Dec. 8, 1942. E. K. GLADDING 2,304,564

YARN PACKAGE AND METHOD AND APPARATUS FOR PRODUCING SAME

Filed Dec. 21, 1940 2 Sheets-Sheet 1

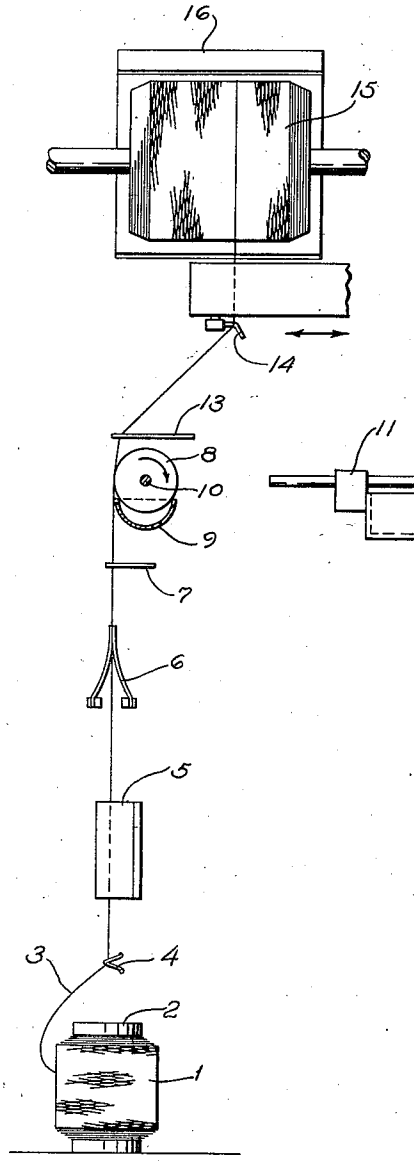


Fig. 2

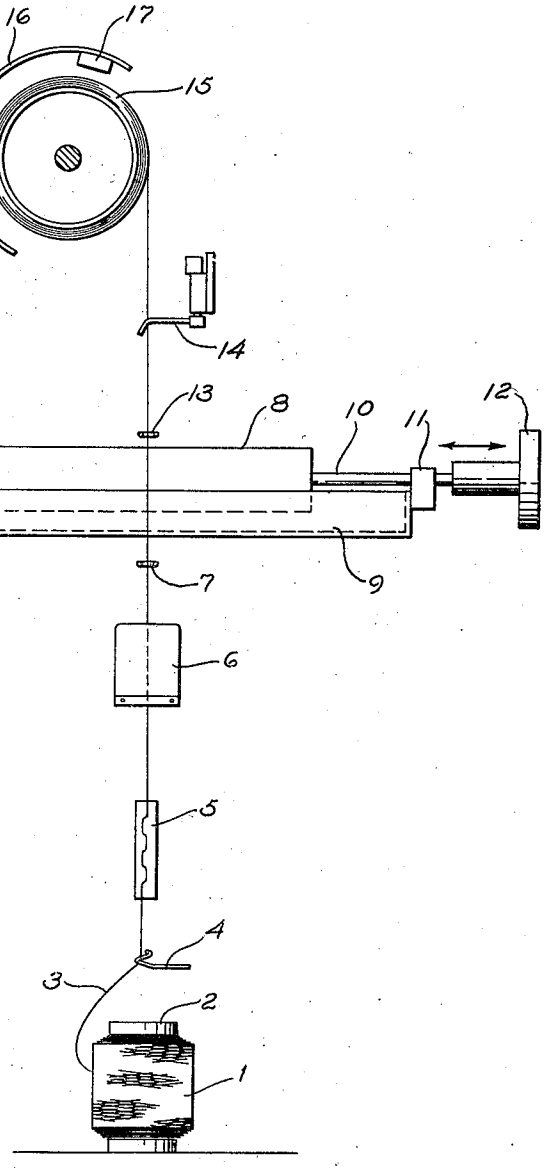


Fig. 1

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Filed Dec. 21, 1940 2 Sheets-Sheet 2

Fig. 4.

