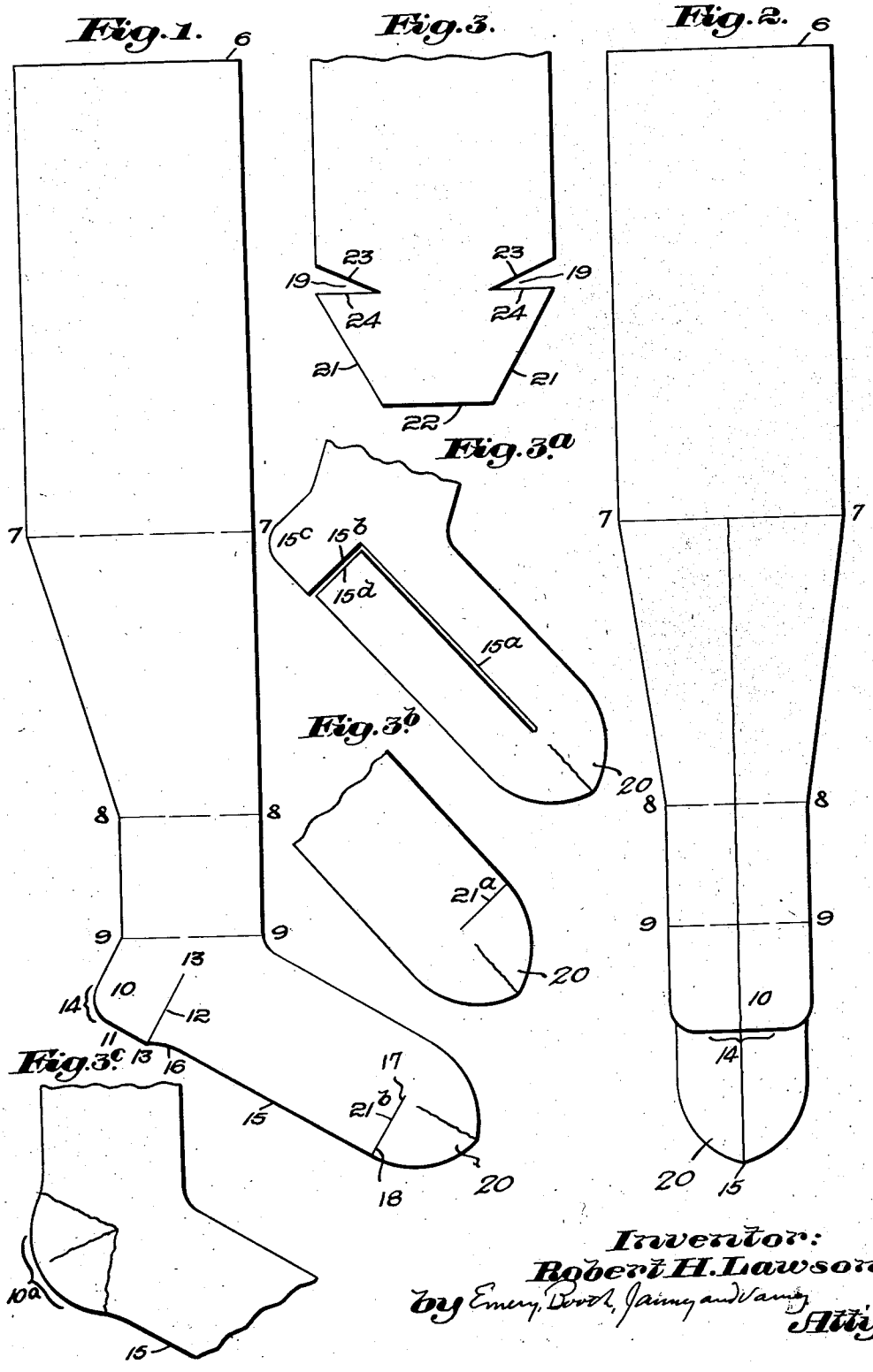
Feb. 14, 1933. R. H. LAWSON 1,897,131

METHOD AND MECHANISM FOR KNITTING FULL FASHIONED HOSIERY

Filed Jan. 24, 1929 4 Sheets-Sheet 1



Inventor:
Robert H. Lawson,
by Emery, Booth, Jaimy and Vamy
Attys.

