Aug. 29, 1967 J. P. PONS ET AL 3,338,071

SEAMLESS HOSIERY HEEL AND METHOD OF FORMING SAME

Filed Jan. 30, 1964 2 Sheets-Sheet 1

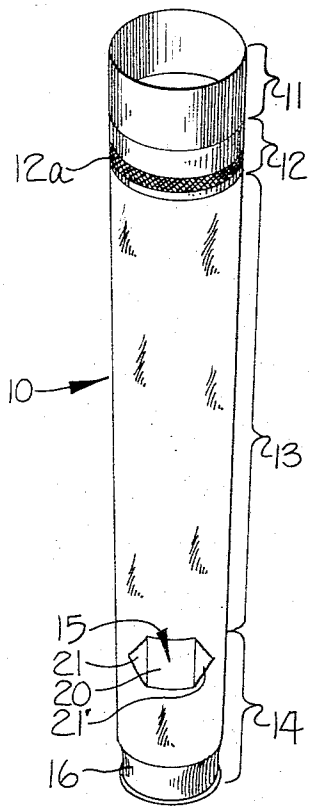



Fig-1

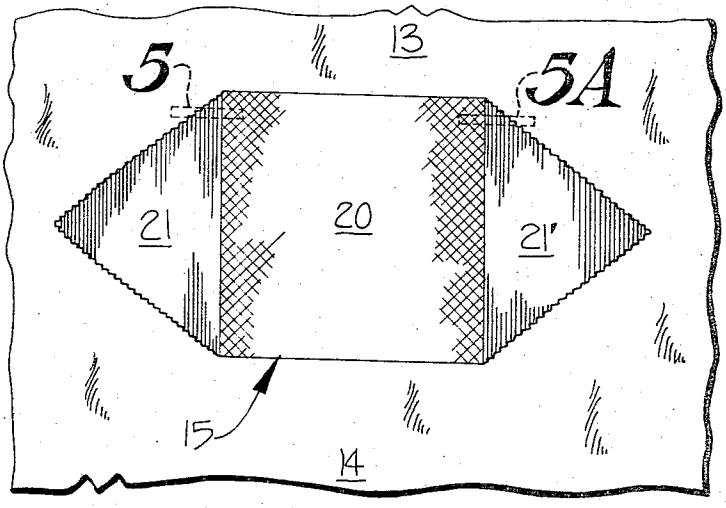



Fig-2

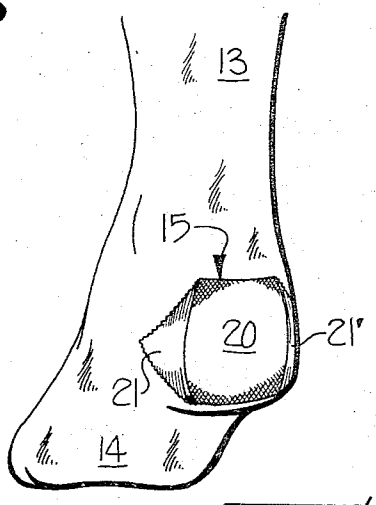



Fig-3

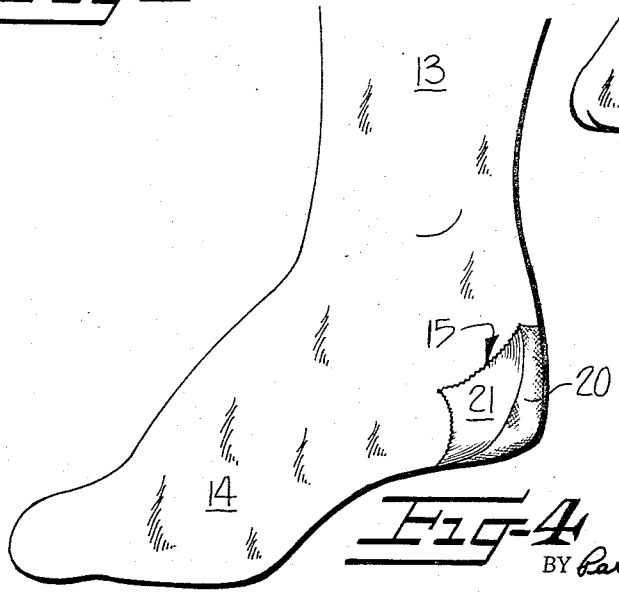



Fig-4

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SEAMLESS HOSIERY HEEL AND METHOD OF FORMING SAME

Filed Jan. 30, 1964 2 Sheets-Sheet 2

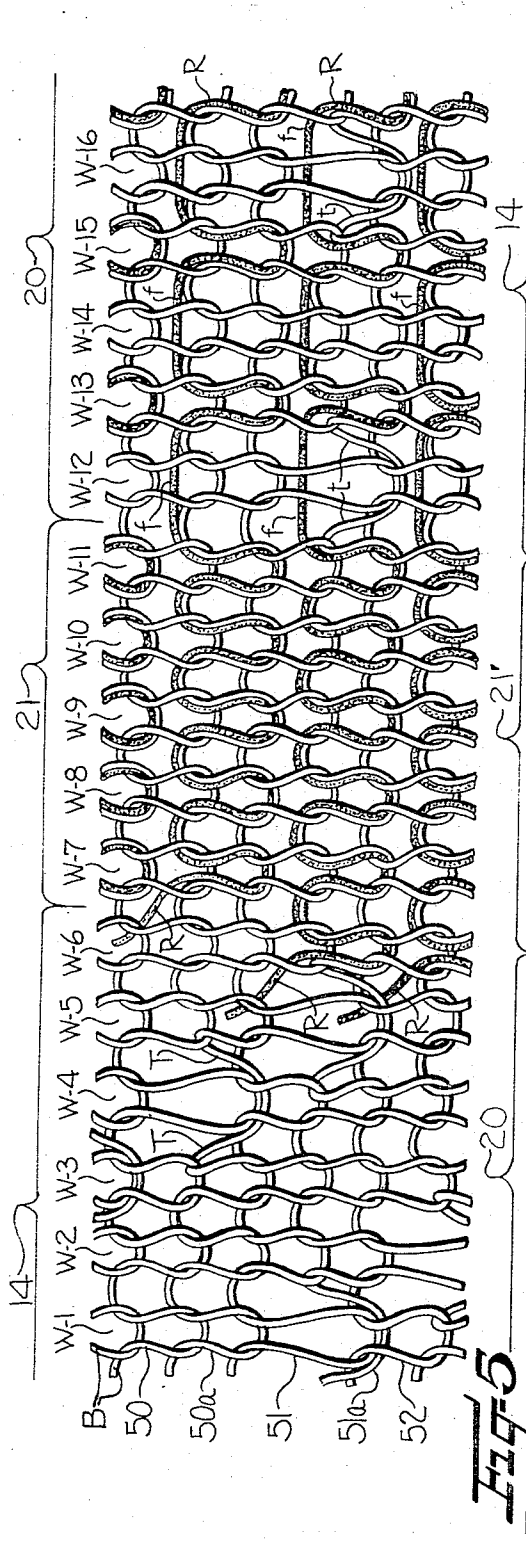



FIG. 5

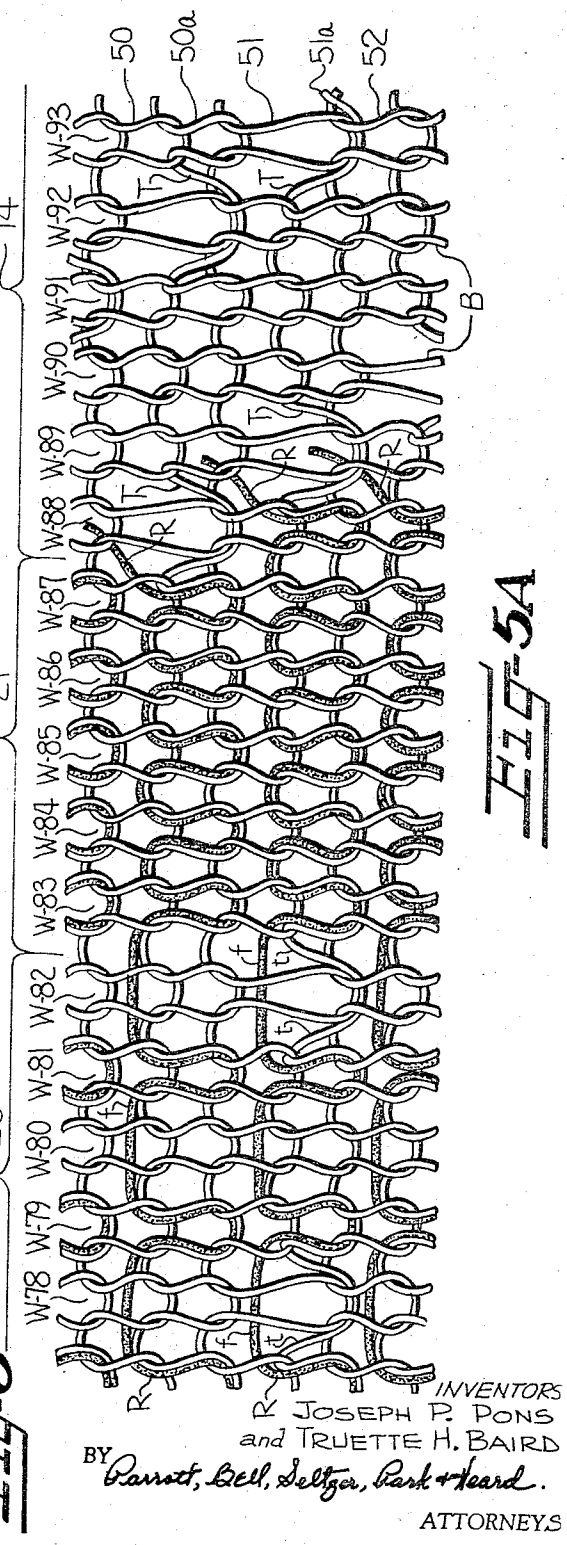



FIG. 5A

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United States Patent Office

3,338,071

Patented Aug. 29, 1967



3,338,071

# SEAMLESS HOSIERY HEEL AND METHOD OF FORMING SAME

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Filed Jan. 30, 1964, Ser. No. 341,182

6 Claims. (Cl. 66—182)

This invention relates generally to circular knit seamless hosiery and more particularly to an improved reinforced heel area for circular knit hosiery of the type that is commonly referred to as "tube" hosiery. The invention is also directed to the method of producing the reinforced heel area while forming complete courses.

