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METHOD OF AND MECHANISM FOR WIDENING FABRIC ON FLAT KNITTING MACHINES

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Fig. 1.

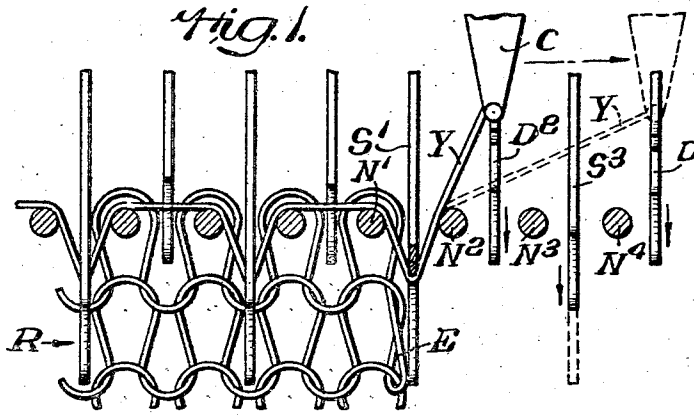


Fig. 2.

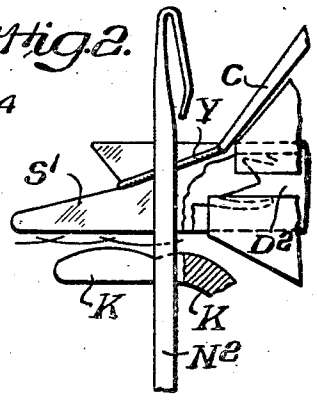


Fig. 3.

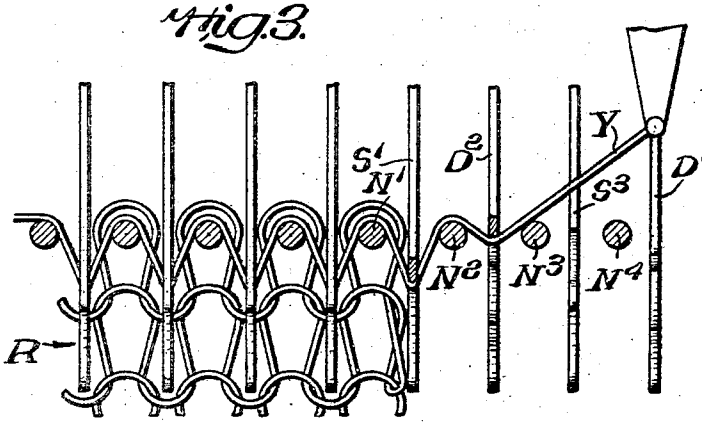


Fig. 4.

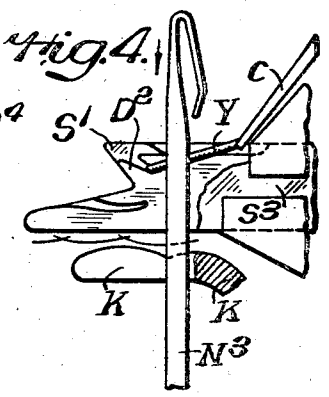


Fig. 5.

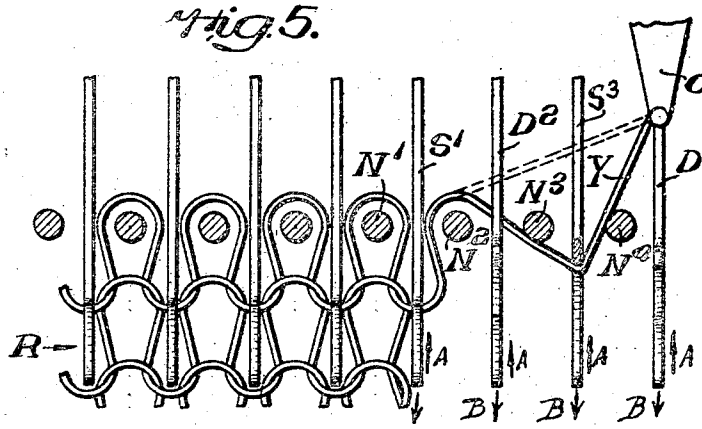
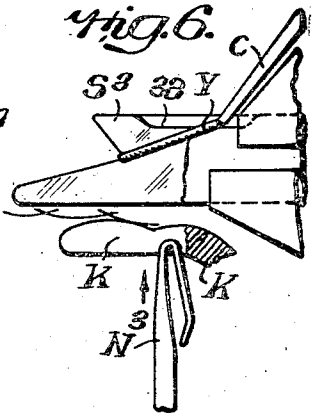


Fig. 6.



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METHOD OF AND MECHANISM FOR WIDENING FABRIC ON FLAT KNITTING MACHINES

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Fig. 7.

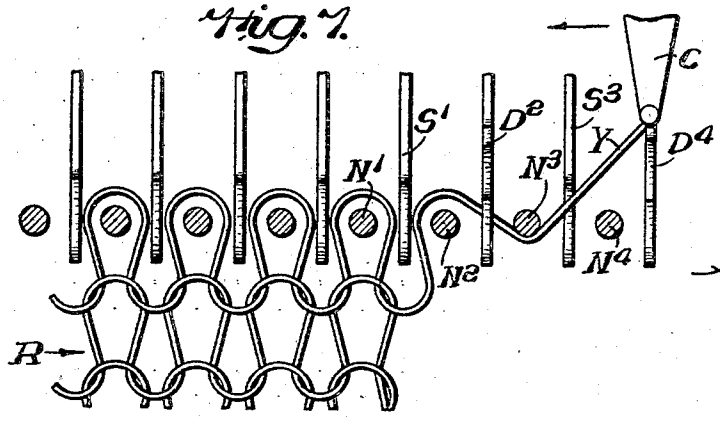


Fig. 8.

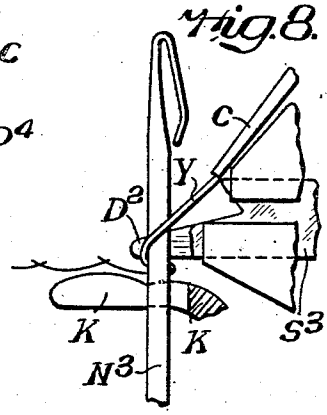


Fig. 9.

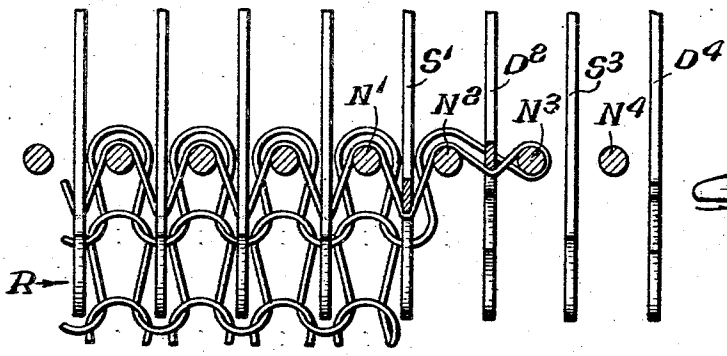


Fig. 10.

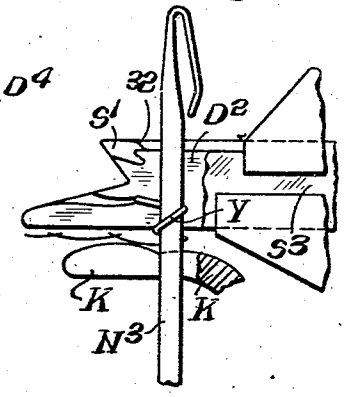


Fig. 11.

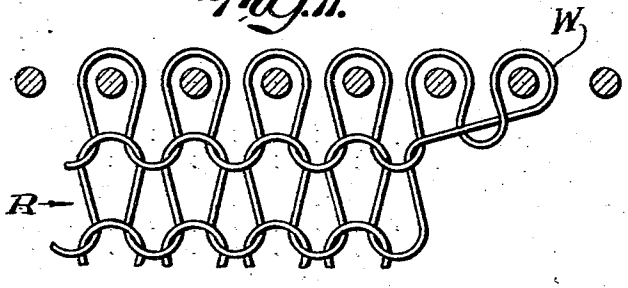


Fig. 13.

