

Oct. 19, 1965

R. M. MATTHEWS ETAL

3,212,297

RUN-PROOF SEAMLESS HOSIERY AND METHOD OF MAKING SAME

Filed March 16, 1962

3 Sheets-Sheet 1

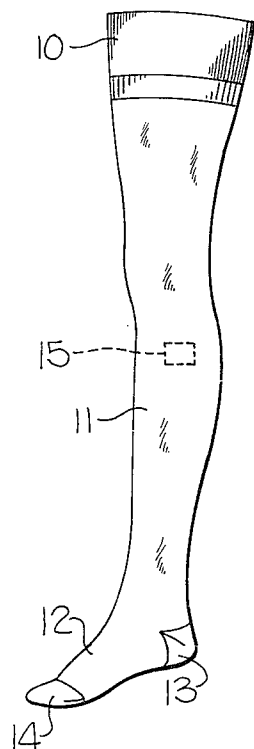


Fig-1

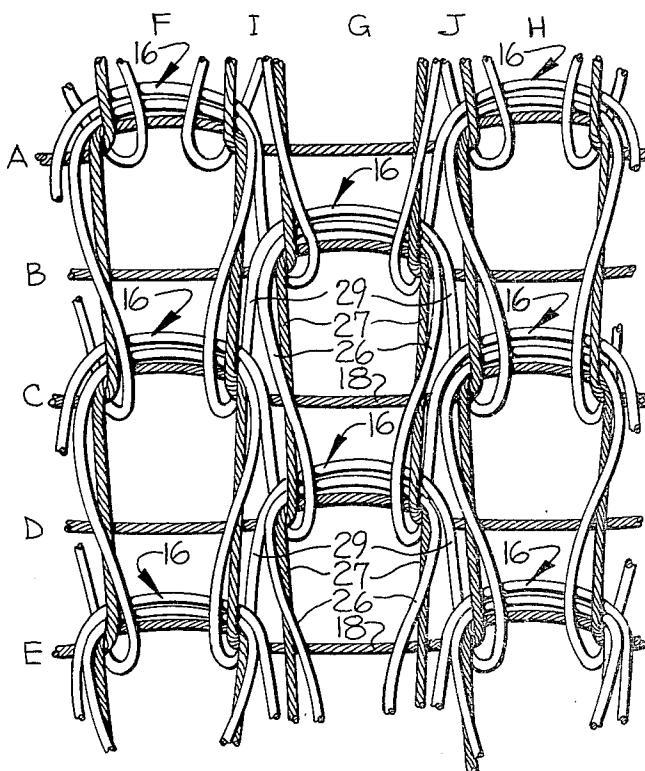


Fig-3

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3 Sheets-Sheet 2

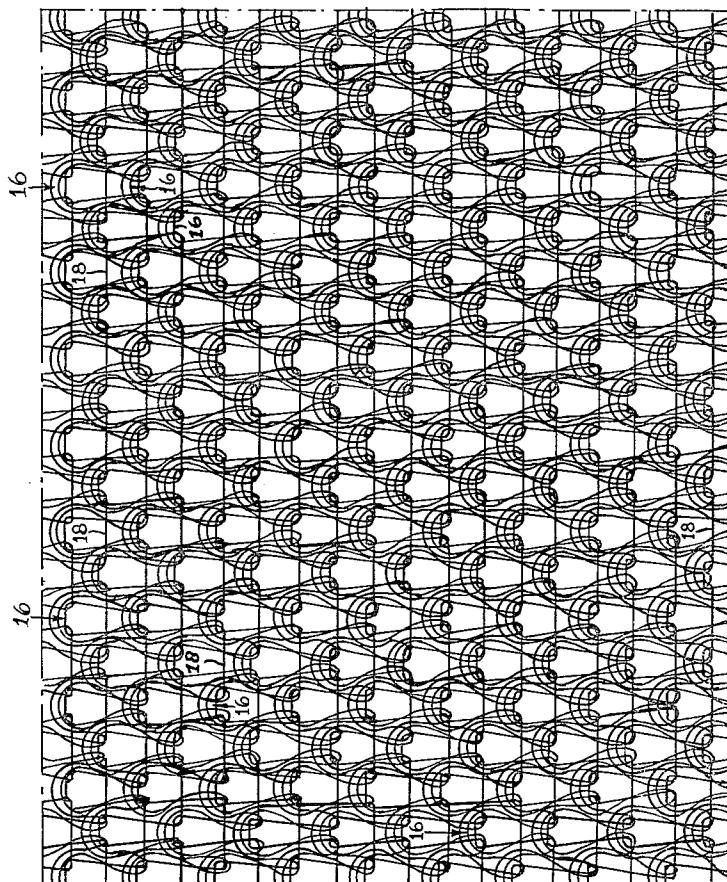


Fig. 2

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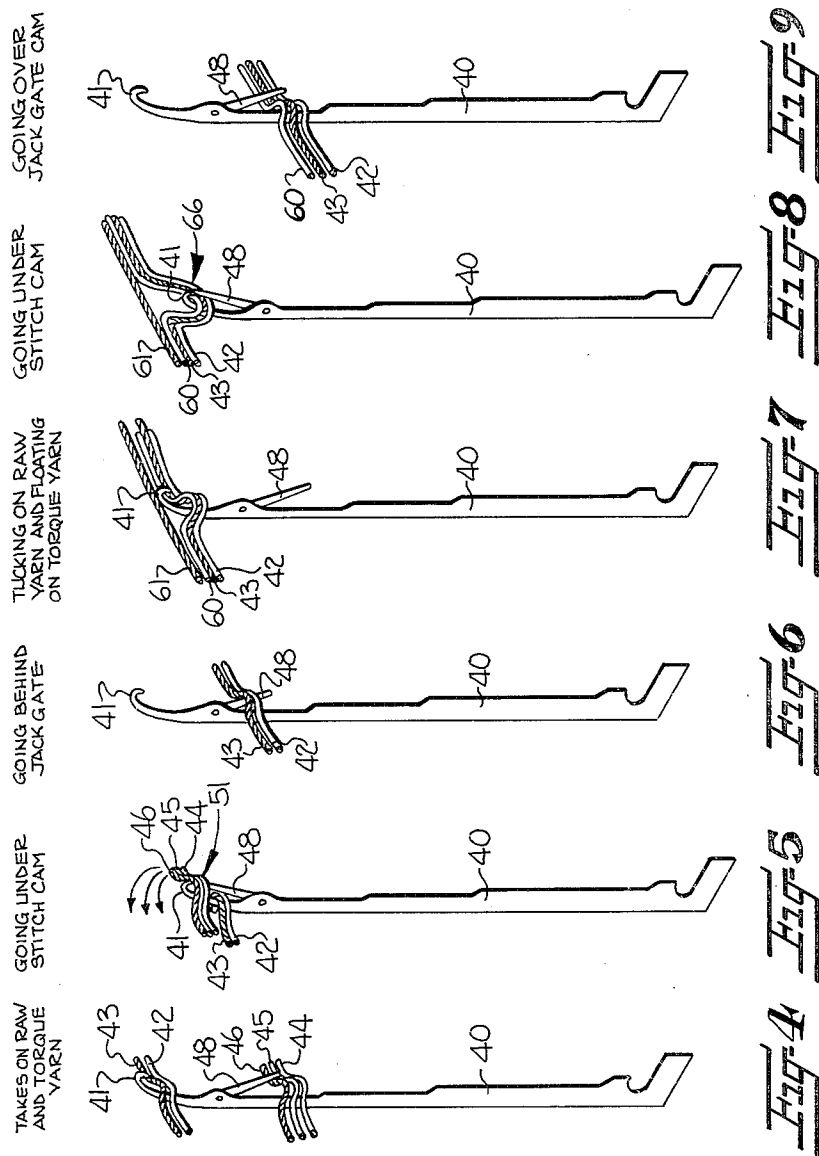
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1

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RUN-PROOF SEAMLESS HOSIERY AND
METHOD OF MAKING SAME

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8 Claims. (Cl. 66—178)

This invention relates to ladies' seamless nylon hosiery and more particularly to such hosiery that will not run in any direction when the hose or stocking is snagged or picked, or even punctured with a sizeable hole.

