May 11, 1948. N. B. REED 2,441,443

ELASTIC GARMENT

Filed July 29, 1942 3 Sheets-Sheet 1

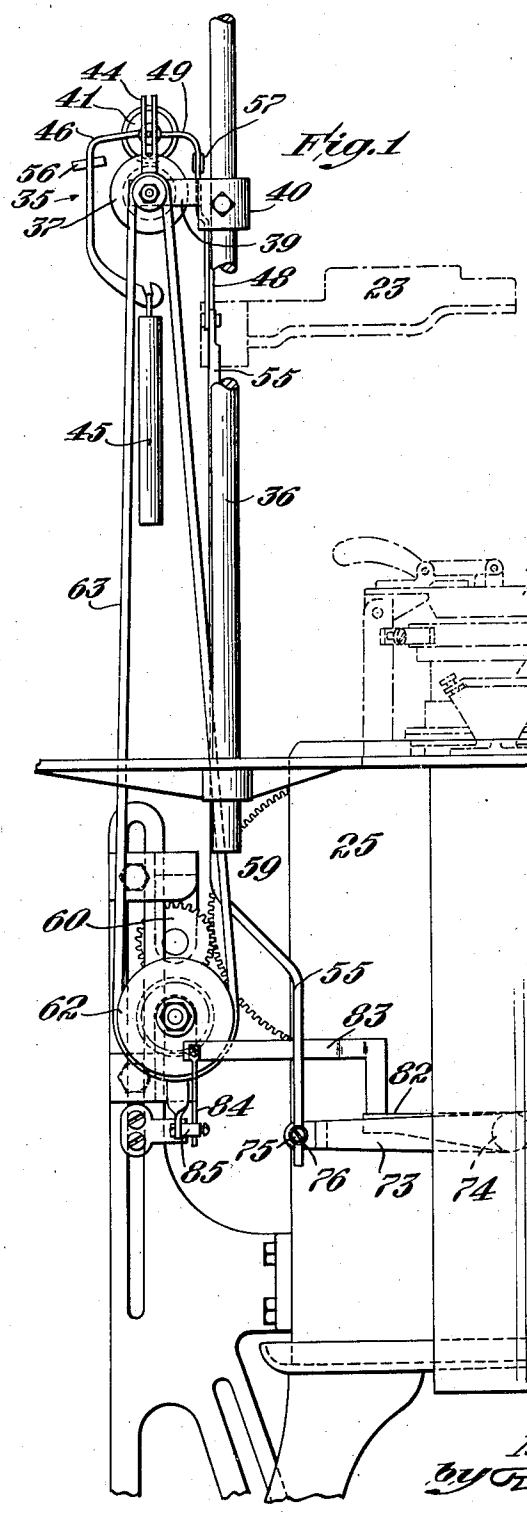


Fig. 1

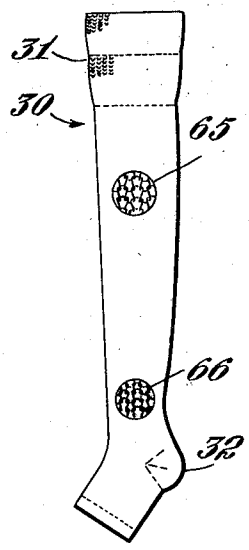


Fig. 6

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May 11, 1948. N. B. REED 2,441,443

ELASTIC GARMENT

Filed July 29, 1942 3 Sheets-Sheet 2

Fig. 5

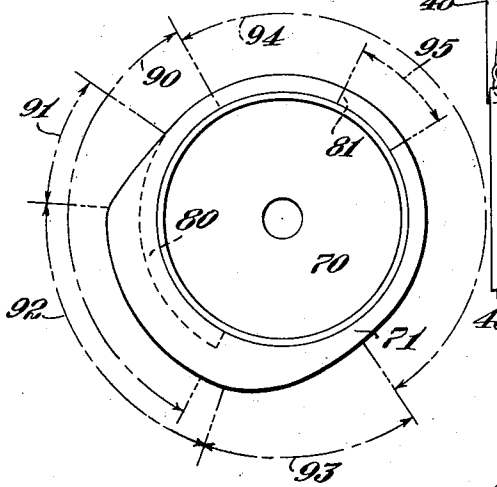


Fig. 2

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May 11, 1948. N. B. REED 2,441,443

