

[54] **METHOD AND APPARATUS FOR PRODUCING TEXTURED YARN**
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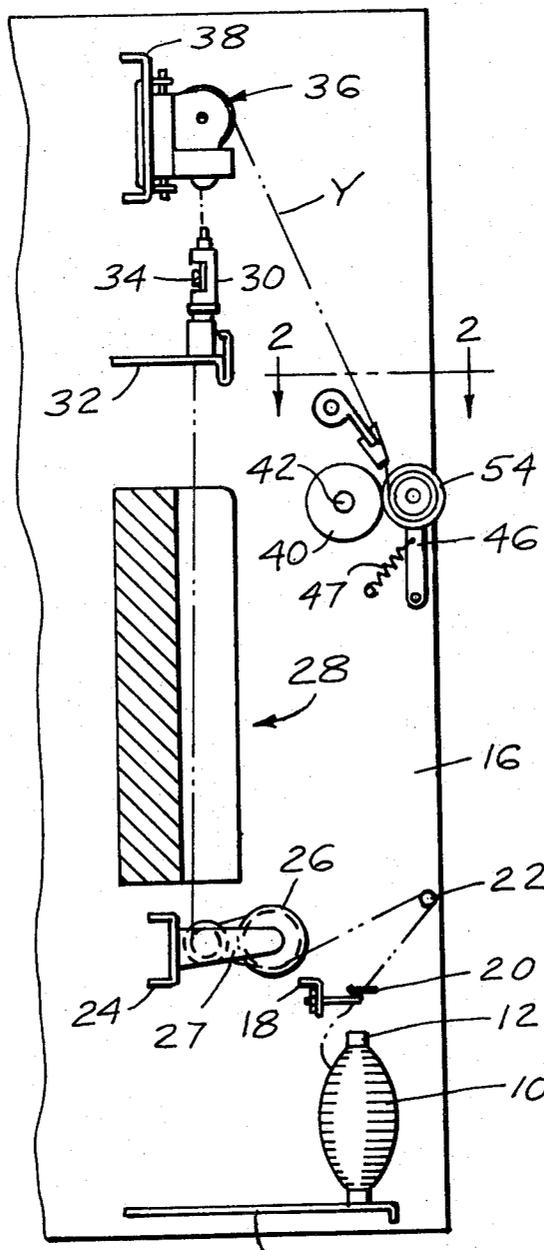
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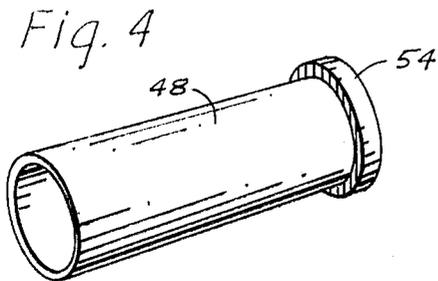
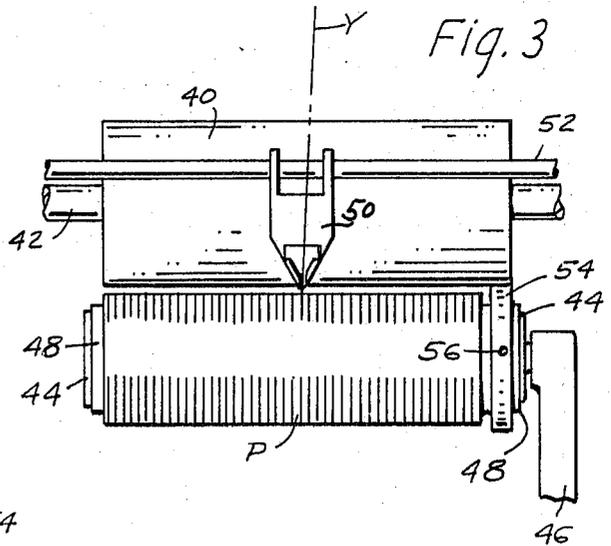
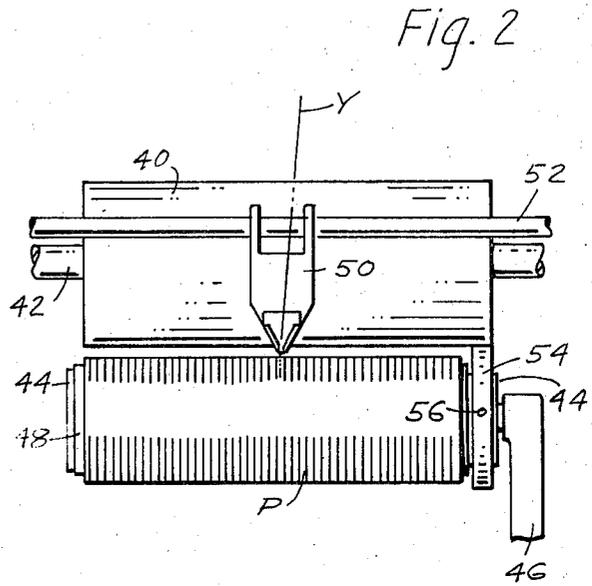
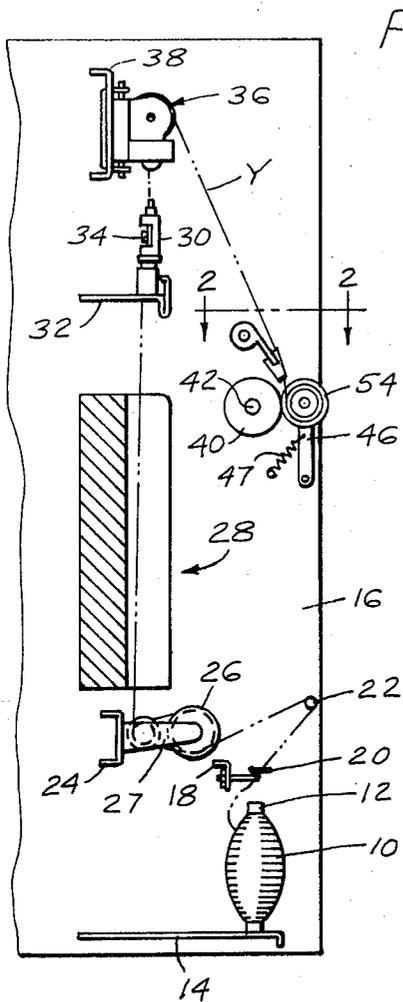
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[57] **ABSTRACT**
 Method and apparatus for producing yarn, especially textured thermoplastic yarn, including winding the yarn up into a soft package suitable for reprocessing, as by autoclaving, to yield set yarn.

