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Hopkins

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[54] METHOD FOR MANUFACTURING A PLIED YARN

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[62] Division of Ser. No. 637,399, May 10, 1967, Pat. No. 3,483,690.

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[51] **Int. Cl.** **D02g 1/18**, D02g 3/04

[58] **Field of Search** .....28/72.17, 1.2; 57/140 BY, 157 MS, 57/157 TS, 34 HS

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[57] **ABSTRACT**

A method for plying continuous multifilament yarns with natural or synthetic yarn into a tow comprising the steps of differentially shrinking the multifilament yarn so as to form a multiplicity of yarn convolutions therein; merging the differentially shrunk filament yarn with a second yarn, and plying the merged yarns to thereby produce a plied bulk yarn having a uniform consistency along the length thereof.

8 Claims, 3 Drawing Figures

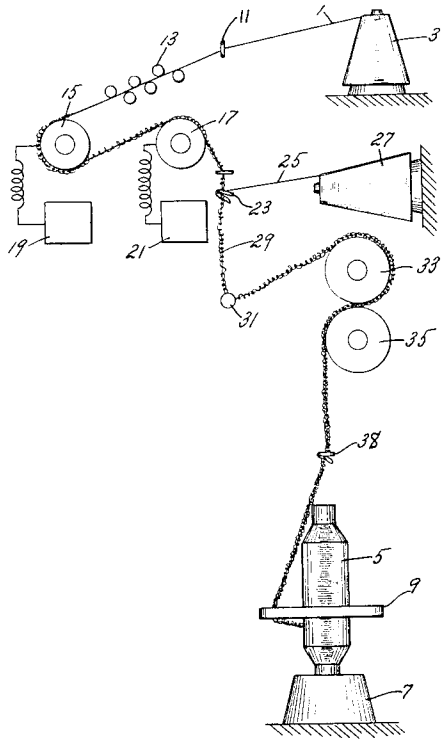


Fig. 1

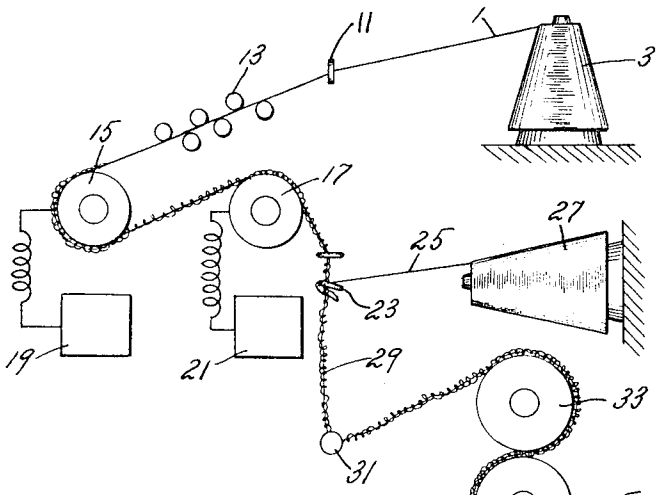
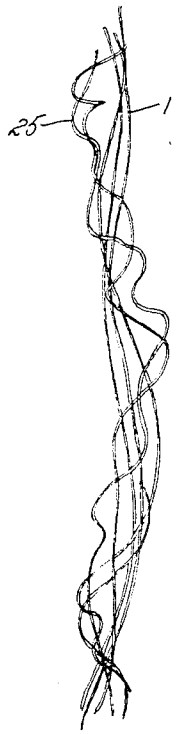


Fig. 2



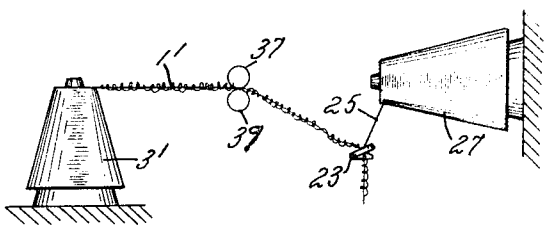


Fig. 3

METHOD FOR MANUFACTURING A PLIED YARN

The present application is a division of application Ser. No. 637,399, filed May 10, 1967, now U.S. Pat. No. 3,483,690.

Under the prior art, it was known that multifilament yarns could be bulked to a high degree by causing a large number of randomly spaced loops to be formed in the individual filaments. This was achieved by maintaining the yarn under low tension in contact with at least one heated surface wherein both the temperature of the heated surface and the extent of the contact of the yarn with said heated surface were controlled whereby shrinkage of only some of the individual filaments was effected. A convoluting of the remaining filaments simultaneously occurred. This is known as a differential shrinkage method for texturizing yarns.

Briefly, this invention comprises the steps of differentially shrinking a multifilament yarn whereby a multiplicity of convolutions are formed therein; merging the differentially shrunk yarn with a spun yarn to form a yarn composite and plying the yarn composite whereby the spun yarn clings to the multiplicity of convolutions in the differentially shrunk yarn, thereby resulting in a plied bulk yarn having a uniform consistency along the length thereof.

