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3,440,701

STRAND TREATMENT

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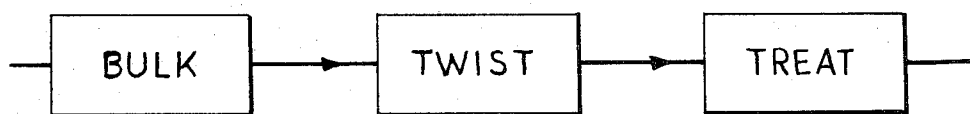


Fig. 1.

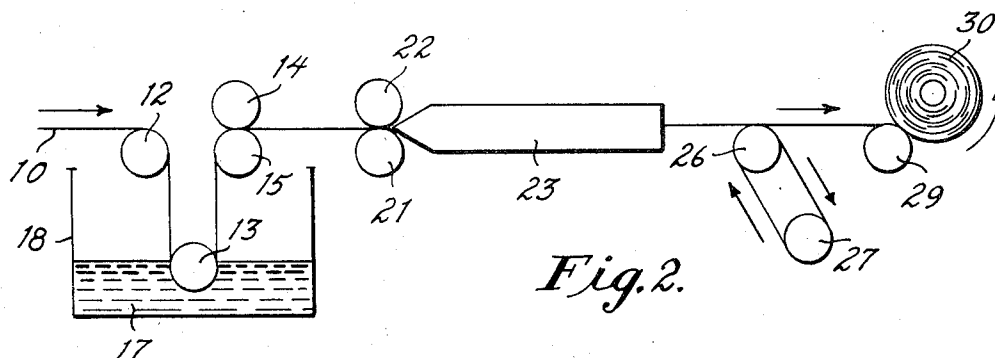


Fig. 2.

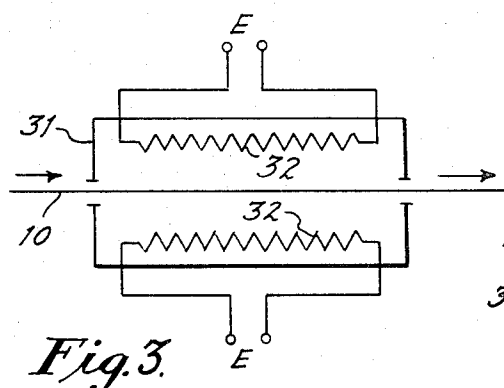


Fig. 3.

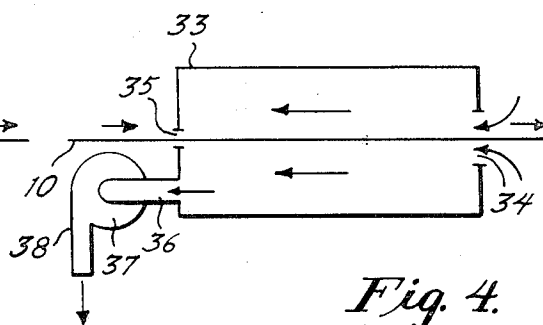


Fig. 4.

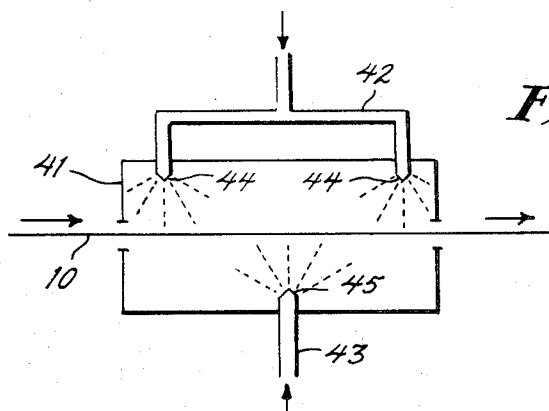


Fig. 5.

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1

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STRAND TREATMENT

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22 Claims

ABSTRACT OF THE DISCLOSURE

Multifilament textile strands are bulked by any of several crimping methods (e.g., gear-crimping, stuffer-crimping, or edge-crimping) not involving addition of twist (or false twist) thereto; then the bulked strand is twisted, either in the single or with plying or cabling; and the twisted bulked strand is plasticized, compressively relaxed, and dried under tension.