18 Claims, 4 Drawing Figures





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METHOD AND APPARATUS FOR PRODUCING TEXTURED YARN

The present invention relates to method and apparatus for producing yarns and has particular application to textured yarns which are to be reprocessed in package form to produce set yarns.

As used herein the term "textured yarns" means yarns which have been treated to impart thereto essentially permanent crimped, coiled, fluffed, wavy or similar deforming characteristics to thereby inhere in the yarn stretch properties. The term "set yarns" as applied herein means yarns which are the product of reprocessing textured yarns to modify their stretch properties.

In modern day textile operations practices have been developed to produce set yarns from textured yarns. These set yarns have received popular acceptance by the public especially in connection with thermoplastic yarns where characteristics such as bulk, opacity, permeability and the like are desired with low stretch. Perhaps the most popular technique for producing set yarns today is by the autoclave method. In this system a soft package of stretch yarn is first produced on a stretch yarn machine by overfeeding the yarn to the take-up package and then subjecting the yarn in package form to heat and moisture in an autoclave. The characteristics of the yarn set by this method are controlled by regulating the density of the package, the amount of heat and moisture the package receives in the autoclave, and the time the package remains in the autoclave.

It has been found that, notwithstanding the wide popularity of the autoclave method as just stated, there is one serious defect to the method. That is, a high degree of variation within the package may develop due to the different reactions of the yarn to heat and moisture at various points in the package. Consequently, non-uniformity of yarn results and it is necessary for the knitter to resort to complicated forms of knitting to mask the defects. Surface effect in the knitted fabric must often be used to minimize the non-uniform appearance.

Investigators have discovered that the problem of irregular yarns as stated above is caused in the main by non-uniform yarn contraction from the inside to the outside of the package during autoclaving. This normally arises where the yarn has been wound rather tightly on a hard core, as a result of which the yarn proximate to the core is unable to contract, or react, to the same extent as yarn farther out on the package. Therefore, the yarn close to the core has a lower amplitude of deformation than that further removed from the core.

