Feb. 19, 1963 F. E. BOBO, JR., ET AL 3,077,757

SUPPORT STOCKING

Filed Dec. 7, 1960 3 Sheets-Sheet 1

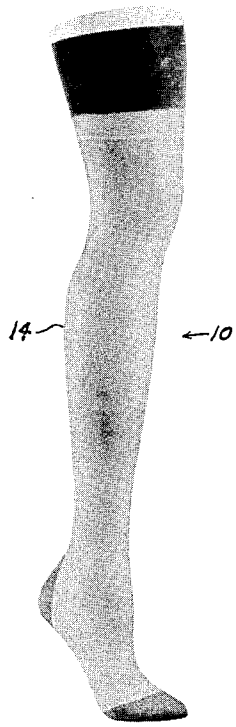


Fig. 1

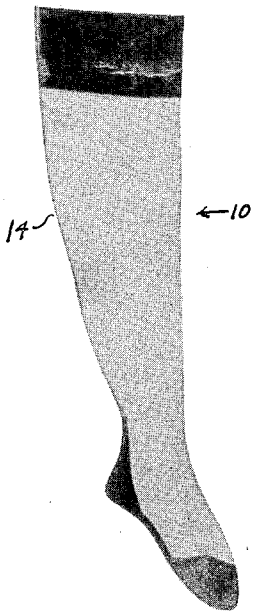


Fig. 2

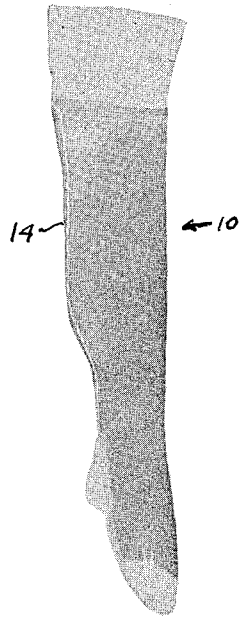


Fig. 3

Inventors,
FRANK E. BOBO, JR. &
ROBERT M. MATTHEWS

By Warley L. Parrott

Attorney

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SUPPORT STOCKING

Filed Dec. 7, 1960 3 Sheets-Sheet 2

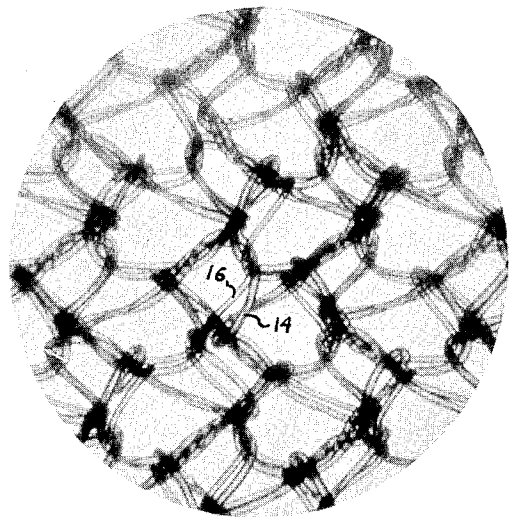


Fig. 4

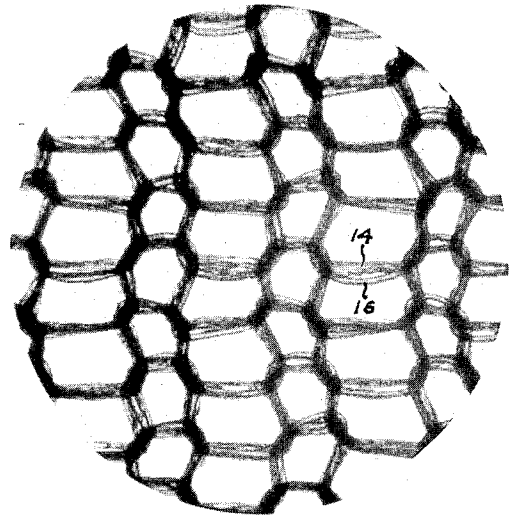


Fig. 5

Inventor
FRANK E. BOBO, JR &
ROBERT M. MATTHEWS
By Warley L. Parrott
Attorney

Feb. 19, 1963 F. E. BOBO, JR., ET AL 3,077,757

SUPPORT STOCKING

Filed Dec. 7, 1960 3 Sheets-Sheet 3

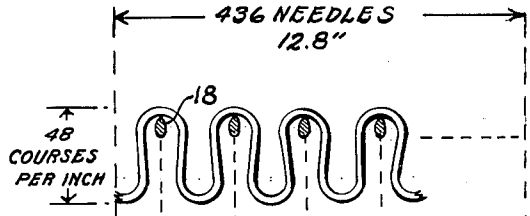


Fig. 6

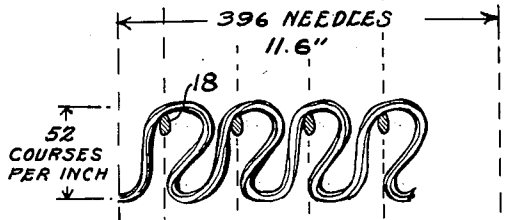


Fig. 7

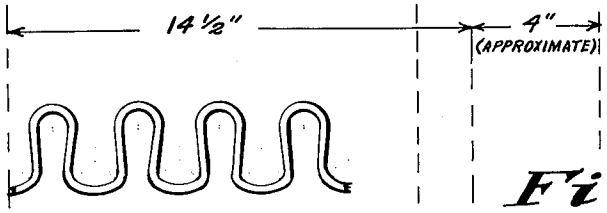


Fig. 8

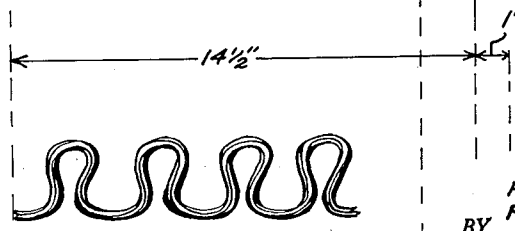


Fig. 9

INVENTORS
FRANK E. BOBO, JR. &
ROBERT M. MATTHEWS
BY
Warley L. Parrott
ATTORNEY

United States Patent Office

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SUPPORT STOCKING

Frank E. Bobo, Jr., and Robert M. Matthews, Charlotte, N.C., assignors to Chadbourn Gotham, Inc., a corporation of North Carolina

Filed Dec. 7, 1960, Ser. No. 74,369
3 Claims. (Cl. 66—178)

This invention relates to support stockings and more particularly to support stockings that provide a support effect comparable or superior to other types of support stockings and yet are markedly sheerer and less expensive than prior support stockings.

Therapeutic support stockings have been made for many years for use in relief of discomfort from varicose veins and for numerous other purposes. Most of these prior support stockings have been made of rubberized yarn with the resiliency of the rubber being relied on to cause the stocking to contract about the leg of the wearer. To obtain sufficient contractive force these rubberized yarns have been made relatively heavy and have been knit in a relatively dense fabric construction. This results in a stocking having a thick, non-sheer appearance that is obviously undesirable, and also is relatively expensive due to the cost of the rubberized yarn and the difficult problems of knitting with rubberized yarn.