ELASTIC GARMENT

Filed July 29, 1942 3 Sheets-Sheet 3

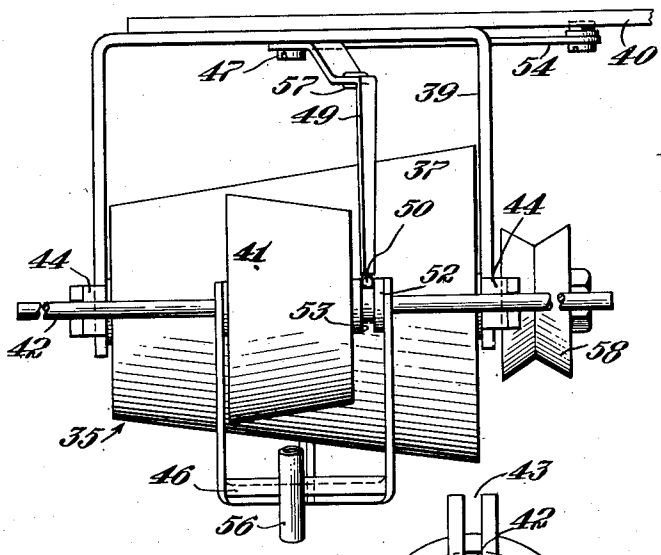


Fig. 3

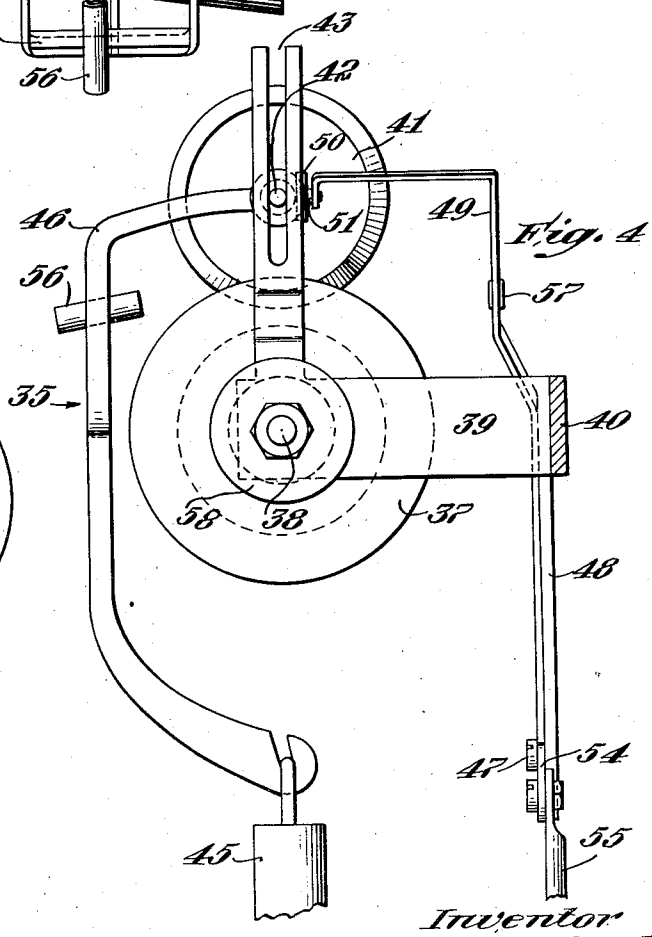


Fig. 4

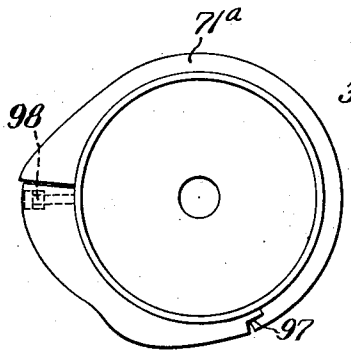


Fig. 7

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UNITED STATES PATENT OFFICE

2,441,443

ELASTIC GARMENT

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Application July 29, 1942, Serial No. 452,688

