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YARN PACKAGE FORMATION

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Fig. 1.

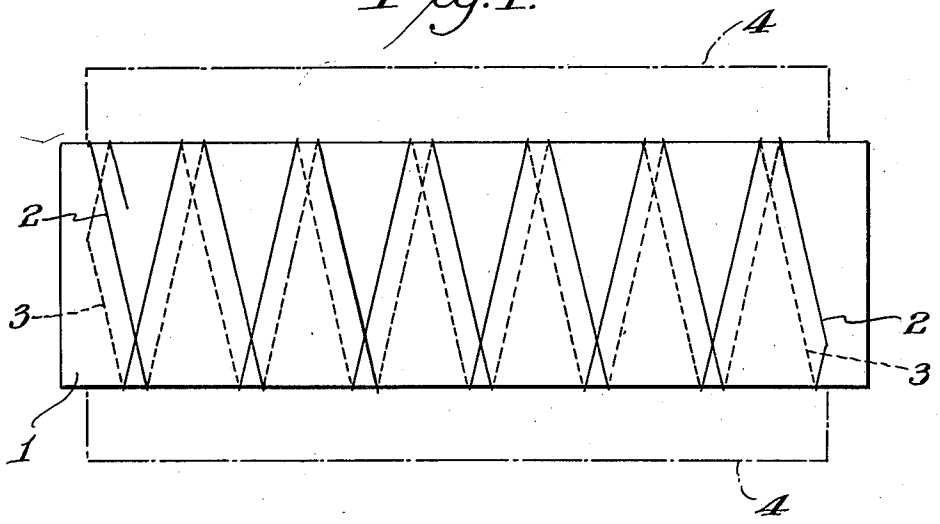
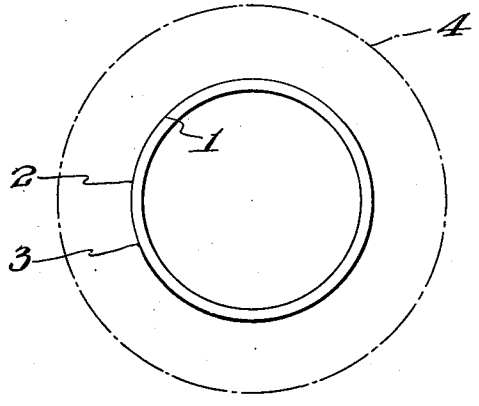


Fig. 2.



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YARN PACKAGE FORMATION

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4 Claims. (Cl. 242—159)

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This invention relates to the winding of yarns. More particularly, this invention is concerned with a method for winding continuous filament yarns into square shouldered cylindrical packages. It is further concerned with the production of square shouldered packages suitable for shipment to distant mills and suitable for direct use on up-twister spindles used to impart a high degree of twist to the yarn.

In the winding of yarns a certain few predetermined wind ratios have been more or less standardized for certain types of packages. In spooling generally a very high wind ratio is used, i. e., the number of helices wrapped around the core per complete, back and forth, stroke of the traversing guide. This may be in the order of 20 or 30 or even more depending on the length of the spool, speed of winding, etc. In other words, the traverse is "slow." However, since the traverse guide is generally spaced from 2 to several inches from the winding-on surface, this slow traverse is necessary to get the yarn to fill the spool barrel completely. If the traverse guide is controlled only by a single primary cam, the yarn windings are very hard and "bunched" at the ends due to the lag in reversal. Accordingly, a secondary cam usually causing a shifting of the primary traverse origin is also used. While this arrangement is satisfactory for spool packages of yarn where spool end flanges are present to hold the yarn in place, it is not at all satisfactory for winding onto headless cores, such as cones or cylinders, such as are wound on a "precision" or cone winder.

In the case of the "precision" or cone winder the yarn is led through a traverse guide actually riding on or in very close proximity to the winding-on surface. In order to form square shoulders without marked bulging at the ends the traverse is "fast" relative to the yarn winding speed. Since the traverse guide rides the package, thereby eliminating any substantial lag at the ends of the stroke, an acceptable package for many purposes is produced with but a single cam for directing movement of the traverse guide. This wind ratio is commonly of the order of 4 to 6. However, with this low wind ratio the yarn stays in place poorly and such a package cannot be rotated at high speeds on an up-twister. Therefore, the yarn is usually taken therefrom while the package is stationary by drawing it over the end. Then too, this low wind ratio is very largely confined to winding onto cone cores, the taper of which aids in keeping the windings in place.