In recent years attempts have been made to overcome the objectionable features of support stockings made of rubberized yarn, not only so that they would be more acceptable to those having particular leg problems, but also so that they would be acceptable to persons who do considerable walking or standing and would benefit by wearing a support type stocking even though they may not have a specific leg ailment. Some of the recent stockings are made without rubberized yarn, utilizing instead a plurality of lively, torque yarns in each course. These lively, torque yarns, although not elastic in themselves, form stitches that, due to the liveliness and torque of the yarns, are distorted when in the relaxed state and have a relatively strong tendency to retract when stretched onto a leg, thereby providing a contractive force somewhat equivalent to the resilient pull of a rubberized yarn stocking. To obtain the contractive force necessary for support purposes, these lively, torque yarn stockings require the use of a plurality of at least three or more yarn ends in each course with the result that the stocking is not as sheer as conventional stockings and is much more expensive to produce because of the cost of twisting the plurality of yarn ends and the difficulty of controlling the knitting of a plurality of ends in each course.

The support stocking of the present invention overcomes the above disadvantages in that it resembles a conventional non-support stocking in sheerness and appearance when worn, and yet provides a supporting force greater than that of stockings made of a plurality of lively, torque yarns. Further, the cost of the stocking of the present invention is substantially less than the cost of rubberized yarn stockings because of the difference in yarn cost, and also is substantially less than the cost of other types of prior support stockings made of a plurality of lively torque yarns because of the reduced number of yarn ends and particularly twisted yarn ends, and the reduction of yarn control problems during knitting.