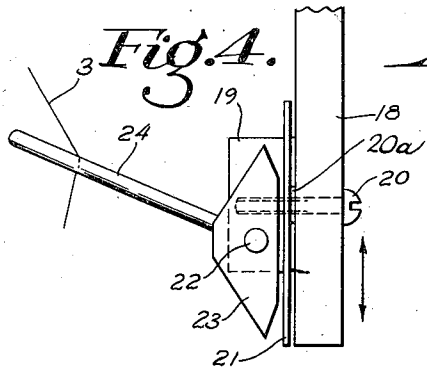


Fig. 9.

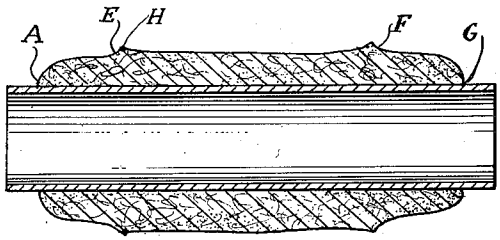


Fig. 5

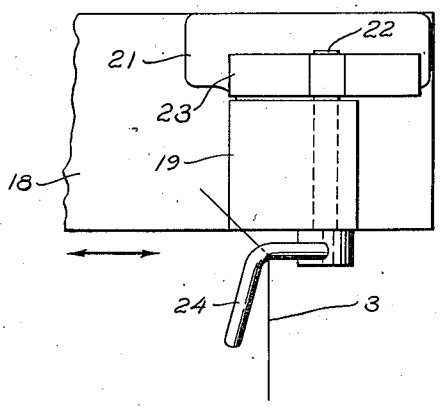
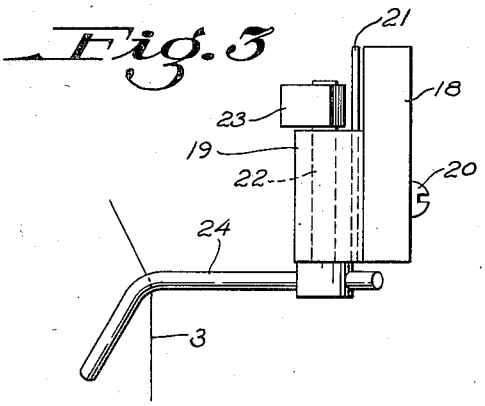


Fig. 3



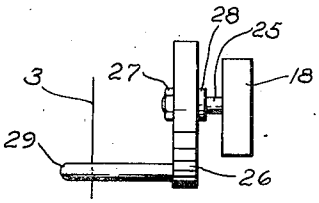


Fig. 6

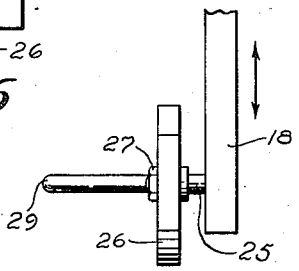


Fig. 7

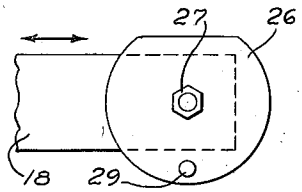


Fig. 8

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2,304,564

UNITED STATES PATENT OFFICE

2,304,564

YARN PACKAGE AND METHOD AND APPARATUS FOR PRODUCING SAME

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Application December 21, 1940, Serial No. 371,106

5 Claims. (Cl. 117—66)

This invention relates to the production of textile yarn packages and is particularly concerned with the winding of synthetic linear polyamide multifilament yarn to which has been applied a sizing composition.

Since the invention in its preferred form is concerned with the combined sizing and winding of synthetic linear polyamide multifilament yarn, it will, for purposes of illustration, be described specifically with respect to this preferred operation and to this preferred type of yarn.

It is desirable to subject synthetic linear polyamide multifilament yarn to a sizing operation in order to adapt the yarn to various textile operations. The term "sizing" refers to the application of an adhesive coating to a yarn to protect the filament thereof during the subsequent handling of the yarn.

It is important, in preparing packages of sized yarn, to apply the sizing composition to the yarn uniformly. Uniform sizing of synthetic linear polyamide yarn may be effected, in accordance with a copending application of Edgar W. Spanagel, Serial No. 369,951, filed December 13, 1940, by contacting the yarn in its passage from the supply bobbin to the wind-up bobbin with an aqueous solution containing a suitable size, the sized yarn being wound on to the wind-up bobbin while still wet with the sizing composition.

