# United States Patent [19]

**Hamby**

[11] **3,874,156**

[45] **Apr. 1, 1975**


[54] **PROCESS FOR SIMULTANEOUSLY EDGE-CRIMPING AND FALSE-TWISTING YARN AND YARN PRODUCED THEREBY**


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[52] **U.S. Cl.** ..... **57/140 R,** 28/1.3, 28/72.11, 57/34 HS, 57/157 TS, 57/157 MS

[51] **Int. Cl.** ..... **D02g 1/02,** D02g 1/10, D02g 1/20

[58] **Field of Search** ..... 57/34 HS, 157 TS, 157 MS, 57/140 R, 140 BY; 28/1.3, 72.13, 72.11, 1.5



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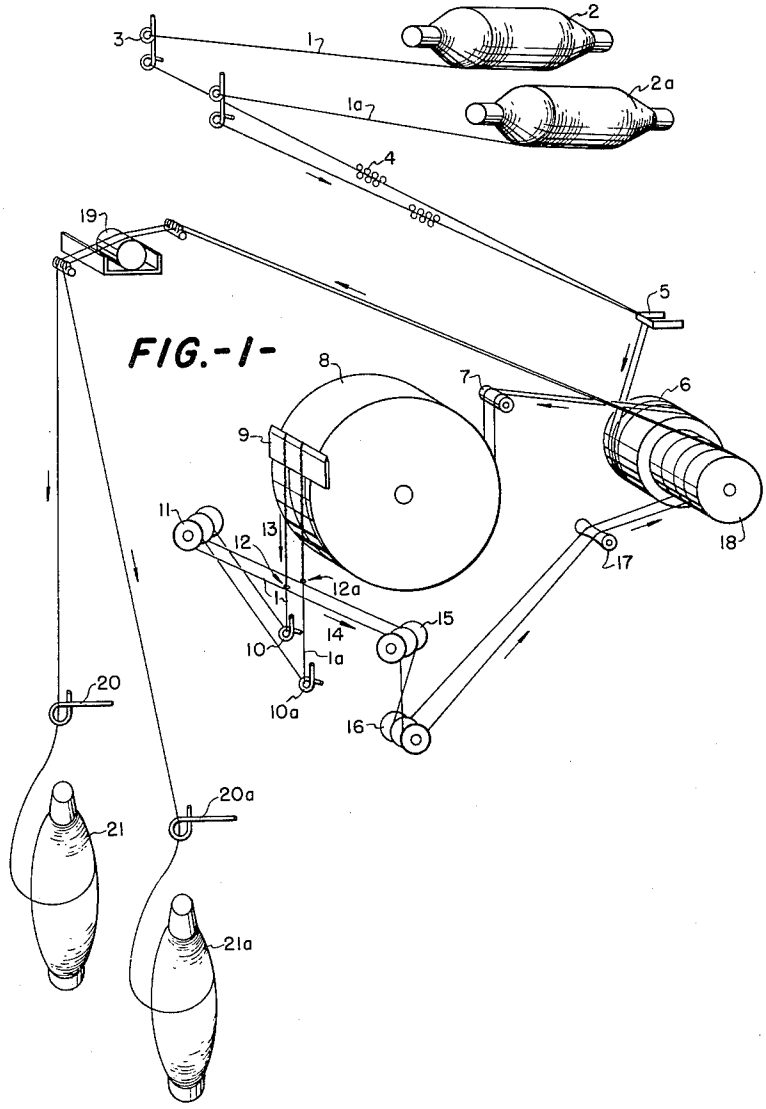
*Attorney, Agent, or Firm*—H. William Petry; L. J. Wilburn

