April 12, 1932. A. E. PAGE 1,853,520

CIRCULAR KNITTING MACHINE

Filed June 2, 1928 5 Sheets-Sheet 1

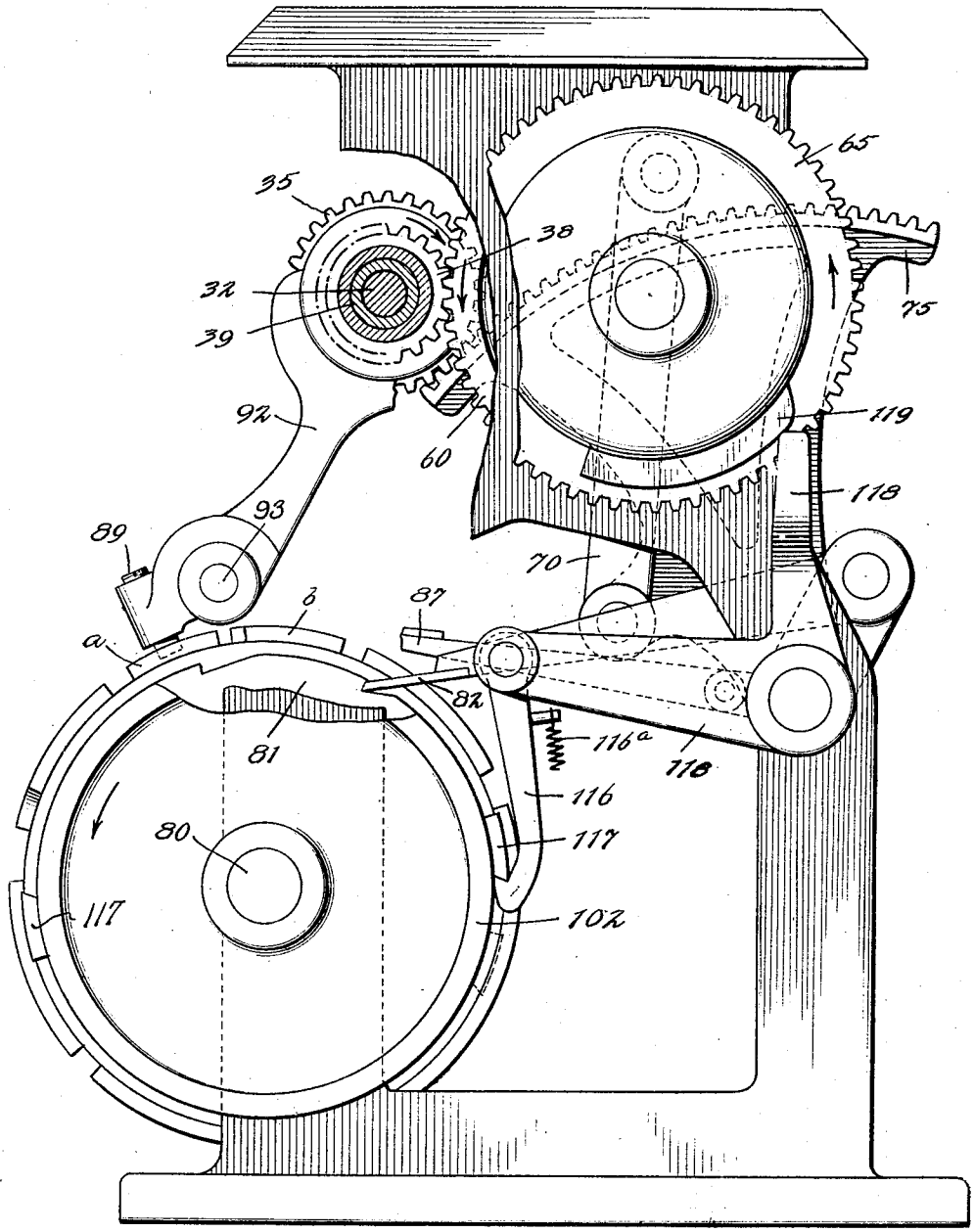

Fig. 1.

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April 12, 1932. A. E. PAGE 1,853,520