5 Claims. (Cl. 66—183)

1

This invention pertains to seamless elastic garments, for specific example stockings, and to a method of making such garments, the present application being a continuation-in-part of my copending application Serial No. 265,710, filed April 3, 1939, upon which Patent No. 2,300,808 issued November 3, 1943.

Elastic garments, for instance girdles, abdominal belts, stockings and the like are used for supporting, constricting or shaping various parts of the body, thus for instance elastic stockings are worn for their remedial effect and to relieve the discomfort of varicose veins. Since the contour of the body parts varies, for instance the leg varies in transverse section from the thigh to the ankle, it is necessary to shape the constrictive garment accordingly, but in so doing care must be exercised lest the variation in diameter of the garment be accompanied by an undesired variation in the constrictive force which the garment exerts. In most instances it is desired to maintain a substantially constant degree of constrictive force at all parts of the garment, for example at the calf and ankle portions of a stocking although such portions vary greatly in diameter.

Heretofore elastic stockings having the desirable characteristics of uniformity of constrictive effect have only been made on flat knitting machines having mechanism for fashioning the stocking and when completed such stockings have a heavy back seam and a bulky, clumsy appearance. Although attempts have been made to knit seamless elastic stockings it has heretofore been impossible to make such stockings (having a uniform constrictive effect) on circular knitting machines due to the fact that the shape of such seamless stockings is accomplished by varying the stitch length. Thus if elastic yarn be employed, the variation in stitch length results in a stocking which is either too tight to be comfortable at the calf portion or else is very loose, baggy, and exerts no constrictive effect at the smaller parts of the leg.

In order that an elastic garment may provide the characteristic constrictive effect desired, it is necessary that the elastic yarn be stretched or elongated by tensioning it before it is fed to the knitting needles, otherwise the stocking would have little more constrictive effect than any other stocking.

In accordance with the usual method of making circular knit stockings, the yarn tension results solely from the draft of the needles, the yarn being retarded on its way to the needles

2

by passing through friction or other tensioning means. The yarn is thus subjected to greater pull or drag when making long stitches than when making short stitches. If elastic yarn be delivered in this way, the yarn which forms that portion of the stocking in which the stitches are long will be stretched more per unit of length than the yarn which forms the shorter stitches. The result, as above noted, is that if the long-stitch calf portion of the stocking be knitted to provide the desired constrictive effect, the ankle portion will be loose and with little, if any, constrictive effect. On the other hand, if the ankle fit properly, then the calf portion will be uncomfortably tight.

The present invention has for its principal object to provide a seamless elastic garment in which the knitted stitches themselves consist of or include the elastic yarn and which may be of variable diameter or cross-sectional contour and wherein, if desired, substantially the same degree of constrictive effect will be provided at each point in the length of the garment or which may, if desired, alternatively, exert lesser constrictive effect at its larger portion than at smaller portions.

A further object is to provide a novel method of producing seamless elastic garments having the above desired characteristics and in an expeditious and inexpensive manner, and which may be carried out, if desired, upon circular stocking knitting machines of standard types with but slight modifications thereof.

In accordance with the present invention the elastic yarn is fed to the needles at a rate such that, regardless of the stitch length, the elongation of the yarn per unit of length is substantially constant throughout the entire length of the garment. To this end the yarn is positively advanced to the needles at a predetermined variable rate such as to provide the proper length to form each stitch loop independently of variations in stitch length due to varying needle draft. In this way the resultant seamless article may be made to exert substantially uniform constrictive pressure when in use at each point in its length or, in other words, the article offers substantially equal resistance to expansion at all points. Alternatively, if desired, it may be made to exert different but definite predetermined constrictive force at different portions of its length.