These advantages are obtained in the present invention by restricting the extended width of the stocking so that when the stocking is worn the stitches are substantially fully distended, thereby imparting a strong supporting force against the leg of the wearer to retain the leg within the limited circumference of the stocking. As the compressive effect provided by this stocking is obtained by full distention of the stitches, it is not necessary to use a

rubberized resilient yarn or even a plurality of lively torque yarns to provide a sufficient contractive force. Rather, by the present invention, an excellent support stocking can be made of suitable strength with significantly improved sheerness, using only two ends of yarn in each course.

The full distention of stitches of the stocking when worn can be obtained by the combination of knitting the stocking to a narrow knitted width so that there are fewer loops to be distended when the stocking is stretched onto the leg, and by knitting a tight stitch formation so as to reduce the height of each loop and thereby reduce the amount of yarn that can be distended in each loop. The tight stitch formation and narrow knitted width cofunction and are integrally controlled to produce full distention of the stocking when worn.

This invention is applicable to both torque and non-torque yarns as it is the stitch distension rather than the type of yarn that produces the desired results. A lively torque yarn may be used to provide a snug fit of the stocking on the narrow portions of the leg, such as at the ankle, and to facilitate pulling the ankle portion over the instep of the wearer. Both of the yarns may be a torque yarn or one of the yarns a torque yarn and the other a raw yarn, in which case, in order to obtain desired lengthwise stretch characteristics, the raw yarn should be of a lesser denier than the torque yarn so that the raw yarn will not prevent the torque yarn from retracting the stocking in the relaxed condition.

Although the type of yarns may be varied, the strength of the yarns should be sufficient to prevent elongation or bursting of the yarn when worn. Normally sufficient strength is obtained if the total of the deniers of the two yarns in each course is about 45 or more; for example, a 30 denier torque nylon yarn and a 15 denier raw nylon yarn. This provides a very sheer appearance in comparison with prior support stockings. If the two yarns used are of a total denier substantially less than 45, the force of the leg against the fully distended stocking will elongate the yarns themselves, thereby increasing the circumference of the stocking when worn and reducing its supporting effect.

In one embodiment of the present invention the support stocking is made with one end of 30 denier monofilament, synthetic polyamide resin (nylon) thermoplastic yarn having a twist-torque equivalent to 15 to 50 turns per inch with a liveliness factor of about 5 to 20 (determined in accordance with the device and procedure disclosed in U.S. Patent No. 2,295,593, issued September 15, 1942, to John Blanchard Miles, Jr.). The other end is a 20 denier raw, monofilament, synthetic, polyamide resin (nylon) thermoplastic yarn that is knit in an untwisted state.

It has been found by comparison tests that support stockings made according to the present invention with the above described 30 denier torque yarn and 20 denier raw yarn provides a supporting effect of approximately 35% greater compressive force at the calf of a standard size leg than a commercial multiple-end support stocking that uses four ends of 15 denier yarn for a total of 60 denier in each course. Further, due to the lower total denier and particularly the use of only two ends, the support stocking of the present invention is much more sheer than that of prior multiple-end support stockings and actually approaches in sheerness a conventional non-support stocking.

Although in the embodiment described above the raw yarn is a monofilament, yarn, it can also be a multifilament yarn. Similarly the present invention is applicable to both full-fashioned and seamless stockings. In the case of seamless stockings, however, it is difficult to

reduce the knitted width of the fabric as present commercial circular knitting machines usually knit only a single width. Therefore control of the tightness of the stitch is principally relied on to produce full stitch distention when worn.

In knitting a seamless stocking, where the knitted width is substantially uniform, the use of raw yarn as one of the ends is particularly advantageous as it will shrink during processing so that when the stocking is boarded the raw yarn will draw the stocking into the shape of the form.

These and other features and advantages of the present invention will be apparent from the following description and drawings in which:

FIG. 1 is a side elevational view of a leg form having thereon a lady's full-fashioned support stocking of the present invention;

FIG. 2 is a side elevational view of a lady's full-fashioned support stocking of the present invention in flat relaxed condition after finishing and boarding;

FIG. 3 is a side elevational view of a lady's full-fashioned support stocking of the present invention in flat relaxed condition before finishing and boarding;

FIG. 4 is an enlarged fragmentary view of a portion of the stocking of FIG. 2 in relaxed condition;

FIG. 5 is an enlarged fragmentary view of a portion of the stocking of FIG. 2 stretched to a substantially fully distended switch configuration that occurs when the stocking is worn;

FIG. 6 is a diagrammatic representation of a section of the calf portion of a conventional non-stretch stocking including a representation of the stitch configuration when the stitches are being knitted on the needles, and designating the relaxed width of the stocking;

FIG. 7 is a view similar to FIG. 6 illustrating the preferred embodiment of the present invention;

FIG. 8 is a view similar to FIG. 6 showing the calf portion of the conventional stocking of FIG. 6 extended to its worn width and in addition designating the width at which the stitches are fully distended; and

FIG. 9 is a view similar to FIG. 8 but illustrating the preferred embodiment of the present invention.