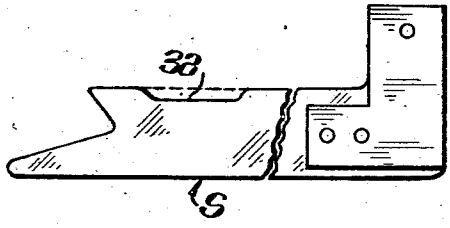
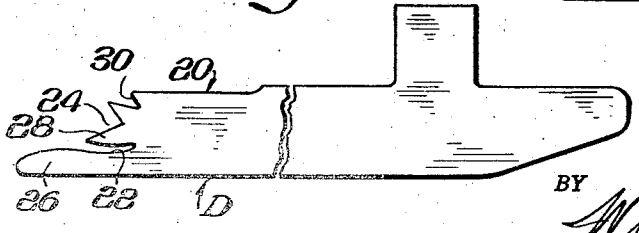


Fig. 12.



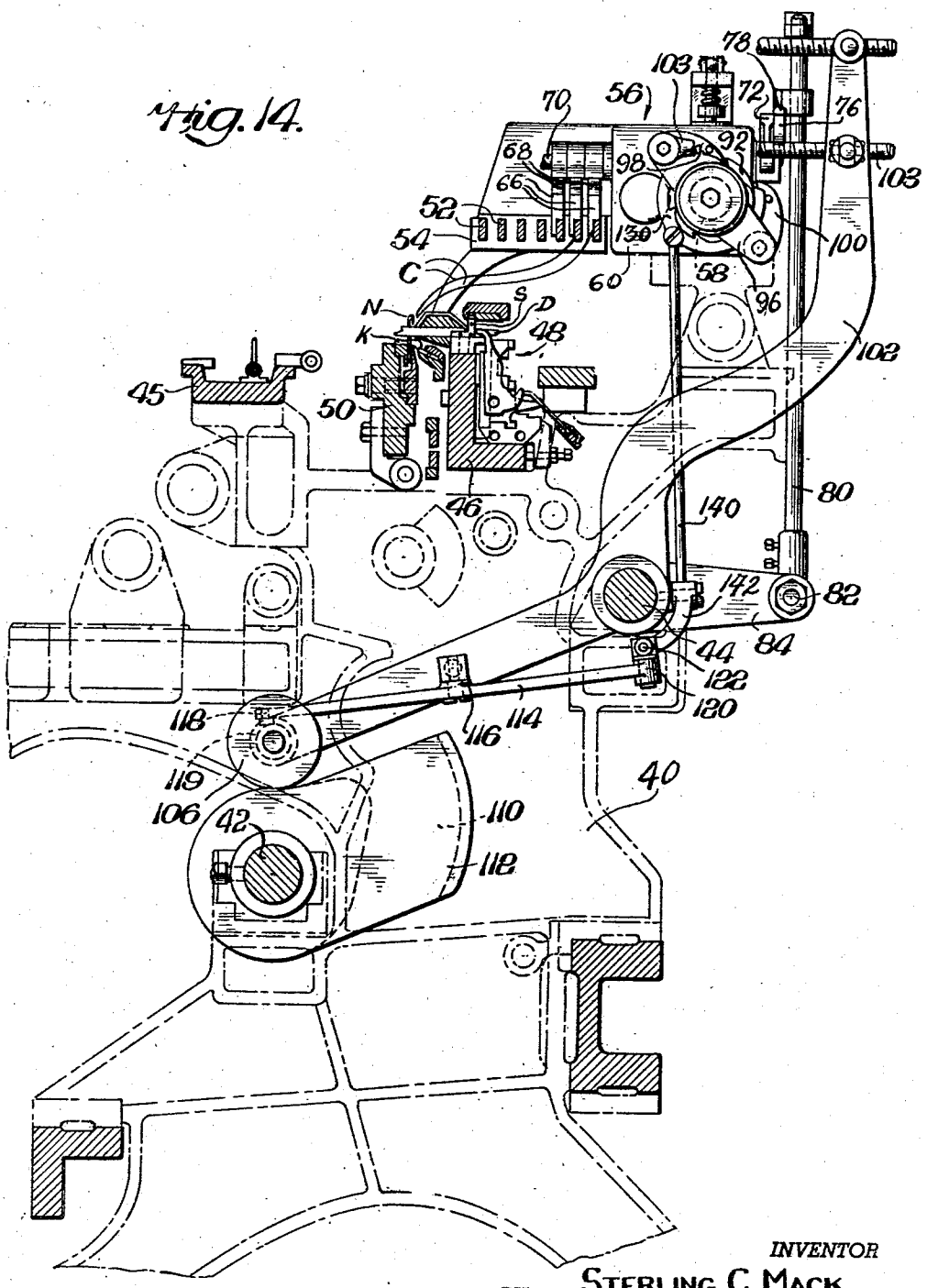
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Fig. 14.



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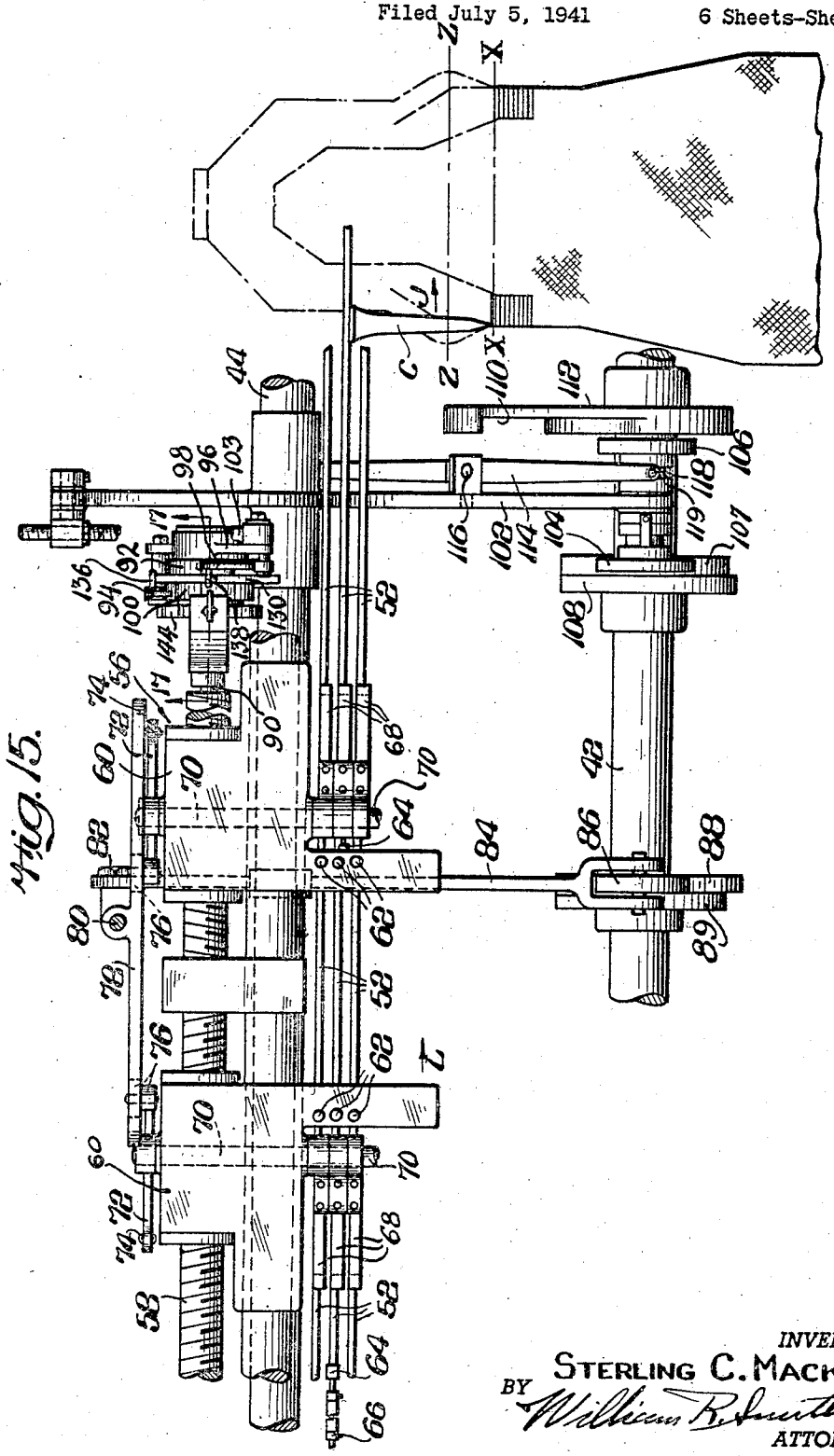


Fig. 15.

