Feb. 4, 1941. B. F. SOMERS 2,230,986

METHOD OF WIDENING ON FLAT KNITTING MACHINES

Filed July 9, 1940 7 Sheets-Sheet 1

Fig. 1.

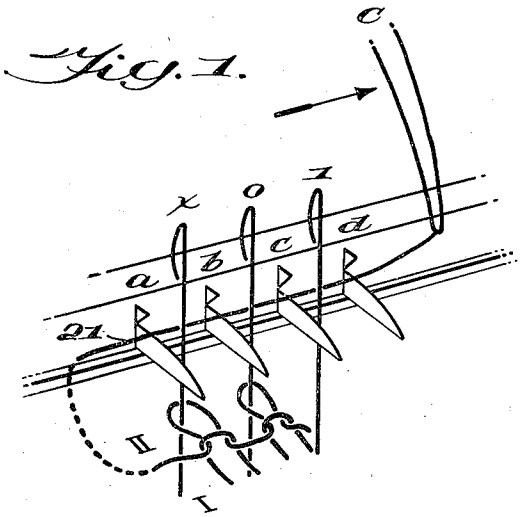


Fig. 2.

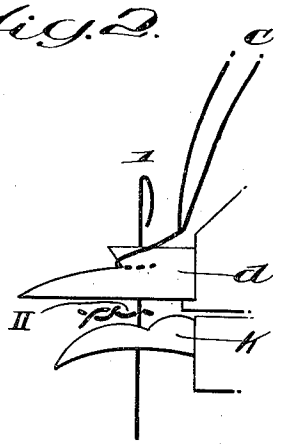


Fig. 3.

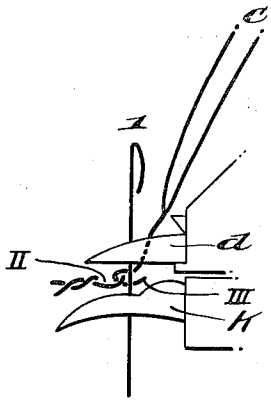
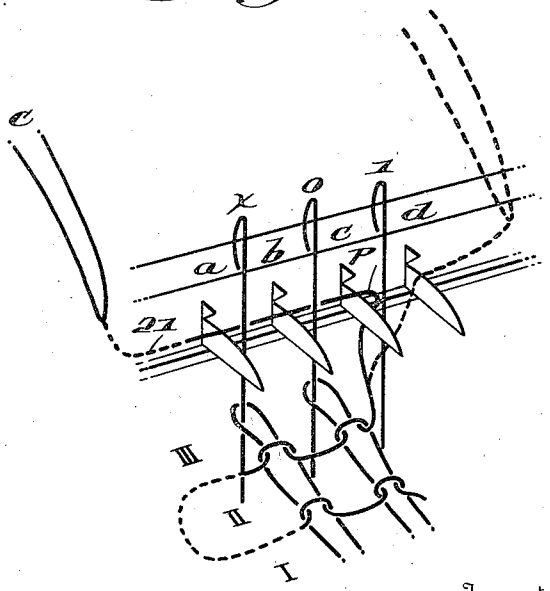


Fig. 4.



Inventor
Benjamin F. Somers,

By Edmund W. Parry Jr
Attorney

Feb. 4, 1941. B. F. SOMERS 2,230,986

METHOD OF WIDENING ON FLAT KNITTING MACHINES

Filed July 9, 1940 7 Sheets-Sheet 2

Fig. 5.

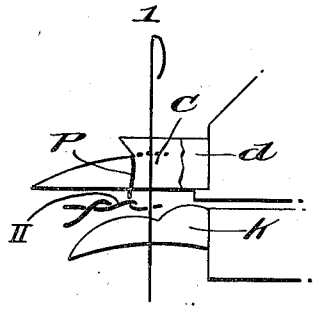


Fig. 6.

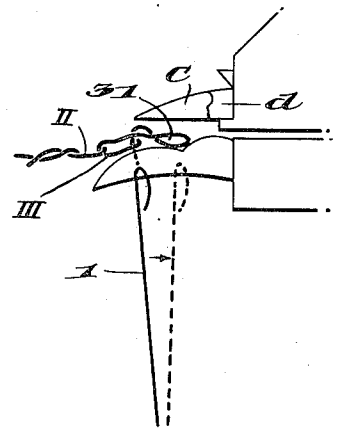


Fig. 7.

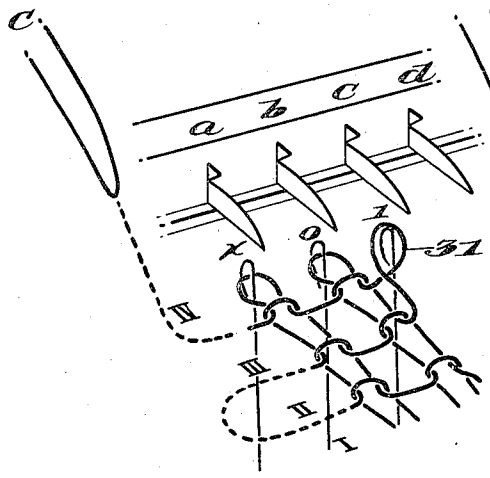
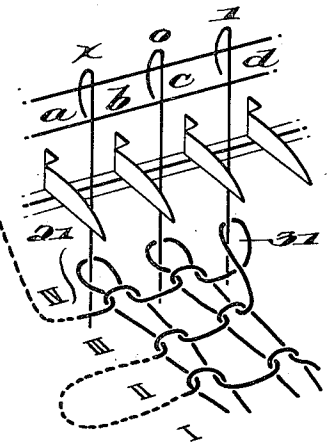


Fig. 8.