Heretofore, most ladies' fine gauge seamless hosiery has been knit with fashioned heel and toe pockets formed by reciprocation of the needle cylinder to make narrowed and widened gussets incorporating a heavier yarn than the leg of the hose. This method of knitting the heel and toe pockets has slowed production and in order to produce hosiery at a faster rate, many manufacturers now use multi-feed knitting machines and frequently eliminate the reciprocatorily knit heel pocket and/or the reciprocatorily knit toe pocket.

With both the heel and toe pockets eliminated, multi-feed seamless ladies' sheer hosiery of the "tube" type can be produced at a very fast rate because the complete stocking blank is knit with continuous rotation of the needle cylinder and the heel and toe pockets are formed in the boarding process. In many of the tube hose currently produced, the heel area is knit of the same yarn as the leg and the resulting "nude" heel does not have the same strength and wear resistance that is found in hosiery in which a heel pocket is knit of heavier yarn. In other tube hosiery a reinforced heel area or patch is formed by knitting a reinforcing yarn in plated relationship on all of the needles in the reinforced heel area. The reinforcing yarn is introduced at one side of the reinforced heel area and is removed at the other side, the ends being cut closely adjacent the fabric either on the knitting machine or in a subsequent operation. This type of reinforced heel area has greater strength and wear resistance than a nude heel, however, when the reinforcing yarn is knit in plated relationship with the body yarn in every wale of every course of the heel, stretchability of the heel area is severely limited. When the hose is pulled onto the leg and foot of the wearer, excessive stretching of the fabric surrounding the heel area occurs and the relatively lightweight yarn is placed under a strain so that it is more easily subject to breaking, causing runs and holes in the hose.

With the foregoing in mind, it is a main object of the present invention to provide a reinforced heel area in a tube hose and the method of knitting the same in which at least the central portion includes a reinforcing yarn that is interknit with a body yarn in certain courses and wherein the reinforcing and body yarns are interknit in selected wales with the reinforcing yarn floating across other wales so that the heel area will stretch and conform to the configuration of the heel of the wearer without placing excessive strain on the fabric surrounding the heel area.