One object of this invention is to provide a method for plying a continuous multifilament yarn with a second yarn;

Another object of this invention is to achieve an improved stability in textile fabrics manufactured from the product produced by the method described herein.

A still further object of this invention is to manufacture a knitted or woven textile fabric capable of being cross-dyed to produce a sharply defined heather effect.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description which is to be considered in connection with the accompany-ing drawings wherein:

FIG. 1 schematically illustrates the method according to the invention;

FIG. 2 shows a 150 denier, 34 filament polyester yarn plied with a 35/1 cotton yarn, greatly magnified after being subjected to the method of the invention; and

FIG. 3 schematically illustrates another embodiment of the invention.

The multifilament continuous yarn is one selected from the group consisting of conventional thermoplastic yarns.

Thermoplastic yarns are those yarns which are made by converting synthetic thermoplastic chemicals into yarns with subsequent drawing to render them suitable for use in weaving, knitting, and other textile operations and which have the common characteristic of becoming ductile, or more ductile and decreasing in length on the mere application of heat when in the relaxed state. Examples of such yarns are polyamides, acrylics, polyesters, polyolefins, tri-acetates, and the like.

With reference to the drawing, the multifilament yarn **1** passes from a supply bobbin **3**, supported on a suitable creel holder, through a guide eye **11**, then through a tension regulator **13**, which controls the tension of the yarn as it is passed over a first heated surface **15** and then over a second heated surface **17**.

The shape of these surfaces is not critical. They can have shapes which may be flat, curved, tubular, corrugated, round, or the like. As shown in FIG. 1, the heated surfaces **15** and **17** are formed as two pins. The pins **15** an **17** are matte finished or sandblasted at their surfaces in order to minimize the friction of the yarn passing thereover. Each of these pins is heated from a separate source in order to obtain a greater control of the bulking of the yarn **1** passing thereover. It is to be understood that only a single pin need be employed or that a single heat source need be used for both pins. It is also within the scope of this invention that the pins themselves could also be the conductor of current passing therethrough whereby they form themselves the resistance heating elements. Other forms of heat, such as radiant, are also within the scope of this invention.

An energy source **19** operatively connected to the first pin **15** maintains it at a temperature ranging from 150° to 400° F., preferably from 250° to 350° F., and a second energy source **21** operatively connected to the second pin **17**, maintains it at a temperature ranging from 300° to 600° F. and preferably from 350° to 450° F.

The yarn passes circumferentially over the surfaces so as to just touch the surfaces and the friction is maintained at a minimum. After passing over the second pin **17** the yarn **1** passes vertically downwardly through a pigtail guide eye **23** wherein it is merged with another yarn **25**.

The second yarn **25** is one selected from the group comprising cotton, flax, rayon, wool, silk, and both texturized and untexturized thermoplastics as defined above. It is to be understood that yarn **25** can be either in the form of continuous filaments or spun staples.

Yarn **25** is mounted on a supply bobbin **27** supported on a suitable creel holder from which the yarn **25** passes through the guide eye **23** and clings to the differentially shrunk yarn because of the multiplicity of convolutions therein. The resulting composite yarn **29** passes through a grooved guide means **31** and then between a pair of cot rolls **33** and **35** for controlling the speed of the multifilament yarn passing over the pins **15** and **17** as well as the speed of the composite yarn being wound on spindle **7**, and finally is plied through a pigtail guide means **38** to a takeup bobbin **5** mounted on a spindle **7**, the latter being driven by a belt **9** to control the twist of the yarn while passing over pins **15** and **17**.

The temperature of pins **15** and **17**, the speed of the yarn passing over the pins, the yarn tension are all correlatively controlled to maintain the tension lower than the dynamic retractive forces of the material being processed in order to insure sufficient shrinkage of the yarn filaments to maintain an overfeed of the multifilament yarn **1** passing through the guide **23**. This enables the multifilament yarn to become wrapped around the yarn **25**. It is extremely difficult to determine the precise temperatures, yarn speeds and yarn tensions which are obtained in the practice of this invention with the apparatus of the drawing. However, the particular temperature for a given speed and for a given tension can be determined by adjusting the temperature of the pins so as to obtain the shrinkage necessary to produce the convolutions in the thermoplastic yarn **1** as shown in FIG. **2**.

Referring to FIG. **3**, it is also within the scope of this invention to include the treatment of a differentially shrunk yarn which has been wound onto a bobbin and stored. In such an embodiment the previously differentially shrunk multifilament yarn **1'** is overfed by overfeed means **37** and **39** to guide **23** and merged with yarn **25** as described hereinabove.

I have found that yarn speeds ranging from 100 to 1,500 feet per minute, preferably 200 to 800 feet per minute, are quite satisfactory. Likewise, yarn tensions prove quite satisfactory if maintained within a range of 0.05 to 5 grams, preferably from 0.1 to 1.5 grams.