It is well-known in the textile arts to wind yarn packages by a precision winding operation in which the traverse guide or button which is operated by the traverse mechanism, is kept at all times in direct contact with the body of yarn being wound, in order to insure uniform lay-down of the yarn by virtue of the fact that the yarn is always laid down at the position occupied by the thread guide. This precision winding tends to eliminate the well-known phenomenon of overthrown ends or "loops." In unwinding a package of yarn in which loops are present and particularly where the unwinding is accomplished by unwinding the yarn over one end of the package only (the unwinding generally being accomplished at a high rate of speed), the loops tend to catch in the main body of the yarn package causing yarn and filament breakage and uneven draw-off tension. This is especially true when dealing with low denier yarn or when dealing with yarn which has been sized and wound wet according to the bobbin-to-bobbin process described in the copending Spanagel application referred to above.

However, if precision winding is used in the winding of yarn while wet with size which has been applied in accordance with the aforementioned Spanagel process, the yarn windings adhere tenaciously to each other because of the fact that the adhesive size hardens on the bobbin and cements adjacent yarn windings together, and this causes great difficulty in the unwinding of the bobbin in subsequent operations. Precision winding of yarn sized and wound while wet is also accompanied by the formation of "tuck-unders," i. e., the displacement of yarn windings and the tucking of such windings under adjacent windings, and this is especially true in the case of synthetic linear polyamide yarn in which the filaments are round in cross-section and tend to roll and become displaced as the adhesive size hardens. "Tuck-unders" are especially likely to take place in the wet winding of sized yarn during precision winding, because of occasional shifting of yarn windings on the wind-up bobbin during drying, and tuck-unders are particularly serious in such a system because of wicking of the size towards the ends of the wind-up bobbin. Tuck-unders may also occur in the case of yarn which possessed a high twist prior to sizing and which was sized, after twisting, according to the Spanagel procedure, especially when the yarn is subsequently subjected to a high temperature-high humidity operation for setting the twist in the yarn.

The phenomena of loops and tuck-unders cause particular trouble where the precision wound yarn is wound with straight ends as distinguished from beveled ends.

Additionally, where yarn is sized in a bobbin-to-bobbin sizing operation and is precision wound while wet, the size tends to collect on the thread guide and, upon drying, becomes a hard abrasive substance which, because of its direct contact with the yarn on the wind-up bobbin, tends to cause filament and yarn breakage.

It is an object of this invention to produce a yarn package which can readily be unwound even when the yarn is wound while wet with a sizing composition.

It is a further object of this invention to provide a novel means and method for traversing yarn during wind-up.

A still further object of the invention relates to the production of a highly useful yarn package in which the yarn is laid down in random fashion.

Other objects of the invention will appear hereinafter.

The objects of the invention are accomplished, in general, by winding yarn, especially yarn which

is still wet with a sizing composition, on to a wind-up package, in random fashion, that is, not according to a pre-arranged or predetermined plan, whereby to produce a yarn package which will unwind, under a constant tension, and with a minimum of yarn or filament breakage, especially when the unwinding takes place by over-end draw-off.

The invention is conveniently carried out by the use of the apparatus shown in the accompanying drawings, in which:

Figure 1 is a diagrammatic front view of a bobbin-to-bobbin sizing machine embodying a wind-up mechanism of the character embodied in the present invention;

Figure 2 is a side view of the apparatus shown in Figure 1;

Figure 3 is a side view (actual size) of a form of traverse arm and guide assembly designed in accordance with the present invention;

Figure 4 is a top view of the traverse arm and guide assembly shown in Figure 3;

Figure 5 is a front view of the apparatus shown in Figure 3;

Figure 6 is a side view of a modified form of traverse arm and guide assembly utilizing the principles of the invention;

Figure 7 is a top view of the assembly shown in Figure 6;

Figure 8 is a front view of the assembly shown in Figure 6;

Figure 9 illustrates a front view of the vertical central plane of a bobbin cake formed by the operation of the traverse mechanism of Figures 3, 4 and 5 used in the wind-up system of Figures 1 and 2.

