May 7, 1940. H. N. SHEPPARD 2,200,209

CIRCULAR KNITTING MACHINE

Filed April 21, 1939 4 Sheets-Sheet 1

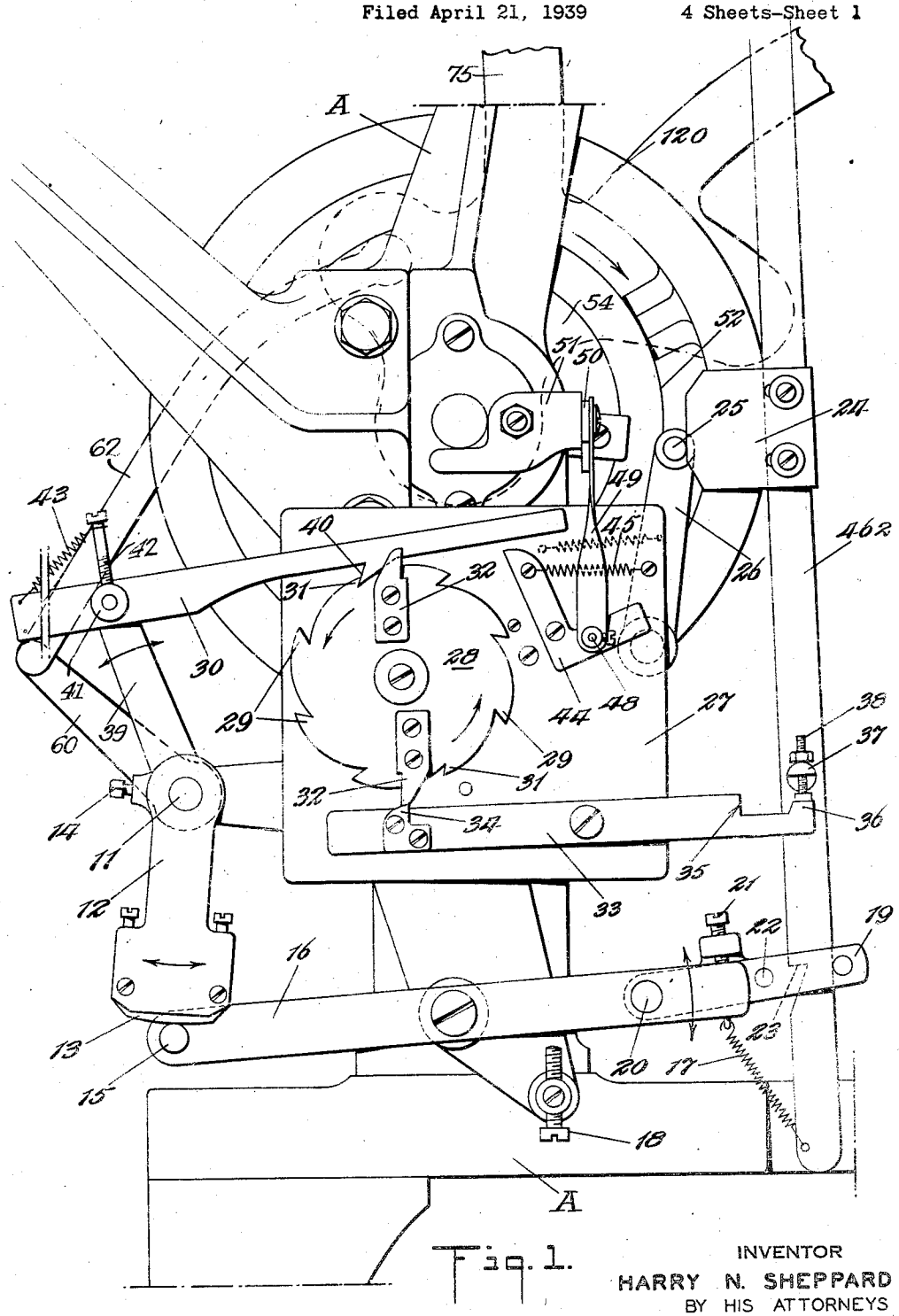


Fig. 1.