CIRCULAR KNITTING MACHINE

Filed June 2, 1928 5 Sheets-Sheet 2

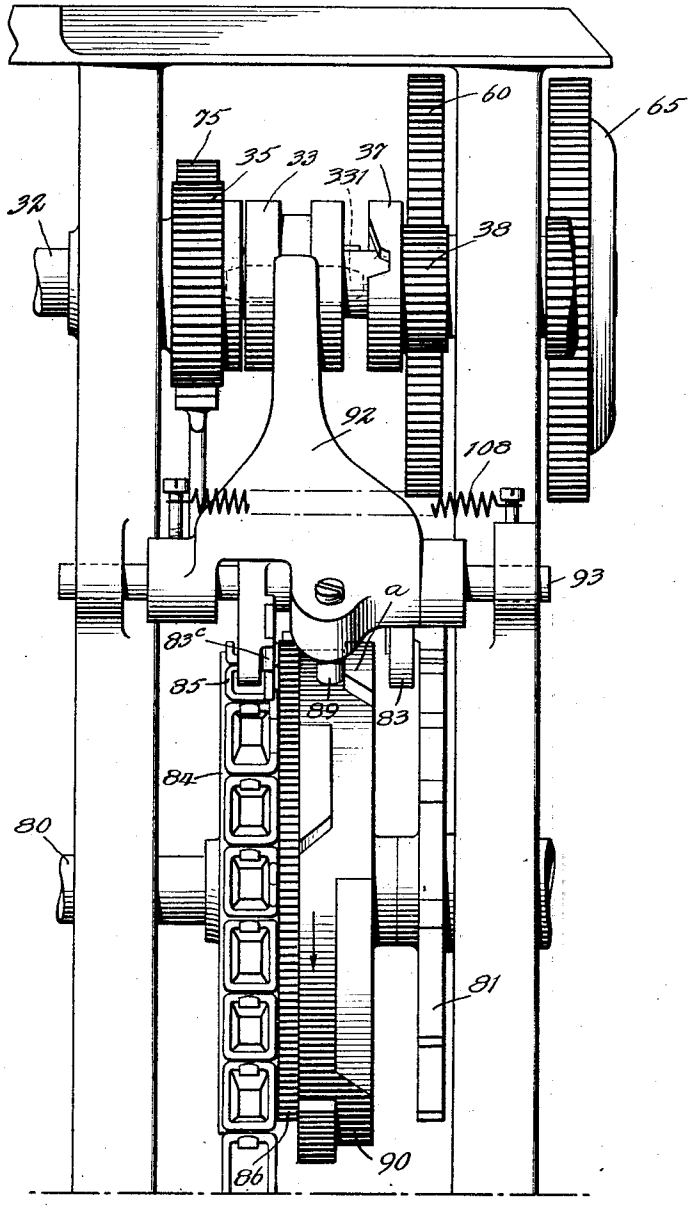

Fig. 2.

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April 12, 1932. A. E. PAGE 1,853,520

