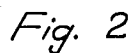
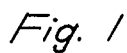


Dec. 31, 1963 **J. M. LATHEM ETAL** **3,115,745**
METHOD OF DRAWING, COVERING AND STABILIZING
SYNTHETIC ELASTOMERIC YARN

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2 Sheets-Sheet 1



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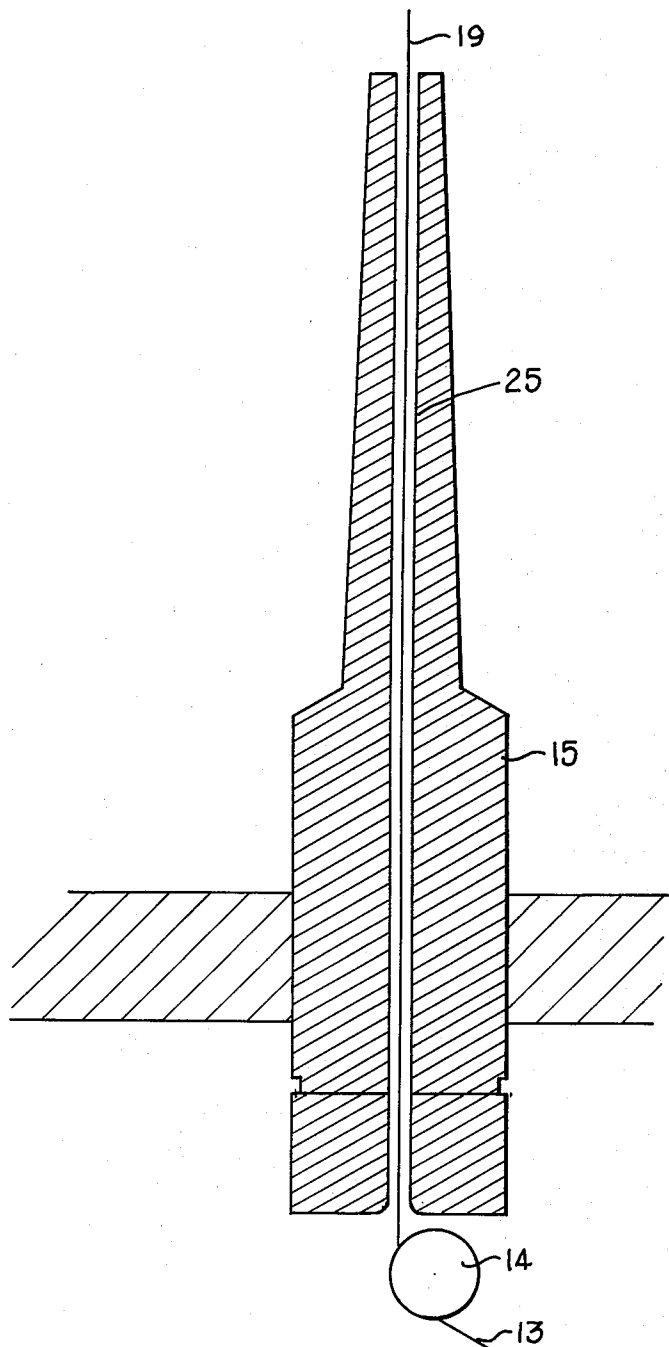


Fig. 3

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3,115,745
METHOD OF DRAWING, COVERING AND STABILIZING SYNTHETIC ELASTOMERIC YARN
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This invention relates to a method of treating synthetic elastomeric yarn to render it more suitable for knitting, to stabilize the yarn with respect to its elasticity and retractability properties and to produce lower denier yarn with greater yardage.

In recent times the synthetic elastomeric yarns have become important for use in the knitting of ladies wearing apparel, particularly foundation garments such as girdles, and support stockings. A commercially important form of this type of yarn known as spandex is produced by E. I. du Pont de Nemours & Co. and is sold under the trade name Lycra. It is understood to be a polyurethane yarn. A similar commercial product is known as Vyrene and is produced by the U.S. Rubber Co. These yarns are obtainable only in small limited quantities to date and in relatively heavy deniers such as for example 70 denier and 140 denier. Yarns of this heavy denier may be used for ladies girdles or the like, but are substantially heavier than desired for producing ladies stockings similar in appearance to sheer nylon stockings. Also, because of the limited supply of these yarns at the present time, the production of garments or stockings using these yarns either in whole or in part is necessarily limited.

A feature of the present invention is a newly discovered procedure of stabilizing the diameter or denier of the yarn whereby the effective yardage may be increased as much as 400% or more, while at the same time protecting the yarn to render it more suitable for knitting of undergarments and stockings. Since there is less contraction in a stabilized yarn than there is in the conventional non-stabilized yarn, a smooth yarn can be produced at a lower number of wraps per inch if the yarn is stabilized.