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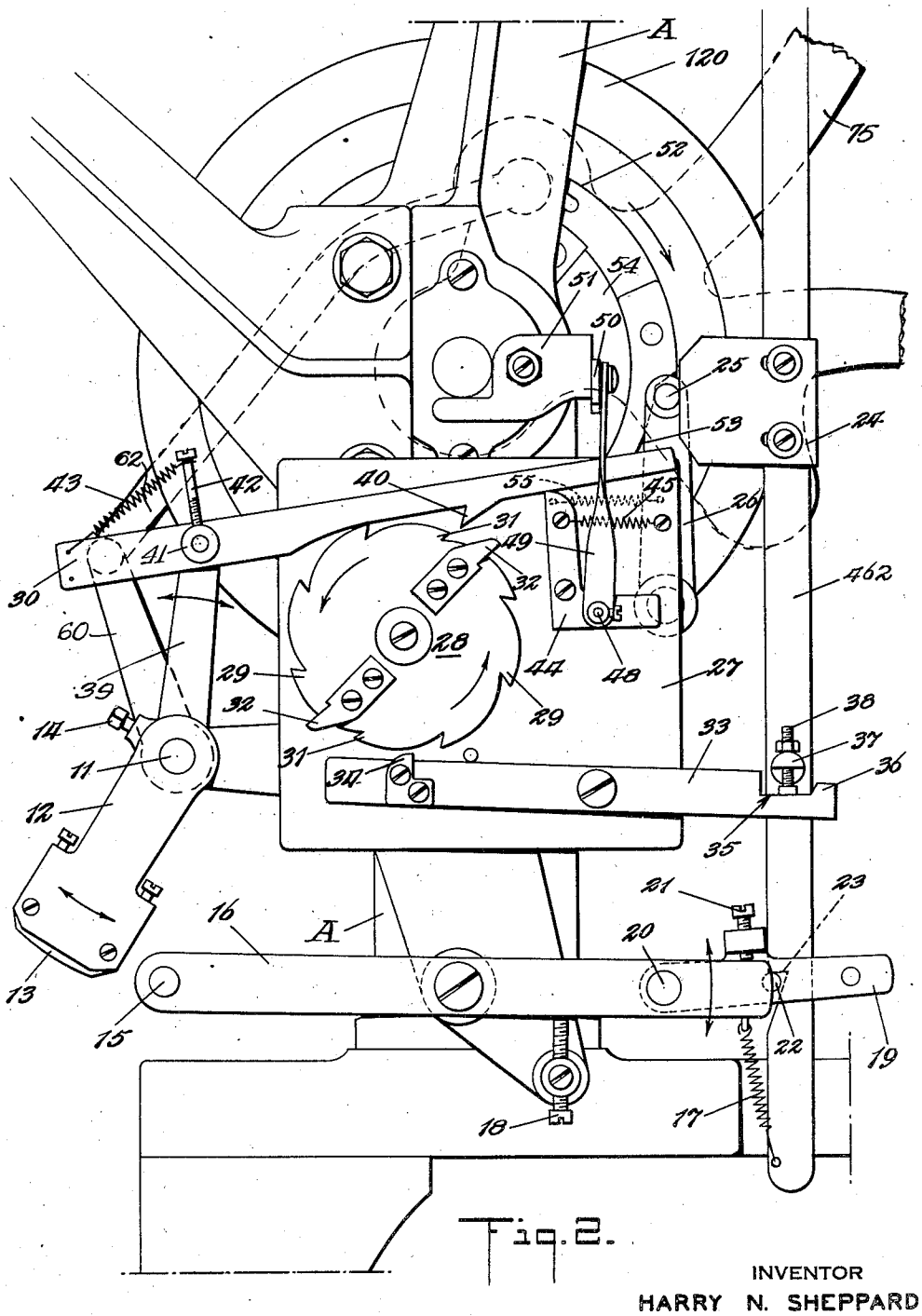


Fig. 2.

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CIRCULAR KNITTING MACHINE

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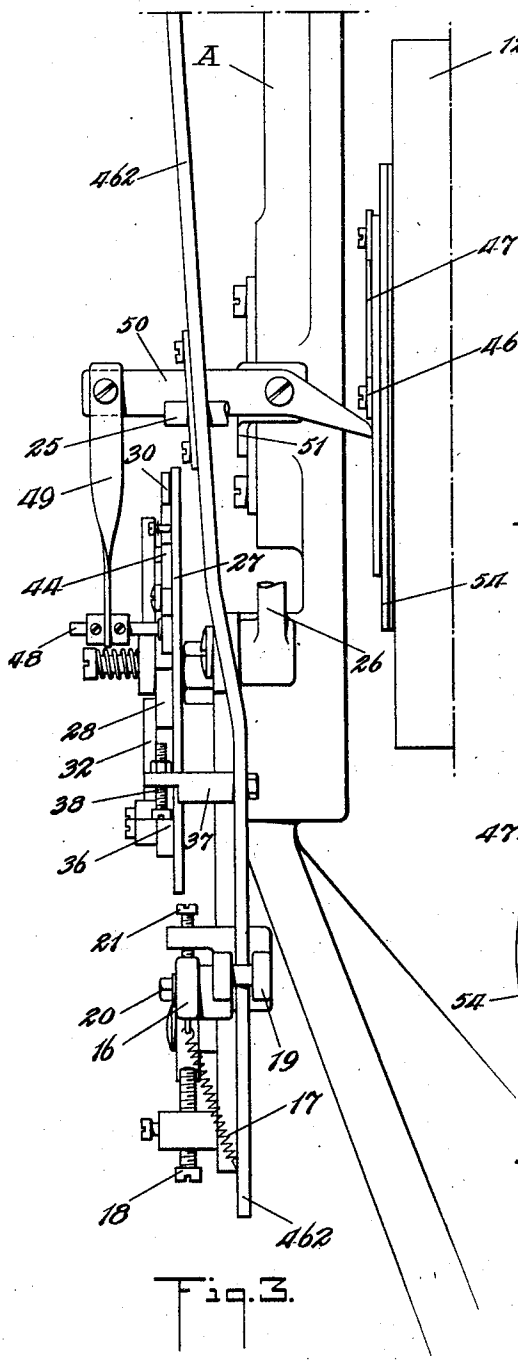


