Sept. 6, 1955 J. H. SURRATT 2,716,876

APPARATUS FOR KNITTING ELASTIC FABRIC AND METHOD

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Fig. 1

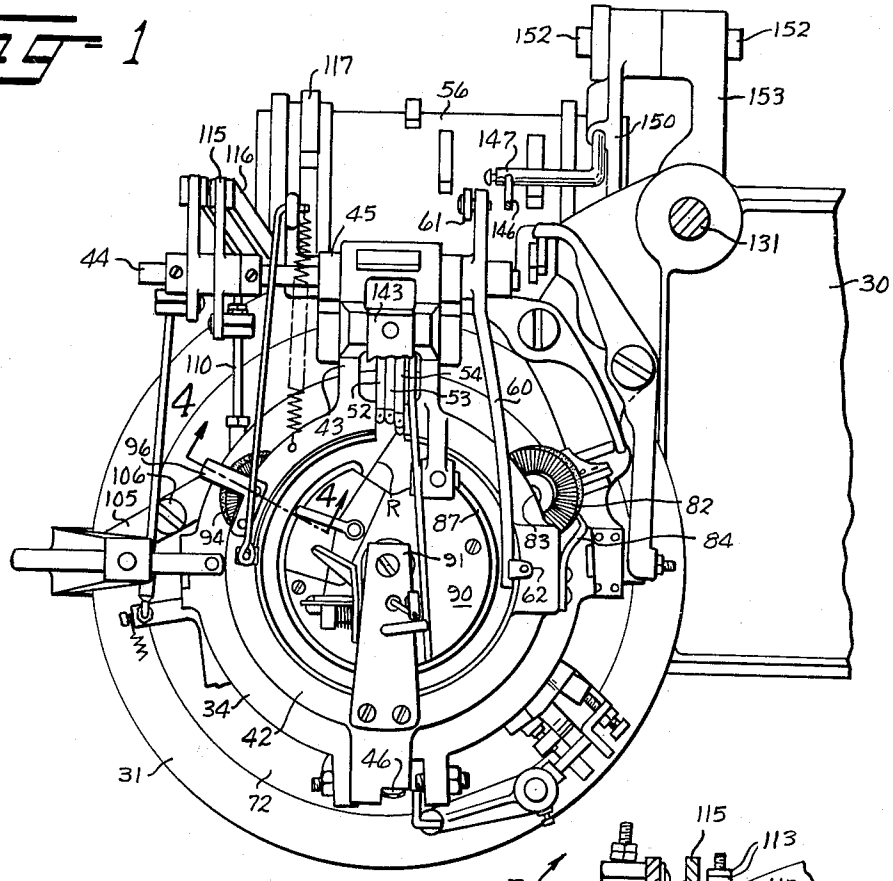


Fig. 4

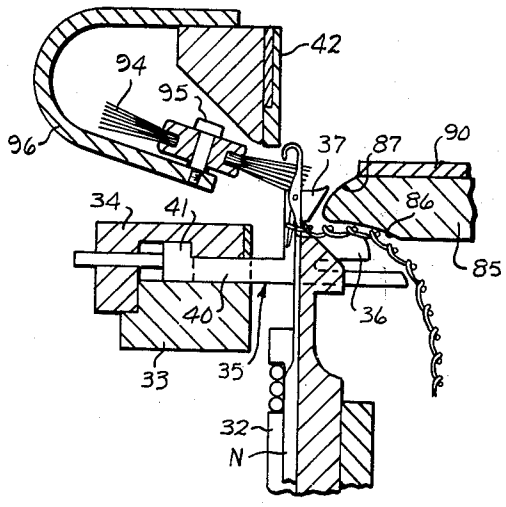
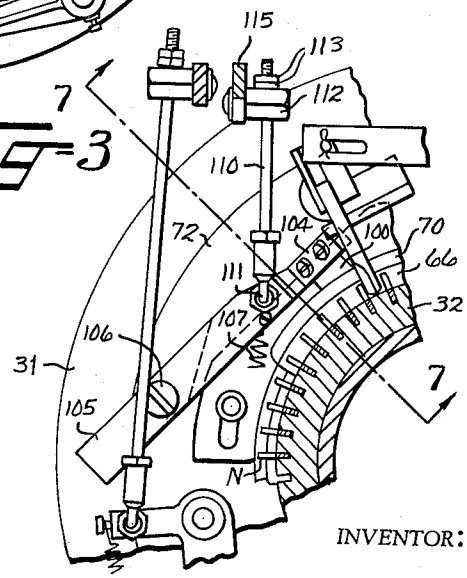


Fig. 3



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APPARATUS FOR KNITTING ELASTIC FABRIC AND METHOD

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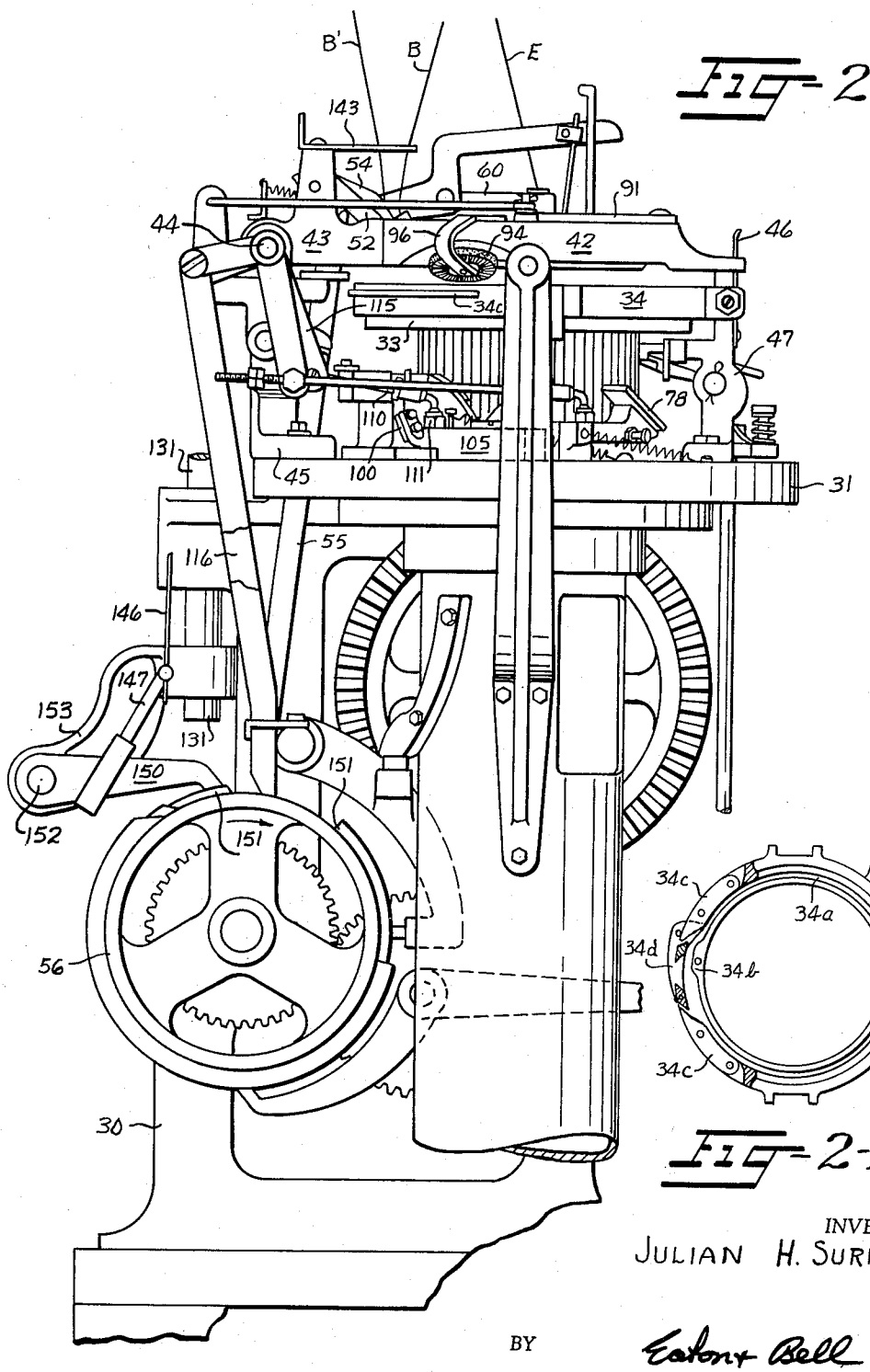


