

- [54] **YARN PROCESSING POST TREATMENT**
 [75] Inventor: **Hans H. Richter**, Warwick, R.I.
 [73] Assignee: **Leesona Corporation**, Warwick, R.I.
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Related U.S. Application Data

- [63] Continuation-in-part of Ser. No. 166,409, July 27, 1971, abandoned.
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 [51] Int. Cl. D02j 1/12, D02g 1/20, D06c 1/08
 [58] Field of Search 57/34 R, 34 HS, 77.4, 57/157 R, 157 TS, 157 MS; 28/62, 72 R; 8/149.3; 68/5 D, 5 E

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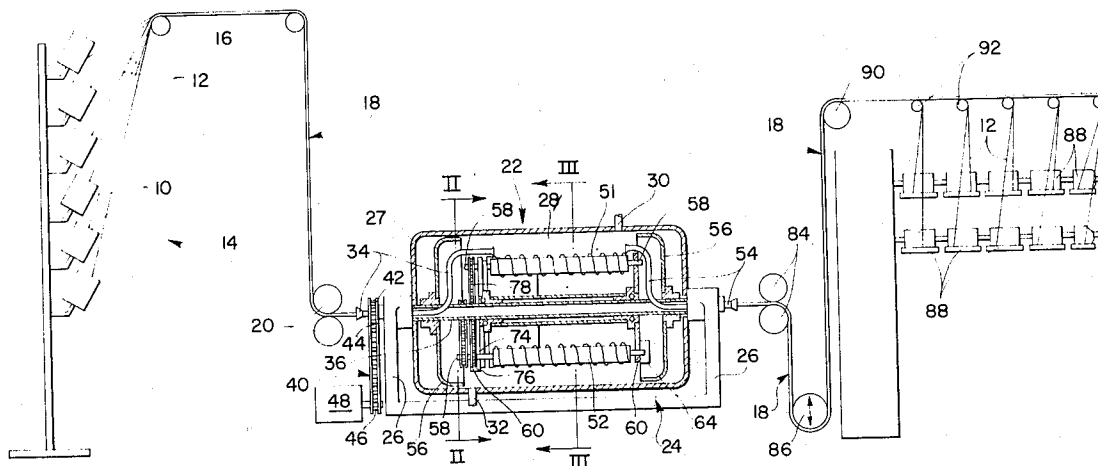
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Primary Examiner—John Petrakes
 Assistant Examiner—Charles Gorenstein
 Attorney—Albert P. Davis et al.

[57] ABSTRACT

Continuous process and apparatus for bulking textured yarn includes combining a plurality of strands of the textured yarn into a continuous tow, forming the tow into a continuous series of loops, moving the looped tow through a bulking zone, setting the bulked tow, separating the tow into individual bulked strands, and collecting the strands into packages. The bulking chamber includes a plurality of positively driven screw-like members, which advance the tow through the chamber under bulking conditions at a predetermined rate. In one embodiment the tow is delivered into the chamber through a course which includes forming the tow into relatively large loops which are permitted to shrink and thus bulk promptly upon introduction into the bulking zone. The bulking zone includes controlled conditions of temperature and humidity. In another embodiment the tow is first subjected to a preconditioning step within the bulking zone and thereafter is bulked while being relaxed under controlled conditions in the bulking zone. Subsequently, the bulk is set in a separate zone by dry heat.

