

May 31, 1955

L. POOLE  
CIRCULAR KNIT HOSIERY

2,709,353

Filed Aug. 9, 1951

4 Sheets-Sheet 1

Fig. 2.

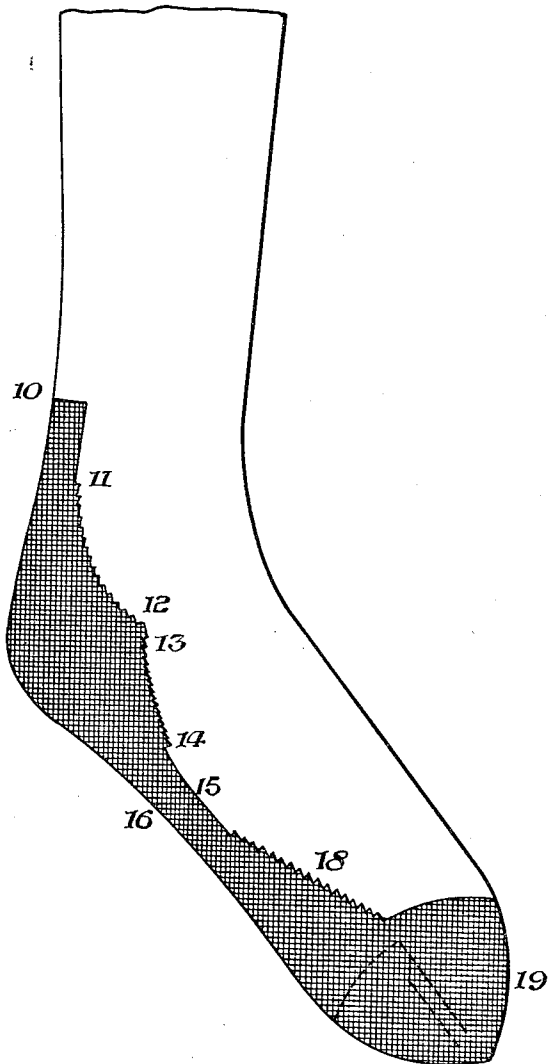
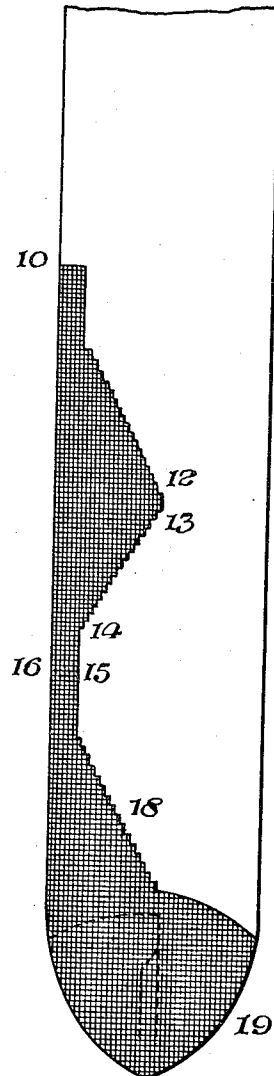


Fig. 1.



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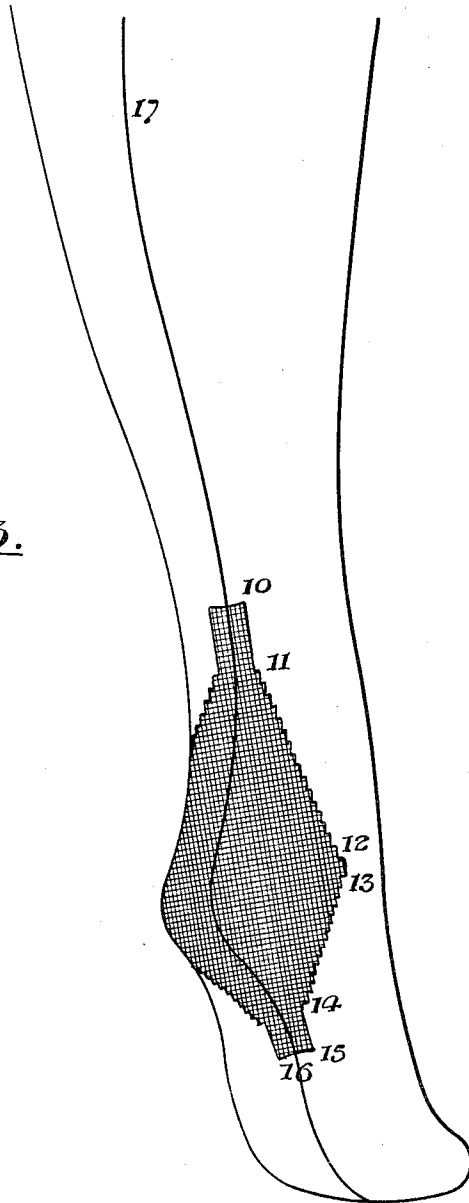
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*Fig. 3.*