The attractive appearance of the support stocking of the present invention is clearly apparent in FIG. 1, which illustrates the stocking substantially as worn. The sheerness and general appearance of the support stocking of the present invention are comparable to the sheerness and appearance of a conventional stocking and do not have the thick unattractive appearance of other types of therapeutic and support stockings. It should be noted that the stocking used in FIG. 1 was dyed a comparatively dark shade so that the stocking would be clearly visible in the photographs of FIGS. 1 and 2, although the sheerness would be more apparent if the stocking had been dyed a lighter shade. Similarly it was deemed necessary to place a dark insert in the corresponding greige stocking of FIG. 3 in order to make it visible in the drawing. The shape of the stocking in the greige state of FIG. 3 is determined by the type of yarn, such as torque or plain; the knitted width; the size of the stitches during knitting, which can be measured by the number of courses per inch; and the knitted length of the stocking. The stocking shown in FIG. 3 is only representative as satisfactory results can be obtained by varying these factors. If all non-stretch yarns are used in place of the one torque-one raw yarns of the illustrated embodiment, the relaxed length and width would be somewhat greater, but full stitch distention would occur at the same worn width. If the courses per inch are reduced during knitting, thereby increasing the size of the stitches, either the knitted width or the total number of courses or both can be reduced so that stitch distention will occur at approximately the same extended width. If the knitted width is increased, the courses per inch can be increased to tighten the stitches and compensate for the increased width so that the fully distended width will be the same. Thus, for a selected type of yarn or combination of yarns and a selected knitted length, the knitted width can be varied without reducing the support characteristic of the stocking by suitable control of the stitch sizes, and, conversely, the stitch sizes can be varied without reducing the desired support effect by making suitable adjustment of the knitted width.

For obtaining desired support characteristics the stocking of the present invention is designed with relation to the leg and particularly the calf of the leg of the wearer. The welt and reinforced foot portions may be of any desired yarn construction and of conventional size and shape, as it is the particular construction, size, and yarn in the calf portion that produces the support features of the present invention.

In the embodiment of FIGS. 1 through 5, the calf portion **12** of the stocking **10** is made with one end **14** of 30 denier monofilament, synthetic resin thermoplastic torque yarn and a second end **16** of 20 denier, monofilament, synthetic resin thermoplastic raw yarn.

The arrangement of the torque yarn **14** and raw yarn **16** in stitches is shown in the enlargements of FIGS. 4 and 5. The torque end **14** has a twist-torque equivalent to from 15 to 50 turns per inch produced by any conventional heat setting and twisting or similar process to impart a torque having a liveliness factor of about 5 to 20. To prevent "spiralling" of the stocking due to the tendency of the torque yarn to incline the stitches and thereby twist the stocking, torque yarns of opposite twist are used in alternate courses or alternate groups of courses. The raw yarn **16** has no twist other than the usual producer's twist of a half turn per inch more or less.

When the stocking is in the relaxed state, illustrated in FIG. 4, the torque yarn inclines the stitches and thereby contracts the stocking, but upon stretching of the stocking onto the leg of the wearer the stitches are pulled upright and are fully distended by the widthwise and lengthwise extension of the stocking into a configuration such as that illustrated in FIG. 5.

The knitted width of the calf portion of this stocking is reduced in comparison with the corresponding width of conventional stockings and the yarn is knit with tighter stitches than in knitting conventional stockings. As the spacing of the needles on a conventional machine cannot be varied, tightening of the stitches does not change the number of stitches per inch in a coursewise direction but rather reduces the height of each stitch, thereby increasing the number of stitches per inch in coursewise direction. The reduced knitted width decreases the number of stitches in each course and the decreased stitch size reduces the amount of yarn in each stitch and therefore in each course. Thus the reduced width and decreased stitch size cofunction to reduce the amount of yarn that can be extended, thereby producing substantially full stitch distention when the stocking is worn. Due to the fact that leg sizes vary substantially, it has been found practical to control width and stitch size so as to produce a stocking wherein full stitch distention occurs at a width slightly greater than the width of a standard size leg.