Fig. 3.

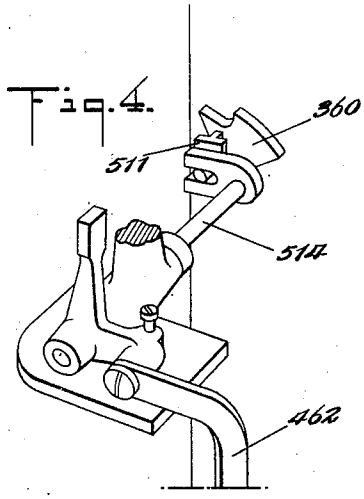


Fig. 4.

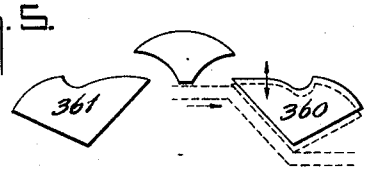


Fig. 5.

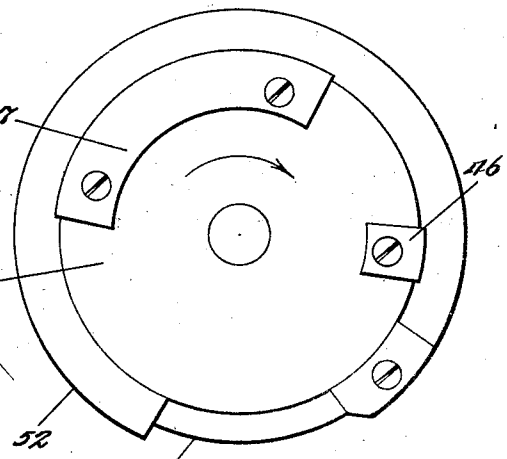


Fig. 6.

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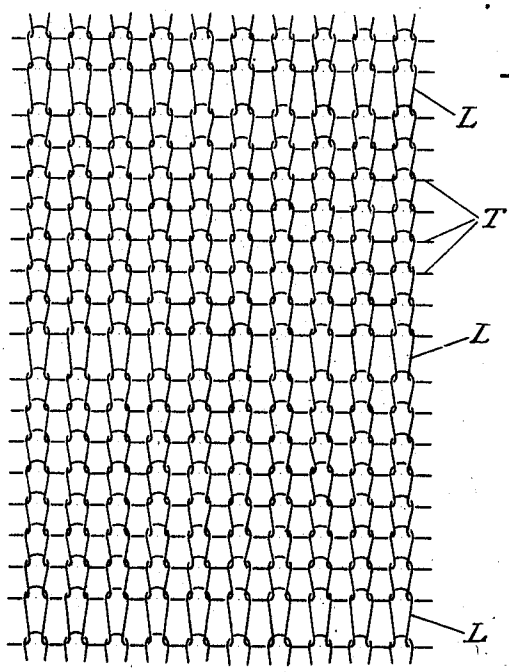


Fig. 7.

Fig. 9.

