Aug. 5, 1941. P. L. THURSTON ET AL 2,251,533

PROCESS OF KNITTING

Original Filed Oct. 5, 1939 7 Sheets-Sheet 1

Fig. 1.

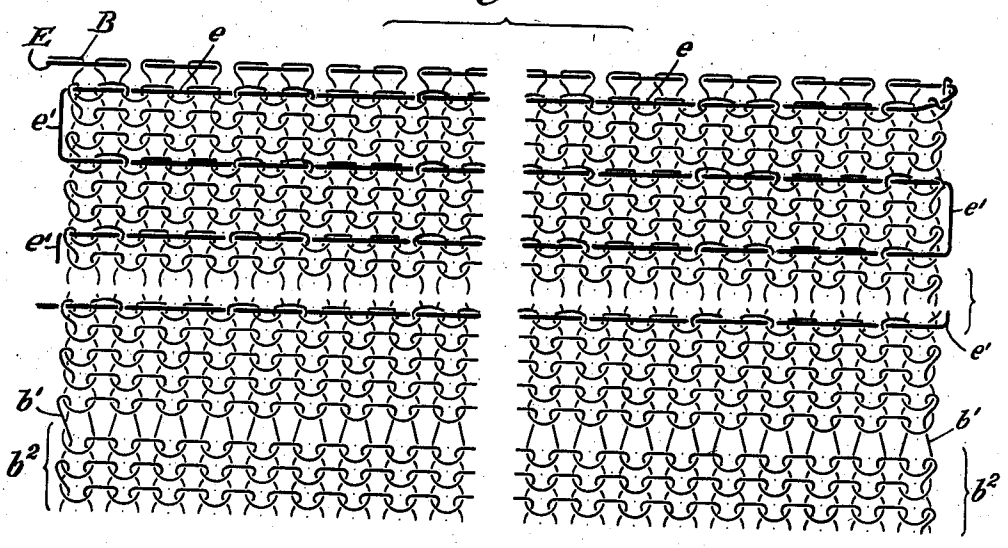
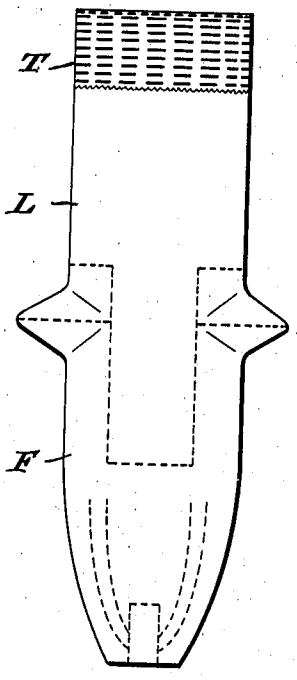


Fig. 2.



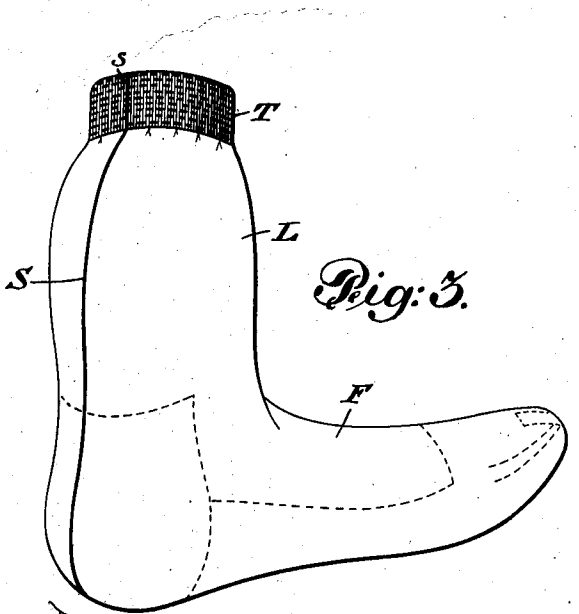


Fig. 3.

Paul L. Thurston INVENTORS
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PROCESS OF KNITTING

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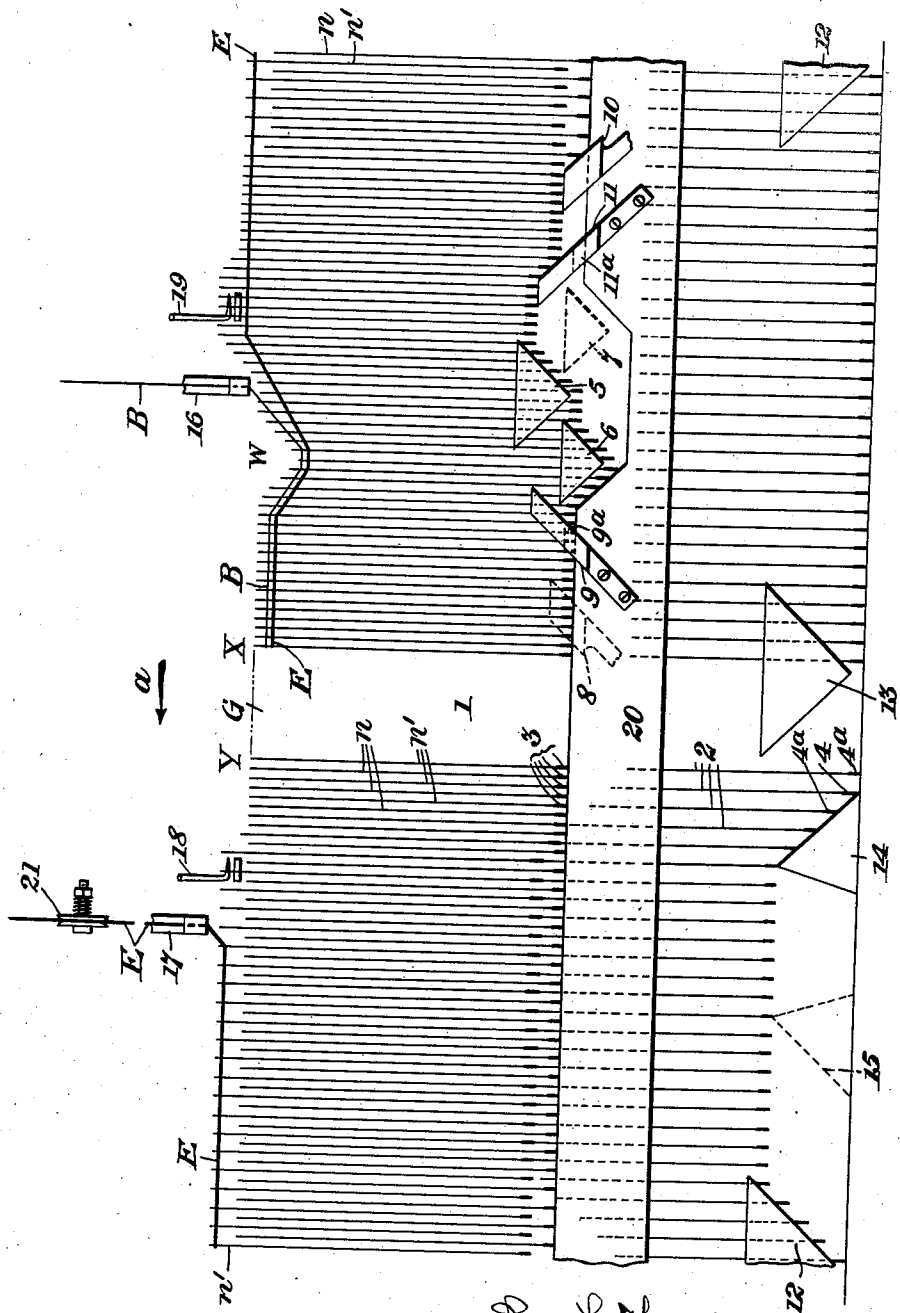


Fig. 4.

