Aug. 4, 1964 O. FREGEOLLE 3,142,974

METHOD OF KNITTING HOSIERY

Filed April 9, 1959 4 Sheets-Sheet 1

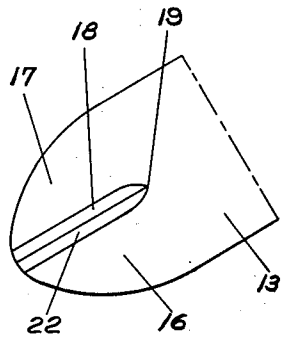


Fig. 2

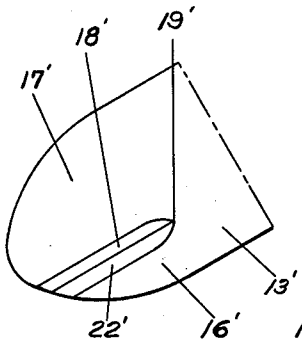


Fig. 2a

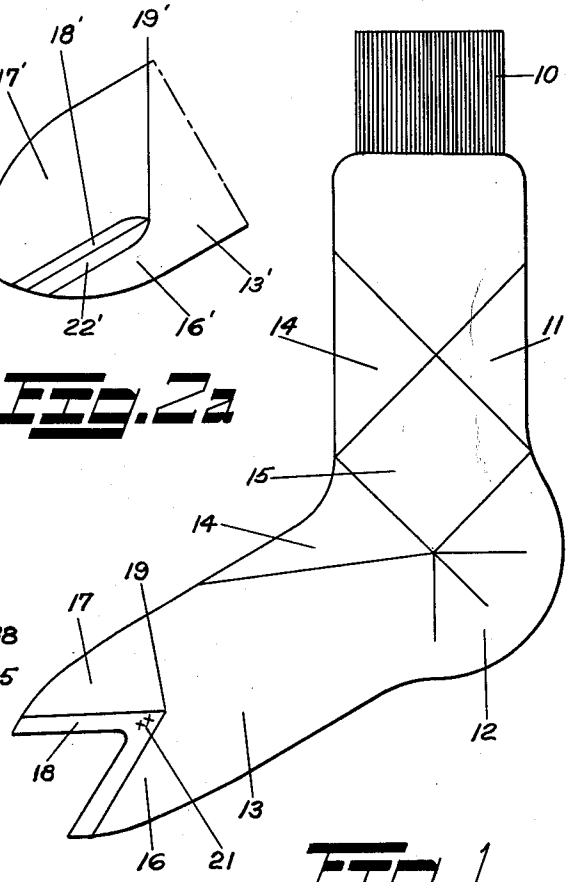
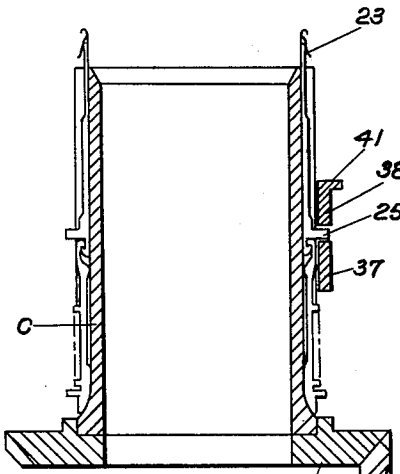