CIRCULAR KNITTING MACHINE

Filed June 2, 1928 5 Sheets-Sheet 3

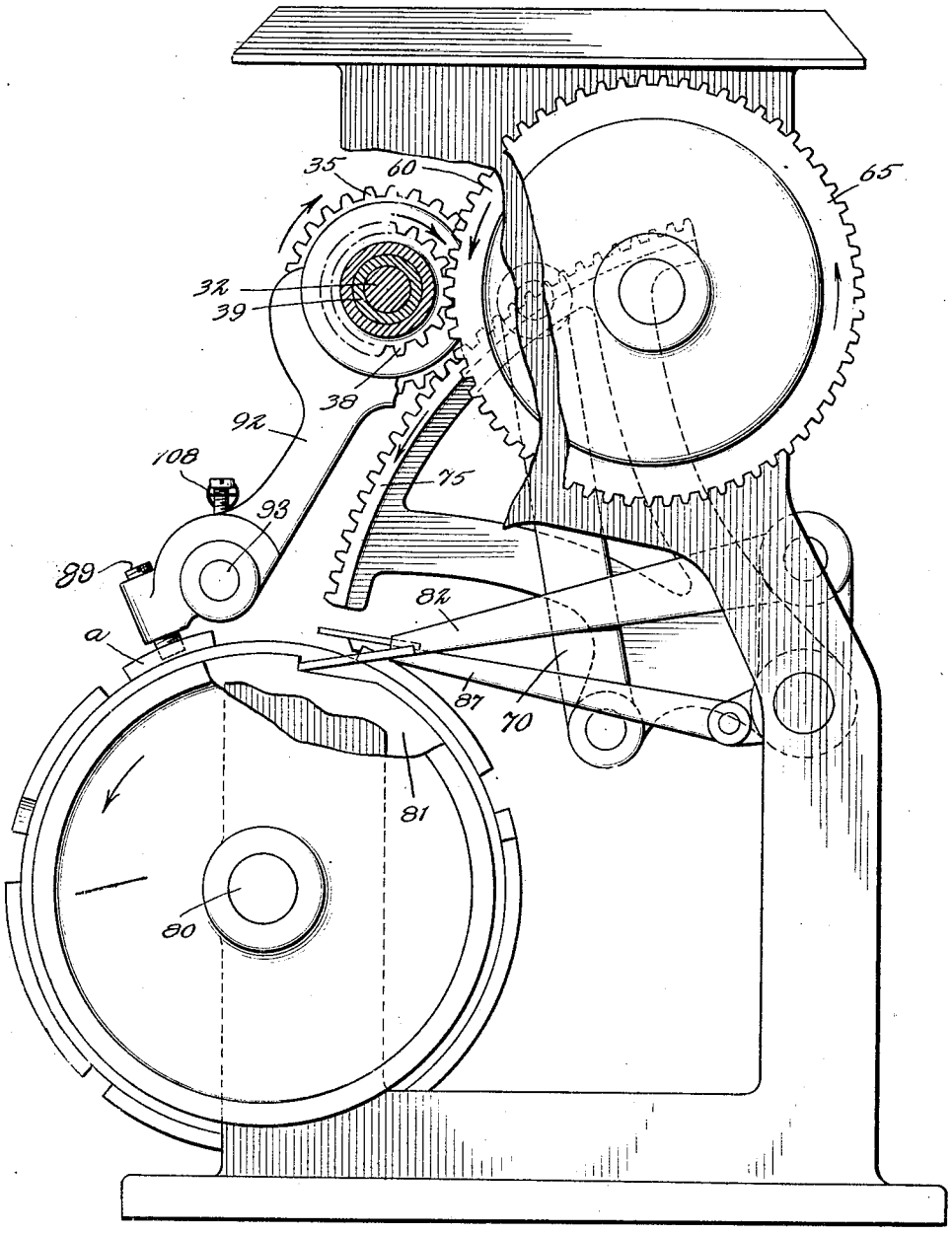

Fig. 3.

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April 12, 1932. A. E. PAGE 1,853,520

CIRCULAR KNITTING MACHINE

Filed June 2, 1928 5 Sheets-Sheet 4

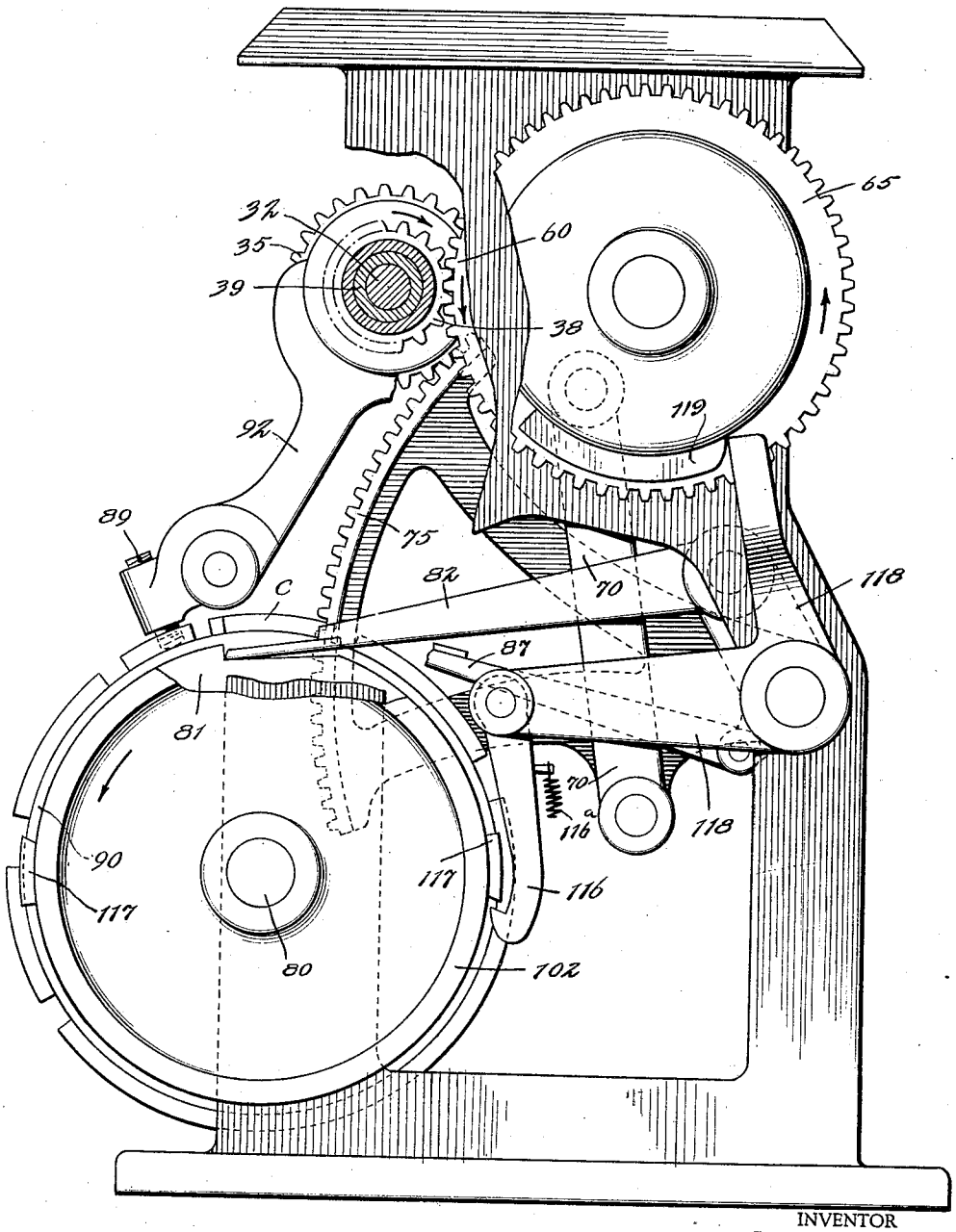

Fig. 4.