Feb. 14, 1933. R. H. LAWSON 1,897,131

METHOD AND MECHANISM FOR KNITTING FULL FASHIONED HOSIERY

Filed Jan. 24, 1929 4 Sheets-Sheet 2

Fig. 4.

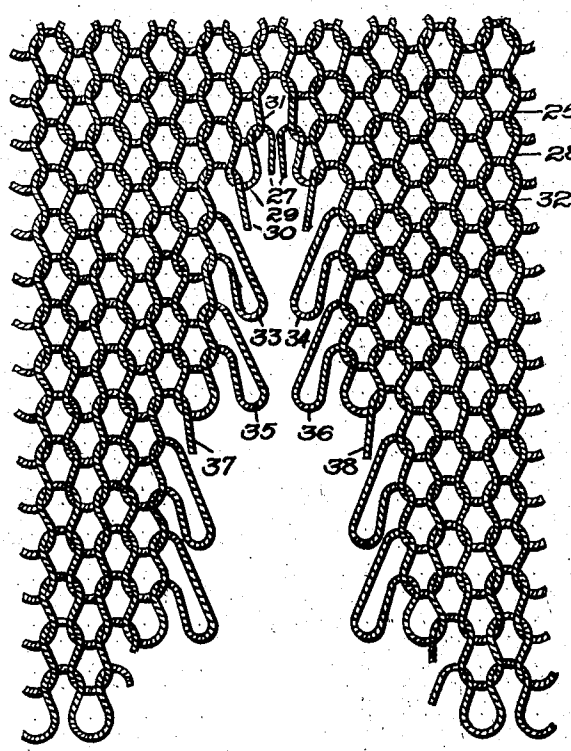


Fig. 5.

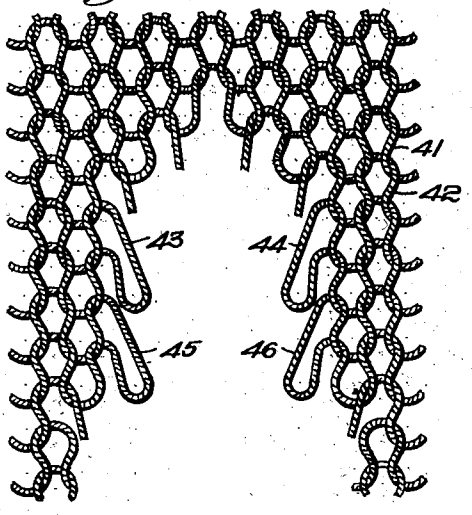
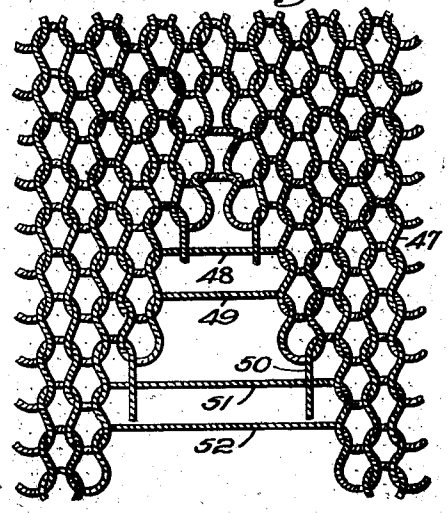


Fig. 6.



Inventor:
Robert H. Lawson,
by Emery, Booth, Janney and Varney,
Attys.

Feb. 14, 1933. R. H. LAWSON 1,897,131

METHOD AND MECHANISM FOR KNITTING FULL FASHIONED HOSIERY

Filed Jan. 24, 1929 4 Sheets-Sheet 3

Fig. 7.