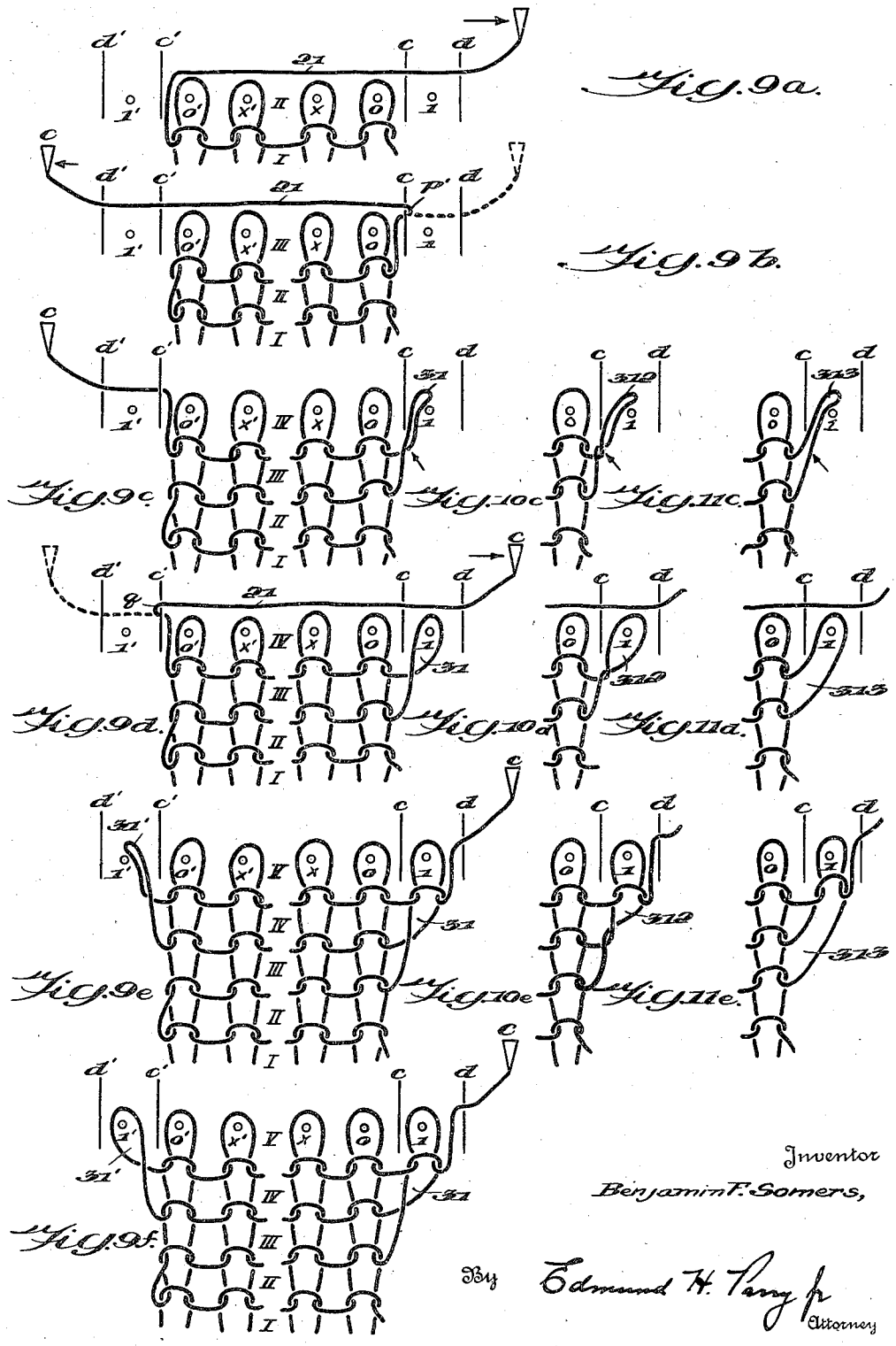
Inventor
Benjamin F. Somers

By Edmund H. Parry
Attorney

Feb. 4, 1941. B. F. SOMERS 2,230,986

METHOD OF WIDENING ON FLAT KNITTING MACHINES

Filed July 9, 1940 7 Sheets-Sheet 3



Inventor
Benjamin F. Somers,

By Edmund H. Perry Jr
Attorney

Feb. 4, 1941. B. F. SOMERS 2,230,986

METHOD OF WIDENING ON FLAT KNITTING MACHINES

Filed July 9, 1940 7 Sheets-Sheet 4

Fig. 12a

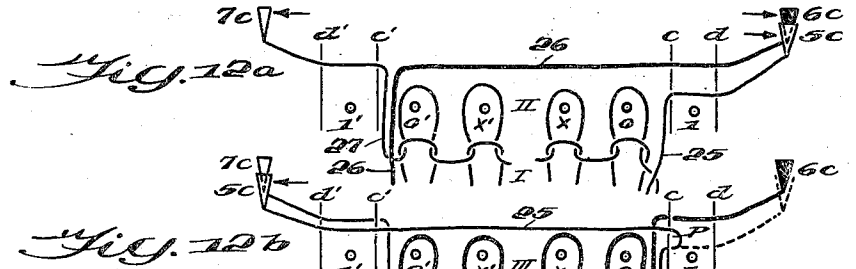


Fig. 12b

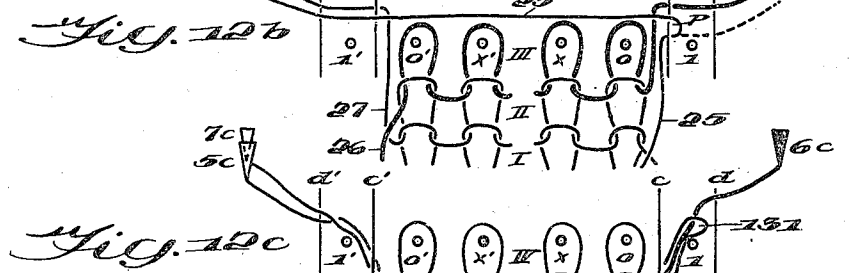


Fig. 12c

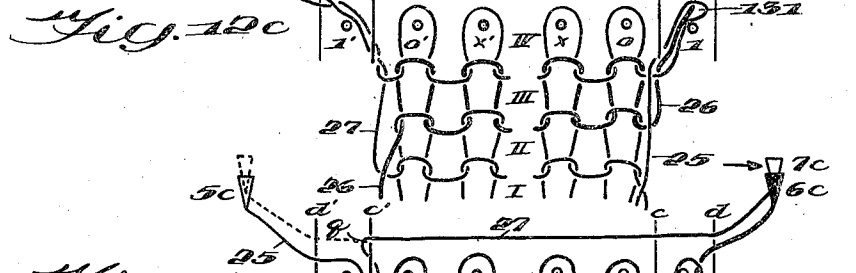


Fig. 12d

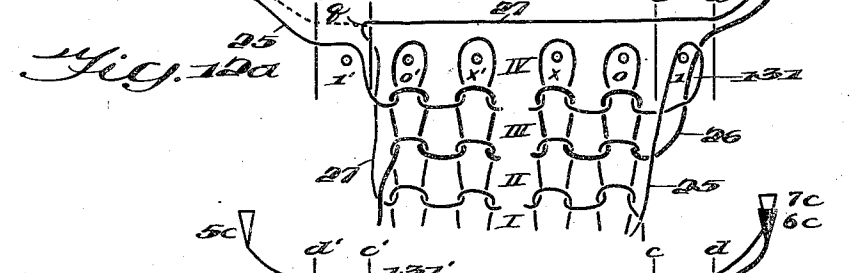


Fig. 12e

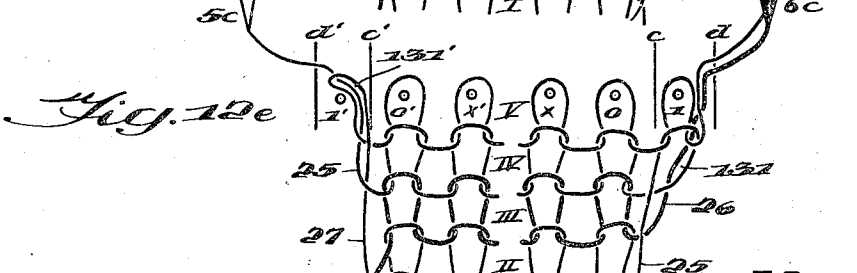
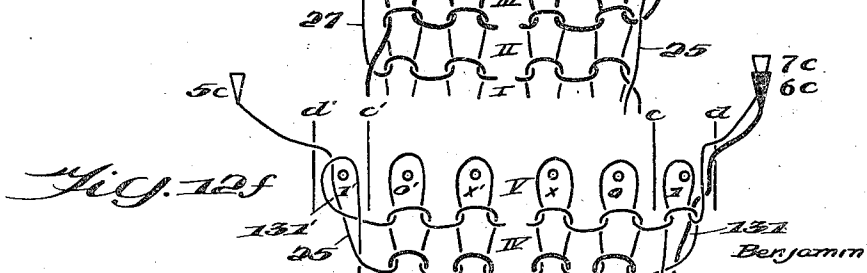