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April 12, 1932. A. E. PAGE 1,853,520

CIRCULAR KNITTING MACHINE

Filed June 2, 1928 5 Sheets-Sheet 5

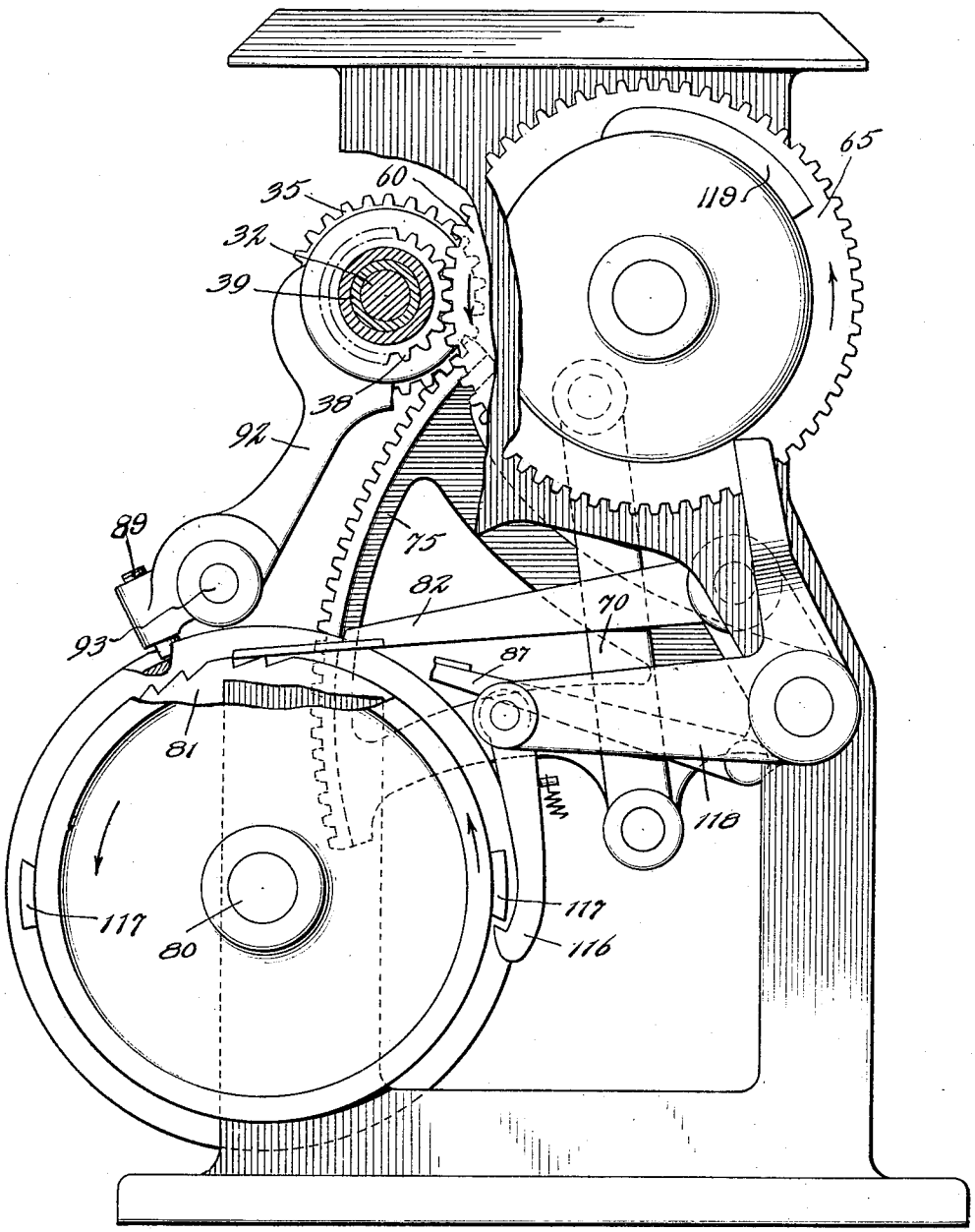

Fig. 5.

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UNITED STATES PATENT OFFICE

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CIRCULAR KNITTING MACHINE

Application filed June 2, 1928. Serial No. 282,361.

This invention relates to circular knitting machines and more particularly to machines adapted to knit narrowed and widened pockets on opposite sides of a seamless stocking.

Machines adapted to make seamless stockings in which the looped courses of the toe comes on the under side of the stocking have been known for a great many years and it is one object of the present invention to make an improved and simple machine which knits such a stocking with the least possible disturbance to the other functions of the machine. Another object of the invention is to produce a machine which will knit stockings of this type without causing undue wear on the machine.