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Fig. 16.

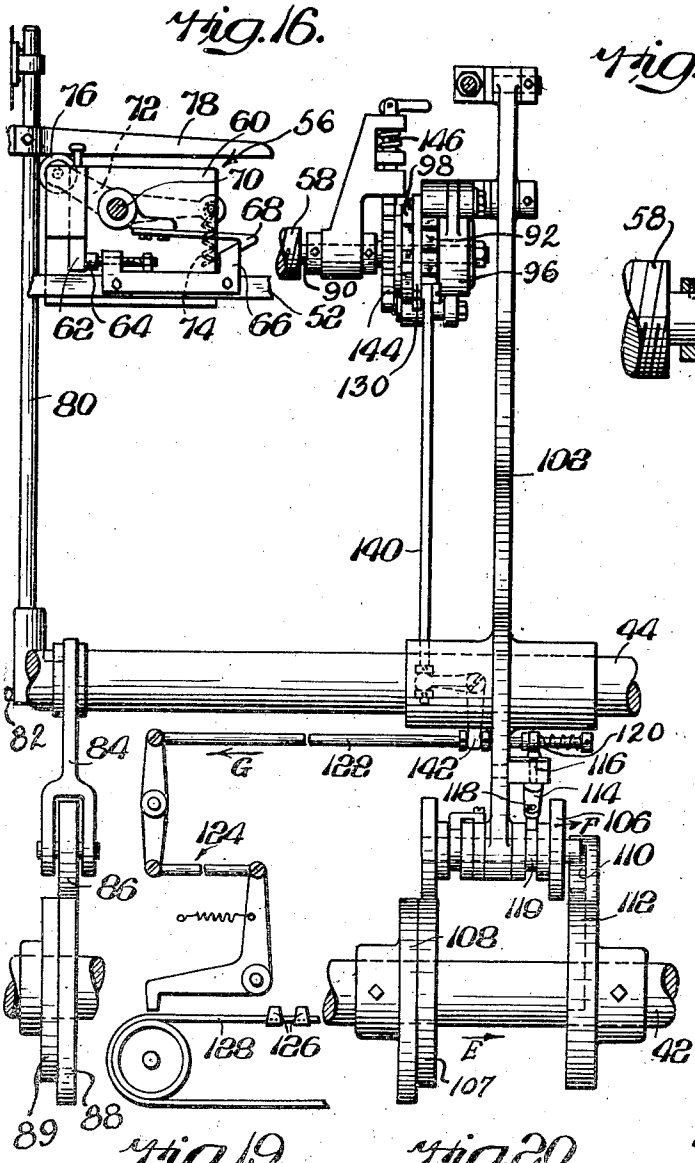


Fig. 17.

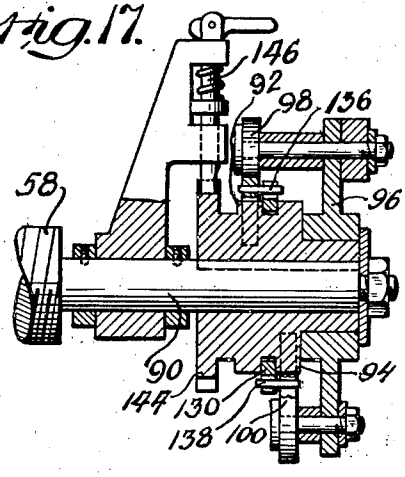


Fig. 18.

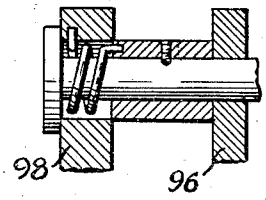


Fig. 19.

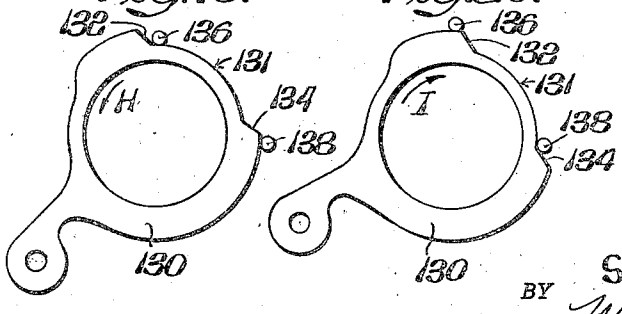
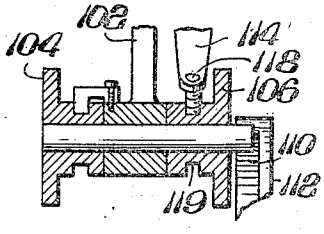


Fig. 20.

Fig. 21.



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METHOD OF AND MECHANISM FOR WIDENING FABRIC ON FLAT KNITTING MACHINES

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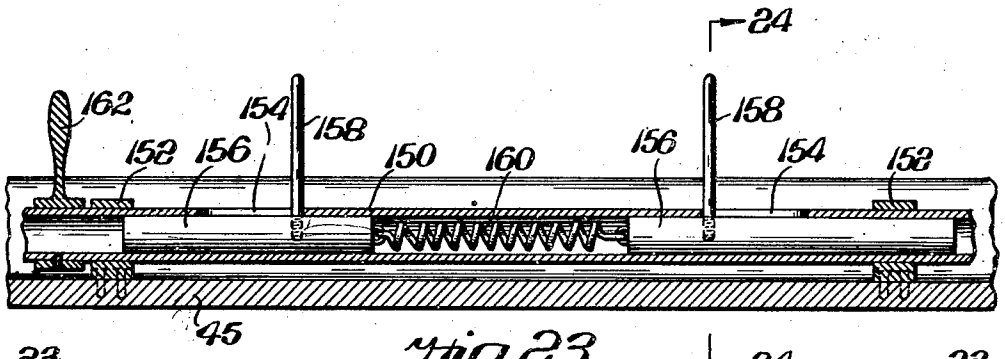


Fig. 23.

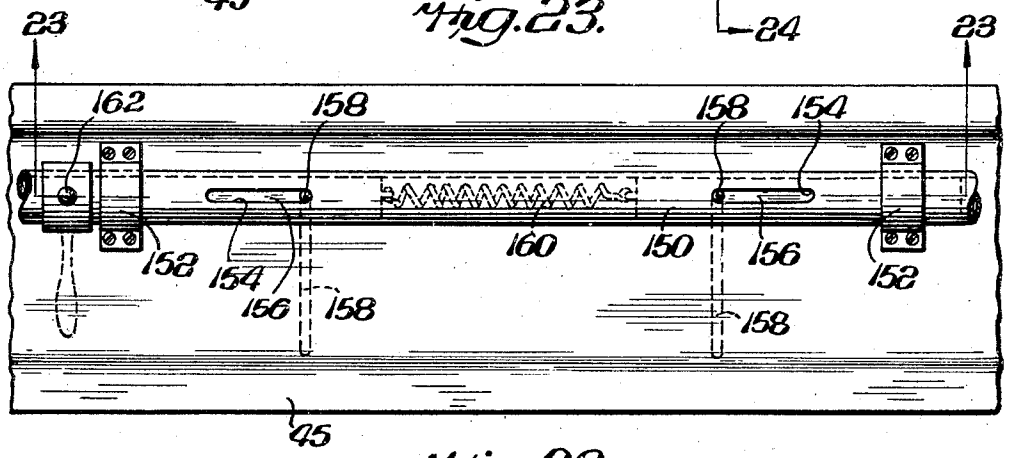


Fig. 22.

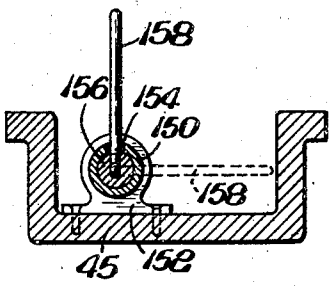


Fig. 24.

