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METHOD OF FORMING TEXTURED YARN

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This invention relates to the art of producing textured yarns and fabrics. In particular, it relates to novel composite yarns, to fabrics produced from such yarns, and to the method of producing these textured yarns.

The art is now replete with methods for forming textured synthetic yarns, and fabrics therefrom, which have many of the qualities of the natural apparel yarns and fabrics. The early problems encountered in imparting to synthetic fibers and yarns the appearance, flexibility, absorbency, hand and other fine qualities possessed by the natural fibers and yarns are well known. In particular, and even yet of acute interest, are methods for imparting to synthetic fibers and yarns the special qualities of bulk and elasticity.

Present methods for texturizing yarns serve their purpose admirably, though in varying degrees. Such methods require, inter alia, however, relatively expensive and complex apparatus for the production of such yarns. Textured yarns are thus manufactured by various core spinning techniques and especially by the heat treatment of thermoplastic yarns by such methods as gear-crimping, stuffer box-crimping, false twist-crimping, edge-crimping and the like. In these methods a synthetic thermoplastic yarn is deformed or placed in some desired configuration and then set by softening with heat and then cooling to effect setting in the deformed condition. The configuration in which the yarn is set may even be removed. Even though set thermoplastic yarn is not permitted to remain in the condition of its deformity, it nevertheless, however, possesses an "elastic memory" or potency to return to its original heat set condition. Because of such memory, the yarn takes on a textured appearance and generally possesses elasticity. Thus, upon application of a deforming force the yarn will be extended and, upon removal of such force, the yarn will return to its relaxed condition. The yarn also possesses bulk provided by its crimped condition or irregular extension into space, as caused by curls and kinks resultant from such treatment. Bulk and elasticity are present in such textured yarns in varying degrees.

While such methods of producing textured yarns, especially those having good bulk and elasticity, have been very successful there is nevertheless an acute need to provide simpler methods of producing such textured yarns.

It is in fact, the primary objective of the present invention to fulfill this need and to provide the art with a relatively simple method for the production of such textured yarns. Another object is the provision of novel composite yarns, or fabrics composed of such yarns, which can be heat treated to provide textured yarns and fabrics.

These and other objects are achieved in accordance with the invention which contemplates the formation of a composite yarn structure by twisting or plying together a plurality of yarns, including a first thermoplastic yarn and a second heat shrinkable yarn. By applying heat to this composite yarn the heat shrinkable yarn contracts or shrinks to cause distortion of said first thermoplastic yarn into the configuration of a series of randomly located loops and coils. Heating to the softening temperature of the said first thermoplastic yarn sets the configuration of loops and coils into said first thermoplastic yarn. Separation of the first thermoplastic yarn from the composite yarn provides a textured yarn.

The heat shrinkable or second yarn is also preferably

a thermoplastic yarn having a flow temperature less than that of the first thermoplastic yarn, and also less than the softening temperature of the first thermoplastic yarn. By providing a composite yarn wherein the flow temperature of the heat shrinkable or second yarn member is lesser than that of the first yarn or thermoplastic yarn member to be heat set, and below its softening temperature, the composite yarn can be heated to effect contraction of the shrinkable yarn. The temperature of the yarn can then be elevated to the softening temperature of the said first thermoplastic yarn to effect its heat setting. In heating such yarn composite ultimately to the softening temperature of the first thermoplastic yarn in this manner the second thermoplastic yarn melts and is thus separated from the yarn composite. In this manner, the component parts of the composite yarn are separated quite conveniently and require no untwisting or other physical or chemical separation of these members. In such embodiment, preferably, the flow temperature of the second heat shrinkable thermoplastic yarn ranges from about 18 to about 45 Fahrenheit degrees less than the softening temperature of said first thermoplastic yarn. It is apparent that if the heat shrinkable yarn volatilizes or heat decomposes below the softening temperature of the first thermoplastic yarn that essentially the same result will be achieved. Moreover, it is apparent that fabrics of such composite yarns can be heat treated in similar fashion to provide textured fabrics.