Accordingly, it is one object of the present invention to provide method and apparatus for winding a package of yarn capable of yielding uniform characteristics throughout during subsequent reprocessing thereof.

Another object of the invention is to provide method and apparatus for continuously producing textured yarn and collecting said yarn in a package having density characteristics varying between the internal and external portions of the package.

A further object of the present invention is to provide a yarn winding system having means for overfeeding yarn to a package winding core and having means for increasing the overfeed rate to the package core during the initial phase of winding yarn thereon.

An additional object of the present invention is to provide a yarn winding system having a core for winding up yarn and having a member of enlarged diameter thereon communicable with a driving roll for rotating said core.

Other objects and advantages will be apparent from the following detailed description taken in connection with the accompanying drawing wherein:

FIG. 1 is a side elevational view of an apparatus according to the present invention;

FIG. 2 is a view taken along lines 2—2 of FIG. 1;

FIG. 3 is a view similar to FIG. 2 illustrating an alternative arrangement for the yarn core driving means; and

FIG. 4 is a view illustrating a yarn tube for use with machine of FIG. 1.

The present invention is shown and described in conjunction with apparatus for texturizing yarn by means of false twisting. However, it is to be understood that the invention will have equal applicability with any apparatus intended to deform the yarn to impart stretch characteristics thereto.

In brief, the invention includes means for advancing a strand of thermoplastic yarn from a supply through a twist-untwist zone to impart false twist to the yarn, and finally winding the yarn so processed onto a rotating take-up core. The take-up core may be driven from a frictional driving roll arranged normally to rotate the core by peripheral contact therewith. In accordance with the present invention a driving ring of selected diameter is affixed to the mandrel upon which the yarn core is mounted. Alternatively, the driving ring may be affixed to the yarn core per se, or the ring may be formed integral with said core or mandrel. Thus, the ring serves as a driving member for the core while the first several layers of yarn are laid on the core. Consequently, this arrangement affords means whereby the core may be rotated at a surface speed slower than that of the frictional driving roll. As a result the overfeed of the yarn to the core is increased over that which would otherwise occur for the first several layers of yarn on the core.

With particular reference now to the drawing, one winding position of a gang-type false twister machine is illustrated, the machine normally having a plurality of similar twisting positions spaced along the longitudinal frame thereof. In FIG. 1 the reference numeral 10 designates a yarn supply of a thermoplastic material such as nylon or the like which is supported on post 12 mounted on a longitudinally extending, horizontal base plate 14. Said base plate 14 is fixed at one of its ends to an end stand 16 which constitutes a part of the general machine framework. A similar end stand, not illustrated herein, is situated at the opposite end of the machine and affords a support for the remote end of base plate 14 as well as other longitudinal components among which is an elongated bar 18. As in the case of plate 14, said bar 18 also extends the length of the machine and is also connected to end stand 16, the bar being in a position somewhat above plate 14, as shown in FIG. 1. Said bar 18 serves as a support for a pigtail yarn guide 20 at each twisting position along the machine, the yarn guide being aligned generally coaxially with supply 10 to guide the strand of yarn Y flowing therefrom. A guide bar 22 extends parallel to bar 18 and provides a surface over which the yarn Y from package 10 may be drawn, and thus guided, in its flow

from the supply 10. A channel shaped beam 24 is mounted similarly to bars 18 and 22 to extend longitudinally along the machine. A rotatable yarn feed roll 26 is supported from beam 24 via an arm 27, one such feed roll being located at each winding position along the machine and each serving to control the yarn Y flowing from supply 10 at a preselected speed as each feed roll is driven by means not shown.

A heater unit 28 is spaced upwardly of feed roll assembly 26 and serves as a means for heating the yarn as it is twisted. Twist is inserted into the yarn by a conventional false twister spindle 30, one of which is located at each winding position, the support for each false twister spindle being provided by a longitudinally extending plate 32 secure between the end stands 16 of the machine. Rotation of the spindle is effected by an endless belt 34 driven from a power source not shown.