Fig. 1



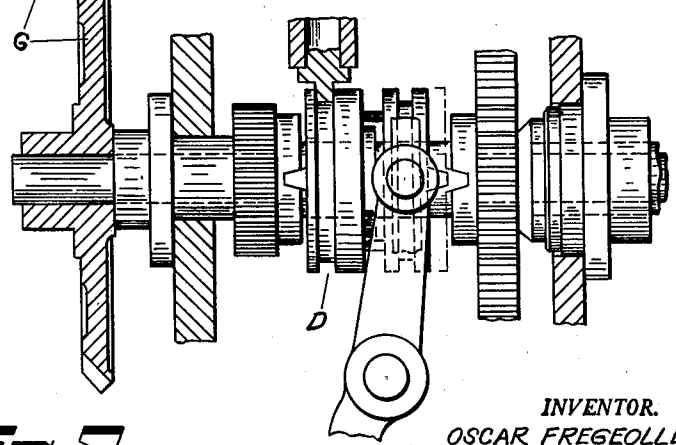


Fig. 3

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METHOD OF KNITTING HOSIERY

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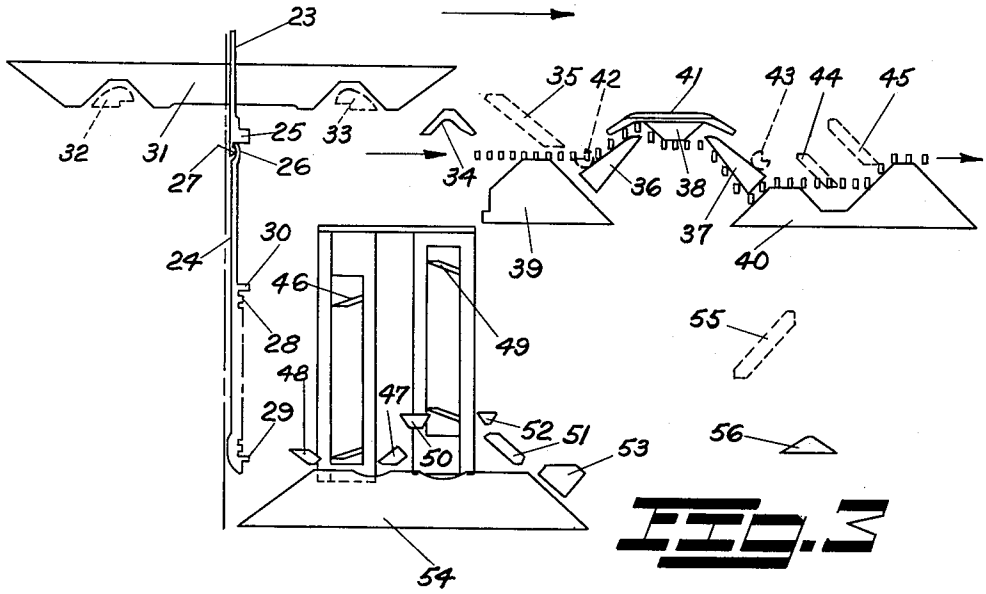