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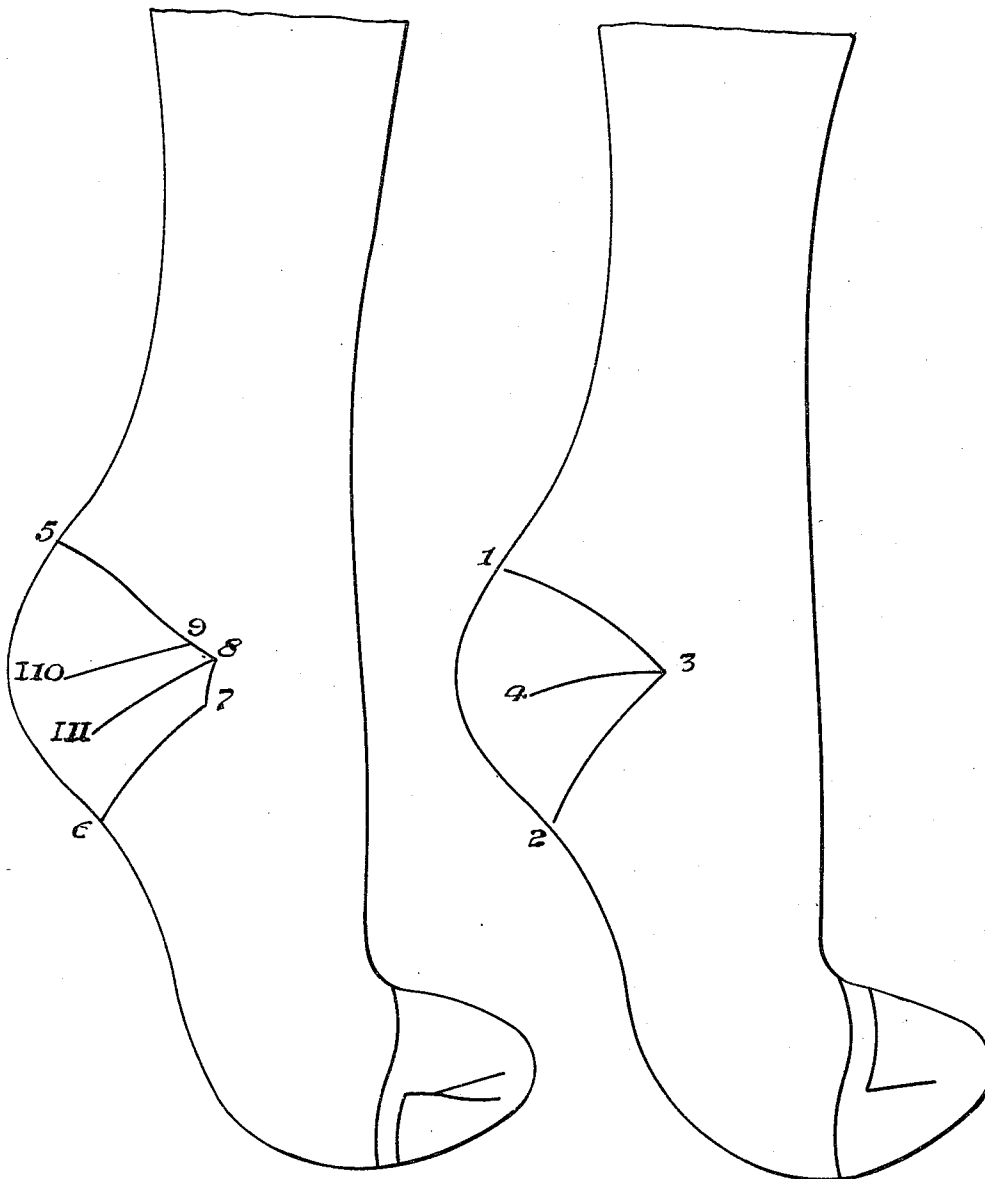
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Fig. 5.