The following description sets forth the novel method of attaining such control and the product of that method. As one means useful in performing this method there is also described a

device adapted to be attached to a knitting machine of conventional type, and in order to facilitate an understanding of this invention there are presented herewith drawings in which

Figs. 1 and 2 are side and rear elevations respectively of a knitting machine to which has been attached a device by which the method of this invention may be performed;

Figs. 3 and 4 are views in plan and side elevation of the device shown in Figs. 1 and 2;

Fig. 5 is an enlarged elevation of a cam drum;

Fig. 6 is a view of a stocking embodying this invention and made in accordance therewith; and

Fig. 7 is a diagrammatic view illustrating a yarn tensioning cam of preferred contour.

This invention has been shown in the drawings and will be described as employed in making fashioned seamless stockings. It will be understood that this type of garment has been selected as illustrative and that the invention is not thus limited thereto.

For the purpose of illustrating the invention there is shown on Figs. 1 and 2 a knitting machine 20 of a suitable well known type whereby fashioned seamless stockings are made. Such machine 20 comprises a knitting cylinder 21, a sinker head 22 and a yarn guiding top 23, which elements are shown in dotted lines since they carry out their intended function without regard to the application or omission of this invention.

It is understood that in the making of these stockings the length of the stitches are varied, being longest at the widest part, i. e., the top, and shortest at the narrowest part. This change in the length of the stitches is carried out by pattern mechanism which is enclosed within the base 25 and is not shown in detail, since it forms no part of the present invention. Whatever type of mechanism be employed, it includes a shaft 26, known as the pattern drum shaft which is driven intermittently and completes a single rotation as each stocking is knit.

In the manufacture of the stocking 30 shown in Fig. 6, which embodies this invention, elastic yarn is used, except at the top 31 and heel 32, with or without other yarn. The "elastic" yarn herein referred to is "rubber elastic" yarn, that is to say yarn having the characteristic stretch of yarn consisting of rubber or having a rubber core, but it is to be understood that the yarn employed does not necessarily comprise natural rubber. If ordinary yarn be knitted in with the elastic yarn to form the knitted stitches in the elastic portions of the garment, such ordinary yarns will be delivered in the usual way and by usual tensioning and guiding elements (not here specifically shown). The elastic yarn likewise must be at all times knitted under tension. In order that the constrictive force exerted by the stocking when in use may be uniform the amount of elastic yarn comprised in each stitch must vary from course to course, the length of elastic yarn per stitch bearing a varying predetermined relation to the length of ordinary yarn per stitch where both elastic and ordinary yarns are employed, or to the length of ordinary yarn which would normally form the corresponding stitch if the stitch were knitted from ordinary inelastic yarn alone.

This control of the tension or rate of yarn delivery is attained by a device 35 to which the elastic yarn is fed from the usual bobbin stand (not shown) supported by a rod 36. The device 35 includes a pair of conical rollers 37 and 41 arranged in reverse positions (see Fig. 3). The lower roller 37 is keyed to a shaft 38 supported at

the ends of the roller in bearings carried by the arms of a yoked bracket 39 mounted upon a bar 40 adjustably secured to the rod 36. The roller 41 is carried on a shaft 42, the ends of which are received in slots 43 of vertical posts 44 supported by the bracket 39. The posts 44 are here shown as integral with the arms of the bracket but they may be separate elements suitably secured thereto. The upper roller 41 rides upon the lower roller 37 and is held yieldably in contact therewith both by the action of the force of gravity and by a weight 45 depending from a yoke 46 which is suspended from the shaft 42, the arms of the yoke 46 enclosing the roller 41. Pivoted upon a pin 47 carried by an arm 48 depending from the bracket 39 is a right angle lever, the arm 49 of which is substantially horizontal (Fig. 3) and carries at its free end a short rod 50 pivotally attached thereto by a pin 51. Fixed on the shaft 42 is a collar 52 having a central peripheral groove 53 which receives the rod 50. Fixed to the other arm 54 of the lever is a rod 55 by which, as will be set forth below, the lever is rocked and the upper roller 41 shifted along the roller 37.