Another factor affecting stitch configuration and the width at which the stitches are fully distended is the knitted length of the stocking. The worn length is standardized for particular leg sizes, and if the knitted length is less than standard the stocking will be stretched more lengthwise with the result that the stitches will be pulled more lengthwise into taller stitches leaving less yarn in each stitch for widthwise extension. Conversely, if the knitted length is increased the stitches will be pulled a lesser amount lengthwise and each stitch will be shorter leaving more yarn for widthwise extension.

As a result, the knitted width and stitch size can also be related to the knitted length of the stocking to obtain full stitch distention at a desired worn width of the

stocking. Normally it is desirable to maintain a knitted length that is within a few inches of a standard length and in practical manufacture a desired knitted length is selected and the knitted width and stitch size are controlled to produce full stitch distention at that knitted length.

In a typical example of the preferred embodiment of the present invention, a size 10½ medium support stocking, which has a selected length of 30" when measured on a Du Pnot volume leg form, is knit on a 51 gauge full-fashioned knitting machine starting with a welt knit on the same number of needles, 476, as are used in the welt of a conventional 15 denier non-stretch stocking of the same size, which has a flat leg length of 32". After the welt is knit, 20 flare narrowings are made at the top of the leg portion, as compared with 10 flare narrowings in the above mentioned conventional non-stretch stocking of the same size. These flare narrowings reduce the needles to 396 in the support stocking as compared with 436 in the conventional stocking. Thus the leg is knit at a width that is 91% of the knitted width of a conventional stocking. Both of these stockings are intended to be worn on a standard size leg, which has been determined by the National Association of Hosiery Manufacturers to have a maximum calf circumference of 14½". The difference in narrowings between the leg portions of the conventional stocking and the stocking of the present invention may be compensated for so that the ankle will be substantially conventional size and will fit over the instep of the wearer, by utilizing less leg narrowings at the ankle in the support stocking than in the conventional stocking.

In addition to reducing the knitted width, which reduces the total number of stitches in each course, the size of the stitches are reduced to reduce the amount of distendable yarn in each stitch. As the stocking is knit on a conventional 51 gauge machine the width of each stitch will be the same as the width of a conventional stitch. Thus, reducing the stitch size reduces the height of each stitch, which results in less yarn available to be pulled out coursewise when the stitches are distended, thereby producing full stitch distension at a relatively narrow width.

The size of the stitches may be controlled by adjusting the depth of the needles with respect to the sinkers. The stitch size is measured in terms of the stitches per inch as the fabric is leaving the needles. In the stocking of the present invention for a size 10½ medium the stitch size is such as to produce 52 courses per inch as compared with 48 courses per inch in the 15 denier non-stretch conventional stocking. Although this does not appear to be a substantial difference in stitch size, the significant difference between 15 denier conventional yarn and the composite 50 denier yarns of the support stocking makes this difference substantial, as heavier yarn requires comparatively larger stitches to produce the same looseness or tightness as with a lighter yarn.

The size 10½ medium support stocking is knit with a total of 2,258 courses of which 1,138 courses are in the leg portion. This produces a stocking of a length of 30 inches. A conventional 15 denier, non-stretch stocking of the same size that is presently in commercial production is knit with 2,220 total courses with 1,070 courses in the leg. This conventional stocking is knit to a length of 32 inches.

As a result of the narrowed knitted width and decreased stitch size the stocking of the present invention has substantially fully distended stitches when the stocking is worn, whereas the conventional stocking can be extended substantially beyond the worn width before the stitches are fully distended.This difference is illustrated in FIGS. 6 through 9 of the drawings. FIG. 6 shows diagrammatically the size of the loops knit for a conventional non-stretch stocking, such as that described above, and indicates a representative knitted width of a section of the calf portion of the stocking. In comparison, FIG. 7 illustrates the size of the loops of the present support stocking, which are seen to be of the same width as the conventional loops of FIG. 6 as the spacing between needles 16 is the same, but the loops are of considerably lesser height. In addition, these loops are inclined due to the liveliness of the torque yarn component. It is seen from a comparison of FIGS. 6 and 7 that the knitted width of the calf portion of the support stocking is less than the knitted width of the conventional stocking. As explained above, the support stocking is knitted to a width of about 91% of the width of the conventional stocking.