In accordance with the present invention, we have discovered that the relatively heavy denier synthetic elastomeric polyurethane yarns may be stretched or drawn, that is, elongated, about four times the original length of the yarn, and the drawn yarn protected and stabilized for knitting. In this process it is important to wrap the drawn yarn, while it is still under tension, with a suitable covering yarn such as, for example, multifilament nylon yarn, to wind the drawn and wrapped yarn under tension, and to heat the drawn and wrapped yarn, either during or after winding, sufficiently to stabilize the core yarn, that is, the elastomeric yarn.

An illustrative but non-limiting example of the process of our invention comprises drawing Lycra yarn of 70 denier on a spinning frame in which the take-up roll operates at a speed of approximately four times the speed of the feed roll so as to stretch the Lycra yarn approximately 400% and while the yarn is being stretched, it is wrapped in a Z direction with multifilament nylon yarn such as a 20 denier 7 filament nylon yarn which has an S twist torque. The stretched and wrapped yarn is wound on a take-up bobbin and the wound package is steamed at about 220° F. for a period of one hour. The nylon, wrapping yarn provides a smooth protective surface for the Lycra core yarn and facilitates knitting. The steaming or heating of the stretched and wrapped yarn stabilizes the Lycra yarn in its stretched length and denier and prevents it from retracting to its original substantially shorter length and substantially larger diameter.

A suitable mechanical arrangement for carrying out the

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above process is illustrated diagrammatically in the accompanying drawing in which:

FIGURE 1 is a diagrammatic front view of an up-twister for drawing and wrapping the drawn elastomeric yarn;

FIGURE 2 is a diagrammatic side view of the up-twister apparatus shown in FIGURE 1;

FIGURE 3 is a longitudinal sectional view of the hollow type spindle used in the equipment illustrated in FIGURES 1 and 2.

The apparatus shown in FIGURES 1 and 2 is basically a conventional double deck up-twister but with modifications to adapt it to the process of the present invention. In this equipment, the elastomeric yarn, e.g. Lycra yarn 10, is supplied from a bobbin 11, which is driven by face contact and at a constant rate of speed by drive roll 12. The yarn 13 is fed from the package 10 over a guide roll 14 and through a hollow spindle 15. This spindle is driven by a belt 16.

Mounted on the spindle 15 is a bobbin 17 containing a supply of wrapping yarn, e.g. multifilament nylon yarn 18. The bobbin 17 is rotated in such a manner that it will cause the yarn 18 to wrap on and around the Lycra yarn 19. The Lycra yarn wrapped with the nylon yarn 18 produces a composite yarn 20 which passes through a pigtail guide 21, then through a traverse guide 22 and onto a take-up bobbin 23. The bobbin 23 is driven at a constant rate of speed by a take-up drive roll 24.

The speed of the drive roll 12 is set at a lower speed than the take-up roll 24 for the purpose of drawing the Lycra yarn into a yarn of smaller diameter and greater yardage. The speeds of the drive roll 12 and take-up roll 24 are determined by the percentage elongation desired in the Lycra yarn. A speed ratio between the drive roll and take-up roll of 4 to 1 has been found practical and desirable. While slightly higher ratios may be used, care should be taken not to approach the breaking elongation of the Lycra yarn. For a 70 denier Lycra yarn, a ratio of 4 to 1 has been found desirable, and for a 140 denier Lycra yarn, a ratio of 4.5 to 1 has been found desirable.

We have found that for a given number of wraps per inch of the Lycra yarn by the nylon yarn, the amount of stretch of the composite yarn will decrease as the drawing ratio is decreased. Examples of this are as follows.

Drawing ratio:	Percent stretch to elastic limit
4 to 1	180
3 to 1	160
2 to 1	100

After the composite yarn 20 has been wound on the take-up bobbin 23 and while it is still held under constant tension, the wound package is placed in a suitable steam cabinet and heated to about 180° F. to 220° F. for a period of one hour for the purpose of stabilizing the Lycra yarn in a drawn condition. The following are illustrative but non-limiting examples of different denier and elasticity values which are obtained for a composite yarn using a 70 denier Lycra core yarn, drawn at a 4 to 1 ratio and covered with 40 wraps per inch of 15 denier, 3 filament textured nylon yarn:

Steaming Temperature, ° F.	Denier of Relaxed Yarn	Percent Stretch To Elastic Limit
160	80	280
180	70	230
200	67	200
220	65	180

Instead of placing the wound package of composite

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yarn in a steam cabinet, a suitable heater may be used in conjunction with the drawing, or stretching, and covering apparatus at any convenient location along the yarn path to stabilize the Lycra yarn. For example, the heater may be located so as to heat either the bare Lycra yarn or the composite yarn prior to its being wound onto the take-up bobbin. This type of heater may be operated at a temperature of around 300° F. to 450° F.

