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METHOD OF MAKING HIGH-BULK YARNS

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This invention relates to high bulk yarns, and more particularly to an improved process for the production of high-curl polyacrylonitrile and polyester yarns of the "high-bulk" type, and to yarns produced by such process.

The high-curl yarns called "high-bulk" yarns in the textile industry have been obtained notably from polyamides by high twisting, setting of the twist and untwisting, either in a number of successive operations, or by the applying of a false twist which is heat-set while it is being applied.

When either of the aforementioned methods is attempted to be practiced with yarns of acrylonitrile polymers or copolymers, or of polyesters, the results obtained are not entirely satisfactory. That is to say, the increase in volume of yarns, generally termed the "high-bulk" effect, is of relatively low order and normally insufficient for many commercial purposes.

It is recognized by those skilled in the art that yarns composed of these particular fibers may not be expected to produce the results achieved with polyamides and various other thermoplastic yarns merely by the practice of methods applicable to polyamides and such other yarns.

According to the present invention it has, however, been found that a substantially increased "high-bulk" effect may be obtained with yarns of acrylonitrile polymers and co-polymers and of polyesters, by a further thermal treatment of the yarn subsequent to the twisting, twist-setting, and untwisting operations of the prior art. This further thermal treatment is preferably effected while the yarn is under no appreciable tension, and may be effected while the yarn is either in skein form, in which case the thermal treatment is preferably effected by placing the skeins in an oven at a moderate elevated temperature, or such may be effected continuously as by linearly passing the yarn continuously through a heating zone at a moderate temperature, and preferably under no appreciable tension as by overfeed of the yarn through this heating zone. The continuous thermal post treatment may be carried out for example by passing the yarn axially through a tube having an effective temperature of approximately 150° C., or by bringing the yarn into contact, without appreciable tension, also as by permissive or positive overfeed, with a convex surface having a temperature of the order of approximately 95° C.

While the invention may be practiced by applying the basic method steps to a single yarn, it is more advantageous and preferable to combine, as by doubling, two treated yarns which have undergone opposite false twists (i.e. one yarn having undergone a false **Z**-twist and a second similar length of yarn having undergone a false **S**-twist). Subsequent to this combining of the two oppositely false twisted yarns, the combined yarn is subjected to the post thermal treatment as discussed above, preferably without appreciable tension, to thereby effect a high-bulk in the combined yarn.

Further, according to another aspect of the invention it is preferable to permit a slight filament heat shrinkage of the yarn, for example of the order of 0.5–2%, during the original high twisting of the base yarn, and to effect a further mechanical or spatial shrinkage of the order of 5–12% as the individual treated yarn proceeds to its take-up bobbin, in accordance with the principle of French Certificate of Addition 67,751 of March 31, 1955, to French Patent 1,054,338. The additional subsequent heat treatment of the yarn in order to effect the "high-bulking" thereof is then preferably carried out either on the individual yarn if such is to be used as a final product as such, or preferably on a doubled yarn of oppositely twist-treated yarns. By varying the shrinkage permitted during the false twisting and during the winding of the individual yarn onto the takeup bobbin preceding the subsequent post thermal treatment as discussed above, "high-bulk" yarns can be obtained which have varying elasticity and varying stretch.

The invention will be more readily understood from a practical example of the practice thereof, which example will naturally be understood to be illustrative only.

Example

A 90-denier yarn having an original twist of 100 **S**-turns or **Z**-turns per meter and consisting of an acrylonitrile co-polymer containing 5% of methylmethacrylate, is given a twist of 2,100 turns per meter on a device such as described in French Patent 1,054,338 of January 23, 1952, French Certificates of Addition 63,963 of June 19, 1953, and 66,140 of September 22, 1954, and notably French Patent 1,140,992 of January 6, 1956. The false-twist tubes for imparting the false twist according to these patents are employed in the instant example at a speed of 50,000 r.p.m., and the false twist is imparted in the opposite direction to the initial twist of the yarn. As in accordance with the above mentioned French patents and certificates of addition, the yarn is heated before it enters the rotating false-twist tubes as by tubular resistors which are disposed directly preceding the rotating tubes and are maintained at a temperature of, for example, 220–225° C. in the case of a yarn which has not yet undergone any heat setting. This heating of the yarn preceding its passage through the rotating false twist tubes serves to set the false twist in the yarn. When the yarn has already undergone heat setting prior to this heating and false twist action the tubular resistors are maintained at a temperature between the temperature of the first heat heat setting thereof and a temperature 5° C. below the softening point of the material of the yarn.