Fig. 2

Fig. 2-A

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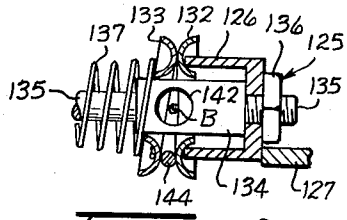


Fig. 6

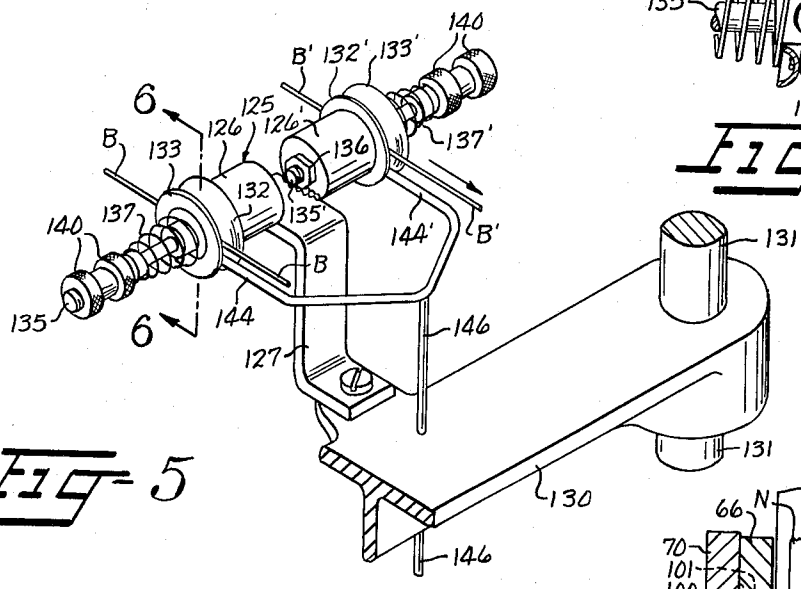


Fig. 5

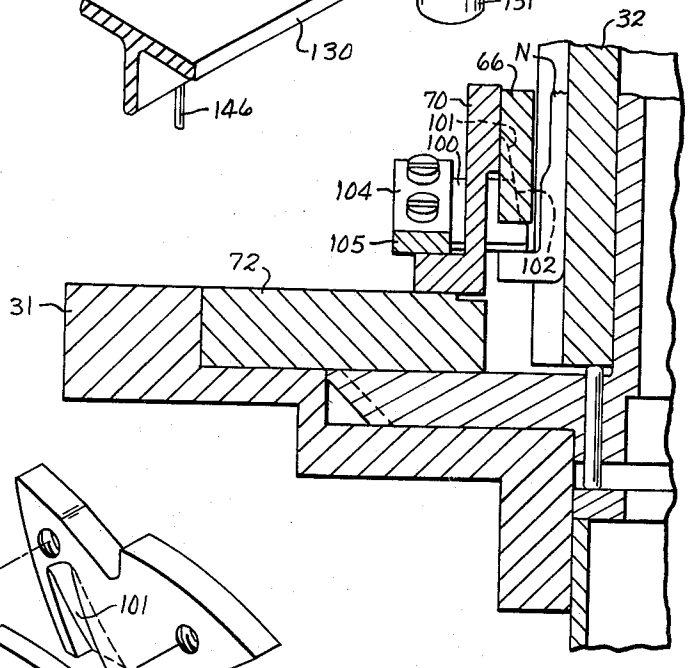


Fig. 8

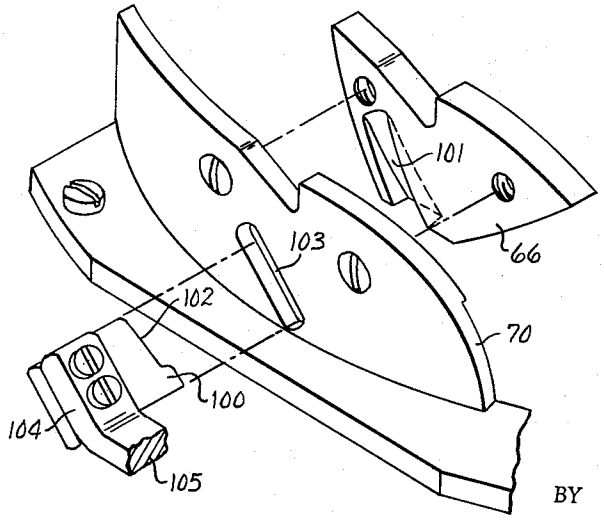


Fig. 7

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APPARATUS FOR KNITTING ELASTIC FABRIC AND METHOD

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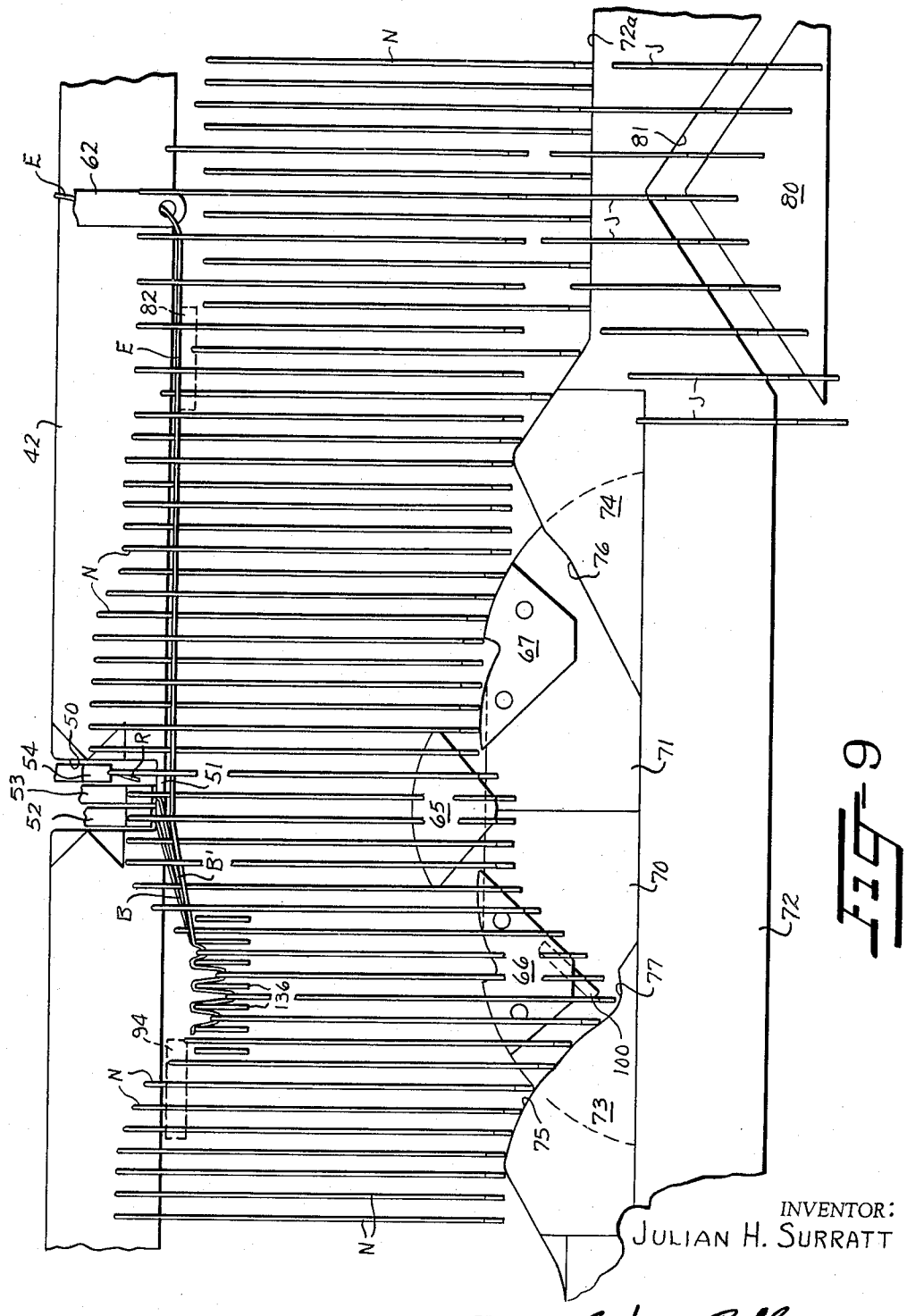


FIG. 9

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2,716,876

APPARATUS FOR KNITTING ELASTIC FABRIC AND METHOD

Julian H. Surratt, Denton, N. C.

Application April 26, 1954, Serial No. 425,500

14 Claims. (Cl. 66—9)

This invention relates to circular knitting machines and, more especially, to an improved method and apparatus for producing elastic fabric such as hosiery.

During plain knitting in a circular knitting machine, inelastic yarns or body yarns are fed after which the needles are lowered by the conventional needle lowering stitch cam to draw stitches over the body portions of the sinkers in drawing loops or stitches of normal length. However, in order to produce a highly stretchable elastic circularly knit fabric, it is necessary to form elongated stitches of a length substantially greater than normal length while laying in or knitting an elastic yarn under tension.

It is therefore an object of this invention to provide an improved method and apparatus, for making elastic fabric wherein an elastic strand is laid in in front of some of the needles or alternate needles and in back of the other needles and the inelastic or body yarn is fed to the needles by the conventional fingers at the throat plate. Immediately past the throat plate, the needles are lowered to a position substantially lower than the position to which they are normally lowered during the forming of normal stitches so that, although the stitches are then drawn oven the body portions of the sinkers, very elongated loops are formed thus resulting in a fabric which can be stretched to a much greater extent than conventional fabrics where the elastic yarn is laid in and the needles are lowered only to their normal lowered position in a stitch forming operation.

It is another object of this invention to provide, in a circular knitting machine, an auxiliary stitch cam with pattern controlled means for moving the auxiliary stitch cam into and out of operative position below one of the conventional stitch cams. The auxiliary stitch cam, when in operative position, serves as an extension to the lower portion of the conventional stitch cam. Thus, during the knitting of elastic portions of a stocking or other tubular fabric, the auxiliary stitch cam moves the needles to an abnormally lowered position during the forming of the stitches to form very elongated loops with the body yarn as it is drawn over the body portions of the sinkers and, during plain knitting of inelastic portions of a stocking or other tubular fabric, the auxiliary stitch cam is withdrawn from operative position so the needles are lowered by the corresponding conventional stitch cam to the normal lowered position to draw stitches of normal length over the body portions of the sinkers.