15 Claims, 8 Drawing Figures



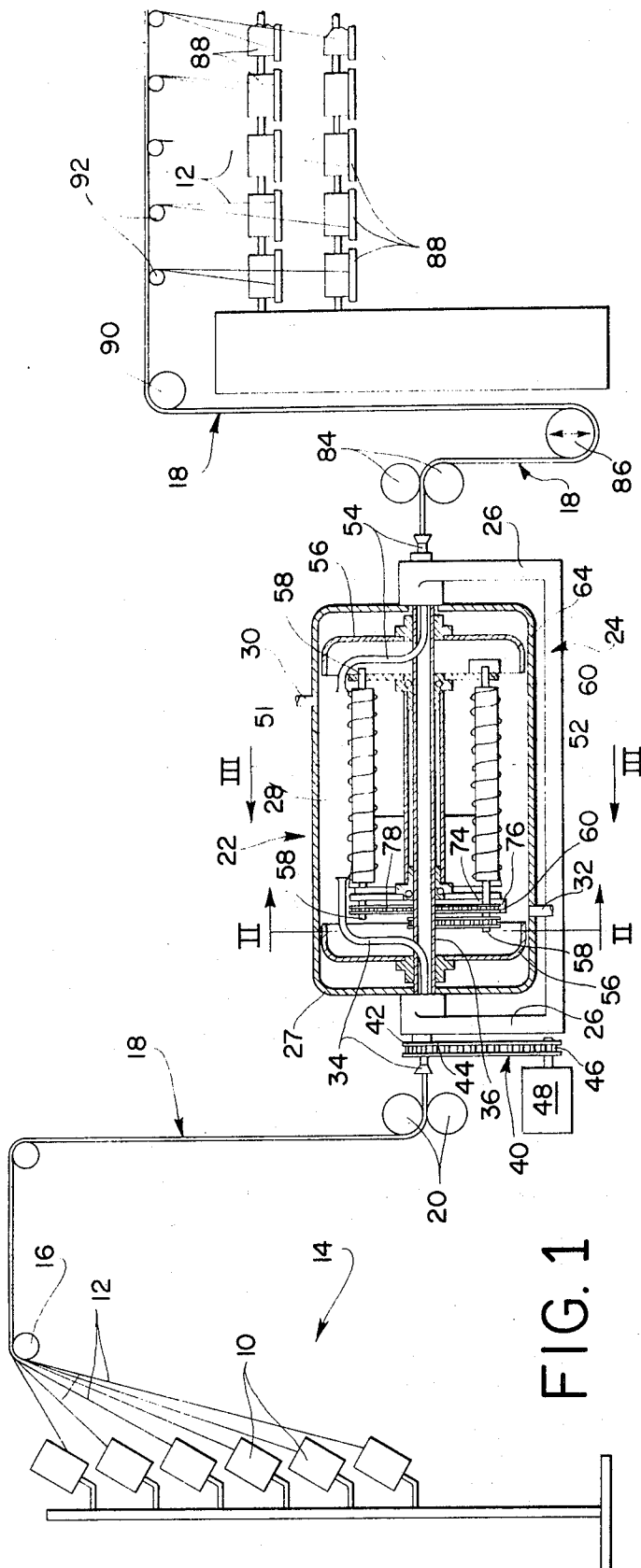


FIG. 1

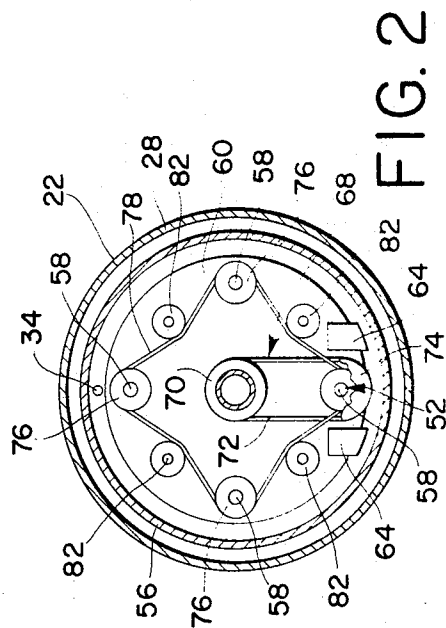


FIG. 2

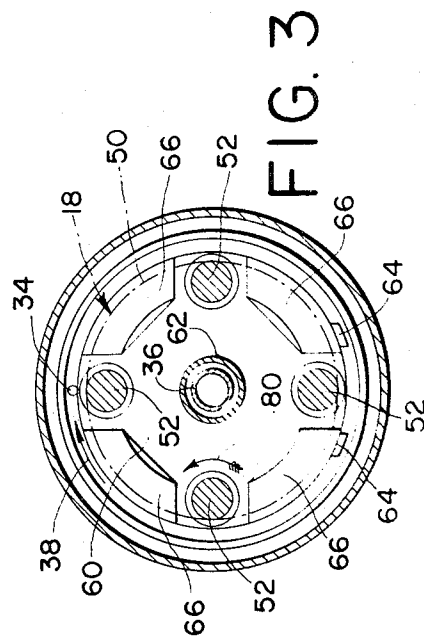