With continuing attention to FIG. 1 a second feed roll 36 is positioned upwardly of spindle 30 and carried for rotation on mounting bracket 38. Said feed roll unit is operative when rotated by means not illustrated to control the yarn at a preselected linear rate from spindle 30, thus regulating the tension in the yarn, and to direct the yarn to a yarn take-up unit. Said yarn take-up unit includes a drive roll 40 which is normally covered with a frictional material such as cork, rubber or the like. The drive roll 40 is supported on and rotatably driven by a drive shaft 42 which may be powered from means such as an electric motor and speed reduction mechanism not shown.

A rotatable mandrel 44 is aligned with drive roll 40 and is supported on a rockable control arm 46 for movement toward and away from said drive roll. Arm 46 is biased counterclockwise as viewed in FIG. 1 by a spring 47 to urge mandrel 44 toward drive roll 40. Mandrel 44 normally has a yarn-receiving tube or core 48 fitted tightly on its periphery for rotation therewith. Thus, as the mandrel 44 and core 48 are rocked by movement of control arm 46 toward drive roll 40 the periphery of the drive roll will, in the absence of any impediment, engage the periphery of core 48 and thereby rotate the core to wind yarn Y thereon. As the yarn is advanced to core 48 it is traversed to and from axially of the core by guide 50 carried on a reciprocating traverse rod 52. In this fashion a package of yarn P is formed on core 48. As the package grows in diameter mandrel 44 will rock away from drive roll 40 as control arm 46 pivots clockwise, viewing FIG. 1.

The yarn wound on core 48 has, as already explained, been textured, i.e., false twisted, and it is desirable that this yarn be wound up into package P in a substantially relaxed condition if it is subsequently to be reprocessed as by autoclaving to produce set yarn. To this end the machine may be arranged to overfeed the yarn to core 48. Such overfeeding is achieved by causing feed roll 36 to rotate faster than drive roll 40. As a consequence of the differential in the speed of the two rolls, the yarn Y is wound up on core 48 at a somewhat lower rate than the yarn delivery rate from feed roll 36. Normal overfeed rates for winding up false twisted yarn which is to be reprocessed range from 10 to 20 percent. That is to say, feed roll 36 delivers the yarn therefrom at 10 to 20 percent faster than the rate of yarn take-up on core 48.

Notwithstanding that the yarn wound up on core 48 is somewhat relaxed by virtue of the afore-described

overfeed, it has been found that after the yarn package is subsequently autoclaved the yarn varies in characteristics from the inside to the outside of the package. That is to say, the yarn wound in close proximity to the core, for example, the first 700-1,200 yards wound on the core, has a noticeably lower skein shrinkage value than the yarn wound externally or outwardly beyond said first 700-1,200 yards. These variations cause uneven quality in subsequently knitted and dyed fabrics. The theoretical explanation for the variations so noticeable in the yarn wound proximate to the core as contrasted to that outwardly on the package as just stated is that the yarn adjacent the core cannot contract during autoclaving to permit crimp development in the yarn to the same extent as crimp develops outwardly on the package. This is thought to be due to the fact that the stiff core provides a resistance to shrinkage in the yarn during the autoclave step in the zone proximate thereto occupied by the first several hundred yards of yarn. However, the yarn outside of said zone is relatively free to shrink or contract since its only resistance is afforded by the substantially yieldable inner yarn wraps on the core.

Consistent with the foregoing it has been found advantageous to wind yarn Y on core 48 in a manner so that the first several hundred yards, for example, the first 700-1,200 yards, are overfed at a rate exceeding the normal overfeed rate provided by the machine. In accordance with the present invention this may be achieved by the use of a drive ring 54 which may be affixed on mandrel 44 for rotation therewith as shown in FIGS. 1 and 2. Alternatively, said ring 54 may be affixed on core 48 as illustrated in FIG. 3. In either of these instances a set screw 56 may be radially positioned through the ring to secure it tightly on the mandrel or core, as the case may be. As a further alternative ring 54 may be formed as an integral part of a one piece core 48 as shown in FIG. 4.