Fig. 12f

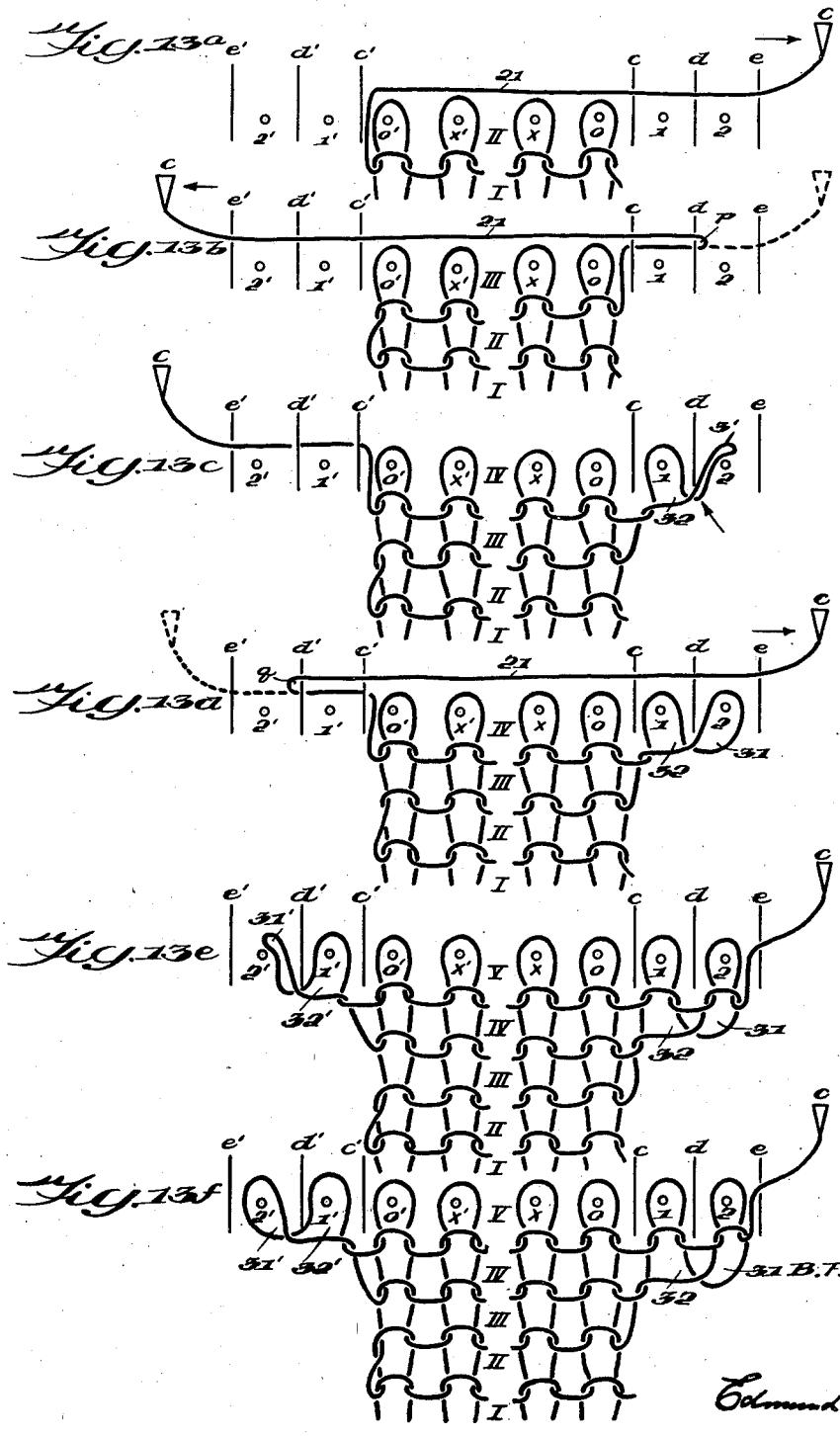


Inventor
Benjamin F. Somers
Edmund H. Parry Jr.
Attorney

Feb. 4, 1941. B. F. SOMERS 2,230,986

METHOD OF WIDENING ON FLAT KNITTING MACHINES

Filed July 9, 1940 7 Sheets-Sheet 5

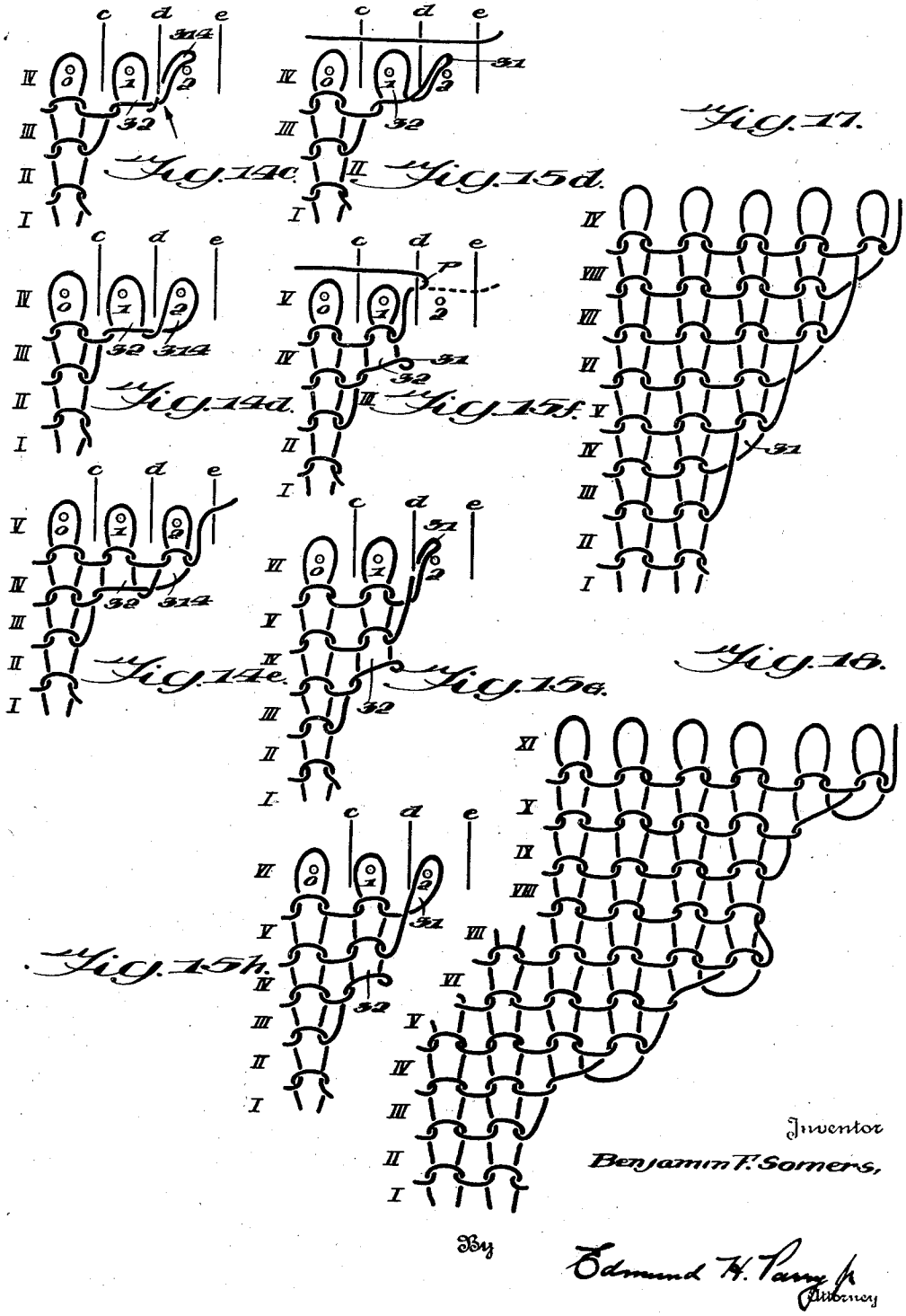


Inventor
B. F. Somers,
Edmund A. Pappy
Attorney

Feb. 4, 1941. B. F. SOMERS 2,230,986

METHOD OF WIDENING ON FLAT KNITTING MACHINES

Filed July 9, 1940 7 Sheets-Sheet 6

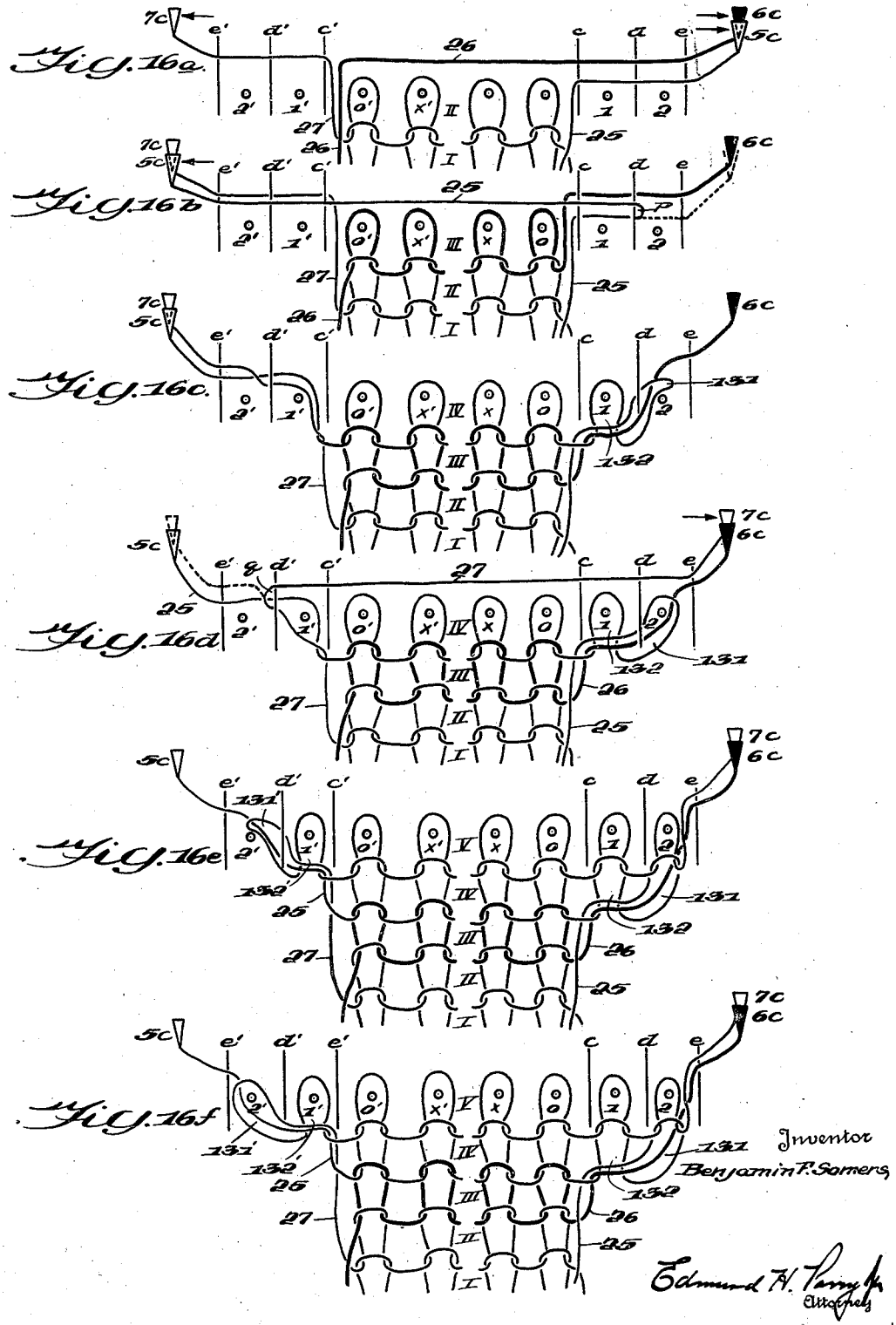


Inventor
Benjamin F. Somers,
By
Edmund H. Parry Jr
Attorney

Feb. 4, 1941. B. F. SOMERS 2,230,986

METHOD OF WIDENING ON FLAT KNITTING MACHINES

Filed July 9, 1940 7 Sheets-Sheet 7



Patented Feb. 4, 1941 2,230,986

UNITED STATES PATENT OFFICE

2,230,986

METHOD OF WIDENING ON FLAT KNITTING MACHINES

Benjamin F. Somers, Indianapolis, Ind., assignor to National Silk Hosiery Mills, Inc., Indianapolis, Ind., a corporation of Indiana

Application July 9, 1940, Serial No. 344,574

37 Claims. (Cl. 66—89)

This invention involves a method of widening fabrics, for example, full-fashioned stockings in the heel or any other sections thereof, on flat knitting machines through the addition of new loops at the end, or ends, of fabric courses. According to the new method all added loops are positively locked in a simple and effective manner so as to provide a good selvage edge along widened areas of the fabric.

The method permits of widening at either or both edges of fabric either by one, two, three, four, or a larger number, of new loops. Also, the method does not depend on the number of yarns and yarn carriers employed, and is equally applicable where successive fabric courses are knit with a single continuous thread, and where a multiplicity of different yarns are employed in successive courses according to a predetermined repeating sequence, as in the production of "ringless" fabric. According to the novel method the knitting machine is operated in the same manner regardless of the number of loops added and regardless of the number or weight of yarns employed, and in each instance a locked selvage edge is formed.

The present widening method is particularly significant in that it may be carried out on conventional flat knitting machines and machines of the latest types merely through the use of the ordinary instrumentalities employed in conventional knitting (i. e.—thread carriers, needles, sinkers and dividers, and knockover bits). It does not require the addition of special needle cooperating elements or require alteration in the operating sequence of the machine parts, so that it may be carried out without expensive rebuilding of a known knitting machine. Important also, it is carried out without interrupting machine operation and at the same machine speed as in straight knitting.

The present invention is particularly directed to the method of operating the ordinary knitting instrumentalities of machines to effect the desired widening. A characteristic and relatively simple locked stitch selvage edge is obtained along the widened fabric areas which is clean-cut, relatively elastic, and easy to seam up.

Widening by the addition of loops at the ends of courses has definite advantage over widening by the loop transfer method in that, among other things, the latter method necessitates slowing down of the machine speed, produces a line of openings in the widened courses, produces an undesired tensioning of stitches which makes the edge along the widened area inelastic and subject to easy rupture, frequently causes needle injury or breakage and defective fabric with dropped loops, and it is practically limited to use with light weight yarn and widening by a single needle at a time. However, widening by the addition of edge loops has not been commercially practiced to any great extent because of the necessity of employing special knitting machines, such as Jacquard machines or at least the necessity of rebuilding and/or otherwise fundamentally altering machines, to enable the widening to be carried out. It has not heretofore been considered that a flat knitting machine, such as a full-fashioned hosiery machine, is inherently capable of widening by means of the usual instrumentalities to produce locked added edge loops regardless of the number of needles added and the number of yarns used.

When widening by the addition of loops it has heretofore been considered necessary that the yarn be placed at the back of the added end needle and carried outside and around such needle to the front, or beard, side thereof. Accordingly, the thread carrier was moved out after a course had been completed, and when the needles had gone down in the knockover. The thread coming up from a preceding course would thus be placed at the back and around the outside of the end widening needle preparatory to laying the next course.

Such method of machine operation for widening was proposed in Poron French Patent No. 601,614 and French patent of Addition No. 30,362, also in Frenzel et al. British Patent No. 483,546. A similar method was apparently employed by Smetana in the production of "ringless" fabric according to U. S. Patent No. 2,109,156.

As illustrated in Heinitz Patent No. 1,829,650, widening by the addition of selvage loops is useful in the manufacture of stockings in a single unit on a flat knitting machine through the operation of widening the stocking blank after the leg is knit to form the heel sections, narrowing the heel sections and thereafter knitting on the foot. Such proposal, however, was not practical because it necessitated the use of a special machine, illustrated in aforementioned Patent No. 1,998,368, incorporating special needle cooperating elements for widening which are lacking and undesirable in flat knitting machines of the conventional full-fashioned hosiery legger type such as are standard equipment in practically all hosiery mills. Since the widening process of the present

invention requires only the ordinary instrumentalities employed in conventional knitting as before stated, stockings with selvage edged widened heels may now be made on the conventional machines. When it was desired to widen by more than one needle at a time difficulties were encountered in securing locking of the added loop or loops intermediate the original end loop and the end added loop which necessitated the carrying out of the widening in successive stages and/or the employment of special needle cooperating elements. Reference in this connection is made to the aforesaid Poron French patent of Addition No. 30,362, and Heinitz U. S. Patents Nos. 1,955,632 and 1,998,368.

As a background for the present invention, it is important to understand certain fundamental facts regarding the position at which the yarn carrier stops in relation to the end needle of a course, and the position of the yarn. When a yarn carrier lays a course across the needle bank in ordinary knitting the stop therefor is so adjusted that the carrier will come to rest position over the divider outside of the needle beyond the desired end needle. Thus, the sinker between the end needle and such extra needle will cooperate in sinking a loop of the yarn on the end needle. Since the end of the yarn carrier is located above the divider beyond the extra needle, such divider will not act on the thread when the sinkers and dividers move out, and the yarn extends from the sinker at an inclination upwardly and away from the extra needle to the yarn carrier over the top of the divider clear of the extra needle. When the needle bank moves down to castoff the previous course and place the newly formed course between the line of sinkers and dividers and the knockover bits, the yarn coming from the newly formed end loop remains on the inside of the sinker located between the end needle and the extra needle, and passes from the inside of the sinker outwardly across the top thereof to the yarn carrier in its position over the divider beyond the extra needle. When the yarn carrier moves inwardly across the needle bank to lay the next course, the yarn coming from the end loop will pass inside the sinker outside the end needle, and will run from the loop formed therefrom and located on the end needle in a position below the sinkers and dividers upwardly and inwardly around the outside and beard side of the end needle clear of the sinker.