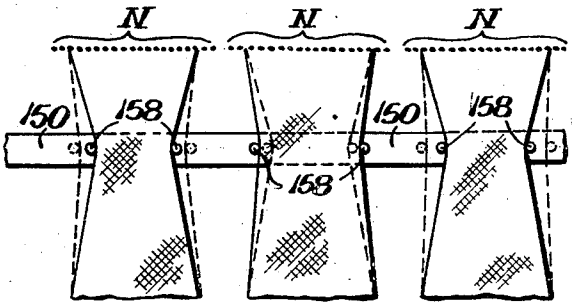


Fig. 25.

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Patented June 18, 1946 2,402,200

UNITED STATES PATENT OFFICE

2,402,200

METHOD OF AND MECHANISM FOR WIDENING FABRIC ON FLAT KNITTING MACHINES

Sterling C. Mack, Bangor, Pa., assignor to Julius Kayser & Co., Brooklyn, N. Y.

Application July 5, 1941, Serial No. 401,112

29 Claims. (Cl. 66—89)

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The present invention generally relates to the art of widening fabrics on flat knitting machines and, more particularly, pertains to the formation of widened portions, especially heel portions, of full-fashioned hosiery knitted in one operation on a single machine.

The invention is particularly concerned with that type of widening wherein loops are added onto the ends of courses, for instance, as suggested in the patent to Woldemar Heinitz, No. 1,998,368, dated September 16, 1935, or in the patent to Benjamin F. Somers, No. 2,230,986, dated February 14, 1941, as distinguished from that type of widening wherein loops at the selvedge portions of the fabric are transferred outwardly.

In that type of widening with which the invention is concerned, great problems have arisen due to the difficulties of forming good selvedge edges in the widened areas of the fabric. For example, in the patent to Heinitz aforesaid, attempts are made to solve the problem of a loose selvedge by not sinking yarn to the penultimate needle, which is then pressed off of normal position bringing the yarn on the beard side of this needle. The system, however, as evidenced by the disclosure of the patent, requires much complicated mechanism and, therefore, is highly impractical from a commercial standpoint.

As to the Somers patent hereinbefore identified, the method disclosed therein for effecting the widening of the fabric essentially resides in feeding yarn to the added needle, then permitting the yarn to be dropped from this needle on the return stroke of the carrier, and then expecting the needle on the way up to reengage the yarn to form the basis of a loop. Such a method, obviously, is not positive, since it merely depends on chance and, therefore, even under ideal conditions, the method is not suitable for the production of quality merchandise because it is common knowledge in the art that the chances of a needle failing to engage a drop loop yarn are far greater than the chances of a needle succeeding in engaging such a yarn unless the speed of the machine is slowed down to such a point that it becomes impossible to practice such a method on a competitive commercial basis.

It is, therefore, the primary purpose of the invention to provide an improved method of widening fabric on full-fashioned knitting machines, which method is positive throughout its entire performance without the necessity of burdening the knitting machine with complicated and intricate mechanism.

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It is also an important object of the invention to provide a method which may be performed by means of a simple attachment capable of being readily incorporated in ordinary full-fashioned knitting machines without necessitating any material changes therein and, further, without requiring detrimental changes in the relative actuation and timed function of the various knitting instrumentalities, such as the yarn carriers, the bearded needles, the sinkers, the dividers, and the knockover bits.

In order to fully and clearly understand the present invention, the association, actuation, and timed function of the various knitting instrumentalities and associated parts as they occur in the usual operation of an ordinary full-fashioned knitting machine must be borne in mind.

As is well known in the art, a sinker head contains a series of sinkers sometimes termed "jack sinkers" and "dividing sinkers" and sometimes termed "sinkers" and "dividers," and a series of knock-over bits which are so positioned that there is one knockover bit below and in the vertical plane of each sinker and divider, the needles are so disposed that one needle extends between every two adjacent knockover bits and between a sinker and an adjoining divider, and the carriers are so positioned that yarn is fed upon the nibs of the sinkers and dividers and to the front (that is, the bearded side) of the needle.

The yarn carriers and sinkers are actuated through the so-called Coulier motion, whereas the needles, dividers, and knockover bits are actuated through cams provided on the main cam shaft.

The Coulier motion includes a friction rod and a slur bar which are mounted to reciprocate in unison and in uniform strokes lengthwise of the knitting machine. The friction rod carries friction boxes connectable with the carriers to impart yarn feeding movements thereto, whereas the slur bar carries slur cocks engageable with jacks to actuate the same for successively and progressively advancing the jack sinkers.

Although the reciprocating strokes of the friction rod and slur bar are uniform, the reciprocating yarn laying strokes of the carriers are variably controlled by means of adjustable stops associated with the narrowing nuts of the carrier narrowing mechanism. The operation of the carrier narrowing mechanism is such that the carrier stops are adjusted to arrest the carriers always over the divider outside the needle next to the desired end needle so that the sinker between said end and additional needles may func-

tion to sink the yarn on the end needle for the formation of the selvedge loop.

While the carriers are arrested, the Coulier motion continues to the end of its stroke so that the slur cocks continue in their movement to advance all the sinkers and, for that purpose, the location of the slur cocks with respect to the sinker heads and end of the Couliering motion is such that, by the time the Couliering motion has reached the end of its stroke in either direction, the slur cocks have passed beyond the last sinkers in the sinker head.

The dividing sinkers or dividers are advanced in gang by means of catch bars which, at times, also act to engage and simultaneously move the jack sinkers and the dividing sinkers; the knockover bits are given a slight up and down motion by means of levers attached to the knockover shaft; and the needles receive movement in a general vertical direction, that is, at right angles to the sinkers, dividers, and knockover bits, by means of lever and link arrangements. The catch bars, the knockover bits motion imparting levers, and the needle movement imparting lever and link arrangements are controlled by appropriate cams on the main cam shaft, as hereinbefore stated. These cams, however, are so shaped and co-related that the movements of the various knitting instrumentalities and associated parts take place in a definite timed relationship. Thus, at the beginning of a course, the needles are in their uppermost position, the sinkers and dividers are in their innermost position and the knockover bits in their lowermost position. Thereupon, the Coulier motion, coming into operation, moves the carriers in one direction which lay the yarn in said direction in the manner hereinbefore specified. As the carriers move, the slur cocks follow at a short distance, thus successively advancing the sinkers and, accordingly, kinking the yarn between alternate needles.

When all the sinkers have been advanced, and before the Couliering starts in the opposite direction, the catch bars are caused to move forwardly, thus forcing the dividers to advance in unison and, accordingly, the yarn which has already been kinked between alternate needles now becomes kinked between each needle.

With the sinkers and dividers remaining in their advanced positions, the needles are caused to descend vertically so that the yarn kinked about the needle shanks becomes engaged within the needle beards to be drawn through the loops of a previously formed course, whereupon pressing off of the loops of said previously formed course takes place in the usual manner.

As is known, during the press-off, the sinkers and dividers are drawn back simultaneously by the catch bars while the knockover bits are being moved upwardly. In this manner, the newly sunk loops, due to the downward movement of the needles, are caused to slip off the nibs of the sinkers and dividers onto the knockover bits, whereupon the sinkers and dividers are advanced simultaneously by the catch bars, thereby holding the fabric in place as the subsequent raising of the needles takes place.

Following the press-off, and after the needles are returned to their uppermost position, the sinkers and dividers are withdrawn en masse to their innermost position by the catch bar, whereupon the laying of another course begins.

In accordance with the method of the present invention, when a widening course is to be made, the laying of the yarn is done in the ordinary manner, as above described, the carrier being arrested as usual over the divider outside the needle next to the ultimate knitting needle in operation while the sinkers beyond said needle are being advanced, but between the time when all the sinkers have been advanced and the time when the dividers are to be advanced, the carrier is displaced a distance of two needles passing over the extended sinker therebetween and coming to rest over the next succeeding divider so that, with the advance of the dividers, that divider over which the carrier was originally arrested engages the yarn and firmly holds the same against the needle between said divider and the immediately preceding sinker, whereupon in the subsequent operation of the knitting instrumentalities, there are formed a loop on said needle next to the original ultimate needle and a firm selvedge loop on the second added needle.

The invention will be understood more clearly from the accompanying drawings and detailed description based thereupon.