As best seen in FIG. 2, ring 54 is located within the axial confines of drive roll 40 and, yet, is disposed out of the effective winding zone for the yarn on core 48 as defined by the traversal movement of guide 50. Since driving ring 54 is engaged against the periphery of drive roll 40, the overfeed to the take-up core 48 is governed by the rotational speed of said ring. When sufficient yarn is wound on core 48 so that package P exceeds the diameter of ring 54 the surface of the package itself contacts drive roll 40 to be frictionally driven therefrom, and at that time the overfeed condition set in the machine governs the overfeed condition of the yarn flowing to package P. However, prior to that time, i.e., when the core and package are rotated via drive ring 54 the overfeed rate of the yarn onto core 48 is a function of the overfeed rate geared into the machine plus the variation between the outside diameter of ring 54 and the outside diameter of core 48 or, if yarn is wound on the core, package P. Thus, while it follows that the yarn overfeed rate to core 48 and package P decreases along a smooth curve from the core outward to the juncture where the periphery of the package engages drive roll 40, this decrease is correlated so that the yarn wound nearest the core is overfed to the greatest degree. Hence, the yarn throughout the zone which previously demonstrated characteristics of non-uniformity because of inability to shrink, i.e., approximately the first 700-1,200 yards wound on the core, is now wound in a less dense or softer condition than the

yarn wraps exteriorly thereof. This less dense condition, resulting from the higher overfeeding of yarn onto

The results, reported as skein shrinkage in percentage, are represented in the following chart:

TAKE UP CORE EQUIPPED WITH	Initial Overfeed Provided by ring In excess Of that set Into machine (in percent)	Radial distance from the inside Diameter of the package at which Yarn sample was taken (in inches)						
		.0	.25	.50	.75	1	2	3
3 53/64 inch ring	7.57	10.1%	11.3%	11.4%	11.4%	12.9%	13.4%	11.2%
4 inch ring	12.35	14.5%	10.2%	11.2%	10.8%	10.2%	12.3%	11.4%
no ring	0	8.0%	10.2%	11.2%	11.6%	11.4%	12.3%	11.4%
3 7/8 ring	8.75	11.4%	9.5%	10.2%	11.4%	11.6%	11.8%	11.0%

the package via drive ring 54 contributes to relatively uniform shrinkage and, thus, relatively uniform crimp development in all of the yarn during reprocessing as by autoclaving.

The following data demonstrates results obtained in practice with the instant invention. The fiber employed in all tests was a polyester more particularly identified as 150 denier, 34 filament, R10, type 56 Dacron manufactured by E. I. Dupont de Nemours and Co., Inc., Wilmington, Delaware. The machine employed was a Model 553 High Speed Stretch Yarn Machine manufactured by Leesona Corporation, Warwick, Rhode Island. The temperature of the yarn heater (corresponding to heater 28 in FIG. 1) was set at 430° F., the lower feed roll (corresponding to feed roll 26 in FIG. 1) was set to overfeed at 2 percent, the top feed roll (corresponding to feed roll 36 in FIG. 1) was set to overfeed at 12 percent, the false twist spindle (corresponding to spindle 30 in FIG. 1) was rotated at 240,000 RPM, and 64 turns per inch were inserted into the yarn by the false twist spindle.

A package of yarn having a thickness of 3 inches was wound on a core in accordance with the foregoing conditions. The package was subsequently autoclaved in package form while retained on the core upon which it was wound, under the following sequential steps:

- 5 minutes vacuum at 26" Mercury
- 45 minutes steam at 270°F.
- 10 minutes vacuum at 26" Mercury
- 3 minutes exhaust

The yarn was removed from the autoclave and permitted to stand in package form at room temperature for 24 hours. Thereafter the yarn was processed as follows:

A 12,500 denier skein was wound and the length of the skein when suspended from one end was measured to obtain an original length of the skein. A 2 gram weight was then hung from one end of the skein.

The weighted skein was immersed in water maintained at a heat of 180° F. for 10 minutes. The skein was removed from the hot water and the skein was hung to dry for 24 hours at room temperature with the weight attached.

After 24 hours had elapsed the skein length was again measured with the weight attached to determine final skein length.

Skein shrinkage was then computed according to the following formula:

$$\frac{\text{Original Length of Skein} - \text{Final Length of Skein}}{\text{Original Length of Skein}} = \text{Skein Shrinkage in Percent}$$

It has been found that there is a direct correlation between the uniformity of shrinkage as determined by the above-described skein shrinkage test and the uniformity of crimp development through a package of textured yarn which has been autoclaved. The uniformity of crimp development, as has already been stated, is a vital factor in providing high quality yarn throughout the autoclaved yarn package. Thus, it will be observed from the foregoing data that drive ring 54 is operable to yield yarn interiorly of the package, i.e., proximate to the package core having generally uniform quality corresponding to the yarn exteriorly on the package, i.e., outside the zone of influence on yarn contraction afforded by core 48 when the diameter of the drive ring is correlated to provide the requisite overfeed for the yarn being wound. Hence, the instant invention provides advantageous method and apparatus for processing textured yarn which permits a high degree of uniformity in the yarn throughout the entire package when reprocessed in package form.