Where widening is to be effected at the end of a course to the extent of only one needle, it is evident from what has just been said that the yarn carrier stop must be adjusted so that the carrier will come to a rest position over the sinker outside of the second extra needle beyond the end needle. Again, where a course is to be widened by two loops, the yarn carrier stop must be adjusted so that the carrier will come to a rest position over the divider beyond the third needle outside of the old end needle of the course.

When the traverse of the yarn carrier is extended for widening as just explained, the added yarn beyond the end needle may be placed below the line of sinkers and dividers when the needle bank descends so that when the yarn carrier moves inwardly to lay another course, the yarn will pass around the outside of a sinker or divider beyond the old end needle and be held thereby during the laying of the new course by the yarn carrier.

The widening method of the present invention is characterized by the following novel features:

a. The yarn is always laid across all added needles beyond the margin of the fabric when the needles are in their raised position.

b. The yarn is not wrapped around the outer side of the added end needle, but is always placed on the front (beard side) of such needle, and, in the case of multiple needle widening, on the front side of all added needles intervening between the added end needle and the margin of the fabric.

c. The yarn is always laid by movement of a yarn carrier, or several carriers, across all added needles in a direction outwardly from the margin of the fabric on the front needle side below the beard and above the sinkers.

d. The yarn is carried around the outside of a sinker (or divider) beyond the old end needle, and in passing from the bottom to the top side of such sinker or divider does not pass around the back and outer side of any needle beyond the old end needle but lies entirely on the front side of each added needle.

e. There are at one time two lengths of yarn located on the front side of the needle bank, one length lying beneath the sinkers and the other length lying across the top side of the sinkers. Such two lengths of yarn will merge in a loop formed around the sinker (or divider) located between the outside added needle and the next inner needle.

f. The movement of the yarn carrier outwardly across the front of one or more additional needles always takes place incident to the formation of a course before the needle bank has been moved downwardly to place the particular course below the sinkers.

g. Whereas in known knitting practice loops are always formed on needles, in the present case certain loops at the ends of widened courses are formed on sinkers (or dividers) and thereafter transferred onto needles.

h. In the case of single needle widening the added end loops are formed on the sinker between the added end needle and the old end needle and thereafter transferred onto the added end needle; and in the case of two needle widening the end added loop is formed on the divider between the two added needles and thereafter transferred onto the outside added needle, while the first added loop is formed on the first added needle.

As previously mentioned the present invention does not require any extra needle cooperating elements, and essentially involves a suitable coordination in the movement of the yarn carrier, or carriers, in laying yarn across the added needles beyond the margin of the fabric in relation to the position and movement of the needle bed and the position and movement of the sinkers. It is not necessary for the purpose of widening to change the timing of movement of the needles and sinkers, and the process is carried out without in any way altering the sequence of operation of the machine as employed in straight knitting. It is merely necessary to move out the yarn carrier stops so that the yarn carrier, or carriers, will lay yarn across the added needle, or needles, beyond the margin of the fabric at a suitable time in relation to the operation of the needles and sinkers.

In its simplest phase the method includes the following steps:

1. A course of yarn is laid in the usual manner across the sinkers on the beard side of the needle bank, say from left to right;

2. The yarn carrier stops are moved outwardly during the laying of such course one or more

needles beyond the margin of such fabric so that the yarn carrier extends the yarn across the front of the added needle, or needles, and stops beyond the sinker outside the added end needle;

3. The sinkers (including the dividers) are projected to sink all loops of the widened course;

4. The needle bank descends and the sinkers retract to cast off the previous course and place the widened course below the sinkers, and thereafter the needles ascend to leave the widened portion of the course on the front of the added needle, or needles, below the sinker (or divider) inside the end added needle but above the sinker (or divider) outside the end added needle;

5. The yarn carrier moves across from right to left to lay the next course, the yarn at the right passing upwardly from the front side of the needle bank around the sinker (or divider) inside the end added needle, forming a loop thereon, and across the front of the next inner needle above the sinkers;

6. The sinkers (including the dividers) are then projected to sink the complete course;

7. The needle bank again descends to castoff the first widened course, including the portion thereof held by intermediate added needles (if any) between the end added needle and the old end needle at the right, and place the second widened course, including the portion thereof held by the intermediate added needles (if any) at the right, beneath the sinkers, and thereafter the needle bank rises preparatory to the laying of the next course;

8. During descent of the needle bank the loop formed on the sinker (or divider) inside the end added needle is drawn off and downwardly to a position across the knockover bits adjacent the end added needle, and while the needle bank is down, as it rises from its knockover movement, such loop is impaled on the end added needle.

The essential steps of the method are the same regardless of whether the widening is effected over one or a plurality of added needles. The widening may be carried out at either or both margins of the fabric, and it is immaterial whether the yarn forming the first widened course or a different yarn (as under the ringless system) is employed in the second widened course.

The practice of the inventive method will be more fully understood from the series of applications thereof illustrated in the accompanying drawings and the following detailed description.

In such drawings:

Figs. 1–8 are more or less diagrammatic views of a small portion of the needle bank of a conventional flat knitting machine together with the cooperating elements, Figs. 1, 4, 7 and 8 being perspectives and Figs. 2, 3, 5 and 6 being end views taken from the right, and showing various stages of the widening of a fabric according to the inventive method;

Figs. 9*a*–9*f* are diagrammatic views taken from above the needle bank generally corresponding to Figs. 1–8, and particularly illustrating progressive operating stages in the widening of a fabric formed from a single yarn by one additional needle at each edge;

Figs. 10*c*, 10*d*, and 10*e* are diagrammatic views illustrating the same operating stages as Figs. 9*c*, 9*d* and 9*e* but showing a variation in the widening loop formation;

Figs. 11*c*, 11*d* and 11*e* are diagrammatic views illustrating the same operating stages as Figs. 9*c*, 9*d* and 9*e* but showing a further variation in the widening loop formation;

Figs. 12*a*–12*f* are progressive diagrammatic views corresponding to Figs. 9*a*–9*f* except that the fabric is formed with three yarns in successive courses;

Figs. 13*a*–13*f* are progressive diagrammatic views showing the widening of a fabric knit with one yarn by two additional needles at each edge;

Figs. 14*c*, 14*d* and 14*e* are progressive diagrammatic views corresponding to Figs. 13*c*, 13*d* and 13*e* but showing a variation in the widening loop formation;

Figs. 15*d* and 15*f* are progressive diagrammatic views showing the same operating stages as Figs. 13*d* and 13*f* but embodying a further variation on the widening loop formation, and Figs. 15*g* and 15*h* show further operating stages;

Figs. 16*a*–16*f* are similar views to Figs. 13*a*–13*f* except that the fabric is formed with three yarns in successive courses;

Fig. 17 shows a section of completed fabric formed of a single yarn and widened by one additional loop in each of a number of courses according to Figs. 1–8 and 9*a*–9*f*; and,

Fig. 18 is a section of completed fabric formed of a single yarn and widened by two loops in each of a number of courses according to Figs. 13*a*–13*f*.

Any conventional flat knitting machine equipped with means for progressively racking out the yarn carrier stops may be operated to widen fabric according to the new method, for example the Schubert and Salzer HSL hosiery legger machine, or the Reading machine. Where widening is to be effected by the addition of an even number of edge needles (2, 4, etc.,), conventional jack sinkers and divider sinkers will be employed. For widening out by an odd number of needles (1, 3, etc.,), the jack sinkers as well as the divider sinkers must be cut low at the top so as not to interfere with the traverse of the yarn carrier, as will be evident to those skilled in the art. It is found undesirable to use either split divider sinkers or hooked knockover bits. The traverse of the yarn carrier must be sufficiently rapid that its lead on the projection of the sinkers will be maintained at all times, it being important that when widening is effected the yarn be laid across the added needles before the sinkers cooperating with the added needles are projected.

In Figs. 1–8, *x*, 0 and 1 represent three needles of the needle bank of a flat machine together with the jack sinkers *a* and *c* and dividers *b* and *d*. The knockover bits are omitted from Figs. 1, 4, 7 and 8 for purposes of clarity, but their position below the sinkers is well known and will be understood from Figs. 2, 3, 5 and 6. The yarn carrier or guide is indicated at C. Two right marginal edge loops of two fabric courses I and II are shown. The former course has been cast off and the two marginal loops of course II are held on needles *x* and 0 beneath the sinkers. The needle bank is in its raised position.

Under the conditions just mentioned, and with the needle bank in its normal raised position, the yarn carrier C moves from the left to the right to lay a new widened course with yarn 21. At this time the yarn carrier stops are racked outwardly to permit laying the yarn across needle 1. The stop will be adjusted to bring the carrier beyond sinker *d* to an end position over the sinker outside the next needle (not shown) beyond needle 1. This is done before jack and divider

sinkers *c* and *d* bordering added needle 1 move out. Where the fabric is to be widened only at the right edge the right stop may be moved out at any time prior to the moving out of sinkers *c* and *d*. The same is true when the fabric is to be widened at the left as well as the right edge where a single yarn is employed, the right and left stops then being racked out simultaneously. Where, however, widening is to be effected at the left as well as the right edge where different yarn carriers lay the left to right and right to left courses, and preferably also in any case, the right and left stops will conveniently be racked out simultaneously before any of the sinkers move out, that is, at or just before, or just after, the time carrier C starts its movement from the left margin of the fabric. In Fig. 1, yarn carrier C has completed its traverse from left to right and laid the yarn across additional needle 1. It will be observed that the yarn lies on the front or beard side of the added end needle, and that the yarn carrier has come to a stop beyond the sinker *d* outside needle 1.

The jack sinkers and divider sinkers come out so that the yarn is held in position to be engaged by the beard of needle 1 as well as the remaining needles when the needle bank moves down as shown in Fig. 2. The needle bank then moves down and the sinkers retract. Course II is castoff the needles with the cooperation of knockover bits *k*. The newly laid course III is thus placed below the sinkers with the yarn still on the front side of needle 1 and coming up to yarn carrier C beneath sinker *c* and up across the top of divider *d*, as shown in Fig. 3 and the broken line portion of Fig. 4. The needles have moved up to their normal raised portion. As shown in Fig. 4 the yarn carrier then moves from right to left to lay an additonal course IV on the front side of the needles. Since the yarn is not held by divider *d* or needle 1, it will be drawn towards the left by the carrier to eliminate the temporary loop sunk on needle 1 in the formation of course III and be formed into a new loop around the outside of the nose of the sinker *c* on the beard side of the needle bank at point *p*. It will be observed that at this time there are two lengths of yarn across the front of the needle bank, one length in extension of course III extending outwardly beneath sinker *c*, and the other length extending inwardly across the top of sinker *c*.

The sinkers now move out to sink the course just laid by movement of the carrier from right to left as indicated in Fig. 5. Thereafter the needles again move down in the usual manner to castoff course III and the sinkers retract. The loop at *p* is drawn off sinker *c* and assumes a position across the knockover bits adjacent needle 1, as shown in Fig. 6, such loop being designated 31.