During and after being formed into fabric, multifilament textile strands often are subject to migration of component filaments from one strand or portion thereof to an adjacent strand or portion. This loss of identity or of structural integrity of a strand is usually undesirable and is particularly prevalent in strands that have been bulked, i.e. treated to increase the average interfilament spacing, such as by crimping distortion of generally rectilinear filament configuration. Simply twisting a strand in an attempt to bind its component filaments together is undesirable because it tends to reduce the imparted bulk and endows the strand with a tendency to untwist, which may actually foster filament migration.

A primary purpose of the present invention is stabilization of the structural integrity of multifilament textile strands.

Another object is preparation of multifilament textile strands for use in floor coverings of frieze, shag, or Saxony type.

A further object is performance of the foregoing in continuous manner.

Other objects of this invention, together with means and methods for attaining the various objects, will be apparent from the following description and the accompanying diagrams.

FIG. 1 is a schematic block diagram representing a succession of steps in the practice of the invention;

FIG. 2 is a schematic side elevation of apparatus for performing the last step of FIG. 1;

FIG. 3 is a schematic representation of apparatus for use in conjunction with the apparatus of FIG. 2;

FIG. 4 is also a schematic representation of apparatus for use in conjunction with the apparatus of FIG. 2;

FIG. 5 is also a schematic representation of apparatus for use in conjunction with the apparatus of FIG. 2.

In general, the objects of the present invention are accomplished in treatment of a multifilament textile strand, by the steps of bulking it without twisting it, imparting twist to the bulked strand, plasticizing the twisted bulked strand, then compressively relaxing the strand, and drying the strand under tension. For the sake of simplicity this process may be visualized, as in FIG. 1, as three successive steps or group of steps, the object of which is to BULK, to TWIST, and to otherwise TREAT the strand.

The bulking step may be accomplished by any method that does not depend upon or involve addition of twist (or false twist) to the strand, such as stuffer-crimping, gear-crimping, or edge-crimping. Examples of suitable stuffer-crimpers and their operation are disclosed in Pats. 2,311,174 to Hitt; 2,715,309 to Rosenstein et al.; 2,734,228

2

to Hay; 3,027,619 to List et al.; and 3,279,025 to Stanley et al. Examples of suitable gear-crimpers and their operation are disclosed in Pats. 2,216,142 to Taylor et al.; 2,668,430 to Laros; 2,988,799 to Atwell; 3,024,516 to Bromley et al.; and 3,217,377 to Baer et al. Examples of suitable edge-crimpers and their operation are disclosed in Pats. 2,790,611 to Massey; 2,919,534 to Bolinger et al.; 2,921,358 to Cox et al.; 3,028,653 to Evans; and Brit. Pat. 558,297 to I.C.I. Accordingly, no further description thereof is necessary here, it being understood that persons ordinarily skilled in the art can incorporate the same herein in performance of the first or BULK step hereof.

The second or TWIST step hereof can be performed on the strand in any suitable manner using, for example, equipment of conventional ring-twister type, such as Leesona Model 10-B, Fletcher Model 50, and Roberts "Ranger" Models; or two-for-one twisters, such as Verdol Model 200 and Scragg Model SDT 4. Thus no further description of twisting or plying equipment or its operation is required here to enable persons having ordinary skill to practice the indicated second step on the strand bulked in the first step. The actual amount or degree of twist imparted will depend upon the physical characteristics of the strand, its intended use, and other factors and is subject to control by suitable adjustment of the apparatus in a well known manner.

The final or TREAT step indicated in FIG. 1 is illustrated further in the succeeding views, which show in schematic form appropriate apparatus and modifications thereof.