While particular embodiments of the present invention have been illustrated and described herein it is not intended to limit the invention to such disclosure but changes and modifications may be made therein and thereto within the scope of the appended claims.

What is claimed is:

1. In the method of forming a soft package of yarn by delivering said yarn at a predetermined linear delivery speed and winding the said yarn onto said package at a predetermined linear winding speed less than said delivery speed thereby to wind said yarn at a predetermined overfeed, the improvement of increasing said overfeed during a portion of said process during which an interior portion of said package is formed whereafter said yarn is wound at said predetermined overfeed.

2. In the method of producing yarn comprising winding thermoplastic yarn on a package core to produce a soft package by delivering said yarn at a predetermined linear delivery speed and winding the said yarn onto said package at a predetermined linear winding speed less than said delivery speed thereby to wind said yarn at a predetermined overfeed, the improvement comprising winding the initial layers of said package at a first overfeed and the remaining layers at said predetermined overfeed, said predetermined overfeed being less than said first overfeed.

3. Means for winding a package of yarn including yarn take-up means, means for delivering yarn to said take-up means at a linear delivery rate, means to drive said take up means at a linear take-up rate less than said linear delivery rate to effect a preselected overfeed of said yarn, selectively engageable controlling means for controlling said overfeed, said controlling means

engaged during the initial stage in the winding of said package to effect an increase in overfeed over said pre-selected overfeed, said controlling means disengaging during the winding of said package in response to growth of said package.

4. Means as set forth in claim 3 wherein said yarn take-up means includes a rotatable member and said controlling means includes ring means for driving said rotatable member.

5. Means according to claim 4 wherein said rotatable member includes a mandrel, said ring means being disposed on said mandrel.

6. Means according to claim 4 wherein said rotatable member includes a winding core, said ring means being disposed on said winding core.

7. Apparatus for producing a yarn comprising, a yarn supply source, a rotatable core for winding the yarn from said supply source, a mandrel for supporting said core, a false twist spindle for twisting and untwisting said yarn during advancement thereof to said core, heater means for heating the yarn during its twisting, feed roll means operable to overfeed said yarn to said core at a predetermined rate, a driving roll for rotating said core during winding of yarn thereon, traverse means for traversing said yarn to and fro axially of said core to distribute the yarn thereon during winding, and a driven member associated with said core, said driven member acting to space said core apart from said drive roll and being engageable with said drive roll to rotate said core as a first length of yarn is wound thereon to form an initial yarn mass, said driven member being separable from said drive roll upon winding of said initial mass on said core to thereby permit said core to be rotated by engagement of said yarn mass with said drive roll.

8. A method of forming a package of textured thermoplastic yarn in at least partially relaxed condition comprising the steps of

- a. delivering the textured yarn from a source at a predetermined linear speed,
- b. initially winding the delivered yarn upon a take-up tube at a linear speed substantially less than the predetermined delivery speed to obtain a relatively high degree of relaxation of the yarn upon the take-up tube while forming therefrom a number of superposed layers of yarn which form the innermost layers of yarn in the package, and then
- c. winding the delivered yarn upon the take-up tube at a faster linear speed than the initial winding speed but at all times less than the predetermined delivery speed to obtain a lower degree of relaxation of the yarn while forming therefrom the remaining layers of yarn in the package, whereby the yarn in the innermost layers of the package is more relaxed than the yarn in the remaining layers thereof.

9. A method according to claim 8 wherein the yarn in the innermost layers of the package is wound on the take-up tube with a gradually decreasing degree of relaxation and the yarn in the remaining layers is wound on the take-up tube with a uniform degree of relaxation.

10. A method according to claim 8 wherein the yarn is initially wound on the take-up tube by rotating the take-up tube at a relatively slow surface speed to form the innermost layers of yarn thereon and then rotating

the take-up tube at a higher surface speed to form the remaining layers of yarn thereon.