A slight filament contracting heat shrinkage of the order of 0.5–2% is preferably permitted during the false twisting of the yarn, as by overfeeding the yarn into the twist zone by this amount. Also, a further mechanical or spatial effective overall yarn shrinkage of 5–12% is effected as a result of the torque imparted to the yarn by the false twisting and setting operation, between the take-up bobbin and the feed roll delivering the yarn thereto, in accordance with the principle of Certificate of Addition 67,751 of March 31, 1955, to French Patent 1,054,338.

A length of treated yarn having undergone a false **Z**-twist and a similar length having undergone a false **S**-twist are assembled as by doubling at 120 turns per meter. The assembled yarn is thereafter subjected in skein form to an oven treatment at 90–95° C. and without appreciable tension thereon.

This subsequent oven treatment of the yarn in skein form imparts an improved "high-bulk" effect to the yarn, which yarn also has elastic and stretch characteristics, the degree of "high-bulk," elasticity and stretch being dependent upon the shrinkage permitted during the false twisting and during the winding as mentioned above.

Although this particular illustrative example is described with the subsequent thermal treatment of the yarn being effected while the yarn is in skein form, or in other words discontinuous post heat treatment under no appreciable tension, in many instances of commercial production a continuous treatment process is much more advantageous. As a prepared alternative to the skein post-heat-treatment, or discontinuoous process, a continuous post-heat-treatment may be carried out, as for

example by passing the yarn axially and without appreciable tension through a heater tube maintained at for example 150° C., or the bringing of the yarn into contact, without appreciable tension, with a convex heater surface maintained at approximately 95° C., as for example by means of electric current.

It will be apparent to those skilled in the art that various modifications may be made without departing from the scope and spirit of the invention. It is accordingly to be understood that the invention is not to be limited by the particular illustrative example disclosed herein, but only by the scope of the appended claims.

That which is claimed is:

1. The method of producing high-curl polyacrylonitrile, acrylonitrile co-polymer, and polyester yarns of the "high-bulk" type, comprising twisting in a first direction a first yarn of material selected from the group consisting of polyacrylonitriles, acrylonitrile co-polymers, and polyesters, setting of said first directional twist and untwisting of said yarn, twisting in the opposite direction to said first direction, a second yarn selected from said group, setting of said twist in said second yarn and untwisting of said second yarn, permitting filament heat shrinkage of each of said yarns during said first mentioned twisting thereof, overfeeding and mechanically spatially shrinking said yarns between approximately 5 to 12% subsequent to said first mentioned filament heat shrinkage, combining said yarns to form a combined yarn, and then subjecting said combined yarn to a subsequent heat treatment while under substantially no appreciable tension.

2. The method according to claim 1 wherein said filament heat shrinkage is in the range of approximately 0.5–2%.

3. The method according to claim 1 wherein said combined yarn is subjected to said heat treatment while continuously linearly moving said yarn through a heating zone.

4. The method according to claim 3 wherein said yarn is subjected to said subsequent heat treatment by continuous linear passage through a heater tube having an effective temperature of approximately 150° C.

5. The method according to claim 3 wherein said subsequent heat treatment is effected by continuous linear movement of said yarn over and in contact with a contact heater having an effective temperature of approximately 95° C.

6. The method according to claim 1 wherein said combined yarn is subjected in skein form to an oven heat treatment at approximately 90–95° C.

7. The method according to claim 1 wherein said yarns are combined by doubling and twisting.

8. The method according to claim 7 wherein said doubling and twisting is of the order of 120 turns per meter.

9. The method of producing high-curl polyacrylonitrile, acrylonitrile co-polymer, and polyester yarns of the "high-bulk" type, comprising twisting in a first direction a yarn of material selected from the group consisting of polyacrylonitriles, acrylonitrile co-polymers, and polyesters, setting of said first directional twist and untwisting of said yarn, permitting filament heat shrinkage of said yarn during said first mentioned twisting thereof, overfeeding and mechanically spatially shrinking said yarn between approximately 5–12% subsequent to said first mentioned filament heat shrinkage, and then subjecting said yarn to a subsequent heat treatment while under substantially no appreciable tension.

10. The method according to claim 9 wherein said filament heat shrinkage is in the range of approximately 0.5–2%.

11. The method according to claim 9 wherein said yarn is subjected to said subsequent heat treatment while continuously linearly moving said yarn through a heating zone.

12. The method according to claim 11 wherein said yarn is subjected to said subsequent heat treatment by continuous linear passage through a heater tube having an effective temperature of approximately 150° C.

13. The method according to claim 11 wherein said subsequent heat treatment is effected by continuous linear movement of said yarn over and in contact with a contact heater having an effective temperature of approximately 95° C.

14. The method according to claim 9 wherein said yarn is subjected in skein form to an oven heat treatment at approximately 90–95° C.

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