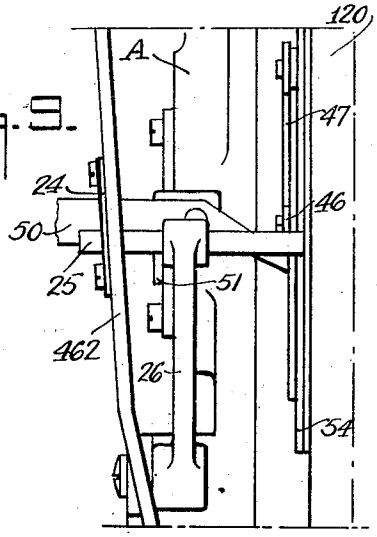
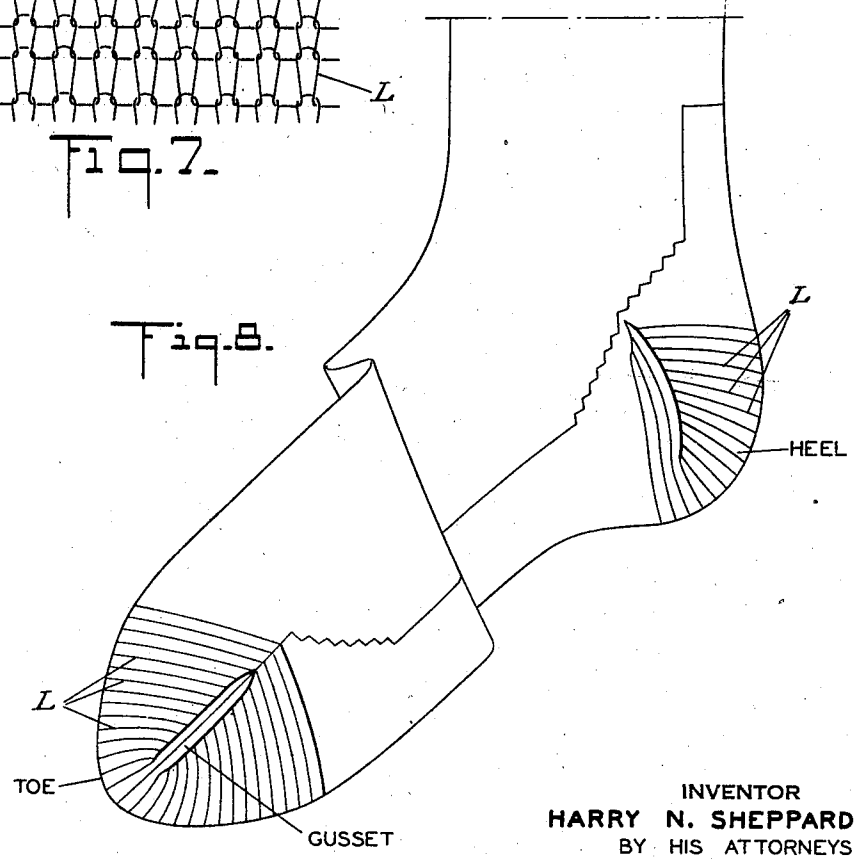


Fig. 8.



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Patented May 7, 1940

2,200,209

UNITED STATES PATENT OFFICE

2,200,209

CIRCULAR KNITTING MACHINE

Harry N. Sheppard, Maplewood, N. J., assignor to Scott & Williams, Incorporated, Laconia, N. H., a corporation of Massachusetts

Application April 21, 1939, Serial No. 269,252

9 Claims. (Cl. 66—54)

This invention relates to circular knitting machines and more particularly to means for the production of loose courses in seamless hosiery. One object of the invention is the production of mechanism which will enable the machines to knit single loose courses repeatedly during reciprocatory knitting, and another object is the efficient incorporation of such mechanism in the modern seamless hosiery circular knitting machine.

In the drawings,

Fig. 1 is a view in elevation from the left side of a Scott & Williams seamless hosiery machine showing control mechanism in accordance with the present invention, the parts being shown in the act of knitting a loose course during reciprocatory knitting;

Fig. 2 is a view similar to Fig. 1, showing the reciprocatory loose course mechanism completely out of action;

Fig. 3 is a view in elevation from the front of the machine, showing the parts of Fig. 1;

Fig. 4 is a view in perspective of the stitch cam and the parts for lowering it in response to the control mechanism of Figs. 1 to 3;

Fig. 5 shows the stitch cams as viewed from the outside of the machine at the back, the horizontal arrow indicating the direction of movement of the needle butts during rotary knitting;

Fig. 6 is a side view of the pattern disk for controlling the rotary and reciprocatory loose course mechanisms;

Fig. 7 is a diagrammatic illustration of a fabric made according to this invention;

Fig. 8 is a diagrammatic view of the foot of a stocking made on a machine embodying the present invention; and

Figure 9 is a partial view similar to Figure 3 and showing a part which is broken away in Figure 3.