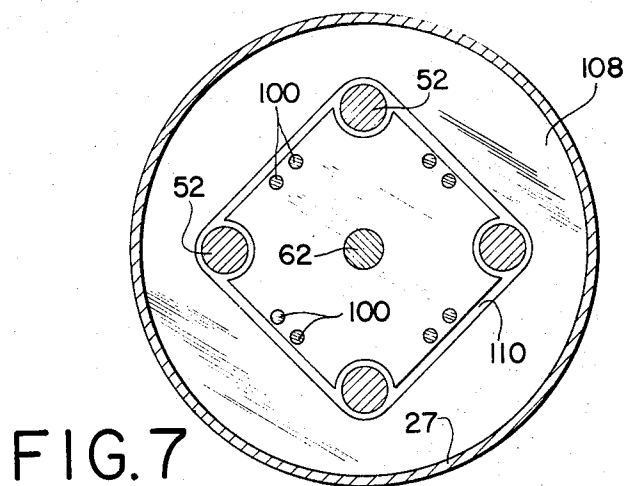
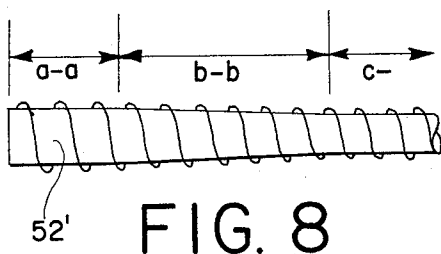
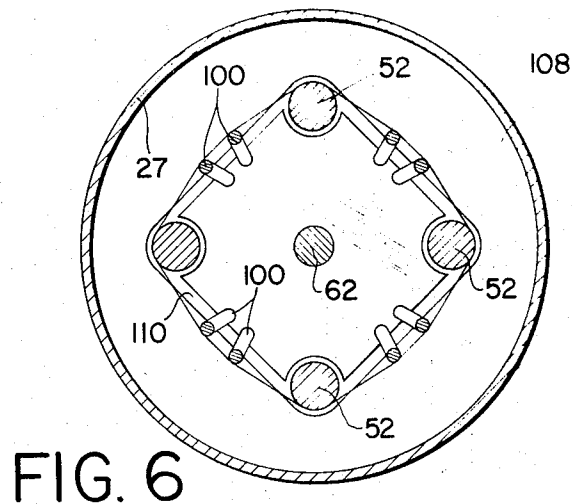
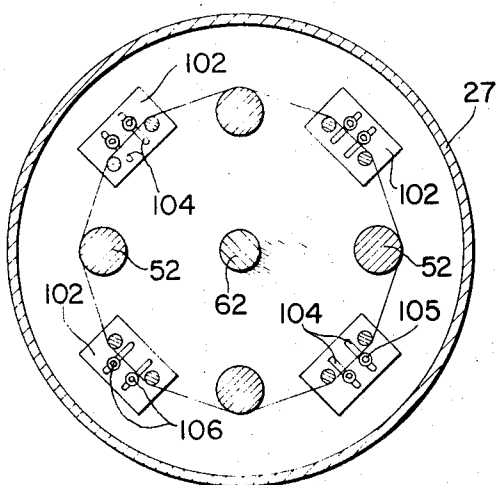
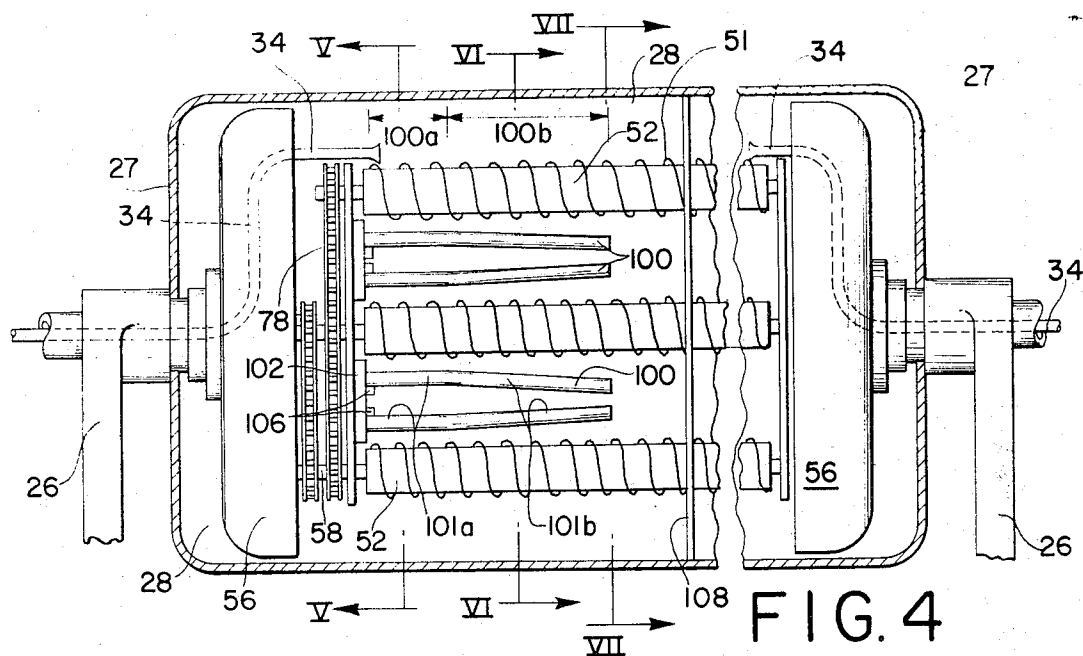