FIG. 3

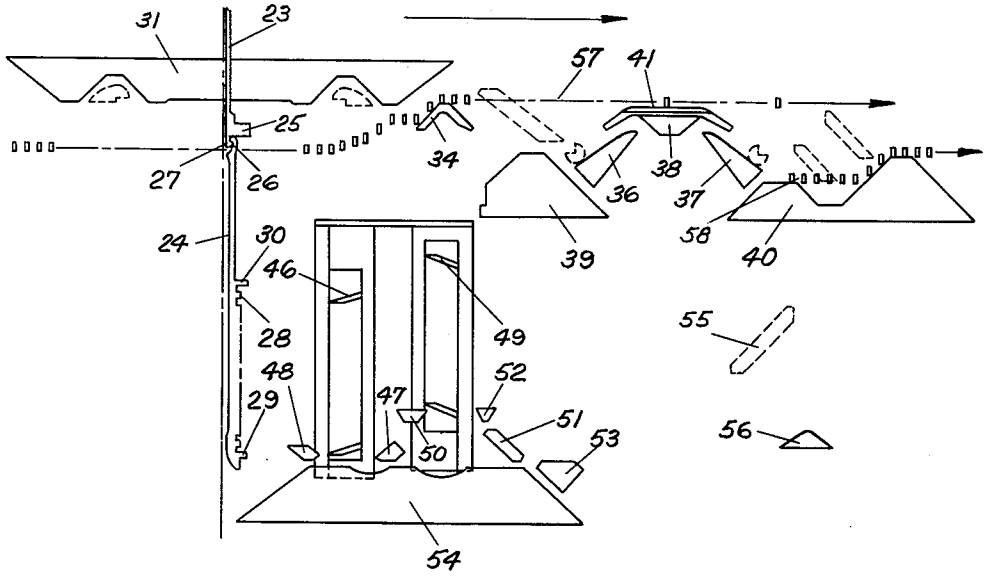

FIG. 4

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METHOD OF KNITTING HOSIERY

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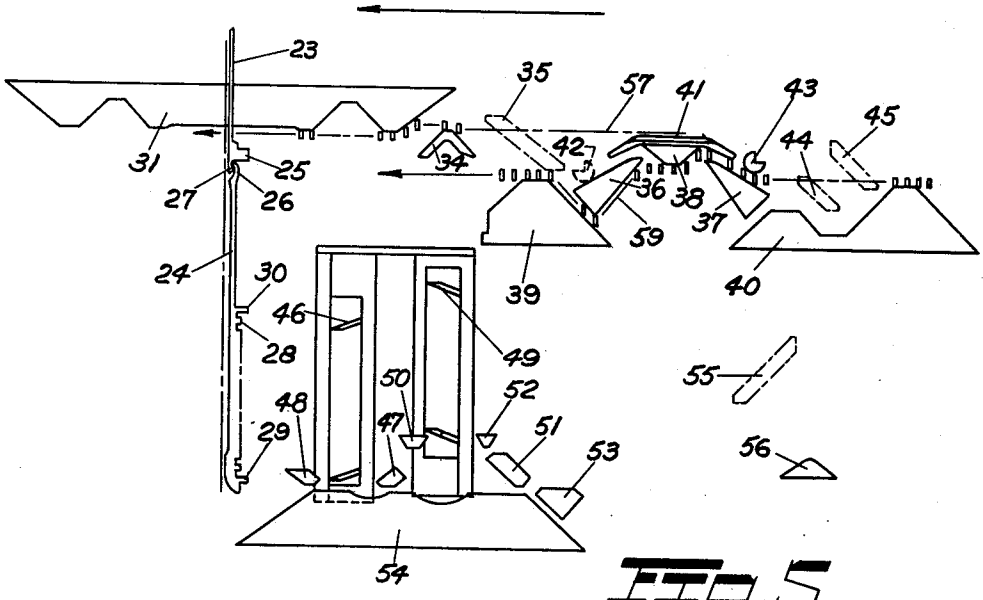

FIG. 5

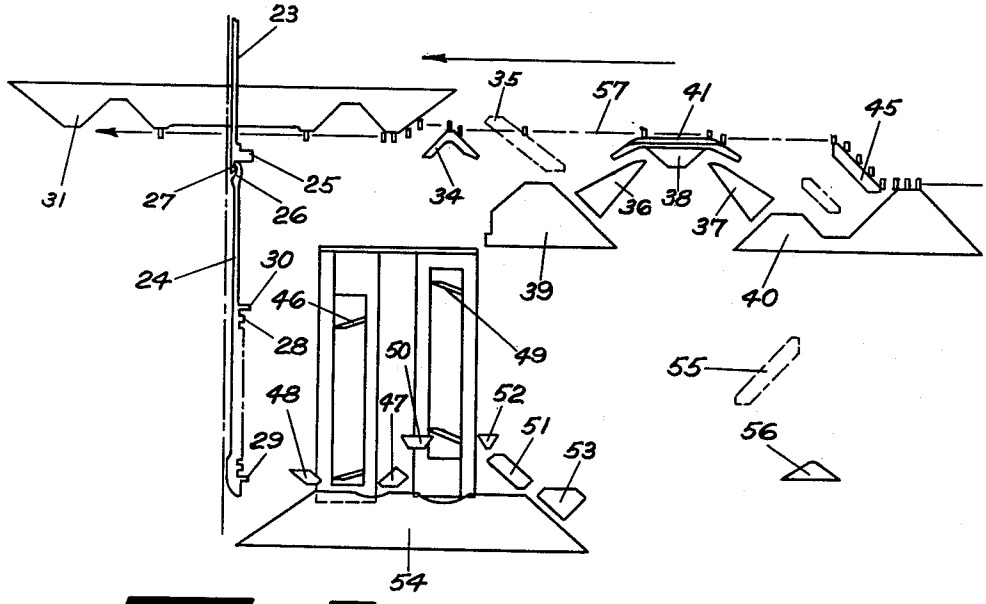

FIG. 6

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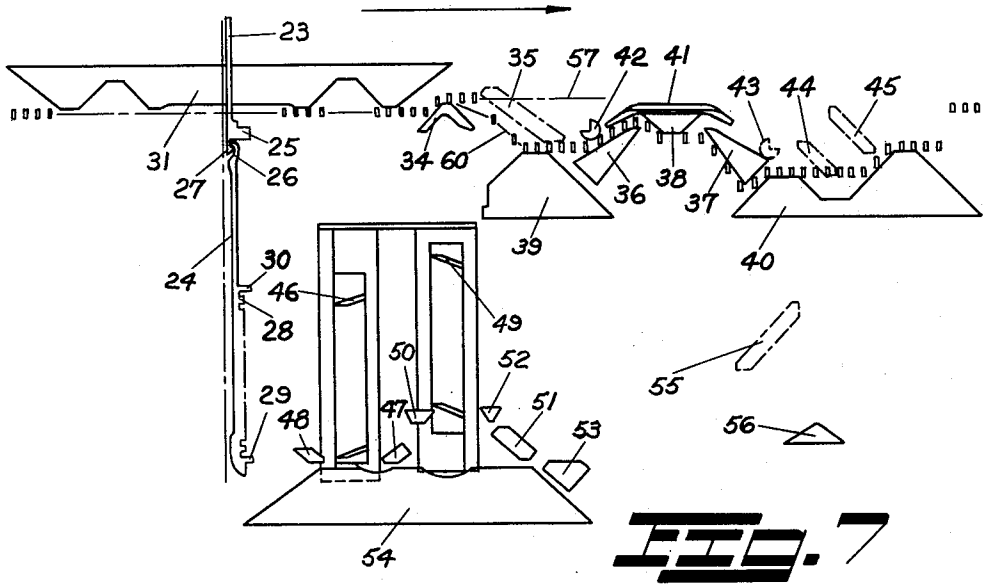