In our co-pending application, Serial No. 153,633, filed November 20, 1961, now Patent No. 3,027,737 we have disclosed and claimed run-proof or non-run seamless nylon knitted hosiery in which the courses and wales have stitches formed of two yarns, one of which is a nylon torque yarn and the other a plain non-torque nylon yarn, and each wale of which has regularly recurring tuck stitches separated by plain stitches, and the tuck stitches in immediately adjacent wales being staggered with respect to each other. The tuck stitches and the plain stitches in this stocking are of different size and the stocking has the appearance of what is commonly known in the industry as a "mesh" stocking. This mesh style of stocking has become more popular in recent years because it is more durable than the plain knit, sheerer nylon stocking. Even so, none of the prior mesh stockings were resistant to runs both upward and downward, and the special knit mesh stocking disclosed in our above-noted Patent No. 3,027,737 was the first completely non-run stocking of mesh design, or any other design, that had even been produced, according to our best information.

Although the mesh pattern stockings have become more popular in recent times because of greater durability, they have not replaced the plain knit, non-mesh, nylon stocking which a large percentage of the ladies still prefer. The non-mesh style of stocking is particularly susceptible to runs and there has been no solution to this longstanding problem to date in this style stocking.

In accordance with the present invention we have produced for the first time, a run-proof, i.e. completely non-run stocking, that corresponds substantially in appearance to the well known, popular plain knit sheer nylon stocking.

The knit construction of the stocking of the present invention is characterized generally by a uniform arrangement of tuck stitches and floats extending throughout the wales and courses of the knitted stocking, and all of the tuck stitches being substantially of the same size. A body yarn end and a float yarn end are used in each of the tuck stitches, and the float yarn end is preferably a nylon torque yarn while the body yarn end is preferably a plain or non-torque nylon yarn. Further, in the knitted pattern of the present invention the successive tuck stitches in each wale are connected to each other and are not separated by plain stitches, and the tuck stitches in adjacent wales partially overlap each other in a longitudinal direction. The knitted pattern has a symmetry which is maintained from wale to wale so as to provide a uniform pattern of tuck stitches of substantially the same size in each and every wale. The floats which extend transversely through the fabric are also uniform in size and disposition and thereby add to the uniformity and symmetry of the entire knitted pattern. In view of these characteristics, the seamless stocking of the present invention has a plain or non-mesh type of pattern. This new stocking appears, at usual viewing distances, to be the same as the popular plain stitch nylon stocking, but which in this case has been rendered run-proof by means of the special knit construction of the present invention, as above described.

2

Another characterizing feature of the knitted fabric and stocking of the present invention is that adjacent needle wales are linked together in a special manner by the non-torque nylon yarn which extends from one needle wale through the adjacent sinker wale to the next adjacent needle wale.

Still another characterizing feature of the fabric of the present invention is that adjacent sinker wales are linked together by means of the non-torque nylon yarn.

A further characterizing feature is that succeeding courses are linked or connected to each other by the torque nylon yarn and the non-torque nylon yarn, which are knitted to form tuck stitches.

The tuck stitches, which are composed of two held loops and one tuck loop (with the nylon torque yarn forming floats behind the tuck stitches) are interconnected throughout the courses and wales of the fabric. These linkages are so numerous and positive that the knitted fabric will resist successfully runs in any and all directions in the fabric from snags and even severely damaging areas in the fabric.

For knitting the non-run nylon seamless stocking of the present invention, we have found that the operation may be carried out successfully on a seamless knitting machine of the type manufactured by Scott & Williams, Inc. of Laconia, New Hampshire and the basic principles of which are disclosed in Scott Patent No. 1,282,958, issued October 29, 1918. The current design of this machine is illustrated and described in an Instruction Manual entitled "Model 'KN' Machine" published by Scott & Williams, Inc. in January 1955, and in their Parts Catalogue published June 1955. These Scott & Williams, Inc. publications illustrate and describe the Model "KN" Machine which we have found well suited for knitting the non-run seamless stocking of the present invention.

