Sept. 13, 1960 A. BURLESON 2,952,116

PROCESSING YARNS

Filed July 26, 1955

FIG. 1.

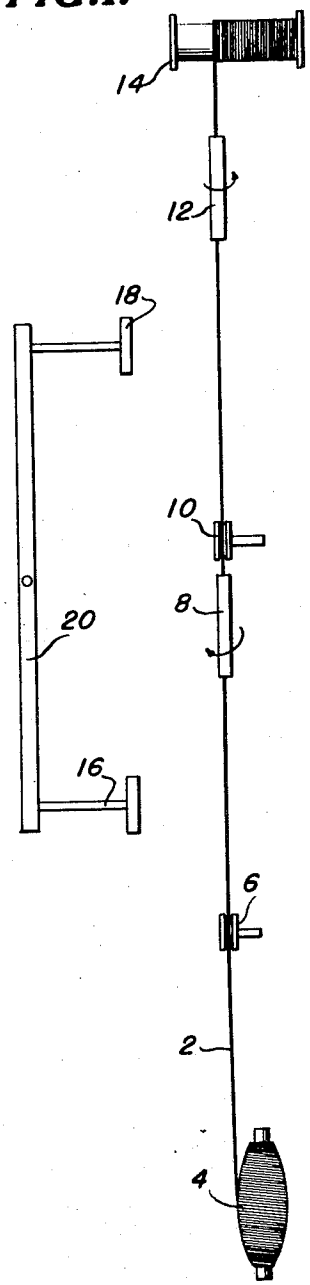
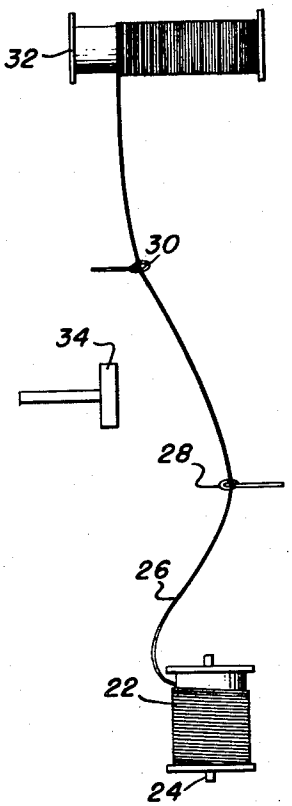


FIG. 2.



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PROCESSING YARNS

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The present invention is concerned with certain novel textile products and methods related thereto. More particularly, the invention relates to the processing of nylon yarn and the like for use in the preparation of knitted and woven fabrics.

It has recently been proposed to prepare knitted fabrics of increased stretchability, e.g., sheer women's hosiery, comprising two nylon yarns of opposite twist, one or more courses of yarn of one twist alternating with one or more courses of yarn of the other twist. Such fabrics, and procedures for making the same, are described in co-pending applications Serial No. 342,709 filed March 16, 1953, now abandoned; Serial No. 367,776 filed July 13, 1953, now Patent No. 2,772,191; and Serial No. 454,204 filed September 3, 1954, now Patent No. 2,771,757; the disclosures of which are hereby incorporated herein.

It has now been found that fabrics possessing a high degree of stretchability, and the various other desirable characteristics of the products described in the above mentioned applications, can also be prepared by knitting with a single yarn having alternating directions of twist or twist torque therein. In other words, instead of using two separate yarns of opposite twist, the opposed torque necessary for stretchability is obtained from a single end of yarn containing both right and left twist or twist torque in alternate sections. This offers the advantage of reduced tracking, i.e., a line or band appearance, in hosiery or other fabrics which might result from the use of two oppositely twisted yarns in alternating courses.

Accordingly, the principal object of the present invention is to provide novel improvements in the production of stretchable hosiery and other knitted or woven fabrics.

Another object of the invention is the provision of a single yarn having both left and right twists or twist torque therein adapted for the production of stretchable textile products.

Further objects will also be apparent from the following detailed description and the accompanying drawings wherein Figures 1 and 2 represent diagrammatic views of apparatus suitable for use in processing nylon yarn or the like according to the purposes of the invention.

Broadly stated, nylon yarn or the equivalent is processed according to the invention by oppositely twisting adjacent sections of the yarn, heat-setting the yarn with the twist therein and then backing out the twist from the heat-set yarn. This results in a yarn having alternate sections of opposed twist or twist torque directions due to the fact that the yarn, after the backtwisting, tries to return to the twisted position it had when heat-set.