A feature of the invention is that the size of the loops and coils formed within the first thermoplastic yarn can be controlled by the quantum of twist applied to a composite yarn. Thus, a high quantum of twisting will reduce the size of the coils or loops, but will increase the number thereof per unit of linear measurement. Conversely, a lesser quantum of applied twist will increase coil and loop size, and the lesser will be the number of coils or loops per linear unit of measurement. Preferably, a twist ranging from about one-half to about thirty turns to the inch, and more preferably from about five to about ten turns to the inch, is provided for optimum results. Numerous simple methods of twisting or plying yarns together are well known to the art, and quite obviously the twisting can even be done by hand.

The following non-limiting examples are illustrative of preferred embodiments of the present invention.

On an Atwood 10–B twister, composite yarns of the following types were prepared:

A. 1.2/70 denier nylon 66 plied with 14 denier polypropylene five turns of Z twist to the inch.

B. A second yarn was prepared as in (A) using 2/70 denier nylon and 40 denier polypropylene, and

C. A yarn composite was prepared as in (A) using 2/140 denier nylon and 14 denier polypropylene.

D. A yarn composite was prepared as in (A) using 2/140 denier nylon and 40 denier polypropylene.

Each of the composite yarns described above were then heated to 300° F. in the dry heat of a circulating oven for a period of fifteen minutes. At this temperature the polypropylene was shrunken, and the nylon distorted into a configuration of loops and coils randomly spaced along the length of the composite yarn. The temperature was then raised to 400° F. for a period of fifteen minutes which melted the polypropylene while simultaneously softening and heat setting the nylon in the aforesaid shrunken configuration. The yarns were then removed from the oven. The resulting textured yarn was found to possess considerable bulk and had good resiliency or elasticity. When the yarns were knitted and woven into fabrics good stretch properties were imparted to these fabrics.

When composite yarns A, B, C, and D, respectively, are knitted and subjected to a similar time-temperature

elevation profile as in the foregoing, knitted elastic fabrices of good quality are obtained. The same is found to be true of fabrics woven of yarns A, B, C, and D, respectively, which are heat treated in similar fashion.

The key and novel feature of the present invention resides in the formation of a composite structure wherein thermoplastic yarn components capable of being set, are twisted or plied together with heat shrinkable yarn members which can be heat contracted to produce deformation of the former. Moreover, preferably the latter will not only shrink upon application of heat but which will also melt, volatilize or decompose below the softening temperature of the thermoplastic yarns to be heat set. And, most preferably, the composite yarn is formed of yarns which will be shrunken at a first temperature to affect loop configuration within thermoplastic yarns to be heat set and, upon further increase in temperature to the softening temperature of the latter the heat shrinkable yarn components will flow and become separated from the composite yarn structure.

It is thus apparent that the heat shrinkable yarn members of the composite structure first serve as a matrix for shaping by deformation of the thermoplastic yarns to be heat set in the form of loops and coils. Then upon the heat setting of the latter in the desired configuration the former is thus conveniently removed by the heat treating leaving behind only heat set shaped textured thermoplastic yarns.

The invention therefore contemplates preselection of the yarns of the composite yarn structure in accordance with these principles, recognizing that certain species of the thermoplastic yarns can be used in a given yarn composite as the first thermoplastic yarn or yarns to be deformed and heat set and yet in another different composite yarn as the second or heat shrinkable yarn member of the component. Conversely, the second thermoplastic yarn or heat shrinkable yarn of one composite yarn may serve as the yarn to be heat set but in another composite yarn may be the heat shrinkable member. The selected yarns, however, differ according to their physical properties as explained.

In general, the heat shrinkable thermoplastic yarn members utilized in accordance with this invention are those having a flow temperature ranging from about 200° F. to about 350° F., more preferably from about 250° F. to about 350° F. (A.S.T.M. D569–59, procedure A).

Exemplary of such materials are polyethlene, polypropylene, preferably high density polypropylene, polyvinyl alcohol, polyvinyl acetate, cellulose acetate, other thermoplastic derivatives of cellulose, polyvinyl butyrates, the lower melting nylons and the like.