It is another object of the present invention to provide an improved reinforced heel area of the type described which includes a center panel and a panel adjacent each side of the center panel, the side panels each having a reinforcing yarn knit in plated relationship with the body yarn in every wale of certain courses, the center panel having a reinforcing yarn interknit in plated relationship with the body yarn in selected wales only and floated across the remaining wales, and both the center and side panels having only the body yarn knit in the other courses.



Some of the objects of the invention having been stated, other objects will appear as the description proceeds, when taken in connection with the accompanying drawings, in which—

FIGURE 1 is a perspective view of a knit hosiery blank in the form of a tube, showing the rotary knit reinforced heel area of the present invention formed therein;

FIGURE 2 is an enlarged fragmentary view of that portion of the hosiery blank which includes the reinforced heel area;

FIGURE 3 is a perspective view looking at the heel of the hose when positioned on the foot of a wearer;

FIGURE 4 is a perspective side view of the hose when positioned on the foot of a wearer;

FIGURES 5 and 5A are greatly enlarged views of the areas encompassed within the elongated dotted rectangles indicated respectively at **5** and **5A** in FIGURE 2.

As shown in FIGURE 1, a hosiery blank, broadly indicated at **10** is first formed on the knitting machine and in this particular instance, the hosiery blank **10** is in the form of a tube which is slightly reduced at the lower end by gradual reduction of the size of stitch loops during the knitting of the tubular blank, in a conventional and well-known manner. The hosiery blank **10** includes a turned welt **11**, a shadow welt **12**, a leg **13** and a foot portion **14**. The foot portion **14** includes the reinforced heel area **15** and a reinforced toe area **16**. It is the usual practice to first knit and turn the welt **11** and then continue rotary knitting to form the leg **13**.

As the leg **13** of the hose is completed, the heel area **15** is knit in a special manner, to be presently described, and the reinforced lower toe portion **16** is then knit with continuous rotary knitting. However, it is to be understood that the lower end of the hose blank **10** may be provided with a conventional reciprocatorily knit toe pocket, if desired.

In the present instance, a curved seam is formed in the reinforced toe area **16** to close the toe of the hose. This seam is made on the usual seaming equipment which is provided with a trimmer for trimming the excess material as the seam is formed.

The welt **11** and shadow welt **12** are usually knit of a heavier denier nylon yarn than the leg **13** and the shadow welt **12** may be provided with a suitable band **12***a* of tuck stitches which are arranged in a predetermined order. It is preferred that the leg **13** of the foot portions **14**, except the heel area **15** and the toe portion **16**, be knit with a monofilament thermoplastic body yarn B, such as 15 denier nylon. The body of the hose may be formed of plain stitches or of various conventional stitch patterns such as the micro-mesh pattern illustrated in FIGURES 5 and 5A. In this particular pattern, alternate courses are knit with plain stitches throughout while intervening courses have a repeating sequence of three plain stitches and one tuck loop.

As shown in the left-hand portion of FIGURE 5 and in the right-hand portion of FIGURE 5A, the tuck loops

T in course **50***a* are stepped over one wale from the tuck loops T in course **51***a* to produce inclined lines of tucks in the leg and foot. This micromesh pattern is well known and may be knit on a single feed knitting machine, in the manner disclosed in the Page Patent No. 2,501,353, on a two-feed knitting machine, in the manner disclosed in the Lawson Patent No. 2,890,577 (FIGURE 12), or on a machine having more than two feeds.

As has been stated, the heel area **15** of the present invention is knit with continuous rotation of the needle cylinder and a reinforcing yarn R (FIGURES 5 and 5A) is selectively interknit and floated with the body yarn B. The reinforcing yarn R is also preferably a thermoplastic multifilament yarn, such as 30/2 denier multifilament plain or texturized nylon. The reinforcing yarn R has been speckled in FIGURES 5 and 5A for ease of identification.

The reinforced heel area **15** preferably includes a center panel **20** and opposite side panels **21** and **21'** (FIGURE 2). In the side panels **21** and **21'**, the reinforcing yarn R is knit in plated relationship with the body yarn B in every stitch loop of courses **50***a* and **51***a* (FIGURES 5 and 5A). As is best shown in FIGURE 2, the outer edges of the side panels **21, 21'** are stepped outwardly and the lengths of the portions of the reinforced courses within the heel area are progressively increased to a point substantially midway of the reinforced heel area **15**. In the lower half of the heel area **15**, the outer edges of the side panels **21, 21'** are stepped inwardly and the lengths of the portions of the reinforced courses within the heel area are progressively decreased to the bottom of the reinforced heel area **15**. The free cut ends of the yarn R extend inside of the hose and along the outer edges of the panels **21, 21'**. As shown in FIGURES 5 and 5A, those portions of the courses **50, 51** and **52** in the side panel areas **21, 21'** are knit of the body yarn B only. Thus, in the side panels **21, 21'**, alternate single courses are knit of the body yarn B alone and intervening single courses are knit of the reinforcing yarn R and the body yarn B in plated relationship in every wale.

