3,220,085

textile process for forming stretching yarn


2 Claims. (Cl. 28—72)

This application is a division of our copending application Serial No. 131,119, filed August 14, 1961, now Patent No. 3,146,575.

This invention relates to a method for making an elastic yarn.

In recent years there has arisen a demand for stretch yarns, i.e., yarns which, without any elastomeric component, have a high degree of recoverable stretch. Such yarns are normally multi-ply yarns in which the stretchiness is obtained by controlling the twist given to the various component yarns.

It has been proposed to make bulky yarns by blending thermoplastic and non-thermoplastic fibers and then heating the blend. On heating, the thermoplastic fibers shrink, causing the yarn to be shortened in length and the non-thermoplastic fibers to be folded upon themselves. Although such yarns are bulky, i.e., of increased diameter, they are not stretchy; that is to say, when pulled out, they recover their original length only to a very limited extent.

The present invention provides a method for making a new type of yarn which is both bulky and stretchy. Yarns made in accordance with the invention comprise thermoplastic fibers and cross linked cellulosic filamentary material in which at least a major portion of said cross linked cellulosic fibers have a memory, rendered permanent by the cross linking, for a physical position in which the individual filaments are buckled or folded under themselves. Such composite yarns are made, in accordance with the invention, by blending thermoplastic filamentary material with cellulosic filamentary material, heating the resulting yarn to shrink the thermoplastic filamentary material, thus folding the cellulosic material upon itself, and cross linking the cellulosic material.

The thermoplastic filamentary material used in the present invention is preferably any thermoplastic filament which shrinks when heated. Polyolefin fibers such as polyethylene or polypropylene fibers are particularly suitable but other similar materials can be used such as nylons, polyesters, e.g., polyethylene terephthlate, vinyl chloride, vinyl acetate, acrylonitrile, acrylic ester and cellulose ester, e.g., cellulose acetate fibers. Preferably the thermoplastic filamentary material is present in the yarn as staple fiber. The denier of the thermoplastic filament is not critical and will, of course, vary with the composition of the filaments, but will usually be from about 1.5 to about 15.

The cellulosic filamentary material may be natural cellulosic fiber such as cotton, linen, jute, sisal and hemp, or it may be regenerated cellulose in which case it may be made by any desired process, e.g., by the viscose, cuprammonium, nitrate processes or by the saponification of cellulose esters such as cellulose acetate. Preferably staple fiber is used. The denier of the filaments may again vary widely but will usually be from about 1.5 to about 15.

The cellulosic filamentary material may be cross linked by any of the reagents known to the art. Those include the formaldehydes such as glutaraldehyde and adipaldehyde, hydroxy aldehydes such as hydroxyaldehyde, mixed aldehydes such as acrolein, glycidyl aldehydes; the so-called reactant type resins, for example modi-
curing agent used is such that premature curing does not take place. In most cases it is preferable to impregnate the blended yarn with curing agent and since in most cases shrinking of the yarn will require a temperature at least equal to the curing temperature of the cross linking agent, it is preferred to impregnate the yarn after it has been shrunk.

Shrinking of the yarn is carried out by simply heating the yarn in a relaxed condition. The temperature required will of course depend on the nature of the thermoplastic fiber and can range from say 70 to 250°C. Any suitable heating apparatus may be employed.

In impregnating the yarn, various manipulative procedures may be used. Conveniently, the yarn may be passed through a bath of the agent or the yarn or a bundle of yarns may be laid down in a plaited pattern on a moving belt and subjected to a spray or bath of a liquor containing the reagent.

The concentration of the cross linking agent in the treating liquor will of course depend on the amount of cross linking it is desired to effect, on the composition of the yarn and on the efficiency of the cross linking agent. In general it should be such as to deposit on the yarn between about 0.1 and about 15% cross linking agent, based on the dry weight of cellulose in the yarn.

After the yarn has been impregnated, it may be dried at a temperature of say 120 to 150°C, and cured at a temperature which will depend on the cross linking agent used, but which will in general range between about 150°C and about 190°C. If desired, drying and curing may be carried out simultaneously. The yarn should be in a relaxed condition during both drying and curing. If desired, impregnation may be carried out before shrinking, and shrinking and curing effected simultaneously. However, in general the results are not as satisfactory as when the yarn is fully shrunk prior to curing.