Referring to Figures 1 to 4 of the drawings, the invention is carried out, in one of its forms, as follows:

Yarn is supplied from a package 1 of unsized yarn wound on a bobbin 2 which is supported in any convenient manner. The yarn 3 is unwound over the end of the supply package 1, passing through a guide 4 through washboard tension guide 5 consisting of two co-acting members, passing thence through leaf guide 6 likewise consisting of two co-acting members which bear against the yarn at their upper ends, the upper edges of which are disposed at 90° to the faces of washboard tension members 5, through thread guide 7. The yarn then passes over the roller 8, the lower portion of which is immersed in a sizing solution contained in trough 9. Roller 8 is supported by means of shaft 10 rotated in bearings 11 and positively rotated by a pulley 12 driven from any suitable source of power. Size is uniformly applied to the yarn 3 as it contacts roller 8. Roller 8 may be connected with means for imparting axial motion in order that the yarn will not wear a groove in the roller. The yarn leaving roller 8 passes through thread guide 13 which guide tends to accumulate size from the yarn passing through it and, since the size, after drying, tends to abrade the yarn, it preferably will be constructed so as to be quickly removed for cleaning and a clean guide substituted therefor. The yarn passing through thread guide 13 comes in contact with a traversing mechanism (described in greater detail below) generally designated by the numeral 14, the yarn passing upwardly from traversing mechanism 14 at an angle to its path just prior to reaching traversing mechanism 14, being then wound on to bobbin 15 which is supported and rotated by any suitable means (not shown). Metallic shield 16 partially surrounds the bobbin 15 and is provided with a heating element 17 adapted to dry the sizing composition on the yarn at a predetermined rate.

Figures 3, 4 and 5 show a traversing thread guide mechanism of novel construction, generally designated by numeral 14. This guide assembly comprises a traverse bar 18, reciprocated longitudinally by any conventional means and preferably adapted to have a constant stroke. A block 19 is attached to the traverse bar 18 by a screw bolt 20 which is threaded into the block 19. A sheet of spring material 21 is held in place between the block 19 and the traverse bar 18 between which members a portion of the spring 21 is clamped. This spring member is provided with any suitable means, e. g., an integral projection 20*a*, which normally maintains the outer part of the spring leaf out of contact with the traverse bar 18. Loosely mounted in the block 19 is an axle 22 to which is non-rotatably fixed a vibrating block 23, a single arm thread guide 24 being non-rotatably fixed to the end of axle 22 opposite the end to which is positioned the vibrating block 23. The axle 22 is freely mounted within the block 19 in order that it may rotate freely. The block 23, because of the loose mounting of the axle 22, is free to turn to an angle of approximately 40° by virtue of the clearance of the block with respect to the spring 21 and the traverse bar 18 and by virtue of the shape of the lower surface of the block as shown, motion of the block 19 being restrained by the spring 21. As the traverse bar 18 reciprocates, the block, by virtue of the continuous contact of the guide arm 24 with the yarn, tends to rotate on its axis until it is stopped by the spring 21, the spring then giving an impulse in the reverse direction, thereby assisting the thread guide arm 24 to snap back and forth in a random manner. This irregular motion of the guide causes the yarn to be laid down on the bobbin 15 according to the position of the guide arm 24. Thus, at each end of the traverse stroke, the yarn is laid down according to no pre-arranged plan, but its position of lay-down depends on the random position of the thread guide when the traverse bar begins to reverse its direction of motion.

Thus, by the operation of the laws of chance, the bobbin is built up with tapered ends from which the yarn may be removed, or unwound, with great facility as compared with the extremely difficult unwinding which is characteristic of yarn wound by direct contact of the traverse button with the body of yarn being wound. A close inspection of the package will show that there are no overthrown ends in the conventional sense but that the lay-down of the thread does not follow the pattern of a conventional shortening stroke traverse. The length of yarn laid down by one movement of the traverse bar is not constant nor is the position of such lengths of yarn on the bobbin constant.