In the center panel **20**, the body yarn B is knit alone in every wale of alternate courses (courses **50, 51** and **52**) while both the reinforcing yarn R and the body yarn B are interknit in intervening courses (courses **50***a*, **51***a*). In this center panel **20**, the reinforcing yarn R is floated, as indicated at *f* across alternate wales (wales **W–12, W–14, W–16, W–78, W–80** and **W–82**) of the intervening courses **50***a* and **51***a*. In the intervening course **50***a*, the body yarn B forms stitch loops in the wales **W–12, W–14, W–16, W–78, W–80** and **W–82** while the reinforcing yarn forms the floats *f* of the center panel **20**. Then, in the intervening course **51***a*, the body yarn forms tuck loops *t* in wales **W–12, W–16, W–78** and **W–82** of the center panel **20** and forms plain stitches in wales **W–14** and **W–80** while the reinforcing yarn R forms floats *f* in each of these wales.

Thus, in the center panel **20**, the reinforcing yarn R is selectively knit in plated relationship with the body yarn in certain wales and is floated across other wales while the body yarn B is selectively knit and tucked. The selective knitting and tucking of the body yarn B, along with the selective knitting and floating of the reinforcing yarn R in the portions of the intervening courses within the area covered by the center panel **20** provides more of an open mesh appearance to the center panel **20** than in the side panels **21, 21'**, where the reinforcing yarn R is knit in plated relationship with the body yarn B in every wale of the intervening courses.

The variations in the appearance of the center panel **20** and the side panels **21, 21'** provide a pleasing contrast with the leg and foot fabric and the open mesh of the center panel **20** provides a greater degree of stretchability so that the hosiery blank may be more easily pulled onto and properly positioned on a hosiery boarding form. Also, the stretchable center panel **20** of the heel area **15** will provide a better fit of the heel on the wearer and prevent undue stress and strain from being placed on the body yarn stitch loops in the areas surrounding the reinforced heel area **15**.

It is preferred that the hose of the present invention be knit on a four-feed circular hosiery knitting machine of the type which is provided with yarn feeding fingers at each of the knitting stations and needle selecting means in advance of two of the knitting stations whereby the needles may be raised to selectively pick up either the body yarn alone or the body yarn and the reinforcing yarn together. There are presently available several different types of four-feed circular hosiery knitting machines on which this hose can be knit. However, it is to be understood that the hose of the present invention can also be knit on a single feed knitting machine, on a knitting machine having two knitting stations, or on a knitting machine having more than four knitting stations.

When the hose is knit on a four-feed knitting machine, body yarn is fed to the needles and knit at each knitting station to knit the leg **13**, down to the heel area **15**. The mesh pattern of tuck stitches is formed at what may be termed the first and third knitting stations and plain courses are formed at the other knitting stations, which may be termed the second and third knitting stations.

As the first course of the heel area **15** is knit, the reinforcing yarn R is introduced at the first and third knitting stations and at a slightly higher elevation than the body yarn B is fed to the needles. The first and third knitting stations are provided with the usual pattern selector mechanism for selectively varying the height of the needles as they approach the yarn feed fingers. At the second and fourth knitting stations, the body yarn B is still fed to all needles and plain stitch loops are formed thereby.

In a four-feed knitting machine, four courses are formed with each rotation of the needle cylinder and the knitting of the four courses **50***a*, **51** and **51***a*, **52** will now be described. These four courses are formed with one rotation of the needle cylinder and they comprise one repeat of the particular pattern of the heel area **15** shown in FIGURES 5 and 5A.