Paul L. Thurston and
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Aug. 5, 1941. P. L. THURSTON ET AL 2,251,533

PROCESS OF KNITTING

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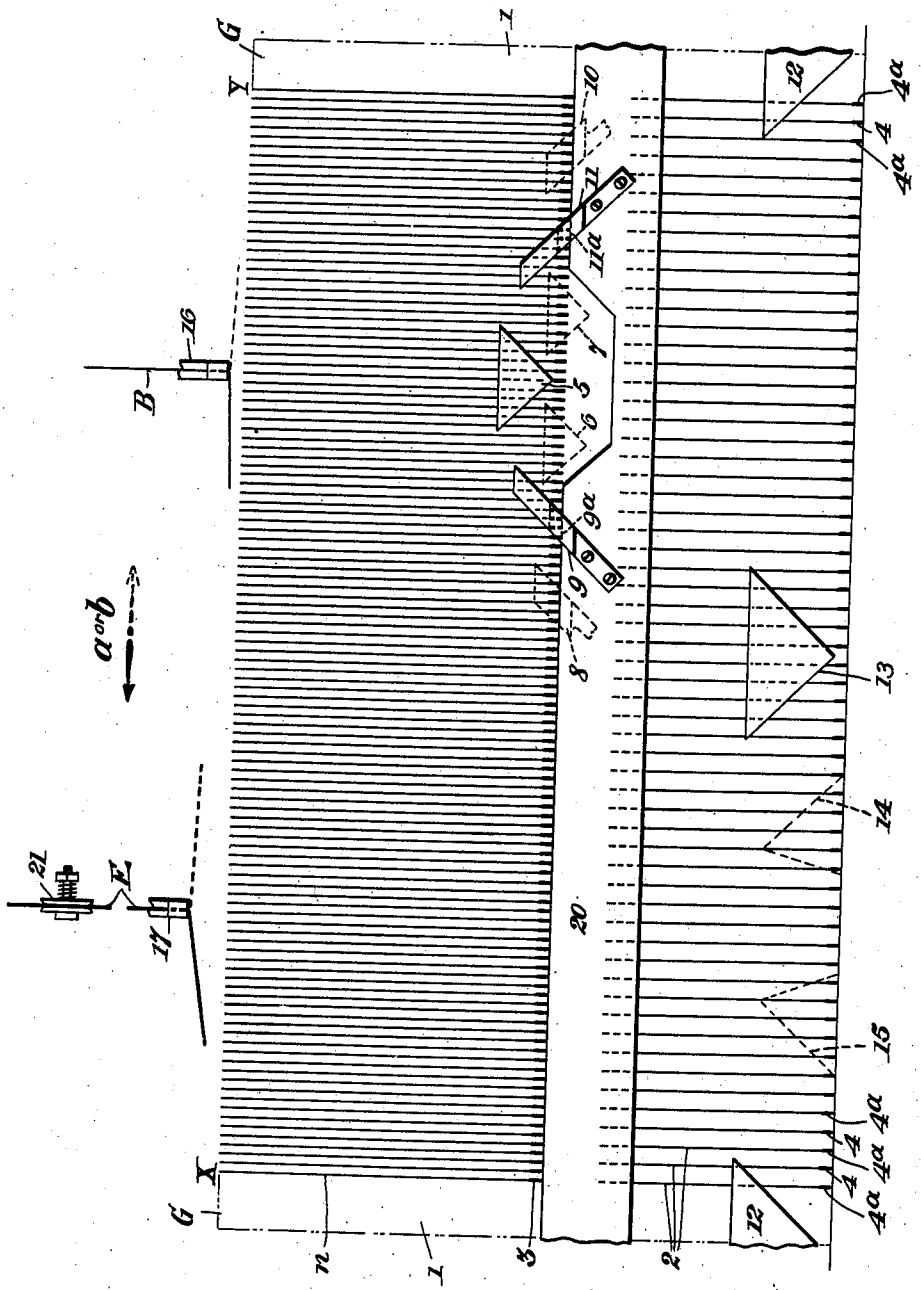


Fig. 5.

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Aug. 5, 1941. P. L. THURSTON ET AL 2,251,533

PROCESS OF KNITTING

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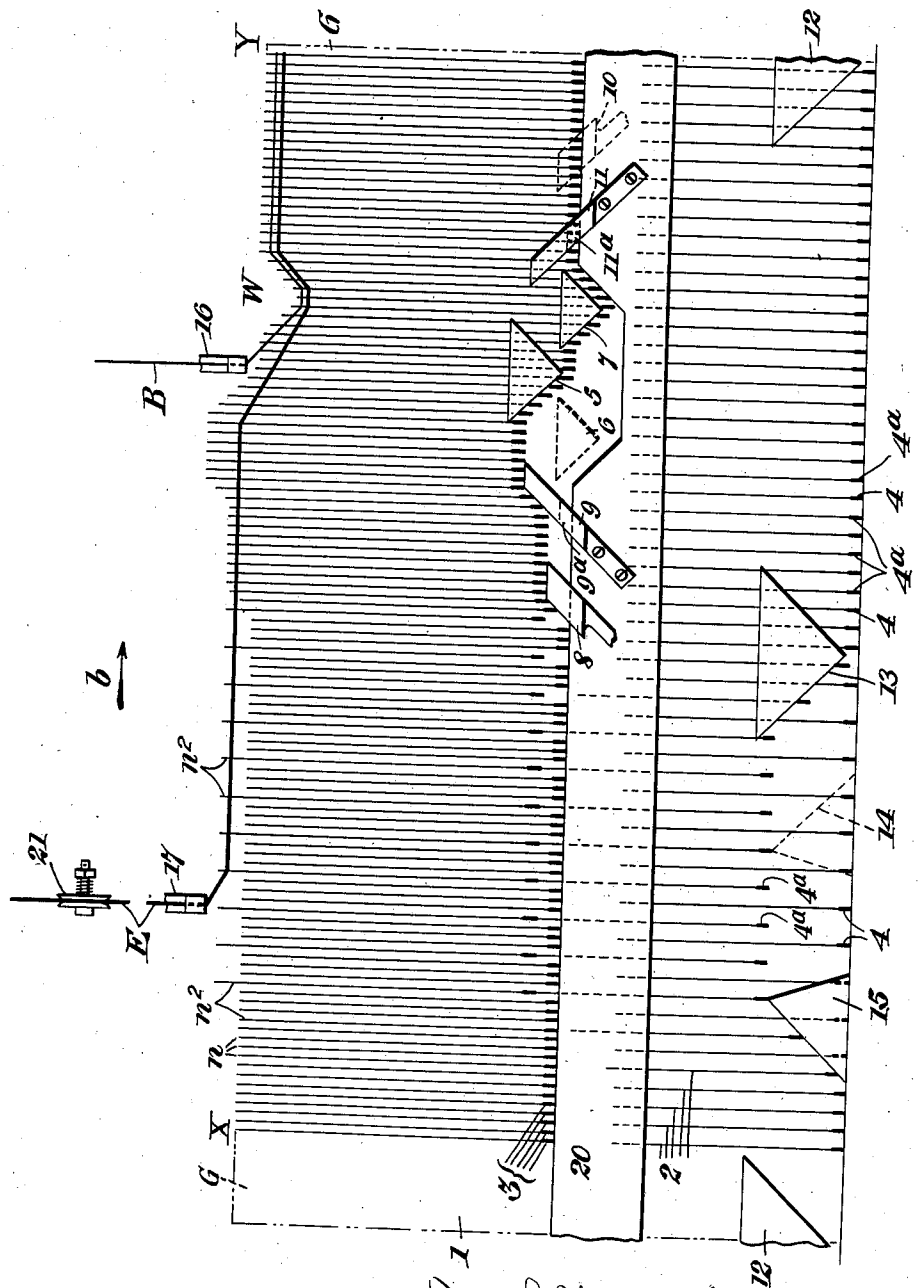


Fig. 6.