Loop 31 is of relatively large size by reason of having been formed around the sinker, and when placed below the line of sinkers becomes temporarily a free loop lying across the knockover bits on the front side of needle 1 as the needle bank descends. The loop becomes impaled on needle 1 when the needle bank is down, during the period between pressoff and the return of the needle bank up again to course-laying position, and ordinarily as the needle bank is rising from its knockover movement.

From microscopic motion pictures of a well known legger type full-fashioned hosiery machine operating according to the present widening process, it would appear that the action of transferring the end widening loop from the sinker on which it is formed to the end widening needle is rendered possible by several factors. First, the yarn itself is "live" by reason of its twist, and the whip which is imparted thereto by the yarn carrier when it comes to rest at its end position and also as the yarn carrier starts its movement in the laying of the second course. Secondly, the clearances between the needle bank and the head, between the needles and their adjacent sinkers and dividers, and between the sinkers and the knockover bits are extremely small in relation to the size of loop 31. Thirdly, at the time loop 31 assumes a position on the knockover bits there is no tension thereon tending to reduce its size or draw it away from a position in front of needle 1. Fourthly, the loop is subjected to a constant churning action by reason of the movement of the sinkers and the knockover bits as the needles descend in the knockover. Of particular importance, too, is the fact that after the pressoff the needle bank moves outwardly away from the head until at the bottom of the knockover movement the upper extremity of needle 1 assumes a position below the tops of the adjacent knockover bits, as represented approximately by the full line showing of needle 1 in Fig. 6, and thereafter, in completing the castoff of the previous course as the needle bank begins to rise, it moves forwardly towards the head, as represented by the dotted line showing of needle 1 in Fig. 6.

As a result of the actions and conditions referred to, loop 31 can be picked up by needle 1. By careful adjustment of the motion of the needle bank, I find that ordinarily loop 31 will be speared by needle 1 as needle 1 moves upwardly from its position as shown in dotted lines in Fig. 6 and in full lines in Fig. 7. When the needle bank reaches its up position loop 31 will be located on needle 8 below the sinker line as shown in Fig. 8.

It may sometimes happen that loop 31 will be picked up by the point of the beard of needle 1 during descent of the needle bank if the beard should open following the pressoff sufficiently soon to permit it. This may occur as the needles descend for the castoff of course III prior to the time needle 1 reaches the position thereof represented in full lines in Fig. 6. Again, if it should happen that needle 1 fails to spear loop 31 as it rises from the position shown in Fig. 7, loop 31 may be picked up by the point of the beard of needle 1 during the next descent of the needles after the next course following course IV is laid.

The widening operation which was commenced by the racking out of the yarn carrier stop incident to the laying of course III is completed in the following course IV. A further widening operation at the right may be commenced in the next movement of yarn carrier C from left to right, or a number of straight courses may be knit before the next widening operation. A completed section of fabric widened along its right margin is illustrated in Fig. 17. New marginal loops 31 have been added in each of courses IV, VI and VIII.

Widening by one loop

Widening by the addition of a single loop per course beyond the right margin of the fabric has already been explained with reference to the detailed operating stages of Figs. 1–6. Figs. 9*a*–9*f* supplement the previous figures in illustrating the widening of the fabric at both the left and

right margins. In Fig. 9*a* yarn carrier C has moved from left to right after the completion of course II. Before the sinkers move out the yarn carrier stops at the left and right move out to end positions over the sinkers (not shown) beyond the new marginal sinkers *d* and *d'*. The needle bank descends for the knockover of course II, the sinkers retract, completing course III, and the needle bank moves up. The yarn is beneath sinker *c* but above divider *d* as shown in broken line in Fig. 9*b*. Then the yarn carrier moves from right to left to lay course IV as further shown in Fig. 9*b*. At the right the yarn passes at the front side of the needle bank upwardly around the outside of sinker *c* to form a loop thereon at point *p*, just as in Fig. 4, and across all the sinkers. Since the yarn carrier stop at the left was moved out simultaneously with the right stop incident to the formation of course III the yarn carrier in laying course IV extends the yarn across the front of needle 1' at the left as shown in Fig. 9*b*. The needle descends, the sinkers retract, course III is castoff. Fig. 9*c* represents conditions at the time of the castoff when the needle bank is down as in Fig. 6. Added loop 31, which was formed on the sinker, occupies a position beneath the sinker line in front of needle 1. Such loop will become impaled on needle 1 as previously explained, ordinarily as the needle bank begins to rise. Fig. 9*d* shows conditions after the needle bank has reached its up position, with loop 31 on needle 1. Since the yarn carrier stops at the left and right were moved out simultaneously, the yarn carrier in laying course IV from right to left, as shown in Fig. 9*b*, carried the yarn across needle 1' at the left on top of sinker *c'* and divider *d'*. When the needles descend to the position shown in Fig. 9*c* the added yarn at the left is placed beneath sinker *c'* but remains on top of divider *d'*. When the needle bank is again up and course V has been laid by the carrier from left to right, a loop is formed around sinker *c'* at *q*, as shown in Fig. 9*d*. During the next descent of the needles in casting off course IV, as shown in Fig. 9*e*, the loop 31' which was formed on the sinker at *q* is placed below the sinker line in front of needle 1'. During the course of the knockover, loop 31' will be impaled on needle 1' so that when the needle bank again reaches its up position the widening at the left edge of the fabric will be completed as shown in Fig. 9*f*. It will be observed that loop 31' at the left is similar to loop 31 at the right but is located in course V instead of in course IV.

In Figs. 6, 7 and 8, and Figs. 9*c* to 9*f*, loops 31 and 31' are shown in a form wherein the yarn coming up from course III to loop 31 is on the loop side of the fabric and forms the inside leg of the loop, as represented by the arrow in connection with loop 31 in Fig. 9*c*. Loop 31 may be described as involving a half twist clockwise. Since loop 31 is composed of a twisted yarn, is temporarily free following its release from the sinker on which it is formed prior to the pickup thereof by needle 1, and due to the movement of the sinkers, knockover bits and needles during the castoff operation, and also possibly due to motion given the yarn forming loop 31 by the castoff of the adjacent loop in course III from needle 0, loop 31 may take a different form from that shown in the views so far described. For example, following formation on sinker *c* at *p* as in Fig. 9*b*, the added loop, instead of having a half twist clockwise as in Fig. 9*c*, may involve a full twist clockwise as shown at 312 in Fig. 10*c*. When the needle bank rises loop 312 will be shown in Fig. 10*d*, and following completion of the next course will appear as in Fig. 10*e*. By way of further example, the added widening loop may assume a form without any twist preliminary to or in the course of being impaled on needle 1, as in the case of loop 313 shown in successive operating stages in Figs. 11*c*, 11*d* and 11*e*. Again, the added loop may involve a half twist counterclockwise and assume a form just the reverse of loop 31 in Fig. 9*c*, and perhaps a full twist counter-clockwise in reversal of the form of loop 312 in Fig. 10*c*.

It will be obvious that the particular form and twist of the added widening loop obtained on needle 1 at the right, and on needle 1' at the left, is immaterial so long as such loop can be interknit with a loop formed on needle 1 in a subsequent course to present a locked widened edge.

The operation of the machine when employing a multiple of yarns in rotation in successive courses is the same as before described. In Figs. 12*a*–12*f* are shown the various operating stages employing three yarns in rotation with widening by the addition of a single needle at the right and left margins of the fabric. The successive views correspond to Figs. 9*a*–9*c*. In Fig. 12*a*, course II has been formed from right to left with yarn 27. Yarn 26 comes up from the left margin of the fabric and yarn 25 from the right margin. At or about the time yarn carrier 6C lays its yarn 26 from left to right, and before the sinkers starting from the left move out, the yarn carrier stops at both sides are moved outwardly one needle, carrying with them idle yarn carriers 5C and 7C to positions over the sinkers beyond the dividers *d* and *d'*. When yarn carrier 6C completes its traverse in laying course III there are two yarns 26 and 25 laid across the front of additional needle 1 at the right. At this time yarn 27 extends outwardly across needle 1' at the left. When the needles go down to castoff course II and come back up, and course IV is laid with yarn 25 through movement of yarn carrier 5C from right to left, the conditions at the margins of the fabric are as shown in Fig. 12*b*. Yarn 26 which formed course III extends across added needle 1 at the right beneath sinker *c* and over the top of divider *d*. In the laying of the course with carrier 5C yarn 25 is drawn from its dotted line position corresponding to that of yarn 26 around the outside of sinker *c* to form a loop at *p*. When the needles descend as shown in Fig. 12*c*, loop 131 formed on the sinker is placed in front of needle 1, and incident to the knockover motion in the castoff of course III and the rise of the needles, loop 131 becomes impaled on needle 1 and yarn 26 passes to the rear side of needle 1 as shown in Fig. 12*d*.

Since the carrier stops at both sides were racked out incident to the laying of course III, as shown in Fig. 12*a*, conditions at the left edge of the fabric will be as shown in Fig. 12*b* when course IV is laid, with yarns 25 and 27 across needle 1'. In the next stage when the needles descend for the castoff of course III conditions at the left will be as shown in Fig. 12*c*. When the needles again rise and carrier 7*c* moves to the right to lay course V a loop of such yarn is formed around sinker *c'* at point *q*. When the needles descend before the castoff of course IV loop 131', which is formed on the sinker, is placed below the sinker line in front of needle 1'. Incident to the castoff of course IV loop 131 is impaled on needle 1' and yarn 25 assumes the po-

sition on the backside of such needle as shown in Fig. 12*f*. It will be observed that loop **31'** at the left is similar to loop **31** at the right except that it occurs in course V instead of in course IV.

Widening by more than one loop

In many instances it will be found desirable to widen by two or more loops per course at either or both margins of the fabric. The operating sequence of the machine is the same as before. In this case the yarn carrier stops are thrown out farther so that the yarn carrier in an uninterrupted movement will extend the yarn across the front of a plurality of added needles beyond the margin of the fabric while the needles are in their raised position. Contrary to the previous teachings of the art it is found that all added loops can be interlocked against running to form a true selvage merely through proper timing of the outward movement of the yarn carrier and without the necessity of special needle cooperating instrumentalities.