In FIGURE 3, there is illustrated more in detail the hollow type spindle shown at 15 in FIGURES 1 and 2 and which contains a center bore 25 running lengthwise of the spindle and through which the Lycra yarn 13 is fed continuously while the spindle rotates to effect the above described wrapping of the Lycra core yarn 19 with the nylon wrapping yarn 18 as shown in FIGURES 1 and 2.

The preferred wrapping yarn is a low denier textured thermoplastic yarn. These yarns, which have a coil-like structure, impart a soft hand and high coverability at a relatively low number of wraps per inch. Non-textured thermoplastic yarns and natural yarns such as silk may also be used, but it is necessary to use a greater number of wraps per inch. In any case, it is desirable that the number of wraps per inch be sufficient to cause the strands of wrapping yarn to lay close to the core yarn when the composite yarn is relaxed. Otherwise uneven delivery and plucking will result during delivery from the knitting package. An excessive number of wraps per inch will cause the composite yarn to take on a certain amount of twist liveliness which is not completely overcome in the steaming operation. This liveliness is not objectionable in the knitting operation, but will cause the fabric to take on a certain amount of spiral. This may be overcome by alternating in the fabric yarn which has been wrapped in a left hand direction with yarn which has been wrapped in a right hand direction. In fact, this is found to have an added advantage of increasing fabric stretch by causing the stitches in alternate courses to contract to the left and right. Another method of eliminating twist liveliness may be effected by double wrapping the Lycra yarn, once in a right hand direction and once in a left hand direction.

It has also been found possible to draw and stabilize the bare Lycra yarn by eliminating the wrapping operation. In this instance the spindle 15 and bobbin 17 are removed from the machine. After drawing and stabilizing, the Lycra may then be plied with a suitable yarn to facilitate knitting and impart a desired hand to the fabric.

The following are illustrative but non-limiting examples of the above described process with respect to materials, conditions, etc.:

Example I

140 denier Lycra yarn was processed in a manner heretofore described by a drawing ratio of 4 to 1 and a covering of 24 wraps per inch in left hand direction with 20 denier 7 filaments S twist torque textured nylon. After processing, the take-up bobbin was steamed at 220° F. for a period of one hour. The resultant yarn performed satisfactorily on a circular knitting machine of the type used in the manufacture of ladies seamless hosiery. A soft pleasing hand was noted in the fabric. The composite yarn was found to have a relaxed denier of ap-

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proximately 110. The Lycra core yarn, which was originally 140 denier, was found to be approximately 80 denier. The composite yarn has a stretch of 170%.

Example II

70 denier Lycra yarn was drawn at a ratio of 3.9 to 1 while being covered with 40 wraps per inch in a left hand direction. The wrap yarn was 15 denier, 3 filaments S twist torque textured nylon. After processing, the take-up bobbin was steamed at 220° F. for one hour. The resultant composite yarn had a denier of approximately 65. The Lycra core yarn had a denier of approximately 40. The composite yarn had a stretch of approximately 175%.

The composite wrapped, drawn and heat stabilized yarn above described, may be used for knitting various articles, such as for example girdles and other underwear garments and ladies' full fashioned and seamless hose. The wrapping or covering yarn may be a thermoplastic yarn as above described, or a non-thermoplastic yarn such as for example silk yarn.

Various modifications may be made in the above described procedures, conditions and materials as indicated by the scope of the appended claims.

We claim:

1. A method for producing a covered elastic composite knitting yarn comprising the steps of uniformly wrapping a multi-filament nylon yarn having a torque in one direction around an elastomeric polyurethane core yarn while said core yarn is elongated and held under tension, and heat setting the core yarn while it is elongated and held under tension to stabilize the core yarn in an elongated condition.

2. A method for producing a covered elastic composite knitting yarn comprising the steps of uniformly wrapping a texturized multi-filament nylon yarn having a torque in one direction around an elastomeric polyurethane core yarn while said core yarn is held elongated and under tension, said wrapping being in the direction opposite to the direction of the torque in the nylon yarn, and heat setting the core yarn while it is held elongated and under tension to stabilize the core yarn in an elongated condition.

3. The method of claim 2 and further characterized in that said wrapping and heat setting are conducted while the core yarn is held under a tension sufficient to stretch it approximately four times its original length.

4. The method of claim 2 and further characterized in that the heat setting is conducted on a wound package with steam at about 220° F. for one hour.

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