

[54] **METHOD AND MACHINE FOR MAKING
TOE PIECES FOR SOCKS AND STOCKINGS**

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66/147, 75, 134, 174

[56] **References Cited**

UNITED STATES PATENTS

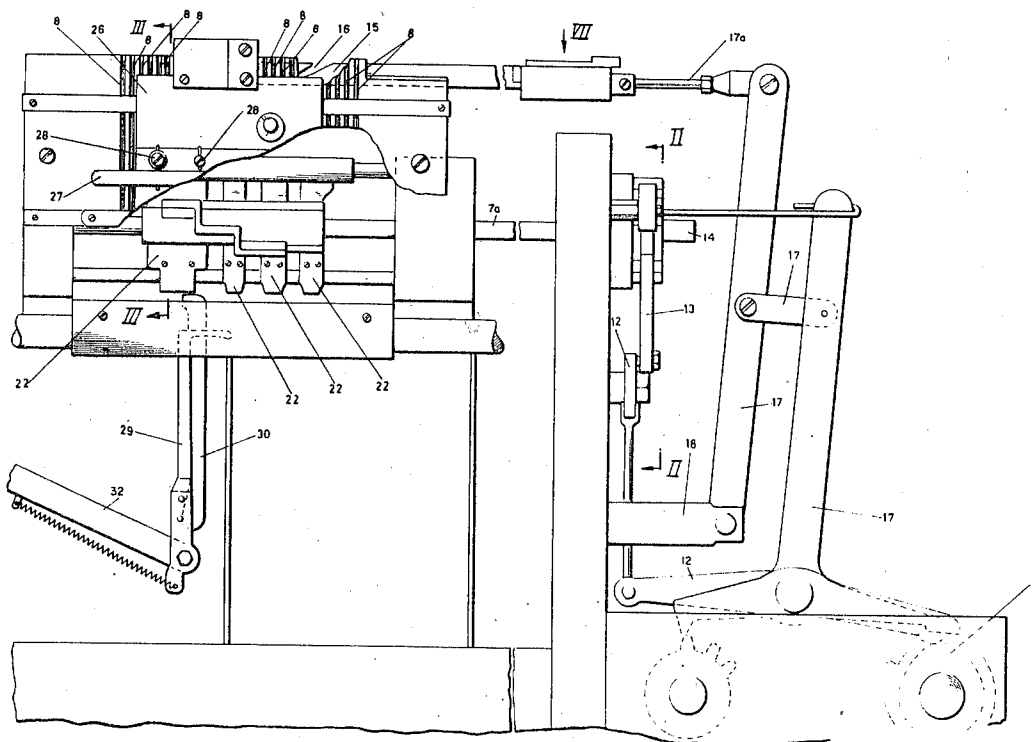
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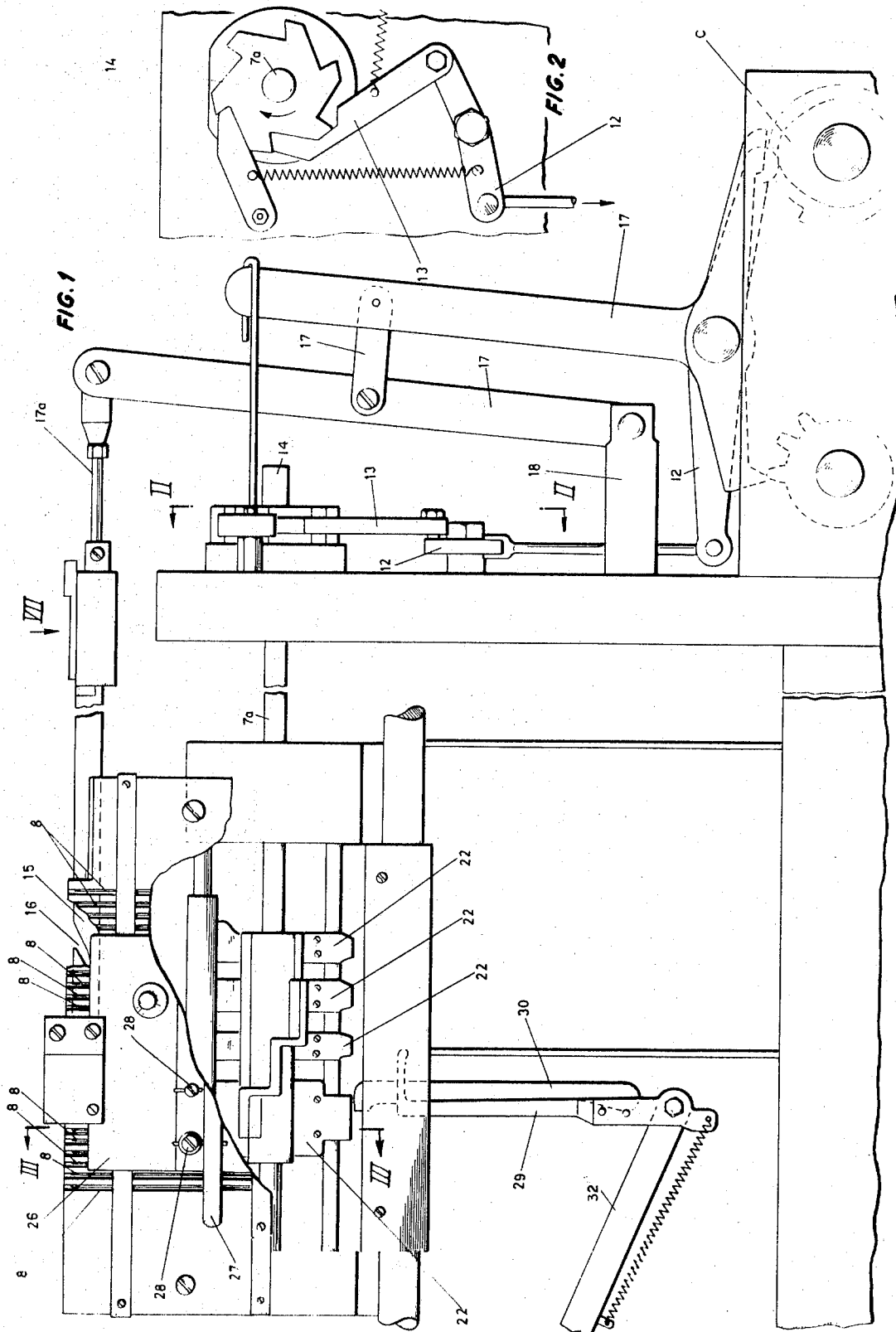
