This invention relates to stockings and methods of making the same and has particular reference to ladies' sheer hosiery knit from nylon or similar yarns. The invention further relates to machines for carrying out the method and producing the stocking.

In the patent to Albert E. Page, No. 2,501,353, dated March 21, 1950, there is described a type of mesh stocking knit from nylon by single feed knitting which has particular advantages as described in said patent. The mesh itself is substantially invisible when viewed from a relatively short distance when it is worn, and this satisfies the quite general requirement of most wearers that there is a desire to wear a stocking of very pronounced mesh that the mesh should be effectively invisible. At the same time the stockings provided in accordance with said patent have pronounced advantages. First, there is suppression of sheen which most wearers dislike. Secondly, imperfections are substantially eliminated by the effective breaking up of streaks or shadows which result from even very slight imperfections in the knitting elements of the machine. Third, downward runs are arrested to the extent that they will not extend for more than a limited number of courses. These and other advantages have made stockings provided in accordance with the patent highly successful commercially.

At the present time for the speeding up of production it is highly desirable to knit at least the leg and instep portions of stockings using two or more feeds.

One of the objects of the present invention is to provide a mesh pattern and method of producing the same suitable for two-feed knitting but by the use of which undue enlargement of width or circumference of the stocking is substantially restrained. This is accomplished in accordance with the present invention by combining tuck stitches and floats in such fashion that, whereas the tuck stitches would tend to produce widened fabric, this is offset by the floats which reduce coursewise extensibility, with the result that the characteristics of the stocking are similar to those of a plain knit stocking.

The invention is applicable to the knitting of either plain yarn or so-called stretch yarn, in the latter case an S-stretch yarn being fed at one feed and Z-stretch yarn at the other in a two-feed machine. Monofilament or multifilament yarns may be used in the knitting.

A further object of the invention relates to the production of picot edges and designs by combined welt and tuck stitch formation.

The attainment of the foregoing objectives as well as of other objects of advantage will become apparent from the following description, read in conjunction with the accompanying drawings, in which:

FIGURE 1 is an inside development of the cams operating on needles, intermediate jacks and pattern jacks in accordance with the invention, there being illustrated at the right of FIGURE 1 a needle in association with an intermediate jack and a pattern jack;

FIGURE 2 is a fragmentary diagram of a portion of a leg of a stocking produced in accordance with the invention;

FIGURE 3 is a fragmentary diagram of a portion of the welt of a stocking showing a picot edge produced in accordance with the invention; and

FIGURE 4 is a diagrammatic elevation of a complete stocking knit in accordance with the invention.

The type of machine used in the practice of the invention may be, except for special cam operations, essentially conventional and as an example of such a machine there may be referred to that described in my prior Patent 2,576,962, dated December 4, 1951. The machine, in general, may be considered to correspond to what is disclosed in said patent, and it will be understood that conventional pattern control devices, driving means and the like may be used therein. There are illustrated, accordingly, only those changes, primarily in the cams, which are required for the practice of the present invention. Details of initiation and termination of turned welt formation are not disclosed herein since this may be conventional, though, as described herein, a picot edge may be provided in the rotary multiple feed knitting of such welt.

Where references are made to movable cams, it will be understood that they are moved in conventional fashion by controls from the main cam drum of the machine or auxiliary control devices of usual type.

Referring first to FIGURE 1, the needle cylinder is indicated at 2 and carries in the usual slots latch needles 4, intermediate jacks 6 and pattern jacks 8. The needles are provided with butts indicated at 10 which may be of various lengths for purposes not involved in the present invention. The intermediate jacks 6 are provided with butts 12. The pattern jacks are provided with butts 14 and 16 of different lengths and with pattern butts 18 which may be selectively broken away in usual fashion for the production of desired patterns. The jacks 8 are of the rocking type and are pivoted with their lower ends for selective engagement of one or more cams. The pattern jacks are also provided with shoulders 20.

Right hand and left hand feeds are respectively provided by the throat plates 22 and 24 with which are associated the usual selectively replaceable yarn feed fingers, not shown. The sinkers cooperating with the needles are conventional and not illustrated, though the level of their platforms is indicated at 26.