FIG. 7

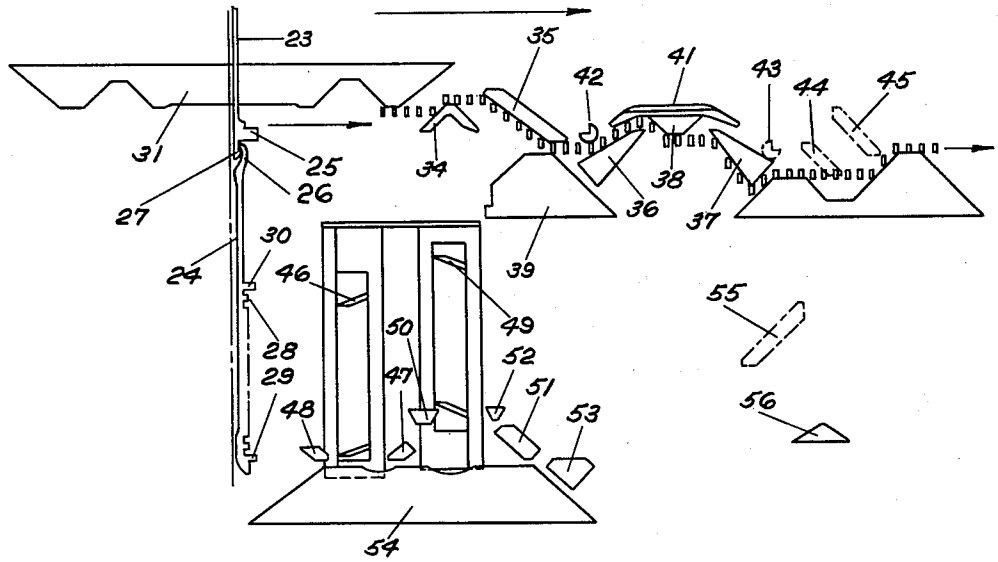

FIG. 8

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United States Patent Office

3,142,974

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3,142,974

METHOD OF KNITTING HOSIERY

Oscar Fregeolle, Lincoln, R.I., assignor to Draper Corporation, Hopedale, Mass., a corporation of Maine

Filed Apr. 9, 1959, Ser. No. 805,336
4 Claims. (Cl. 66—48)

This invention pertains to knitted hosiery and, more particularly, to a novel combination therein which includes an improved toe construction and the method of producing such a toe on a modern knitting machine.

It is a general object of the invention to devise a method of forming a toe in an article of hosiery by which a toe heretofore contemplated, but never produced commercially may be readily knitted in existing hosiery machines.

A more particular object is that of forming such a toe in conjunction with reciprocatorily knitted, solid color patterned hosiery in which the pattern may be carried into the foot.

A further object is that of forming such hosiery on a circular, independent needle knitting machine having a single feeding and knitting station.

Other object will become apparent from the following more detailed disclosure.

For a great many years the toes of circularly knitted hosiery have been formed by reciprocatory knitting while narrowing and then widening to shape the toe pocket, after which a small amount of added material has been knitted to serve for handling and for looping purposes. These so-called loopers rounds have been formed in circular work. The looping has normally been confined to the top of the foot, but in instances, notably in ladies seamless wear, the seam is located at the bottom.

According to certain older disclosures, e.g., the Henshall, U.S. Patent No. 388,678 of 1888, it has been suggested that one might form a toe by narrowing only, this being done first at the bottom and then the top of the foot section after which loopers rounds may be knitted, the resultant product being seamed to close the toe. While this concept has been more or less complete insofar as the concept of a knitted article only is concerned, it does not appear that anyone has taught the art how to accomplish this desired result in a practical fashion, that is, in a commercial hosiery knitting machine.