Primary Examiner—Ronald Feldbaum
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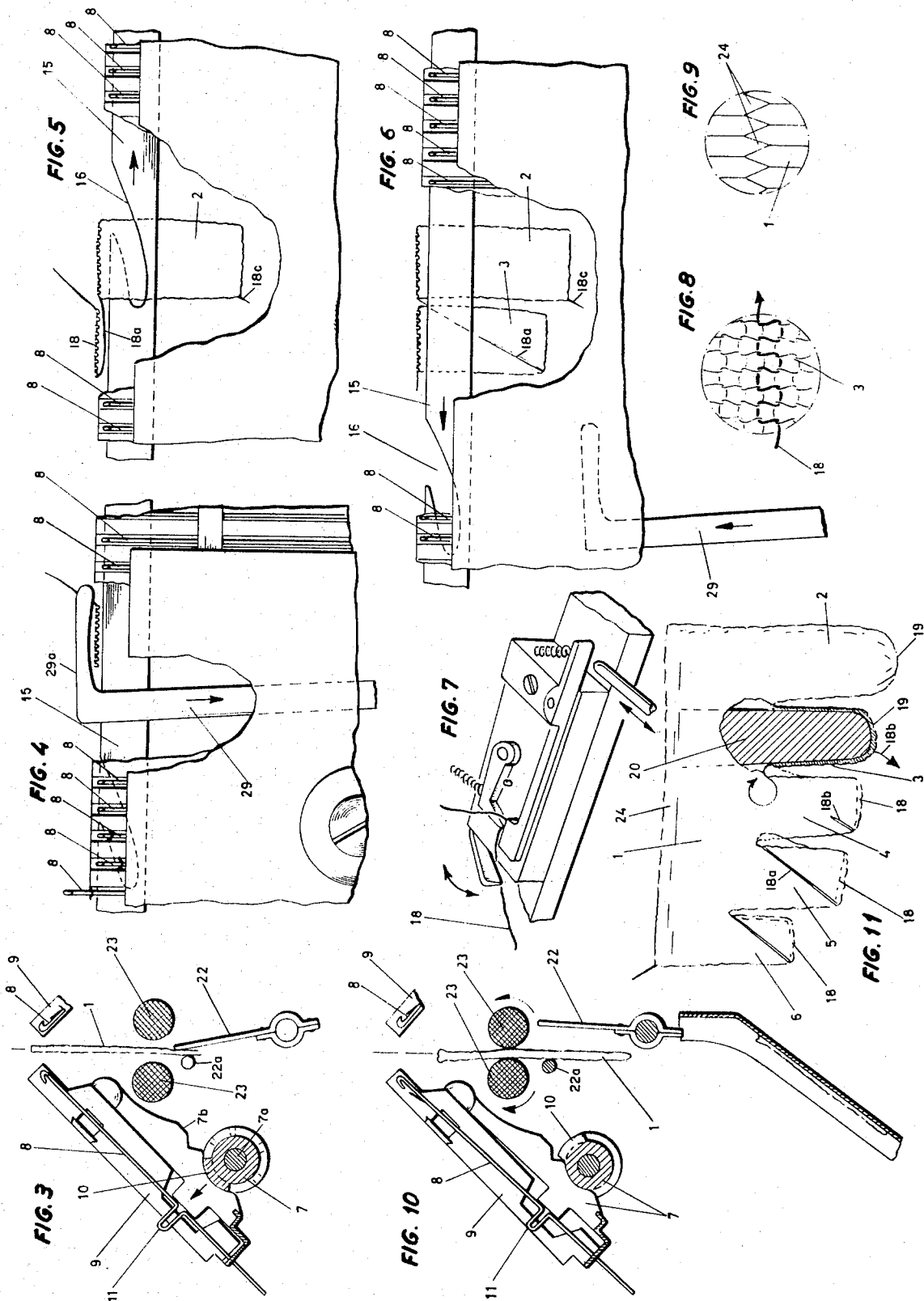
[57] **ABSTRACT**