The twisting and setting of the yarn can be carried out in various ways. For instance, two adjacent sections of the yarn may be twisted in opposite directions either simultaneously or sequentially and the oppositely twisted sections thereafter heat-set either individually or severally. Generally speaking, however, it is preferred to use a process involving the steps of twisting the yarn in one direction, e.g. applying a right twist thereto, heat-setting

alternate sections of the yarn with the twist therein, thereafter applying an opposite twist to the yarn, heat-setting those sections of the yarn which were not previously heat-set with said opposite twist therein, and then backtwisting to remove the twist in said yarn. Preferably, the yarn is divided into an even number of sections that are equal in length and have a twist or twist torque therein which is equivalent to the opposite twist in an adjacent section.

Setting of the yarn with right and/or left twist therein may be accomplished in any convenient manner. For instance, the twisted yarn may be exposed to wet heat, e.g. steam or hot water, for a time sufficient to effect the desired heat-setting. Typically suitable setting operations involve subjecting the yarn to either steam at a temperature within the range of 220 to 270° F. for a period of time between 15 and 60 minutes, or hot water at a temperature of from 190 to 212° F. for between 10 to 60 minutes. It is preferred, however, to set the yarn with dry heat, e.g. by using a heated metal plate or like member which contacts the yarn for the necessary length of time. A metal plate heated to from 220 to 450° F. and in contact with the yarn for $\frac{1}{10}$ second to $\frac{1}{2}$ minute, and preferably $\frac{1}{5}$ second, gives satisfactory setting.

In backing out the yarn after the twisting and setting operations, it is generally preferred to backtwist the yarn an amount equal to the twist which the yarn had when set, i.e. to zero twist. However, if desired, the backtwisting can be carried out even further, e.g. to the point where the yarn has from 1 to 5 turns per inch in a direction opposite to the twist set therein although in this event, the back twist in the various sections of the yarn should balance out.

While the invention is of particular importance with respect to nylon yarn of the monofilament or multifilament type, other thermo-plastic yarns which can be heat set when twisted, e.g. a condensation polymer of terephthalic acid and ethylene glycol (Dacron) or a vinyl chloride-acrylonitrile polymer (dynel) may also be processed in the manner described herein. Similarly, the invention is broadly applicable to the production of all types of woven and knitted fabrics in which stretchability is desired, e.g. knitted underwear, sweaters and bathing suits. One of the more important applications of the invention, however, is in the processing of monofilament nylon yarns, for example 10, 12 or 15 denier monofilament yarn, for use in making full fashioned and/or seamless hosiery.

With reference to the drawings, Figure 1 diagrammatically illustrates one system for processing yarn in a continuous manner in order to obtain opposed torque or twist torque in alternate sections of the yarn. According to Figure 1, continuous filament nylon yarn or the like **2** from a supply package **4** is passed through twist trap tensioning means **6**, the purpose of which is to regulate the tension of the yarn at generally between .06 and .66 gram per denier. Means **6** also serves to keep the twist imparted to the yarn (as hereinafter discussed) from running back to the package **4**. From tensioning means **6**, the yarn is passed through a false twisting spindle **8** of any conventional construction where the yarn is given a twist, e.g. a right twist of from 5 to 40 turns per inch, running back to tensioning means **6**. As the yarn leaves the false twister **8**, the twist imparted to the yarn is backed out, as is well understood in the art, the yarn then being passed sequentially through another tensioning device **10** and a false twisting spindle **12**. The latter is operated, as shown, to impart a twist opposite to that placed in the yarn by false twisting means **8** but otherwise equivalent thereto. The yarn

leaving spindle 12 is back twisted by the spindle to zero twist and collected on a take up package 14 using winding tensions between .12 and 1.6 grams per denier.

The system of Figure 1 also includes a suitable heating member 16 for setting yarn between false twisting spindle 8 and tensioning means 6. A similar heating member 18 is positioned between spindle 12 and tensioning means 10. These heating members 16 and 18 may take any suitable form, e.g. they may be electric heaters that contact the yarn for the desired length of time to effect setting, or the yarn may be brought in contact with the heaters and they are arranged for alternate operation as by means of a pivoted operating member 20 which alternately moves the heaters into and out of contact with the twisted yarn so as to heat-set first a section of yarn twisted in one direction and then a section of yarn twisted in the other direction.