In certain cases it is considered desirable to incorporate loose courses at spaced intervals in hosiery, and mechanism has heretofore been known for producing same in such rotary knit portions of a stocking as the welt. The mechanism for producing such round-and-round single loose courses in the welt will be shown and described herein because of the novel manner in which it can be combined with the novel loose course mechanism about to be described. In certain cases it is desired to produce single loose courses in portions of the stocking knit by reciprocatory or oscillatory movement of the needle cylinder, such for instance as the heel and toe, and it is sometimes desirable that these loose courses be as infrequent as one course in eight. The following simple mechanism enables such loose courses to be produced with the minimum number of parts and in cooperative relation with the loose course mechanism for the welt, all of which will be set forth in detail hereinafter.

The machine has the usual clutch and driving mechanism of the modern seamless hosiery machine with revolving needle cylinder, such for instance as the Scott & Williams type shown in the patent to Robert W. Scott No. 1,152,850, dated September 7, 1915.

One method of making loose courses in the welt is to lower the stitch cam temporarily, and this method of producing loose courses is used in both the mechanisms shown in the drawings. The mechanisms can be used for slackening by moving other knitting elements than the stitch cam. They are so combined as to operate the same stitch cam or running-down cam and from the same thrust rod, the control being shifted from one mechanism to the other, as required. Briefly, the means for slackening single courses in the welt comprise a wiper or rocker cam 12 operated from the usual quadrant or segment gear 75 of the machine, which rocker cam intermittently moves the thrust rod for the stitch cam. In the drawings there is a horizontal loose course rod 11 extending across the back of the machine which is linked by a lever arm 60 fixed on the rod 11 and a rod 62 to the quadrant and has an oscillatory cycle of movement of four knitted courses during rotary knitting. At the left end of the rod 11 as the machine is viewed from the front is the rocker cam 12 having an adjustable plate 13 on the bottom thereof, the angular position of this cam on the rod 11 being adjustable by means of a set screw 14. The plate 13 on the rocker cam is adapted to engage a pin 15 in the rear end of the welt loose course operating lever 16 pivoted on the frame A of the machine. The forward end of this operating lever 16 is attached to a thrust rod 462 by means of a tension spring 17 which tends to hold the rod up and back. There is a set screw 18 on the frame of the machine underlying the front half of the lever 16 to limit the downward movement of the rod 462 and lever 16.

The forward end of the operating lever 16 is in the form of a jaw 19 embracing the lower end of the thrust rod 462 loosely, the exact elevation of this jaw being determined and fixed by tightening the screw 20 which joins the jaw to the main portion of the lever, and a set screw 21 on

the jaw overlying the upper edge of the main portion of the lever. This gives the vertical adjustment of the thrust rod 462. There is a small pin 22 extending across the inner end of the jaw and there is a corresponding notch 23 in the edge of the thrust rod facing this pin. The parts can be seen in engaged position in Fig. 2, and it will be obvious that any time the wiper cam 12 pushes down against the pin 15 while the thrust rod notch 23 is resting on the pin 22, the thrust rod will be raised and loose stitches will be made. The mechanism by which the vertical movement of the thrust rod is transmitted to the stitch cam is shown in Fig. 4 and includes a shaft 514 rotated by elevation of the thrust rod, which in turn causes lowering of a slide 511 carrying the stitch cam 360. The companion stitch cam which acts as a clearing cam during round-and-round knitting is designated in Fig. 5 by the reference character 361.

By proper angular adjustment of the wiper cam 12, the operating lever 16 can be operated every two or four courses of rotary knitting. If the wiper cam is adjusted as shown in Fig. 1, it will oscillate the operating lever 16 once on its forward stroke and once on its backward stroke, which means that one loose course will be knit every second revolution of the needle cylinder.

In order that the above mechanism may be idled except when needed in the welt, means are provided which hold the thrust rod 462 forward and away from the pin 22, as shown in Fig. 1. This mechanism comprises a cam plate 24 on the thrust rod 462 at an elevation about opposite the axis of the main pattern drum 120. This plate extends rearwardly to a point where it comes in contact with a pin 25 in the upper end of a control lever 26 pivoted on a stationary part of the machine. This pin 25 projects to the right of the thrust rod 462 as shown in Fig. 9 a distance sufficient to bring it in contact with the periphery of a cam disk 54 shown in Figs. 1, 2 and 6. This cam disk is fixedly mounted on the axle which carries the main pattern drum 120 and revolves with that drum, one complete revolution for each stocking knit. As can be seen in Fig. 6, the periphery of this disk has a high portion 52 and a low portion 53. The low portion corresponds to the welt of the stocking and permits the notch 23 of the thrust rod 462 to engage the pin 22, as shown in Fig. 2, while the high portion of the periphery of this disk causes the pin 25 to force the plate 24 and thrust rod 462 outwardly until the thrust rod notch 23 is out of contact with the pin 22, as shown in Fig. 1. There is a tension spring 55 tending to hold the pin 25 against the cam surfaces 52 and 53. (The arrow in Fig. 6 shows the direction of rotation of the cam disk as viewed from the left side of the machine.)