In these drawings:

Figures 1 to 11 inclusive illustrate in a more or less diagrammatic form the various stages of the fabric widening method of the invention;

Figure 12 is a side elevation illustrating the preferred construction of the dividers in the widening areas of a knitting head;

Figure 13 is a side elevation illustrating the preferred construction of the sinkers in the widening areas of a knitting head;

Figure 14 is a cross sectional view of a full-fashioned knitting machine having the mechanism of the present invention attached thereto;

Figure 15 is a top plan of parts thereof;

Figure 16 is a front elevation of a portion of the mechanism shown in Figure 15;

Figure 17 is an enlarged section taken on line 17—17 of Figure 15;

Figure 18 is an enlarged detail of one of the pawls for operating the carrier nut spindle;

Figure 19 is a detail illustrating the pawl control element in one of its positions;

Figure 20 is a view similar to Figure 19, but illustrating the pawl control element in another of its positions;

Figure 21 is a cross sectional detail of the cam controlling rollers;

Figure 22 is a top plan view of the hosiery blank tension device within one knitting section of the machine;

Figure 23 is a section taken on line 23—23 of Figure 22;

Figure 24 is a section taken on line 24—24 of Figure 23;

Figure 25 is a diagrammatic representation illustrating the function of the blank tensioning device in several knitting sections of the machine.

Referring more particularly to the drawings wherein like characters of reference will designate corresponding parts throughout, there is shown diagrammatically in Figures 1 to 11 inclusive certain needles of a needle bar and associated knitting elements. The end needle of the series on which the last fabric course before the knitting of a widening course takes place is designated at N1, whereas the first three needles in the widening area over which added loops of extended or widening courses are formed are indicated at N2, N3, and N4. Co-related with the needles in the order mentioned are sinker S1, divider D2, sinker S3 and divider D4, with each of which are associated the

knockover bits K. A carrier intended to feed yarn Y is designated at C.

It will be understood that in the laying of the yarn for the formation of a regular course, such as course R which immediately precedes a widening course, the carrier C is arrested over the divider D2 so that the sinker S1 may cooperate in forming the selvedge edge loop E.

In accordance with the present invention, as represented in Figures 1 and 2, as the widening operation commences, the carrier C is also arrested over the divider D2 and is held in that position until all the sinkers, including, of course, sinker S3, have reached their advanced position.

In the interval after the sinkers in the widening portion of the knitting head have been moved out, and before the dividers, including, of course, the dividers D2 and D4, are moved forward, the carrier C is displaced over a distance of two needles, that is, the carrier C passes over the needle N3, over the extended sinker S3, over the needle N4, and comes to rest over the divider D4 so that a portion of the yarn Y lies across the nib of the divider D2, as indicated in dotted lines in Figure 1.

The dividers are then advanced simultaneously to sink the yarn between each needle, thus forming the loops of the new course, as represented in Figure 3. In so doing, as illustrated in said Figure 3, and also in Figure 4, the divider D2 engages that portion of the yarn Y which was laid across the nib of the divider D2 by the movement of the carrier to its position over the divider D4 and thus firmly holds the yarn against the needle N2.

At this particular moment, the needles, in their usual sequence of movement, descend as indicated by the arrow in Figure 4, for the purpose of drawing the newly formed loops of the widening course being made through the previously formed loops of the preceding course R.

It will be understood that in this descending movement of the needles, the yarn held against the needle N2 becomes engaged within the beard thereof, but that the portion of the yarn passing over the needle N3 is not engaged thereby because of the angle at which said yarn portion is drawn.

As the needles continue to descend, the sinkers and dividers, as is customary for the press-off operation, are withdrawn en masse, as indicated by Arrow A, and then advanced en masse, as indicated by arrow B, for the purpose of holding down the newly drawn loops, while the needles are raised to their uppermost position. It is to be noted that the yarn being engaged within the beard of the needle N2 will be drawn downwardly as the needle descends and, accordingly, upon withdrawal and subsequent advance of the sinkers and dividers, said yarn is permitted to be caught under the divider D2 which places the portion of the yarn leading from the needle N2 to the carrier C at such an angular position (dotted line Figure 5) that, upon the advancing movement of the sinkers and dividers, the sinker S3 engages the yarn as indicated in full lines in Figure 5, and since this advance of the sinkers and dividers takes place prior to the raising of the needles, as indicated by the arrow in Figure 6, the yarn leading from the carrier C becomes located forwardly of the needle N3 in the manner clearly shown in Figures 7 and 8 when the needles reach their uppermost position and the sinkers and dividers are withdrawn in unison to their innermost position preparatory to the laying of the yarn for the next course.

In laying the yarn for the formation of the next course, the carrier C moves in the opposite direction, that is, in the direction indicated by the arrow in Figure 7, so that, as illustrated in Figure 9, the yarn, upon being sunk, is positively wrapped about the needle N3, thus forming a plain, firm, widened selvedge W as illustrated in Figure 11.

In order that the method as explained above may be carried out without change in the proven advantageous relative position between the carriers and sinker heads, I have devised modified constructions for the dividers and sinkers located within the widening area of the sinker heads. The preferred constructions for such dividers and sinkers are shown respectively in Figures 12 and 13.

In ordinary full-fashioned knitting machines, it has been found that in order to assure the proper laying of the yarn for preventing accidental dropping of a loop and the formation of a rough selvedge, the tip of the yarn carrier must be slightly lower than the top edges of the sinkers, and because the carrier is always stopped over a divider so that the preceding divider may be used in forming the selvedge, the leading edge of each divider is formed with a cut-out portion, such as shown at 26 in Figure 12, whereby said leading edge lies in a plane somewhat lower than the top edges of the sinkers. In this manner, the lower tip of the carrier is cleared when the dividers are advanced.

Also in ordinary full-fashioned knitting machines, in order to provide means for taking up the excess yarn that would usually be drawn by the regular dividers when carried forward by the catch bar and thus contributing to the formation of a tight selvedge, it is customary to form the selvedge divider with a slot 22 at a point below the usual throat 24 of such divider. Because of the provision of said slot 22, when the carrier is reversed at the end of its stroke and returns to the opposite end of the knitting section, the yarn is wrapped securely around the last needle in operation and pulled over the nib 26 of the selvedge divider so that, upon forward movement of the divider to form the loops between adjoining needles, the yarn is forced under the shortened nib 28, accordingly making the ultimate or selvedge loop smaller than normal size.

Moreover, in accordance with the present invention, the selvedge sinkers which are located in the widening area of the knitting section are each provided with a notch 30 at the leading edge of the divider adjacent the cut-out or recessed portion 26 and immediately above the throat 24 thereof. By providing this notch 30 in the manner stated, the yarn, as more clearly shown in Figure 4, becomes engaged within said notch when the divider (for instance, divider D2) is advanced after the carrier C has moved to its extreme position over the next following divider (for instance, divider D4) in accordance with the particular steps of the method as hereinbefore described. Since the tip of the carrier extends below the normal upper edge of the sinkers, and since, in accordance with this method, the movement of the carrier C from its position over one divider (for instance, divider D2) to its position over the next succeeding divider (for instance, divider D4) occurs, after the sinkers have been advanced, the upper edge of these sinkers located within the widened area of the knitting section are provided with recessed or cut-out portions 32 so disposed that the carrier C may undergo its movement from one stop position to its other stop position without interference, as will more clearly appear from Figure 6.

According to the present invention, the method

herein shown and described may be performed readily by utilizing a simple attachment capable of being easily incorporated in any suitable well known full-fashioned knitting machine. For the purpose of illustration, I have chosen the widely known Schubert & Salzer H. S. L. hosiery machine, although it is to be understood that any other known types of flat knitting machines may be likewise used.

In Figures 14, 15, and 16, which illustrate the attachment, there is shown only those parts of the ordinary knitting machine which will help to clearly understand the invention.

With particular reference to these figures, the machine embodies the usual frame 40 provided with bearings for the main cam shaft 42 and back cam shaft 44. The machine frame also includes the ordinary front table 45 and center bed 46 about which are arranged the multiple knitting sections, one such section being designated in its entirety for convenience herein by the reference character 48.

Each knitting section comprises a needle bar 50 provided with its bank of needles N which, in cooperation with the sinkers S, dividers D, and knockover bits K, function to form the knitted loops of the fabric through the operation of the machine, as hereinbefore set forth. Yarn is fed to the knitting sections by means of carriers C arranged on the carrier bars 52 mounted for reciprocation in brackets such as shown at 54. The reciprocating movement of the carrier bars is controlled by the function of the carrier narrowing motion mechanism 56 which includes the usual double threaded spindle 58 in engagement with oppositely movable carrier nuts 60. The carrier nuts 60 are provided with stops 62 placeable in the path of movement of a pair of abutments 64 suitably arranged on each of the carrier bars 60 so that the carrier bars are limited in their movement in either direction.