In the knitting of course **50***a*, at the first knitting station, the needles which knit the body yarn B in the wales **W–1** through **W–6** are raised high enough to pick up the body yarn B and plain stitch loops are formed, except in wale **W–4**, where the needle is not raised to shed level so that the tuck loop T is formed. As the needles in wales **W–7** through **W–11** pass through the first knitting station to knit the side panel **21**, they are selectively raised high enough to pick up and form plain stitch loops of both the body yarn B and the reinforcing yarn R is plated relationship in each of these wales. After the reinforcing yarn is introduced at wale **W–7**, it is cut closely adjacent the fabric to leave a free end extending inside of the fabric.

In the knitting of that portion of the course **50***a*, in the center panel **20**, all of the needles pick up and knit the body yarn B at the first knitting station, as shown in wales **W–12** through **W–6** of FIGURE 5 and wales **W–78** through **W–82** of FIGURE 5A, while the reinforcing yarn R alternately floats and knits. The floats *f* are formed in wales **W–12, W–14, W–16, W–78, W–80** and **W–82** because these needles are raised high enough to pick up only the body yarn B and form stitch loops therefrom. On the other hand, the needles in wales **W–13, W–15, W–79** and **W–81** are raised high enough to pick up both the body yarn B and the reinforcing yarn R and form stitch loops of both yarns in plated relationship.

In that portion of course **50***a* in the side panel **21'**, the needles in wales **W–83** through **W–87** all are raised high enough to pick up and knit both the body yarn B and the

reinforcing yarn R. After the reinforcing yarn R is knit in wale W–87, it is cut closely adjacent the fabric, by any suitable cutting mechanism, and the free end extends inside of the fabric. Continuing the course **50***a* to knit the area **14** of the foot, the needles in wales W–88 through W–93 are raised high enough to pick up the body yarn B and form plain stitch loops in all of these wales, except the wales W–88 and W–92 where the needles are raised high enough to form the tucks T.

As the needles in wales W–1 through W–16 and W–78 through W–93 pass through the second knitting station, they are all raised high enough to pick up and knit the body yarn B to form the course **51**, as shown in FIGURES 5 and 5A. The needles in wales W–1 through W–16 and W–78 through W–93 then pass through the third knitting station to form the course **51***a*.

The needles in wales W–1 and W–5 pick up the body yarn form tuck loops T while the needles in wales W–2, W–3 and W–4 pick up the body yarn and form plain stitch loops. In this course **51***a*, the reinforcing yarn R is introduced in wale W–6 and is knit in plated relationship with the body yarn B. Thus, the outer edge of the side panel **21** is stepped over one wale. The remaining needles in wales W–7 through W–11 then pick up and knit both the body yarn B and the reinforcing yarn R at the third knitting station to complete this portion of course **51***a* in the side panel **21**.

The reinforcing yarn R is again floated by the needles in the wales W–12, W–14 and W–16 of FIGURE 5 and wales W–78, W–80 and W–82 of FIGURE 5A while it is knit in plated relationship with the body yarn in wales W–13, W–15, W–79 and W–81. The needles in wales W–12, W–16, W–78 and W–82 pick up and form tuck loops T of the body yarn while the needles in wales W–14 and W–80 pick up the body yarn and form plain stitch loops. Thus, in this portion of course **51***a* in the center panel **20**, a repeated pattern of tuck loop T is formed of the body yarn B while a repeated pattern of floats is formed of the reinforcing yarn R.

In side panel **21'**, the needles in wales W–83 through W–88 are all raised to pick up and knit both the body yarn B and the reinforcing yarn R in plated relationship and the reinforcing yarn R is removed at the wale W–88. The reinforcing yarn R is thus knit in one more wale of course **51***a* than it was knit in course **50***a* so that the outer edge of the side panel **21'** is stepped outwardly. The needles in wales W–89 through W–93 then pick up the body yarn at the main knitting station and form stitch loops, except those needles in wales W–89 and W–93 which are raised high enough to form the tuck loops T of course **51***a*.

As the needles then pass through the fourth knitting station, the course **52** is formed of the body yarn B and the needles in wales W–1 through W–16 and the needles in wales W–78 through W–93 are all raised to pick up and form plain stitch loops. Four courses are formed with each succeeding rotation of the needle cylinder to form courses similar to the repeat shown in courses **50***a*, **51**, **51***a* and **52**. However, the number of needles knitting in the side panels **21**, **21'** is gradually increased and the tuck loops of the body yarn which are formed in the center panel **20** are stepped over two wales in the next repeat and then stepped back to the position shown in FIGURES 5 and 5A in the following repeat of the pattern.