Various cams are illustrated in FIGURE 1 for cooperation with needle butts, some of these not being directly used in connection with the present invention but provided for the knitting of various parts of a stocking. Among these cams are the switch cam 28 and a group of adjacent cams 30, 32 and 34 which are used as described in my prior patent. A cam 36 is arranged to raise needles in various parts of the cycle of operation to tuck level. A stitch cam 38 is provided for use during reverse reciprocatory strokes and also serves as a clearing cam during forward reciprocatory strokes and to raise needles at times during rotation. Cams 40, 44, 48 and 56 are provided but these have no action during leg and instep or foot knitting in accordance with the invention, the latter three being primarily provided only in heel and toe knitting. A cam 42 is arranged to lower needles and is followed by a stitch cam 46 to impart a downward wave to needles during rotary knitting to cause them to take yarn at the right hand feed 22. A cam 50 raises needles and is followed by a cam 52 which further raises them to tuck level through jacks 6 elevates needles to clear height, after which they are lowered slightly by cam 54, taking yarn at feed 24 and knitting as they are fully lowered by stitch cam 60. A cam 61 following cam 60 raises needles to tuck level. Cams 62, 64 and 66 are not involved in the practice of the present invention during leg and instep knitting, but have functions similar to those described in my prior patent. After leaving cam 61 the needles selected to miss yarn at feed 22 are lowered by cam 34.
A lowering picker is indicated at 68, and raising pickers at 70 and 72. These may be used for the formation of two-feed heels and toes, though the present invention may be used in connection with single feed knitting of heels and toes.

A point cam indicated at 78 is provided with a rise 74 arranged to act upon the butts 12 of the intermediate jacks 6. A later cam 75 located at the left hand feed also acts upon the butts 12 of the intermediate jacks.

The edge 76 of cam 78 is arranged to depress shoulders 20 of the pattern jacks 5, positioning butts 14 and 16 for the initial lowering of the pattern jacks by the cam 82, while cam 88 limits their downward movement. A cam 80 serves for jack selection under conditions not involved in the matter of the present invention except in knitting a plain sole and/or high splice. A cam 84 engageable with the upper ends of the pattern jacks below their shoulders 20 serves to rock their lower ends outwardly. Selecting cams 92 of conventional type controlled in the usual fashion from a trick wheel serve to rock the lower ends of the pattern jacks inwardly to cause their lower butts to miss the cam 86 which engages the notches 19 in pattern jacks which are not rocked inwardly to raise such jacks. A cam 90 serves for jack levelling prior to selection.

The foregoing indicates the general cam layout of the machine, there being othercams not mentioned or not illustrated. Since the present invention is concerned only with the formation of welt, leg and foot portions of a stocking, there will be herein no description of the formations of other parts of stockings, but reference may be made to my prior patent for other operations.

In accordance with a preferred embodiment of the present invention, each needle is selected by a cam 92 in one round of rotary knitting and is then unselected for three rounds, when the cycle is completed. Thus, a walewise cycle involves the knitting of four rounds or eight courses. Each successive needle is selected in the round following the selection of a preceding needle and undergoes a similar cycle. The result is that there is a repeat of pattern in the fabric which is four wales in width and eight courses in length. This will be evident following the description of the typical cycle of one needle and examination of FIGURE 2.

The description of the cycle of each needle may be best made clear by considering a needle starting at the point A. As will appear hereafter, such a needle has not been selected by the action of a cam 92 at its previous passage by the position of such cam. At A it will be at cleared level. Its first 360° passage through the cams is illustrated by the dash line, and its next subsequent 360° passage is indicated by the dotted line. These lines are not intended to indicate more than the general butt paths, and are separated vertically for clarity. They are not intended to indicate any particular portion of the needle butt.

From the cleared position at A the needle under consideration engages stitch cam 60 and is depressed thereby to take yarn and cast off a previous stitch at the left hand feed 24. It is then raised to tuck level over the top of cam 61. Following this it moves along path B and as its jack 8 passes the cams 92, the jack is selected, i.e., one of its butts 18 is engaged to rock its lower end inwardly. As a result the jack misses the cam 86 and is not raised by the needle to proceed along the path C past withdrawn cams 36 and 38 moving below cam 40 and missing cam 48 which is also withdrawn. The needle is then raised by cam 50 and then by cam 52 to tuck level at D. It then moves into engagement with stitch cam 60 whereby it is lowered to take yarn at the left hand feed 24. It will be noted that in the movement through path C the needle has not been raised to take yarn at the right hand feed 22, which yarn, accordingly, floats. Following stitch cam 60, the needle is raised to tuck level E over cam 61.