It is still another object of this invention to provide a shield in the form of a hold down plate or disk which is disposed immediately above the sinkers and is of slightly less diameter than the diameter of the needle circle and serves to hold down the fabric as the needles are raised to take either the inelastic or elastic yarn or both in the hooks thereof and to thereby insure that the old stitches on the needles are held down below the latches of the needles as the needles are raised.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds when

taken in connection with the accompanying drawings, in which—

Figure 1 is a top plan view of a knitting machine, with parts broken away, embodying the improved stitch forming means;

Figure 2 (Sheet 2) is an elevation of the main portion of a knitting machine looking at the left-hand side of Figure 1;

Figure 2–A is an inverted plan view of the sinker cap showing the conventional cams for controlling the sinkers;

Figure 3 (Sheet 1) is an enlarged fragmentary plan view of the left-hand upper portion of Figure 1, partially in section, but being taken below the level of the sinker head and showing parts of the means for controlling the improved auxiliary stitch cam;

Figure 4 is an enlarged fragmentary sectional view taken substantially along line 4—4 in Figure 1;

Figure 5 (Sheet 3) is an isometric view showing an improved means for controlling the tension of the body yarns, which means is disposed above the level of the structure shown in Figures 1 and 2;

Figure 6 is an enlarged fragmentary vertical sectional view taken substantially along line 6—6 in Figure 5;

Figure 7 is an enlarged fragmentary vertical sectional view taken substantially along line 7—7 in Figure 3 and showing the improved auxiliary stitch cam in operative position;

Figure 8 is a fragmentary exploded isometric view of the improved stitch cam arrangement as though looking from the outside of the bed plate toward the left-hand side of Figure 7;

Figure 9 is a developed elevation showing some of the cams for controlling the needles as though looking outwardly from within the needle circle.

Referring more specifically to the drawings, the knitting machine shown therein is substantially of the type disclosed in the patent to R. W. Scott, No. 1,152,850, dated September 7, 1915, and substantially as manufactured by Scott & Williams, Incorporated, under their Model No. B5. However, it is to be distinctly understood that the principles of the present invention may be readily applied to many different types of circular knitting machines and the particular knitting machine is shown in the accompanying drawings by way of illustration only.

The knitting machine comprising a frame 30 which carries a conventional substantially circular bed plate 31 in which a needle cylinder 32 is rotatably mounted and which needle cylinder 32 is selectively driven in either a rotary manner or a reciprocatory manner by conventional means well known in the art. The needle cylinder 32 has the usual circular series of latch needles N mounted for vertical movement therein and alternate needles N have corresponding needle jacks J positioned therebeneath (Figure 9), which needle jacks are also mounted for vertical reciprocation in the needle cylinder. The pertinent cams for controlling the needles N and the jacks J will be later described.

The knitting machine also comprises a conventional sinker head 33 and sinker cap 34 in which conventional sinkers broadly designated at 35 are mounted. The sinkers 35 are controlled as to radial movement by the usual cams provided in the sinker cap 34 (Figure 2–A) and which will be later described.

In this instance, each of the sinkers 35 comprises a main body portion or platform 36 and a nib or hook portion 37 extending upwardly and inwardly above the body portion 36. Thus, the nibs 37 serve to hold down the elastic yarn against the platforms 36 during the knitting of elastic fabric as will be clarified hereinafter. Of course, each of the sinkers 35 also comprises a stem or shank portion 40 having a butt 41 thereon which is

engaged by the conventional sinker cams in the sinker cap 34.

One advantage of the present method lies in the fact that conventional sinker control cams may be employed, without modification thereof, for controlling the sinkers 35 in the usual manner while laying in elastic yarn in fabric formed with elongated body yarn loops. In Figure 2–A a typical set of sinker cams is shown which is similar to that shown in Figure 7 of said Patent Number 1,152,850.

In this instance, the underside of the sinker cap 34 has a concentric groove 34*a* for control of the butts 41 of the sinkers 35. The sinker cap 34 has a sinker withdrawing or retracting cam portion 34*b* which is disposed at the rear of the sinker cap adjacent the body yarn feed station to give the sinkers 35 their outward radial thrust above the knitting cams, to be later described. The sinkers 35 are subsequently returned inwardly to advanced position by either of a pair of advancing cams 34*c* (depending upon the circular direction in which the sinkers 35 are moving) or by an intermediate sinker advancing cam 34*d* (Figure 2–A) as the sinkers move clockwise in Figure 2–A.

Spaced closely above the sinker cap 34 is a conventional latch ring 42 provided with a rear extension 43 which is pivotally mounted on a pivot shaft 44, fixed in a post 45. The post 45 is suitably secured to the bed plate 31 at the rear of the machine (Figures 1 and 2). The latch ring 42 is latched in closed position by means of a spring member 46 carried by a front post or standard 47 at the front of the machine.

The latch ring 42 is provided with the usual throat 50 therein (Figure 9), which also defines a main yarn feeding station, and the bottom of the throat 50 is closed by a throat plate 51. The eyes of a plurality of conventional inelastic or body yarn feed fingers are normally disposed within the throat 50, there being three such yarn feed fingers shown in Figures 1 and 2 which are indicated at 52, 53 and 54. A plurality of push rods or thrust rods 55 (Figure 2) are provided for manipulating the body yarn feed fingers 52, 53, 54 which push rods are controlled by a conventional main pattern drum 56 having conventional cams thereon, among other special cams to be later described, for controlling the various operating parts of the knitting machine. Only the cams on the main pattern drum 56 which are instrumental in controlling the improved auxiliary stitch cam will be described later in this context.

Any one or more of the yarn feed fingers 52, 53, 54 may be used for feeding yarn to the needles or knitting the different parts of a stocking or other tubular fabric and during the knitting of the elastic portion or top of a stocking, it is preferable that two body yarns are fed under minimum or relatively low tension, to the needles and, therefore, the two yarn feed fingers 52, 53 are shown in lowered or operative position in Figure 9 from which respective body yarns B, B′ pass and are fed to the needles. The other yarn feed finger 54 may be used for feeding a reinforcing yarn R (Figure 1) to the needles when desired, such as in knitting a reinforced heel or a reinforced toe in a stocking. An improved means is provided for controlling the tension in the main body yarns B, B′ which will be later described.

The machine is also equipped with a conventional elastic or rubber yarn feed comprising an arm or lever 60 pivoted on the shaft 44 and to the rear end of which the upper end of a thrust rod or control rod 61 is pivotally connected. The lower end of the thrust rod or control rod 61 bears against the upper surface of the main pattern drum 56 or suitable cams thereon. The front or free end of the arm or lever 60 has a downwardly extending elastic yarn feed finger 62 fixed thereon through which an elastic strand or yarn E passes from a suitable source, not shown.

Referring to Figures 2 and 9, it will be observed that the machine is provided with conventional needle control cams and stitch forming cams, the stitch forming cams including a top center cam 65 spaced below the throat plate and conventional primary left-hand and right-hand stitch cams 66, 67. The stitch cams 66, 67 are suitably secured to the inner surfaces of respective stitch cam supporting plates 70, 71, suitably secured to the upper surface of the flange of a conventional cam cylinder 72 carried by the bed plate 31.