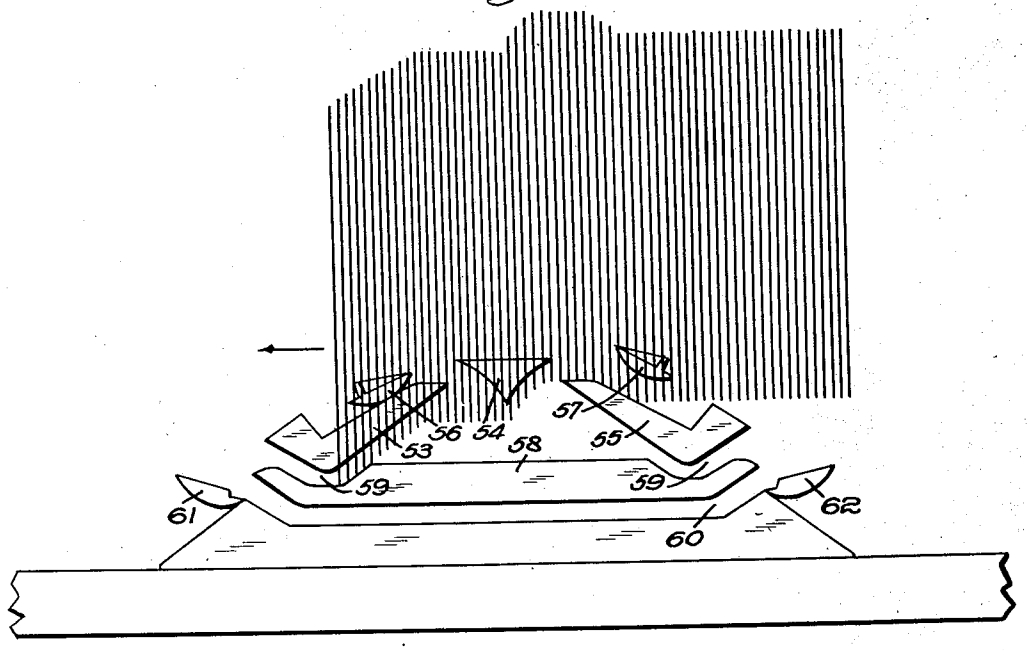
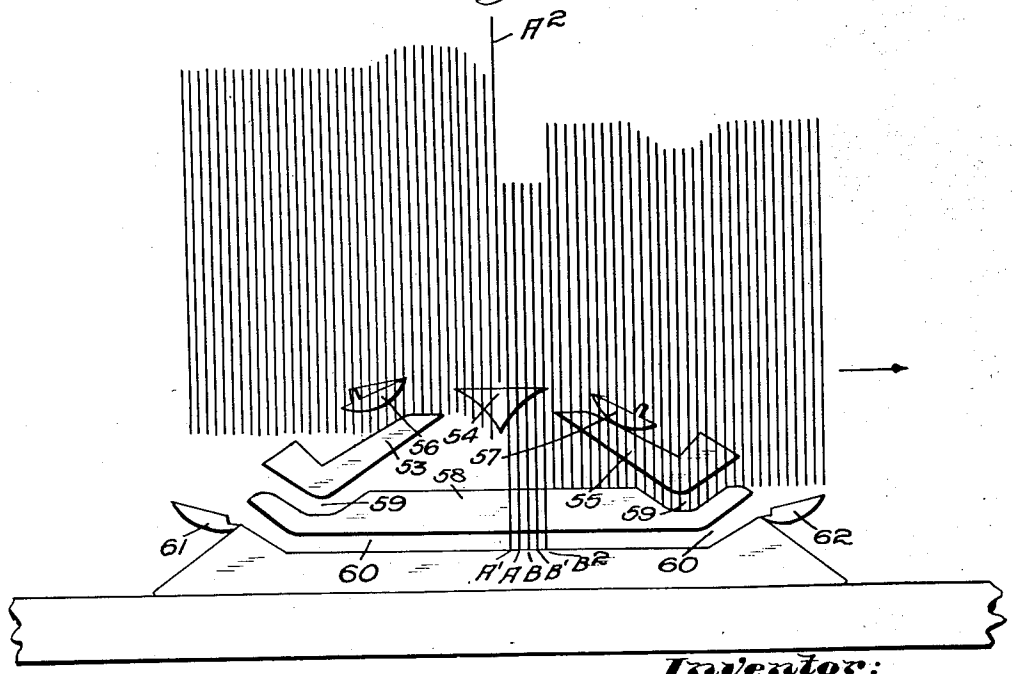


Fig. 8.



Inventor:
Robert H. Lawson,
by Emery, Booth, Janney and Varney,
Attys

Feb. 14, 1933. R. H. LAWSON 1,897,131

METHOD AND MECHANISM FOR KNITTING FULL FASHIONED HOSIERY

Filed Jan. 24, 1929 4 Sheets-Sheet 4

Fig. 9.