When its jack reaches the position of cams 92, the jack is not selected and accordingly the notch 19 is engaged by cam 86 to raise the jack. The rise of the pattern jack then locates the intermediate jack butt 12 above the point of cam 78, whereupon the intermediate jack is raised by cam 74. As a result of these operations, the needle butt is raised by cam 46. Following the action of cam 74 on its intermediate jack, to cleared level at G. In the meanwhile, the action of cam 76 on shoulder 20 depresses the pattern jack which is then further depressed to its normal selection level by the cam 82.

The needle under consideration then engages successively the cams 42 and 46 whereby it is depressed to take yarn and knit at the right hand feed 22. It is then raised by cam 86. In the meanwhile, the intermediate jack after rising over cam 74 is depressed by the raceway which follows this cam and is again raised by cam 75 whereby the intermediate jack 6 raises its needle along path H to be cleared, and then lowered slightly by cam 54 to the level at A.

The arrangement of the selecting cams 92 and butts 18 is such that the pattern jack of the needle being considered is not selected through the next two rounds of knitting, with the result that in each of these rounds, as in the last of the two rounds just described, the needle will take yarn at both feeds and is cleared until its pattern jack is again selected, whereupon it takes the path C to repeat the cycle.

It will be evident from the foregoing that the cycle consists of an absorption of four right courses as indicated above.

Considering that the needle described is that involved in the wale 102 in FIGURE 2, it will be evident that the result of the operation is to produce a wale as there illustrated. In the course represented at 100, the needle, cleared at A, will have drawn yarn at the left hand feed to form the wale. Since the cycle is completed, on its path C, it will miss the yarn at the right hand feed to form the float 106. It is then raised only to tuck level so that the loop 104 is not cleared, and yarn at the left hand feed is again taken to draw the loop 108. The next time around, clearing takes place at the level G, and accordingly both of the loops 104 and 108 are cleared. Then yarn is taken at the right hand feed to form the plain loop 110. Clearing then repeatedly takes place so that the chain of stitches 112, 114, 116 and 118 are formed in the rounds described when there is no pattern jack selection. Then at 120 there is again drawn a loop corresponding to 100 to provide another tuck stitch. As will be evident from FIGURE 2 the next succeeding wale has its corresponding cycle delayed by one round or two courses, and similar successive delays of the cycle occur in subsequent wales. Finally, four wales later the cycle again attains the same sequence as in the wale 102. Thus the pattern repetition is four wales in width.

Whereas the held loops 104 would normally provide a widening or expansibility of the fabric, the floats 106 are relatively inextensible and tend to balance the course-wise stretch of the fabric.

The arrangement of tuck stitches and floats provides a breaking up of the continuity of the wales and courses otherwise of normal stitches with the resulting attainment of the results described above which are similar to those of said A. E. Page patent.

Knitting in accordance with the foregoing is carried out in the conventional manner, i.e., it begins at the foot or in the instep if there is desired a reinforced sole or plain sole without the mesh. In the latter case, it is only necessary to interrupt the selection of the jacks of the sole needles, the interruption being effected in conventional fashion, for example, through the use of the cam 50 acting upon longer butts 36 of the sole jacks, the instep jacks having shorter butts 14. It will, of course, be evident that the same mesh formation may be carried out in the rotary knitting of the welt and/or shadow welt of the stocking if these are knit two feed.
FIGURE 4 diagrams a conventionalized stocking involving the invention. Here a turned welt is indicated at 122, with a picot edge at 123, and is followed by the single welt 124, the heel 128, the foot 130, the instep 132, the toe 136, and the loopers' rounds 138. The looping of the toe may be accomplished either at the top or bottom thereof. As has already been indicated, the mesh fabric may be used in any or all of the rotary knit portions of the stocking. The heel and toe may be knit either single feed or double feed. Various other conventional variations may be made in the stocking, the present invention not being concerned with these.

It will be evident that variations may be made in the invention. For example, the tuck stitches and floats may follow each other at either longer or shorter intervals, and it is not necessary that each wale should involve the tuck stitches and floats, since alternate wales or groups of wales may be knit of plain stitches. Desirably, however, the arrangement illustrated in FIGURE 2 is used. In such case, there are not too many tuck stitches to provide a more noticeable mesh and at the same time they are not so more widely spaced as to defeat the desired ends of the invention by permitting longer runs or by failing to break up sufficiently the sequences of regular stitches which might show streaks or shadows.

