for operating each group of needles, narrowing and widening devices, means for rendering one group of needles inactive during the narrowing and widening, and a needle picker for rendering the suture needle inactive which is the last in its group in knitting the first course of reciprocatory knitting, substantially as described.

13. A circular knitting machine, having, in combination, a needle cylinder, needles therein comprising two substantially semi-circular groups, suture needles interposed between the needles at the end of one group, cams for operating each group of needles, narrowing and widening pickers, means for rendering one group of needles inactive during the narrowing and widening, and a picker for acting on the suture needle at the rear end of its group during the first course of reciprocatory knitting, substantially as described.

14. A circular knitting machine, having, in combination, a needle cylinder, needles therein comprising two substantially semi-circular groups, suture needles interposed between needles at the end of one group, cams for operating each group of needles, narrowing and widening pickers, the narrowing pickers being arranged to continue in operation during reciprocatory knitting, means for rendering one group of needles inactive during the narrowing and widening, and an additional picker for acting on

the suture needle at the rear end of the group during the first course of reciprocatory knitting, substantially as described.

15. A circular knitting machine, having, in combination, a rotary needle cylinder provided with segmental groups of long and short butt needles, main knitting cams, supplemental knitting cams comprising stitch cams 33 and 34, switch cam 35, and needle elevating cams 36 and 37, a radially movable support for the cams 33, 34 and 35, and means for moving said support to bring the cams thereon into the path of the long and short butt needles during the rotary knitting and out of the path of the short butt needles during the reciprocatory knitting, substantially as described.

16. A circular knitting machine, having, in combination, a rotary needle cylinder provided with segmental groups of long and short butt needles, main knitting cams, supplemental knitting cams, a radially movable support for the supplemental cams, a vertically movable slide, needle elevating and depressing cams 42 and 43 carried by the slide, and connections between the slide and support for moving the support outward when the slide is raised and inward when the slide is depressed, substantially as described.

17. A circular knitting machine, having, in combination, a rotary needle cylinder provided with segmental groups of long and short butt needles, main knitting cams, supplemental knitting cams, a radially movable slide on which the supplemental knitting cams are mounted, a vertically movable slide, needle elevating and depressing cams carried by the slide, a lever for raising and lowering the slide, a lever for moving the radially movable slide in and out, and a connection between said levers, substantially as described.

In testimony whereof I affix my signature, in presence of two witnesses.

EXILIAS PAQUETTE.

Witnesses:

EDWARD MARTIN,
AUGUSTE JEAN.