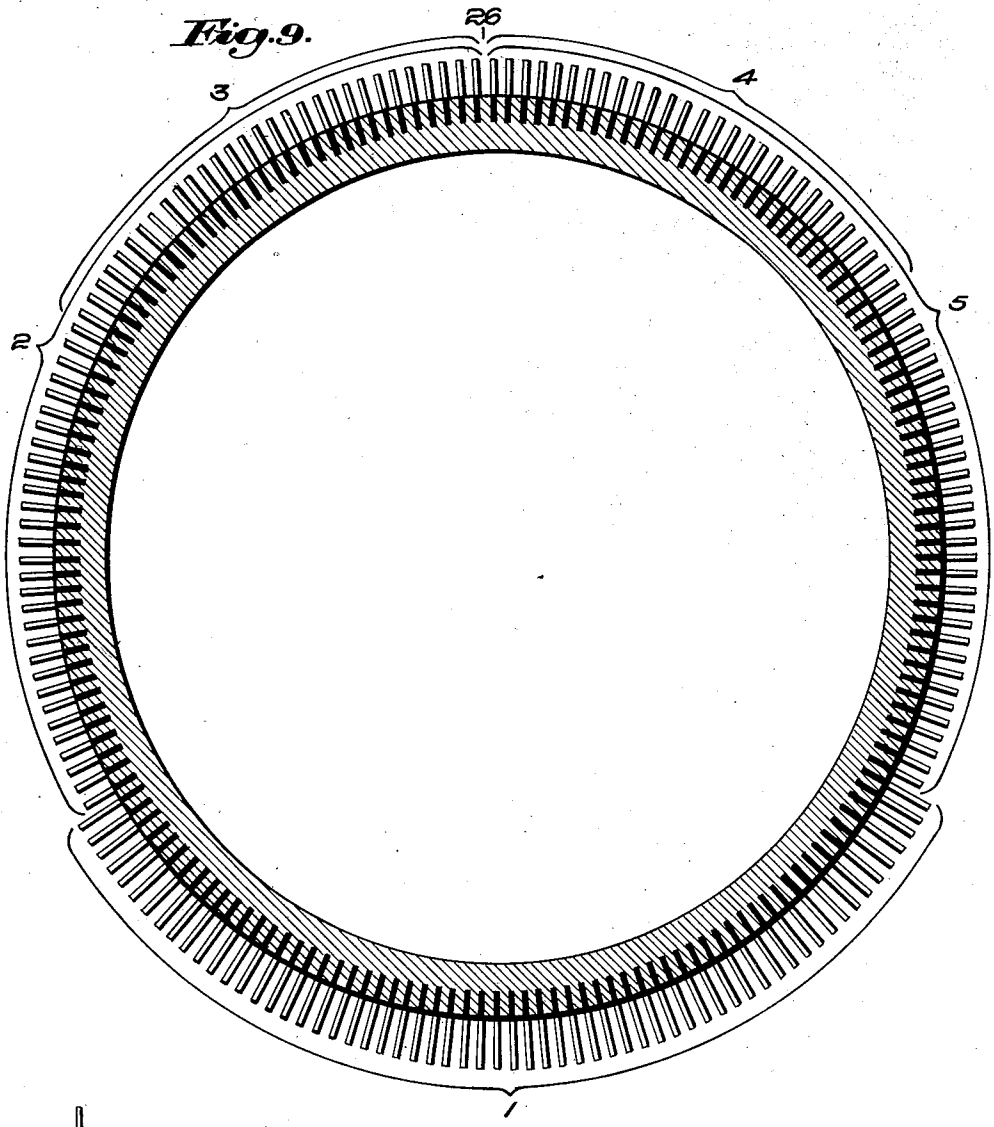
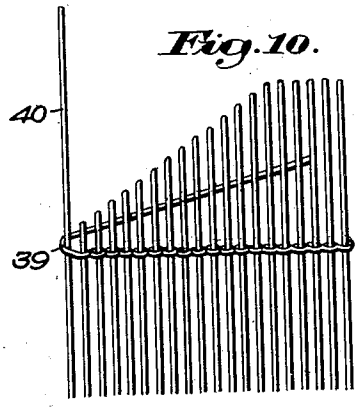


Fig. 10.



Inventor:
Robert H. Lawson,
by Emery, Booth, Jamney and Varney,
Attys

Patented Feb. 14, 1933 1,897,131

UNITED STATES PATENT OFFICE

ROBERT H. LAWSON, OF PAWTUCKET, RHODE ISLAND, ASSIGNOR TO HEMPHILL COMPANY, OF CENTRAL FALLS, RHODE ISLAND, A CORPORATION OF MASSACHUSETTS

METHOD AND MECHANISM FOR KNITTING FULL-FASHIONED HOSIERY

Application filed January 24, 1929. Serial No. 334,825.