In Figs. 13*a*–13*f* are shown the various operating stages when knitting with a single yarn corresponding to Figs. 9*a*–9*f* except that the traverse of the yarn carrier C is extended across two additional needles **1** and **2** at the right and **1'** and **2'** at the left, and that at the respective sides is brought to a stop over the dividers (not shown) beyond the sinkers *e* and *e'* outside the added end needles **2** and **2'**. Course III is laid by movement of yarn carrier C from left to right, as in Fig. 13*a*, the course is sunk and course II is cast off to complete course III, and the yarn carrier moves from right to left to lay course IV as in Fig. 13*b*. At the start of such movement of the carrier the yarn at the right is across needles **1** and **2** beneath sinker *c* and divider *d*, and across the top of sinker *e*. In the movement of the carrier the yarn is drawn into a loop around divider *d* at point *p*. At this time there are two lengths of yarn across the front side of needle **1**, the first length beneath sinker *c* and divider *d*, and the other length above sinker *c* and divider *d*, such lengths being interconnected by the loop formed on divider *d*. After course IV is sunk and the needles moved down for the castoff of course III, as indicated in Fig. 13*c*, loop **31** which was formed on divider *d* is placed below the line of sinkers in front of needle **2**, and a knitted loop **32** is formed on the first widening needle **1**, intermediate the old end needle **0** and the end added needle **2**. Incident to the castoff and the rise of the needle bank to its up position, loop **31** becomes impaled on needle **2**, as represented in Fig. 13*d*. Course V is then laid as further shown in Fig. 13*d*, and after the same has been sunk, the needles go down for the castoff of course IV as shown in Fig. 13*e*, and then rise again preparatory to the laying of the next course as shown in Fig. 13*f*.

Since the carrier stop at the left was racked out at the time of laying course IV, as shown in Fig. 13*b*, the yarn of such course is extended across needles **1'** and **2'**, and during the laying of course V, as in Fig. 13*d*, a loop is formed around divider *d'* at point *q*. When the needle bank descends to the position shown in Fig. 13*e* loop **31'** is placed beneath the sinker line in front of needle **2'**, and loop **32'** is formed on the first widening needle **1'**. Incident to the castoff of course IV and the rise of the needle bank to the position shown in Fig. 13*f* loop **31'** is impaled on needle **2'**.

As previously explained in the discussion of widening by one needle at a time, the form of the end loop added in the widening operation is subject to variation. In Figs. 13*c* through 13*f* loops **31** and **31'** formed on the end added needles **2** and **2'** are shown with corresponding half twists, loop **31** having a half twist clockwise and loop **31'** having a half twist counter-clockwise. A further example of the form the added end loop may take following the operating stage shown in Fig. 13*b* is illustrated in Fig. 14*c*. Therein, the end loop **314**, when the needles are down in the castoff, is shown as having a full twist clockwise. When such loop is impaled upon the rise of the needles, conditions will be as shown in Fig. 14*d*, and following the formation of course V and the castoff of course IV as shown in Fig. 14*e*.

It further should be explained that if, due to operating conditions needle **2** should fail to impale loop **31** (according to Fig. 13*d*), either during descent of the needle bank, during the castoff or subsequently, the widened edge of the fabric will still be locked and will not run. Fig. 15*d* represents the needle bank in its up position after the castoff of course III and shows loop **31** still in front of needle **2** instead of being impaled thereon as in Fig. 13*d*. The yarn for course V has been laid from left to right. In the descent of the needles and the castoff of course IV loop **31** is drawn away from needle **2** and is lost as shown in Fig. 15*f*. However, loop **32** formed on the first widening needle **1** is locked so that it can not run. Loop **31** merges into loop **32**. When course VI is laid as further shown in Fig. 15*f* another loop is formed around divider *d*, and when the needles descend for the castoff of course V such further loop **31** is placed in front of needle **2** as shown in Fig. 15*g*. Such loop is therefore in a position to be picked up by needle **2** incident to the rise of the needle bank to its up position as shown in Fig. 15*h*. Thus, even though due to conditions beyond control the machine fails to add two loops in one course as intended, the two needle widening can be accomplished following the initial lengthening of the traverse of the yarn carrier to the extent of two needles by the successive formation of the two desired added loops in progressive courses.

A section of completed fabric with two needle widening is shown in Fig. 18 with the loop formation in the widened edge areas according to Figs. 13*a*–13*f*. In such fabric two added end loops **31** and **32** are formed in course IV, and similar widening is effected in courses **6** and **10**. It will be obvious as therein shown that one widening may immediately follow another, or that a number of straight courses may be knit between successive widenings.

In Figs. 16*a*-16*f* are illustrated the operating stages in widening by two needles at the right and left margin of the fabric when knitting with three yarns. The movement of the three yarn carriers **5C**, **6C** and **7C** in laying yarns **25**, **26** and **27**, and the effect of moving out the idle yarn carriers, will be understood from the previously described widening by a single needle as in Figs. 12*a*-12*f*. Fig. 16*a* shows the first stage following the racking out of the yarn carrier stops incident to the laying of course III with yarn **26**. In the laying of course IV as shown in Fig. 16*b* a loop is formed at the right around divider *d* at point *p*. At the left yarn **27** from course II is beneath sinker *c'* and divider *d'* and over the top of sinker *e'*. When the needle bank descends for the castoff of course III loop **131** at the right is placed in front of needle **2** and

loop 132 is formed on needle 1. In Fig. 16*d* the needle bank has again risen and loop 131 is impaled on needle 2. Carrier 7C has moved to the right to lay course V, forming a loop around divider *d'* at the left at point *q*. When the needles descend for the castoff of course IV, as shown in Fig. 16*e* loop 131' is placed in front of needle 2' and loop 132' is formed on the first widening needle, 1'. When the needle bank again rises to its up position, as represented in Fig. 16*f*, loop 131' becomes impaled on needle 2'. It will be observed that loops 131' and 132' at the left are similar to loops 131 and 132 at the right except that they occur in course V instead of in course IV. The widening loop formation is similar to that shown when knitting with a single yarn as in Fig. 13*f* except that the added loops are formed from a different yarn than in the next preceding course due to the use of different yarns in sequence. It will be observed in Fig. 16*f* that at the right yarn 26 from preceding course III as well as yarn 25 from which course IV is formed is interknit with the first widening loop 132, but is not interknit with the end widening loop 131'. Similarly at the left yarn 25 from course IV as well as yarn 27 from which course V is formed is interknit with the inside widening loop 132', but that yarn 27 is not interknit with end widening loop 131'.

The method of operating the machine according to the invention is not limited to widening by merely one or two needles. Fabrics have been actually knit involving widening at one time by as many as four and eight needles beyond each margin of the fabric.

From the various illustrative applications of the invention herein described it will be evident that the widening operation of the method is of general utility and permits of widening by any desired number of needles at one or both margins of a fabric, regardless of whether successive courses are formed with one or a series of different yarns. As far as is known such process is the first producing locked selvage edges which permits variability in the number of loops added and/or the number of yarns employed. In the past it has been necessary to use a different process of widening depending on the number of needles added, and as previously mentioned it has ordinarily been necessary also to utilize special needle cooperating elements.

As will be understood from the summary of the characterizing features of the invention set forth in the earlier part of the specification, the key to the present invention is the laying of the yarn, by extending the traverse of the yarn carrier or carriers, outwardly over all added needles, whether one or more, while the needle bank is in its raised position. The added yarn will be located on the front or beard side of the added needle or needles until the castoff operation of the needle bank incident to the completion of the next following course. Whereas it has heretofore been proposed to form a loop on the end added needle by bringing the yarn around the outside thereof from back to front, the present invention proposes the novel practice of initially forming a loop on a jack sinker or a dividing sinker, according to whether one or more loops are to be added at the end of a course, and thereafter transferring such loop onto the end widening needle. The operative procedure of the invention has been used extensively on various makes of flat hosiery knitting machines, including those previously mentioned, and has produced very satisfactory widened selvage edges. Good results have been obtained both with natural silk yarn and with synthetic yarn produced under the trade name "Nylon."

In the specification and claims the term "sinkers" is used in a comprehensive sense for convenience and will be understood to include both jack sinkers and divider sinkers.

The term "end added needle" and similar expressions as employed in the claims will be understood to include the outermost needle employed in forming a widened course. It will be evident that in cases where the traverse of the yarn is extended a distance of one needle beyond the old end needle for a single needle widening the outside needle will be the only added needle, while in cases where the traverse of the yarn is extended a distance of a plurality of needles beyond the old end needle for multiple needle widening there will be one or more further added needles intermediate the outer added needle and the old end needle.

This application is a continuation in part of my prior copending application Serial No. 290,662, filed August 17, 1939.

I claim:

1. The method of producing selvage-edged widened fabric areas in a stocking blank on full-fashioned hosiery legger machines through the addition of selvage loops, without the aid of special needle-engaging and special yarn-manipulating instrumentalities, such as individual needle pressers, transfer points and the like, which includes the steps of moving a yarn guide out during formation of a course on the beard side of the needle bar for a selected number of needles beyond the margin of the blank before the needle bar moves down from its course-laying position, sinking the widened course and carrying the same beneath the sinkers when the needle bar moves down for its knockover motion, retaining the yarn on the beard side only of each additional needle when the needle bar moves up again to course-laying position, moving the yarn guide inwardly in forming the next course on the beard side of the needle bar without passing the yarn around the back of the added outermost needle, sinking the second course into loops on the needles inwardly of the added outermost needle, completing the second course and knocking over the first course when the needles again move down and up again, and forming the yarn at the end of the second course into a selvage loop on the added outermost needle.

2. The method of producing a selvage-edged widened heel area in a stocking blank on full-fashioned hosiery legger machines through the addition of selvage loops at the margin of the blank, without the aid of special needle-engaging and special yarn-manipulating instrumentalities, such as individual needle pressers, transfer points and the like, which includes the steps of moving a yarn guide out during formation of a course on the beard side of the needle bar for a selected number of needles beyond the magin of the blank before the needle bar moves down from its course-laying position, sinking the widened course and carrying the same beneath the sinkers when the needle bar moves down for its knockover motion, retaining the yarn on the beard side only of each additional needle when the needle bar moves up again to course-laying position, moving the yarn guide inwardly in forming the next course on the beard side of the needle bar

without passing the yarn around the back of the added outermost needle, sinking the second course into loops on the needles inwardly of the added outermost needle, completing the second course and knocking over the first course when the needles again move down and up again, and forming the yarn at the end of the second course into a selvage loop on the added outermost needle.

3. The method of producing selvage-edged widened heel sections at the opposite sides of a stocking blank on a full-fashioned hosiery legger knitting machine through the addition of selvage loops at the margins of the blank without the aid of special needle-engaging and special yarn-engaging instrumentalities, which includes the steps of moving a yarn guide across the sinkers to lay a course to the width of the blank and widening the heel section at one side of the blank before the needles move down by moving the yarn guide outwardly beyond the margin of the blank course across the beard side of one of more additional needles, retaining the widened course on the beard side only of each added needle when the needles move down to knock over the previous course and come up again and moving the yarn guide inwardly across the sinkers to lay a second course without passing the yarn around the added outermost needle, and when said second course has been laid to the opposite margin of the blank widening the heel section at the second side of the blank by moving the yarn guide out before the needles go down to lay the yarn across the beard side of one or more additional selvage needles beyond said margin, and retaining the yarn on the beard side only of each added needle at said second margin of the blank when the needles move down to cast off the first widened course and back up, moving the yarn guide again across the sinkers to lay a third course of the yarn across the sinkers to the added outermost needle at the first side of the blank without passing the yarn around the added outermost needle at the second margin of the blank, and moving the needles down to knockover the second widened course and up to complete the third widened course.