The Scott & Williamson Model "KN" Machine employs 75 gauge needles. For obtaining the desired non-run uniform knitted pattern of the present invention, we use a machine equipped with the so-called "forward hook" needles, an example of which is one known in the trade as "Arrow No. 3962," manufactured by Textile Machine Works, of Reading, Pennsylvania.

The forward hooked end of the needle facilitates the laying-in of the float yarn behind alternate needles during the operation of the 400 needle Model "KN" Machine. For knitting the non-run uniform pattern, seamless nylon hose of the present invention, using these forward hook needles, we employ, as one of the nylon yarns, a "torque" yarn that has been twisted sufficiently to impart to the yarn a marked torque or tendency to untwist in the direction opposite to the twist. This type of yarn is disclosed in Burleson and Holmes U.S. Patent No. 2,271,737, issued November 27, 1956, and in Leath and Bobo Patent No. 2,771,733, issued November 27, 1956.

In the operation of the Model "KN" Machine, in which the needles are rotated in a counterclockwise direction, a torque yarn having an S torque is used to assure deposition of the torque yarn in floating position behind alternate needles. It is to be understood that the torque of the yarn, whether S or Z, is opposite in direction to the direction in which the yarn is twisted. For example, the above-mentioned S torque yarn will have been twisted in a Z direction. In a typical example, sufficient torque is obtained for the purpose of the present invention by twisting 7 or 10 denier monofilament nylon yarn about 20-30 turns per inch, as described in the Burleson et al. and Leath et al. patents, supra. This yarn does not require any pre-heat setting, and once the yarn is knitted and the stocking heated during boarding the torque yarn will shrink and set the stitches.

A more detailed understanding of the present invention will be obtained by reference to the following specific

description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a diagrammatic illustration of a ladies seamless nylon stocking embodying the special knit construction of the present invention;

FIG. 2 is an enlarged inverted elevational view of the small area enclosed in dotted lines in the calf of the stocking illustrated in FIGURE 1, and showing greatly magnified the uniform stitch construction of the non-run stocking of the present invention;

FIG. 3 is a diagrammatic illustration, on a substantially enlarged scale, of a small portion of the knitted pattern shown in FIGURE 2;

FIGS. 4, 5, 6, 7, 8 and 9 are elevational views of one of the forward hook needles used for knitting the seamless stocking of the present invention and illustrating the needle at different positions in the operation of the seamless knitting machine and also illustrating the disposition of the several loops formed by the torque and non-torque yarns at different needle positions.

Referring now to the individual figures in the drawings and generally in the order in which they occur, the stocking of the present invention illustrated in FIGURE 1 comprises a welt 10, a calf or leg portion 11, a foot 12, heel 13 and toe 14. The special knit construction of the present invention is particularly applicable to the leg and foot portions 11 and 12, while the welt 10 and heel and toe 13 and 14 may be conventional knit construction if desired. The broken line square 15 in FIGURE 1 indicates a small portion in the leg of the stocking which is illustrated in magnified form in FIGURE 2 of the drawing. Referring now to FIGURE 2, it will be noted that the tuck stitches such as illustrated broadly at 16 extend throughout the knitted fabric and are substantially of uniform size and shape. The floats such as shown at 18 extend transversely of the fabric and are substantially of uniform size and disposition. Further details of the special knit construction shown in FIGURE 2 can be more easily seen and understood by reference to the substantially enlarged diagrammatic illustration in FIGURE 3.