This invention relates to full fashioned hosiery and to method and mechanism for making the same. The term "full fashioned" is employed, because the hosiery, although knitted on a circular series of needles, is actually fashioned by the withdrawal of needles and the elimination of wales during the knitting operation.

In order that the principle of the invention may be readily understood, I have, in the accompanying drawings, disclosed several embodiments of the fabric of the invention and the best means known to me for constructing said fabric.

In said drawings:

Fig. 1 is a side elevation of a full fashioned stocking constructed in accordance with my invention;

Fig. 2 is a rear elevation of the stocking shown in Fig. 1;

Fig. 3 is a detail in plan representing a part of the foot and toe;

Fig. 3*a* is a side elevation of the foot of a full fashioned stocking showing a modification thereof;

Fig. 3*b* is a detail showing the seam at the top of the toe;

Fig. 3*c* is a detail showing a heel made by narrowing and widening;

Fig. 4 is a detail upon an enlarged scale of certain of the loops along the two selvage edges which are preferably at the back of the stocking, said figure showing one embodiment of such portion of the fabric;

Figs. 5 and 6 are views similar to Fig. 4, but of further embodiments of the fabric;

Fig. 7 is a somewhat diagrammatic representation of a part of the interior construction of the cams, etc. at and in the vicinity of the knitting cams, and representing the production of circular work.

Fig. 8 is a view similar to Fig. 7 but representing the production of reciprocating work;

Fig. 9 is a diagrammatic plan indicating the grouping of the needles, but without attempt to show the actual number of needles employed; and

Fig. 10 is a detail in elevation showing how the elongated loops of the selvages are formed.

In accordance with the preferred embodiment of my invention, I employ a circular hosiery knitting machine (such, for example, as a Banner knitting machine, of sufficiently large diameter, as, for example 3¾ inches) and mount therein the desired number of needles (as, for example, 300, or 350, or 400, or other suitable number). One third of the needles are long butt needles, and I have indicated the same by the numeral 1 in Fig. 9. The remaining two thirds of the needles are short butt needles, and I have indicated them collectively by the several numerals 2, 3, 4 and 5. All of the needles 2, 3, 4 and 5 are preferably the same, but the groups of needles 3 and 4 are the needles employed in fashioning, the group 3 constituting one sixth of the total number of needles, and the group 4 also constituting one sixth of the total number of needles. My invention is not limited, however, to this grouping, as it may be varied as found desirable.

Preferably I rotate the needle cylinder, though my invention is not limited to so doing. The stocking may be begun at the top or at the toe, but I will describe the same as though it were knitted beginning at the top.

Referring to Fig. 1, the work is begun at the top, as indicated at 6, and is continued upon all the needles by round and round knitting down to the line 7—7. Beginning at the line 7—7 the stocking is knitted throughout the entire remainder thereof by reciprocating knitting.

During such reciprocating knitting I form two selvages, and where desired I withdraw a needle from each edge or selvage portion. Such fashioning is continued upon as many courses as desired and as often as desired down to the line 8—8, after which the reciprocating knitting is continued upon the remaining number of needles without fashioning down to the line 9—9. The heel, which is indicated at 10, is shown in Fig. 1 as a full fashioned heel, and may be somewhat similar to that shown in the patent to Scott & Williams, No. 430,695, dated June 24, 1890. I may, however, make the heel by a narrow-

ing and widening operation, as indicated at 10*a* in Fig. 3*c*. In the knitting operation the stitches along the part which becomes the bottom edge 11 in Fig. 1 are directly connected as a knitted structure with the stitches along the line 12 of Fig. 1, thus forming a sort of a pocket which is cut along the line 13—13 and afterward seamed together, so as to make the full fashioned heel 10. In making such heel of Fig. 1, there may be an actual fashioning at the corner 14 by the elimination or otherwise of needles. The foot shown in Fig. 1 is knitted by reciprocation knitting throughout, so as to form two selvage edges along a line 15 to be afterward seamed together when the stocking is seamed up the back of the ankle and the back of the calf. Instead, the selvage edges may occur at both sides of the foot, as indicated at 15*a* in Fig. 3*a*, in which case there would be selvage edges at 15*b* caused by knitting a full fashioned heel 15*c* to be seamed to the final partial course of the sole at 15*d*.