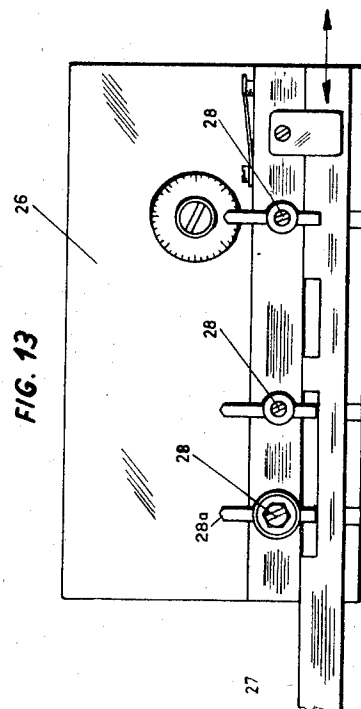
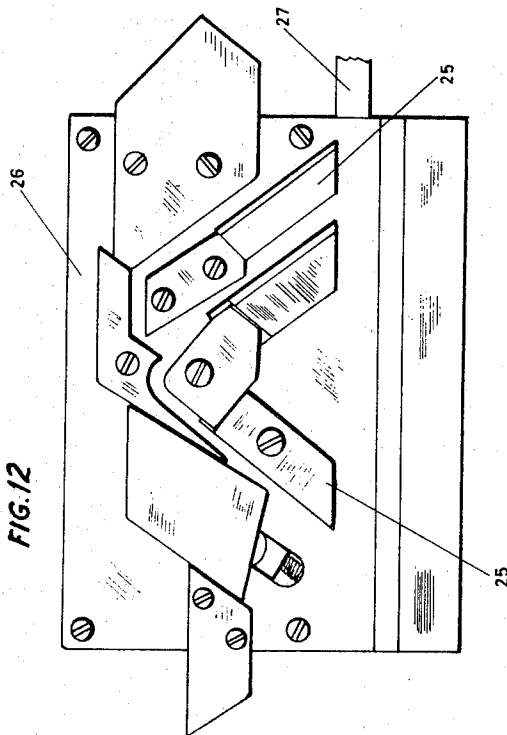
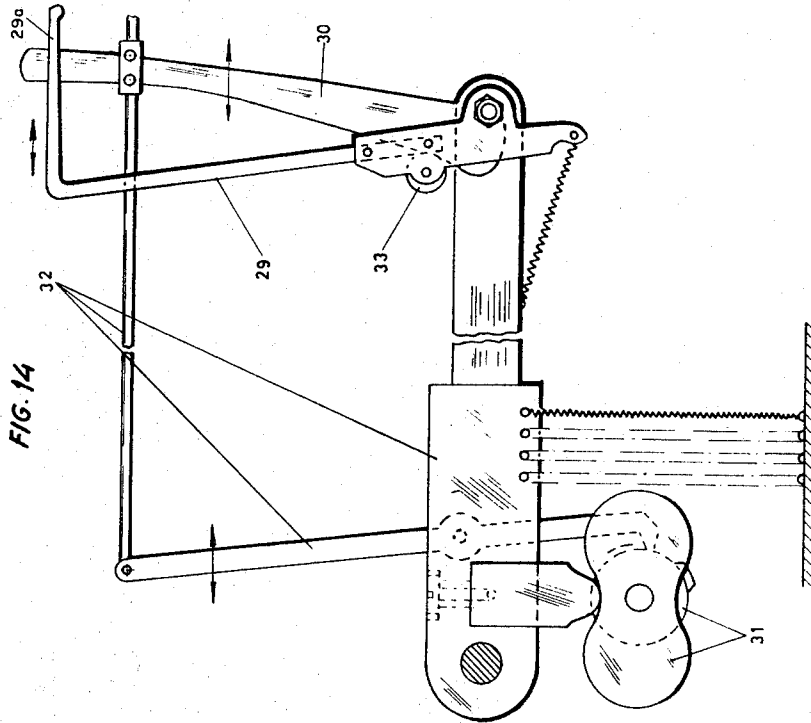
A Lamb knitting machine is modified and controlled to sequentially knit individual, closed ended, tubular toe sheaths from the closed end upwardly, and finally to form a knit toe piece suitable for joining to a separate portion of a stocking to form a complete stocking having individual toe sheaths at its extremity. Knitting of each sheath takes place under the control of an automatic cam which controls the needles to be lifted by the needle lifter assembly to vary each sheath size, and, as each sheath is knit in the same area of the knitting head of the machine, it is laterally shifted by a slotted bar and held in place while the next sheath is knitted. Upon completion of the knitting operation, each closed end of the sheaths is drawn to a pucker by a yarn length left in place during the knitting of the sheaths, this final operation being performed on a suitable mold which finally shapes the knit toe pieces.