Referring now to FIGURE 3, there are illustrated five courses, A, B, C, D and E, three needle wales, F, G, and H, and two sinker wales I and J. Each needle wale F, G and H, comprises successive tuck stitches 16. Each of these tuck stitches 16 comprises two held loops 26 and 27 formed of both yarns and one tuck loop 29 formed of the non-torque body yarn. It will be noted that each of the tuck stitches 16 in each needle wale F, G and H is linked or connected to the next succeeding tuck stitch by the plain non-torque nylon body yarn held loop 26 and by the torque nylon float yarn held loop 27. Also, it will be noted that the tuck stitches in adjacent needle wales are connected or interlinked by the plain non-torque nylon body yarn tuck loops 29. In order to readily distinguish the two different yarns in FIGURES 3-9, the torque nylon float yarn has been striped and the non-torque nylon body yarn has been left plain.

Further, it will be noted in FIGURE 3 that the floats 18 of the nylon torque yarn, which are contained in each course, interconnect alternate needle wales.

In addition, it will also be noted in FIGURE 3 that adjacent sinker wales, such as I and J, are interlinked by means of the non-torque nylon body yarn tuck loops 29.

For knitting the non-run seamless stocking of the present invention with the knit construction illustrated in FIGURES 2 and 3 and described above, the following is an illustrative but non limiting example.

A KN single feed knitting machine is set up for knitting the linked course, linked wale, non-run fabric by cutting the cylinder pattern jacks to make the desired pattern. Then the selector drum jacks are cut so that alternate needles will be tucking and floating in each successive course. In addition, the knitting machine is also to be equipped with 400 forward hook needles, such as the Arrow No. 3962 forward hook needle.

The knitting machine is threaded as follows:

Finger No. 1—120/2 cotton loop margin;
Finger No. 2—50 denier, 17 filament raw nylon welt yarn;
Finger No. 3—This is the body yarn finger which uses a 10 denier raw nylon monofilament yarn;
Finger No. 4—40 denier, 7 filament 3 turns Z heel and toe yarn;

Finger No. 5—Idle;

Finger No. 6—This is the float finger which is to be threaded with a 10 denier twisted nylon torque yarn which has been twisted in a Z twist direction which will correspondingly have an S twist torque.

A general description of the operation of the needles, which will be identified further and more specifically below with reference to FIGURES 4-9 of the drawings, is as follows.

The selected forward hook needle in the high knitting position has positioned below the latch of the needle a held loop of each yarn and one tuck loop as it approaches the stitch cam. While in this position, the hook of the needle takes on a plain or raw body yarn and a float yarn from the body yarn finger and float yarn finger. This needle has been placed in this high knitting position by the jack gate cam. As the cylinder rotates, the needle is forced downward by the action of the stitch cam which sheds the two held loops and the tuck loop while the hook of the needle still holds the plain body yarn and torque float yarn which were previously placed in the hook of the needle while it was in the high knitting position. The cylinder rotates, and the cylinder jack goes behind the jack cam which leaves the needle in a low tucking position at which point the latch is open permitting the needle to take on another body yarn, immediately following which the torque float yarn is positioned behind the hook of the forward hook needle.

The cylinder then rotates in the direction of the stitch cam with two loops of body yarn, one loop of torque yarn in the hook of the needle; the needle goes downward closing the latch on the needle as it passes underneath the stitch cam. The cylinder rotates again in the direction of the jack gate cam at which time the needle is raised by the cylinder jack gate cam to the high knitting position which positions the two loops of body yarn and the loop of torque yarn beneath the latch of the needle. This completes the knitting sequence and the action of the needles is repeated as outlined above. This leaves the hook free at this point to receive the body yarn and the float torque yarn when the needle is again positioned to start a new cycle.

Referring now to FIGURES 4-9 of the drawings, the following specific description illustrates the operation of one of the needles in the circular knitting machine in two revolutions of the needle cylinder.

In FIGURE 4 the needle 40 is shown in the high knitting position at which time the forward hook 41 of the needle takes on or holds the raw, i.e. plain, non-torque nylon yarn 42 and the torque nylon yarn 43 to form stitch loops thereof and at the same time the latch is cleared for shedding the tuck stitch previously formed and consisting of the two raw non-torque yarn loops 44 and 45 and the torque nylon yarn loop 46. As shown in FIG. 4, the yarn loops 44-46 are below the latch 48.