4. The method of producing selvage-edged widened heel sections at the opposite sides of a stocking blank on a full fashioned hosiery legger knitting machine, wherein a plurality of yarns are employed sequentially in successive courses, through the addition of selvage loops at the margins of the blank without the aid of special needle-engaging and special yarn-engaging instrumentalities, which includes the steps of moving a yarn guide across the sinkers to lay a course to the width of the blank and widening the heel section at one side of the blank before the needles move down by moving the yarn guide which has laid the course, and also the idle yarn guide which is to lay the next course, outwardly beyond the margin of the blank across the beard of one or more additional selvage needles, and also before the needles move down moving out an idle yarn guide at the opposite margin of the blank across the beard side of one or more additional selvage needles to widen the second heel section, retaining the widened course on the beard side only of the added needles at both sides of the blank when the needles move down to knockover the previous course and come up again, moving the first idle yarn guide inwardly from the first side of the blank across the sinkers to lay a second widened course without passing its yarn around the outer added selvage needle at the first side of the blank, and extending said yarn guide outwardly across the beard side of each added selvage needle at the second side of the blank, lowering and raising the needles for the knockover of the first widened course, then moving the second idle yarn guide inwardly from the second side of the blank across the sinkers to lay a third course, and moving the needles down to knockover the second widened course and up to complete the third widened course.

5. The method of adding selvage loops to widen fabric on flat knitting machines which includes the steps of laying a course of yarn across the needles, and laying a length of yarn at one end of said course and across the beard side only of a new edge needle outwardly beyond the margin of the fabric before the sinkers coactive with the added new edge needle move out, and retaining the yarn at the new edge needle on the beard needle side during the next lowering and raising of the needles, and laying the next course without passing the yarn around said new edge needle.

6. The method of adding selvage loops to widen fabric on flat knitting machines which includes the steps of adding a plurality of needles at the end of a course beyond the margin of the fabric while the needle bank is still in its up position by laying yarn outwardly across the beard side only of all said added needles in a single operation, retaining the yarn on the beard side of each added needle when the needle bar goes down and places the course beneath the sinkers, and after the needle bank rises again laying the next course without passing said yarn around the outside of the outermost added needle.

7. The method of adding selvage loops to widen fabric on flat knitting machines, which includes the steps of laying a yarn outwardly across one or more added needles at the end of a course beyond the margin of the fabric on the beard side of each added needle, then placing said yarn beneath the sinker between the added outermost needle and the next inward needle while retaining said yarn on the beard side of each added needle and above the sinker outside of the added outermost needle, and after the completion of the first course laying a second course with said yarn inwardly across the needles from the added outermost needle without passing the yarn around said added outermost needle.

8. In the knitting of fabric on flat knitting machines, the method of adding selvage loops to widen the fabric which includes forming a loop of yarn at the end of one fabric course around the nose of a sinker located outwardly beyond the edge of the previous fabric course, on the beard side of the needle bar and free of the needle next outwardly of said sinker, and holding said yarn by means of said sinker while laying said yarn inwardly across the needle bar for the next course.

9. The method of adding selvage loops to widen fabrics on flat knitting machines in which during the laying of one course and before the needles go down a yarn guide moves outwardly at the end of the course beyond the margin of the fabric to lay its yarn across the beard side of one or more additional needles, and in which after the needles descend and come up again the yarn at each said added needle is retained only on the beard side and the yarn guide laying the next course lays its yarn across the beard side of the needle bank beginning at the additional

outermost needle, and thereafter during the next descent and rise of the needles the entire widened second course is placed on the needles below the sinkers.

10. The method of adding selvage edge loops to widen fabric on flat knitting machines, which includes the steps of laying a widened fabric course across the needle bar with the needles up with the yarn at the end of the course extending across the beard side of a selected number of needles beyond the margin of the previous fabric course, retaining the yarn at the beard side only of the outermost needle when the needles move down to knockover and up again, then laying said yarn inwardly across the needle bar for the next course, and when the needle bar moves down and up again knocking over the first widened course and completing the second course, and forming a selvage loop of said yarn on said outermost needle.

11. The method of adding selvage edge loops to widen fabric on flat knitting machines, which includes the steps of laying yarn outwardly during formation of a course on the beard side only of a selected number of needles beyond the margin of the previous course, laying said yarn inwardly in the next course without passing the same around the added outermost needle, and subsequently forming the portion of the yarn at the end of the second course into a selvage loop on the outermost needle.

12. A method of adding selvage loops to widen fabric on flat knitting machines, in which in the formation of a course of loops, a yarn guide, laying yarn on the beard side of the needles, is moved out for a selected number of needles beyond the margin of the fabric, and during completion of the course the yarn is retained on the beard side only of the added outermost needle and then laid inwardly in the next course without passing around the back of the outermost needle, and a selvage loop is formed on the outermost needle after the laying of said next course.

13. The method of adding selvage loops to widen fabric at both sides on flat knitting machines which includes moving a yarn carrier across the needle bar to lay a course, and incident to the laying of such course, before the needle bar descends, moving out all carrier stops, and idle carriers (if any), at the two margins of the fabric being knit to the extent of the number of needles by which it is desired to widen in one operation beyond each fabric margin, so that a length of yarn is extended by a yarn carrier across the beard side only of all added needles at the margin of the fabric towards which the first course is laid, projecting the sinkers, and lowering and then raising the needle bar, and retaining the yarn on the beard side of each added needle at said margin of the fabric, moving a yarn carrier, before the needle bar again descends, from its stop beyond said first margin of the fabric to its stop beyond the second margin of the fabric to lay a widened second course on the beard side of the needle bar, projecting the sinkers, and lowering and raising the needle bar to cast off the first course, and retaining the yarn on the beard side only of each added needle at the second margin of the fabric, moving a yarn carrier, before the needle bar again descends, from its stop beyond the second margin of the fabric to its stop beyond the first margin of the fabric to lay a widened third course on the beard side of the needle bar, again projecting the sinkers, and again lowering and raising the needle bar to cast off the widened second course.

14. The method of adding selvage loops to widen fabric at both sides on flat knitting machines which includes the steps of laying a course across the needle bar in one direction, and at the end of the course laying a yarn across the beard side only of one or more end additional needles beyond the margin of the fabric before the needles go down, and, with the yarn at each added needle still on the beard needle side after the needles go down and rise again, laying the next course with said yarn across the needle bar in the opposite direction beginning at the added outermost needle beyond the first margin of the fabric, extending said yarn across the beard side only of one or more additional needles at the other end of the course beyond the opposite margin of the fabric before the needles again go down, and, with the yarn at each additional needle at the end of the course beyond the second margin of the fabric still on the beard needle side after the needles go down and rise again, laying a third course of yarn inwardly across the needle bar in the first direction beginning at the added outermost needle beyond the second margin of the fabric.

15. The method of adding selvage loops to widen fabric on flat knitting machines, wherein a plurality of yarns are employed sequentially in successive fabric courses, which includes moving a yarn guide to lay a course of yarn across the needle bar and at the end of the said course moving the yarn guide out to extend said yarn across the beard side only of one or more additional needles beyond the margin of the fabric, and moving out at the end of said course the idle yarn guide which is to be used in the next course so as to lay a second yarn across the beard side only of the same additional needle or needles before the needles descend, and after the needles descend and come up again retaining the first and second yarns at each added needle on the beard needle side and moving the second yarn guide inwardly from the added outermost needle to lay the next course of said second yarn across the beard side of the needle bar, and when the needles descend again casting off the first course.

16. The method of adding selvage loops to widen fabric at both sides on flat knitting machines, wherein a plurality of yarns are employed sequentially in successive fabric courses, which includes laying a course of yarn across the needle bar with one yarn guide and at the end of said course extending the traverse of said yarn guide to lay its yarn across the beard side only of one or more additional needles at said end of the course beyond the margin of the fabric before the needles descend, and before the needles descend also moving a second yarn guide outwardly at the same end of said course to lay a second yarn across the beard side only of the same additional needle or needles, and before the needles descend also moving a third yarn guide at the opposite end of the course outwardly in the opposite direction to lay a yarn across the beard side of one or more additional needles beyond the second margin of the fabric, and after the needles descend to cast off the first course and come up again, and, while the yarns at each added end needle at the opposite margins of the fabric still remain on the beard needle side, moving the second yarn guide to lay a course of the second yarn across the beard side

of the entire widened group of needles, and after the needles again descend to cast off the first course and come up again, and while the third yarn at each added needle still remains on the beard needle side, moving the third yarn guide to lay a third course of the third yarn across the beard side of the entire widened group of needles, and during the next descent and rise of the needles casting off the widened second course and completing the third widened course.

17. In a method of adding selvage loops to widen fabric on flat knitting machines the steps of moving a yarn guide to lay a length of yarn outwardly across the beard side of one or more added needles at the end of a course beyond the margin of the fabric incident to the laying of such course before the needles descend, and across the top of the noses of the sinkers on each side of the added outermost needle, moving the needle bank down to place said yarn beneath the sinker located at the inner side of the end added needle and on the beard side of the needle bank, raising the needle bank, and while said yarn is still on the beard side of the added outermost needle drawing said yarn up inside the sinker at the outer side of the added outermost needle and around the outside of the nose of the sinker inside the end added needle, and laying said yarn inwardly across the needle bank for the next course.

18. The method of adding selvage loops to widened fabric on a flat knitting machine which includes the steps of forming a yarn into a course of loops on a group of needles of the needle bar with the needle bank in its raised position, and during the movement of the needle bar down to knockover the previous course and back up to raised position placing a new end loop of the yarn at one end of the course on an additional needle at the margin of said needle group.

19. The method of adding selvage loops to widen fabric on flat knitting machines, including the step of placing a new needle loop on an additional needle at the end of a course of loops as the needle bar is moving up from its knockover motion.

20. The method of adding selvage loops to widen fabric on flat knitting machines, the steps of forming a loop by moving a yarn guide, laying yarn at the beard side of the needle bar, outwardly at the end of one course to lengthen said course beyond the margin of the fabric, and, after completing said course, without passing the extended portion of the course to the opposite side of the needle bar, moving the yarn guide inwardly at the beginning of the next course, thereby forming a loop in the yarn at the end of said course on the beard side of the needle bar, and converting said loop into a selvage needle loop by subsequently impaling the same on an additional needle beyond the margin of the fabric.

21. The method of adding selvage loops to widen fabric on flat knitting machines, including the steps of forming a yarn loop at the end of a course while the needle bar is up in course-laying position, and after the needle bar has moved down converting the loop into a selvage needle loop by impaling the same on an additional needle beyond the margin of the fabric while the needle bar is moving up from its knockover motion.

22. In the widening of fabric on flat knitting machines the steps which include forming a loop of yarn around the nose of a sinker, and then transferring said loop onto the needle next outwardly of said sinker.