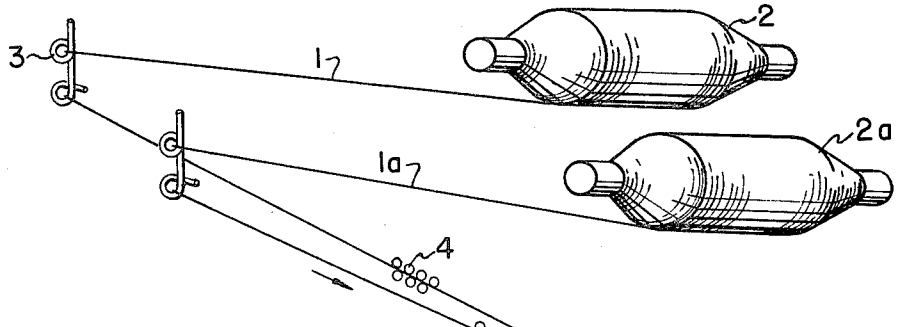


[57] **ABSTRACT**

A method and apparatus for texturing yarn is provided which combines the processes of edge-crimping and false-twisting. A continuous filament thermoplastic yarn is subjected to heat after which the heated yarn is drawn over an edge-crimping member at an acute angle. Immediately following the edge-crimping operation, the yarn is false-twisted so that the twist runs back in the yarn to the edge of the edge-crimping member. The yarn is then cooled, untwisted, and collected in a yarn package.


**8 Claims, 2 Drawing Figures**




3
1
2
1a
2a
4

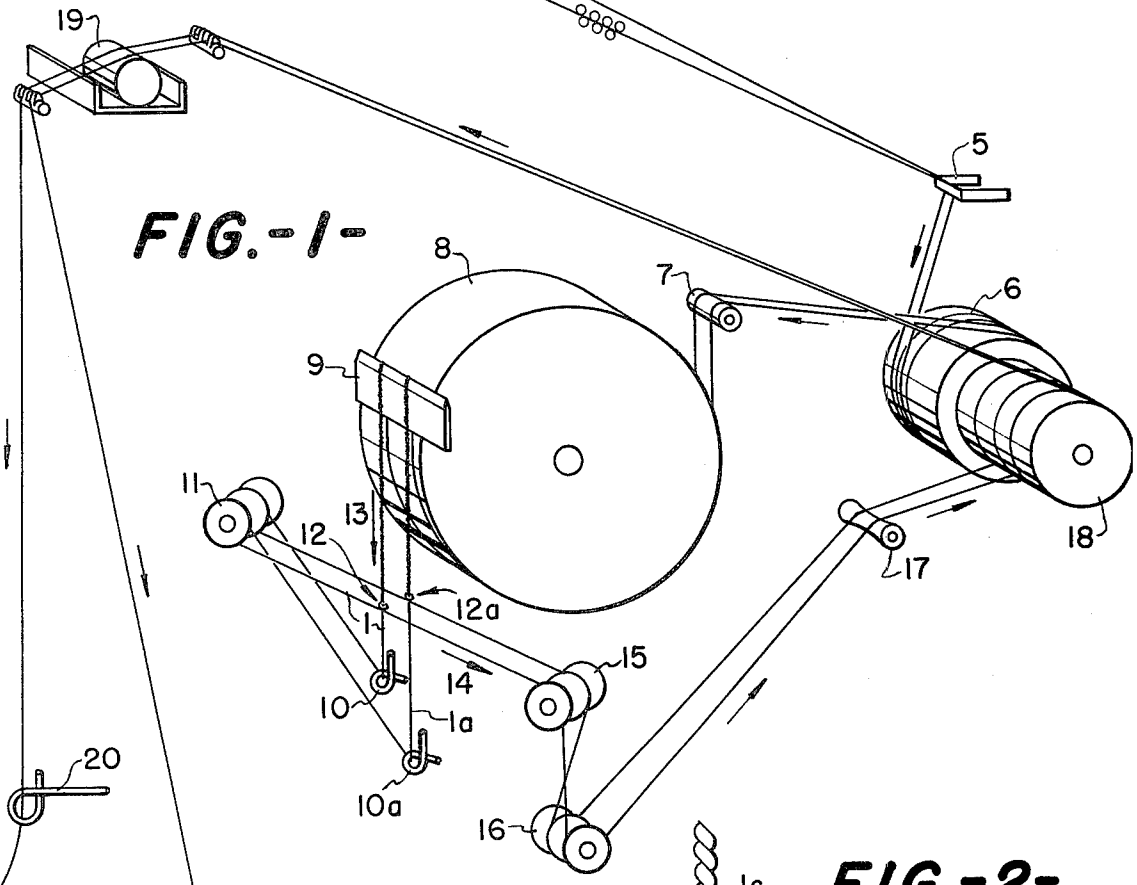
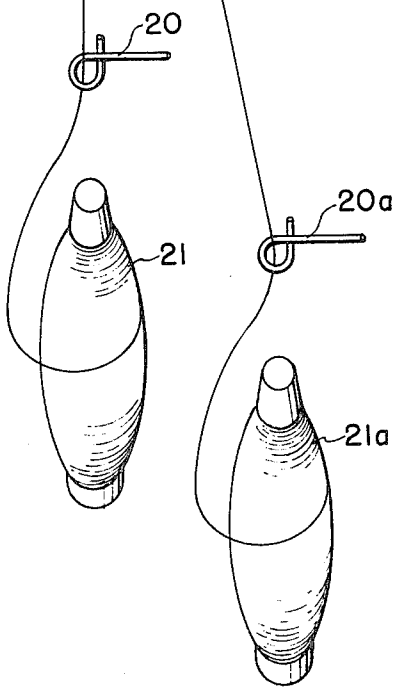