If desired, there may be an actual fashioning just in advance of the heel at the area 16 of Fig. 1 by the elimination of needles or by the transfer of loops. In some cases, at the termination of the foot (that is, when a line is reached extending from 16 to 17 to 18) I proceed in any one of several ways to make at each edge of the fabric a notch 19, one of which is shown in Fig. 1, and both of which are shown in Fig. 2. Thereafter the toe portion 20 is knitted by fashioning along both edges in the same manner as at the back of the calf. Such two opposite edges, indicated at 21—21 in Fig. 3, are seamed together in the general seaming operation referred to. The fashioning of the toe portion is continued down to the line 22, thus completing the knitting operation. I may, however, so construct the toe that the seam is at 21*a* at the top of the toe, as shown in Fig. 3*b*, or the seam may instead be at 21*b* at the under side of the toe, as shown in Fig. 1.

In order to make the two notches 19—19 (the edges of which are respectively to be seamed or looped together) thereby to give the right shape to the foot and toe, I may, when the two edges 23, 23 are reached, push up one needle at a time, and in knitting the two edges 24, 24, pull down all the needles at once, so as to make what I term a horizontal line as contrasted with the inclined line 23; or I may instead pick up all the needles at a time to make one edge and pull down one of the needles at a time to make the other edge; or I may pick up every other needle to make one edge and then pick down every other needle to make the other edge; or I may resort to variations of these procedures.

Having now described the general structure of the stocking, I will refer to the selvage construction which will be along both edges of the fabric wherever there is reciprocating work (that is to say, it will exist from the line 7—7 onward to the end of the toe). Said selvage edges have two features, each of which constitutes an important feature of the invention. The first of these is the structure of fabric resulting from withdrawing a needle from action, severing the thread and binding or locking, as it were, the stitch and the severed end, so that the severed end will not ravel. The second of these features is the formation of enlarged or elongated loops at the non-fashioned parts of the selvage edges, said enlarged loops offering facilities in the seaming operation and not only strengthening the selvages but providing additional material to be engaged by the seaming thread so that a stronger seam can be made.

Referring first to that embodiment of the invention shown in Fig. 4, the circular knitting with which the stocking is begun, is continued down through the course marked 25. Then, to commence the first reciprocating course, which will desirably begin at one of the very center needles of all the short butt needles, as, for example, at 26 in Fig. 9, the thread is thrown into the binder and cutter and is cut as indicated at 27 in Fig. 4. The reciprocating action continues until the toe is completed.

The first course of the reciprocating knitting, which is indicated at 28 in Fig. 4 is continued as indicated in said figure until the last loop thereof is formed at 29 in Fig. 4. I then withdraw from action the needle which made said loop 29, and in doing so I pull the thread through the loop as indicated at 30, this being the free end of the thread resulting from severing the thread in the binder, as already stated. This thread end being pulled through, the loop 29 is bound or pinched in by the loop 29 and so is held from raveling. It will be understood that the other severed end of the thread, as indicated at 27, is pinched or held by the loop 31 and is so held from raveling out. Then the next course is knitted, which will be the course indicated at 32, the knitting going in the opposite direction, and the same operation is gone through with of withdrawing a needle and severing the thread, provided I desire to continue to withdraw needles in successive courses. In Fig. 4 I do not withdraw a needle from each selvage in immediately successive courses, but instead I next make one or more courses upon all the remaining needles and form the enlarged, non-knitted loops at both edges of the fabric, as indicated at 33, 34, 35, 36, etc. When I have made a sufficient number of enlarged loops in a series of courses, I then narrow again by withdrawing one needle from action at each end of the series of needles in a course and throw the thread into the binder and cut the same, as indicated

at 37, 38, these operations being continued throughout the fabric.

It is to be understood that the points at which I withdraw needles and the point at which I make the enlarged loops depend upon the amount of fashioning desired and the points at which the fashioning is to be done.

In order to make the enlarged loops 33, 34, 35, 36, etc. I lap the thread, as indicated at 39 in Fig. 10, around the last needle 40 of the series. The thread is wrapped around the stem of the needle entirely below the latch and in such position that the thread does not get into the inside of the latch of that needle and consequently is not knitted by that needle. The said needle is by the mechanism of the machine entirely withdrawn from action, thus leaving the enlarged loops as described.