An alternative thread traversing apparatus is illustrated in Figures 6, 7 and 8, and may be described as follows: A pin 25 is non-rotatably mounted in the traverse bar 18 and rotatably mounted on this pin is a disc 26 held in place on the pin 25 by means of nut 27 and collar 28. A single arm thread guide 29 is non-rotatably fixed in disc 26, near the periphery thereof. In operation, the yarn passing to bobbin 15 is maintained continuously in contact with guide arm 29. The disc 26 and the guide arm 29 take their positions at random during the motion of the traversing bar 18. It is preferable, in order to facilitate such

a random positioning, to construct the assembly so that the center of gravity of the disc and guide arm unit will not coincide with the axis of rotation, and such an expedient is shown in the drawings which illustrate the disc as a mutilated circle. The yarn pressure on the guide arm causes the assembly to oscillate in a random manner around its center of rotation thereby causing the yarn to be laid down depending on the position of the thread guide at the end of the stroke of the traverse bar. As in the case of the assembly shown in Figures 3, 4 and 5, the yarn package will be formed with tapered ends.

Yarn packages produced with random lay-down according to the description set forth above can, contrary to what would be expected, be unwound from one end of the bobbin with substantial freedom from yarn breakage and with substantially uniform tension. Thus, when the yarn is subjected to a coning operation it is unwound rapidly at low tension, if desired, and facilitates the formation of a uniformly wound cone of yarn.

This invention is not limited, in its application, to the use of the two species of traverse guide assemblies illustrated in Figures 3 to 8. Any yarn guide, for example, a fixed guide of sufficiently resilient character, which, by virtue of its construction, will cause the yarn to be laid down at random, is adapted for use in applying the principles of the invention provided that the construction of the package is within the limits set forth below.

Referring to the guide shown in Figures 3 to 5, it is not essential that a spring be included to supplement the bouncing action of the block **23**, although such a spring element is preferred. This spring may be constructed of any suitable material, for example, steel, fiber board, etc. The relationship between the center of gravity and the center of rotation of the random guide assembly may be determined to suit those conditions which insure best performance. Instead of an angle of play of 40° for block **23** any other convenient angle may be used. Although, in the species of random guide assembly shown in Figures 3 to 5, it is preferred that the guide arm be attached to a block, this is not necessary, since any type of single arm guide which is mounted in such a way as to have limited motion in the direction of traverse may be used in applying the principles of the invention.

In the random guide assembly of Figures 6 to 8 inclusive, the disc member **26** may have a shape very different from that illustrated in the said figures of the drawings so long as the center of gravity is so positioned as to present a satisfactory random rotation.

It has been found expedient to locate the wind-up bobbin, as shown in Figure 1, in a position above and back of the size roll thereby permitting the yarn to be laid on to the bobbin by means of a single arm traverse guide instead of the usual bifurcated one. This results in simplicity of construction, facility in stringing up the machine and, particularly, a lessening of the amount of size composition rubbed off during contact of the yarn with the thread guide. In order that a minimum of size be rubbed off of the yarn, the yarn should, after leaving the sizing roller, come in contact with as few elements as possible prior to being wound up.

Referring to the modification shown in Figures 6 to 8 inclusive, shaft **25** and guide arm **29** have been illustrated as perpendicular to the plane of travel of the yarn, thereby preventing the yarn from moving back and forth along the guide arm **29** during winding. Due to this construction, the size rubbed off on the guide arm is removed about as rapidly as it is deposited and does not have an opportunity to collect as a hard abrasive upon drying of the guide. In the embodiment of Figures 3, 4 and 5, the same object is obtained by virtue of the fact that the guide is bent at the end thereby maintaining the yarn at the bend in the guide arm, during its travel to the wind-up bobbin.