Fig. 4.



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Fig. 6.

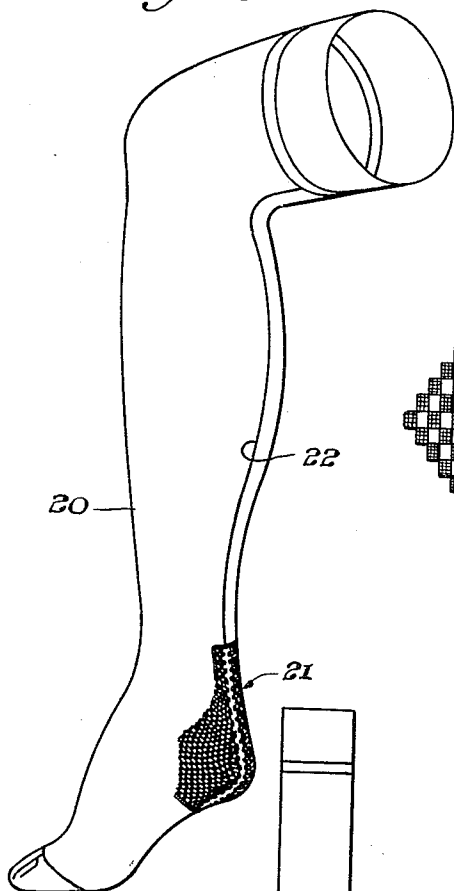


Fig. 9.

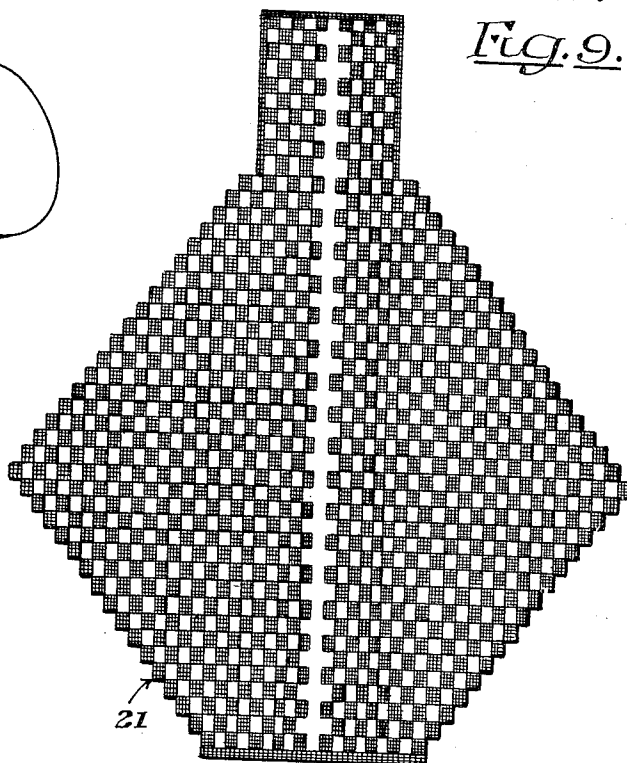


Fig. 7.