In the construction shown in Fig. 4, I withdraw one needle from action at each edge of the fabric, and then in the next course, and preferably in the next two courses, I form enlarged selvaged loops. I am not limited to such procedure, however, and as representation of a variation thereof I have in Fig. 5 represented the cutting of the thread in each of two successive courses, as, for example, courses 41, 42, and in the next two subsequent courses I form enlarged, non-knitted loops indicated at 43, 44, 45, 46. Other variations of this procedure may be employed, as, for example, by forming the enlarged loops in a greater number of successive courses before again withdrawing needles, and withdrawing needles, if desired, in a greater number of successive courses than two, as for example, when making the toe, or at other desired points.

In Fig. 6 I have indicated another method of procedure which is wholly by circular work, and that circular work will be carried throughout as much of the stocking as desired. I, however, actually withdraw needles in the manner already described along the two edges, and the float which occurs where a needle or needles is or are withdrawn is thrown into the binder and is there severed, and this operation is continued as long as desired.

In said Fig. 6, I have represented a course 47 where a needle is withdrawn and the float cut, and at 48, 49, 50, 51, 52, I have represented succeeding courses in the third of which the float is thrown into the binder and cutter and cut, this sequence of operations being continued throughout the fashioning.

In order to carry out the two operations of withdrawing the needles and making the longer, non-knitted loops, I may and preferably do employ mechanism, a part of which is represented in Figs. 7 and 8. Therein the knitting cams are indicated at 53, 54, 55, and in regular knitting the needles move in the direction of the arrow on Fig. 7. Above the cams 53, 55, are the two pickers 56, 57. Below said cams is a cam 58, just above which is provided a pathway 59 for what I term the "temporarily inactive" needles, namely, the needles (one of which is represented at 40 in Fig. 10) about which the elongated loops are formed and which needles are drawn down out of action so as not to knit but are at once again restored to action. Therefore, said needles travel along the pathway indicated at 59. One of such needles is indicated at A2 in Fig. 8. Said needles are, of course, subsequently permanently withdrawn, that is, wherever the fabric is actually fashioned, and in Fig. 8 certain of the permanently withdrawn needles are shown as in the fully inactive pathway 60, said needles being the needles A, B for one course, the needles A′, B′ for a succeeding course, and the needle B2 for another succeeding course, it being understood that the needle A2 also finds its way into the said fully inactive pathway.

In order to guide the needles at the proper times, I employ additional pickers or it may be cams. In Figs. 7 and 8, I have represented a second set of pickers 61, 62, and it will be understood that a needle which in either direction of reciprocation is engaged by a picker 61, 62, is thereby elevated so as to come above a cam 53 or 55 and at the proper time will come under the influence of a picker 56 or 57, so as to be thrown above the cam 54. A needle is thrown above the cam 54, as indicated at A2 in Fig. 8, when the thread is to be wrapped around the stem thereof below the latch to make an enlarged, non-knitted loop. It is not to be understood that in the making of the enlarged loop the needle is brought from the fully inactive pathway 60. A needle about which the enlarged loop is to be formed is the terminal needle at one end of the active series, and would be elevated from the active series by the picker 56 or 57, so as to pass above the cam 54. Such needle will in the next course either again have an enlarged loop formed around it, as just described, or it will be entirely withdrawn from action and thrown down by suitable cam means or other picker means into the wholly inactive pathway 60. The needles which are entirely withdrawn from action gradually accumulate in the fully inactive pathway 60 and when the stocking is finished, they are automatically brought back into action so that the next stocking is begun upon all the needles.

In the reciprocating action the reciprocating element (desirably the needle cylinder) is moved through a complete revolution and an additional part of a revolution, as, for example, one third of a revolution in excess. That would result in twice elevating some of the needles, namely, those represented by the excess one third of a revolution. To prevent such a result, I cause all the needles repre-

sented by that one third of an excess revolution to pass along the temporarily inactive pathway 59 as indicated in Fig. 8.

