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METHOD FOR PRODUCING BULKED, HIGHLY STRETCHABLE TEXTURED COTTON YARNS

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A nonexclusive, irrevocable, royalty-free license in the invention herein described, throughout the world for all purposes of the United States Government, with the power to grant sublicenses for such purposes, is hereby granted to the Government of the United States of America.

This invention relates to cotton yarns that exhibit high stretch and subsequent recovery from stretch characteristics together with inherent bulk. The production of these cotton yarns is likewise the subject of this invention. The yarns that are the subject of this invention have particular utility in the manufacture of upholstery, rugs, and certain items of wearing apparel where yarns with considerable bulk and good stretch and stretch recovery are required.

In general, the cotton yarns of this invention are produced by resin treating plies of a plurality of single yarns having the same directional twist, the yarns having been twisted during plying in the same direction as the several singles from which it was made, with a crosslinking type resin and heat curing the resin. The twist in the resultant plied yarn is subsequently set in position by heat curing the resin and the yarns carrying the cured resin treatment are then backtwisted. The backtwisted yarn, when relaxed tends to return to the position in which it was set when the resin was cured. The component yarn strands separate and the relaxed, backtwisted resin treated yarn takes on the appearance of multiple, helical coiled springs, each yarn strand forming coils in the direction of the backtwist.

When tensioned and fully extended, the yarns that are the subject of this invention resemble ordinary plied yarns.

It is known to treat yarns made from continuous synthetic filaments by heating, twisting, crimping, and various combinations of these treatments and thereby to produce stretch or the so-called elastic yarns, but the production of yarns that possess these characteristics from relatively short discontinuous fibers such as those of cotton has, until now, not been accomplished.

We have found various modifications of our basic procedure that are desirable for producing particular products.

We can, for example, resin treat cotton sliver, dry without heat curing, draw the treated sliver into roving, spin the roving into singles yarn, and ply the yarns in the same direction as the twist in the single components. The resultant plied yarn after receiving the required twist is heat cured. The heat curing of the resin serves to set the yarn in its twisted position. The yarn is then washed, dried, and backtwisted. Roving may be handled in similar fashion.

Another method is to treat single yarns with resin during a wet twisting operation whereby the yarns are plied in the same direction as the twist in the single components. The yarns are subsequently made into skeins to prevent resin migration during drying in a conventional oven. The resin-treated yarns are then cured, washed, dried, and backtwisted.

Dielectric heat can be used to dry and cure the highly twisted plied yarns in package form, since this method of heating provides a uniform heat throughout the package and minimizes resin migration. The single yarns are

plied without resin (Z twist on top of Z twist), wound to approximately one-pound packages on perforated fiber tubes, treated with the resin solution in a package dyeing machine, centrifuged to the required wet pick-up, cured using dielectric heat, washed, dried, and backtwisted.

It is also possible to resin treat and cure the yarns on a continuous range and then backtwist.

We have investigated a variety of resin treatments and have concluded that dimethylol ethyleneurea and urea formaldehyde are two of the best; however, we have found that any resin treatment wherein crosslinking is involved (i.e., the resin treating reagent is at least difunctional) will yield good results with our process.

The bulk and the stretch of the cotton yarns that are the subject of this invention are controlled by varying the amount of twist in the component yarns, the amount of ply twist prior to heat curing, and the amount of backtwist after the yarn has been set by heat curing of the resin. For a given yarn size, the size of the helical coils in the relaxed yarn, alluded to earlier in this disclosure, is governed to some extent by the amount of twist in the original single yarns that go into the plies. As the twist of the singles is decreased, the coils become larger and the yarn can be straightened by less tension. The amount of ply twist and backtwist given to the yarn control the number of coils, the number of coils per inch increasing with increasing twist.

The following are detailed descriptions of methods for producing the products of our invention. As will be apparent to those skilled in the art, either a Z twist or an S twist can be used in the single yarns at the start. If S twist singles are used, these are plied with an S twist on top of the S twist singles and then backtwisted to a Z twist after the resin treatment.

Example 1

Single yarn—24/1, 19.6 t.p.i. Z was plied to produce—24/2, 20.8 t.p.i. Z (Z twist on top of Z twist). The plied yarn was wound on perforated fiber tubes (approximately 1.2 pounds per tube package). The yarn was then treated with a 10% by weight aqueous solution of dimethylol ethyleneurea which solution contained in addition 1.5% by weight of an acid salt catalyst and .01% by weight of a wetting agent. After treatment the yarns were centrifuged to a 65–70% by weight pick-up of the treating solution. This pick-up with the strength resin solution indicated accomplishes about a 4% by weight resin add-on to the yarn (yarn contained approximately 1% by weight of nitrogen).