19
5
8
7
6
9
11
13
12
1
12a
15
14
10
1a
10a
16
17
18

FIG.-1-


20
21
20a
21a

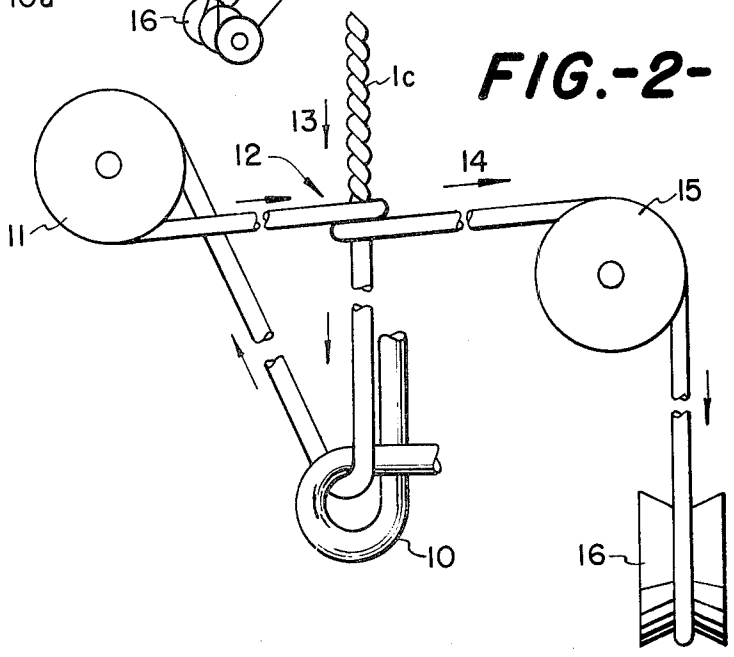

1c
13
12
14
15
11
10
16

FIG.-2-

# PROCESS FOR SIMULTANEOUSLY EDGE-CRIMPING AND FALSE-TWISTING YARN AND YARN PRODUCED THEREBY

## BACKGROUND OF INVENTION

Many thermoplastic yarns are textured to give them improved characteristics of stretch recovery and/or appearance in the final yarn product. The achieved characteristics may vary widely according to the desired end use of the yarns and therefore a great variety of texturing processes have been developed to produce diversified types of yarn.

Generally, the mechanical texturing processes for thermoplastic yarns include the steps of heating the yarn to a point where the molecules thereof will flow or become capable of reorientation, applying a stress to the heated yarn to cause a molecular reorientation and deformation therein, and then cooling the molecularly reoriented yarn to set the molecules in their reoriented state. It is this molecular reorientation which gives the yarn the varied degree of stretch and/or bulk for various desired end uses.