The pickers, cams and other parts to carry out these operations are automatically operated under pattern control from the main pattern drum or a supplemental pattern drum or chain, but I have not attempted in this application to show the same. Recapitulating, I state as follows: The machine is operated by continuous circular knitting (that is, by continuous round and round movement of the needle cylinder down to the line 7—7 of Fig. 1, which corresponds to the line indicated by 25 in Fig. 4). Thereafter only reciprocating knitting is done in the preferred form of the invention. Each reciprocating movement is a long one (that is to say, it is sufficiently long to carry the knitting needles past all of the knitting cams). That means that the needle cylinder for each stroke of reciprocation makes one complete turn and about one third of another turn. Then the return stroke of the reciprocation begins and continues sufficiently far to constitute one revolution and a third of another, and then the next reciprocation begins, and so on. In the preferred embodiment of the invention, however, this long reciprocation continues at all times after the line 7—7 is reached.

As to how the machine works when cutting off the yarns, we refer to Fig. 4, and considering either the right hand side or the left hand side of the figure, it will be seen that the yarn is severed at 27. The yarn is severed at the end of a reciprocation, if at that point a needle is to be withdrawn from action, and the severed end of the yarn is drawn through a loop (see the severed end 30 which is drawn through the loop 29). If a needle is not withdrawn from action at the end of reciprocation, the yarn is not severed, but the loops are made longer at the selvage (see the loops 33, 35). This is a new feature, and the unusually long loops at the selvage edges offer facilities in the seaming operation, because they provide additional material to be engaged by the seaming threads.

If a thread is severed at the end of a stroke in one course, the severed end is shown at that course (see, for example, one of the ends 27), and the other end of that cut would be shown in the next course (see, for example, one of the ends marked 30). Of course, Fig. 4 is shown much enlarged for the sake of clearness. In actual practice, the end 30 is held fixed, and the same is true of the other severed ends.

Having thus described certain embodiments of the fabric of my invention and certain methods for practicing the method of my invention and means for producing the fabric and carrying out the method, I desire it to be understood that although specific terms are employed, they are used in a generic and descriptive sense and not for purposes of limitation, the scope of the invention being set forth in the following claims.

I claim:

1. That method of knitting full fashioned hosiery which comprises knitting tubular work as far as desired and then reciprocating and in so doing severing the thread end at the commencement of the reciprocation and drawing the severed end through a terminal loop to be pinched or held thereby from raveling.

2. That method of knitting full fashioned hosiery which comprises knitting tubular work as far as desired, and then reciprocating and in desired courses wrapping the thread about the stem of the needle but without knitting the thread by said needle whereby an enlarged selvage loop is formed at both ends of a course of reciprocation.

3. That method of knitting full fashioned hosiery which comprises knitting tubular work as far as desired, then reciprocating and in so doing severing the thread end at the commencement of the reciprocation and drawing the severed end through a terminal loop to be pinched or held thereby from raveling, and in desired courses wrapping the thread about the stem of the needle but without knitting the thread by said needle whereby an enlarged selvage loop is formed at both ends of a course of reciprocation.

4. That method of knitting full fashioned hosiery which comprises knitting tubular work as far as desired, and then reciprocating and in desired courses elevating the terminal needle at each end of the reciprocation sufficiently to permit the thread to be wrapped around the stem of the needle without being knitted thereon, and then in a subsequent course withdrawing said needle from action and severing the thread, whereby the withdrawal of the needle effects the drawing of the severed end through the terminal loop and the pinching or binding of said end by said loop.

5. In a circular knitting machine, means for forming circular work, means for forming reciprocating work, means for withdrawing successively the end needle of the series from action upon severance of the thread, whereby the needle in the act of withdrawing pulls the end of the thread through the last loop so as to be pinched thereby.

6. In a circular knitting machine, means for forming circular work, means for forming reciprocating work, and means for wrapping the thread at one or both ends of reciprocating courses about the terminal needle but without knitting the thread by such needle, whereby an enlarged terminal non-knitted loop is formed.

7. In a circular knitting machine, means for forming circular work, means for forming reciprocating work, means for withdraw-

ing successively the end needle of the series from action upon severance of the thread, whereby the needle in the act of withdrawing pulls the end of the thread through the last loop so as to be pinched thereby, and means for wrapping the thread at one or both ends of reciprocating courses about the terminal needle but without knitting the thread by such needle, whereby an enlarged terminal non-knitted loop is formed.

8. In a circular knitting machine, means for forming circular work, means for forming reciprocating work, and means for elevating the end needle at one or both ends of the series and wrapping the thread about such elevated needle so as to form enlarged terminal non-knitted loops, and means for subsequently withdrawing from action said elevated needle upon severance of the thread, whereby that needle draws the severed end through a terminal loop.

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

ROBERT H. LAWSON.