There is a need in the trade for cylindrical packages of substantial size of purified, doped and dried rayon yarn which can be mounted directly on up-twister machines and rotated at high speed to produce a high twist yarn, i. e.,

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crepe twists with 40 to 80 turns per inch. Since, a pound package of 100 denier yarn lasts, rotating continuously at 8000–10,000 R. P. M. for 7 or 8 days, provision must be made to prevent the yarn from being irreparably soiled. Dirt and dust is twisted into the yarn if no precautions are taken. In copending application of Paeplow and Kiachif Serial No. 97,527, filed June 7, 1949, apparatus is described for preventing soiling. In order to provide adequate protection of a yarn package, it must be square ended, and the apparatus referred to is used with square-ended packages. Also square ends are required so that the conventional type drop wire flyer may be used with assurance that the guide eye therein will be below the top shoulder. A "precision" wind is also necessary since no supporting flanges can be present but the wind universally used with conventional winding machines is not at all acceptable.

It is, therefore, an object of this invention to provide an improved yarn package suitable for use directly on an up-twister spindle. Another object of this invention is to provide a square ended package permitting the use of an improved winding apparatus. Other objects will be apparent from the description that follows.

While not essential to an understanding of the invention, the drawings, as described below, are presented to illustrate the true cylindrical package formed by the process of the present invention.

Figure I represents a side view of a headless core 1 containing a first 2 and second 3 lay down. Broken lines 4 represent the final build up of the yarn.

Figure II represents an end view, the numerals identifying identical elements as in the previous figure.

The objects of this invention are accomplished by preparing in a special manner a square ended cylindrical yarn package that does not distort or slough when rotated at high speeds to produce high twist yarns. By "square ended cylindrical yarn package" is meant a cylindrical yarn package having a uniform thickness from one end to the other. The package has no tapered sections either at the ends or along its length; the plane of each end surface is perpendicular to the long axis of the package and each end is, of course, circular, the package being a true cylinder. The winding is accomplished by the method of this invention which results in laying the yarn down at the proper helix angle and with proper tension upon it so that shoulders or bulged ends are avoided and so that the package is self-supporting on the headless core upon which it is wound.

In order to produce the package of this invention, the yarn must be laid down using a wind

ratio in the range of 12.50+ to 13.50+. That is, there are that number of helices of yarn laid down around the core for every complete stroke of the traverse guide. This range is operative when a 5¾ inch stroke is used. A stroke is one back and forth movement of the guide or a complete cycle of the primary cam. The use of this wind ratio determines the helix angle which is low ranging from 12° to 15°±1°. If a longer or shorter package is to be wound, the same helix angle is maintained, but the ratio may have to be varied somewhat. The variation is usually not more than 10%. Throughout the winding, the traverse guide speed is maintained exactly at a constant ratio to the primary cam by the use of a gear gainer. To assist in the prevention of bulging shoulders, it is necessary to use a secondary cam of approximately $\frac{1}{32}$ inch throw. The cycle of the secondary cam to the primary cam must be maintained at about 1 to 14.2+. This prevents the lag resulting with the use of a primary cam only and undesirable bulges are avoided. It is further essential that the tension on the yarn in the package be accordingly controlled within narrow limits. Tension at the wind-on point should be between 0.17 to 0.38 gram per denier. This figure is based on 100 denier yarn and the range may vary downward somewhat for deniers smaller than 100 denier and upward somewhat for deniers larger than 100 denier.

To determine the tension on the yarn as it is wound onto the package in the process of this invention, yarn is led from the inside of the traverse button to a roller well below the winder and returned upward around this roller to the package. Tension measurements were taken on the thread ahead of the button and on the downcoming thread at the discharge side of the winder button. The latter values simulated the tension of the yarn as it is wound on the package. After establishing the relationship between the tension ahead of and after the winder button, measurement during control was made conveniently on the yarn ahead of the button. Constant thread speed was required to maintain the constant tension. During winding the tension is maintained constant at a value which must be between 8 to 14 grams for a 100 denier yarn. While this range may be used from package-to-package, the range within a given package must be held within more narrow limits to avoid poor package formation. The constant thread speed needed to accomplish this is attained using mechanical devices as tapered pulleys or properly designed cams.