In FIG. 2 strand 10, which was bulked and twisted in preceding steps, is shown passing successively over roll 12, under roll 13, and through the nip of rolls 14 and 15 above bath pan 18 containing liquid 17 into which roll 13 is immersed about halfway. Nip rolls 14 and 15 serve to squeeze excess bath liquid from the strand as well as to forward it to the nip of feed rolls 21 and 22 at the entrance of stuffing chamber 23 in which the strand accumulates temporarily under the compression of strand previously accumulated therein. From the exit of the stuffing chamber the strand proceeds in a plurality of wraps about pair of godets 26 and 27, and then on over drive roll 29, preferably of self-traversing type, for package 30 and onto the package.

Bath liquid 17 is preferably hot enough to soften the strand. Moreover, the wet strand may be heated otherwise before its entry into stuffing chamber 23, as by conventional internal or external heating of one or more of the rolls over which the strand passes. Instead of or in addition to heating the strand by means of the bath liquid or the rolls (or both) other conductive or convective heating means may be employed, as may radiant heating means illustrated in FIG. 3, which may be inserted between the pairs of nip rolls 14, 15 and 21, 22. Cylindrical chamber 31, through which the strand passes axially, has a plurality of heaters 32 of electrical resistance type connected to sources of electrical potential E and capable of raising the strand temperature to the softening temperature of any textile strand composition.

One or both of godets 26 and 27 may be heated internally or externally by conductive or convective means in conventional manner, or the radiant heating means illustrated in FIG. 3 may be used in place thereof or in addition thereto, for the purpose of drying the strand upon its exit from stuffing chamber 23. However, the heating arrangement illustrated in FIG. 4 is preferred to expedite transport of moisture away from the vicinity of the heater itself. Cylindrical chamber 33 accommodates the strand axially much as did chamber 31 in FIG. 3. However, opening 34 at the exit end of chamber 33 is somewhat larger than opening 35 at the entrance end. Communicating with the chamber interior by way of tube 36 near the entrance,

is exhaust pump 37 shown as being of centrifugal type. As indicated by arrows, air in the chamber interior enters principally by way of larger opening 34 and flows counter to the direction of travel of the strand before being drawn into the pump and exhausted through pump outlet 38. Thus, the driest air continuously encounters the driest portion of the strand, and the moistest air enters the pump from the vicinity of the moistest portion of the strand in the chamber and is exhausted, forcing replacement by dry air at the other end.

FIG. 5 shows alternative moistening means that may be substituted for the bath shown in FIG. 1. Cylindrical chamber 41, which also accommodates the strand axially, has pair of nozzles or jets 44 supplied from tubing 42 shown above the strand, and nozzle or jet 45 supplied from tube 43 below, all of which may have a common manifold (not shown). Additional nozzles or jets may be arranged about the axis and may be directed as desired. They may wet the strand by sprinkling or spraying it, or may produce a finely atomized fog of suspended droplets. Heating means (not shown) may be incorporated in the nozzles or jets or in their supply lines or manifolds therefor or at the liquid source, as may be done in or for the bath of FIG. 1.

The liquid used may be a solvent or plasticizer for the strand composition or may simply be an inert liquid heated then or subsequently to soften or plasticize the strand. Water usually falls somewhere between these two extremes, having a mildly plasticizing effect on many strand compositions, especially when hot. The temperatures attained by the liquid before application to the strand or by the strand thereafter, whether heated by the liquid or otherwise, should not be so high as to melt any component thereof in the form in which it is present, but only to approach closely enough thereto to render the strand more amenable to subsequent treatment, and preferably hotter than any previous treating temperature to which the strand has been subjected. For example, a temperature of $200^{\circ}\text{C.} \pm 20^{\circ}\text{C.}$ usually will suffice in treatment of ordinary nylon strands. Of course, heat transfer is facilitated in the instance of strands having relatively low total denier (e.g., not much over 1000) and low denier per filament (not much over 10).