Figure 2 illustrates the manner in which yarn can be processed according to the invention using a conventional twister spindle. Specifically, a supply package 22 is placed on a twister spindle 24 and twist, e.g. right twist, inserted in yarn 26 as it is taken off the package and fed through guide members 28 and 30 onto takeup package 32. A movable heater 34 is also provided and this may be moved in and out of contact with the twisted yarn or the yarn may be brought in contact with the heater for the purpose of heat-setting alternate sections of the yarn. After the package of yarn has been treated in the manner mentioned, it is put back on the twister supply package and the spindle 24 runs in the opposite direction with double the number of turns used in the first twisting operation. The original twist is thus backed out and an opposite twist, equal to the original twist put in the yarn. Heater 34 is then placed on those sections of the yarn which were not contacted and heat-set when the original twist was inserted. Thereafter the yarn is run again, without any heating, to remove any residual left twist therein. The yarn is then ready to be knit or woven into stretchable fabrics of any form.

The following is an example using the apparatus shown in Figure 1:

An end of 15 denier monofilament nylon yarn was taken off supply package 4 and fed at a rate of 120 feet per minute through the tension device 6 and false twist spindle 8, the latter imparting a left twist of 18 turns per inch to the yarn between the spindle and tension device 6. The tension of the yarn at this point was .33 gram per denier and this tension was maintained throughout the entire process.

A section of 7 feet of yarn with left twist therein was heat-set by maintaining heater 16 in contact with the yarn for 3.85 seconds. The temperature of the heater was 420° F.

The yarn leaving false twist spindle 8 with zero twist was then passed through tension device 10 and false twist spindle 12 with a right twist of 18 turns per inch being imparted to the yarn between spindle 12 and tension device 10. Heater 18 was brought into contact with the right twist yarn after heater 16 was withdrawn so as to heat-set the yarn which had not been contacted by heater 16. A section of 7 feet of the right twist yarn was heat-set by maintaining heater 18 in contact with the yarn for 3.85 seconds after which heater 16 was again brought into contact with the yarn and heater 18 taken out of contact. This alternate heating of equal lengths or sections of the yarn first with heater 16 and then with heater 18 was continued until the entire package of monofilament yarn (4 oz.) was processed, the yarn being collected on takeup package 14 with substantially no twist therein under a tension of .5 gram per denier.

The 15 denier monofilament yarn produced in the manner discussed above and possessing alternate sections of opposite twist torque therein was knit in conventional manner on a full-fashioned hosiery knitting machine. The resulting hosiery demonstrated extremely desirable stretchability.

While the foregoing example refers specifically to the production of full-fashioned women's hosiery from 15 denier monofilament nylon yarn, it will be appreciated from the preceding discussion that the invention is not limited thereto and that all types of fabric in which stretchability is desired, whether knit or woven, may be made from either monofilament or multifilament yarn of any denier processed in the manner described herein.

The amount of right and left twist applied to the yarn before the heat-setting operation can be rather widely varied. Generally, however, it should not be outside the range of from 5 to 40 turns per inch and preferably is between 10 and 20 turns per inch. Preferably, the amount of twist heat-set in the yarn in one direction should be equal to the twist which is heat-set in the other direction so that a balanced fabric can be made therefrom although it can be appreciated that many variations of yarn can be produced to make balanced fabrics by alternating short and long sections of yarn of opposite twist torques by varying the twist in either false twister or varying the temperature in either heater, thus it is possible to produce a long section of low twist torque in one direction and still maintain a fabric balance. Also, it is possible to pass previously twisted yarn by conventional method through a single false twister and heat setting sections of yarn leaving alternating sections unset but still maintaining opposite twist torques.

Obviously various modifications may be made in the invention as described herein without deviating from the scope thereof as defined in the appended claims wherein:

I claim:

1. A process for preparing thermoplastic yarn suitable for the production of fabrics of substantial stretchability comprising the steps of twisting the yarn in one direction, yarn-setting only selected sections of the yarn with the twist therein, collecting said twisted yarn, collecting said yarn, thereafter twisting said yarn in the opposite direction with a substantially greater number of turns than used in the first twisting operation, yarn-setting alternate sections of said oppositely twisted yarn, the intermediate sections including the selected yarn sections previously yarn-set, collecting said yarn, thereafter twisting said yarn in the first direction in an amount to remove the twist inserted prior to said second yarn-setting step, and collecting said yarn.

2. A process according to claim 1 wherein said first yarn-setting step yarn-sets only said intermediate sections of the yarn.

3. A process according to claim 1 wherein said step of twisting the yarn in the opposite direction comprises twisting the yarn with twice the number of turns used in the first twisting operation.

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