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Aug. 5, 1941. P. L. THURSTON ET AL 2,251,533

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Fig. 7.

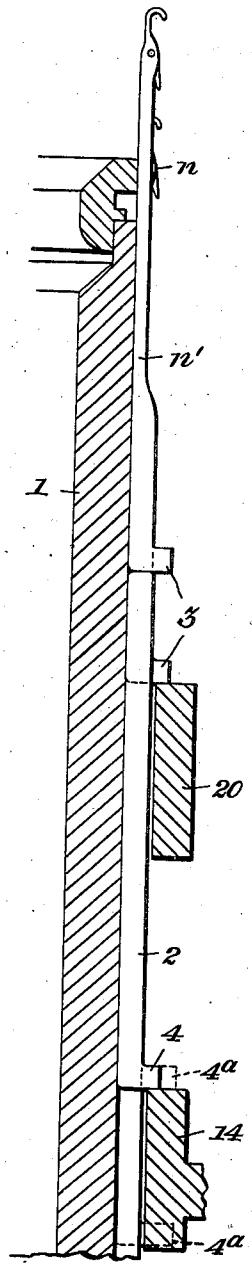


Fig. 8.

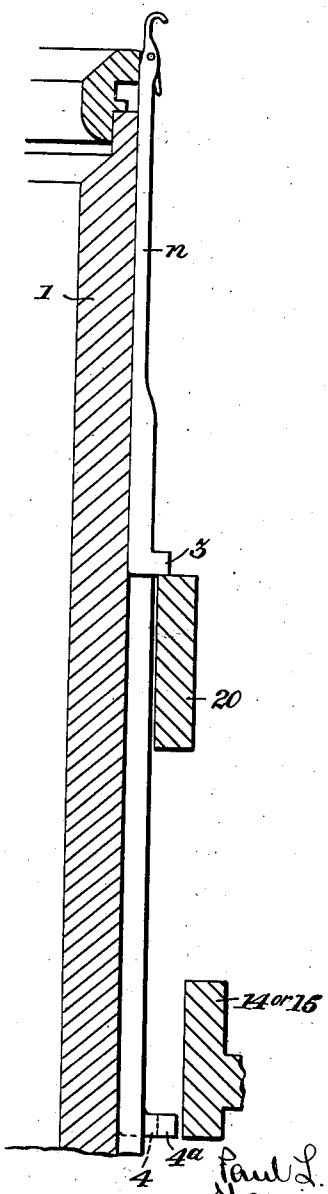
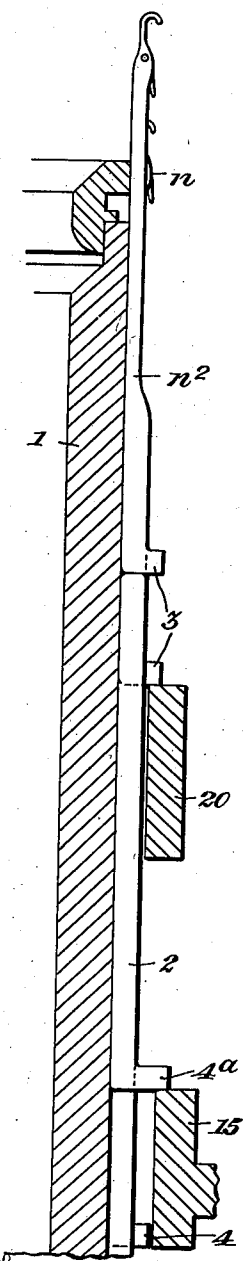


Fig. 9.



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Fig. 10.

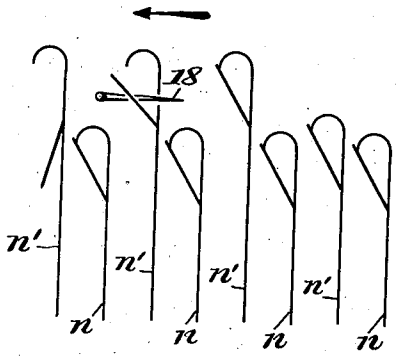


Fig. 13.

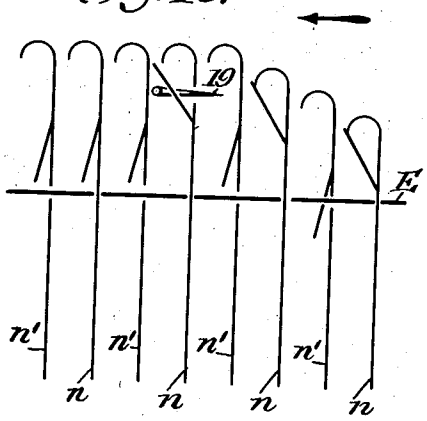


Fig. 11.

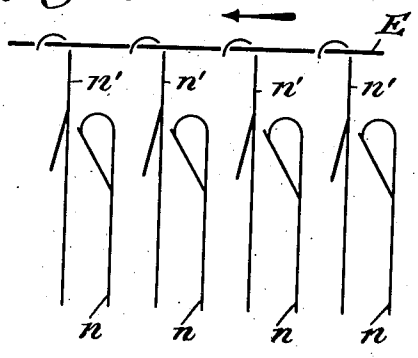


Fig. 14.

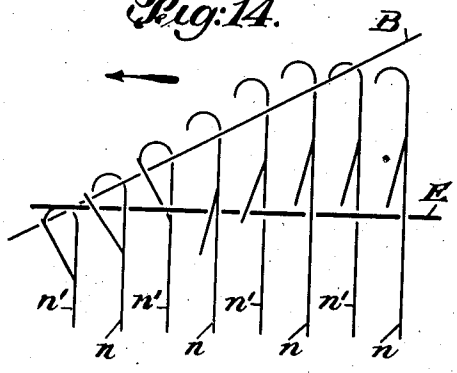
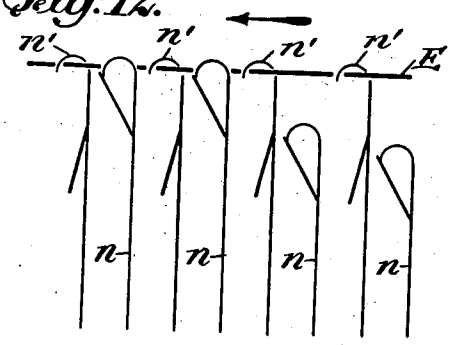


Fig. 12.