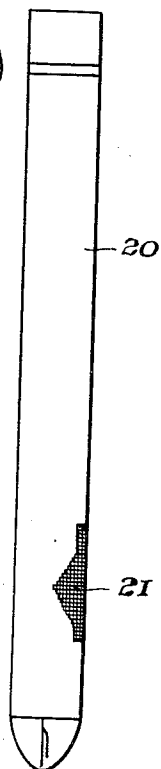
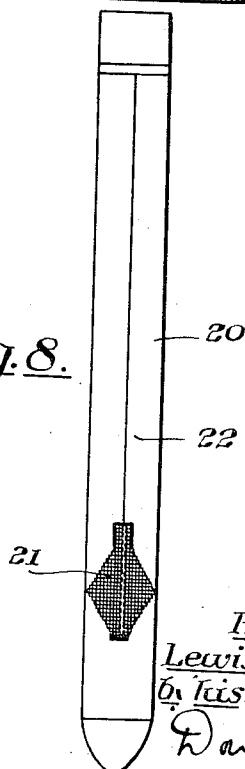


Fig. 8.



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## CIRCULAR KNIT HOSIERY

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6 Claims. (Cl. 66—181)

This invention relates to circular knit hosiery and involves a novel method of knitting such hosiery and the novel resulting products.

An object of this invention is to provide a novel method of circular knitting the heel and/or foot of women's fine gauge hosiery.

A further object of the invention is the provision of a self seam or "knit-in" seam extending from the welt portion through the reinforced heel, heel and/or into the foot section without interruption.

Another object of this invention is to provide a novel method of circular knitting women's fine gauge hosiery to provide a spliced heel and/or foot construction by continuous round and round knitting without the formation of a heel pocket by the usual practice of oscillating the knitting cylinder.

Still another object of the invention is to provide a novel method of circular knitting ladies' hosiery in which all the needles continue to knit throughout the formation of the heel, reinforced heel and/or foot portion.

Another object of the invention is the provision of novel circular knit hose having a reinforced spliced heel and/or foot composed of interknit body yarn and reinforcing yarn.

A still further object of the invention is the provision of a novel circular knit hose having a continuous seam from the welt through the splicing, reinforced heel and/or through the reinforced sole portion extending, if desired, to the toe.

Other and more detailed objects of the invention are to provide a novel method of knitting circular hose and the product which will give improved service to the wearer, present a good appearance, and result in the saving of machine operator time in the knitting thereof and provide simplification and savings in the mechanism and operation.

Another specific object of the invention is to effect substantial savings in materials through the elimination of one section formerly considered necessary in shaping the foot of a stocking and a saving in time by reducing the number of automatic changes required and by eliminating knitting failures, with a further result of savings in materials and an increase in the life of needles and other machine elements.

Other and more detailed objects of the invention will be apparent from the following disclosure of the invention made, in connection with the attached drawings.

In the accompanying drawings, Figure 1 is an elevational view of a circular knitting tube as it comes from the machine, comprising that portion of circular hose which includes the entire foot, made in accordance with this invention;

Figure 2 is a similar view of the knit structure after it has been boarded;

Figure 3 is a perspective view of the appearance of one circular knit stocking made in accordance with this invention, in which the reinforced area does not extend into the foot area as it does in the structure of Figures 1 and 2;

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Figure 4 is a side elevational view, diagrammatically illustrating the present common method of forming the heel pocket in circular knit hose;

Figure 5 is a similar view of another common construction;

Figure 6 is a perspective view of a circular knit stocking made in accordance with the method herein disclosed, showing a variation in the design employed to reinforce the high splice and heel proper;

Figure 7 is an elevational view of the tubular knit fabric of the stocking of Figure 6 before it has been formed to provide the heel pocket;

Figure 8 is another and quite similar view of the tubular fabric; and

Figure 9 is an enlarged detail view of the checkerboard pattern of the reinforcing.

It has long been considered necessary in the circular knitting art to provide a heel pocket so that the stocking would fit the wearer's foot properly, within the known limitations of circular knit hose, without fold or accumulation of excess fabric on the instep side. This operation is generally referred to as "turning the heel," and is practiced by hosiery knitters working with hand knitting needles. In accordance with this practice the hose is knit by interrupting on the instep the knitting of one-half the fabric tube (the instep side). In accordance with this usual method, the heel is then formed by back and forth courses of gradually diminishing length until the point of the heel is reached, whereupon the courses are gradually increased in length until they are equal to the width of the fabric tube. The knitting of the foot is then begun with full courses of knitting extending around the hose. This method of knitting the heel pocket by oscillating the knitting cylinder and interrupting knitting on a considerable portion of the total needle bank during its formation is the method most commonly practiced today in the production of circular knit ladies' hose. It has many attendant disadvantages, as will be referred to hereinafter.