In machines made according to the present invention the needle cylinder is allowed to drop back half a revolution between the heel and toe, and half a revolution between the toe and heel by a novel manipulation of the clutch which shifts the machine between reciprocatory and rotary knitting.

In the drawings:

Fig. 1 is an elevation from the right side of the well known Scott & Williams type of revolving needle cylinder hosiery machine showing the driving mechanism with the frame and gearing partly broken away with one form of the novel actuating means taken just after the machine has shifted from rotary to reciprocatory knitting;

Fig. 2 is a front elevation of part of a slightly modified form of actuating means taken at the same moment as Fig. 1, showing the position of the pattern chain, clutch, and clutch shifting drum;

Fig. 3 is a side elevation of the novel clutch shifting means of Fig. 2 when the clutch is about to be shifted back to rotary knitting;

Fig. 4 is a similar view of another modification in which the shift back to rotary knitting is about to be made with the quadrant at the end of its forward stroke; while

Fig. 5 is a view similar to and showing the mechanism of Fig. 1 two revolutions of the needle cylinder prior to shifting to the reciprocatory side.

In machines heretofore known for knitting seamless heel and toe pockets on opposite sides of the stocking it has been necessary to break the connection between the clutch and a driving means on the one hand and the needle cylinder on the other in order to allow the needle cylinder to stand still in order to vary its position relatively to the rest of the machine. According to the present invention it is not necessary to change the connection between the driving means and the needle cylinder in any way to put the toe pockets on opposite sides of the tube, the relation of the needle cylinder to the rest of the machine being altered by special manipulation of the ordinary clutch.

The invention will be shown and described embodied in a machine forming the subject matter of the patent to Robert W. Scott 1,152,850, September 7, 1915. In this machine the needle cylinder is driven from the main drive shaft 32 by a clutch collar 33 splined thereon. The clutch collar causes the shaft 32 to reciprocate when its tenon 331 (shown in dotted lines in Fig. 2) engages with the left clutch pinion 35, and causes rotary action of the needle cylinder when the tenon of the clutch collar engages with the face 37 of the right clutch pinion 38. This right clutch pinion 38 is unitary with a hollow sleeve 39 (Fig. 1) on which the driving pulley (not shown) is mounted. Meshing directly with the pinion 38 is a segment driving gear 60 which can be driven either by the gear 38 or can be used to drive the gear 38 if desired by means which it is not necessary here to describe but which will be found fully set forth in the above mentioned Scott Patent 1,152,850. These means include a so-called plate gear 65 revolving in unison with the gear 60 and carried just outside the frame of the machine on the same shaft with the gear 60, Fig. 2.

The segment driving gear 60 serves to reciprocate the left clutch pinion 35 by means of a pitman 70, transmitting an oscillatory movement to the usual quadrant or sector 75 meshing with the left clutch pinion 35. By virtue of the connection between pinions 35 and 38 it will be observed that the speed of the right clutch pinion is always the same relatively to the average speed of the left

clutch pinion, and in the machine shown in the drawings the gears are so cut that the right clutch pinion 38 will make four revolutions while the quadrant is completing one cycle of movement, i. e., one complete reciprocation. It therefore follows that the left clutch pinion will be making one complete reciprocation during four revolutions of the right clutch pinion 38. In the ordinary Scott & Williams machines the main shaft 32 revolves once for every revolution of the needle cylinder and therefore the needle cylinder makes one revolution for every revolution of the pinion 38 during rotary knitting. When the machine is reciprocating, however, the needle cylinder makes one revolution in each direction, i. e., a total of two revolutions while the right clutch pinion is making four revolutions. Said in another way, the needle cylinder's speed during reciprocaton is half that of its speed during rotation. Advantage is taken of this difference in speed in the present invention. Wherever in this specification revolution is spoken of without qualification, revolution of the needle cylinder is meant.

The mechanism for shifting or changing the clutch collar 33 from rotary to reciprocating knitting and vice versa will now be described. This shifting is controlled from the usual pattern chain 85 by mechanism which racks around a clutch shifting drum 90 the latter in turn causing the shifting of the clutch. This clutch shifting drum 90 is located directly beneath the clutch collar 33 and by means of a grooved cam path on its circumference moves laterally the clutch fork 92 sliding on a rod 93 on the frame of the machine. This clutch fork grips the collar 33 by means of a peripheral groove and is shifted laterally as above mentioned by means of a stud 89 lying in the cam path of the clutch shifting drum.