Moreover, each of the carrier bars is supplied with a pair of projections 66 engageable with latch members 68 journalled in the carrier nuts 60 by means of a traverse shaft 70. Rigid with the shaft 70 is an arm 72 acted upon by a spring 74 to normally urge the shaft 70, together with its latches 68, into position for positive engagement with their associated carrier projections 66.

The arm 72 carries a roller 76 in bearing engagement with a cross piece 78 adjustably affixed to a vertically extending rod 80 pivotally connected, as at 82, to a lever 84 mounted for rocking motion on the knockover bit shaft 44. The lever 84 carries a roller 86 disposed for riding engagement with an active cam 88 or a neutral cam 89 on the main cam shaft 42, depending upon the shifting positions of the latter.

From the foregoing, it will be understood that the carrier bars 52 with their carriers C are locked securely to the carrier nuts 60 by means of the spring urged latches 68 but that, upon action of the cam 88 on the roller 86, the lever 84 is rocked to exert a downward pull on the rod 80 and its cross piece 78 which then presses on the roller carrying arm 72, accordingly causing the latches 68 to disengage the projections 66 and thus freeing the carrier rods for their reciprocating motion. The cam 88 is so shaped and disposed as to effect the carrier release immediately before the reciprocating movement of the carrier starts.

In accordance with the present invention, the reversable threaded spindle 58 of the carrier narrowing mechanism 56 is intended to be rotated in opposite directions, rotation in one direction effecting narrowing of the fabric and rotation in the other direction effecting widening of the fabric. For that purpose, there is rigidly attached to an extended portion 90 of the spindle 58 a pair of integral ratchet wheels 92 and 94 respectively having their teeth extended in opposite directions. Freely mounted on said extended portion 90 is an oscillating pawl carrying arm 96 having one pawl 98 disposed to engage the ratchet wheel 92 and one pawl 100 disposed to engage the ratchet wheel 94. The pawl carrying arm 96 is given its oscillatory motion by means of a lever 102 connected to said arm 76 through an adjustable rod 103 and mounted for rocking motion on the knockover bit shaft 44. The lever 102 is provided with a fixed roller 104 and a shiftable roller 106. The fixed roller is adapted to have riding engagement with the peripheral edge of a neutral cam 107 or with an active cam 108 on the main cam shaft 42 when the latter is shifted to its narrowing position, that is, in the direction of arrow E in Figure 16.

Thus it will be understood that whenever the main cam shaft 42 is shifted to its narrowing position, the cam 108 is brought in contact with the roller 104, thereby causing the lever 102 to exert a rearward pull on the pawl carrying arm 96 and, accordingly, move the pawl 98 to act on its ratchet wheel 92 for rotating the spindle 58 in the direction to move the carrier nuts 60 for effecting narrowing of the fabric. The roller 106 is engageable with a cam track 110 of a cam 112 also on the main cam shaft 42 when said roller 106 is shifted in the direction of arrow F in Figure 16.

For the purpose of shifting the roller 106, there is preferably provided a shifting lever 114 pivoted at its intermediate portion 116 to the rocking lever 102 and having one end portion 118 in engagement with a groove 119 suitably formed with said roller 106 and having its other end 120 in engagement with a shifting rod 122. The shifting rod 122 is associated with an oscillating link and bell crank assembly 124 suitably mounted on the machine frame to be acted upon by buttons 126 on a pattern chain 128 which may be, and preferably is, the usual main pattern chain of the knitting machine. Thus, whenever a button 126 during the progressive movement of the pattern chain 128 comes in position to act on the link and bell crank lever arrangement 124, the latter moves the shifting rod 122 in a direction, that is, in the direction of arrow G in Figure 16, for causing the shifting lever 114 to shift the roller 106 into engagement with the track 110 of the cam 112. In this manner, the track 110 actuates the lever 102 to exert a forward thrust to the pawl carrying arm 96, accordingly moving the pawl 100 to act on its ratchet wheel 94 for rotating the spindle 58 in the direction to move the carrier nuts 60 for widening of the fabric.

In order to provide means for disengaging the pawl 98 or 100 from its associated ratchet wheel 92 or 94, to permit rotation of the spindle 58 when acted on by the remaining pawl and ratchet wheel, there is preferably provided for free oscillating motion on the spindle extension 90 an annular disc 130 having a cut-out portion 131 on a sector of its peripheral edge, thus providing a pair of diametrically opposed camming surfaces 132 and 134 respectively. The pawls 98 and 100 carry pins 136 and 138 respectively disposed for association with the camming surfaces 132 and 134 so that, upon oscillation of the disc 130 in one direction, that is, in the direction of arrow

H, the pin 136 will ride down the surface 132 allowing the pawl 98 to engage the ratchet wheel 92, and the pin 138 will ride up the surface 134 forcing the pawl 100 out of engagement with the ratchet wheel 94. However, upon oscillation of the disc 130 in the opposite direction, that is, in the direction of arrow I, the pin 136 will ride up the surface 132 forcing the pawl 98 out of engagement with the ratchet wheel 92, and the pin 138 will ride down the surface 134 allowing the pawl 100 to engage the ratchet wheel 94.

In order that the oscillation of the disc 130 for the relative displacement of the pawls 98 and 100 may be controlled in timed relationship with respect to the operation of the knitting machine to effect narrowing or widening of the fabric, said disc 130 is connected by means of a rod 140 and bell crank lever 141 to the shifting rod 122. In this manner, it will be appreciated that when the shifting rod 122 is in its inactive position, that is, in the position shown in the drawings, the pawl 98 engages its ratchet wheel 92 while the pawl 100 is out of engagement with its ratchet wheel 94 so that narrowing may take place, whereas when the shifting rod 122 is in its active position, that is, shifted in the direction of arrow G (Figure 16), the pawl 98 is out of engagement with its ratchet wheel 92 while the pawl 100 engages its ratchet wheel 94 so that widening of the fabric may take place.

It is to be observed that an index wheel 144 preferably formed integral with said ratchet wheels 92 and 94 and cooperating with a spring pressed plunger 146 is advantageous in preventing accidental back movement of the carrier nut spindle 58 during operation of either ratchet 98 or 100.

The operation of the knitting machine attachment in performing the method of the invention as hereinbefore explained will now be described, in connection with the fabrication of a single unit stocking blank of the type shown diagrammatically in Figure 15 wherein the heel fabric is formed by widening courses in the area between line X—X and line Z—Z.

The knitting machine operates in the usual manner to knit the stocking blank up to the point where a widening course is to be made. At this point, the carrier C moving to lay the yarn, for instance, to the right as indicated by the arrow J (Figure 15) proceeds until the abutment 64 of its carrier rod abuts the stop 62 associated therewith and mounted on the left carrier nut 60 which has become located in such a position that the carrier C is arrested over the divider D_2 (Figure 1). By the time that all the sinkers are advanced and when the dividers are to be advanced, a button 126 moving progressively with the progressive movement of the pattern chain 128, comes into engagement with the link and bell crank assembly 124 which functions to set the attachment for operation in the manner hereinbefore stated, accordingly displacing the left carrier nut 60 in the direction of arrow L (Figure 15).

Since the carrier rod is then rigid with said nut, the projection 66 being engaged by the latch 68, the carrier follows said movement of the carrier nut which brings the carrier C to rest over the divider D_4 (Figure 1) whereupon the knitting machine continues in its operation to complete the widening course in the manner described in connection with Figures 3 to 11 inclusive.

During the knitting of widening courses, it is found preferable to apply lateral tension on the hosiery blank so that the opposed selvedges of the blank are guided towards each other. In this manner, an inward angular pull is exerted on the blank whereby the yarn looped about the selvedge needles is kept taut and, accordingly, contributes to the formation of a tight, well-formed selvedge edge.