It should be noted that the cam cylinder 72 is cut away to provide an opening in which the lower portions of the conventional stitch cams 66, 67 are disposed and, also mounted in the latter opening is a pair of upwardly diverging needle raising cams 73, 74 of conventional construction, which cams 73, 74 are provided with respective inclined upper surfaces 75, 76 for raising any needles which are lowered by the conventional stitch cams 66, 67. In order to accommodate the improved auxiliary stitch cam as it pulls the needles down to abnormally low position, as compared to the normal position to which they are moved by the conventional stitch cam 66, the inclined upper surface 75 of the needle raising cam 73 is cut away to form a notch 77 therein.

It should also be noted that the uppermost portions of the needle raising cams 73, 74 are disposed on a substantially higher level than the upper surface or ledge of the cam cylinder 72, which ledge is indicated at 72*a*. Of course, the remote portions of the needle raising cams 73, 74 are inclined downwardly to meet the ledge 72*a*.

As the needles N move from right to left after being raised by the left-hand needle raising cam 73 in Figure 9, they are lowered by a conventional switch cam 78 (Figure 2) into engagement with the ledge 72*a* so the needles are disposed in the position shown in the extreme right-hand portion of Figure 9.

Thus, in order to lay the elastic yarn E in front of or outside of alternate needles and in back of or inside of the needles between said alternate needles, the jacks J disposed beneath alternate needles engage and are elevated by a conventional jack advancing cam 80 which is positioned in an opening 81 formed in the cam cylinder 72. The uppermost portion of the jack advancing cam 80 is positioned immediately in advance of the elastic yarn feed finger 62 so that the hooks of alternate needles elevated by corresponding jacks J, are raised above the eye of the elastic yarn feed finger 62 to take the yarn E therefrom. Thus, the alternate needles pass upwardly inside of the elastic yarn E which is, in other words, deposited on the front of or outside of the needles.

The sinkers 35 are in advanced position at the elastic yarn feeding finger 62 and since the eye of the finger 62 is above the level of the nibs 37 of the sinkers 35, the elastic yarn is initially drawn above the nibs 37 as the needles move from the yarn feed finger 62 to the body yarn feed station 50. Immediately after each successive needle moves past the elastic yarn feed finger 62, the intervening needles between said alternate needles, that is, the needles which do not have any jacks therebeneath, move upwardly in engagement with the inclined right-hand surface of the right-hand needle raising cam 74 in Figure 9 and, in so doing, the upper ends of the needles move upwardly on the outside of the elastic yarn E then extending between, and held in the hooks of, the previously raised alternate needles. Thus, the elastic yarn is deposited in front of alternate needles and in back of the other needles.

In order to assist in holding down the stitches carried by the needles, and to insure that the latches of the needles are fully opened immediately after the needles pass the elastic yarn feed finger 62, a rotary first latch opener 82 is provided (Figures 1 and 9) which is in the form of a relatively thin brush wheel provided with radial tufts which project into the path of the needles moving thereby immediately beneath the lower edge of the latch ring 42 and above the upper edges of the sinkers 35. The brush wheel or latch opener 82 preferably projects at an angle to the

knitting axis and is rotatably mounted on a pin 83 carried by a bracket 84 suitably secured to the latch ring 42. Although the use of brush wheel types of latch openers is well known in the art, the provision of this type of latch opener immediately subsequent to the point at which elastic yarns are fed to the needles, for opening the latches on the needles between the alternate needles as they are elevated, is believed to be new in the art.

It will be noted that, after the needles have been elevated by the right-hand inclined surface of the right-hand needle elevating or raising cam 74, they are further elevated by the right-hand stitch cam 67 to where the latches thereof pass above the elastic yarn E.

In order to insure that the previously knitted fabric is held downwardly against the body portions 36 of the sinkers 35 during raising of the needles relative thereto, there is provided an improved fabric hold-down element shown in the form of a disk 85 whose lower surface is provided with an annular shallow depression 86 which overlies the body portions 36 of the sinkers 35 when the latter are in their innermost positions, thus holding the fabric downwardly against the body portions 36 of the sinkers 35. The periphery of the hold-down disk 85 is preferably relatively sharp and provided with an inwardly curving surface 87 which curves upwardly and inwardly toward the center of the upper surface of the disk 85, as at 87. The disk 85 may serve as means for supporting the usual cutting and clamping mechanisms although, in this instance, the disk 85 has a plate 90 suitably secured to the upper surface thereof on which the conventional cutting and clamping mechanisms are mounted. Since the clamping and cutting mechanisms are well known in the art, a further description and illustration thereof is deemed unnecessary. It might be stated, however, that the disk 85 and plate 90 are fixed to an arm 91 which projects forwardly and is suitably secured to the upper surface of the latch ring 42 (Figure 1).

It is apparent that, after the needles are elevated by the right-hand stitch cam 67, the sinkers 35 are moved outwardly momentarily by the sinker retracting cam portion 34*b* (Figure 2–A) as the needles take the body yarn from any of the body yarn feed fingers which happen to be in lowered position, such as the fingers 52 and 53, in this instance. After the butts 41 of the sinkers 35 move past cam portion 34*b* they are advanced in the usual manner as the needles are lowered by the left-hand stitch cam 66.

In so doing, the new stitches are drawn over the body portions 36 of the sinkers 35 and are then drawn through the old stitches to form new stitches of normal length. Of course, during the formation of stitches of normal length, the elastic yarn is not laid in, since it is desirable that the elastic yarn E be laid in only during the formation of elongated stitches which are formed by means to be later described.

After the stitches have been drawn over the sinkers, with movement of the butts of the needles beneath the conventional left-hand stitch cam 66, the needles are then elevated through engagement with the surface 75 of the left-hand needle raising cam 73 in Figure 9, in the course of which the fabric is held down by the hold-down element or disk 85 (Figure 4). In order to insure that the latches on the needles are fully opened as the needles are elevated by the left-hand needle raising cam 73, there is also provided a rotary brush latch opener 94 (Figures 1, 4 and 9) of the same type as the rotary brush latch opener 82. As shown in Figure 4, the rotary brush latch opener 94 is rotatably mounted on a shoulder screw or pin 95 fixed in a substantially C-shaped bracket 96 which extends outwardly and then curves upwardly and then extends inwardly and its upper inner portion is fixed to the upper surface of the latch ring 42. It will be noted in Figure 4 that the rotary brush latch opener 94 is disposed at an angle to the knitting axis so the brush 94 contacts the needles at a point immediately above the nibs 37 of the sinkers 35 to thereby insure that the latches are opened as the hooks of the needles pass upwardly beyond the lower edge of the latch ring 42.