According to the instant invention which relates more particularly to a method by which this toe may be made in single feed machines, a circular independent needle hosiery machine is provided with a feeding station at which yarns may be fed to knit in rotary and in reciprocatory work, and also with cams and selecting means all of which will be described more particularly. These cams are mainly effective in both directions of reciprocation while the selecting devices function to control needles and their jacks in one direction of reciprocation and may positively effect a needle to raise it or to depress it.

Briefly, the method comprises knitting a first half of the toe as a narrow tab, then shogging the cylinder 180°, more or less, to bring the opposite half of the needles into play for knitting a second tab. Narrowing picks only are used since there need be no widening step. Upon narrowing the second tab to a predetermined point, a number of loopers rounds are knitted, either of the same or a different yarn, and preferably, during this last step, a few tuck stitches may be made preferably beyond the looping line and at opposite sides to mark and facilitate looping. These give reference points by which the looper can very readily put the material on the looper in proper relationship for correct looping. Of course, a conventional looper may be used but it is also contemplated that the end may be closed by sewing, e.g., in a

butt type sewing machine adapted to make a flat, nonbulky suture.

The method applies to making the toe itself in any article of hosiery to which it may be found adaptable, but however, it is particularly desired to combine such a toe in hosiery ornamented by reciprocatory solid color work which may, if desired, be continued down into the foot portion, especially the instep part of the stocking.

The invention will be described in greater detail by reference to particular embodiments it may take and by reference to a method as illustrated in the accompanying figures of drawing, wherein:

FIG. 1 is an elevational view showing a stocking with the toe involved, as the same appears before closing;

FIG. 2 is a similar view with the toe closed;

FIG. 2*a* is a view similar to FIG. 2, but showing a construction in which the top toe tab is made larger than the bottom.

FIG. 3 is a cam development showing cams and butt pathways for ending the foot preparatory to starting a toe;

FIG. 4 illustrates knitting in the first part of the toe;

FIGS. 5, 6, 7 and 8 show, respectively, the ending of the first toe tab, preparation for shogging the cylinder, first course in the second toe tab and the last course in the second tab preparatory to knitting loopers rounds. FIG. 9 is a section taken through a cylinder, drive gears and clutch according to the invention.

Now referring to FIGS. 1 and 2, the toe is shown in an article of hosiery knitted in both rotary and reciprocatory work, preferably in the well known Banner VIP circular hosiery machine manufactured by Wildman Jacquard Co. of Norristown, Pennsylvania. Such a stocking has a top **10**, preferably of simulated rib work incorporating an elastic yarn, a leg **11**, heel **12** and foot **13**. The heel may be formed by narrowing and widening in the usual manner.

While the toe need not be a part of a pattern stocking, nor need it be a part of a stocking pattern in some particular way, it is, however, specially adapted to be made as a part of hosiery in which a solid pattern is also knitted. Here a pattern comprises diamonds **14** and **15** of different color from that of the leg and foot. The mechanism and method by which such a pattern is produced are now so well known that they need no further description here.

This pattern must, of course, be formed in reciprocation, but the fabric preceding and following it is knitted in circular or straight away knitting. If desired this pattern might start at the beginning of the leg **11** and could be continued to the toe. It does, however, extend into the instep portion or past the heel by preference.

Having reached the point at which a toe should be started, and, assuming a toe of equal halves is to be formed, one-half the needles are displaced to an inactive level, preferably the instep group, and then a toe tab **16** at the sole side is knitted, the same being narrowed as end needles are picked from the active to an inactive group.

When a tab of sufficient extent is completed, all needles are retired to inactive level and the needle cylinder is shogged or racked so as to bring the segment or group of needles first rendered inactive into a position to knit as they are reciprocated to and fro past the single knitting station involved. Those needles which were active at the formation of tab **16** are then left at or are displaced to inactive level and a second tab **17** is knitted in the same manner the first was. Preferably, these tabs are of substantially equal extent and are narrowed in practically the same degree. It is now desirable to knit a few courses of material for handling purposes and to serve as a basis for the seaming or closing steps. Loop-

ers rounds 18 are formed either of the same or a different yarn preferably after the cylinder has been shogged back to its original position. For that purpose the machine is rotated for anything from eight to sixteen courses depending on the gauge of the machine and other factors, for example, and while not entirely essential, the corners 19 and that on the opposite side (not shown) at the points of divergence of the toe gap may be marked to facilitate putting the material on points for looping. Here two needles, one at each corner, are pattern controlled to tuck for four courses, more or less. That produces tuck stitches 21 near each corner so the looper may start putting the material on the looper points using these for a guide.