The invention will be further described with reference to the following specific examples which are given for purposes of illustration only and are not to be taken as in any way limiting the invention beyond the scope of the appended claims.

**Example 1**

A yarn containing 25% by weight 2 inch, 3 denier polypropylene staple fiber and 75% by weight 2 inch, 3 denier viscose rayon staple fiber is heated at 160°C. for 3 minutes to effect curing. A bulk yarn having excellent elastic recovery is obtained.

**Example 2**

The yarn used in Example 1, containing 25% by weight 2 inch, 3 denier polypropylene staple fiber and 75% by weight 2 inch, 3 denier viscose rayon staple fiber is heated at 160°C. with impregnation with cross linking agent. A shrinkage of 26% is observed. The bulky yarn so obtained is treated with an aqueous solution containing 10% by weight dimethylol ethylene urea and 3% MgCl₂·6H₂O, padded to 100% pickup, dried at about 80°C, and cured for three minutes at 160°C.

Samples ten inches long are again weighed, and stretch and recovery measured. The results are shown in Table B below:

<table>
<thead>
<tr>
<th>Load, grams</th>
<th>Percent Stretch</th>
<th>Percent Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>11</td>
<td>91</td>
</tr>
<tr>
<td>40</td>
<td>10</td>
<td>88</td>
</tr>
<tr>
<td>60</td>
<td>14</td>
<td>88</td>
</tr>
</tbody>
</table>

It will be observed that when shrinkage is completed before cross linking, higher stretch and elastic recovery are obtained than when stretching and curing are carried out simultaneously.

**Example 3**

The yarn used in Examples 1 and 2 is heated to 160°C. to effect a shrinkage of 26% and then impregnated with an aqueous solution containing 3% HCHO and 3% MgCl₂·6H₂O. It is padded to 100% pickup, dried at 80°C. and heated to 160°C. for 3 minutes to effect curing. A bulk yarn having excellent elastic recovery is obtained.

**Example 4**

To compare yarns according to the invention with non-cross linked yarns and to illustrate the effect of cross linking in promoting elastic recovery, the same yarn used in Examples 1 and 2 is heated to 160°C. for three minutes to give 36% shrinkage and then tested, without impregnation, for stretch and recovery. As before, 10 inch samples were used. The results are listed in Table C below:

<table>
<thead>
<tr>
<th>Load, grams</th>
<th>Percent Stretch</th>
<th>Percent Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>20</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>30</td>
<td>17</td>
<td>22</td>
</tr>
<tr>
<td>40</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>50</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>60</td>
<td>24</td>
<td>25</td>
</tr>
</tbody>
</table>

The foregoing examples show clearly that cross linking the cellulose establishes a memory in the cellulose for its folded, contracted position and greatly enhances the elastic properties of the yarn.

We claim:

1. A method for forming a stretchy yarn which comprises blending cellulose filamentary material with thermoplastic filamentary material to form a yarn, heating said yarn to shrink said thermoplastic filamentary material and to cause the individual cellulose filaments to be folded back upon themselves, impregnating the shrunken yarn with a cross-linking agent for the cellulose which is substantially inert to said thermoplastic material and heating the impregnated yarn in the substantially absence of tension to effect cross-linking of the cellulose filaments in said folded position.
2. A method for forming a stretchy yarn which comprises blending cellulosic filamentary material with thermoplastic filamentary material to form a yarn, impregnating said yarn with a cross-linking agent for the cellulose which is substantially inert with respect to said thermoplastic material and heating said impregnated material in the substantial absence of tension to shrink the thermoplastic material, thereby causing the cellulosic filaments to fold back upon themselves; said heating simultaneously causing cross-linking of the cellulosic filaments in said folded position.

References Cited by the Examiner

UNITED STATES PATENTS

2,504,523 4/1950 Harris et al. 57—140
2,575,755 11/1951 Foster 57—157
2,602,285 7/1952 Woodell 57—157
2,701,406 2/1955 Bloch 57—140
2,808,311 10/1957 Hare 28—72
2,930,521 8/1960 Wheat et al. 28—75 X

DONALD W. PARKER, Primary Examiner.