The knit-in section, comprising the heel, is formed into a pocket and serves to dispose the foot section at approximately the correct angle to the leg portion. Subsequent developments in heel formation, in the circular hosiery knitting art, included the knitting in of an additional triangular section of fabric or gusset aimed at forming the foot at a more nearly correct angle with relation to the leg section.

All conventional methods, including those referred to above for the formation of the heel, are slow, tedious and exert undesirable stresses on the yarns, needles and other machine elements. For this type of knitting it is necessary to oscillate the cylinder with from one-half to five-sixths of the needles in the idle position. With the present invention oscillation of the knitting cylinder in knitting the heel is eliminated and all needles continue to knit throughout the formation of the heel, and if desired, the foot portion up to the toe.

The two most common conventional methods of knitting women's circular hose in the heel area are diagrammatically illustrated in Figures 4 and 5. In Figure 4 is illustrated the first of these conventional methods referred to above, in which the heel pocket is formed of two segments 1, 3, 4 and 2, 3, 4 essentially triangular in shape. The section 1, 3, 4 is knit as stated above by oscillating the needle cylinder, knitting on approximately one-half the needles in back and forth courses of gradually diminishing length until the point of the heel is reached. The triangular section 2, 3, 4, is then formed by continuation of interrupted knitting, i. e. by oscillating the needle cylinder, in which the courses are gradually increased in length until they are equal in width to the fabric tube. These triangular sections are united on the

lines 3, 4 to form the heel pocket. The lines of juncture 3, 4 are known in the art as gore lines and are a distinguishing mark of all circular knit hosiery of conventional design.

Figure 5 diagrammatically illustrates the variation referred to above, in which an additional wide triangular section of fabric is knitted by oscillating the needle cylinder and using only a portion of the needle bank. In this construction the heel is composed of three segments 5, 9, 110; 6, 7, 8, 111; and 111, 8, 9, 110. These segments are united along the lines 9, 110 and 8, 111, to form several gore lines or sutures. The knitting of these segments is accomplished by reciprocating the machine cylinder with more than one-half the needles in the idle position. During the process, the action of the well known lifting and lowering pickers exerts strain on the needles. It is well known that there is a strong likelihood of mechanical and yarn failure in reciprocatory knitting, and that the fabric so formed is necessarily marked by unsightly gore lines or sutures where the angular sections are joined.

An important defect of this method of circular knitting is present in the fact that the self seam or "knit-in" seam, sometimes called the automatic seam, must terminate at point 1 of the structure of Figure 4, and point 3 of the structure of Figure 5. This is another characteristic of present circular knitting practice, namely that the simulated seam does not run through the heel area as it does in full fashioned hose, which is considered by many to be a desirable characteristic of circular knit hose.

The method of this invention finds commercial practicability in the fact that modern hose are commonly knit with yarns having thermo-plastic characteristics, and particularly the characteristic of being thermo-setting. There are a number of such known thermo-plastic yarns or filaments of which nylon is an example. As is generally known in the art, fabrics formed of nylon or other thermo-plastic yarns or filament, when placed on metal forms of the desired shape and subjected to a brief treatment with steam under pressure or other heating medium, become permanently set to the shape of the form. The ensuing shrinkage eliminates any wrinkles, creases or folds such as appeared initially in the instep of the hose when placed on the form. The instep fabric is able to absorb the excess of material, comprising the wrinkles, creases or folds in part, because of the fact that in fine gauge hosiery the threads are interlaced in open loops, facilitating shrinkage.

In accordance with the method of this invention the knitting of the tube to be later boarded to be shaped to the desired form is continuously knit by rotary knitting and when the heel area is reached the heel reinforcement is formed without interrupting the rotation of the knitting cylinder and with all of the needles at working level. The result is that the fabric is knitted from end to end in the form of a straight tube. In this method the reinforcing yarn is spliced in on the side in which the heel is to be formed by preboarding. The advantage of the extra reinforcing yarn results in the production of a heel section of uniform texture throughout without gore lines, resulting in a product of higher durability and better appearance. The reinforcing yarn may be introduced into the fabric at a point considerably above the point at which the conventional circular-knit heel is started, and at the beginning will be taken by a relatively few needles so that the slender lines of the French heel, widely used in full-fashioned hosiery are now feasible in circular knit hosiery.

