This invention relates to a man's improved seamless support sock and the method of making the same. More particularly, the support sock of the present invention is knit in a novel manner to provide the desired degree of compressive force on all parts of the leg of the wearer.

The need for and value of support or surgical stockings and socks has long been recognized and many different types of yarns and knit constructions have been proposed. For the wearer to receive the full benefit of the support sock, all portions of the sock should engage the leg of the wearer with substantially the same degree of compressive force. This desired result has been accomplished to a satisfactory degree in full-fashioned support stockings where it is possible to shape the stocking during the knitting operation to substantially conform to the configuration of the leg.

However, this problem of providing the desired degree of compressive force on all parts of the leg has not been solved in the case of seamless support socks since they are made on a machine having a fixed diameter and number of needles and which normally produces a tube of substantially uniform diameter throughout its length. It will be understood that a support sock has no compressive force in its relaxed condition, but exerts a compressive force against the leg of the wearer due to the stretched or tensioned state of the fabric when worn and the tendency of the elastic yarns to return to a relaxed condition. Thus, a circular-knit fabric which is of substantially the same diameter throughout will be stretched to varying degrees, for example at the ankle or calf, and the compressive force will vary accordingly. It is possible to achieve some degree of uniformity by varying the diameter of the tube being knit to a limited degree by changing the size of the stitch loop being formed and/or changing the tension on the yarn forming the stitch loops. However, this small amount of change has not been sufficient to shape the support sock to the degree required so that all portions of the leg receive the desired degree of compressive force thereon.

With the foregoing in mind, it is a main object of the present invention to produce a seamless support sock which is knit of a particular combination of yarns and with a particular combination of different types of stitch loops in certain portions of the sock so that the desired degree of compressive force is obtained on all portions of the leg of the wearer.

In accordance with the present invention, the support sock includes a leg portion of sufficient length to extend up the leg sufficiently to cover the calf of the wearer. This leg portion is preferably knit of an alternating pattern of courses of thermoplastic "stretch" yarn and courses of covered spandex "elastic" yarn. In the major portion of the leg, the courses of stretch yarn and the courses of elastic yarn are knit in such a manner that they produce walewise extending mock ribs and provide limited stretchability and a substantial compressive force on the corresponding portions of the leg of the wearer. The sock is provided with an area at the rear of the leg which is adapted to engage the calf of the wearer and which is knit in such a manner that it has a non-rib appearance and a greater degree of stretchability than the mock rib portion while providing the desired degree of compressive force on the enlarged calf of the leg of the wearer. In this calf area of the support sock, the stretch yarn and the elastic yarn are both knit in plain stitches in every wale, and throughout the remaining major portion of the leg the stretch yarn is knit every wale while the elastic yarn is knit in alternate wales and floated across intervening wales.

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 side elevation of the support sock of the present invention, in flattened condition; FIGURE 2 is a rear perspective view of the support sock in position on the foot and leg of a wearer; and FIGURE 3 is an enlarged fragmentary elevational view of the small portion of the fabric enclosed in the dotted rectangle 3 in FIGURE 1, illustrating the different types of yarn and knit stitches in the support sock.

The support sock, as shown in FIGURE 1, includes a top or cuff 10, a leg 11 having a rectangular area 11a adapted to engage the calf of the wearer, and a foot including a heel pocket 12, an instep portion 13, and a toe pocket 14. The top or cuff 10 is preferably formed of a band of woven elastic webbing material which is suitably connected to the upper edge of the leg portion 11 by any suitable means, such as an overedge seam extending along the line 15. It is preferred that the elastic webbing material be woven with inverted extending loops of uncovered rubber or spandex strands which frictionally engage the legs of the wearer to hold the top of the sock in position. If desired, the support sock may have a conventional type cuff or top formed integrally with the upper portion of the leg 11 on the circular knitting machine.

The major portion of the leg 11 has vertically or walewise extending mock ribs, as indicated by the vertical shade lines shown in FIGURES 1 and 2. These mock ribs are formed by knitting a thermoplastic stretch yarn, indicated at S in FIGURE 3, and a covered spandex elastic yarn, indicated at E in FIGURE 3.

In the major portion of the leg, other than the calf area 11a, the stretch yarn S (FIGURE 3) is knit in every wale of the alternate courses (as shown in courses C-50, C-52 and C-54) while the elastic yarn E is knit in alternate wales W-20, W-22 of the intervening courses C-51, C-53 and C-55 and the elastic yarn forms floats, indicated at f, which extend across the intervening wales W-21, W-23. The mock rib appearance of the major portion of the leg 11 is caused by the floats f of the elastic yarn pulling together the even numbered wales and the greater length of yarn in the elongated draw or held stitches of the stretch yarn in the odd numbered wales.