Two of the most prevalent types of texturing thermoplastic yarns are the processes of edge-crimping and false-twisting. The process of edge-crimping basically comprises heating a thermoplastic yarn and subjecting it to a stress which is uneven across the yarn's cross-section. This is accomplished by drawing the heated yarn over a sharp edge under tension so that the yarn path to and from the edge forms an acute angle therebetween. After cooling, the deformation created by the sharp edge-bending of the yarn causes the yarn to form in continuous helices which reverse periodically along the length of the yarn. The resultant yarn product has good stretch characteristics and has a balanced, or zero, resultant torque. The balanced torque nature of edge-crimped yarn makes it particularly useful for manufacture of fine denier woven and knitted fabrics, such as women's hosiery, as well as in permitting the knitting or weaving of fabrics made from such yarns without having to balance the torque effect of the yarns therein. Related prior art edge-crimping processes are described in U.S. Pat. Nos. 2,919,534 and 3,154,835.

The false-twist process involves the continuous steps of twisting a thermoplastic yarn, heating the twisted yarn, cooling the twisted yarn to set the twist therein and then untwisting the yarn. Although there is no actual twist left in the yarn at the end of this process, it does tend to twist about its axis because of the deformation produced during the texturing process. This type of yarn has greater stretch and is generally of a higher bulk than the edge-crimped yarn. It is not a balanced yarn in that it will have a resultant torque present in the textured state. In order to obtain a "balanced" fabric utilizing false-twist yarn, it is necessary that two strands of the yarn having opposite torque be knitted in alternate courses, or the yarns used as a single balanced plied yarn composed of multiple yarn ends of opposite twist. Related false-twisting processes are described in U.S. Pat. Nos. 2,987,869; 3,166,881; 3,435,603 and 3,626,682.

It has now been found that, as a result of combining the processes of edge-crimping and false-twisting in a single continuous operation, a yarn can be produced which has significantly improved stretch and modulus over conventional edge-crimped yarns. In addition, the new yarn so produced has an improved high level of crimp, or stretch, without the undesirable high torque levels heretofore present in conventional stretch false-twist yarns. Thus, fabrics produced from such yarns are found to possess high stretch recovery with much improved snag resistance.



## BRIEF DESCRIPTION OF THE INVENTION

Thermoplastic yarn is taken off a supply package and passed over a heater. The heated yarn is then drawn under tension and at an acute angle around an edge-crimping member. Immediately following the edge-crimping member a multiple number of turns of twist are inserted in the yarn and the twist allowed to run back to the edge of the crimping member. In this manner, the heated yarn is edge-crimped and false-twisted simultaneously, thereby producing a yarn having a high degree of stretch recovery and particularly suited for the production of light weight, fine denier fabrics, such as hosiery.

Any yarns which have thermoplastic characteristics and are capable of being texturized under application of heat and external stress to cause deformation or molecular reorientation may be employed in the present invention. Typical of such yarns which are well known to be textured in such a manner are nylon and polyester. The thermoplastic yarns are heated to a sufficient temperature to permit the molecules thereof to "flow" or reorient themselves when subjected to stressing forces; thus the particular temperatures employed may vary, depending on the chemical and physical nature of the particular yarns being texturized.

## BRIEF DESCRIPTION OF THE DRAWING

The instant invention is more fully described in conjunction with the accompanying drawings which show a preferred embodiment of the invention. In the drawing:

FIG. **1** is a schematic diagram showing the yarn path and simultaneous treatment of two yarn strands in the texturing apparatus of the present invention; and

FIG. **2** is an enlarged schematic diagram showing a portion of the yarn path of a single yarn strand being processed in accordance with the present invention as it would be seen at the false-twist position **12** in the path of FIG. **1**, as the yarn is wrapped about itself to provide a false-twist to the yarn.

## THE PREFERRED EMBODIMENT

The apparatus of this invention is arranged as follows. A strand of thermoplastic yarn **1** is drawn from a supply package **2** by a driven delivery roll **6** about which it is wrapped. Roll **6** is driven by suitable means, not shown. Guides **3**, tension gates **4** and a guide **5** provide the necessary direction and tension between supply package **2** and the delivery roll **6**. For economy, and to minimize variations in treating conditions as will be explained hereinafter, a second yarn strand **1***a* from package **2***a* is shown and, as will be described, is simultaneously processed with yarn strand **1** in the apparatus of the drawings; however, it should be understood that only a single yarn strand could be processed in accordance with and on the apparatus of the present invention, if desired.