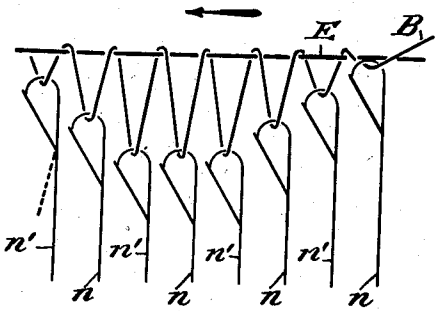


Fig. 15.

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Fig: 16.

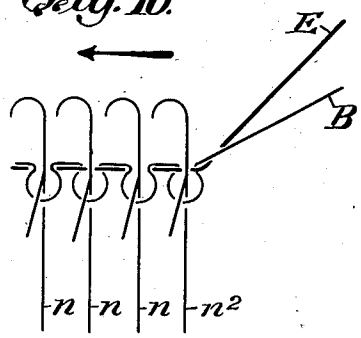


Fig: 19.

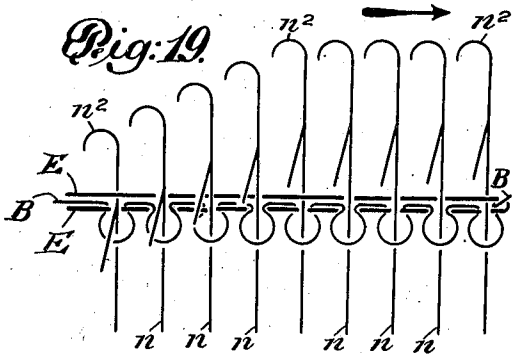


Fig: 17.

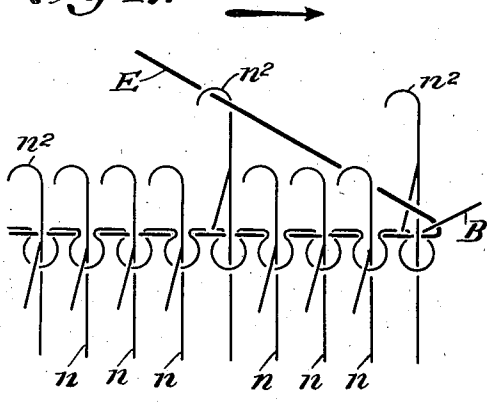


Fig: 20.

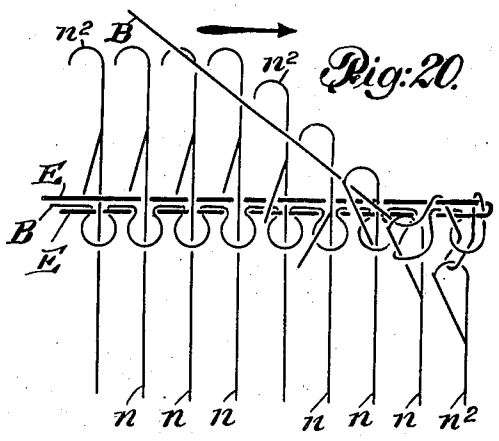


Fig: 18.

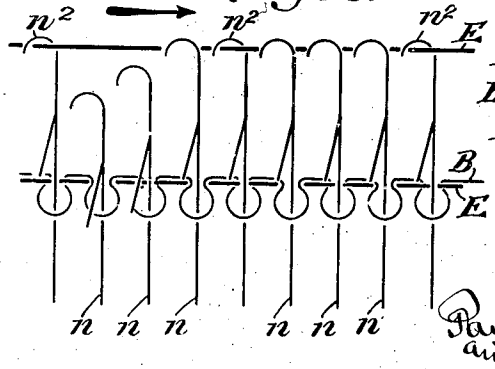
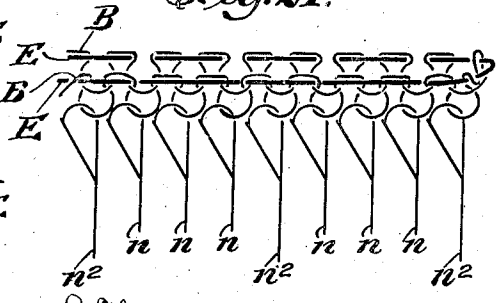


Fig: 21.



Paul L. Thurston and Harrison F. Hiller INVENTORS

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Louis Prevost Whitaker

ATTORNEY

Patented Aug. 5, 1941 2,251,533

UNITED STATES PATENT OFFICE

2,251,533

PROCESS OF KNITTING

Paul L. Thurston and Harrison F. Hilker, Martinsburg, W. Va., assignors to Interwoven Stocking Company, New Brunswick, N. J., a corporation of New Jersey

Original application October 5, 1939, Serial No. 297,970. Divided and this application March 8, 1940, Serial No. 322,874

10 Claims. (Cl. 66—1)

Our invention consists in the novel features hereinafter described, reference being had to the accompanying drawings which illustrate our improved full-fashioned stocking, sock or anklet, and one method of carrying out our improved process selected by us for purposes of illustration, and the said invention is fully disclosed in the following description and claims.

This application is a division of our former application for Letters Patent of the United States filed by us October 5, 1939, and given Serial No. 297,970.

Our invention relates to the hereindescribed process for the manufacture of full-fashioned stockings, socks or anklets having a form-fitting and self-supporting top at the upper end of the leg, in which an elastic thread or threads is or are incorporated in certain courses in which the elastic thread is united to the fabric at spaced points or wales and floated on the inside of the top between such points of union so as to form horizontally extending beads on the inner face of the top to indent the leg and interlock therewith, thus permitting the stocking, sock or anklet to be held firmly in position on the leg without the use of garters, and with a minimum of constriction from the elastic thread.

As is well-known, full-fashioned hosiery is formed as a flat fabric on a machine capable of simultaneously producing an entire course of stitches of varying lengths to facilitate the fashioning of the stocking, sock or anklet, and this flat fabric is subsequently folded on a vertical central line, and the edges are united by a seam extending vertically down the back of the leg, and along the bottom of the foot portion to complete the article. These machines are very complicated and very expensive, and operate at comparatively slow speed. It has been proposed to introduce elastic thread into the top of a full-fashioned sock or anklet, for garter purposes, but this involves material changes in and additions to the already extremely complicated knitting machines, increasing the expense thereof, and the introduction of an elastic thread in the operation of such machines further slows down their operation so that the output per day is comparatively small.

According to our invention we form the form-fitting and self-supporting top for a full-fashioned leg and foot by knitting the top of plain knitting with incorporated elastic thread, preferably in the manner hereinafter described, on a simple circular plain knitting machine of the kind provided with a circular series of independently operable needles and operating cam mechanism and means for establishing relative rotation between the needle cylinder and cam mechanism for the production of a knitted tube. These machines are very simple in construction, can be made very cheaply, and can be operated at extremely high speeds. We prefer to use a circular plain knitting machine of this type, which is not complicated by any narrowing and widening mechanism or other foot forming means, although obviously, our invention could be carried out on any circular knitting machine capable of making plain knit fabric.