The novel mechanism for producing single loose courses in the heel and toe is also actuated from the loose course rod 11 at the back of the machine. However, it is so constructed and arranged that it not only is inoperative at all times during the knitting of the stocking (except when specifically desired), but also it is so arranged that it causes the knitting of loose courses in only one of the two directions of knitting taken by the needles during reciprocatory knitting. In addition, as already mentioned, the mechanism can be so constructed that loose courses in the one direction during reciprocatory knitting will occur only intermittently. Thus in the embodiment shown in the drawings, the loose courses occur during reciprocatory knitting only when the needles are moving in the direction of round-and-round knitting, and in only every eighth course. The mechanism is carried on a vertical plate 27 on the frame of the machine at the left side, and has as its two most important elements a rack wheel 28 and pawl 30 therefor. (See Fig. 3.) The rack wheel 28 is mounted vertically on the face of the plate 27. It is spring-pressed against the plate to prevent its rotating unintentionally. There are eight teeth on the periphery of the wheel,—six regular teeth 29 and two low teeth 31 equally spaced apart. At a point just following each low tooth 31, a finger 32 is screwed to the outer face of the wheel in such a position as to project beyond the teeth, these fingers 32 presenting bevelled leading faces in the direction of rotation of the wheel indicated by the arrows in the drawings.

There is a loose course operating lever 33 pivoted on the outer face of the plate 27 at a point forward of the axis of the wheel 28. The rear end of this lever has a lip 34 lying in the path of the fingers 32 on the wheel. The forward end of this operating lever is adapted to cooperate with and influence the movements of the thrust rod 462 in the following manner. The end of the lever contains a deep notch 35 with an upward step 36 at its extreme outer end. On the thrust rod, at about this level, is a pin 37 projecting laterally through the thrust rod. The end of this pin 37 overlies the forward end of the operating lever 33 and contains a vertical screw 38 with an adjusting nut. The dimensions and pivot points of the parts are such that when the lip 34 on the rear end of the operating lever 33 is pushed down by one of the fingers 32 and the screw 38 is resting on the step 36 at the forward end of the lever, the thrust rod will be at the same elevation as if the notch 23 of the pin 22 and the other slackening mechanism were in engagement and the rocker cam 12 were raising the thrust rod. The screw 38 rests on the step 36 of the operating lever whenever the high portion 52 of the periphery of the disk 54 forces the thrust rod out of engagement with the pin 22 on the welt loose course operating lever 16. Thus it will be seen that when the lip 34 is engaged by a finger 32 and the screw 38 is resting on the step 36, the stitch cam 360 will be lowered to the dotted position shown in Fig. 5, where a slack course will be knit by the active needles if the cylinder is turning in the rotary or round-and-round knitting direction. It might be noted that when the lever 26 drops down onto the pin 25 of low portion 53 of the cam 54, the spring 17 pulls the notch 23 and the pin 22 into engagement and brings the screw 38 off the step 36 of the operating lever 33 and over the deep notch 35 in that lever. In this position of the thrust rod the lip 34 and the finger 32 can no longer cause slackening of stitches.

This mechanism is operated from the loose course operating rod 11 at the rear of the machine. On the rod 11 is an upstanding arm 39 which reciprocates in time with the rod. To the upper end of the arm is pivoted the pawl 30 at a point intermediate its ends, the claw 40 of the pawl being on the under edge thereof in a position approximately over the axis of the wheel 28. Mounted on the pivot pin which supports the arm 39 is a collar 41 secured in adjusted position by a long set screw 42. Extending between the upper end of this screw and the rear end of the pawl is a tension spring 43 tending to hold the claw 40 of the pawl downwardly in engagement

with the teeth 29 and 31 on the periphery of the wheel 28. It will be seen that as the rod 11 oscillates, the pawl 30 will go through a cycle adapted to rack the wheel 28 around one tooth for each oscillation of the loose course or welt rod 11. In the example used, this heel and toe loose course mechanism is effective only during reciprocatory knitting. One complete revolution of the rack wheel 28 corresponds to sixteen courses in the fabric knit during reciprocation and during such revolution two loose courses, equally spaced, are knit, as shown in Fig. 7.

It will be noted that the pin 25 of the operating lever 26 is riding on a high portion 52 of the periphery of the disk, and the heel and toe loose course mechanism is in its operative relation with the thrust rod 462 except during the making of the welt. The following mechanism has therefore been devised to keep this reciprocatory loose course mechanism idle except when needed.