Now, whenever the elastic yarn E is fed to the needles in the manner heretofore described, it is desirable that elongated stitches or loops are formed from the body yarns B, B′ in order to knit a very flexible fabric which can be stretched to a much greater extent than in the conventional fabric where the elastic yarn is laid in and conventional knitting takes place. Therefore, there is provided a pattern controlled auxiliary stitch cam 100 which projects inwardly beneath the primary left-hand stitch cam 66 and forms an extension to the lower portion of the primary left-hand stitch cam 66 so that, after the butts of the needles have been lowered by the primary stitch cam 66, they then engage the auxiliary stitch cam 100 and are further lowered to a substantially lower than normal position. In order to permit the needles to be lowered by the auxiliary stitch cam 100, the notch 77 is provided in the upper surface of the left-hand needle raising cam 73 and into which notch the butts of the needles pass as they are lowered by the auxiliary stitch cam 100. Thereafter, those needles that have been lowered by the auxiliary stitch cam 100 are elevated in the conventional manner as they ride up the inclined surface 75 of the left-hand needle raising cam 73.

In order to insure that the auxiliary stitch cam 100 is properly positioned when moved into operative position by means to be later described, the outer surface of the primary left-hand stitch cam 66 is provided with a groove 101 therein in which a recessed upper portion 102 of the auxiliary stitch cam 100 fits when the auxiliary stitch cam 100 is in operative position. The auxiliary stitch cam 100 extends outwardly and slidably penetrates an angularly disposed slot 103 provided in the stitch cam support 70 and the outer end of the shank of the auxiliary stitch cam 100 is suitably secured to an angularly formed portion 104 of an arm 105 (Figures 2, 3 and 8).

The arm 105 extends outwardly and is pivoted, as at 106, on the bed plate 31 (Figures 1 and 3). The auxiliary stitch cam 100 is normally urged into operative position, with its surface 102 against the wall of the groove 101 by means of a spring 107 which is shown in the form of a tension spring in Figure 3. One end of a link 110 is pivotally or universally connected to the arm 105, as at 111, and this link extends outwardly and slidably penetrates a block 112 and has an abutment, in the form of nuts 113, on the outer end thereof which is normally urged into engagement with the block 112 by the spring 107.

The block 112 extends laterally from the lower end of one arm of a bell crank 115 pivotally mounted on the shaft 44 (Figures 1, 2 and 3) and the other arm of the bell crank 115, which arm extends rearwardly from the shaft 44, has the upper end of a thrust rod or control rod 116 pivotally connected thereto which extends downwardly and rides upon the periphery of the main pattern drum 56 or corresponding cams 117. It is thus seen that radial inward and outward movement of the auxiliary stitch cam 100 is controlled by the main pattern drum 56.

As is usually the case, substantially half of the needles N have long butts and the others have short butts for the purpose of knitting the heel and toe of a stocking. Accordingly, the auxiliary stitch cam 100 first moves partially into operative position against the short butts and subsequently snaps into fully operative position beneath the long butts on the needles.

It is apparent that the elastic yarn E, when fed to the needles N (Figures 9), lies above the nibs 37 of the sinkers 35 until the sinkers are withdrawn by the cam portion 34*b* (Figure 2) adjacent the throat plate 51. As new body yarn loops are subsequently drawn over the elastic yarn E, over the body portions 36 of the then advanced sinkers 35 and through the old body yarn loops, the

elastic yarn E is pulled down against or in close proximity to the upper edges of the body portions 36 of the sinkers as the needles move below the elastic yarn E. Of course, as the sinkers 35 are advanced above the stitch cam 66, the body yarns B, B' and the elastic yarn E are caught beneath the nibs 37 of the sinkers 35.

In order to maintain the body yarn B, B' under tension during ordinary knitting, that is, while the auxiliary stitch cam 100 is withdrawn from operative position, and in order to automatically relax the tension in the body yarn B, B' when the elongated loops are formed and the auxiliary stitch cam 100 is in operative position, there is provided an improved pattern controlled tension mechanism broadly designated at 125 (Figures 5 and 6) which comprises a pair of spaced hollow cup-like blocks 126, 126' which are disposed on a substantially horizontal axis and whose proximal ends are fixed to the upper portion of a substantially Z-shaped bracket 127. The bracket 127 extends downwardly and is suitably secured to another bracket 130 which extends outwardly and is fixed on a conventional post 131 carried by the frame 30 of the knitting machine (Figures 1, 2 and 5).

The open outer ends of the blocks 126, 126' are engaged by respective tension disks 132, 132' which are, in turn, engaged by respective outer tension disks 133, 133'. The tension disks 132, 133 and 132', 133' are each mounted on an enlarged medial portion 134 of a shaft 135. The reduced proximal ends of the shafts 135 loosely penetrate the corresponding ends of the cup-like blocks 126, 126' and each is secured to the corresponding block 126 or 126' by a nut 136 (Figure 6). The outer tension disks 133, 133' are urged toward the respective inner tension disks 132, 132' by respective compression springs 137, 137' which surround the outer portions of the corresponding shafts 135.

The shafts 135 have suitable abutments 140 thereon which are engaged by the outer ends of the corresponding springs 137, 137'. The abutments 140 are shown in the form of adjustable nuts for the purpose of adjusting the pressure exerted on the outer tension disks 133, 133' by the respective springs 137, 137'. It will be observed in Figure 6 that the enlarged portion 134 of each of the shafts 135 has an opening 142 therethrough which is disposed in alinement with the juncture of the corresponding disks 132, 133 and 132', 133'. The body yarns B, B' pass from a suitable source, not shown, and thence through the corresponding openings 142 in the enlarged portions 134 of the shafts 135 and, in so doing, the body yarns B, B' pass between the proximal faces of the respective disks 132, 133 and 132', 133'.

The body yarns B, B' pass from the tension device 125 through a suitable guide 143 (Figure 2) to the respective yarn feed fingers 52, 53 and, thus, the body yarns B, B' are normally maintained under proper tension during ordinary knitting. However, during the knitting of the elastic portion of a stocking or other tubular fabric, the tension in the yarns B, B' is released by means of a pair of fingers 144, 144' which are parts of a fork-like member and which extend forwardly and then converge inwardly and are connected to the upper end of a thrust rod or control rod 146. The upper portion of the control rod 146 is guided for vertical movement in the bracket 130 and it will be observed in Figure 2 that the lower portion or end of the control rod 146 is fixed to an arm 147 extending upwardly at an angle from a cam lever or arm 150. The free end or toe of the cam lever 150 alternately engages the periphery of the main pattern drum 56 and a cam or cams 151 carried by the main pattern drum 56 (Figures 1 and 2).

The cam lever 150 extends rearwardly and is pivotally mounted on a shaft 152 fixed in a bracket 153 which extends upwardly and then forwardly and is fixed on the lower end of the post 131 heretofore described. It will be observed in Figure 2 that the post 131 penetrates the upper portion of the frame 30 so the lower end of the post 131 is exposed for supporting the bracket 153.