In carrying out our invention, we select a circular plain knitting machine having a greater number of needles than the full-fashioned knitting machine which is to knit the full-fashioned leg and foot of the stocking, sock or anklet, and remove therefrom a group of consecutive needles of the circular series of needles so as to leave a number of needles equal to the number of needles of the full-fashioned machine in order to knit the top as a non-tubular plain knit fabric having vertical selvages at its opposite lateral edges, and to facilitate the attachment of said top to the full-fashioned leg by transferring the top to the needles of the full-fashioned knitting machine, or by looping, sewing or otherwise. The circular knitting machine is then operated in the formation of the top by reciprocating circular movement in conjunction with means for feeding a body thread to all the remaining needles in every course, and an elastic thread in selected and preferably spaced courses in which it is fed to selected and preferably spaced needles, in any one of the known ways in which an elastic thread may be incorporated in a plain knit fabric, so as to provide a series of horizontal floats on the inner face of the fabric to indent the skin of the wearer and support the stocking on the leg. The plain knit, form fitting and self-supporting top thus produced on a circular knitting machine by rotation alternately in opposite directions is referred to as a circular knit top to distinguish it from a flat knit article produced on a full-fashioned knitting machine. However, unlike circular knitting produced by continuous rotation in one direction, it is not tubular seamless fabric but has lateral selvage edges and may be straightened out into a single plane. The circular knit top preferably has a transfer course of stitches equal in number to the number of needles of a full-

fashioned knitting machine, and can therefore be transferred to a full-fashioned knitting machine to knit the full-fashioned leg and foot integrally therewith, the stocking being completed by seaming together the lateral selvages of the flat knit foot and leg and the lateral selvages of the top to form a complete full-fashioned stocking, sock or anklet, or as above indicated, the leg and foot may be knit separately on a full-fashioned machine, and the circular knit top may be applied thereto by looping, stitching, or in any other desired manner.

As the top is knit by reciprocating work on the circular knitting machine, the introduction of the elastic thread will obviously take place first in one direction, and then in the other direction in immediately succeeding courses in which it is incorporated, thereby producing adjacent to the lateral edges or selvages of the top, vertical floats where the elastic thread is carried from one course to the succeeding course in which it is incorporated. It is particularly desirable to make this top by reciprocating work on the circular knitting machine in order to provide vertical selvages at each lateral edge of the top, and also to avoid cutting the elastic thread which is fed under appreciable tension. In this manner of knitting, the elastic thread is continuous throughout the top and the individual portions in each course will retain the tension under which the elastic thread was fed.

It is known that an elastic thread may be incorporated in knitted fabrics in a number of ways, including the following:

1. By laying-in (as it is termed in the art) the elastic thread, by feeding it to the selected and preferably spaced needles, so that it lies below the latches thereof prior to the drawing of a stitch of body thread thereby in which case the elastic thread does not form part of any stitch, but is united to the fabric by the encirclement of the sinker wales on opposite sides of the stitches formed by the selected needles.

2. By feeding the elastic thread to selected needles in plating relation with the body thread so that the stitches drawn by such selected needles will contain both the body thread and the elastic thread.

3. By feeding the elastic thread to the hooks of selected needles which draw a stitch of the elastic thread through the previously formed stitch of body thread which is cast off.

Our invention may be carried out in any one of these ways, but for purposes of illustration, we have herein described the incorporation of the elastic thread by the first mentioned method, to wit, the "laying-in" of the elastic thread. so that it is not knit, but is held by the sinker wales on opposite sides of the stitches formed by the selected needles. In the formation of the circular knit top, we prefer to provide it with a preliminary anti-ravel course of stitches at its upper edge through all of which the elastic thread extends, preferably by feeding the elastic thread to every other of the needles which are temporarily raised above the intervening needles, then raising the intervening needles to the same level as the selected needles and subsequently raising all the needles to bring the elastic thread below the latches of the selected needles and subsequently feeding the body thread to the hooks of all the needles which then draw loops of the body thread on opposite sides of the elastic thread to form the anti-ravel course. This involves a 1 x 1 needle selection for the anti-ravel course. We prefer to provide in the subsequent courses, and preferably beginning with the second course of the top, for a wider needle selection which may be a separation of two, three, four or other number of needles between the selected needles, as may be found most advantageous.

We also prefer to introduce the elastic thread in spaced courses, as it is more expensive than the ordinary body thread, but on account of the reciprocations of the machine, it can only be introduced either in a course following the preceding course containing it, or a course separated therefrom in which the travel of the reciprocating cylinder will be in the proper direction, that is to say, the first, third, fifth or seventh and so forth, course following a preceding course containing it. In this instance, we have shown the elastic thread incorporated in the second course immediately after the formation of the anti-ravel edge, and thereafter in every third course, uniformly through the fabric, although it is not essential that the separation of the elastic thread bearing courses should be uniform throughout the top and any desired arrangement is within the scope of our invention. We wish it to be understood, however, that the formation of the anti-ravel course may be omitted, and the anti-ravel effect produced by turning over a welt and stitching it, or by the formation of any other type of anti-ravel edge.

In the accompanying drawings,

Fig. 1 is a diagrammatic view of the inner face of a circular knit rubber incorporated top for full-fashioned hosiery provided with a course of enlarged transfer stitches and ravel courses and embodying our invention.

Fig. 2 is a plan view of a full-fashioned stocking, sock or anklet having the circular knit top united to the upper end of the leg thereof.

Fig. 3 is a perspective view of a completed full-fashioned sock provided with the circular knit rubber incorporated top.

Fig. 4 is a diagrammatic view of the cylinder and cams of the knitting machine for producing the top by reciprocating work as they would appear if cut and spread out in a single plane, and showing the cam mechanism, thread feed fingers and latch openers, the parts being arranged in position to make an anti-ravel course at the upper end of the top, and illustrating the rotary movement of the cylinder in one direction.

Fig. 5 is a similar view with the cylinder turned to a different position with respect to the cam mechanism and indicating the position of the parts during the movement of the cylinder in either direction after all of the needles have received their thread or threads.

Fig. 6 is a view similar to Fig. 4 with the cylinder in slightly different relation to the cam mechanism showing the cam mechanism in position to produce the needle selection necessary for the introduction of the elastic thread at selected courses in the body portion of the top, and illustrating the rotary movement of the cylinder in the opposite direction from that shown in Fig. 4.

Fig. 7 is an enlarged detailed partial sectional view illustrating the needle cylinder, the needles, jacks and operations for effecting the selection required for producing the anti-ravel top.

Fig. 8 is a similar view showing the parts in the positions which they occupy during the knitting of intermediate courses between those se-

lected courses in which the elastic thread is incorporated.

Fig. 9 is a similar view showing the parts in a position which they occupy to effect a needle separation in the courses of the body of the top in which the elastic thread is incorporated.

Fig. 10 is a diagrammatic view illustrating the needle selection for the production of the anti-ravel edge.

Fig. 11 is a similar view showing the elastic thread fed to the selected needles.

Fig. 12 is a similar view showing the raising of the unselected needles to interlace the elastic thread so that it will pass in front of the selected needles and in rear of the unselected needles.

Fig. 13 is a similar view illustrating the raising of all the needles to carry the elastic thread below the latches of the selected needles.

Fig. 14 is a similar view showing the needles passing down the main knitting wave and taking the body yarn in the hooks thereof.

Fig. 15 is a similar view showing the needles drawing loops of body yarn around the elastic yarn to produce the anti-ravel edge.

Fig. 16 is a similar view showing the needles raised and the latches open preparatory to the following needle selection.

Fig. 17 is a similar view showing the second needle selection on the reverse reciprocation of the needle cylinder to feed the elastic thread to the selected needles.

Fig. 18 is a similar view showing the unselected needles raised in front of the elastic thread to interlace it between the selected and unselected needles.