For that purpose, as shown in Figures 22, 23, and 24, there preferably is mounted in the well of the front table 45 an elongated tube 150 extending throughout the length of the machine. The tube 150 is mounted for oscillation in suitable brackets 152 fixed at spaced points along the front table 45. Each portion of the tube disposed within the confines of a knitting section is formed with a pair of elongated slots 154. Slidably received within the tube and underlying the slots 154 are cylindrical bodies 156, each having a rigid pin 158 mounted to extend through the corresponding slot 154. The bodies 156 are yieldably connected by means of a spring 160 so that said bodies are normally drawn towards each other so that the pins 158 normally abut the inner ends of their respective slots 154, as more clearly shown in Figures 22 and 23. The tube 150 may be oscillated in its brackets 152 so as to place the pins 158 either in vertical operating position or horizontal inoperative position, as represented in Figure 24. The oscillation of the tube may be facilitated by means of a handle 162 conveniently affixed to the tube 150.

From the foregoing, and upon particular reference to Figure 25 of the drawings, it will be understood that the intermediate portion of the fabric blank in each knitting section leading from the needles N to the usual well known take-up roller (not shown) may be engaged between the pins 158 when swung in their vertical position. These pins thereupon act by function of the spring 160 to exert a yieldable force on the blank selvedge edges at their point of contact with said pins for the purpose hereinbefore specified. Moreover, as somewhat diagrammatically shown in Figure 25, the yieldability of the pins in one knitting section being independent of the yieldability of the pins within the other knitting sections, the arrangement provided is most suitable in adapting itself to variations in tension incident to the knitting of the respective associated fabric blanks.

Whereas I have described the formation of added loops at one selvedge only of the fabric, it will be understood that the same operations are performed for the formation of added loops at the other selvedge of the fabric. Also, whereas I have described the invention by referring to one carrier only, it will be understood that the operation is the same when a plurality of carriers are used in the knitting of the fabric. Likewise, the actuation and control of reinforcing carriers in the making of reinforced widened heel courses is identical to the actuation and control of the main carrier or carriers with the exception that while the main carrier or carriers are reciprocated over the entire width of the fabric, the reinforcing carriers reciprocate only over parts of the width of the fabric, that is, over restricted areas extending from the selvedge edges to a point inwardly of the fabric, it being of course understood that the control of the reinforcing carrier strokes inwardly of the fabric may be accomplished by means of the well known "Pointex" mechanism not shown herein.

Finally, it will be understood that the invention is not to be limited to the specific embodi-

ment herein shown and described, but includes any possible changes and modifications which come within the scope of the subjoined claims.

What I claim is:

1. In a method of widening fabric on flat knitting machines wherein yarn is fed to needles and the fed yarn is sunk between needles by means of sinkers and dividers, the dividers operating subsequently to the operation of the sinkers, the step of: feeding yarn to a number of additional needles between the time when the sinkers have sunk the yarn and the time when the sunk yarn is divided by the dividers.

2. In a method of widening fabric on flat knitting machines wherein yarn is fed to needles and the fed yarn is sunk between needles by means of sinkers and dividers, the dividers operating subsequently to the operation of the sinkers, the step of: feeding yarn to two additional needles between the time when the sinkers have sunk the yarn and the time when the sunk yarn is divided by the dividers and forming an added loop on one additional needle and a free selvedge loop on the other added needle.

3. In a method of widening fabric on flat knitting machines wherein the loops of a course are shaped by sinking fed yarn between needles by means of sinkers and dividers, the operation of the dividers taking place subsequently to the operation of the sinkers, the step of: extending the feed of the yarn over a number of needles after the sinking of the yarn but prior to the dividing of the sunk yarn, and engaging the extended yarn under a divider.

4. In a method of widening fabric on flat knitting machines wherein the loops of a course are shaped by sinking fed yarn between needles by means of sinkers and dividers, the operation of the dividers taking place subsequently to the operation of the sinkers, the step of: extending the feed of the yarn over two needles after the sinking of the yarn by the operation of the sinkers but prior to the dividing of the sunk yarn by the dividers and forming an added loop on one additional needle and a free selvedge loop on the other added needle.

5. In a method of widening fabric on flat knitting machines wherein yarn is fed to needles and the fed yarn is sunk between needles by means of sinkers and dividers, the dividers operating subsequently to the operation of the sinkers, the steps of: arresting the feed of yarn while the operation of the sinkers continues to completion; and then extending the feed of yarn over a number of additional needles before the division of the sunk yarn by the dividers commences, and forming a free selvedge loop from the extended yarn.

6. In a method of widening fabric on flat knitting machines wherein yarn is fed to needles and the fed yarn is sunk between needles by means of sinkers and dividers, the dividers operating subsequently to the operation of the sinkers, the steps of: arresting the feed of yarn while the operation of the sinkers continues to completion; and then extending the feed of yarn over two needles before the division of the sunk yarn by the dividers commences, and forming an added loop on one additional needle and a selvedge loop on the other added needle.

7. In a method of widening fabric on flat knitting machines by adding loops onto courses, the steps of: arresting a carrier feeding yarn in one direction to a series of needles over the divider outside the needle next to the ultimate needle of the series; advancing the sinkers beyond said needle next to the ultimate needle in operation; displacing the carrier over a number of additional needles in said one direction; and advancing the dividers so that the yarn is sunk between each needle, including the portion of the yarn moved over the additional needles, whereby to form added and selvedge loops on said additional needles.

8. In a method of widening fabric on flat knitting machines by adding loops onto courses, the steps of: arresting a carrier feeding yarn in one direction to a series of needles over the divider outside the needle next to the ultimate needle of the series; advancing the sinkers beyond said needle next to the ultimate needle in operation; displacing the carrier over two additional needles in said one direction thereby laying a portion of yarn over the nib of the divider over which the carrier was originally arrested and over the extended sinker between said two additional needles; moving the dividers so that the yarn is sunk between each needle including the portion of yarn which, by the displacement of the carrier over said two additional needles, was laid on the nib of the divider over which the carrier was originally arrested, thereby firmly engaging yarn with the beard side of the needle next to the original ultimate needle; moving the sinkers and dividers in conjunction with the needles to press off the loops of the previously knitted course thereby causing the portion of the yarn leading from the carrier to said needle next to the original ultimate needle to become located between the divider over which the carrier was originally arrested, and to become engaged by the sinker between the two additional needles over which the carrier was displaced, accordingly bringing said yarn portion from the beard side of the first added needle to the opposite side thereof; and then feeding and sinking yarn in the other direction, thereby forming an additional loop on the needle next to the original ultimate needle and a firm selvedge loop on the first added needle.

9. In a method of widening fabric on full-fashioned knitting machines by adding loops onto courses, the steps of: feeding yarn in one direction to a series of needles by means of a carrier and sinking the fed yarn by means of sinkers between alternate needles up to the ultimate needle in operation; arresting the carrier in its movement in said one direction over the divider outside the needle next to the ultimate needle in operation; advancing the sinkers beyond said needle next to the ultimate needle in operation; displacing the carrier over a number of additional needles in said one direction; and advancing the dividers so that the yarn is sunk between each needle, including the portion of the yarn moved over the additional needles, whereby to form added and selvedge loops on said additional needles.

10. In a method of widening fabric on full-fashioned knitting machines by adding loops onto courses, the steps of: feeding yarn in one direction to a series of needles by means of a carrier and sinking the fed yarn by means of sinkers between alternate needles up to the ultimate needle in operation; arresting the carrier in its movement in said one direction over the divider outside the needle next to the ultimate needle in operation; advancing the sinkers beyond said needle next to the ultimate needle in operation; displacing the carrier over two additional needles in said one direction thereby laying a portion of yarn over the nib of the divider over which the carrier was orig-

inally arrested and over the extended sinker between said two additional needles; moving the dividers so that the yarn is sunk between each needle including the portion of yarn which, by the displacement of the carrier over said two additional needles, was laid on the nib of the divider over which the carrier was originally arrested, thereby firmly engaging yarn with the beard side of the needle next to the original ultimate needle; moving the sinkers and dividers in conjunction with the needles to press off the loops of the previously knitted course thereby causing the portion of the yarn leading from the carrier to said needle next to the original ultimate needle to become located between the divider over which the carrier was originally arrested, and to become engaged by the sinker between the two additional needles over which the carrier was displaced, accordingly bringing said yarn portion from the beard side of the first added needle to the opposite side thereof; and then feeding and sinking yarn in the other direction, thereby forming an additional loop on the needle next to the original ultimate needle and a firm selvedge loop on the first added needle.