FIG. 3



YARN PROCESSING POST TREATMENT

This application is a Continuation-In-Part of copending application Ser. No. 166,409 filed July 27, 1971 now abandoned.

This invention relates to a process and apparatus for bulking textured yarn and, more particularly, relates to process and apparatus for continuously bulking a plurality of strands of textured yarn by combining the strands into a tow, bulking and setting the strands and thereafter separating and taking-up the individual strands of bulked yarn.

BACKGROUND OF THE INVENTION

Various methods of bulking textured yarn are known in the art, a preferred method being to form the textured yarn into skeins and subject the skeins to alternating cycles of vacuum and pressure stream in an autoclave. This method produces good bulked yarn but has obvious disadvantages in that the yarn is generally cut to form the skeins, the method is not continuous, and it requires considerable costly attention of operators.

SUMMARY OF THE INVENTION

The invention, in brief, is directed to process and apparatus for continuously bulking textured yarn. A plurality of strands of textured yarn are formed into a tow which, in turn, is formed into loops comparable to skeins. The looped tow is passed through a bulking chamber. Thereafter the bulked yarn is set or stabilized and is separated into individual bulked strands which may be rewound into individual packages, if desired. The tow is introduced into the chamber through a rotating hollow flyer which deposits the tow in loops on the screws. The screws, in turn, carry the tow from one end of the chamber to the other. At the latter end the tow is removed through a second hollow flyer commonly rotated with the first flyer. In one preferred embodiment the chamber is constituted as a single zone and the steps of (1) shrinking and bulking the tow under controlled conditions and (2) setting the bulk are accomplished in this single zone. In a further embodiment the tow is passed through two separate zones within the chamber, each zone having a different temperature and humidity condition. In a first of the zones which provides a moist heat environment the tow is initially preconditioned without being permitted to shrink, and is then relaxed under controlled conditions to afford shrinking and bulking of the tow. The thus bulked tow is then and in a continuous manner passed to the second zone of dry heat where the bulk is set.

It is a primary object of this invention to provide a new and useful process and apparatus for bulking textured yarn.

A more specific object is provision of a new and useful continuous process for bulking textured yarn including the steps of combining a plurality of strands of textured yarn into a continuous tow, forming the tow into a continuous series of loops, moving the looped tow through a bulking environment, setting the bulked tow, and separating the tow into individual bulked strands.

A further object is provision of new and useful apparatus for bulking textured yarn, including mechanism for combining a plurality of strands of the textured yarn into a continuous tow, mechanism including a chamber for bulking the yarn therein, mechanism for forming

the tow into a continuous series of loops and moving the looped tow through the chamber, mechanism for moving the tow through a setting or stabilizing zone, and mechanism for separating the tow into individual bulked strands.

These and other objects and advantages of the invention will be apparent from the following description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic, elevational view of one embodiment of the invention for bulking textured yarn, with parts broken away for clearer illustration;

FIGS. 2 and 3 are enlarged, schematic sectional views taken generally along the lines II—II and III—III, respectively, in FIG. 1;

FIG. 4 is a view similar to FIG. 1 but illustrating a modified form of the invention;

FIGS. 5, 6 and 7 are views taken along lines V—V, VI—VI and VII—VII, respectively, of FIG. 4; and

FIG. 8 is a view of a modified form of screw useful with the embodiment of FIGS. 4-7.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIG. 1 of the drawing, a plurality of wound packages 10 of textured strands of yarn 12 are mounted on a creel 14 with unwinding ends of the strands of yarn directed across suitable guides 16 as the strands are formed into a continuous tow 18 which is fed by a suitable feed roll assembly 20, or other suitable means such as a pring dyeing assembly, to a twist setting and/or bulking unit 22.