In FIGURE 5, the needle 40 is shown in knitting position while going under the stitch cam on the knitting machine. In this position the latch 48 has been closed so as to hold the non-torque yarn loop 42 and the torque loop 43. The tuck stitch indicated generally at 51, composed of two held loops 44, 45 and one tuck loop 46, is being shed.

In FIGURE 6 the needle 40 is shown in the next position in which its jack is going behind the jack gate cam and at which time the tuck stitch previously formed has been knocked over, the latch 48 having been opened as the needle was raised by the end cam after passing under the stitch cam, the non-torque plain yarn loop 42 and

the torque yarn loop 43 have not been shed from the needle but remain on the latch 48.

In FIGURE 7, the needle 40 has just passed the yarn feeding point and picked up a non-torque yarn 60 to tuck the same while a torque yarn 61 is floated. In this position the latch 48 is open and the needle hook 41 contains two loops of plain nylon yarn 42 and 60, 61 and one loop of torque nylon yarn 43, while the torque yarn shown at 61 is floating behind the needle hook.

In FIGURE 8, the needle 40 is in knitting position and is going under the stitch cam. The latch 48 is closed to form the tuck stitch indicated generally at 66 and which is composed of two held loops 42, 43 and one tuck loop 60 while the torque yarn 61 is being floated.

In FIGURE 9 the needle 40 is shown raised to a high knitting position as it goes over the jack gate cam. In this position there are no yarns held by the hook 41, the latch 48 is open and the tuck stitch indicated generally at 60, composed of two held loops and one tuck loop, is below the latch 48 and in position to be cast from the needle when it is drawn down to stitch forming level in the next revolution of the needle cylinder. At this point the needle returns to the position illustrated in FIGURE 4 to begin the formation of the next stitch and the cycle is repeated.

It will be understood that this operation applies to the alternate needles in knitting alternate needle wales, such as needle wales F and H in FIGURE 3, and to the intervening needles in knitting intervening needle wales such as needle wale G in FIGURE 3.

Another way of describing the knitting of applicants' fabric would be to say that on any given revolution of the needle cylinder, the alternate needles, as they approached the knitting station would have two loops of non-torque yarn and one loop of torque yarn in their hooks, and the intervening needles would have one loop of non-torque and one loop of torque yarn in their hooks. The alternate needles would be raised to latch-clearing position and take the non-torque and the torque yarns in their hooks whereas the intervening needles would be raised to tuck level and take only the non-torque yarn in their hooks, the torque yarn being floated behind the hooks. On the next revolution of the needle cylinder, the needle selection would be reversed so that the intervening needles would be raised to latch-clearing position and take both yarns in their hooks and the alternate needles would be raised to tuck level and take only the non-torque yarn in their hooks. This sequence of knitting would be repeated throughout the knitting of the non-run fabric.

The hosiery of the instant invention has been referred to herein as "non-run," "run-proof," "completely non-run" and the like. These references are intended as applied to the hosiery under stresses and strains normally encountered in average wearing conditions. When subjected to stresses and strains in excess of those normally encountered, the hosiery of the instant invention may run in a direction upwardly, but not downwardly, of the hosiery. Because, under normal conditions of wear, run producing stresses and strains decrease upwardly of the hosiery, the hosiery of the instant invention under normal conditions of wear is considered to be non-run.

This invention is not to be limited to the foregoing description and the illustrations in the drawings which are for illustrative purposes only. The scope of the invention is indicated in the appended claims.

We claim:

1. Knitted ladies' sheer seamless non-run nylon hosiery which prevents runs in all directions in the hosiery from snagged yarns or even punctures, said hosiery having the appearance of a plain knit fabric, being characterized by the absence of any plain stitches and consisting of courses and wales of knitted stitches with two yarns in each stitch, each wale having regularly recurring tuck stitches directly

connected to each other, the tuck stitches in immediately adjacent wales partially overlapping with respect to each other in a longitudinal direction, one only of said yarns being a nylon torque yarn, said nylon torque yarn being knitted in all of said tuck stitches and floated across all of said tuck stitches.