Inasmuch as this invention exhibits its greatest advantages when applied to the winding of sized yarn which is wound while wet, it is desirable to point out that the size should be applied to the yarn uniformly. Assuming that the angular rotation of the wind-up package remains constant as the yarn builds up, the linear velocity of the yarn increases and this means that, in such a system, progressively less size will be applied to the yarn as the wind-up package is formed. This difficulty may be overcome by compensation, for example, the time of contact of yarn with the size roll may be kept constant by making the arc of contact of the yarn with the size roll progressively greater or the rotation of the wind-up bobbin may be progressively decreased or the bobbin may be driven by a face drive mechanism, although the latter expedient causes trouble since the moist size tends to accumulate on the driving roller. These different compensating means are expensive and the necessity for using such compensation may be eliminated by utilizing a large wind-up bobbin, for example, 6 inches in diameter, on which a comparatively thin cake of yarn, e. g., ½ inch thickness or less, is wound. The use of a 6-inch bobbin on which a ½-inch cake is wound involves a difference of only about 10% of size applied, per unit of length of yarn, from the beginning to the end of the wind-up, and an added advantage in the use of bobbins and yarn cakes of this size where the yarn is wound up while still moist with size, resides in the fact that drying takes place more rapidly and wicking ("the migration of size" from the inside to the outside of the yarn cake) is minimized. Of course, where it is not important to maintain the application of size per unit of length of yarn within narrow limits during the winding, a thick cake of yarn may be wound on the receiving package and a less diameter of bobbin or other yarn receiving element (e. g., a tube or a pirn) may be used, the package still presenting utility as a supply package in subsequent operations such as twisting or knitting.

In order to dry the yarn on the wind-up bobbin **15** at a controlled rate, a heating device such as is illustrated in elements **16** and **17** of Figure 1 is used. Heating element **17** may, for example, be an electrical strip heater, metallic shield **16** being so formed that the heated air may remain in proximity to the wind-up bobbin for a longer period of time. Other forms of heating device and shield may be used, for example, infra red lamps and other types of devices located near the wind-up bobbin. By the use of heating apparatus, of the character described, the yarn dries at a predetermined rate and the size adheres tenaciously and imparts to fabrics made from the sized yarn, a high resistance to snagging.

In line with the desire to obtain uniform application of size to yarn, especially in a bobbin-to-bobbin operation in which the yarn is wound up wet, yarn having a low degree of twist, e. g., two

turns per inch, could heretofore be sized uniformly only with great difficulty. Non-uniformity of size application to low twist yarn tends to lower the quality of the finished product and causes great difficulty in the subsequent twisting of the sized yarn causing, among other things, an uneven twist. Non-uniformity of size application especially with low twist yarn, is caused by a fluttering of the yarn on the size roll. Such fluttering is diminished by means of the tension devices **5** and **6** of Figure 1 which are disposed perpendicularly to one another.

In the case of yarn which is wound up while wet with size, the size being dried on the wind-up bobbin, the windings of yarn will adhere with some force to adjacent windings due to the solidification of the size while the yarn windings are in tight contact with each other. It is evident that such a character of yarn will not, unless great care is taken, unwind readily under anything like constant tension and without a large number of breaks. In accordance with the present invention, it is found that yarn cakes of this character may readily be unwound. The ease with which the package is unwound depends to a large extent on the taper at the end of the package. Thus sized yarn which is wound wet into a package having straight ends cannot be unwound satisfactorily and this is especially true where the unwinding is accomplished over one end of the package. However, when utilizing the random wind-up of the present invention, unwinding takes place rapidly and efficiently.

It is essential that the taper on that end of a wound package from which the yarn is unwound, which package is composed of yarn which has been sized and wound wet, fall within certain limits; in the case of a package unwound by an end-over operation, the end over which the yarn is unwound, must fall within the said limits, and where the yarn is unwound from end to end then both ends must fall within said limits. One form of taper is illustrated in Figure 9 which represents a yarn cake wound up by the use of the apparatus of Figures 1 and 2 utilizing the traverse assembly of Figures 3 to 5. In Figure 9 curves AE and GF represent lines formed by the intersection of the tapered ends of the bobbin with the vertical central plane of cross-section. H represents the point furthest removed from the bobbin surface AG. E and F (the practical ends of the taper) represent the first points along the curves AH and GH which fall within a distance of 0.15 inch measured perpendicularly from a line drawn through H parallel to AG. It has been found that when the angles formed between AG and AE and between AG and GF are less than 65° and when no segments of the curves AE and FG have tangents forming angles of 90° or greater with any plane parallel with AG and when the sum of the segments of said curves having tangents forming angles in excess of 65° with any plane parallel with AG does not exceed 0.15 inch then yarn packages formed from sized yarn which is wet when wound unwind with ease, and substantially no underwindings (tuck-unders) are formed during the winding of the sized yarn package. It is not intended to claim the novel package of sized yarn produced in accordance with the present invention, since this is included within the subject matter of my copending application entitled "Yarn packages," filed of even date herewith.