The bulking unit 22 includes a base 24 having spaced apart upright arms 26 carrying a fixed bulking container 27 defining in its interior an enclosed treating chamber 28. An environment of steam, hot air, or other suitable bulking medium may be passed through chamber 28 via an inlet 30 and an outlet 32 connected into the chamber to uniformly heat the chamber to a temperature sufficient to bulk the strands of textured yarn 12 constituting tow 18. From the feed roll assembly 20 the tow 18 passes into an inlet end of a hollow flyer 34. Said flyer 34 is fixed on a hollow shaft 36 which, in turn, is journaled at its opposite ends in the arms 26 of base 24. The flyer shaft 36 is rotated in the direction of the arrow 38 (FIG. 3) by a chain drive 40. Said drive 40 includes a driven sprocket 42 mounted on an end of the shaft 36 which extends outwardly from the left one of the arms 26 (FIG. 1). Sprocket 42 is connected by a chain 44 to a drive sprocket 46 on the drive shaft of a motor 48.

As flyer 34 is rotated it continuously imparts a slight twist to tow 18 about its longitudinal axis and seats the tow in the form of loops 50 (FIG. 3) between helical lands 51 at first ends of rods or screws 52 which are mounted generally axially parallel to the shaft 36. As illustrated, four screws 52 are provided, all of which are rotated in unison with the flyer 34 to carry the loops 50 of tow 18 through the chamber 28 at a uniform rate of speed. The screws 52 cause the tow to move in the direction of the longitudinal axis of the tow, as well as causing the loops 50 to rotate about a generally central axis normal to the general plane of the loops 50. Thus, as the rods rotate they propel the tow 18 from one end of chamber 28 to the other while simultaneously imparting a linear motion to the tow. The linear motion

insures that no portion of the tow rests solely on a screw or screws 52 while the tow is carried through the chamber. Accordingly, essentially equal penetration of the steam or other treating medium is imparted to all portions of the tow within chamber 28.

As the loops 50 of tow 18 are moved to the right-hand ends of screws 52, as viewed in FIG. 1, the tow 18 is removed from between the lands 51 and the twist is removed by a second hollow flyer 54 which is also fixedly mounted on the flyer shaft 36 and which rotated at the same speed as the first flyer 34. Thus, the cooperative effect of flyers 34 and 54 serve to twist-untwist the yarns in tow 18. The twist imparted to the yarns within chamber 28 contribute to transposition or relative movement of the adjacent strands of yarn 12 within the tow 18 as the tow is moved through chamber 28 by screws 52. This, in turn, contributes to equal penetration of the bulking medium through all of the strands in the tow. Suitable shields 56, fixedly secured to the flyer shaft 36, are provided about the flyers 34 and 54. These shields serve as a form of seal to generally contain the treating medium in the region of screws 52.

Each of the screws 52 has opposed axles 58 (FIGS. 1 and 2) journaled in opposed supporting members 60 within chamber 28. Members 60 are journaled via suitable bearings on the flyer shaft 36 and are fixedly interconnected with each other by a hollow sleeve or shaft 62 encircling flyer shaft 36. Eccentric weights 64 (FIGS. 1 and 2) fixed to the supporting members 60 prevent any substantial rotation of these members and thus effectively prevent planetary rotation of the screws 52 around shaft 36.

In order to present the loops 50 of tow 18 in chamber 28 in a size to afford shrinking and bulking of the tow without restriction by the several screws 52, the tow is first deposited onto sloping or inclined segmental members 66 by flyer 34 as the tow is introduced into chamber 28. These members 66 are fixedly secured to the left-hand supporting member 60 (FIG. 1) and extend generally axially between the rods 52. Since the effective circumference of a line drawn around the left-hand ends of segments 66 is somewhat larger than that of a line encircling screws 52 taken on their minor diameters, as is readily apparent in FIG. 3, the loops 50 tend to slacken or relax as they are initially moved rightward (FIG. 1) by the cooperative action of screws 52. Thus, the left-hand flyer 34 deposits the tow 18 on the sloping members 66 under light tension and as the looped tow 18 is moved from left to right on the screws 52, as viewed in FIG. 1, it slides down the outer beveled surfaces of the segmental members 66 into the roots of screws 52 and is thus relaxed, facilitating bulking of the tow.