It is understood that in the lower half of the heel area **15**, the number of needles which knit the reinforcing yarn in the side panels **21** and **21'** will be gradually reduced, so that the outer edges of these side panels will be stepped inwardly, as shown in FIGURE 2. Upon completion of the knitting of the heel area **15**, the micro-mesh fabric of the foot portion **14** is then formed at all four knitting stations with the tuck loops T being formed at the first and third knitting stations and plain courses of the body yarn being knit at the second and fourth knitting stations.



While a preferred pattern is shown for the reinforced heel area **15**, it is to be understood that various changes may be made without departing from the invention. For example, each of the intervening courses in the center panel **20** could be extended to the outer edges of the heel area **15**, if desired. While the body yarn is knit alone in alternating single courses and the reinforcing yarn is knit with the body yarn in intervening single courses, it is to be understood that the knitting of the body yarn alone and the knitting of the reinforcing yarn and body yarn together need not be alternated in single courses but may be alternated in groups of two or more courses. Further, the leg **13** and the foot **14** may be formed of plain stitches throughout, except in the reinforced heel area **15**.

Also, the stitch loops in the reinforced heel area **15** could be made longer than the stitch loops in the adjacent areas of the leg **13** and foot **14** to provide a greater amount of fabric in the heel area **15**. This could be accomplished by employing stitch cams which are lowered a slight amount while the needles pass therebetween which form the heel area **15** in a manner such as that disclosed by the Holmes Patent No. 2,163,557. The longer stitches may also be formed by the use of split-face stitch cams so that longer butt needles in the heel area would be lowered a greater amount than the shorter butt needles.

In the drawings and specification there has been set forth a preferred embodiment of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only, and not for purposes of limitation, the scope of the invention being defined in the claims.

We claim:

**1.** A seamless knit hose having leg and foot portions including courses knit of body yarn, said foot portion including a reinforced heel area having a reinforcing yarn incorporated therein and being formed of portions of complete courses, said reinforced heel area including

(A) a center panel comprising

(a) portions of alternate complete courses within said center panel being formed of stitch loops of said body yarn in every wale,

(b) portions of intervening complete courses within said center panel being formed of stitch loops of said body yarn and said reinforcing yarn,

(c) said reinforcing yarn being knit in plated relationship with said stitch loops of said body yarn in certain regularly recurring wales of said portions of said intervening course, and

(d) said reinforcing yarn being floated across other regularly recurring wales of said portions of said intervening courses, and

(B) a pair of side panels positioned adjacent opposite sides of said center panel and comprising

(a) portions of alternate complete courses within said side panels being formed of stitch loops of said body yarn in every wale, and

(b) portions of intervening complete courses within said side panels being formed of stitch loops of said body yarn and said reinforcing yarn knit in plated relationship in every wale.

**2.** A seamless knit hose having leg and foot portions including courses knit of body yarn, said foot portion including a reinforced heel area having a reinforcing yarn incorporated therein and being formed of portions of complete courses, said reinforced heel area including

(A) a center panel comprising

(a) portions of alternate complete courses within said center panel being formed of stitch loops of said body yarn in every wale,

(b) portions of intervening complete courses within said center panel being formed of stitch loops of said body yarn and said reinforcing yarn,

(c) stitch loops of said body yarn being formed in every wale of said portions of said intervening courses,

(d) said reinforcing yarn being knit in plated relationship with said stitch loops of said body yarn in certain regularly recurring wales of said portions of said intervening courses, and

(e) said reinforcing yarn being floated across other regularly recurring wales of said portions of said intervening courses, and

(B) a pair of side panels positioned adjacent opposite sides of said center panel and comprising

(a) portions of alternate complete courses within said side panels being formed of stitch loops of said body yarn in every wale, and

(b) portions of intervening complete courses within said side panels being formed of stitch loops of said body yarn and said reinforcing yarn knit in plated relationship in every wale.