The synthetic thermoplastic yarns which can be deformed and heat set in accordance with this invention are those widely disclosed and acclaimed in the technical and patent art, especially in the cramping art, i.e., stufferbox-crimping, edge-crimping, false twisting and gear-crimping. (See, e.g., Shirley Institute Pamphlet No. 81, A Survey of the Literature and Patents Relating to Bulked Continuous Filament Yarns, by E. A. Hutton and W. J. Morris.) In general, however, such yarns are those having a softening temperature ranging from about 250° F. to about 450° F. and preferably from about 350° F. to about 450° F. Exemplary of such yarns or such artificial filaments are regenerated cellulose produced from viscose, nitrocellulose, cuprammonium acetate, cellulose esters, such as cellulose acetate, cellulose propionate, cellulose acetate butyrate; cellulose ethers, such as ethyl cellulose and benzyl cellulose; nylons, such as the polyamides; proteinous fibers such as those from casein; resin fibers such as the vinyl polymers, e.g., polyvinyl chloride, polyvinylidene chloride, copolymers of vinyl chloride and vinyl acetate, copolymers of vinyl chloride and acrylonitrile, polyethylene; resins from polyacrylic derivatives, such as polyacrylonitrile; and the like.

Yarns are also selected on the basis of providing the desired results after only a few minutes of heating depending in part upon the temperature employed, the relative flow temperatures of the composite members and the efficiency of the heating system employed. Numerous methods of heating these composite yarns are available and essentially any method can be used which is compatible with the preservation of the final yarn product and with the method steps to be achieved. The heat employed can be of wet or dry type, e.g., wet or dry steam, gas such as air and the like. Radiant heat can be used or heat may be applied to the yarn in the form of a hot contact surface upon which the yarn impinges. A source which will provide uniform heating is preferred. Accordingly, the invention should not be limited except as within the scope of the appended claims.

Having described the invention what is claimed is:

1. A method of forming textured thermoplastic yarns comprising forming a composite yarn by twisting together a pluarility of yarns including a first thermoplastic yarn and a second heat shrinkable yarn, and then applying heat to said composite yarn to effect contraction of the heat shrinkable yarn thereby causing said first thermoplastic yarn to assume a configuration having a series of randomly disposed loops and coils along its length, heating said composite yarn to the softening temperature of said first thermoplastic yarn to effect setting of said first thermoplastic yarn in the aforesaid configuration and separation of the first thermoplastic yarn from the yarn composite.

2. The method of claim **1** wherein the composite yarn is formed of a first thermoplastic yarn and a second heat shrinkable thermoplastic yarn, said second thermoplastic yarn having a flow temperature less than the softening temperature of said first thermoplastic yarn.

3. The method of claim **2** wherein the second thermoplastic yarn has a flow temperature ranging from about 18 to about 45 Fahrenheit degrees less than the softening temperature of the first thermoplastic yarn.

4. The method of claim **1** wherein the composite yarn is twisted together at from about one-half to about thirty turns per inch.

5. A method of forming textured thermoplastic yarns comprising forming a composite yarn by twisting together a plurality of yarns at from about one-half to about thirty turns to the inch, said composite yarns including a first thermoplastic yarn having a softening temperature ranging from about 250° F. to about 450° F. and a second heat shrinkable thermoplastic yarn having a flow temperature ranging from about 200° F. to about 350° F. and at least about 18 to about 45 Fahrenheit degrees less than the softening temperature of the first thermoplastic yarn, applying heat to said composite yarn to effect contraction of the heat shrinkable thermoplastic yarn thereby causing said first thermoplastic yarn to assume a configuration having a series of loops and coils randomly disposed along its length, then further heating said composite yarn to the softening temperature of said first thermoplastic yarn to effect setting of said first thermoplastic yarn in the aforesaid configuration and thereby melting the said heat shrinkable thermoplastic yarn and thus effecting its separation from the said first thermoplastic yarn, and then reducing the temperature.

6. The method of claim **5** wherein the composite yarn structure includes a first thermoplastic yarn of nylon and a second thermoplastic yarn of polypropylene.

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