Now, during ordinary knitting, that is, during the periods in which loops of ordinary length are formed and during which the auxiliary stitch cam 100 occupies an inoperative position, the toe of the cam lever 150 rests against the periphery of the main pattern drum 56 and tension in the body yarns B, B' is maintained. However, during the feeding of the elastic yarn E to the needles in the manner heretofore described, the auxiliary stitch cam 100 is moved into operative position and, at this time, one of the cams or the cam 151 moves into engagement with the toe portion of the cam lever 150 thereby raising the same along with the control rod 146 and the fingers 140, 140'. It will be observed in Figures 5 and 6 that the fingers 140, 140' are disposed in the vertical planes of the respective sets of the disks 132, 133 and 132' and 133' so that, as they are moved upwardly, they pass between the lower portions of the respective sets of disks 132, 133 and 132', 133', thus moving the outer disks 133, 133' away from the inner disks 132, 132' as shown in Figure 6. It is apparent that this relieves the tension on the respective yarns B, B' so that, not only are the relatively long stitches formed as the auxiliary stitch cam 100 moves into operative position, but the stitches are also relatively loose as compared to the stitches formed during ordinary knitting.

It is thus seen that I have provided simple and efficient attachments which may be readily attached to existing knitting machines without materially changing any of the parts of the knitting machine and which will produce elastic fabric having elongated stitches formed from body yarn with elastic yarn laid in the fabric knitted from the body yarn to produce a mock-ribbed effect in the fabric and wherein it is unnecessary to make any changes whatsoever in the cams in the sinker head for controlling the sinkers, since the sinkers are controlled in a conventional manner and are merely withdrawn in the usual manner at the body yarn feed station 50 as the body yarns B, B' are fed to the needles.

In the drawings and specification there has been set forth a preferred embodiment of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only, and not for purposes of limitation, the scope of the invention being defined in the claims.

I claim:

1. In a knitting machine having a circular series of independent needles, a set of stitch cams and means for feeding yarn to the needles; in combination, an auxiliary stitch cam, and means for moving the auxiliary stitch cam into position below at least one of the stitch cams in said set to thereby form an extension to said one of the stitch cams whereby the needles are lowered to a substantially lower level than that to which they are lowered when the auxiliary stitch cam is in withdrawn position to thereby form elongated loops with the needles when the auxiliary stitch cam is in operative position.

2. In a knitting machine having a circular series of independent needles, a set of stitch cams and means for feeding yarn to the needles; the combination of an auxiliary stitch cam, and pattern controlled means for moving the auxiliary stitch cam into position below at least one of the stitch cams in said set to thereby form an extension to said one of the stitch cams whereby the needles are lowered to a substantially lower level than that to which they are lowered when the auxiliary stitch cam is in withdrawn position to thereby form elongated loops with the needles when the auxiliary stitch cam is in operative position.

3. In a circular knitting machine having a cylinder provided with a plurality of vertically movable needles, a yarn feeding station for feeding inelastic yarn to the needles, at least one primary stitch cam for lowering the needles after they have taken said yarn at the yarn

feeding station and sinkers having body portions over which the loops are drawn as the needles are lowered; the combination of an auxiliary stitch cam movable into and out of operative position relative to the primary stitch cam, and said auxiliary stitch cam being so arranged as to form an extension to the lower portion of the primary stitch cam when the auxiliary stitch cam occupies operative position to thereby lower the needles to a substantially lower than normal level in the drawing of stitches of substantially greater than normal length over the body portions of the sinkers.

4. In a circular knitting machine having a cylinder provided with a plurality of vertically movable needles, a yarn feeding station for feeding body yarn to the needles, means in advance of said station for feeding elastic yarn to some of the needles, at least one primary stitch cam for lowering the needles after they have been raised to take said body yarn at the yarn feeding station and sinkers having body portions over which loops are drawn as the needles are lowered; the combination of an auxiliary stitch cam movable into and out of operative position relative to the primary stitch cam and said auxiliary stitch cam being so arranged as to form an extension to the lower portion of the primary stitch cam when the auxiliary stitch cam occupies operative position to thereby lower the needles to a substantially lower than normal level in the drawing of stitches of substantially greater than normal length over the body portions of the sinkers.

5. In a circular knitting machine having a cylinder provided with a plurality of vertically movable needles, a yarn feeding station for feeding body yarn to the needles, means in advance of said station for feeding elastic yarn to some of the needles, at least one primary stitch cam for lowering the needles after they have been raised to take said body yarn at the yarn feeding station and sinkers having body portions over which loops are drawn as the needles are lowered; the combination of an auxiliary stitch cam movable into and out of operative position relative to the primary stitch cam, said auxiliary stitch cam being so arranged as to form an extension to the lower portion of the primary stitch cam when the auxiliary stitch cam occupies operative position to thereby lower the needles to a substantially lower than normal level in the drawing of stitches of substantially greater than normal length over the body portions of the sinkers, and a shield disposed closely above the body portions of the sinkers to hold down the fabric as the needles are raised.

6. In a circular knitting machine having a cylinder provided with a plurality of vertically movable needles, a yarn feeding station for feeding yarn to the needles, at least one primary stitch cam for lowering the needles after they have taken said yarn at the yarn feeding station and sinkers having body portions over which the loops are drawn as the needles are lowered; the combination of an auxiliary stitch cam movable into and out of operative position relative to the primary stitch cam, said auxiliary stitch cam being so arranged as to form an extension to the lower portion of the primary stitch cam when the auxiliary stitch cam occupies operative position to thereby lower the needles to a substantially lower than normal level in drawing stitches of substantially greater than normal length over the body portions of the sinkers, at least one pair of tension disks between which the yarn passes in its course to the feeding station, resilient means normally urging the tension disks toward each other, and a pattern controlled finger movable between said disks for relieving the tension in said yarn when the auxiliary stitch cam occupies operative position.

7. In a circular knitting machine having a cylinder provided with a plurality of vertically movable needles, a plurality of body yarn feed fingers for feeding body yarns to the needles, a plurality of radially movable sinkers disposed between the needles, means for feeding an elastic strand to the needles at a point in advance of the body yarn feed fingers, means for raising alternate needles prior to the point where the elastic strand is fed to cause the hooks of the raised needles to take the elastic strand, means for raising intervening needles so they are disposed outwardly of said strand and so all the needles are elevated to take the body yarns in the hooks thereof, means for moving the sinkers outwardly as the needles take the body yarns from said fingers, means for advancing the sinkers inwardly so the body portions of the sinkers appear between the needles whereby all the body yarns fed by the yarn feed fingers are deposited on top of the body portions of the sinkers and remain in this position while he needles are lowered, and means for lowering the needles to an abnormally low level as compared to the level to which they are normally lowered during ordinary knitting to produce very elongated loops with the elastic strand laid in front of alternate loops and in back of the others.