Fig. 19 is a view similar to the preceding figures showing all needles raised to place the elastic thread under the latches of the selected needles.

Fig. 20 is a similar view showing all the needles taking the body yarn at the main knitting wave on the reverse movement of the cylinder.

Fig. 21 is a similar view showing the anti-ravel course and the following course as produced at the upper edge of the top, the last course being held on the hooks of all the needles with the latches closed.

Referring to the accompanying drawings, 1 represents the needle cylinder of a suitable circular knitting machine for carrying our invention into effect, and which is provided with a greater number of needles than the number of needles in the full-fashioned machine which is to knit the leg of the stocking.

The machine will also be provided with mechanism not shown for driving the cylinder first in one direction, and then in the opposite direction of rotation. The machine will also be provided with a knitting cam mechanism which in this instance will be stationary and supported by the usual cam ring. A certain number of consecutive needles of the machine will be removed from the cylinder 1, so that the remaining number of needles shall be equal to the number of needles of the full-fashioned machine which is to knit the leg of the stocking. This leaves a gap which is indicated at G in Figs. 4, 5 and 6, in which it appears in different locations in accordance with the position of the cylinder with respect to the cam mechanism. The needles, which will be indicated at *n'*, *n2*, are preferably provided with jacks indicated at 2, and both the needles and the jacks are provided with suitable butts. In this instance, as shown in Figs. 7, 8 and 9, the needles are provided with butts 3, at their lower end, while the jacks are shown with selecting butts 4, 4*a*, respectively, of different lengths, the longer butts being indicated at 4*a*.

In this instance, as shown in Figs. 4, 5 and 6, as long as only two needle separations are required, one for the selvage and the other for the insertion of the elastic thread in spaced courses, preferably in every fourth course, we find it convenient to simplify the machine by omitting therefrom every alternate jack, so that by raising all the jacks a 1 x 1 separation is secured, while by raising only the long butt jacks, the 1 x 4 separation is secured.

The cam mechanism is preferably arranged as shown in Figs. 4, 5 and 6, and comprises the main knitting cam 5 and the auxiliary cams 6 and 7 on opposite sides of the main knitting cam, the auxiliary knitting cams being movable into and out of operative position, preferably radial of the cylinder one being used when the cylinder is is moved in one direction, and the other being brought into operation when the cylinder is moved in the opposite direction, while the first mentioned auxiliary cam is withdrawn, and at certain times both auxiliary cams are withdrawn as hereinafter described.

On opposite sides of the auxiliary cams 6 and 7 are arranged riser cams 8 and 9 and 10 and 11, the cams 9 and 11 being provided with cut away portions 9*a* and 11*a*, which are in alignment horizontally with the cams 8 to 10 respectively. The riser cams 8 and 10 are movable into and out of operative position, and obviously, when out of operation, permit the butts 3 of the needles to pass by them and through the adjacent cut away portions 9*a* and 11*a* of the cams 9 and 11 as will be readily understood.

In addition to the knitting cams, there are provided certain cams for engaging the butts of the jacks, to wit, stationary draw down cams 12 and 13, and movable riser jack cams 14 and 15, as shown in Figs. 4, 5 and 6, which latter may be alternately or simultaneously brought into operative or inoperative position by suitable mechanism not shown. 16 represents the thread feed finger for the body thread B, and 17 represents the thread feed finger for the elastic thread E, located on the opposite side of the cylinder from the feed finger 16, which will be a thread of rubber, or a thread composed of rubber and fibrous material such as that known under the registered trade-mark "Lastex" or any other kind of elastic thread which will accomplish the result desired.

We also prefer to locate a latch opener 18 in front of the feed finger 17, and a second latch opener 19 in front of the thread feed finger 16 to insure all the latches of the bare needles being opened to receive the respective threads E and B, when beginning the first course of the top. As these latch openers are needed only for the first course, they need be operative in one direction only.

In the formation of the circular plain knit top embodying our invention, we prefer to start up on bare needles and as before stated to provide in the first course of the top, an anti-ravel, and it will be thus described. Assuming that the cylinder is rotated in a clock-wise direction as indicated by the arrow *a*, in Fig. 4, the shunt cam 8, auxiliary knitting cam 7, and selecting cam 15 will be drawn out into inoperative position as indicated by dotted lines in Fig. 4, while the shunt cam 10, and auxiliary knitting cam 6

will be pushed in, into operative position. The selecting cam 14 will also be pushed inwardly into its innermost position, to engage all the butts of the needle jacks which will thus raise every other needle since the jacks for the intermediate needles have been removed, as before stated. The feeding of elastic thread will always precede the formation of stitches of body thread and the first needles to receive the elastic thread will be those at the right of the gap G as indicated at *x* in Fig. 4 which represents the cylinder after the first revolution of the cylinder is nearly completed. At that point in the operation of the machine, the needles will be supported by the engagement of their butts 3 with the upper edge of the cam ring 20, and cams 8 and 15 which are indicated in that figure in dotted lines will be withdrawn into inoperative position. As the portion of the cylinder indicated at *x* approaches the feed finger 17 for the elastic thread, a needle separation is effected by the jack cam 14, which is pushed inward to its fullest extent as indicated at Fig. 7 so as to engage both the short butts 4 and the long butts 4*a* of the jacks, which are provided for the alternate needles indicated at *n'*. These needles are therefore raised by their jacks and carried past the latch opener 18 (see Fig. 10) which insures the opening of the latches and receive the elastic thread E in their hooks as indicated in Fig. 11 and at the left in Fig. 4, which latter figure, however, illustrates the position of the cylinder after the point indicated at *x* has made almost a complete revolution, and has passed the knitting point. The butts of the jacks which have been raised will be drawn down by the jack cam 12. As the cylinder rotates further, the needle butts 3 of the unselected needles will engage the cam 10, which raises them to the height of the selected needles and in front of the elastic thread E, as shown in Fig. 12, thereby effecting the interlacing of the elastic thread in front of the selected alternate needles *n'* and in rear of the unselected intermediate needles *n*. Thereafter the butts 3 of all the needles engage the upper portion of cam 11, which raises them with respect to the elastic thread, which will be held in the sinkers, thus bringing the elastic thread below the latches of the selected needles *n'*. The needles then pass the latch opener 19, which will insure the opening of any closed latches of the needles and all the needles will then be drawn down the main knitting wave W by the engagement of the butts 3 with the main knitting cam 5 and auxiliary knitting cam 6, the needles receiving the body thread B from the finger 16, as shown in Fig. 14. As the needles proceed down the knitting wave, the selected needles *n'* and the unselected needles *n*, respectively, draw loops of the body thread B on opposite sides of the elastic thread E, as shown in Fig. 15, thus forming an elastic anti-ravel course.

The portion of the needles adjacent to the point *x* of the cylinder on the right hand side of the gap G will now have body stitches or loops of body thread thereon, while the elastic thread will extend through all of said loops, but it is necessary to continue the rotation of the cylinder substantially in an entire additional revolution in order that the first course of knitting in this manner may be completed and the portion of the cylinder on the opposite side of the gap G indicated at Y shall be carried past the knitting wave.