3 Claims, 14 Drawing Figures









METHOD AND MACHINE FOR MAKING TOE PIECES FOR SOCKS AND STOCKINGS

This application is a continuation of Ser. No. 166,768, filed July 28, 1971, now abandoned.

BACKGROUND OF THE INVENTION

Hosiery of various types having separate toe sheaths are known in the prior art, but have always been made individually or in a craftsmanship style, not in a mass production manner by automated machinery. Lamb-type knitting machines are quite well known in the knitting field, and have been modified far beyond the basic original concept in many ways to facilitate the production of various knit styles and patterns as well as to improve the operation of the basic machine.

Although more modern and efficient knitting machines are available, the basic Lamb machine is still favored for many knitting operations, particularly tubular knits having varying widths because of the inherent flexibility of the two knitting heads having needles that may be variably selected during a knitting operation. Typical early models of Lamb machines are shown in U.S. Pat. Nos. 611,130 and 753,715. A discussion of the basic machine and advantages of the Lamb knitter for performing certain operations is also set forth in U.S. Pat. No. 2,877,635, particularly in column 1 of the specification thereof. The essential characteristics of the Lamb machine are the double rows of knitting needles and the reciprocating needle lifters which utilize a cam system to activate the needles in proper sequence for accomplishing the knitting operation. Many of the improvements to the Lamb machine are directed to the cam plates used to actuate the needles, as can be seen, for example, in U.S. Pat. Nos. 850,786 and 941,206. In short, for purposes of this invention, the basic Lamb machine with its refinements only forms the basic tool from which this invention obtains. Applicant here has made further refinements to the basic, well-known machine to accomplish the knitting of individual, varying width and length toe sheaths in a unique manner not accomplished previously on a machine of this type. Utilized here is a specific knitting and forming procedure to make the desired toe piece for a stocking, the stocking having individual toe sheaths for accommodating a human foot at the toe area.

The knitting of individual finger sheaths on gloves by means of a Lamb machine is well known, as exemplified by, for example, U.S. Pat. No. 2,877,635 mentioned above, as well as U.S. Pat. No. 2,259,381. However, it has not generally been recognized that toe sheaths of varying width can be formed on a Lamb machine automatically and individually in the manner contemplated by the present invention, nor has it been recognized that a toe piece formed on the Lamb machine in accordance with the method of this invention readily is adapted for further forming on a mold where the extremities of the sheaths at their closed ends may be finally shaped by a simple step of drawing a free yarn end taut.

SUMMARY OF THE INVENTION

The present invention relates to a method of knitting toe pieces for socks or stockings having individual toe sheaths using a modified Lamb-type knitting machine. The tow pieces are joined to upper stocking sections to make a complete sock, but this latter step forms no part of the present invention.

In brief summary, a Lamb machine is adapted by the present invention to knit individual, closed ended, tubular toe sheaths of varying length and breadth sequentially from their closed end upward, leaving a length of yarn between toe sections in a specific manner enabling the closed end of the tubular sheaths to be shaped in the form of a pucker by a simple operation. The main body of the toe piece is formed by a continuation of the circular knitting procedure on the modified Lamb machine, and the completed toe piece is shaped and finished on a mold, where the toe sheaths are hand-formed and loose yarn ends resulting from the procedure stitched back into the yarn that has been knitted.

The invention provides an automatic, needle selector cam arrangement driven through the basic machine cam tree for enabling the needle lifters of the machine to activate selected needles from each needle plate during each cycle of operation to produce individual toe sheaths of varying width.

Unique to this invention is the concept of knitting each sheath with selected ones of the same basic group of needles, and removing each completed sheath from the knitting area, while still supporting the sheaths individually between the needle plates until all the sheaths have been formed. The toe sheaths are then joined by a continuation of the circular knitting procedure to the remaining body of the toe piece, with no gaps, seams or holes in the toe piece being produced.

The individual toe sheaths are each formed by flat knitting a first course, then tubular knitting each successive course until the length of the sheath is knitted. After the first sheath is formed at a certain knitting area between the heads or needle plates of the machine, it is automatically laterally shifted by a slotted arm and retained in a new position between the plates by an automatically controlled spring clip. This leaves a length of yarn between the last knit course on the first sheath and the first course of the next succeeding sheath to be knit. This procedure is repeated, with successive sheaths being programmed automatically by cams to vary in width and length, until the fifth toe sheath is formed. Four toe sheaths at this point are supported between the needle plates by these spring clips and the fifth sheath is connected to the needles that have knit the last course of yarn. The needles are then programmed for full circular knitting of the body of the toe piece which then results in the toe sheaths being connected together and the tubular toe piece body being completed.