On the mounting plate 27 is an L-shaped idling lever 4 pivoted near the meeting point of its two arms. The upper arm of this lever underlies the forward end of the pawl 30. This arm is long enough so that when it is raised to substantially vertical position, as shown in Fig. 2, the pawl will be raised to such a level that its claw 40 cannot engage a low tooth 31 on the wheel 28. There is a tension spring 45 tending to hold the idling lever 44 in this upright or pawl-idling position, and this spring is effective to prevent the heel and toe loose course mechanism from making loose courses except when under the influence of a pair of side cams 46 and 47 on the outer face of the cam disk. To make these arcuate side cams 46 and 47 effective, there is a pin 48 projecting laterally outward from the lower arm of the idling lever 44, and this pin is engaged by an upwardly extending link 49 which in turn is pivotally connected to a horizontal finger or lever 50 which is pivotally mounted on a bracket 51 on the main frame of the machine. The inner end of the finger or lever 50 lies against the side face of the cam disk 54 in the path of cams 46, 47 and is normally in contact with the disk face. As the disk is racked around with the main pattern drum during the making of the stocking, the inner end of this finger 50 will come into contact first with the heel cam 46 and thereafter with the toe cam 47. These cams, being higher than the outer face of the disk 54, operate the finger 50 to raise the link 49 and thereby lower the upper arm of the idling lever 44 against the tension of spring 45 to a level where the claw 40 can engage the adjacent low tooth 31 on the wheel 28. In the drawings the disk 54 is shown composed of a multiplicity of plates to give the various surfaces needed. As long as the cam 46 or the cam 47 is in engagement with the finger 50, the pawl 30 will continue to rack the wheel 28 and loose courses will be knit intermittently. The lengths of the cams 46 and 47 are determined by the racks through which the machine passes during the making of the heel and the toe. Thus in Fig. 8 a gusset is shown in the toe of the stocking, and this gusset requires extra racks of the main pattern drum. This accounts for the extra length of the toe cam 47.

The construction of the novel and associated parts of the machine having been described, their operation will now be set forth. At the time the machine is ready to shift from rotary to reciprocatory knitting for the making of the heel, the welt loose course mechanism is inoperative because the notch 23 in the thrust rod is held out of contact with the pin 22 in the jaw by virtue of the high portion 52 of the disk 54. The heel and toe loose course mechanism is inoperative because its idling lever 44 is holding the pawl 30 up so that its claw 40 is idling back and forth above one of the two low teeth 31 on the rack wheel 28, and in this position of the rack wheel neither finger 32 is in contact with the lip 34 on the operating lever 33. The change from rotary to reciprocatory knitting is made by a rack of the control mechanism which shifts the clutch into operative connection with the quadrant. This shift is made in such timed relation to the movement of the quadrant 75 that the latter first moves the cylinder in the forward or round-and-round direction, this serving to raise the instep needles out of action. This rack also turns the cam disk 54, bringing the side cam 46 under the finger 50, which lowers the idling lever 44 and the pawl 30. While the needle cylinder is moving forward and raising the instep needles, the pawl 30 is also coming forward and therefore has not yet turned the rack wheel. The first movement of the needle cylinder in a reverse direction and the backward or pulling movement of the pawl begin simultaneously. During this first reverse movement of the needle cylinder a racking of the wheel 28 brings the finger 32 into contact with the lip 34, thus tipping the operating lever 33 and lowering the stitch cam. This lowering operation is completed at a point in the reverse movement of the needle cylinder when the idle instep needles occupy the rear half of the machine where the stitch cam 360 is located. It might be noted at this point that while the cylinder is turning in this reverse direction the cam 360 is merely acting as a clearing cam over which the active needles pass, and the companion cam 361 is acting as a running-down or stitch cam. It might also be noted that when the cam 360 is in its lower or dotted position, as shown in Fig. 5, it is high enough to clear the needles on the reverse stroke.

On the next movement of the cylinder in the forward direction the active needles are cleared by the companion cam 361 and pass down under and are caused to knit by the lowered stitch cam 360, this making a loose course. During this forward movement of the cylinder the pawl 30 is coming forward to take the next tooth on the rack wheel 28, and the pawl becomes effective at such a time that after the cylinder has moved about a quarter of a revolution in the reverse direction on its second reverse movement, the thrust rod 462 begins to lower. By the end of the reverse movement the racking of the wheel 28 on the first high tooth 29 has been completed and the machine has knit the first tight course T after the loose course L. The machine continues to knit one tight course on each oscillation in either direction while the pawl 30 continues to rack the wheel 28 one tooth every two courses, but no loose courses are knit until seven tight courses have been made because no finger 32 comes into contact with the lip 34 on the operating lever 33. During the making of the seventh tight course—which occurs while the cylinder is moving in the reverse direction—the other finger 32 tips the operating lever 33 and lowers the stitch cam so that the eighth course made while the cylinder is going in the forward direction as before, will be a loose course.