3. A seamless knit hose having leg and foot portions including courses knit of body yarn, said foot portion including a reinforced heel area having a reinforcing yarn incorporated therein and being formed of portions of complete courses, said reinforced heel area including

(A) a center panel comprising

(a) portions of alternate complete courses within said center panel being formed of stitch loops of said body yarn in every wale,

(b) portions of intervening complete courses within said center panel being formed of stitch loops of said body yarn and said reinforcing yarn,

(c) stitch loops of said body yarn being formed in certain wales of said portions of said intervening courses and tuck loops of said body yarn being formed in other wales of said portions of said intervening courses,

(d) said reinforcing yarn being knit in plated relationship with said stitch loops of said body yarn in certain regularly recurring wales of said portions of said intervening courses, and

(e) said reinforcing yarn being floated across other regularly recurring wales of said portions of said intervening courses, and

(B) a pair of side panels positioned adjacent opposite sides of said center panel and comprising

(a) portions of alternate complete courses within said side panels being formed of stitch loops of said body yarn in every wale, and

(b) portions of intervening complete courses within said side panels being formed of stitch loops of said body yarn and said reinforcing yarn knit in plated relationship in every wale.

4. A seamless knit hose having leg and foot portions including courses knit of body yarn, said foot portion including a reinforced heel area having a reinforcing yarn incorporated therein and being formed of portions of complete courses, said reinforced heel area including

(A) a center panel comprising

(a) portions of alternate complete courses within said center panel being formed of stitch loops of said body yarn in every wale,

(b) portions of intervening complete courses within said center panel being formed of stitch loops of said body yarn and said reinforcing yarn,

(c) stitch loops of said body yarn being formed in every wale of said portions of certain of said intervening courses,

(d) stitch loops of said body yarn being formed in certain wales and tuck loops being formed in other wales of other intervening courses,

(e) said reinforcing yarn being knit in plated relationship with said stitch loops of said body yarn in certain regularly recurring wales of said portions of both of said certain and said other intervening courses, and

(f) said reinforcing yarn being floated across said stitch loops of said body yarn in other regularly recurring wales of said portions of said certain intervening courses and being floated across said tuck loops of said body yarn in other regularly recurring wales of said portions of said other intervening courses, and



(B) a pair of side panels positioned adjacent opposite side of said center panel and comprising

(a) portions of alternate complete courses within said side panels being formed of stitch loops of said body yarn in every wale, and

(b) portions of intervening complete courses within said side panels being formed of stitch loops of said body yarn and said reinforcing yarn knit in plated relationship in every wale.

5. A seamless knit hose having leg and foot portions including courses knit of body yarn, said foot portion including a reinforced heel area having a reinforcing yarn incorporated therein and being formed of portions of complete courses, said reinforced heel area including

(A) a center panel comprising

(a) portions of alternate complete courses within said center panel being formed of stitch loops of said body yarn in every wale,

(b) portions of intervening complete courses within said center panel being formed of stitch loops of said body yarn and said reinforcing yarn,

(c) stitch loops of said body yarn being formed in every wale of said portions of certain of said intervening courses,

(d) stitch loops of said body yarn being formed in alternate wales and tuck loops being formed in the intervening wales of other intervening courses,

(e) said reinforcing yarn being knit in plated relationship with said stitch loops of said body yarn in certain regularly recurring wales of said portions of both of said certain and said other intervening courses, and

(f) said reinforcing yarn being floated across said stitch loops of said body yarn in said alternate wales of said portions of said certain intervening courses and being floated across said tuck loops of said body yarn in said alternate wales of said portions of said other intervening courses, and

(B) a pair of side panels positioned adjacent opposite sides of said center panel and comprising

(a) portions of alternate complete courses within said side panels being formed of stitch loops of said body yarn in every wale, and

(b) portions of intervening complete courses within said side panels being formed of stitch loops of said body yarn and said reinforcing yarn knit in plated relationship in every wale.

6. A method of knitting a seamless hose having leg and foot portions with the foot portion including a reinforced heel area formed of portions of complete courses, said method comprising the steps of

(a) knitting a first series of complete successive courses of a body yarn to form the leg, and

(b) knitting a second series of complete successive courses to form that portion of the foot portion which includes the heel area while

(1) knitting said body yarn alone in alternate complete courses,

(2) interknitting a reinforcing yarn with said body yarn in certain portions of intervening complete courses within the heel area,

(3) knitting said reinforcing yarn in plated relationship with said body yarn in certain regularly recurring wales of said portions of said intervening courses within the heel area and floating said reinforcing yarn across other regularly recurring wales of said portions of said intervening courses within the heel area, and

(4) knitting at least the plated stitch loops of at least said portions of said intervening courses within the heel area longer than the stitch loops of the remaining portions of said intervening courses, and

(c) knitting additional courses to complete the foot portion.

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