At this point, the toe sheaths are rectangular in form from end to end, and are connected by a piece of yarn extending between the toe sheath's extremities and the ends where they join the body of the toe piece. Upon discharge from the knitting machine, which takes place automatically, the toe pieces are formed by means of forming molds inserted in the toe sheaths, at which stage the connecting yarn length between the toe sheath is cut midway, and the closed ends of the sheaths are pulled to a small pucker by the cut yarn ends, with the free ends of the yarn then being quickly hand-looped or sewn back into the knitted fabric. As an incidental feature, the top, open end of the toe piece body is knit with looser loops than the rest of the body to facilitate the subsequent joining of the toe piece to the stocking upper section on a special machine described in applicant's Pat. No. 3,802,358.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION THE DRAWINGS

FIG. 1 schematically shows a Lamb-type knitting machine from a front view and shows some of the modifications of the present invention;

FIG. 2 is a detailed view taken along line II—II of FIG. 1;

FIG. 3 is a view taken along line III—III of FIG. 1;

FIGS. 4, 5 and 6 show the operation of the slotted bar modification to the basic knitting machine, and the fabric tension means between the needle plates;

FIG. 7 is a detailed view of the yarn holder and cutter mechanism;

FIGS. 8 and 9 schematically show, respectively, the yarn courses at the closed ends of the sheaths and the open end of the toe piece body;

FIG. 10 shows the knitted toe piece being ejected from the knitting machine;

FIG. 11 shows the toe piece being shaped with a form, with the toe sheath ends being pulled tight by a free yarn length;

FIGS. 12 and 13 show the needle lifter assembly from, respectively, the needle engaging side and the outer side; and

FIG. 14 schematically shows how the fabric tensioner is operated during the knitting of each toe sheath.

DETAILED DESCRIPTION OF THE DRAWINGS

With reference to FIGS. 1 and 3 of the drawings, a Lamb-type knitting machine is schematically and partially represented. Basic Lamb machines are well-known, and include knitting plates 9 separated along a central space where the knitting operation takes place. The plates 9 each contain needles 8 which are normally lifted in sequence to perform a knitting operation, either flat or tubular, in a well known manner, by a needle lifter assembly 26 of the type shown in FIGS. 1, 12 and 13. The needles 8 each are provided with protuberances 11 which are engaged by the cam 25 of the lifter 26 when lifter 26 reciprocates left and right as viewed in FIG. 1, assuming the needles have been programmed in a manner to be described for lifting into their respective knitting positions by cam 25 of lifter 26. Needles 8 are lifted by cam 25 in a manner well known in the art.

This invention, in one respect, is concerned with the manner in which selected needle protuberances 11 can be raised from an inactive position as shown in FIG. 10, to an active position as shown in FIG. 3. Accordingly, a programmed cam 7 supported on shaft 7a engages needle lifter bars 7b which are resiliently supported beneath each needle 8. As seen in FIG. 3, rotation of cam 7 causes a raised section 10 of the cam to strike a needle lifter bar 7b which causes the butt end of a needle 8 to rise from its at rest position shown in FIG. 10. This causes protuberance 11 to be lifted above the upper level of the face of the needle plate 9 where it may then be engaged by cam 25 of lifter assembly 26 as the lifter is reciprocated left and right. Synchronized rotation of cam support shaft 7a is achieved through a pawl drive 14 driven through rods and levers 12 from an internal cam tree of the machine, indicated at C in FIG. 1. As shown in FIGS. 12, 13, lifter assembly 26 includes conventional cams 25 and a control bar 27 operating cam

control levers 28a on shafts 28. Such cam assemblies are well known in Lamb knitting machines.

Thus it can readily be observed that sequential indexing of cam 7 for each knitting row causes different needles to be activated, by means of which the width of each row of knitting can be varied simply by raising more or fewer needle protuberances during the knitting operation. The length of fabric knitted during each cycle, of course, is controlled by a timer mechanism (not shown) which can be preset for each knitting cycle to produce the toe sheaths of different lengths.