11. In combination with the carrier arresting mechanism, the sinker actuating mechanism, and the divider actuating mechanism of a full-fashioned knitting machine: a mechanism automatically displacing said carrier arresting mechanism subsequent to the operation of said sinker actuating mechanism and prior to the operation of said divider actuating mechanism.

12. In combination with the main cam shaft, the carrier arresting mechanism, the sinker actuating mechanism, and the divider actuating mechanism of a full-fashioned knitting machine: a mechanism activated by said main cam shaft and automatically displacing said carrier arresting mechanism subsequent to the operation of said sinker actuating mechanism and prior to the operation of said divider actuating mechanism.

13. In combination with the pattern chain, the main cam shaft, the carrier arresting mechanism, the sinker actuating mechanism, and the divider actuating mechanism of a full-fashioned knitting machine: a mechanism controlled through said pattern chain and activated by said main cam shaft for displacing said carrier arresting mechanism subsequent to the operation of said sinker actuating mechanism and prior to the operation of said divider actuating mechanism.

14. In combination with the carrier nut mechanism of a flat knitting machine: a pawl and ratchet device operable to move said carrier nut to effect narrowing; a pawl and ratchet device operable to move said carrier nut to effect widening; an operating arm common to both pawl and ratchet devices to actuate the same; means for operating said arm to impart to the narrowing pawl and ratchet device its movement; means for operating said arm to impart to the widening pawl and ratchet device its movement; and mechanism operatively associated with the pawl and ratchet devices to set the same in operation in timed relationship with respect to the operation of said arm by either of said means.

15. In combination with the carrier nut mechanism, shiftable main cam shaft, and pattern mechanism of a flat knitting machine: a pawl and ratchet device operable to move said carrier nut to effect narrowing; a pawl and ratchet device operable to move said carrier nut to effect widening; an operating arm common to both pawl and ratchet devices to actuate the same; a fixed

roller and a shiftable roller carried by said arm; a cam on the main cam shaft engageable with said fixed roller upon shifting of the main cam shaft for operating said arm to impart to the narrowing pawl and ratchet device its movement; a cam on the main cam shaft engageable with said shiftable roller for operating said arm to impart to the widening pawl and ratchet device its movement; and pattern chain control mechanisms operatively associated with the shiftable roller to bring the same in engagement with its cam on the main cam shaft and operatively associated with the pawl and ratchet devices to set the same for operation in timed relationship with respect to the operation of said arm for narrowing or for widening.

16. In a flat knitting machine supplied with means for effecting the widening of fabric knitted on a kniting head thereof: a plurality of dividers each provided with a leading edge and a nib; each of the dividers within the widening areas of the knitting head having a yarn engaging notch immediately below its leading edge, a yarn engaging slot immediately above its nib, and a yarn engaging throat intermediate said notch and said slot.

17. In a flat knitting machine supplied with means for effecting the widening of fabric knitted on a knitting head thereof: a plurality of dividers each provided with a leading edge and a nib; each of the dividers within the widening areas of the knitting head having a lowered portion at its leading edge, a yarn engaging notch immediately below the lowered portion of its leading edge, a yarn engaging slot immediately above its nib, and a yarn engaging throat intermediate said notch and said slot.

18. In a flat knitting machine supplied with means for effecting the widening of fabric knitted on a knitting head thereof: a plurality of sinkers and dividers each provided with a leading edge and a nib; each of the sinkers within the widening areas of the knitting head having a recessed portion upon its leading edge, and each of the dividers within the widening areas of the knitting head having a yarn engaging notch immediately below its leading edge, a yarn engaging slot immediately above its nib, and a yarn engaging throat intermediate said notch and said slot.

19. In a flat knitting machine supplied with means for effecting the widening of fabric knitted on a knitting head thereof: a plurality of sinkers and dividers each provided with a leading edge and a nib; each of the sinkers within the widening areas of the knitting head having a recessed portion upon its leading edge, and each of the dividers within the widening areas of the knitting head having a lowered portion at its leading edge, a yarn engaging notch immediately below the lowered portion of its leading edge, a yarn engaging slot immediately above its nib, and a yarn engaging throat intermediate said notch and said slot.

20. In a flat knitting machine supplied with means for effecting the widening of fabric knitted on a knitting head thereof: mechanism for applying lateral tension to the selvedge edges of the fabric during the widening thereof comprising a pair of members engageable with the opposed selvedge edges of the fabric to draw said edges towards one another, and spring means yieldably interconnecting said members.

21. In a flat knitting machine supplied with means for effecting the widening of fabric knitted on a knitting head thereof; mechanism for applying lateral tension to the selvedge edges of

the fabric during the widening thereof comprising a hollowed casing having slotted portions, a pair of bodies slidable in said casing, pins carried by said bodies and projected through the slotted portions of said casing for engagement with the opposed selvedge edges of the fabric to draw said edges towards one another, and spring means yieldably interconnecting said bodies.

22. The method of forming a widened knitted fabric on a flat knitting machine having a bank of needles, a carrier operable to feed yarn to said needles, stop means operable to arrest the carrier, a spindle operable to displace said stop means, sinkers operable for the kinking of the yarn about the needles, and dividers operable separately of the operation of the sinkers for kinking the yarn about other needles, said method comprising the steps of: operating the carrier to feed yarn to the needles; operating the stop means to arrest the carrier after feeding yarn to a predetermined number of needles; operating the sinkers individually for the kinking of the yarn about alternate needles; operating the spindle to displace the stop means for the feeding of the yarn by the carrier to additional needles; and operating the dividers en masse for the kinking of the yarn about the needles intermediate said alternate needles.

23. The method of widening fabric on a flat knitting machine having a knitting head provided with special sinkers permitting passage of a yarn carrier over such sinkers when projected and special dividers in the widening area thereof, said method comprising the steps of: arresting a carrier feeding yarn in one direction to a series of needles out of said widening area; advancing the sinkers including the special sinkers in said widening area; displacing the carrier in said one direction over a number of needles in said widened area; and advancing the dividers including the special dividers in said widening area so that the yarn is sunk between each needle including the portion of the yarn moved over the needles in said widening area, whereby to form added and selvedge loops on said last mentioned needles.

24. A sinker head having a group of ordinary sinkers and dividers at its intermediate section, and a group of special sinkers and dividers at each of its end sections; each of said ordinary and special sinkers being provided with a leading edge and a nib; each special sinker having a recessed portion upon its leading edge; and, each special divider having a lowered portion, a yarn engaging notch immediately below the lowered portion of its leading edge, a yarn engaging slot immediately above its nib, and a yarn engaging throat between said notch and said slot.

25. A divider provided with a leading edge and a nib, and having a lowered portion, a yarn engaging notch immediately below the lowered portion of its leading edge, a yarn engaging slot immediately above its nib, and a yarn engaging throat between said notch and said slot.

26. The method of widening incident to production of fabric on a flat knitting machine having a series of needles, cooperative sinkers and a traversing yarn carrier, by repetition of a cycle which includes moving the carrier to lay yarn across a definite number of needles, moving sinkers aforesaid to form kinks on said needles, thereafter shifting the carrier outward in the same direction by a distance of one or more needles to lay the yarn across sinkers associated with the added needles; then, at a time when the needles are depressed, causing a sinker to be projected to effect displacement of and support the extra yarn as a bight to the rear of one of the added needles, said last named sinker being operatively associated with such last named needle; and finally causing the needles to be elevated so that said last named needle will come up within the displaced yarn bight supported by the sinker aforesaid.

27. A device of the character described comprising, a support arranged to be attached to the front bed of a full-fashioned fabric blank knitting machine, and means on said support for laterally tensioning the fabric blank produced on said machine including a pair of movable resiliently actuated elements arranged to engage the opposite side edge sections of said blank.

28. A device of the character described comprising, a support arranged to be attached to a knitting machine adjacent to the fabric produced on the latter, and a resilient clamp-like device cooperatively associated with said support and including a plurality of movable fabric tensioning elements each arranged to be engaged with one of the side edge sections of said fabric.

29. A device of the character described comprising, a support arranged to be attached to a knitting machine adjacent the fabric produced thereon, and a resilient clamp-like device cooperatively associated with said support and including a pair of similar fabric tensioning elements each adapted to be moved beyond one of the opposite side edge sections of said fabric.

STERLING C. MACK.