Although the invention has been described in its preferred form as a combined sizing and winding operation, the principles of the invention may nevertheless be applied generally to other types of winding operations, e. g., spinning, twisting, and coning. Furthermore, although the greatest benefits of the invention have been experienced in connection with yarns composed of polyhexamethylene adipamide and other types of synthetic linear polyamides, it may be applied with advantage to yarns formed from other types of synthetic linear polymer and to other synthetic and natural fibers such as viscose rayon, cellulose acetate and other cellulose derivative fibers, cotton, wool and silk. For purposes of convenience, it is desired to state that the term "synthetic linear polyamide," as used throughout the specification and claims, is intended to refer specifically to the fiber-forming material described and claimed in United States Letters Patent Nos. 2,071,250, 2,130,523 and 2,130,948. Synthetic linear polymers other than the polyamides are described in United States Letters Patent No. 2,071,250.

It will be seen from the above description that by the practice of this invention, it is possible to build up a taper-ended package without the necessity of using complicated devices to decrease the traverse stroke or to change its point of origin. Packages of yarn produced in accordance with this invention may be unwound easily under constant tension and with a minimum of breakage, even though the yarn is wound during the formation of the package while wet with size. Additionally, the invention has produced yarn packages free from loops and tuck-unders by laying the yarn down in a random fashion. It could hardly have been expected, in advance, that the random lay-down of yarn windings would produce an easily unwound package since the formation of loops under prior art practice was considered a definite disadvantage, and the use of a random lay-down principle superficially at least appears to be somewhat analogous to the formation of loops.

Inasmuch as the above description and the drawings are largely illustrative rather than limitative, any modification or variation thereof which utilizes the principles of the invention are intended to be included within the claims.

I claim:

1. The process of winding yarn which comprises contacting the yarn with a size contained in a vaporizable liquid medium, winding the yarn while wet with said size and medium on a yarn receiving device, continuously traversing the yarn during wind-up from one end portion of the yarn receiving device to the other and laying the yarn down at random at the ends of the package.

2. The process of winding yarn which comprises contacting the yarn with a size contained in a vaporizable liquid medium, winding the yarn while wet with said size and medium on a yarn receiving device, continuously traversing the yarn during wind-up from one end portion of the yarn receiving device to the other and laying the yarn down at random at the ends of the package by superimposing a random motion on the yarn during its reciprocation.

3. Yarn sizing and winding apparatus comprising means for applying to a yarn a size contained in a vaporizable fluid medium, a yarn receiving device so arranged with respect to the size applying means as to receive the yarn while wet, said size applying means positioned to one side of said yarn receiving device, said means adapted to pull the yarn to that side of said device, traversing mechanism for positively reciprocating the yarn from one end of the yarn receiving device to the

other, said mechanism including a traverse element adapted to pass back and forth longitudinally of said yarn receiving device, and a thread guide freely rotatably mounted on the traverse element, said thread guide positioned to contact one side of the yarn whereby to pull the latter to the side of said device opposite the size applying means, the thread guide being adapted to change its position on the traversing mechanism whereby to effect a random laydown of the yarn on the yarn receiving device.

4. Yarn sizing and winding apparatus comprising means for applying to a yarn a size contained in a vaporizable fluid medium, a yarn receiving device so arranged with respect to the size applying means as to receive the yarn while wet, said size applying means positioned to one side of said yarn receiving device, said means adapted to pull the yarn to that side of said device, traversing mechanism for positively reciprocating the yarn from one end of the yarn receiving device to the other, said mechanism including a traverse element adapted to pass back and forth longitudinally of said yarn receiving device, and a thread guide freely rotatably pivoted on the traverse element, said thread guide positioned to contact one side of the yarn whereby to pull the latter to the side of said device opposite the size applying means, the thread guide being adapted to rotate, at least in part, on its pivot whereby to effect a random lay-down of the yarn on the yarn receiving device.

5. The apparatus of claim 4, characterized in that said apparatus embodies heating means for drying the yarn after it is wound on the yarn receiving device.

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