The clutch shifting drum 90 is racked around at irregular intervals controlled by the pattern chain 85 by mechanism which will now be described. The drum 90 is fast on the shaft 80 on which a sprocket 84 carrying the pattern chain revolves freely and is adjacent to the main rack wheel 81 having teeth cut on its circumference at irregular intervals. This main rack wheel is also fast on the shaft 80 and is the ordinary means for racking the clutch shifting drum 90. The pattern chain is racked around by means of the usual pattern chain rack wheel 86 fast to the sprocket wheel 84 carrying the pattern chain, the pawl 87 carried by the quadrant 75 racking the pattern chain 85 and wheel 86 once for every revolution of the gear 60. The indications given by the lugs on the pattern chain are transmitted as usual through a finger 83*c* to a pawl controller 83 pivoted on the fixed shaft 93. (Fig. 2.) This standard construction is fully set forth and described in the patent to Robert W. Scott, 1,152,180, where a description of the main pawl 82 and the rack wheel 81 is also to be found. This controller underlies the main pawl 82 which is carried by the quadrant 75 and is adapted to engage the teeth of the main rack wheel 81. The pawl controlled 83 is so positioned as to hold the main pawl 82 out of engagement with the main rack wheel except when the controller is tipped by a lug on the pattern chain, thus making it possible to cause the main rack wheel 81 to be turned whenever a lug on the pattern chain comes under the finger 83*c*. The pattern chain pawl 87 and the main pawl 82 are so mounted on the quadrant 75 that they ordinarily are moving in opposite directions, and the cams on the surface of the clutch shifting drum 90 in the ordinary machine are so located that the clutch collar 33 is shifted from rotary to reciprocatory knitting and vice versa when the quadrant is at the mid-point of its downward or forward stroke (Fig. 3). At this moment the pinions 35 and 38 are revolving in the same direction as indicated by the arrow in Fig. 3 and the notches in the right and left clutch pinions 38 and 35 which are adapted to receive the tenon 331 on the clutch collar 33 are opposite the tenon and the shift is therefore easily made.

In order to change the position of the needle cylinder relatively to the rest of the mechanism to permit the knitting of the toe pocket on the opposite side of the tube of fabric from the heel fabric according to this invention the needle cylinder is allowed to drop back half a revolution with relation to the rest of the machine while the machine is making round and round or rotary knitting, thus insuring that the toe pocket will be knit on the opposite half circle of needles from the heel pocket. It has been discovered that it is possible, by manipulation of the clutch during rotary knitting, to permit the cylinder to thus lose half a revolution relatively to the pattern chain without disturbing the timing of any of the other functions of the machine including the changes necessary to the making of the heel and toe pockets and that mechanism for dropping the cylinder back another half a revolution, after the toe has been made, can also be provided without in any way disturbing the other functions of the machine. This dropping back is accomplished without allowing the driving means to revolve while the cylinder stands still—the drive is positive at all times and the clutch goes directly from one operative connection to the other. It will be noted that the mechanism about to be described permits this dropping back at practically any time between the making of the heel pocket and the making of the toe pocket, and again between the making of the toe pocket and the making of the heel pocket, thus avoiding all possibility of interference with, or up-

setting of the timing of the parts of the machine performing other functions. According to the present invention the clutch collar 33 is shifted during rotary knitting in order to have the needle cylinder connected to the reciprocatory driving means for one revolution of the right driving pinion 38 when the reciprocatory driving means are turning in the same direction as the rotary means. This is accomplished by putting the clutch collar 33 into engagement with the left clutch pinion 35 during half of the down or forward movement of the quadrant 75. It has been found that engagement and disengagement between the clutch collar 33 and the left clutch pinion 35 can be accomplished at the beginning, middle or end of the forward i. e. down movement of the quadrant (if an extra notch is provided on the clutch face 37 diametrically opposite to the regular notch for receiving the tenon 331.) The desired shift to reciprocatory knitting can be at either the beginning or mid-point of the forward quadrant stroke and the desired return to rotary knitting at mid-point or end of the forward quadrant stroke.

I shall first describe the mechanism for causing the shifting of the clutch from rotary to reciprocating knitting when the quadrant is in its uppermost position ready to commence its downward or forward stroke. This auxiliary means for shifting the main rack wheel 81 and the cam control 90 slightly sooner than usual involves an auxiliary hook pawl 116 controlled by a cam 119 on a plate gear 65 giving the shaft 80 a short rack sufficient to shift the clutch shifter fork 92 into engagement with the gear 35 but not enough to complete the rack and cause the other changes necessary to shift from rotary to reciprocatory knitting or vice versa, as the case may be. Thus the shift is made without affecting the pattern chain as far as concerns the rest of the machine. This rack of the main rack wheel, early in point of time, is caused by the hook pawl 116 engaging one of two cams 117 mounted on the circumference of the belt shifter drum 102, the pawl 116 being mounted on and obtaining its movement through a bell crank lever 118 one of whose arms lies in the path of the cam 119 on the plate gear 65, this belt shifter drum being fast on the pattern chain shaft 80 like the rack wheel 81 and the drum 90. It will be obvious that whenever the rack of the main rack wheel 81 has brought one of the belt shifter drum cams 117 within reach of the pawl 116, the engagement of the cam 119 with the bell crank lever 118 will give the cam drum 90 the necessary short rack. One of the belt shifter drum cams is for the dropping back of the cylinder between the heel and toe, and the other for the dropping back between the toe and heel. The pawl 116 is held in contact with the surface of the belt shifter drum by means of a tension spring 116*a* in order to bring the cam 117 on the belt shifter drum within reach of pawl 116.