The yarn is guided between the rollers by a tube 56 carried by the yoke 46 and an eye 57 in the lever arm 49. The roller 37 is positively driven by means to be described, through a pulley 58 on the shaft 38, and the roller 41 resting upon the roller 37 is moved by such contact in unison therewith, thus advancing the yarn.

Mounted in the base 25 is a drive gear 59 which, through an idler gear 60, drives a gear 61. The gear 61 in turn rotates a pulley 62, in line with the pulley 58, and connected therewith by a belt, cable or the like 63. The gear 61 acts through a clutch which includes a slidable clutch collar 64.

From the above description it will be apparent that the length of elastic yarn which is comprised in each stitch is controlled by the device 35. In the stocking 30 (Fig. 6) the area designated by the numerals 65 and 66 shows the long stitch employed at the calf and the short stitch employed at the lower smaller part of the stocking and the foot. The rate at which the elastic yarn is fed depends upon the speed of travel of the surface of the roller 37 against which the yarn is held by the roller 41. The location of the yarn is determined by the positon of the roller 41 which is moved longitudinally of the roller 37 by the following means, so that the amount of the elastic yarn supplied per stitch is varied.

Mounted upon a cup-like cam drum 70 fixed to the intermittently driven pattern drum shaft 26 is a continuous cam 71 upon which rests the tip 72 of one end of a lever 73. The lever 73 is fulcrumed at a point intermediate its ends upon a stud 74 projecting from the base 25. The other end of the lever 73 is connected to the lower end of the rod 55 by a swivel pin 75 having an opening therein which receives the rod, and a set screw 76 by which the rod is secured in place. The lever 73 is thus actuated by the rotation of the cam 71 to shift the roller 41 longitudinally of the roller 37.

When those portions of the stocking, where the elastic yarn is not used, are being made, the feed of the yarn is cut off by shifting the clutch collar 64 to disengage the clutch, i. e. to the right in Fig. 2. This shifting is automatically controlled by the pattern drum shaft 26 through the provision of cams 80 and 81 on the drum 70 and a lever 82, one end of which rests normally upon the surface of the drum in the path of the cams 80 and 81 and is raised thereby. The lever 82 is fulcrumed upon

the stud 74 and connected at the other end through an extension 83 and link 84 to one arm of a right angle lever 85. The other arm of the lever 85 rides in the central groove 86 of the collar 64. Hence when the lever 82 is actuated by one of the cams 80, 81, the clutch is disengaged so that the roller 37 of the device 35 is no longer driven to feed the elastic yarn.

The operation of the elastic yarn control device 35 during the knitting of the stocking 30 (Fig. 6) is as follows: Let it be assumed that the drum 70 is in such position that the lever 82 has been tripped by the cam 80 so that the device 35 is at rest. Until the drum 70, which, under the control of the pattern mechanism, moves intermittently in the clockwise direction, as shown in Figs. 1 and 5, has traveled through the period 90, the elastic yarn is not fed, at which time the top 31 of the stocking is being made. While the drum is moving through the period 90 the cam 71 actuates the lever 73 to shift the roller 41 to the right in Fig. 3 during the period 91. The roller is held in that position during the period 92. The period 90, however, terminates before the period 92, so that the feed of the elastic begins while the roller 41 is so shifted. After passing the period 92 the cam 71 during the period 93 allows the roller 41 to return slowly to the position shown in Fig. 3, thus reducing gradually the amount of yarn fed by the device. As the drum travels through the period 94, the amount of yarn fed remains uniform. The cam 81, which acts during the period 95, cuts off the supply of elastic yarn as the heel 32 of the stocking is being knitted.