With reference to FIG. 2, as the flyer shaft 36 is rotated by the motor 48 (FIG. 1) via chain drive 40, another chain drive 68 rotates the lower screw 52. The chain drive 68 includes a drive sprocket 70 on the flyer shaft 36 connected by a chain 72 with a driven sprocket 74 fixed on the axle 58 of the lower screw 52. The axle 58 of the lower screw 52, as well as the axles three other screws 52, each carry fixed chain sprockets 76 (FIG. 2) which receive a chain 78 for driving the screw 52 in unison with the flyers 34 and 54, all in the direction of the arrow 80 (FIG. 3). Suitable idler sprockets 82 may be provided on the left-hand supporting member 60, viewing FIG. 1, between the sprockets 76 to maintain the chain 78 taut.

As the right-hand flyer 54 (FIG. 1) removes the tow 18 from the screws 52, the tow is withdrawn from this flyer by a feed roll assembly 84. Upon exposure to ambient air setting of the bulked strand of yarn 12 is achieved. In the alternative other suitable means may be provided for setting the bulked strands. For example, if steam is used for bulking the yarn, a dryer, not herein illustrated, may be provided between the flyer 54 and the feed roll assembly 84 for setting the bulked yarn. After being fed through the feed roll assembly 84 the tow passes about a speed synchronization roll 86 of any suitable type for regulating the speed of take-up machines 88. From the synchronization roll 86 the tow 18 passes upwardly and about a guide pulley 90. Thereafter the strands 12 are separated at smaller guide pulleys 92 and are collected individually, each strand being wound up at one of the take-up stations 88.

In FIGS. 4-7 a modification of the invention of FIGS. 1-3 is illustrated. In this modification the construction is the same as that already described in connection with the first embodiment herein, except as otherwise noted. Consequently, description of the like parts will not be repeated again except to the extent necessary to afford and complete understanding of this modified embodiment. Further, where elements already discussed in connection with the first described embodiment are mentioned in connection with this second embodiment the same reference numerals will be used as were employed for the same elements in the first embodiment.

With reference now to FIG. 4 bulking chamber 28 includes a plurality of stepped guide rods 100 firmly secured in pairs in adjusting plates 102. In turn, adjusting plates 102 are fastened to the interior wall of supporting members 60 at the left-hand end of chamber 28, viewing FIG. 1. As best seen in FIGS. 5-7 each adjusting plate 102 mounts two guide rods 100, although it will be appreciated that any desired number of such guide rods could be affixed in each plate 102. Each adjusting plate 102 is provided with a pair of elongated slots 104. Cap screws 105 pass through the slots 104 to secure each plate 102 to the interior wall of bulking chamber 28. Radial adjustment of each of the plates 102 and, consequently, the rods 100 is afforded by slots 104. Thus, rods 100 may be aligned along an imaginary circle intersecting the roots or minor diameters of screws 52 or these rods may be displaced radially inwardly or outwardly from said imaginary circle within the limits of slots 104. It is, however, desirable that the rods not be elevated to such an extent that gripping of the tow by the lands 51 of screws 52 is lost, simply to insure that the tow is always advanced positively at a speed determined by the rotation of said screws.

In the embodiment of FIGS. 4-7, the method and the apparatus for practicing the method provide for passing the tow 18 within chamber 28 of container 27 through three distinct zones or steps. These include, firstly presenting the tow in a zone where it is "preconditioned", that is to say, passing the tow through a zone where shrinking and, hence, bulking of the tow is substantially precluded, but where the steam or other treating medium is allowed to penetrate evenly through tow 18. The second zone provides for releasing the tension in the stream over a predetermined time period during which the tow is permitted to shrink and thus bulk. The third step is carried out in a further zone where setting of the bulked yarn takes place. This third zone includes a dry air environment and a temperature level which is

higher than that existing in the first and second zones.