In FIG. 2 the toe is shown as it appears when finished. Excess material has been removed after looping and the loopers rounds, preferably four in number, are joined by the seaming thread at 22.

Now having described in a general way the manner in which the toe is made and its physical construction, a more detailed disclosure will be made with more particular reference to FIGS. 3–8. These figures show in developed form cams and selector devices which control needles 23 and their jacks 24. These needles are of latch type and have butts 25. Jacks are of a type having a hooked end 26 engageable with a similar end 27 of the needle so that both elements move as a unit and jacks may draw needles down as well as push them upwardly. A number of selector butts 28 may be broken out at will to set up a pattern control. Master butts 29 elevate or depress any jack selected and butts 30 are usually set up as alternate long and short butts to control knitting an elastic top or the like.

First, taking cams which act on needle butts, FIG. 3, elongated cam 31 acts primarily to guard the widening picks 32 and 33. It also lines up the needle butts which are to be affected by a pick when picks are working. These function in the heel and toe and also during patterning if a pattern is to be made. If they carry a needle up in their return motion, then the cam 31 will immediately restore it to a lower level.

Cam 34 is both a levelling and a raising cam and cam 35 is a front pull-down cam. It is movable and acts upon all needles in the straightaway and when coming out of a heel or toe.

Cams 36 and 37 are front and rear stitch cams and these function in conjunction with a center cam 38 and front and rear raise cams 39 and 40. A wing cam 41 is positioned above cam 38 and serves to complete the raising movement imparted to needles picked up by both up picks 42 and 43. It is needed since the swing of a pick does not raise a needle to the extent required in this particular machine.

A movable cam 44 pulls down those needles which have taken the rubber yarn for the elastic top.

The cam 45 is also movable and is brought into action in preparation for shogging the needle cylinder and then raises any needles not already over the cam block to that level.

The Right hand or higher end of cam 40 elevates needles to a normal level at which they approach the cam block.

Jacks are affected by two selecting means, one operable for raising jacks and the other for depressing them. The usual inclined plungers 46 may act, when pushed in by a pattern drum or the like, to lift any jacks 24 having a butt 28 at that level so that their master butts 29 will ride up a master cam 47. Corresponding needles are thus raised until their butts travel over cam 34. Cam 48 levels jacks prior to selection and has an inner face inclined toward the cylinder to push into their slots any jacks which may be travelling in an unintentionally or accidentally outwardly displaced position.

A second selecting means is similar to that just described but has plungers 49 which move jacks downwardly instead of upwardly. Jacks are levelled by cam 50 and, if selected, are drawn down by master cam 51. Of course, such action pulls the corresponding needles downwardly, too.

Cam 52 is a levelling cam effective in both directions and cam 53 is known as a safety cam. It inclines as does cam 48 and affects jacks as they enter the selecting zone.

Cam 54 is another safety cam and raises jacks and needles moving in either direction to a normal height to pass through without interference. Such elevation is necessary for needles which have been drawn down by a stitch cam and have had their butt broken in so doing, or for jacks so moved which have their connection to their needle destroyed.

Cam 55 is movable and is used to raise alternate needles to take elastic yarn as for the top. Cam 56 is a levelling cam for jacks.

It is to be understood that all of these movable cams are controlled by appropriate pattern means as are the narrowing picks 42 and 43.

Now having described the various cams which are to be found in the machine the steps and action of parts involved at the toe will be explained.

It is to be assumed that the machine is knitting in circular work just prior to the start of the toe and that, of course, the clutch is in regular position. These VIP type machines have a needle cylinder C driven in rotation and reciprocation by gears G, power to which is transmitted through a dog clutch generally indicated at D. The cylinder is adapted to be shogged to four different positions for effecting pattern work, this clutch and associated parts being described in United States Patent No. 2,834,192. For purposes of making the toe only, a clutch affording two positions substantially 180° apart would suffice.

In such rotary work needle butts would follow the pathway indicated in FIG. 3. Cams not in action are shown dotted. Needle butts pass over cam 36, take yarn and then are lowered by cam 38 and knit under rear stitch cam 37. They are then raised up over cam 40 to their original level. Of course, no selector plungers are in at this time.

Upon going into the toe, the lower or sole tab is to be knitted first since many parts are already in position for that. While the toe may be made from a different yarn, it is most likely the same yarn will be used so no change is needed.