Yarns **1** and **1***a* are passed over a heater **8** where they are heated to a temperature sufficient to allow molecular reorientation to occur. The heated yarns are then drawn under tension at an acute angle about an edge-

crimping member or blade **9** located adjacent the heater.

After leaving the crimping blade **9**, the yarns are passed, as shown by arrow **13**, through respective guide **10** and **10***a*, and then through suitable guides, such as rollers **11** and **15** as indicated by arrow **14**. Rollers **11** and **15** are positioned so that the yarns wrap about each other to form twisting points **12** and **12***a*. As can be seen, the yarn directions **14** downstream of twist points **12, 12***a* are substantially perpendicular to yarn directions **13** upstream of the twisting points. As the two yarns pass through twisting points **12, 12***a* they are wrapped one turn about each other, so that as the strands longitudinally move through the wrapping points in directions **14**, they effectively rotate their yarn sections moving in directions **13** to impart twist to the yarn sections upstream of the twist points **12, 12***a*.

If desired, and as shown in FIG. **2**, a single yarn may be processed in accordance with the invention. In such case, the single yarn strand **1***c* crosses its own path at point **12** and is wrapped about itself one complete turn so that, as yarn **1***c* moves through point **12**, it effectively twists its own yarn section upstream of twist point **12**. This twist travels back along the yarns to the edge of crimping blade **9**. Thus, the molecular reorientation and the deformation occurring in the heated yarns adjacent the crimping blade is produced by a unique combination of false-twisting and edge-crimping forces acting on the yarns.

The yarns are then drawn under the influence of driven output roll **18** through guides **16** and **17**, and are subsequently passed over an oil roll **19** through guides **20, 20***a* to be taken up by ring twisters on packages **21**, 21*a*.

When utilizing a yarn-over-yarn, false-twist procedure wherein a running yarn is wrapped about itself to impart the twist to the yarn, it has been found highly desirable to utilize two yarns, as described herein, to minimize variations or fluctuations which occur in both single yarns along their running length, and to minimize tension variations which occur between different yarn ends in a multiple yarn process.

Specific Example

Utilizing the apparatus and yarn path arrangement shown in FIG. **1** of the drawings, a pair of 18 denier 3 filament nylon 66 yarn strands having a producer's twist of approximately ¼ TPI in Z direction are drawn from supply packages through the appropriate guides and tensioning devices by driven feed roll **6**. The yarn strands are passed about rotatably driven heater roll **8** which is maintained at a temperature of approximately 400°F. The yarns contact the surface of the heater roll for a distance of approximately 2 ½ inches and then are passed in an acute angle of approximately 15° about stainless steel chrome-coated blade **9**.

The yarns leaving the blade are guided by elements **10, 10***a*, **11**, and **15** to cause the paths **13, 14** of the yarns to be at substantially right angles to each other. The yarns are wrapped a single turn of approximately 360° each about the other at **12, 12***a* to produce an S direction twist in each yarn which passes back along the yarns to the edge of the blade **9**. The two yarns are thus subjected to a substantially simultaneous edge-crimping and false-twisting effect. The thus textured yarns are fed by driven delivery roll **18** over oiling roll **19** to be collected on ring twister take-up packages **21** with an inserted true twist of 1.7 TPI in S direction. The amount of shrinkage and/or contraction in the yarns is determined by the ratio of the surface speeds of the driven rolls **6, 18**. In the present case the yarns are overfed 7.4% through the texturing apparatus to permit shrinkage.

The collected texturized yarns, when knitted with similarly texturized yarns in alternating S and Z arrangement, produce knitted fabrics having significant improved stretch over conventional edge-crimped yarns and without the undesirable high torque levels found in false-twisted yarns.

The twist applied to the yarns at the crimping blade caused by wrapping the yarns about themselves at twisting points **12, 12***a* is believed to cause the yarns to be drawn from the crimping edge **9** continually in the same helical coil direction instead of with the periodic reversal of coil direction that occurs in a conventional edge-crimping operation. This results in an unbalanced, high-crimp yarn possessing lower torque than that found in yarns of equivalent crimp produced by a conventional false-twist operation. Since the yarn immediately leaving edge **9** is still in the heated state, the false twist imparted to the yarn reinforces the crimp imparted by the edge-crimping blade, thereby providing a double texturing process.