It should be understood that by proper arrangement of the bats 18 and control of the selector cams 92, the combined welt and tuck stitch formation may be utilized for other purposes than mesh, such as a picot edge and designs. For example, a stocking may be produced with a picot edge 121, a design in the shadow welt 123, and with a leg 124 and instep 152 of mesh, or the leg and instep may have bands of mesh in alternation with those of designs or made completely of design fabric.

As an example of the last matters, FIGURE 3 shows the formation of a picot edge in a turned welt in which the fold will occur approximately at 140. Comparison of the wale 142 of FIGURE 3 with wale 102 of FIGURE 2 will make clear the special picot stitch formation. In course 144 the loop 146 is drawn at the left hand feed in correspondence with loop 104 in FIGURE 2. The needle then follows path C missing the yarn at the right hand feed to provide float 148. Without clearing it then takes yarn at the left hand feed to draw loop 150, corresponding with loop 108 in FIGURE 2. On the next round its jack is again selected so that it again follows path C, missing the yarn at the right hand feed to form float 152. It then again takes yarn at the left hand feed, without being cleared, drawing loop 154. Thereafter it follows path G by reason of non-selection of its pattern jack, with clearing of the three loops drawn by it previously. Yarn is taken at the right hand feed to form loop 156 and normal knitting proceeds. The spacing of the picot stitch structures is subject to choice, but it is satisfactory to have them occur every fourth wale as shown. It will be evident that the picot stitch structures may be interspersed with the mesh or design forming stitches as shown in FIGURE 2.

What is claimed is:

1. A method of rotary knitting a portion of a stocking on a two-feed machine comprising causing each of spaced needles to draw a loop of yarn at one feed, then miss yarn at the other feed, and, without clearing the first mentioned feed, draw a second loop of yarn at the first mentioned feed, thereafter clear both of said drawn loops and then repeatedly take and knit yarn at both feeds to form plain knit loops, thereby to form wales having spaced held loops crossed by floats, and causing other spaced needles to follow the same sequence but to draw the held loops in courses in which plain loops are formed by the first mentioned spaced needles, so that both walewise and coursewise said held loops are spaced by multiple plain knit loops.

2. A method according to claim 1 in which all of the held loops provided by non-clearing are formed by one yarn and all of the floats resulting from missing yarn are formed by a second yarn.

3. A method according to claim 1 in which the held loops in each course repeat in eight courses.

4. A method according to claim 3 in which the held loops in each course repeat in four wales.

5. A method according to claim 1 in which the held loops in each course repeat in four wales.

6. A method of rotary knitting a conventionalized stocking with a picot edge on a two-feed machine comprising knitting a first welt portion at two feeds primarily of plain knit loops, thereafter knitting a second picot edge portion of the welt by causing each of spaced needles, separated by pluralities of needles, to draw a loop of yarn at one feed, then miss yarn at the other feed, without clearing the first mentioned loop, draw a second loop of yarn at the first mentioned feed, again miss yarn at the other feed, without clearing either of the first and second mentioned loops, draw a third loop of yarn at the first mentioned feed, and thereafter clear all of said drawn loops, and causing said pluralities of needles to form plain stitches at both feeds during the knitting of said picot edge portion of the welt, and thereafter knitting a third welt portion at two feeds primarily of plain knit loops.

7. A circular knitting machine having a circle of independent needles, a pair of feeds, and means, including pattern controlling devices, for causing each of spaced needles to draw a loop of yarn at one feed, then miss yarn at the other feed, and, without clearing the first mentioned loop, draw a second loop of yarn at the first mentioned feed, thereafter clear both of said drawn loops and then repeatedly take and knit yarns at both feeds to form plain knit loops, thereby to form wales having spaced held loops crossed by floats, and causing other spaced needles to follow the same sequence but to draw the held loops in courses in which plain loops are formed by the first mentioned feed, and thereby clear all of said drawn loops, and for causing said pluralities of needles to form plain stitches at both feeds, and means, including pattern controlling devices, for thereafter causing the needles to knit a third welt portion at two feeds primarily of plain knit loops.

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