A lug is provided on the pattern chain 85 to allow the main pawl 82 to give the main rack wheel 81 and shaft 80 a short rack about three revolutions of the right clutch pinion 38 before the quadrant is at the middle of its downward stroke. The position of the parts just after this rack is given is shown in Fig. 5. Two revolutions after this rack has been given, namely when the quadrant is in its topmost position, the cam 119 on the plate gear 65 causes the pawl 116 to rack the belt shifter drum 102 and the clutch shifting drum 90 which brings the parts to the position shown in Fig. 1. The pin 89 has now been brought into engagement with a cam *a* on the surface of the clutch shifter drum 90, causing the clutch collar 33 to be shifted to the left into engagement with the left or reciprocating clutch pinion 35. When this shift is made the reciprocating clutch pinion 35 is about to begin turning in the direction indicated by the arrow thereon in Fig. 1, and the needle cylinder is thereby caused to continue its movement in the rotary or forward direction. However, while the maximum speed of the reciprocatory clutch pinion 35 is the same as the maximum speed of the rotary clutch pinion 38, the pinion 38 maintains its maximum speed uniformly while the reciprocatory pinion 35 is continually accelerating and decelerating with an average speed of half of that of the pinion 38. By the time the quadrant 75 has completed half its downward stroke and is in the position shown in Fig. 3, the right clutch pinion 38 will have completed one revolution, but the left clutch pinion 35 will have made only half a revolution, thus bringing the tenon 331 of the clutch collar in register with the extra notch in the face 37 of the pinion 38. This extra notch is circumferentially opposite the regular notch. The clutch collar 33 and therefore the needle cylinder would have made a complete revolution in the ordinary machine if engaged with the rotary clutch pinion 38 but having been engaged with the reciprocatory clutch pinion 35 it had made only half a revolution, and therefore the necessary retardation of the needle cylinder relatively to the rest of the machine has been accomplished.

If the machine is not ready to go into the making of the heel or toe at this point the clutch collar can be shifted back into engagement with the rotary clutch pinion 38 for rotary knitting. This shift can be accomplished by means of the main pawl 82 as shown in Fig. 3, the pawl racking the main rack wheel 81 around until the pin 89 in the clutch fork 92 has passed off the cam *a* which has been holding the fork to the left. The return of the fork to the right can be

accomplished either by a cam *b* (Fig. 1) on the surface of the drum or by a tension spring 108 located between the frame of the machine and the clutch fork 92 in such manner as to snap the clutch fork back to the rotary side as soon as the pin 89 passes the cam *a* (Figs. 2 and 3.)

The shifting of the clutch from the rotary to the reciprocatory and back again to drop the cylinder back, can be carried out during the last revolution of the right clutch pinion 38 prior to the time when reciprocation begins for the making of the heel and toe pocket. If the retarding of the cylinder is done at this time, the shifting of the clutch from rotary to reciprocatory knitting can be accomplished in the manner already described but there is no need of shifting the clutch back to rotary knitting—the machine is ready to begin reciprocation for the making of the heel or toe pocket. It will be observed in this case that the short cam *a* on the surface of the clutch shifting drum 90 would not be used. Instead, one long cam is provided to shift the clutch and to permit the main pawl to give the additional rack to the main rack wheel which will cause all the needle cam and yarn changes necessary to commence reciprocatory knitting and to knit the pocket. It will be observed that by the mechanism which has been described, there is no jerking forward of the needle cylinder by power driven means when the needle cylinder is standing still. The engagement of the clutch parts is positive and certain at all times and cannot possibly get out of time. It will also be observed that when the change is made just prior to going into the heel or toe, the only shifting of the clutch required is the one which would be required even in the ordinary machine.

The necessary manipulation of the needles for the formation of the heel and toe pockets on the opposite sides can be obtained by the use of mechanism such as shown and described in my Patent No. 1,853,519, dated April 12, 1932.

Another form of mechanism to accomplish the dropping back of the cylinder is one which shifts the clutch from rotary to reciprocatory knitting at the point in the cycle of movement of the quadrant where the shift would ordinarily be made, i. e., at the midpoint of the forward stroke, and shifting back again to rotary knitting when the quadrant has completed its forward stroke. In this case the shift from rotary to reciprocatory knitting is made by the main pawl 82 racking the clutch drum. The lug on the pattern chain 85 which permits the pawl to make its rack is so high that it brings the pawl into engagement with the main rack wheel 81 shortly after the pawl begins to move forward. There is a notch on the main rack wheel 81 so located that the pawl comes into engagement with it as soon as the pawl touches the rack wheel and the racking movement therefore is a long one. When the quadrant has reached its mid-point and the pawl has turned the clutch shifting drum far enough to shift the clutch to the left for reciprocation, the parts will be in the position shown in Fig. 3. As the quadrant continues its downward movement the pawl continues to turn the main clutch drum and when the quadrant has reached its lowermost point, as shown in Fig. 4, the auxiliary pawl 116 under the influence of the cam 119 will rack the clutch shifting drum around and the clutch will return to rotary knitting by virtue of the cam *c*. If desired the shift can be made by the use of the spring 108. In this case the pin 89 will ride off the cam *a* just prior to the end of the stroke of the quadrant and the spring 108 will hold 331 against the face 37 of the pinion 38 but still in engagement with pinion 35 till the quadrant is at the end of its stroke. At this moment the pinion 35 has completed one of its reciprocations, the tenon 331 will be opposite one of the notches in the face 37 of the rotary pinion 38, and the spring will shove the clutch collar home.