Rods 100 cooperate with screws 52 within chamber 28 to afford control of tow 18 as follows. Viewing FIGS. 4 and 5 rods 100 cooperate with screws 52 to form a relatively large circular yarn path or zone as defined by the reference symbol 100a. Flyer 34 lays the loops 50 of tow 18 onto the rods 100 in zone 100a while simultaneously engaging the tow between lands 51 of screws 52. It will be noted that rod portion 101a which reside in zone 100a are generally parallel with the axes of screws 52. Consequently, tow 18 which is laid on portions 101a of the several rods under very light tension is not permitted to shrink to any appreciable degree while it remains in zone 100a, but is subjected to a preconditioning treatment by exposure to the steam or other treating medium in chamber 28. In this fashion the tow is carried across zone 100a by screws 52 while shrinkage of the tow is controlled to essentially a zero level. Such preconditioning of tow 18 promotes more even bulking in the ensuing movement of the tow through chamber 18.

With attention now to FIGS. 4 and 6 it will be observed that each of the rods 100 is provided with a portion 101b which cooperatively define a zone 100b extending from zone 100a. Rod portions 101b, which lay in zone 100a are inclined inwardly toward shaft 52. Screws 52 thus act to carry the loops 50 of tow 18 from zone 100a into zone 100b where the loops 50 of the tow slide down the rods and, coincidentally, pass from a gripping locus at the upper extremes of lands 51 to a deeper position between said lands. It will be recalled that the loops 50 of tow are held to a relatively large circumference while in zone 100a. Once the loops enter zone 100b said loops are free to relax and shrink to a degree controlled by the decreasing circumference of a circle defined by the rod portions 100b and screws 52 in said zone 100b. Such decreased circumference is illustrated in FIG. 6 which is a section taken off FIG. 4 approximately midway along zone 100b. During the shrinking/bulking process carried out as the tow moves through zone 100b the individual yarns constituting tow 18 shrink and bulk to essentially the same degree due to the preconditioning of the tow effect in zone 100a coupled with the previously described movements of the tow within chamber 28. Consequently, whereas without preconditioning of the tow the outer yarns in the tow may, under certain conditions, shrink and bulk to a greater degree than the inner yarns in the tow, such inequality in shrinking and bulking is essentially precluded with tow preconditioning as disclosed herein. Of course, in practice with the present invention the shrinking/bulking operation can be carried out over any predetermined time period as dictated by the angle of incline of the plurality of rods 100 in zone 100b.

Viewing FIG. 7 it will be observed that the outer terminal ends of rods 100 are situated below the line of the loops as these loops lay encircling the minor diameters of screws 52. Thus, the shrinking/bulking process is essentially completed as the tow moves off the inclined portions 101b of rods 100 in zone 100b and engages on the minor diameters of screws 52. Thereupon, the bulk in the tow 100 is set, i.e., stabilized, by conducting the tow in a zone of dry heat, said heat being at an elevated temperature over that in which the preconditioning and the shrinking/bulking processing is carried out.

To this end chamber 28 is partitioned by means of cooperating barrier walls 106 and 108 to provide said zone of dry heat in the right-hand region of chamber 28, viewing FIG. 1. Wall 106 is affixed to shaft 62 while wall 108 is secured to the interior surface of container 27. A clearance space 110 is provided between walls 106 and 108 proximate screws 52 to afford passage of tow 18 from the wet heat zone to the dry heat zone. After passage through the dry heat zone the tow is removed from chamber 28 by means of flyer 54 as previously described and, thereafter, the tow may be separated into its constituent yarns and the yarns wound up as has been described in connection with the first embodiment herein.

By way of an example of a typical procedure for producing bulked set yarn of commercial quality for manufacture into, say, carpeting in accordance with the present invention the following procedure is presented. Using 100 ends of 1300 denier, 68 filament two ply textured Dupont nylon yarn, this yarn is formed into a tow and fed continuously to the apparatus of FIGS. 4-7 and wrapped in loops in zone 100a under a tension of 30 grams per end. Steam is introduced into chamber 28 to heat the chamber and, consequently, zones 100a and 100b uniformly to 210°F. Screws 52 are rotated to afford the looped tow 15 seconds exposure in zone 100a and thereafter movement of the tow through zone 100b is controlled to 45 seconds duration and the inclination of rods 100 in zone 100b are set to afford five per cent shrinkage in the tow. The tow is then moved into the setting zone, i.e., past barrier walls 106, 108 and to the right viewing FIG. 4, where it is exposed to substantially dry air of 400°F. for 1.5 minutes after which the bulked yarn is separated and wound up into individual packages.