In the calf area 11a, illustrated in wales W-24, W-25 and W-26 of course C-50, C-51, C-52 and C-53, the stretch yarn S is knit in every wale and the elastic yarn E is also knit in every wale of the numbered wales and the greater length of yarn in the elongated draw or held stitches of the stretch yarn in the odd numbered wales.

The plain-knit rectangular calf covering area 11a preferably extends substantially half the distance on each side of the leg (FIGURE 1) so that it is substantially the same width.
as the adjacent mock rib portion. The calf area IIa is about one and one-third as long, in a walewise direction, as 3,386,270.

Thus, in the mock rib portion of the leg II, a predetermined length of covered elastic yarn E is drawn into the fabric by the needles of the knitting machine. Since only the needles pick up and form stitch loops of the yarn E, a lesser length of elastic yarn E is incorporated in the mock rib areas of the leg II than the length of the elastic yarn incorporated in the calf area IIa. The greater length of elastic yarn E is incorporated in the calf area IIa because all of the needles are raised to pick up and form stitch loops of the elastic yarn E in every wale. Therefore, the area IIa is shaped or fashioned and will move readily stretch to a greater extent, in both walewise and coursewise directions than the mock rib fabric in the major portion of the leg II.

When the sock is drawn onto the leg, as shown in FIGURE 2, the calf area IIa will be stretched to a greater extent as it is positioned over and conforms to the shape of the enlarged calf portion of the leg of the wearer. However, the compressive force of this calf area on the leg of the wearer is about the same as the compressive force on the other portions of the leg because a greater length of elastic yarn is incorporated in this area. On the other hand, if the leg were knit throughout of the stitch construction in the mock rib portions, the compressive force on the enlarged calf portion of the leg of the wearer would be much greater than the compressive force on the smaller portions of the leg above and below the calf area.

The mock rib construction may be continued into or throughout the foot, although it is disclosed as being discontinued just above the heel pocket 12, along the line 16 in FIGURE 1. The remainder of the foot, including the heel and toe pockets 12, 14 and the instep portion 13, is preferably knit with plain or undistorted loops of the thermoplastic stretch yarn only, and in the conventional manner.

In order to shape the fabric and reduce the diameter of the leg II as knitting progresses from the top to the bottom, it is preferred that the tension on the elastic yarn E be progressively increased, thereby progressively decreasing the diameter of the leg, substantially as shown in FIGURE 1, so that the compressive force on the ankle may be substantially the same as the compressive force on the remaining portions of the leg. By varying the tension, variations in compressive force may be accomplished if desired. The tension on the elastic yarn E may be increased after the knitting of predetermined numbers of courses or it may be progressively increased in a gradual manner as knitting continues. Also, the leg may be fashioned to decrease the diameter of the tube by gradually decreasing the size of the stitch loops as knitting of the leg progresses from the top to the bottom, in the conventional manner. Thus, progressive variation of the stitch loop size may be employed to provide some fashioning to the leg so that it is reduced in size in the ankle area while the calf area of greater stretchability provides the desired degree of compressive force on the enlarged calf of the leg of the wearer.

The support sock is knit on a multiple feed machine and in the present instance is described as being knit on a two-feed circular hosiery knitting machine having suitable needle selecting pattern mechanism so that the needles may be selectively raised to latch clearing level or remain in a lowered position wherein they do not pick up yarn at a yarn feed station. The stretch yarn S is fed at one station and all needles are raised to latch clearing level before the yarn is picked up and stitch loops are formed on each needle, throughout the knitting of the leg. The elastic yarn E is fed at the other station and every other needle is raised to latch clearing level to pick up and knit the elastic yarn while the other needles remain at a low level and do not pick up the elastic yarn so that floats are formed inside of these needles, during the knitting of the mock rib major portion of the leg. During the knitting of the courses while the calf area IIa is being knit, the needles in the half of the cylinder that knit the front half of the sock are raised in the 1 x 1 manner described to form mock ribs and the needles in the half of the cylinder that knit the rear half of the sock (commonly referred to as the heel needles) are all raised to pick up and knit the elastic and form non-rib fabric in this area.

The type and size of stretchable yarn S and elastic yarn E may be varied in accordance with the cylinder size and number of needles in the cylinder of the knitting machine to provide the desired degree of compressive force in the fabric or sock. As a non-limiting example, it has been found that a satisfactory support sock can be knit on a 108 needle machine by using 100/4 denier Supersoft stretch yarn S and a covered spandex elastic yarn formed with a 70 denier Lyca core wrapped with two ends of 70 denier Fluoron.