23. The method of adding selvage loops to widen fabric on flat knitting machines, including the steps of forming a loop of yarn around the nose of a sinker at one end of a course, on the beard side of the needle bank, and subsequently transferring said loop from the sinker onto an added needle outwardly of said sinker.

24. The method of adding selvage loops to widen fabric on flat knitting machines which includes the steps of forming a loop around a sinker at one end of a course, then removing said loop from the sinker and placing said loop across the top of the knockover bits below the sinker when the needle bank moves down for its knockover movement and while the needle bank is down impaling said loop on the needle outwardly of the sinker upon which said loop was formed.

25. The method of adding selvage loops to widen fabric on flat knitting machines which includes the steps of moving a yarn guide to lay yarn in an outward direction across the beard side of one or more additional needles at the end of the course beyond the margin of the fabric before the needle bank descends, and when the needle bank descends for its knockover motion placing said yarn beneath the sinker located between the added outermost needle and the next inward needle, retaining the yarn on the beard side of said outermost needle when the needle bank rises again, and laying the next course of said yarn, without passing the yarn around the outermost needle, across the beard side of the needle bank over the top of said sinker, to form a loop on said sinker, removing the sinker-formed loop from its sinker and placing it beneath the sinker across the knockover bits adjacent the added outermost needle when the needle bank moves down for its knockover movement, and while the needle bank is down inpaling said loop on the added needle outwardly of the sinker on which said loop was formed.

26. The method of adding a plurality of selvage loops at the end of a fabric course on flat knitting machines to widen the fabric, which includes the steps of moving a yarn guide outwardly at the end of a course to lay a yarn across the beard side of a plurality of additional needles beyond the margin of the fabric, retaining the yarn on the beard side of the added outermost needle when the course is completed and moving the yarn guide inwardly across the beard side of the needle bank in the next course, forming a loop of said yarn around the sinker located between the added outermost needle and the next inner added needle, removing said loop from said sinker and placing it below the sinker when the needle bank moves down for its knockover of the first course, and while the needle bank is down impaling said loop on the added outermost needle outwardly of the sinker on which said loop was formed.

27. The method of adding selvage loops to widen fabric on flat knitting machines which includes laying a course of yarn across the needle bank and at an end of the course laying a yarn beyond the margin of the fabric across the beard of a single additional needle before the needles descend, and after the needles descend and come up again retaining the yarn at the beard side only of the additional needle and laying the next course with said yarn across the beard side of the needles in the opposite direction, and when

the needles again descend casting off the first course.

28. The method of adding selvage loops to widen fabric on flat knitting machines which includes laying a course of yarn across the needle bank and at the end of said course extending said yarn beyond the margin of the fabric across the beard of a single additional needle before the needles descend, and after the needles descend and come up again retaining said yarn at the beard side only of the additional needle and laying another course of said yarn inwardly across the beard side of the needles beginning at the added needle, and when the needles again descend casting off the first course.

29. The method of adding selvage loops to widen fabric on a flat knitting machine which includes moving a yarn guide across the sinkers to lay a course of yarn at the beard side of the needles and at the end of the course extending the traverse of the yarn guide to lay the yarn across the beard side of a single additional needle beyond the margin of the fabric, projecting the sinkers to sink the course, lowering the needles to knockover position, and in so doing placing the yarn beneath the sinker located between the old end needle and said added needle, raising the needles to their original position and maintaining the yarn at the beard side of the added needle, moving the yarn guide inwardly across the sinkers to lay a second course at the beard side of the needle bar, and in so doing drawing the yarn clear of said added needle and forming the same into a loop around the outside of the nose of said sinker between the added needle and the old end needle, projecting the sinkers to sink the second course, lowering the needles to knockover position and in so doing withdrawing the sinker-formed loop from its sinker and placing the loop beneath said sinker and across the front of said added needle on top of the knockover bits, transferring the sinker-formed loop onto the added needle during the knockover motion, and again raising the needles to their original position.

30. The method of adding selvage loops to widen fabric on flat knitting machines which includes laying a course of yarn across the needle bank and at the end of said course and before the needles descend laying a second yarn outwardly across the beard side only of a single additional needle beyond the margin of the fabric, and laying across the beard side of said additional needle also the first yarn, and after the needles descend and come up again retaining the first and second yarns at the beard of said additional needle and laying another course with the second yarn inwardly across the needles beginning at said additional needle, and when the needles again descend casting off the first course.

31. The method of adding selvage loops to widen fabric on a flat knitting machine, wherein a plurality of yarns are employed sequentially in successive courses, which includes moving a yarn guide across the sinkers to lay a course of one yarn at the beard side of the needles, and at the end of the course extending the traverse of said yarn guide to lay the yarn across the beard side of a single additional needle beyond the margin of the fabric, and also moving out an idle yarn carrier to lay a second yarn outwardly across the beard side of said single additional needle beyond the margin of the fabric, projecting the sinkers to sink the course, lowering the needles to knockover position, and in so doing placing the first and second yarns beneath the sinker located between the old end needle and said added needle, raising the needles to their original position and maintaining the two yarns at the beard side of the added needle, moving the second yarn guide inwardly across the sinkers to lay a second course at the beard sides of the needle bar, and in so doing drawing the second yarn clear of said added needle and forming the same into a loop around the outside of the nose of said sinker between the added needle and the old end needle, projecting the sinkers to sink the second course, lowering the needles to knockover position and in so doing withdrawing the sinker-formed loop of the second yarn from its sinker and placing the same beneath said sinker and across the front side of said added needle on top of the knockover bits, transferring the sinker-formed loop onto the added needle during the knockover motion, and again raising the needles to their original position.

32. The method of adding selvage loops to widen fabric on flat knitting machines which includes laying a course of yarn across the needle bar and at the end of the course, while the needle bar is still up, laying a yarn across the beard side only of two additional needles and projecting the sinkers coacting with said two needles, and when the needles move down to knockover the previous course placing the entire widened course beneath the sinkers, and when the needle bar moves up again retaining the yarn at the beard side of the two added needles and laying the yarn inwardly across the beard side of the needle bar for the next course, and when the needle bar again moves down to knockover casting off the first course.

33. The method of adding selvage loops to widen fabric on flat knitting machines which includes laying a course of yarn across the needle bank and at the end of said course before the needles descend laying a yarn across the beard side of two additional needles at the end of the course beyond the margin of the fabric, and after the needles descend and come up again retaining the yarn at the beard side of both additional needles and then laying said yarn inwardly across the needle bank for the next course, the yarn being drawn free of the added outermost needle and forming a loop around the nose of the sinker intermediate the two added needles serving to hold the yarn as it is laid inwardly across the beard of the inner added needle and the needles beyond, and during a subsequent descent and rise of the needles transferring the sinker-formed loop from the intermediate sinker onto the added outermost needle.

34. The method of adding selvage loops to widen fabric on flat knitting machines which includes laying a course of yarn across the needle bank and at the end of said course laying a yarn outwardly across the front of a plurality of added end needles beyond the margin of the fabric before the needles descend, and after the needles descend and come up again laying a second course of said yarn, with the yarn coming from the front of said additional needles upwardly inside the outermost added needle around the nose of the sinker intermediate the outermost added needle and the next inner added needle to form a loop around the nose of said sinker, and when the needles next descend to cast off the first course shifting the loop formed on said intermediate sinker onto the added outermost needle.

35. The method of adding selvage loops to widen fabric on flat knitting machines comprising moving a yarn guide to lay yarn at the end of a course across the beard side of two additional needles beyond the margin of the fabric with the needle bar up in course-looping position, projecting the jack sinkers inside the first additional needle and outside the second additional needle, and the dividing sinker between said two additional needles, to sink the yarn against both needles, moving the needle bar down to its knockover position so that the yarn is engaged by the beards of the two added needles and carried down inside the jack sinker located outside the second needle to a position across the knockover bits beneath the jack sinker inside the first needle and the dividing sinker between the first and second needles, retaining the yarn on the beard side of both the first and second added needles as the needle bar moves up to course-laying position, then laying the yarn inwardly in the next course to draw the yarn up around the nose of the divider sinker between the two added needles clear of the second added needle, and inwardly over the top of the noses of said divider sinker and the jack sinker inside the first added needle on the beard side of said first needle, with the formation of a loop on the dividing sinker, projecting the sinkers to sink a loop on said first added needle and hold the loop formed around the divider sinker, moving the needle bar down again to knockover position, drawing the sinker-formed loop of the dividing sinker down to a position on the knockover bits adjacent the second needle, and casting off the first needle the yarn placed thereon in the first course so as to lock the loop formed on said needle in the second course, and moving the needle bar again up to course-laying position, and impaling the sinker-formed loop as a selvage edge loop on the second needle to complete the widening.

36. The method of adding selvage loops to widen fabric on flat knitting machines which includes moving a yarn guide across the sinkers to lay a course of yarn at the beard side of the needles, and at the end of the course extending the traverse of the yarn guide to lay the yarn across the beard side of two additional needles beyond the margin of the fabric, projecting the sinkers to sink the course, lowering the needles to knockover position, and in so doing placing the yarn beneath the two sinkers respectively located between the old end needle and the first added needle and between the first and outer added needles, raising the needles to their original position and retaining the yarn at the beard side of both added needles, moving the yarn guide inwardly across the sinkers to lay a second course on the beard side of the needle bar, and in so doing drawing the yarn clear of the added outermost needle and forming the same into a loop around the outside of the nose of the sinker between the first and outermost added needles, projecting the sinkers to sink the second course, lowering the needles to knockover position, and in so doing completing the loop on the first added needle and withdrawing the sinker-formed loop from its sinker and placing said loop beneath said sinker and across the beard side of the outer added needle on the top of the knockover bits, and transferring the sinker-formed loop onto the outer added needle during the knockover motion, and again raising the needles to their original position.

37. The method of adding selvage loops to widen fabric on a flat knitting machine, wherein a plurality of yarns are employed sequentially in successive courses, which includes moving a yarn guide across the sinkers to lay a course of one yarn at the beard side of the needles, and at the end of the course extending the traverse of said yarn guide to lay the first yarn across the beard side of two additional needles beyond the margin of the fabric, and also moving out an idle yarn carrier to lay a second yarn across the beard side of said two additional needles, projecting the sinkers to sink the course, lowering the needles to knockover position, and in so doing placing the first and second yarns beneath the sinkers respectively located between the old end needle and the first added needle, and between the first added needle and the added outermost needle, raising the needles to their original position and maintaining both yarns at the beard side of both added needles, moving the second yarn guide inwardly across the sinkers to lay a second course at the beard side of the needles, and in so doing drawing the second yarn clear of the added outermost needle and forming the same into a loop around the outside of the nose of the sinker located between the first and second added needles, projecting the sinkers to sink the second course, lowering the needles to knockover position, and in so doing completing the loop on the first added needle and withdrawing the sinker-formed loop from its sinker and placing the same beneath said sinker and across the beard side of the added outermost needle on top of the knockover bits, transferring the sinker-formed loop onto the added outermost needle during the knockover motion and again raising the needles to their original position.

BENJAMIN F. SOMERS.