FIG. 8 illustrates the loop configuration of the conventional stocking when stretched to the worn length and designates the worn width as well as the additional width to which the stocking can be extended to produce full distention of the stitches. Thus it is noted that full distention does not occur at or near the worn width. The conventional stocking described previously is capable of extension of approximately 4" beyond the worn width to produce full stitch distention. In comparison, FIG. 9 illustrates the loop configuration of the present invention when the stocking is worn wherein the stitches are substantially fully distended as seen in FIG. 5. FIG. 9 also indicates the worn width and the width at which the stitches are fully distended. In this case full distention occurs at from one to two inches beyond the worn width, which is from 25 to 50% less than the difference between the worn and fully distended width of the conventional stocking. It would be preferable to have full stitch distention at the worn width, but as the actual sizes of different legs are not standard, it is necessary that the width be slightly greater than desired for the standard size so that the stocking will fit slightly oversized legs.

As the stitches in the stocking of the present invention are substantially fully distended when worn the yarn itself must withstand the pressure of the leg of the wearer to avoid further extension that would elongate the yarns themselves. Sufficient strength has been obtained by using yarns in each course having a total denier of approximately 45. In the example described above the 30 denier torque yarn and the 20 denier raw yarn combine to a total of 50 denier, which provides satisfactory results.

The supporting strength of the above described example of the present invention is apparent from a comparison test made using the pressure gauge testing apparatus described in the specification of Patent No. 2,883,842 with the stockings mounted for testing on a standard size leg form that has been developed by the National Association of Hosiery Manufacturers as being representative of the average leg measurements of 10,000 American women. Using the apparatus referred to in the above patent, a stocking providing optimum support will indicate a reading of 18–24 millimeters of mercurcy. The stocking of the preferred embodiment of the present invention described above has a supporting strength when worn equivalent to 23 mm. of mercury when tested on the above device. A commercial support stocking of the multiple-end type that has four ends of 15 denier torque yarn and that obtains supporting strength from the retractability of the stitches of torque yarn produces a comparative force of only 17 mm. of mercury. Thus the stocking of the present invention provides approximately 35% more supporting strength than prior commercial support stockings.

The present invention has been described above for purposes of illustration only and is not intended to be limited by this description or otherwise except as defined in the appended claims. It should be understood that, although the above description and the following claims recite the invention in terms of stockings, the scope of the present invention is not intended to be limited to stockings as it is applicable as well to other garments

where support is desired and to other uses of fabrics where it is desired to apply a supporting force to an object over which the fabric is extended.

We claim:

1. A knitted support stocking comprising courses having in each course a synthetic, preset, lively torque yarn of approximately 30 denier and another synthetic yarn of approximately 20 denier with the torque yarn in alternate groups of courses having opposite twist-torques, said other yarn having been raw when knit and having shrunk substantially when heated and boarded during finishing to produce substantial circumferential compression when the stocking is worn, the leg portion of said stocking being knit to a restricted width measured while on the knitting machine of approximately 10% less than the width of the leg portion of a conventional stocking for the same size leg so that when worn on the intended size leg the stitches in the leg portion of the stocking are substantially fully distended and will resist further widthwise distention and thereby exert a substantial compressive force against the leg of the wearer.

2. A knitted support stocking comprising courses having in each course a synthetic, preset, lively, torque yarn of approximately 30 denier and another synthetic yarn of approximately 20 denier with the torque yarn in alternate groups of courses having opposite twist-torques, said other yarn having been raw when knit and having shrunk substantially when heated and boarded during finishing, the leg portion of said stocking being relatively tightly knit at a limited width as compared with the tightness and width of the leg portion of a conventional stocking for the same size leg so that when worn on the intended size leg the stitches in the leg portion of the stocking are fully distended and will resist further widthwise distension and thereby exert a substantial compressive force against the leg of the wearer.

3. A knitted support stocking comprising courses having in each course a synthetic, preset, lively, torque yarn of approximately 30 denier and another synthetic yarn of approximately 20 denier with the torque yarn in alternate groups of courses having opposite twist-torques, said other yarn having been raw when knit and having shrunk substantially when heated and boarded during finishing to produce substantial circumferential compression when the stocking is worn, the leg portion of said stocking being knit to a restricted width measured while on the knitting machine of approximately 10% less than the width of the leg portion of a conventional stocking for the same size leg and the leg portion of said stocking being relatively tightly knit as compared with the tightness of a conventional stocking for the same size leg so that when worn on the intended size leg the stitches in the leg portion of the stocking are substantially fully distended and will resist further widthwise distention and thereby exert a substantial compressive force against the leg of the wearer.

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