As a matter of fact, in order to insure the completion of the movement of the cylinder in each direction during its reciprocations we construct the driving mechanism for the cylinder in such manner as to produce a movement thereof in each direction through substantially 2¼ revolutions before reversing. In order to prevent the needles which have been supplied with both the elastic yarn and body yarn during the rotary movement of the cylinder in one direction from being drawn down and raised by the knitting cam mechanism the second time they pass the throat we provide means for withdrawing the cam 8 (or 10) which has been in operative position for that movement of the cylinder and both of the auxiliary knitting cams 6 and 7 and jack cam 14 (see Fig. 5) into inoperative position, as shown in Fig. 5 in which the cylinder is shown in slightly different relation to the cam mechanism so that portions of gap G appear at each side of the figure. Therefore, on this second passage of the thread, the butts 3 of all the needles will pass through the apertures 11*a* and 9*a* in the cams 11 and 9 respectively, and in front of the auxiliary cams 6 and 7, and continue along the upper edge of the cam ring 20 without vertical movement.

We also prefer to provide the second course of knitting or in other words, the course which immediately follows the anti-ravel course with the elastic thread which in this course and all subsequent courses is fed to selected needles more widely spaced. In the second course of knitting the cylinder is rotated 2¼ revolutions in counterclockwise direction (see Fig. 6) which shows the cylinder in a different position with respect to the cam mechanism so that the gap G appears at the left hand side of the figure.

The cylinder is now being rotated in a counterclockwise direction indicated by the arrow *b*, and the first needles to receive the elastic thread will be those at the left of the gap G, indicated at the point indicated by Y. The jack cam 15 will be moved into position, as shown in Fig. 9, to engage only the long butts 4*a*, which are provided on the jacks 2 for the selected needles, in this case every fourth needle, and will not engage the short butts 4 of any of the jacks. Every fourth needle will therefore be raised to receive the elastic thread E from the thread finger 17 in advance of the throat. The riser cam 8 will be moved into operative position and the riser cam 10 into inoperative position, so that when the butts of the unselected needles engage the riser cams 8 and 9, the unselected needles will be raised in front of and to the same level as the selected needles by the cam 8 and all the needles will be raised by cam 9 to bring the elastic thread below the latches of the selected needles which are indicated at *n*2 (see Fig. 19). The needles will then be drawn down by the main knitting cam 5 and auxiliary knitting cam 7, the auxiliary knitting cam 7 having been returned to operative position, and auxiliary cam 6 having been withdrawn, the needles will take the body thread B and draw a loop through the corresponding loop of the preceding course (see Fig. 20), so that in the second course, the elastic thread will be united to the fabric at spaced wales formed by the selected needles and floated on the inner face of the fabric across the wales formed by the unselected needles, thus forming a horizontal bead on the inner face of the fabric to indent the flesh of the wearer and provide the self-supporting feature of the top (see Fig. 21).

In Fig. 1, the floated portions of the elastic thread are indicated at *e*. The remainder of the top, which may consist of any desired number of courses, is formed in the same manner as previously described with reference to the formation of the second course where the elastic thread is incorporated, and the elastic bearing courses are preferably separated by a series of courses in which no elastic thread is incorporated. As indicated in Fig. 1, the elastic thread is incorporated in every third course, but as before stated, the extent of separation is immaterial, and may be varied to suit the views of different manufacturers.

When knitting the intervening courses in which no elastic thread is incorporated, it is only necessary to withdraw the jack cam 14 or 15 which would otherwise be operative to its outermost position as indicated in Fig. 8, so that they will not engage either the long or short butts of the jacks 2 of the selected needles. The selected needles will therefore not be raised high enough to receive the elastic thread during the reciprocation of the cylinder in either direction, and a plurality of courses may thus be formed between the elastic bearing courses comprising stitches of the body thread only.

After the last course containing the elastic thread has been knit, we prefer to knit several courses, as for example, four courses of plain knitting without the elastic thread followed by a transfer course of stitches of the body thread in which the stitches are enlarged or elongated. This may be accomplished either by moving the sinkers inwardly to a greater extent during the formation of this special course indicated at *b'*, in Fig. 1, or by increasing the length of the stitches of the said course by a downward adjustment of the auxiliary knitting cams 6 or 7, or both. After this transfer course is formed, we also prefer to knit a plurality of courses usually twelve to sixteen courses of body thread alone, portions of which are indicated at *b2* in Fig. 1, which are termed "raveling courses," which completes the top.

The top is then pressed off by withdrawing one of the riser cams 8 or 10 as the case may be, permitting the needle butts to pass through the apertures *9a* and *11a* of the cams 9 and 11, and be drawn down by one of the auxiliary cams 6 or 7, according to the direction of movement of the cylinder before the body thread can be fed to the needles from the finger 16. This permits the latches of all of the needles to close and the needles will cast off the loops of the last knitted courses of plain knit fabric, so that the top will drop from the machine and be suspended within the cylinder by portions of the body thread and elastic thread between the last stitches containing the same and the feed fingers therefor, and in position to set up a new top on bare needles and repeat the operations previously described.

This leaves the tops as they come from the machine, as flat pieces of plain knitting with the elastic thread incorporated therein as previously described, and having lateral longitudinal selvages formed at opposite sides of the gap G, and connected by the portions of the body thread and elastic thread. The tops are then separated from each other by cutting the elastic thread close to the last stitch in which it occurs, and severing the body thread so as to leave an end which is available, for unravelling the ravel courses *b2*, and back to the transfer course *b'*, after it has been applied to the needles of a full-fashioned knitting machine and the leg of the stocking is knit thereon integrally with the circular plain knit form-fitting and self-supporting top. No binder or cutter is therefore required on the circular knitting machine and the thread feed fingers remain always in operative position.

It will be understood that the elastic thread is preferably delivered from the feed finger 17 under desired tension, that tension being applied in any suitable manner and to any suitable degree.

In Fig. 4, for example, we have shown diagrammatically, a tension device 21, but any desired form of tension mechanism may be employed.

It will also be understood that the leg and foot of the stocking may be made on one full-fashioned machine if desired, or the leg may be knit on one full-fashioned machine and then transferred to a full-fashioned footer on which the foot is knit.

The completed stocking in either case will be like that shown in Fig. 2, in which T represents the circular knit form-fitting top, L the leg, F the foot. The stocking is completed as shown in Fig. 3 by uniting the edges of the stocking fabric in the usual manner to form the seam S, extending down the back of the top of the leg, and heel portions, and along the bottom of the foot, the portion of the seam at its upper end indicated at *s*, uniting the longitudinal selvage edges of the top T.

It will be noted with reference to Fig. 1 that the elastic thread E is continuous through all the courses in which it occurs and is connected from one course to the next course in which it occurs, at or adjacent to opposite edges or selvages of the fabric to form longitudinal floats indicated at *e'* in Fig. 1.

By our invention it is possible to produce a full-fashioned stocking having a plain knit rubber incorporated form-fitting and self-supporting top without adding to the complicated structure of the full-fashioned machines and slowing down their already slow production, the tops being formed separately on a simple circular plain knitting machine by reciprocating work as a top having lateral selvages and being of less length than the circumference of the circular series of needles, these tops being capable of being produced on the simplest form of circular knitting machine capable of knitting a tubular fabric or upon other available circular knitting machines capable of producing a plain knit tubular fabric which may be available for use, these tops being transferred to the full-fashioned knitting machine, so that the leg may be knit integrally therewith, or being otherwise appropriately secured to the leg knit on the full-fashioned machine.

In knitting the remainder of the stocking on the full-fashioned machine, it may be formed by rib knitting throughout portions or all of the leg and the top of the foot, or by plain knitting, as may be desired or found advantageous.