In the first course of the toe the narrowing picks are out of action and one plunger 46 comes in to raise the needles at the instep side out of action. This is shown in FIG. 4, where the path 57 shows those needles going up over cams 34 and 41. Once at that level they stay there until purposely drawn down. The sole needles follow path 58 and form the first course of tab 16. It is to be noted that in these developed views, cams not in action are shown in dot-and-dash lines.

In FIG. 5 a counterclockwise stroke in the process of narrowing this tab is shown and after the initial course the picks 42 and 43 are brought into play. Here needles that knit in pathway 59 are cleared over stitch cam 37 and take yarn and knit under cams 38 and 36, then being raised by cam 39 to a normal level. Pick 43 is shown raising a needle to cam 41 above which that needle joins the inactive group in path 57. This action goes on to a practical point, for example, down to six or seven needles in a seventy-six needle machine. Naturally, different degrees of narrowing may be attained by use of picks adapted to control more needles at a time or picks may be pattern controlled to act at spaced courses only.

The last course should be one in a counterclockwise direction (not shown and which takes place intermediate the strokes illustrated in FIGS. 5 and 6) and contemplates shogging 180° at the next clockwise move. First, all needles are raised to inactive level and for that purpose, cam 45 is moved into action, FIG. 6. The last needles (six or seven) will be raised by it to inactive track 57

whereupon the clutch is shifted to disengage. It stays disengaged for the equivalent of a little less than ½ turn of the cylinder during which time the latter is stopped. It then engages again and the cylinder will function in a 180° different or retarded relationship to what previously prevailed.

While not wholly necessary the feeding yarn is taken out of action by raising its yarn feeding finger in known manner. If left in, a float would be formed and while it could be cut later, taking yarn out and then returning it to action avoids that. The yarn is then dropped in again about three needles before the first of the instep needles which knit the second tab.

At the start of this tab picks **42** and **43** are in position and one of the plungers **49** will be pressed in to engage butts **28** in line with it and which are set up to affect all needles of the instep group.

As shown in FIG. 7, those jacks affected by master cam **51** pull down their needles from pathway **57** to one at **60** at which they pass through cams **36**, **38** and **37** to knit. The leading one is elevated by pick **42** as shown and joins the inactive group immediately.

This action then continues on with the tab **17** being formed and narrowed down to a desired extent and width. At the last clockwise stroke ending the tab cam **45** is again used to raise the last needles left knitting so that all are raised preparatory to shogging the cylinder so the clutch will be returned to regular position. That involves a 180° shift and while that is accomplished no yarn is fed, however, a yarn is immediately introduced and may be the same or a different one from that fed in the toe. It will preferably be a different yarn and is introduced to overlap about three needles so as to avoid possibility of a hole at that area. The machine is then rotated for a number of courses sufficient to make the convenient loopers rounds.

While it is not entirely necessary, the corners of the toe opening to be looped are preferably marked by tuck stitches. That is accomplished by setting up jacks and the pattern drum to control one needle at each corner to tuck. These marking stitches may be either an accumulation of stitches or float tucks, preferably the latter.

In practice these tucks are formed for four courses (one move of the pattern chain) and the knitting in these loopers rounds is continued for about twelve courses, more or less. Looping is preferably done so the seam comes at the fourth course of these rounds, although, of course, that may well be varied to suit conditions. Preferably the tuck stitches are formed at the second four courses of the loopers rounds.

Instead of looping conventionally, the toe may be closed by a seaming process such as would use one of the butt seaming machines which is adapted to make a flat, non-bulky seam.

The toe is very comfortable since it has no seam or roughened areas at either the top or bottom. The seam at the end comes off the end of the wearer's toes where it can effect no pressure or lead to discomfort although, of course, the looper is adapted to form a connection not far different from the knitted structure itself.

While this description relates in particular to a single feed solid color hosiery knitting machine, it is to be understood that it applies equally well to other independent needle, circular machines provided for shogging the cylinder and cams relatively for that angular extent necessary to bring first one-half, more or less, of the needles into position to reciprocate past the cams to form a first tab and then the remaining needles after shogging to knit the second tab.

While it is generally preferred to make the toe with tabs of more or less equal size so the looping or seaming connection comes in substantially a central, horizontal plane, that may be varied and especially in ladies seamless wear, it may be of advantage to divide the needle and jack setup in such a way that the lower tab will be somewhat

smaller than that at the top or instep side. This results in concealing the looping line or other seam beneath the foot.