While it is preferred that the leg of the support sock be knit of alternating courses of a thermoplastic stretch yarn and an elastic yarn in the stitch construction described, it is possible to form a support sock in accordance with my invention by using different types of stretch or elastic yarns as desired. If the elastic yarn, knit in the special stitch in the intervening courses, has sufficient elastic power, a nonstretchable yarn may be knit in the alternate plain stitch courses.

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.

1. A man's support sock having a leg portion and a foot portion, the leg portion being of sufficient length to extend up to a point above the calf of the wearer, said leg portion comprising
(a) alternate courses of a first yarn and intervening courses of a second yarn,
(b) said first yarn being knit in every wale of the alternate courses throughout said leg portion,
(c) said second yarn being elastic and being knit in alternate wales and floated across intervening wales throughout the major portion of said leg, said knit and floated elastic yarn forming mock ribs in the major portion of said leg and cooperating with the first yarn to provide limited stretchability and a substantial compressive force on the leg of the wearer,
(d) said elastic second yarn being knit in every wale in an area at the rear of the leg adapted to engage the calf of the wearer, the calf area thereby having a non-rib plain knit appearance and having a greater length of elastic yarn incorporated therein to provide a greater degree of stretchability to the area of the sock adapted to engage the calf of the wearer;

2. A man's support sock according to claim 1 wherein the length of the elastic yarn per course and the size of the stitches are reduced from top to bottom of the leg portion to generally shape the fabric.

3. A man's support sock according to claim 1 wherein said first yarn is a thermoplastic stretch yarn and said elastic second yarn is a covered spandex yarn.

4. A man's support sock according to claim 1 wherein said first yarn is a thermoplastic stretch yarn and said second yarn is a covered spandex yarn.

5. A man's support sock according to claim 1 wherein a woven elastic band is attached to the upper end of the leg portion and provides a supporting top for the sock.

6. A man's support sock according to claim 1 wherein the plain knit rear calf area is rectangular and extends substantially half the distance on each side of the leg.
7. A man's support sock according to claim 6 wherein the walewise length of the rectangular rear calf area is one and one-third as great as the width thereof and the upper edge of the calf area is spaced downwardly from the top edge of the leg about one-third the length of the calf area.

8. A method of forming a man's support sock having leg and foot portions, said method comprising the steps of
   (a) knitting the leg portion while
   (1) knitting alternate courses of thermoplastic stretch yarn and forming stitch loops in every wale, and
   (2) knitting intervening courses of covered spandex elastic yarn and while forming stitch loops in every other wale and floats in the remaining wales of the intervening courses throughout the major portion of the leg, and while knitting the elastic yarn and forming stitch loops in every wale of an area at the rear of the leg adapted to cover the calf of the wearer, and
   (b) knitting the foot portion while knitting all courses of the thermoplastic stretch yarn.

9. A method according to claim 8 including the step of progressively increasing the tension on the elastic yarn during the knitting of the leg to reduce the diameter of the leg from top to bottom.

10. A method according to claim 8 wherein the sock is knit on a circular two-feed knitting machine and wherein the stretch yarn is fed at one feed station and forms stitch loops on every needle during the knitting of the leg portion, the elastic yarn is fed at the other feed station and forms stitch loops on alternate needles while floating inside of the intervening needles during a major portion of the knitting of the leg, and the elastic yarn being knit to form stitch loops on all of a group of adjacent needles during the knitting of the calf portion of the leg of the sock, and knitting the stretch only during the knitting of the foot of the sock.

References Cited

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Date</th>
<th>Inventor</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,050,535</td>
<td>8/1936</td>
<td>Martel</td>
<td>66-178</td>
</tr>
<tr>
<td>2,102,369</td>
<td>12/1937</td>
<td>Martel</td>
<td>66-172</td>
</tr>
<tr>
<td>2,142,157</td>
<td>1/1939</td>
<td>Seidel</td>
<td>66-172</td>
</tr>
<tr>
<td>2,574,737</td>
<td>11/1951</td>
<td>Goodchild</td>
<td>66-178</td>
</tr>
<tr>
<td>2,702,998</td>
<td>3/1955</td>
<td>Purcell</td>
<td>66-178</td>
</tr>
<tr>
<td>3,064,456</td>
<td>1/1962</td>
<td>Bird</td>
<td>66-178</td>
</tr>
<tr>
<td>3,166,922</td>
<td>1/1965</td>
<td>York et al.</td>
<td>66-172</td>
</tr>
<tr>
<td>3,216,223</td>
<td>11/1965</td>
<td>Margulies</td>
<td>66-178</td>
</tr>
<tr>
<td>3,301,018</td>
<td>1/1967</td>
<td>Knohl</td>
<td>66-178</td>
</tr>
</tbody>
</table>

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