The twist of the composite yarn **29** is maintained within a range of 0.2 turns per inch to 8.0 turns per inch, preferably 0.25 to 3.0 turns per inch.

It is to be further understood that at high linear speeds, the temperature has to be increased and the tension has to be decreased due to the lowered residence time of the yarn on the heated surfaces. It is actually possible at sufficiently high speeds to have the heated surfaces **15** and **17** higher in temperature than the melting point of the yarn.

The degree of bulking can vary quite markedly according to the conditions of treatment; however, it is not converted into a stretch yarn and the dimensional stability of the composite yarn blend is markedly improved by following the method of this invention.

EXAMPLE I

A 70 denier,* (*The denier of each of these multifilament yarns will be increased by an amount commensurate with the

degree of shrinkage undergone by them in the treatment according to this invention.) 34 filament polyester yarn was passed from a supply spindle **3** at a rate of 600 feet a minute, and a tension below 0.5 grams over pin **15**, which was maintained at a temperature of 370° F., then over pin **17** which was maintained at a temperature of 410° F. After passing over the pin **17**, the yarn was plied with a 30/1 carded cotton yarn and the composite yarn blend was then twisted 0.25 turns per inch.

This yarn blend demonstrated a marked bulking effect and also possessed both excellent dimensional stability and uniform consistency along the length thereof.

EXAMPLE II

A 200 denier,* (*The denier of each of these multifilament yarns will be increased by an amount commensurate with the degree of shrinkage undergone by them in the treatment according to this invention.) 20 filament nylon yarn was passed at 213 feet per minute at a tension of 1 gram over pin **15**, which was maintained at a temperature of 370° F., then over pin **17** which was maintained at a temperature of 400° F., after which the yarn was plied with a 60/1 carded cotton yarn and the composite yarn blend twisted 2.5 turns per inch. Again this composite yarn exhibited a marked bulkiness and also exhibited excellent dimensional stability.

EXAMPLE III

A 210 denier,* (*The denier of each of these multifilament yarns will be increased by an amount commensurate with the degree of shrinkage undergone by them in the treatment according to this invention.) 34 filament polypropylene yarn was passed at a speed of 280 feet per minute under a 0.5 gram tension over pin **15** which was maintained at a temperature of 240° F., then was passed over pin **17** whose temperature was maintained at 280° F. after which it was plied with a textured nylon "set" superloft yarn (2 ply 70 denier) and the composite yarn blend was twisted 1.7 turns per inch. Again, a marked bulking effect was produced and the stability of the yarn ply was excellent.

EXAMPLE IV

A 150 denier,* (*The denier of each of these multifilament yarns will be increased by an amount commensurate with the degree of shrinkage undergone by them in the treatment according to this invention.) 68 filament polyester yarn was passed at a speed of 600 feet per minute under a tension of 0.5 grams over pin **15** which was maintained at a temperature of 370° F. then was passed over pin **17** whose temperature was maintained at 410° F. after which it was plied with a 35/1 carded cotton yarn and the yarn blend was twisted 1.35 turns per inch. As indicated hereunder, this yarn blend also exhibited good stability and marked bulking.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise then as specifically described herein.

What is claimed is:

1. A method of plying a continuous multifilament thermoplastic yarn with a spun yarn comprising passing a continuous multifilament thermoplastic yarn over at least one heated surface while maintaining said multifilament yarn under a tension which permits shrinkage of individual filaments and controlling the temperature of each heated surface and the extent of contact of the multifilament yarn therewith so that shrinkage of only some of the filaments is effected and convolutions are formed in the other filaments; merging said multifilament yarn with a spun yarn; and twisting said merged yarns together, whereby a plied yarn is produced in which the spun yarn clings to the convolutions in the unshrunken filaments of the multifilament yarn resulting in a plied yarn having a uniform consistency along its length.

2. A method according to claim **1** wherein said multifilament thermoplastic yarn is passed over two heated surfaces to effect shrinkage of only some of the filaments.

3. A method according to claim **2** wherein the temperature of the first heated surface ranges from 150° to 400° F. and the temperature of the second heated surface ranges from 300° to 600° F.

4. A method according to claim **1** wherein passage of said multifilament yarn over at least one heated surface is carried out at a yarn speed of 100 to 1,500 feet per minute while maintaining said yarn under a tension of 0.1 to 1.5 grams.

5. A method according to claim **1** wherein said multifilament thermoplastic yarn is comprised of a thermoplastic material selected from the group consisting of polyamides, acrylics, polyesters, polyolefins and tri-acetates.

6. A method according to claim **1** wherein said spun yarn is comprised of a material selected from the group consisting of cotton, flax, rayon and wool.

7. A method according to claim **1** wherein said multifilament thermoplastic yarn is polyester yarn and said spun yarn is cotton yarn.

8. A method according to claim **1** wherein said multifilament thermoplastic yarn is overfed prior to the merging step.

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