With reference to FIGS. 4, 5, 6 and 8, a first yarn course 18 for each sheath 2, 3, 4, 5 and 6 is first knit in routine, flat fashion. Succeeding courses are continued in circular knit fashion, however, as is customary in the art, to produce a closed-ended, tubular sheath during each sheath knitting cycle. Each sheath is knit with the same general group of needles to the left of a needle plate 8 shown in FIG. 1. As soon as the top, or open end of each sheath is completed, the upper loops of yarn are cast off these needles and the completed sheath is automatically engaged by the slot 16 of a reciprocating bar 15 and laterally shifted away from the group of needles by the distance of the pitch between one or two adjacent needles, as shown in FIG. 5. This leaves a length of yarn 18a between the last course on the previous sheath and the starting course of the next sheath. This can be readily seen in FIG. 5 where sheath 2 has been completed, and moved to one side by the slotted bar 15. The first course 18 of the succeeding sheath has been knit and a length of yarn 18a is left between the sheaths. As seen in FIG. 6, the length of yarn 18a between sheaths 2 and 3 is of sufficient length to substantially hang in the manner shown in this figure.

When each sheath 2-6 is shifted laterally in the knitting machine, clips 22 shown in FIGS. 1 and 3 automatically grasp each sheath between it and a presser bar 22a. This is accomplished by a cam and lever arrangement (not shown) that is sequentially actuated from the control mechanism of the basic machine, the actuating means here not forming part of this invention.

The slotted bar 15 is actuated in proper sequence to move each sheath by means of a lever system 17 operated by the central cam tree C of the basic machine. It is programmed, of course, to reciprocate to the right as shown in FIG. 5 to shift a knitted sheath to the right away from the sheath knitting area, then back to the left as shown in FIG. 6 in preparation for engaging the next sheath.

The sheaths 2-6 are thus knit in sequence, from the closed end upwards, with the widths being varied in accordance with the automatic setting of cam 7 for each sheath knitting cycle, and the length of the sheaths are controlled by an automatic timer mechanism. At the completion of the last sheath 6, the bar 15 is not activated, and the full set of needles 8 are programmed by cam 7 to tubular knit the remaining full body section of the toe piece 1, connecting together in routine fashion the free open ends of the sheaths 2-6. If necessary, the loops that have been cast off the needles of the individual toe sheaths may be manually hooked onto the needles or placed thereon by suitable automatic means known in the art. The completed toe piece is then ejected downwardly from the machine by advancing rollers 23 as shown in FIG. 10.

In FIG. 7, there is schematically illustrated a yarn holder and nipper for cutting yarn 18 while it is re-

tained against its being pulled while the toe piece is ejected from the machine. Simultaneously, the yarn is cut by means of a pivotal cutter blade in a manner well known in a Lamb knitting machine.

As shown in FIGS. 9 and 11, the last course of knitted yarn 24 at the top of completed toe piece 1 is a loosely knit course as shown diagrammatically at FIG. 9. This is to facilitate the later joining of the toe piece to the remainder of the stocking, as illustrated in applicant's Pat. No. 3,802,358.

As illustrated in FIGS. 4 and 14, a fabric tensioning rod 29 has an elbow 29a that is small enough to fit between successive yarn courses. Once a first course 18 is made in the machine, the bar 29 is cam and lever actuated to be inserted laterally above the row 18 while successive rows are knitted above elbow 29a. The rod 29 is slowly urged downwardly in synchronism with the knitting of each sheath as is customary with machines of this type to maintain a slight tension on the knitted fabric during the knitting operation. FIG. 14 shows the rod 29 actuated from central cams 31 displacing bar 31 through levers 32, bar 31 in turn actuating cam follower roller 33 to move rod 29 both left to right (FIG. 14) and up and down (FIG. 1) in synchronism with the knitting of each toe sheath.

Upon completion of the knitting operation, the toe piece 1 is suitably supported so as to receive shaping molds 20 in each toe sheath as shown in FIG. 11. Here the sheaths 2-6 are finally shaped by stretching and the interconnecting yarn sections 18a are hand cut at some intermediate point. As indicated at 18b, the tip end 18b of each yarn section 18a is pulled to constrict the closed end of each sheath, and subsequently the free ends of yarn 18a are hand sewn or looped back into the fabric in a quick, simple operation. The free end of yarn 18c on the first sheath 2 (FIG. 5), of course, is shown already pulled and sewn into the fabric in FIG. 11.