From the above description it will be apparent not only that no elastic yarn is fed while the top 31 and heel 32 are being knitted, but also that, as the length of the stitches is changed, the amount of elastic yarn delivered to the needles in forming successive stitches is also changed, but in a ratio which varies with respect to the stitch length, thereby to produce a stocking which exerts a substantially uniform constrictive force throughout its length when in use.

In Fig. 7 a yarn tensioning cam of a slightly different and preferred contour is illustrated. The active portion 71a of this cam comprises the riser period 91 which acts to shift the roller 41 to the right as viewed in Fig. 3, thus moving the roller to the position corresponding to the maximum stitch length. During the period 94 the roller 41 is permitted to move gradually to the left while the thigh portion of the stocking is being fashioned. During the period 95 the roller 41 remains substantially in the same position as at the end of the period 94, but during the period 96 it begins to shift to the right again for increasing the diameter from the knee toward the calf and then during the period 93 the roller 41 slowly shifts to the left so as to diminish the amount of yarn delivered per stitch toward the ankle portion of the stocking. If desired, the cam 71a may be pivoted at 97 and provided with an adjusting screw 98 whereby the tension at the upper part of the thigh may be varied.

While as above suggested it is desirable in most cases to deliver the elastic yarn to the needles at such a rate that, regardless of the stitch length, the garment, when in use, will exert a substantially uniform constrictive force at all points, it may be considered desirable under some circumstances to deliver the yarn to the needles under an even greater tension than that previously described while forming the shorter stitches, thereby to accentuate the fashioning effect. This may

readily be accomplished by a proper contouring of the tensioning cam, as will be evident to those skilled in the art. Thus for example the elastic yarn may be delivered to the needles with substantially no elongation when forming the long stitches in the top or thigh portion of the stocking but may be elongated as much as 125% in forming the shortest stitches in the ankle portion.

Heretofore an elastic stocking having these advantages has been made flat and provided with a back seam. Such a stocking is objectionable due to its bulky appearance, and consequently many who really require the support given by elastic stockings, have been unwilling to wear them. A seamless elastic stocking not fashioned is open to objection because either the pressure at the large parts of the leg is too great for comfort, or the pressure at the small parts of the leg and at the foot is too light and the stocking bags at those points. An elastic stocking made according to this invention, however, is not open to these objections and may be worn under a sheer silk stocking with perfect comfort and without fear of discovery.

While one embodiment of this invention has been shown and described, it will be understood that the invention is not limited thereto and that various changes may be made in the control device and its associated parts, in the method or in the article without departing from the spirit and scope of the invention as set forth in the following claims.

I claim:

1. A seamless fashioned knitted garment wherein variation in diameter is a concomitant of variation in stitch length, said garment having an elastically stretchable portion wherein knitted stitches each comprises inelastic yarn and an elastic yarn, the elastic yarn comprised in each stitch being under an initial tension when the garment is in non-distended condition, the length of elastic yarn per stitch bearing a varying relation to the length of inelastic yarn in the corresponding stitch throughout the elastic portion of the garment.

2. A garment according to claim 1 wherein the garment is a stocking.

3. A seamless, two-way stretch knitted elastic garment wherein variation in diameter is a concomitant of variation in stitch length, said garment having a fashioned elastically stretchable portion wherein knitted stitches each comprises an inelastic yarn and a tensioned elastic yarn, the length of elastic yarn per stitch differing from the length of the inelastic yarn in the undistended garment, the percent elongation of the elastic yarn being substantially uniform throughout the fashioned portion when the garment is distended.

4. A seamless two-way stretch fashioned knitted garment, said garment having an elastically stretchable portion of varying diameter wherein knitted stitches each comprise an elastic yarn, the stitches being of greatest length in the portion of the garment of greatest diameter and being progressively reduced in length to the portion of least diameter, the elastic yarn in each stitch being under an initial tension when the garment is in non-distended condition and such tension progressively increasing from the portion of largest diameter to the portion of least diameter, whereby when the completed garment is distended it exerts the greatest constrictive force at the portion of least diameter.

5. A garment according to claim 4 wherein the garment is a stocking.

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