This structure is clearly illustrated in Figures 1 and 2. The reinforcing yarn is introduced at the point 10 to a relatively small group of needles. At point 11 the spliced area is extended to cover four additional needle wales on each side of the centerline of the reinforcement, that is along the seam line. In other words, at the point 11, eight additional needles are brought into action to knit splicing yarn, four on each side. Similar widening of the spliced area is effected between the points 11 and 12 at

eight course intervals. Between the points 13 and 14 the spliced area is reduced in step order, that is four needles at a time on each side, at eight course intervals. After knitting a straight section the heel can be terminated at 15, 16 to provide the structure of Figure 3, or the spliced area may be continued through the sole, widening out toward the line of juncture with the toe 19 to form a cradle foot, as indicated at 18 in Figures 1 and 2. It will be understood that the heel structure thus produced is not limited to the contour shown, but may be worked out at other angles.

Time studies on machines set up to produce the older type of stockings with the conventional heel, of which Figures 4 and 5 are examples, show that more than two minutes are required to form the heel. This is more than ten percent of the total time required to knit the complete stocking. In applicant's method and structure this time can be saved, providing an outstanding economic advantage in this method.

For emphasis it will be noted that throughout the heel area and even through the formation of the sole, knitting is effected on all the needles with continuous rotation of the needle cylinder. At this time the body yarn is continuously fed to the needles, as well as the reinforcing yarn, producing a structurally strong heel area, and if desired sole area, of neat appearance.

Another important feature of this invention is that the automatic seam 17 may extend through the reinforced heel area to the point 16 of the structure of Figure 3, and when desired on through to the toe, as also illustrated in this figure. In other words, the automatic seam need not be interrupted at the point 10, as is the common characteristic of conventional knit circular hose.

The fabric tube comes from the machine in the form shown in Figure 1, and is then preboarded and heat treated to give it the desired final shape as shown in Figure 2. This preboarding procedure is well known and may be applied, as known, to the structure of Figure 1, and hence no further description in this respect is required.

The method herein disclosed is practiced on circular knitting machines of the float stitch type with means for feeding two yarns, i. e. the body yarn which is taken and knitted by all the needles to form the main fabric of the leg and foot portion, and the reinforcing yarn which is fed at a somewhat higher level and will be taken only by selected needles which are elevated slightly higher than the others by cylinder jacks and cams so that they pass the throat plate or yarn feeding station in position to take the reinforcing yarn also. The floated portions are clipped away in a well known manner after the stocking fabric is knitted.

Known mechanisms suitable for practicing the methods herein disclosed include the Scott and Williams Model K machine of the 25-step spiral float stitch class.

Another advantage of this invention is present in the fact that, by elimination of knitting by oscillation of the knitting cylinder, there is no mechanical interruption of the stitch tension, with the result that a great improvement in the control of the total hosiery leg length is effected.

For the sake of clarity, it is noted that the difference between Figures 1 and 2 and Figure 3 is that Figure 3 illustrates the structure when the reinforcing does not extend into the sole area, in which event knitting in the reinforcing thread is interrupted at the line 15, 16 to provide only a reinforced heel. In Figures 1 and 2 the knitting in of the reinforcing yarn is continued beyond the line 15, 16 to provide the reinforced area 18 up to the toe reinforcing, at which point the reinforcing yarn in addition to the body yarn may be fed to all of the needles to provide the toe 19, or an additional heavier yarn substituted. The stocking of Figure 3 is, of course, intended to have a reinforced toe area made in the conventional manner.