In the copending application of Albert E. Page and Frank R. Page Serial Number 246,243 filed June 2, 1928, there are claims directed broadly to varying the angular relation of the cylinder and clutch jaw.

It will be obvious that any manipulations of the clutch which have been described can be used between the toe and heel as well as between the heel and the toe and that in this way stockings can be successfully knit with heel and toe pockets on opposite sides of the tube. It will also be obvious that only the minimum number of extra parts are required and these parts are not located directly in the driving means and are quite simple to attach to the ordinary machine. Furthermore, as already pointed out, it is possible, by the mechanism described, to arrange the manipulations in a manner to avoid any intereference with the timing of the rest of the machine.

What I claim is:

1. A circular knitting machine having a revolving needle cylinder, a pattern chain controlling said machine and a clutch normally controlled by said chain and always connected to said cylinder adapted to cause reciprocatory or rotary knitting by said cylinder at respectively different speeds in combination with means so constructed and arranged with relation to said chain and clutch as to cause said clutch to lose half a revolution relatively to the pattern chain during rotary knitting.

2. A circular knitting machine having a pattern chain, a knitting head, a rotating cylinder in the knitting head, and a clutch adapted to positively drive said cylinder

with reciprocatory or rotary movement at all times, in combination with means so constructed and arranged with relation to said chain and clutch as to vary the time of shifting of the clutch relatively to the pattern chain to cause said needle cylinder to lose half a revolution, between the knitting of the heel and of the toe.

3. A circular knitting machine having a pattern chain, a knitting head, and a rotating element in the knitting head, in combination with mechanism adapted to cause reciprocatory movement of said rotating element, other mechanism adapted to cause rotary movement thereof at a different average circumferential speed from that for reciprocation, a clutch driven by one or the other of said mechanisms adapted to change said machine from rotary to reciprocatory knitting and vice versa and means controlled from the pattern chain adapted to cause the revolving knitting elements to be driven by the reciprocatory mechanism an extra revolution of the rotary mechanism in a rotary direction, while the machine is otherwise adjusted for rotary knitting

4. A circular knitting machine having a pattern chain, a rotating needle cylinder, normally controlled by said chain, mechanism adapted to cause reciprocatory movement thereof and other mechanism adapted to cause rotary movement thereof at a higher average circumferential speed from that for reciprocation, in combination with a clutch adapted to shift said machine from rotary to reciprocatory knitting and vice versa in such manner as to drive said cylinder positively at all times and auxiliary means so constructed and arranged with relation to said clutch and chain as to cause said cylinder to lose half a revolution relatively to the pattern chain by an abnormal shift of the clutch to the reciprocatory mechanism.

5. A circular knitting machine having revolving pattern means, a knitting head, a rotating cylinder in said head, a clutch to drive said cylinder and whose time of shift is normally controlled by said pattern means, said clutch being shifted from one position to another to change the cylinder from reciprocation to rotation and vice versa means to drive said clutch for reciprocation of said cylinder and means to drive said clutch for rotation of said cylinder at a different speed, in combination with means so arranged with the pattern means as to cause the clutch to be driven by the reciprocatory means to retard the cylinder from normal relation with the head.

6. A circular knitting machine having a rotary cylinder, a clutch to drive said cylinder, said clutch being shifted from one position to another to change the cylinder from reciprocation to rotation and vice versa rotary means to drive said clutch and an oscillating quadrant to reciprocate said clutch at a different average speed from the rotary drive means, in combination with means so constructed and arranged with said clutch as to shift the clutch to and from engagement with the quadrant during a movement of the latter in one direction to alter the relation of the cylinder to the rotary drive means.

7. A circular knitting machine having a revolving needle cylinder, a clutch to drive said cylinder, means to drive the clutch for reciprocation and means to drive the clutch for rotation of the cylinder, said means moving the cylinder at relatively different speeds, and revolving pattern means controlling the time of shift of said clutch, in combination with means so constructed and arranged with said clutch as to give said clutch an abnormally early shifting to the reciprocatory means leaving said cylinder half a revolution behind when the reciprocatory means has given the cylinder one revolution.

In testimony whereof I have signed my name to this specification.

ALBERT E. PAGE.