In FIG. 8 there is illustrated a modified form of a screw suitable for use with the apparatus of FIGS. 4-7. Here, the screws 52' is contoured to conform to the contour of portions 101a and 101b of rods 100. Thus, screw 52' has a zone a-a which is essentially cylindrical and of the same length as portion 101a of each rod 100. Similarly, screw 52' has a zone b-b which is tapered or inclined at the same angle as portion 101b of each rod 100 and which is coextensive with said portions 101b. Zone b-b blends into a zone c-c which is cylindrical but of smaller diameter than zone a-a. It will be appreciated that the screws 52 of FIGS. 4-7 can be displaced by a like number of screws 52' and, in this event, zones a-a and b-b of screw 52' would be disposed in previously described zones 100a and 100b, respectively, while zone c-c of screw 52' would constitute that portion from zone b to the right-hand extreme of the screw. With screws 52' employed cooperatively with rods 100 the degree of shrinkage and, thus, bulking of tow 18 can be increased since the smaller diameter of screws 52' as compared to screw 52 in the zones b-b and c-c permit greater shrinking and, hence, increasing bulking of the tow.

While this invention has been described with reference to particular embodiments in a particular environment, various changes may be apparent to one skilled in the art and the invention is therefore not to be limited to such embodiment or environment except as set forth in the appended claims.

What is claimed is:

1. A continuous process for post treating textured yarn comprising the steps of, providing a zone for bulk-

ing the yarn, combining a plurality of strands of the textured yarn into a continuous tow, forming the tow into a continuous series of loops on support means, advancing the loops of tow by strand engaging means generally in the direction of the longitudinal axis of said loops while simultaneously moving said tow around the axis of said loops relative to said support means at a substantially uniform rate through the bulking zone, and thereafter separating the tow into individual bulked strands.

2. The process as set forth in claim 1 wherein the step of moving the tow includes transposing adjacent strands within the tow relatively to each other to provide substantially equal exposure of the plurality of strands to said zone.

3. The process as set forth in claim 1 wherein the step of moving the tow includes false twisting the tow generally about its longitudinal axis to transpose the strands within said tow relatively to each other to provide substantially equal exposure of the strands to said zone.

4. The process as set forth in claim 1 including the step of relaxing the tow as it is moved through said bulking zone.

5. The process as set forth in claim 1 including the step of passing the tow through a setting zone after said tow has been bulked to thereby stabilize the bulk in each of said strands.

6. The process as set forth in claim 1 including the step of initially forming the tow into relatively large loops within said chamber, and thereafter releasing said relatively large loops for controlled shrinking and bulking.

7. The process as set forth in claim 1 including the steps of exposing the looped tow to said bulking zone for a predetermined interval while precluding substantial shrinking of the tow, and thereafter affording a controlled degree of relaxation in the tow to permit shrinking and bulking of the strands in said tow.

8. The process as set forth in claim 7 including the step of moving the tow through a setting zone having a higher temperature than said bulking zone to thereby stabilize the bulked strands.

9. The process as set forth in claim 8 wherein said

bulking zone is heated by pressurized fluid.

10. Apparatus for post treating textured yarn comprising, means for combining a plurality of strands of the textured yarn into a continuous tow, a chamber for bulking of the tow therein, support means, means for forming the tow into a series of continuous loops on said support means, means for advancing the looped tow generally along its longitudinal axis while simultaneously moving said tow around the axis of said loops relative to said support means to move said tow through said chamber, and means for separating the tow into individual bulked strands after passage of the tow through said chamber.

11. Apparatus as set forth in claim 10 wherein said chamber has opposite ends; and the moving means includes rotating means extending between said ends for receiving said loops and moving the loops from a first of said ends toward a second of said ends.

12. Apparatus as set forth in claim 11 wherein said tow forming means includes a flyer adjacent said first end of said chamber for collecting the plurality of strands and delivering said strands in a tow to said moving means.

13. Apparatus as set forth in claim 10 wherein said moving means includes a plurality of spaced apart members engaging said tow, and elongated elements disposed between said members, said elongated elements including first areas cooperative to receive the tow and form the tow into relatively large loops within said chamber, and second areas inclined to said first areas along which the tow is slidable to permit shrinkage of the tow and concomitant bulking thereof.

14. Apparatus as set forth in claim 13 wherein said spaced apart members each include a first area of generally cylindrical shape disposed in the same plane as said first areas of said elongated elements, and said spaced apart members each include a tapered section defining a second area disposed in a common plane with the second areas of said elongated elements.

15. Apparatus as set forth in claim 13 wherein said elongated elements are adjustable to control the size of said loops of tow wound thereon.

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