2. Knitted seamless non-run nylon hosiery as defined in claim 1 and in which succeeding courses are interconnected by tuck stitches, each of which includes two loops of the plain non-torque nylon yarn and one loop of the nylon torque yarn.

3. Knitted seamless non-run nylon hosiery as defined in claim 1 and in which the tuck stitches in immediately adjacent needle wales are interlinked to each other by a tuck loop of plain non-torque nylon yarn and the tuck stitches in alternate wales are interconnected by floats of the nylon torque yarn.

4. Knitted seamless non-run nylon hosiery as defined in claim 1 and in which each needle wale is composed of succeeding tuck stitches of substantially the same size, and each tuck stitch comprises two loops of plain nylon yarn and one loop of torque nylon yarn.

5. A seamless knitted ladies' sheer non-run hosiery fabric having the appearance of a plain knit fabric, said non-run fabric characterized by the absence of any plain stitches and consisting of

(1) successive courses having wales of knitted stitches each formed of two synthetic heat-settable yarns,

(2) each alternate single course consisting of held loops positioned in alternate single wales and being formed of both of said yarns, tuck loops positioned in intervening single wales and being formed of one of said yarns, and floats positioned in said intervening single wales and being formed of the other of said yarns, and

(3) each intervening single course consisting of held loops positioned in said intervening single wales and being formed of both of said yarns, tuck loops positioned in said alternate single wales and being formed of said one of said yarns, and floats positioned in said alternate single wales and being formed of said other of said yarns.

6. Ladies' seamless hosiery with the leg portion being non-run and having the appearance of a plain knit sheer fabric, said non-run leg portion being characterized by the absence of plain stitches and consisting of

(1) successive courses having wales of knitted stitches each formed of two synthetic heat-settable yarns,

(2) each alternate single course consisting essentially of held loops positioned in alternate single wales and being formed of both of said yarns, tuck loops positioned in intervening single wales and being formed of one of said yarns, and floats positioned in said intervening single wales and being formed of the other of said yarns, and

(3) each intervening single course consisting essentially of held loops positioned in said intervening single wales and being formed of both of said yarns, tuck loops positioned in said alternate single wales and being formed of said one of said yarns, and floats positioned in said alternate single wales and being formed of said other of said yarns.

7. A method of forming the leg portion of a seamless non-run knitted ladies' sheer hose having the appearance of a plain knit fabric, the leg portion of the hose including a plurality of complete successive courses with two synthetic heat-settable yarns knit in each course, said method comprising the steps of

(1) knitting a complete course while holding loops of both yarns in alternate single wales, forming tuck loops of one of the yarns in intervening single wales, and forming floats of the other of the yarns in the intervening single wales,

(2) knitting the next succeeding complete course while holding loops of both yarns in the intervening single

7

wales, forming tuck loops of one of the previously held yarns in the alternate single wales, and forming floats of the other of the previously held yarns in the alternate single wales, and

- (3) repeating the above steps throughout the leg portion of the hose. 5

8. A method of knitting the leg portion of non-run seamless hosiery on a circular knitting machine having vertically movable independent cylinder needles, a knitting station adjacent to the needle cylinder and means for feeding a body yarn at a low position and a float yarn at a high position to the needles at the knitting station, said method consisting of the following steps 10

- (A) during single alternate rotations of the needle cylinder;

(1) raising alternate single needles to latch-clearing position as they approach the knitting station, 15

(2) feeding both yarns to the alternate single needles,

(3) raising intervening single needles to tuck level as they approach the knitting station, 20

(4) feeding the body yarn to the intervening single needles while floating the float yarn behind the intervening single needles, and

(5) then lowering all needles to stitch drawing level as they pass through the knitting station, 25

- (B) during single intervening rotations of the needle cylinder;

(1) raising intervening single needles to latch-clearing position as they approach the knitting station, 30

8

(2) feeding both yarns to the intervening single needles,

(3) raising alternate single needles to tuck level as they approach the knitting station,

(4) feeding the body yarn to the alternate single needles while floating the float yarn behind the alternate single needles, and

(5) then lowering all needles to stitch drawing level as they pass through the knitting station.

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