8. In a circular knitting machine having a cylinder provided with a plurality of vertically movable needles, a throat plate provided with a plurality of yarn feed fingers for feeding body yarns to the needles, a plurality of radially movable sinkers disposed between the needles, means for feeding an elastic strand to the needles at a point in advance of the throat plate, means for raising some of the needles prior to the point at which the elastic strand is fed to cause the hooks of the raised needles to take the elastic strand while the sinkers are in advanced position whereby the elastic strand is deposited above the nibs of the sinkers while all of the needles are raised upwardly in advance of the throat plate, means for moving the sinkers outwardly as the needles take body yarns at the throat plate, means for advancing the sinkers inwardly so the body portions of the sinkers appear between the needles whereby all the body yarns fed by the yarn feed fingers at the throat plate are deposited on top of the body portions of the sinkers and remain in this position while the needles are lowered; the combination of means for lowering the needles to an abnormally low level as compared to the level to which they are normally lowered during ordinary knitting to produce very elongated loops with the elastic strand laid in front of some of the loops and in back of others, and means for varying the tension in the body yarns so that the body yarns are under tension during ordinary knitting and so they are released from tension during the formation of elongated loops.

9. That method of kitting a tubular fabric on an independent needle circular knitting machine having sinkers, each provided with an inwardly projecting body portion and an uprising nib thereon, which comprises raising the needles and feeding at least one body yarn to the needles, then lowering the needles to a normal level as the sinkers are moved inwardly to cause the needles to draw stitches of normal length over the body portions of the sinkers in knitting successive courses in a portion of said tubular fabric, knitting other portions of said tubular fabric by feeding an elastic strand to at least some of the needles at a point substantially in advance of the station at which the body yarn is fed to the needles while the sinkers are in advanced position to deposit the elastic strand above the nibs thereof, then again feeding body yarn to the needles while withdrawing the sinkers, and then lowering the needles to a substantially lower level than that to which they are moved during the forming of stitches of normal length as the sinkers are moved inwardly immediately after moving past the station at which the body yarn is fed to thereby draw stitches of relatively greater than normal length over the body portions of the sinkers.

10. That method of knitting a stocking on a circular independent needle knitting machine of the type having means for lowering needles to a normal level for drawing stitches of normal length therewith after they have taken a body yarn in the hooks thereof, said method including feeding an elastic strand to alternate needles above the level of the nibs of the sinkers to cause the

strand to be engaged by the hooks of the latter needles, then raising the intervening needles disposed between the needles which had previously taken the elastic strand to cause the elastic strand to be deposited on the backs of the intervening needles, then moving the sinkers outwardly while feeding at least one body yarn to all the needles, then advancing the sinkers inwardly as the needles are lowered to a position substantially lower than said normal level to cause the needles to draw relatively elongated loops from the body yarn over the body portions of the sinkers as the sinkers are moved inwardly and to cause the needles to shed the body yarn loops previously formed.

11. That method of knitting a stocking on a circular independent needle knitting machine which comprises raising some of the needles and leaving intervening needles lowered, feeding an elastic strand above the nibs of the sinkers to the raised needles to cause the strand to be engaged by the hooks of the raised needles, then raising all of the needles disposed between the inwardly advanced sinkers to cause the elastic strand to be deposited on the backs of the intervening needles whose hooks do not engage the elastic strand while the latches of said some of the needles pass above said strand, then withdrawing the sinkers outwardly while feeding at least one body yarn to the needles at the point where the sinkers are moved outwardly, then advancing the sinkers inwardly, as they pass through the knitting wave, a distance sufficient only to form loops on the body portions of the sinkers, and lowering all the needles to an abnormally low position as compared to the position to which they are lowered during ordinary knitting to form elongated stitches from the body yarn over the body portions of the sinkers while the elastic strand is confined below the nibs of the sinkers and to cause the needles to shed the previous body yarn loops and the elastic strand.

12. That method of knitting a stocking on a circular independent needle knitting machine which comprises raising alternate needles and leaving intervening needles lowered, feeding an elastic strand to the raised needles to cause the strand to be engaged by the hooks of the raised needles while the sinkers are in advanced position, then raising all of the needles disposed between the inwardly advanced sinkers to cause the elastic strand to be deposited on the backs of the alternate needles, then withdrawing the sinkers outwardly while feeding at least one body yarn at the point where the sinkers are moved outwardly, then advancing the sinkers inwardly, as they pass through the knitting wave, a distance sufficient only to form loops from the body yarn on the body portions of the sinkers, and lowering all the needles to an abnormally low position as compared to the position to which they are lowered during ordinary knitting to form elongated stitches from the body yarn over the body portions of the sinkers while the elastic strand is confined below the nibs of the sinkers and to cause the needles to shed the previous body yarn loops.

13. That method of knitting a stocking on a circular independent needle knitting machine of the type having means for lowering needles to a normal level for drawing stitches of normal length therewith over the body portions of the sinkers after the needles have taken a body yarn in the hooks thereof, said method including feeding an elastic strand to alternate needles to cause the same to be engaged by the hooks of the alternate needles, then raising the intervening needles disposed between the alternate needles to cause the elastic strand to be deposited on the backs of the intervening needles then moving the sinkers outwardly while feeding a body yarn at the point where the sinkers are moved outwardly, then advancing the sinkers inwardly as the needles are lowered to a position substantially lower than said normal level to cause the needles to draw relatively elongated loops from the body yarn over the body portions of the sinkers as the sinkers are moved inwardly and to cause the needles to shed the body yarn loops previously formed.

14. That method of knitting a circular knit stocking on a circular knitting machine having sinkers provided with body portions and nibs on the medial portions thereof, said method comprising raising some of the needles, then feeding an elastic strand to the raised needles while the sinkers are in inward position, then raising the remaining needles and said some of the needles to cause the elastic strand to be disposed on the inside of those needles whose hooks do not engage the elastic strand, and to cause the latches of said some of the needles to pass above said strand, then retracting the sinkers outwardly, then feeding body yarn to the needles at the throat plate, then advancing the sinkers inwardly immediately past the throat plate and through the knitting wave so the body yarns will be deposited on top of the body portions of the sinkers, but below the nibs of the sinkers, while lowering the needles to a substantially lower level than that to which they are normally lowered during ordinary knitting so the needles will knit the new course during the knitting wave while the elastic strand is held below the nibs of the sinkers, thus forming elongated loops on the body portions of the sinkers in the knitting wave and providing a stocking having an elastic strand laid in throughout the courses.

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