The duration of hold-up of the strand for compressive relaxation in the stuffing chamber depends upon the foregoing factors, as the strand should remain therein sufficiently long to permit a high degree of stress-relief by way of molecular rearrangement. Crimp produced thereby may be relatively minor compared with the configurational rearrangement imparted to the strand in the first bulking step. A considerably, perhaps major, portion of the more recent crimp (as well as a portion, though minor, of the earlier crimp) may, and preferably will, be removed during the drying step, which is performed under sufficient tension to straighten the strand substantially if not completely. The required tension will depend on the physical characteristics of the strand and is readily determinable. Some tension may be imposed merely by shortening of the strand as it dries. However it is most convenient to overdrive winding drive roll 29 with respect to the surface speed of the last preceding rolls to impart the desired tension, which may be adjusted by conventional speed-control means associated therewith. If the godets are replaced because of substitution of one of the alternative heating means, suitable means for controlling the speed of the strand at the entrance to the drying zone should be substituted, such as other rolls or snubbing means.

Multifilament strand treated according to this invention exhibits increased structural integrity in the sense that individual filaments become less likely to become detached or separated from their place in the strand or filament bundle and break or to migrate and become more associated with other filament lengths juxtaposed thereto, as during or after fabric formation. This enhancement of structural integrity is conducive to less down time during

processing and to longer product life, whether in apparel, home furnishings, or industrial uses. The economic advantages and related benefits thereof are apparent.

The claimed invention is:

1. In treatment of multifilament textile strand, the steps of bulking it without twisting it, imparting twist to the bulked strand, plasticizing the twisted bulked strand, including the step of moistening the strand, then compressively relaxing the strand, and drying the strand under tension.
2. Process according to claim 1 wherein the bulking is accomplished by a crimping method selected from the group consisting of stuffer-crimping, gear-crimping, and edge-crimping.
3. Process according to claim 1 wherein the twist is imparted to the strand in the form of a single end.
4. Process according to claim 1 wherein the twist is imparted in plying the strand with at least one other strand.
5. Process according to claim 1 wherein the strand is plasticized by being both moistened and heated.
6. Process according to claim 1 wherein the strand is compressively relaxed by stuffer-crimping it.
7. Process according to claim 1 wherein the strand is dried by exposure to radiant heating.
8. Process according to claim 1 wherein the strand is dried by exposure to convective heating.
9. Process according to claim 8 wherein the strand is dried on the run through a flow of hot air moving along the strand.
10. Process of treating multifilament textile strand to improve its structural integrity, comprising bulking the strand by a method selected from the class consisting of stuffer-crimping, gear-crimping, and edge-crimping, twisting the bulked strand, moistening and heating the twisted bulked strand, stuffer-crimping the twisted bulked strand and maintaining it moist and hot until relaxed, and drying the strand under tension.
11. Process according to claim 10 performed in continuous manner.
12. Process according to claim 11 wherein the strand is wound onto a package at the conclusion thereof.
13. Process according to claim 10 wherein the strand is moistened to from about 10% to about 100% by weight of liquid based on the strand weight and is dried to less than about 5% moisture.
14. Process according to claim 10 wherein the strand is heated to and maintained at a softening temperature for the strand composition while in the vicinity of the entrance to the crimping means.
15. Process according to claim 10 wherein the strand is subjected to sufficient tension during the drying step to remove crimp imparted to the strand during the immediately preceding stuffer-crimping step.
16. Process according to claim 15 wherein the strand is subjected to sufficient tension to render it essentially straight during the drying step.
17. Strand-treating process comprising subjecting a twisted bulked multifilament textile strand to moisture and heat, stuffer-crimping and thereby compressively relaxing the strand, and drying the strand under tension sufficient to straighten it substantially and thereby remove part of the crimp imparted thereto.
18. Process according to claim 17, wherein the strand is subjected to moisture in the form of a liquid bath through which the strand is passed.
19. Process according to claim 17, wherein the strand is subjected to moisture in the form of spray thereonto.
20. Process according to claim 17, wherein the strand is subjected to moisture in the nature of an inert liquid.
21. Process according to claim 17, wherein the strand is subjected to moisture in the nature of a solvent for the strand composition.
22. Process according to claim 17, wherein the strand

is subjected to moisture in the form of a fog comprising water.

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5

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