11. A method according to claim 10 wherein the take-up tube is rotated at a constant rotative speed during the formation of the innermost layers of yarn so that the surface speed thereof gradually increases due to the increase in diameter of the package as the layers of yarn are wound thereon, and then the take-up tube is rotated at a progressively decreasing rotative speed and constant surface speed to provide a uniform degree of relaxation in the yarn in the remaining layers.

12. In a yarn texturing machine having means for texturing thermoplastic yarn and means for delivering the yarn from the texturing means at a predetermined linear speed; the combination therewith of means for forming a package of the textured thermoplastic yarn with the yarn being at least partially relaxed comprising

- a. a yarn take-up tube, and
- b. means for initially rotating said take-up tube and for winding the yarn thereon at a linear speed substantially less than said predetermined delivery speed to obtain a relatively high degree of relaxation of the yarn upon the take-up tube while forming a number of superposed layers of yarn on the take-up tube which form the innermost layers in the package and, for then increasing the speed of the take-up tube and winding the delivered yarn at a faster linear speed than the initial winding speed but at all times less than the predetermined delivery speed to obtain a lower degree of relaxation of the yarn while forming the remaining layers of the yarn in the package, whereby the yarn in the innermost layers of the package is more relaxed than the yarn in the remaining layers thereof.

13. A yarn texturing machine according to claim 12 wherein said means for rotating the take-up tube and winding yarn thereon includes a drive roll normally adapted to be in surface contact with the take-up tube and yarn wound thereon for rotating the take-up tube at a constant surface speed, and means interposed between said drive roll and said take-up tube for rotating the take-up tube at a speed less than the surface speed of said drive roll during the formation of said innermost layers of yarn on the take-up tube, the increase in diameter of the yarn package due to the formation of the innermost layers of yarn on the take-up tube bringing the yarn wound on the take-up tube into surface contact with the drive roll and rendering said means interposed between said drive roll and take-up tube inoperative so that said drive roll rotates the take-up tube through surface contact with the yarn wound thereon at the same surface speed as that of the drive roll.

14. A yarn texturing machine according to claim 13 wherein said means interposed between said drive roll and take-up tube comprises a drive ring drivingly connected to said take-up tube and having a greater diameter than the diameter of said take-up tube, said drive ring being supported to be initially drivingly engaged by the surface of said drive roll and to drive said take-up tube at a substantially constant rotative speed during the formation of the innermost layers of yarn so that the surface speed of the package being formed gradually increases due to the increase in diameter of the package as the innermost layers of yarn are wound thereon, said drive ring being moved out of engagement with the surface of the drive roll when the diame-

ter of the package increases to an amount exceeding the diameter of the drive ring.

15. A yarn texturing machine according to claim 14 wherein said drive ring surrounds and frictionally engages one end portion of said take-up tube.

16. A yarn texturing machine according to claim 14 wherein said means for rotating the take-up tube and winding yarn thereon includes a freely rotatable mandrel supporting the take-up tube for rotation therewith and wherein said drive ring is fixed on said mandrel adjacent one end of said take-up tube when the tube is supported on the mandrel.

17. Apparatus for producing yarn comprising, a yarn supply source, a rotatable core for winding the yarn from said supply source, a mandrel for supporting said core, heater means for heating the yarn, feed roll means operable to advance said yarn to said core at a preselected linear advancing rate, a driving roll for rotating said core at a preselected linear winding rate less than said linear advancing rate to effect an overfeed during winding of yarn thereon, traverse means for traversing said yarn to and fro axially of said core to dis-

tribute the yarn thereon during winding, and a driven member associated with said core, said driven member acting to space said core apart from said drive roll and being engageable with said drive roll to rotate said core as a first length of yarn is wound thereon to form an initial yarn mass, said driven member being separable from said drive roll upon winding of said initial mass on said core to thereby permit said core to be rotated by engagement of said yarn mass with said drive roll.

18. In the method of winding a package of yarn by advancing yarn to said package at a linear advancing rate and winding said yarn on said package at a linear winding rate less than said linear advancing rate to produce an overfeed, the improvement comprising controlling the winding rate at the start of the winding of said package to produce a first overfeed and thereafter continuously increasing the winding rate and thereby continuously decreasing the overfeed to a second overfeed, and winding the remainder of said package at said second overfeed.

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