It will also be apparent to those skilled in the art that the method herein disclosed greatly simplifies the machine construction. Reference is made specifically to the features required for knitting the reverse toe or toe in which the looper's line is on the bottom of the wearer's toe instead of the top. It is well known in the art that the knitting machine cylinders were for many years fitted with needles one-half of which had short butts and the other half long butts. The short butt side of the cylinder knitted both the heel and the toe with the long butt needles thrown up out of action. This method of knitting hosiery left the toe open on top and the closing of the toe by looping invariably left the looping line or seam visible from the top of the foot. When the machine builders developed a machine for placing this line on the bottom of the foot, it was necessary to knit the toe on the long butt side of the cylinder, and in effecting this change, it was necessary to provide means for reciprocating the cylinder on an additional center 180 degrees around the cylinder or directly opposite the center of reciprocation used in the heel. In knitting the reverse toe it was further necessary to act on long butt needles with pickers. Pickers exert more strain on long butt needles, resulting in higher rate of needle breakage. In knitting hosiery by my method I propose to reciprocate the cylinder only in knitting the toe. This reciprocatory motion can easily be effected with the short butt needles in the knitting position, and still permit toe closure to be effected on the bottom of the foot (under the wearer's toes). The present invention therefore makes possible the production of "reverse-toe" hosiery on machines of earlier type without the addition of advanced mechanisms.

Figures 6 to 9 inclusive illustrate diagrammatically another form of ornamental and reinforced heel circular knit stocking made in accordance with the method herein disclosed. The stocking body 20 is circular knit with the usual body yarn and is provided with a seam 22 which is either knit in after the knitting of the stocking is complete, or it can be knitted in the stocking as it is being made. It is noted that it is shown running through the splice and heel proper areas, but as previously explained, it may be continued on through to the toe, if desired.

Figures 7 and 8 are elevational views of the tubular fabric that is knit in accordance with this invention before preboarding to form the heel pocket. The reinforcing area is added to the stocking by feeding an extra yarn to certain needles which are selected automatically by a pattern in the pattern drum of a Scott and Williams Spiral, Model K, knitting machine. The design of the splice and heel showing alternate blocks in black and white results from feeding a plain body yarn to all of the needles so as to continuously knit the stocking body as the needle cylinder rotates, and a black splicing yarn is fed to certain of the needles to knit in the splicing yarn as the needle cylinder continues to rotate. The checkerboard pattern thus resulting is generally indicated by the reference numeral 21.

This form of the invention is illustrated for the purpose of clearly indicating that the method of this invention is not limited to a particular design for the reinforced heel and heel areas. It is noted that the feeding of the black yarn continues so that the sole area will also be reinforced by it and the feeding of the black yarn to the needles can be varied to provide some other design in the sole area, as for example a solid uniform reinforcing.

From the above description it will be seen that the novel method herein disclosed also produces novel circular knit hosiery. This hosiery is novel in that it is new in the circular knit hose to have a spliced reinforced heel and/or sole area without gores. It is also new in that it was not heretofore known how to provide circular knit hose with a self seam running through the reinforced heel area and/or sole. It is, therefore, an important object of this invention to provide new products of this kind.

Those skilled in the art will also understand, as suggested above, that this method may be practiced to produce a considerable variation in the designs produced by the outline of the reinforced heel, heel and/or sole areas, and I do not, therefore, desire to be strictly limited to the method as herein disclosed for illustrative purposes. On the contrary, I prefer to be limited only as required by the appended claims.

What is claimed is:

1. Circular knit hose having a spliced and reinforced heel knit from body and reinforcing yarns and a self seam knit from another yarn running through the heel area.
2. Circular knit hose having a spliced and reinforced heel knit from body and reinforcing yarns and sole area and a self seam knit from another yarn running through the reinforced heel and sole area.
3. Circular knit hose having a reinforced heel area knit from body and reinforcing yarns and a self seam knit from another yarn running from the welt to the terminal distant end of the reinforced area.
4. Circular knit hose having a reinforced heel and sole area knit from body and reinforcing yarns and a self seam knit from another yarn running from the welt to the toe.
5. Circular knit hose comprising a body yarn and a reinforcing yarn knitted therein to form a continuously knitted reinforced heel area and a self seam knit of an additional yarn extending through the reinforced heel area.
6. Circular knit hose comprising a body yarn and a reinforcing yarn knitted therein to form a continuously knitted reinforced heel and sole area and a self seam knit of an additional yarn extending through the reinforced heel and sole area.

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