I claim:

1. A method of making from yarn or the like a knit toe piece having individual, closed ended, tubular toe sheaths connected to a toe piece body, comprising:

- A. flat knitting a first course in a Lamb-type knitting machine using a first group of needles, said first course substantially corresponding in width to the desired width of a first toe sheath; and leaving a free end of yarn at the beginning of said first course;
- B. tubular knitting succeeding courses continuously from said first course towards an upper, open end of said first toe sheath;
- C. casting off the loops of the last-knit course of said first toe sheath at its open end and laterally shifting said first sheath with respect to said group of needles a predetermined distance without cutting the yarn forming the sheath;
- D. sequentially flat knitting over desired widths the first course of the next successive toe sheaths and tubular knitting the remaining courses of said successive toe sheaths using at least some of the needles selected from said first group of needles;
- E. casting off the last knit row of loops of each successive toe sheath except the last sheath upon the completion of each sheath, and laterally displacing in the same direction said successive toe sheaths except the last sheath a predetermined distance with respect to said first group of needles, leaving

a length of yarn between successive toe sheaths to thereby place all sheaths in laterally spaced, aligned proximity to each other, separated by a predetermined distance, and with a length of yarn extending between successive toe sheaths;

F. continuing to knit from said last sheath in tubular fashion the body of the toe piece towards an open end thereof, connecting together the open ends of all said toe sheaths in the process;

G. removing the knit toe piece from the knitting machine;

H. placing a suitable mold in each toe sheath for shaping said sheaths;

I. cutting the yarn lengths connecting the toe sheaths and drawing the closed toe ends into puckers while said molds are within said toe sheaths using the appropriate free ends of the cut yarn lengths and the said free end of yarn at the beginning of said first sheath; and

J. locking the free and cut yarn lengths in place in the knit fabric of the toe piece.

2. The method recited in claim 1, further wherein the last knit course of said toe piece body is relatively loosely knit with respect to the remainder of the said body to provide loose loops for facilitating later joining of the toe piece to a stocking body.

3. In a Lamb knitting machine, having a pair of slotted needle plates with knitting needles thereon and a reciprocating needle lifter mechanism for each needle plate, the improvement for automatically knitting toe pieces with individual, closed ended, tubular toe sheaths from the closed end upwardly to the open ends thereof, with each toe sheath being of different width, said improvement comprising:

A. a programmed cam means beneath said needle plates;

B. needle lifter bars between each needle in said needle plates, each bar being disposed between a respective knitting needle and the cam means;

C. said needles having protuberances which are engaged by said needle lifter mechanism when a portion of the needles are raised from the needle plates, but which are not engaged by said needle lifting mechanism when said needles are at their normal at rest position;

D. means for operating said cam means in synchronism with the operation of the knitting machine during the knitting of said toe pieces to cause selected needles to be lifted by said needle lifting mechanism of said knitting machine, said cam means bearing against individual needles of said lifter bars effecting raising from the needle bed of needles to be lifted by said needle lifting mechanism during each knitting cycle;

E. said cam being programmed to cause selected needles to knit multiple tubular, closed ended toe sheaths of varying sequentially beginning with the closed end thereof and using needles selected from the same group of needles among all the needles of the knitting machine;

F. a slotted bar means for engaging and laterally shifting a predetermined distance between the said needle plates each knitted toe sheath except the last one thereof, with respect to said group of needles, including means for synchronizing the operation of said bar with the sequential knitting of each toe sheath except the last thereof;

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G. clip means for supporting each knit toe sheath, except the last thereof, upon said toe sheaths being laterally shifted by said slotted bar means, said sheaths being vertically supported by said clips in lateral alignment between said needle plates, with the last-knit courses in horizontal alignment;
H. said cam means being further programmed to

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cause said needles to circular knit the body of said toe piece, with said body being connected integrally with said individual toe sheaths, after said toe sheaths have been individually knit;
I. means for ejecting the completely knitted toe pieces from the knitting machine.

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