This sequence of operation continues until the heel is completed, when the rack which shifts the clutch from reciprocatory to rotary knitting causes the side cam 46 to pass out of contact

with the finger **50**, thereby restoring the idling lever **44** to its operative position in which the pawl **30** cannot reach either of the low teeth **31**. If this action occurs while high teeth on the rack wheel are passing under the pawl, the pawl will continue to turn the rack wheel until it reaches a low tooth, when the rack wheel stops in the proper timed position to begin making the single loose course upon resumption of reciprocatory knitting, as above described. The foot of the stocking is then knit by rotary knitting, after which the machine shifts back to reciprocatory knitting in the same manner that it shifted into the heel. The side cam **47** then engages the finger **50** lowering the idling lever **44**, and permitting the operation of the rack wheel **28** by the pawl **30** and the making of the toe loose courses to be carried out in the same manner as in the heel.

Many modifications of this construction which do not depart from the scope of my invention will occur to those skilled in the art.

What I claim is:

1. In a circular knitting machine, a needle cylinder, an oscillatory element adapted to give the cylinder reciprocatory movements and a knitting cam, in combination with means actuated by the oscillatory element to cause the cam to draw a course of longer stitches intermittently.

2. In a circular knitting machine, a needle cylinder having rotary and oscillatory movements, and an oscillatory element to drive the cylinder during oscillation, in combination with a knitting cam and means actuated by the oscillatory element to cause the cam to draw longer stitches intermittently.

3. In a circular knitting machine, a needle cylinder having rotary and oscillatory movements, and an oscillatory element to drive the cylinder during oscillation, in combination with a knitting cam, a racking element adapted to cause the cam to draw longer stitches and a pawl actuated by the oscillatory element to bring the racking element into and out of operative position.

4. In a circular knitting machine adapted to knit in either a rotary or reciprocatory manner, a needle cylinder and an element adapted to give the cylinder reciprocatory movement, in combination with cam means to cause knitting in each direction of movement and means actuated by said cylinder reciprocating element to cause the cam means intermittently to draw a course of longer stitches when knitting in one direction but not the other.

5. In a circular knitting machine, a needle cylinder, an element adapted to cause reciprocation of the cylinder and stitch cam means adapted to cause knitting in each direction of movement, in combination with means for causing the stitch cam means to draw longer stitches in selected courses and a pawl actuated by the cylinder reciprocating element to rack the slackening means.

6. In a circular knitting machine adapted to knit seamless hosiery, a needle cylinder and an element adapted to cause reciprocation of the cylinder for the knitting of heels and toes, in combination with a cam operative in one direction of movement to draw down the needles to knit, a thrust rod to control the length of stitch drawn by said cam, a rack wheel adapted to select courses to be slackened, a pawl actuated by the cylinder reciprocating element to turn said wheel, means transmitting the rack wheel indications to the thrust rod and control means moving the thrust rod into and out of operative relation with said transmitting means.

7. In a circular knitting machine, a stitch cam, a thrust rod controlling the length of stitch drawn by said cam, means adapted to actuate the thrust rod for the production of single loose courses during round-and-round knitting, and means adapted to actuate the thrust rod for the production of single loose courses during reciprocatory knitting, in combination with pattern means adapted to shift control of the thrust rod from one slackening mechanism to the other and idling means associated with one of said two mechanisms.

8. In a circular hosiery knitting machine, a needle cylinder, an oscillatory element adapted to drive the cylinder during reciprocatory knitting, a stitch cam and a rack wheel for selectively causing certain courses of reciprocatory knitting to be slackened, in combination with a pawl driven by the oscillatory element to rack said wheel in such timed relation with the needle cylinder that the slackening always occurs on courses knit in the same direction.

9. In a circular hosiery knitting machine, a needle cylinder, an oscillatory element adapted to drive the cylinder during reciprocatory knitting, a stitch cam and a rack wheel for selectively causing certain courses of reciprocatory knitting to be slackened, there being one or more low teeth on said wheel, in combination with a pawl driven by the oscillatory element to rack said wheel in such timed relation with the needle cylinder that the slackening always occurs on courses knit in the same direction, and idling means preventing the pawl from catching a low tooth, thereby leaving the stitches of normal length.

HARRY N. SHEPPARD.