In cases where the untextured raw yarn received from the supplier contains a small amount of true twist, or "producer's twist," it has been found that such producer's twist can have a significant effect on the quality of the textured yarn product. It has been found quite important in obtaining highest crimp level in the textured yarn product to ascertain the direction of the producer's twist and to then apply twist at the crimping edge in a direction which is opposite thereto.

Although the molecular orientation and resultant properties of the yarn produced by the present dual texturing processes are difficult to precisely define, it has been found essential that the two texturing steps be done in tandem, i.e., edge-crimping followed by false-twisting wherein the twist in the yarn flows back to the edge-crimping member, in order to produce the unique yarn product desired. If the texturing operation is done in a different sequence or in separate stages, for example, false-twisting followed by edge-crimping, or edge-crimping the yarn and subsequently taking the edge-crimped yarn and false-twisting it, the characteristics of the yarn so produced are not only quite different but the yarn can generally be classified as "non-commercial" because of the unsatisfactory crimp levels, uniformity, or other properties. Thus, the tandem dual texturing steps of the present invention are believed to produce additive crimp factors not available heretofore in textured yarn products.

Although the present invention has been specifically described herein in relation to the passage of yarn over an edge-crimping blade, followed by false-twisting by a "yarn over yarn" twisting arrangement, it is obvious that other apparatus may be employed to provide the dual edge-crimping/false-twist texturing effect than those disclosed.

For example, other means, such as wires, rods or the like, may be employed as the crimping edge, provided they permit the passage of the yarn thereabout under tension and at an acute angle. Similarly, other false-twisting means, such as the conventional rotating cross pin spindles, friction spindles, or the like, may be em-

ployed to impart false twist to the yarn on the downstream side of the crimping edge.

That which is claimed is:

**1.** A method for texturing a thermoplastic yarn to produce a textured torque yarn product consisting essentially of the steps of

a. heating a strand of the thermoplastic yarn;

b. passing the heated yarn in an acute angle and under tension about a single sharp edge;

c. inserting multiple turns of twist in the moving yarn downstream of the edge to a degree such that the twist applied to the yarn backs up in the yarn strand to the sharp edge;

d. allowing the yarn to cool;

e. removing the inserted twist from the yarn; and

f. thereafter collecting the textured torque yarn product.

**2.** A textured yarn which is produced according to the process described in claim **1.**

**3.** A method for texturing yarn as defined in claim **1** wherein raw yarn having a true twist in a specific direction is utilized and wherein the yarn is twisted in twisting step (c) in a direction which is opposite to the direction of the true twist of the raw yarn.

**4.** A method for texturing yarn as defined in claim **1** wherein twist is inserted in the yarn by passing the yarn at least one complete turn about itself.

**5.** A method for texturing yarn comprising the steps of:

a. heating yarn;

b. passing the heated yarn in an acute angle and under tension about a sharp edge;

c. passing the yarn at least one complete turn about itself with the directions of movement of the yarn as it passes about itself being substantially perpendicular to insert multiple turns of twist in the moving yarn downstream of the edge to a degree such that the twist applied to the yarn backs up in the yarn to the sharp edge;

d. allowing the yarn to cool;

e. removing the inserted twist from the yarn; and

f. collecting the textured yarn.

**6.** A method for texturing first and second strands of yarn comprising the steps of

a. heating the yarn strands;

b. passing the heated yarn strands in side-by-side relation in an acute angle and under tension about a sharp edge;

c. passing the moving first strand one complete turn about the second strand and passing the moving second strand one complete turn about the first strand to insert multiple turns of twist in the moving yarns downstream of the edge to a degree such that the twists applied to the yarns backs up in the yarn strands to the sharp edge;

d. allowing the yarn to cool;

e. removing the inserted twist from the yarn strands; and

f. collecting the textured yarn strands.

**7.** A method for texturing yarn as defined in claim **6** wherein the directions of movement of the strands of yarn as they pass over each other are substantially perpendicular.

**8.** A method for texturing yarn as defined in claim **6** wherein yarns having true twist therein are employed in the texturing method and the twist inserted in the twisting step is in an opposite direction to the true twist therein.

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