The resin-treated yarn was dried and heat cured for five minutes by means of dielectric heating using an applied voltage of ten kilovolts, a frequency of forty megacycles and a spacing between plates of seven inches. After curing, the yarns were washed free of unreacted reagent and catalyst, dried, and backtwisted 34.6 t.p.i.

Example 2

Single yarn—24/1, 22 t.p.i. Z was plied to produce 24/3, 17.0 t.p.i. Z (Z twist on top of Z twist). The yarn was treated with a 10% by weight aqueous solution of dimethylol ethyleneurea which solution contained in addition 1.5% by weight of an acid salt catalyst and .01% by weight of a wetting agent, during the plying operation. A 65–70% by weight wet pick-up was obtained by adjusting the twister speed. The yarns were then made into skeins, dried in an oven at 80° C. for ten minutes, cured in an oven at 160° C. for six minutes, washed free of unreacted reagent and catalyst and dried. The result was a 4% by weight resin add-on. The dried yarn was then backtwisted 29.8 t.p.i.

Example 3

Single yarn—16/1, 18.1 t.p.i. Z was plied to produce 16/2, 17.0 t.p.i. Z (Z twist on top of Z twist). The yarn was made into skeins and treated on a padder with 15% by weight aqueous solution of tris-(1-aziridinyl)phosphine oxide (APO) which solution contained in addition 8% zinc fluoroborate catalyst based on weight of the APO and .01% by weight of a wetting agent. A wet pick-up of from 70–80% was obtained, resulting in a resin add-on of about 7.5%. After treatment the skeins of yarn were dried in an oven at 80° C. for ten minutes, cured in an oven at 160° C. for six minutes, washed free of unreacted reagent and catalyst and dried. The dried yarn was then backtwisted 29.8 t.p.i.

Example 4

Sliver was treated on a padder with a 10% by weight aqueous solution of dimethylol ethyleneurea which solution contained in addition 1.5% by weight of an acid catalyst and .01% by weight of a wetting agent. The pressure between the rolls of the padder was adjusted to obtain a 65–70% by weight wet pick-up. After treatment the sliver was dried in an oven. The sliver containing the dried but uncured resin was then processed into single yarn—24/1, 19.6 t.p.i. Z and plied to produce 24/2, 20.8 t.p.i. Z (Z twist on top of Z twist). The yarns were then cured in an oven at 160° C. for six minutes, washed free of unreacted reagent and catalyst, dried and backtwisted 34.6 t.p.i.

The yarns described in Examples 1–4 above were capable of complete recovery after being stretched to approximately 400% of their relaxed length. The yarns may appear to lose their stretch properties when kept in an extended position, such as being stored on bobbins, for a considerable length of time. However, they will gradually recover when relaxed and will spring back immediately upon wetting.

We claim:

1. A process for producing stretchable cotton yarns comprising the following sequential operations: plying a plurality of single yarns having the same directional twist, the plied yarn being twisted during plying in the same direction as the several singles from which it is made; treating the plied yarn with a heat curing resin of the crosslinking type; curing the plied resin treated yarn to set the initial yarn twist; and backtwisting the resin treated and cured yarn.

2. The process of claim 1 wherein additional twist is applied to the yarn prior to the resin treatment.

3. The process of claim 1 wherein the plied yarn being twisted during plying is simultaneously subjected to the resin treatment.

4. The process of claim 1 wherein the resin employed is selected from the group of crosslinking resins consisting of dimethylol ethyleneurea and tris(1-aziridinyl)phosphine oxide.

5. The process of claim 4 wherein the resin is dimethylol ethyleneurea in an amount sufficient to provide a resin add-on of about 4% by weight based on the weight of the untreated, plied yarn.

6. The process of claim 4 wherein the resin employed is tris(1-aziridinyl)phosphine oxide in an amount sufficient to provide a resin add-on of about 7.5% by weight based on the weight of the untreated plied yarn.

7. A process for producing stretchable cotton yarns comprising the following operations to be carried out in sequence: resin treating cotton sliver with a heat curable, crosslinking type textile treating resin; drying the resin treated sliver; drawing and spinning the resin-treated sliver into yarn; plying single yarns of the same directional twist into plies of a plurality of single yarns, the plied yarns having the same directional twist as the single yarns from which they are made; heat treating the plied yarns to cure the resin and set the initially installed and inherent twist in the plied yarns; and backtwisting the resin treated and heat cured yarns.

8. A process for producing stretchable cotton yarns comprising the following operations to be carried out in sequence: resin treating cotton roving with a heat curable, crosslinking type textile treating resin; drying the resin treated roving; spinning the resin-treated roving into yarn; plying single yarns of the same directional twist into plies of a plurality of single yarns, the plied yarns having the same directional twist as the single yarns from which they are made; heat treating the plied yarns to cure the resin and set the initially installed and inherent twist in the plied yarns; and backtwisting the resin treated and heat cured yarns.

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