We believe it to be new to form an elastic circular knit form-fitting top as a flat fabric, with selvages at the longitudinal edges for union with a full-fashioned leg united thereto, the lateral edges of the top and leg being united by a vertical seam, and such a construction is within our invention whether the elasticity of the top is provided by the incorporation of elastic thread in a plain knit top, or by knitting the top of rib fabric with lateral selvages and with or without the incorporation of elastic thread, or otherwise.

It is also understood that our improved top may

also be used in connection with hosiery having circular knit legs, by transferring it to the needles of a circular knitting machine having the same number of needles as the number of stitches in the top, and knitting the leg and foot of the stocking, or otherwise attaching it to the circular knit leg as by looping or sewing, in any case arranging that the selvages of the top shall meet at the back of the stocking. The selvages may then be united, for example, at the time of stitching a mock seam up the back of the leg, or independently of the leg.

It will be understood that in knitting the hereindescribed top, suitable take-up mechanism may be employed to take up the slack of the body thread, and also the elastic thread, if necessary or desirable, when the rotary movement of the cylinder is reversed at the ends of its reciprocating movements.

What we claim and desire to secure by Letters Patent is:

1. The process of producing a full-fashioned stocking having a form-fitting top, which comprises forming a top portion by feeding an inelastic thread to a plurality of consecutive needles of a circular knitting machine less than the number of needles which would be required to form a complete circular series, operating said machine by reciprocation to form a plurality of courses on all of said needles terminating at each end in a selvage, and incorporating an elastic thread in selected courses of said top portion, knitting a full-fashioned leg portion on a flat knitting machine, the upper edge of the leg portion being united to the lower edge of said top, and connecting together the lateral edges of said leg portion and top by a vertical seam.

2. The process of producing a full-fashioned stocking having a form-fitting top, which comprises feeding an inelastic thread to a plurality of consecutive needles of a circular knitting machine less than the number of needles which would be required to form a complete circular series, and operating said machine by reciprocation to form a plurality of courses on said needles terminating at each end in a selvage, and feeding an elastic thread to certain of said needles in certain of said courses and floating it vertically from each course containing it to the next adjacent course containing it, forming a full-fashioned leg portion on a flat knitting machine, the said leg portion being united at its upper edge to the lower edge of said top and connecting the lateral edges of the leg and top portions by a vertical seam.

3. The process of producing a full-fashioned stocking having a form-fitting top, which comprises feeding an inelastic thread to a plurality of consecutive needles of a circular knitting machine less than the number of needles which would be required to form a complete circular series, and operating said machine by reciprocation to form a plurality of courses on said needles terminating at each end in a selvage, and feeding continuous elastic thread under tension to selected needles in selected courses, and floating it on the inner face of the fabric between the selected needles and floating it vertically from one of the courses containing it to another adjacent to one or other of said selvages, alternately, knitting a transfer course of stitches with the inelastic thread only below said rubber incorporated courses, transferring said transfer course to the needles of a flat knitting machine and knitting integrally with said top a full-fashioned leg, and uniting the lateral edges of said top and leg by a continuous seam.

4. The process of producing a plain knit form-fitting and self-supporting top for an article of hosiery, which comprises feeding an inelastic thread to a plurality of consecutive needles of a circular knitting machine less than the number of needles which would be required to form a complete circular series, and operating the machine by reciprocation to form a plurality of consecutive courses of uniform length terminating in lateral selvages, and feeding an elastic thread to selected needles in selected courses and floating it on the inside of the fabric from one selected needle to another in each course containing it and vertically between consecutive courses containing it adjacent to one or other of said selvages.

5. The process of producing a plain knit form-fitting and self-supporting top for an article of hosiery, which comprises feeding an inelastic thread to a plurality of consecutive needles of a circular knitting machine less than the number of needles which would be required to form a complete circular series, and operating the machine by reciprocation to form a plurality of consecutive courses of uniform length terminating in lateral selvages, and feeding an elastic thread to selected needles in selected courses, and floating it on the inside of the fabric from one selected needle to another in each course containing it and vertically between consecutive courses containing it adjacent to one or other of said selvages, providing an anti-ravel construction at the upper edge of said top, and one or more courses formed of inelastic thread only at its lower edge.

6. The process of producing a plain knit form-fitting and self-supporting top for a full-fashioned article of hosiery which comprises feeding to a plurality of consecutive bare needles of a circular knitting machine less than the number which would be required to form a complete circular series, an elastic thread so as to interlace it in front of and below the latches of alternate needles and in rear of intermediate needles, and feeding an inelastic thread to the hooks of all of the said consecutive needles during the operation of the machine in the same direction to form an anti-ravel edge and knitting a plurality of consecutive courses by reciprocation on said needles with said inelastic thread to form selvages at the opposite ends of said courses and feeding an inelastic thread to selected needles in selected courses, and floating said elastic thread horizontally on the inner face of the fabric between said selected needles, and vertically between said selected courses adjacent to one or other of said selvages alternately.

7. The process of producing a plain knit form-fitting and self-supporting top for a full-fashioned article of hosiery which comprises feeding to a plurality of consecutive bare needles of a circular knitting machine less than the number which would be required to form a complete circular series, an elastic thread so as to interlace it in front of and below the latches of alternate needles and in rear of intermediate needles, and feeding an inelastic thread to the hooks of all of the said consecutive needles during the operation of the machine in the same direction to form an anti-ravel edge and knitting a plurality of consecutive courses by reciprocation on said needles with said inelastic thread and forming a course of transfer stitches, of the inelastic thread

only below the last course containing the elastic thread.

8. The process of producing a plain knit form-fitting and self-supporting top for a full-fashioned article of hosiery which comprises feeding an inelastic thread to all of a plurality of consecutive needles of a circular knitting machine less than the number of needles which would be required to form a complete circular series and operating said machine by reciprocation to produce a plurality of consecutive courses terminating at each end in a vertical selvage, and in certain of said courses effecting a needle separation and feeding an elastic thread to spaced selected needles and floating said elastic thread horizontally on the inner face of the fabric between said selected needles and floating it vertically between the courses containing it, adjacent to the said selvages and knitting a transfer course of stitches of the inelastic thread after the completion of the last course containing the elastic thread.

9. The process of producing a plain knit form fitting and self-supporting top for an article of hosiery, which comprises feeding an inelastic thread to a plurality of consecutive needles of a circular knitting machine less than the number of needles which would be required to form a complete circular series, and operating the machine by reciprocation to form a plurality of courses terminating in lateral selvages, interlacing an elastic thread alternately in front of and behind successive needles during the knitting of one or more of said courses and drawing loops of inelastic thread alternately on opposite sides of the elastic thread to form an antiravel construction, feeding the elastic thread to selected needles spaced by not less than two intervening needles during the knitting of the immediately suceeding course and one or more subsequent courses and manipulating the needles to incorporate the elastic thread in the fabric at the spaced wales formed by said selected needles and to float the elastic thread on the inside face of the fabric between said wales.

10. The process of producing a form fitting and self-supporting top for an article of hosiery, which comprises feeding an inelastic thread to a plurality of consecutive needles of a circular knitting machine and operating the machine by rotary movement alternately in opposite directions to form a plurality of courses terminating in lateral selvages, and feeding an elastic thread to selected needles in selected courses and floating it on the inner side of the fabric from one selected needle to another in each course containing it and vertically between consecutive courses containing it adjacent to one or other of said selvages.

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