Such a toe is shown in FIG. 2*a* wherein a foot **13'** is provided with a toe having lower tab **16'** and upper tab **17'**, the first of which is formed on a segment of needles at the sole substantially less than half the total number. The top tab is thus substantially larger and this division and control of needles are governed by jacks or in any other convenient manner.

Loopers rounds are knitted and a seam formed by a looper or sewing machine will then be located just under the front of the foot (beneath the ends of the wearer's toes) and is not normally visible even with open toed shoes. The seam will, however, not be under the foot either in a position laterally across or longitudinally of the foot in which positions it may be less comfortable to the wearer. It extends in an arc roughly conforming to a semicircle or partial ellipse.

The loopers rounds are shown at **18'** and the seam at **22'**.

By way of illustration, the method is described as practiced in a knitting machine already provided for shogging the needle cylinder relatively to the cam set. However, all machines may be so reconstructed as to provide that facility if they do not already have it.

In double cylinder machines the lower cylinder is to be so controlled and, of course, all needles should be transferred to one cylinder, preferably the lower, at that time. Dial rib machines may likewise be modified and, of course, the dial and its needles are not in action when shogging is done nor when the toe tabs are being formed.

The looping or sewing thread or the loopers rounds, or both, may be of a different color from that of the toe tabs and thus the toe end becomes somewhat distinctive and ornamental accentuating the smoothness of both the top and lower portions thereof.

Another distinguishing characteristic of toe resides in its freedom from the "dog ears" formed in toes knitted conventionally which so often persist to a disturbing degree even after finishing.

In applying the toe to hosiery having a pattern as in FIG. 1, the reciprocation of the machine serves along with the selecting means and mechanism provided for shogging the cylinder to make possible the reciprocation of segments of needles past the cams to knit separate areas at different cylinder positions and to connect those areas by a knitted seam. The same means, when employed as herein described and claimed, is effective in knitting the improved toe. A heel may be formed in the usual way.

While not described here, a gusset may be added in the toe if desired.

While one embodiment of the invention has been disclosed, it is to be understood that the inventive concept may be carried out in a number of ways. This invention is, therefore, not to be limited to the precise details described, but is intended to embrace all variations and modifications thereof falling within the spirit of the invention and the scope of the claims.

I claim:

1. A method of knitting a toe of a circularly knitted article of hosiery on a circular, independent needle knitting machine having needles, a relatively rotatable and reciprocable needle cylinder and cam means which comprises the steps of rendering inactive a segment of needles at the instep side greater than half the total number of needles, reciprocating the remaining needles through said cam means while feeding yarn to them and progressively retiring end needles from action to knit a narrowed tab, then shogging said cylinder and needles substantially 180°, rendering inactive those needles on which the sole tab has been knitted and reciprocating the opposite segment of needles through said cam means while similarly retiring end needles to knit a second narrowed tab at the instep side of greater extent and size than the sole tab.

2. A method of knitting a toe in a circularly knitted article of hosiery having solid colored pattern areas therein on a circular, independent needles, knitting machine having needles, selectively controlled jacks for actuating said needles, a relatively rotatable and reciprocable needle cylinder and cam means, which comprises the steps of rendering inactive a segment of needles, reciprocating the remaining needles through said cam means while feeding yarn to them and progressively retiring end needles from action to knit a narrowed tab, rendering inactive all of the needles, withdrawing the feeding yarn, then shogging said cylinder and needles substantially 180°, returning the yarn to feeding relationship, reciprocating through said cam means the segment of needles first rendered inactive while similarly retiring end needles to knit a narrowed tab opposite the first, and then knitting several courses of loopers rounds forming at least one contrasting stitch at each point of divergence of the two tabs to mark a point for starting the fabric on the points of a looper.

3. A method as defined in claim 2 wherein said contrasting stitch is a tuck stitch.

4. A method of knitting a toe in a circularly knitted article of hosiery having solid colored pattern areas therein on a circular, independent needle, knitting machine having needles, selectively controlled jacks for actuating said needles, a relatively rotatable and reciprocable needle cylinder and cam means, which comprises the steps of rendering inactive a segment of needles, reciprocating the remaining needles through said cam means while feeding yarn to them and progressively retiring end needles from action to knit a narrowed tab, rendering inactive all of the needles, withdrawing the feeding yarn, then shogging said cylinder and needles substantially 180°, returning the yarn to feeding relationship, reciprocating through said cam means the segment of needles first rendered inactive while similarly retiring end needles to knit a narrowed tab opposite the first, and then knitting several courses of loopers rounds, one of said tabs being knitted on more needles and of greater extent than the opposite tab.

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