By way of example, in winding the 100 denier yarn a square ended package satisfactory for use in uptwisting is made using a 5¾ inch traverse stroke with a wind ratio corresponding to 9520 revolutions of the tube for 741 complete traverse strokes. The wind ratio in every case must be an indeterminate fraction to avoid any possibility of minor ribbons since these cause bad sloughing during up-twisting operations. It is preferable for the wind ratio, expressed above, as ranged from 12.50+ to 13.50+ when expressed as a fraction to have a low whole number denominator. With this condition, the pattern laid down on the yarn package repeats more frequently and a more staple package results. However, if the pattern is repeated before the number of completed traverse strokes is 25, spiral ridges form at the ends of the package. Accordingly, the number of traverse strokes before the pattern is repeated should be from 25 to 741 with the range of 30 to 100 being preferred. In demonstrating the critical nature of the wind ratio it was found that with a wind ratio of 10, sloughing was so pronounced that the resultant package could not be used at all in uptwisting. With a wind ratio of 16, cylindrical package formation could not be maintained even by modifying and increasing the throw of the secondary cam and in spite of trying all sorts of corrective measures the package always resulted in bulges at the ends which caused repeated breaks when an attempt was made to twist therefrom on an up-twister.

In respect to the acceleration of the primary cam, the wind ratios used are high enough so that with the ordinary primary cam, bulges result at the ends of the package. To overcome this, the primary cam is accelerated at the reversals by about 25% and in addition to this a secondary cam of approximately $\frac{1}{32}$ inch throw is used to reduce the density of the shoulder. To obtain the desired shoulder density, the cycle of the secondary cam to the primary cam must be maintained at about 1 to 14.2+. That is, the secondary cam should make one complete revolution for every 14.2+ revolutions of the primary cam. Further, the secondary stroke should be no less than $\frac{1}{32}$ inch and no more than $\frac{3}{64}$ inch on a 6 inch package, for outside that range undesirable shoulder bulges are obtained. This range, of course, will vary somewhat depending upon the length of the package but for most purposes the range produces satisfactory results, the displacement being adequate. Usually, a package of about 6 inches is preferred.

In respect to the tension requirements, the yarn being wound on the package is normally led to and around a traverse guide at various angles. This angle may be, for example, of the order of 45° to 100°. Due to this snubbing, the tension on the yarn as measured on the package is greater than the tension of the yarn as it is led to the traverse guide. In order to obtain a package with equal density on the shoulders and in the middle or, in fact, throughout the entire package, the tension on the yarn as it is being fed to the traverse guide must be maintained between 6 to 12 grams for 100 denier yarn with approximately 100° angularity around the guide. This tension corresponds to 26 to 38 grams measured on the yarn as it is wound on the package. If a lower angularity of approximately 45° or less is used, the tension range within which a satisfactory package can be produced is from 6 to 18 grams. This corresponds to tension on the package of 17 to 25 grams. For 100 denier yarns, it is preferred that the tension on the yarn traveling to the traverse guide be from 8 to 14 grams. Tensions under 8 grams tend to produce single filament loops. Tensions above 8 grams stretch the filaments to a common length and are accordingly preferred. The allowable tensions will, of course, vary roughly depending upon the denier of the thread. For most operations tension on the yarn traveling to the traverse guide must be maintained between 0.06 to 0.25 gram per denier with the tension on the yarns at the wind-on point varying from 0.17 to 0.38 gram per denier. If the tension is not controlled as described, poor package formation results; sloughing and bulging at the ends occur.

Of course, in order to maintain the critical limits described above in the various steps of the process of this invention, the apparatus must be controlled in a precise manner. Thus, for the

winding of a headless high wind package having a uniform thickness throughout, it is more essential that a true running spindle be employed along with a concentric chuck for the tube, a uniform and low back pressure of about 300 to 500 grams, a traverse guide with a sharp V for the thread groove and a compensated drive to produce constant thread speed. This back pressure is the force exerted on the traverse button by the "traverse back" of the winder. If this pressure is too high, the package becomes hard and the ends or shoulders are forced out. If too low, the package is soft and unstable, and, if excessively low, the button loses contact with the package thereby destroying the precision nature of the wind.

Through this invention, a package is produced which may be shipped to a distant mill and used directly on up-twister spindles for the production of crepe twisting yarn. The yarn may have on it a sizing such as is used in crepe yarns and the doped yarn may be handled directly with elimination for the mills of the steps of doping, drying and spooling. No difficulties are encountered; the package maintains its form through the trip and throughout up-twisting. Due to the helix angle of the yarn lay the various courses of yarn maintain their position without distortion even when the package is rotated at spindle speeds of 8000 or even 10,000 R. P. M. Further advantage of this invention lies in that it is readily adapted to use with the apparatus of Paeplow and Kiachif referred to above permitting the prevention of the yarn from soiling during up-twisting. A further advantage of this invention lies in the fact that conventional spool winds are obviated. In such winds, there is insufficient thread helix angle to provide an interlocking pattern. Through the process of this invention a much simpler core can be used and the difficulties in spool winding are avoided.

Further, by the use of this invention a number of expensive steps in the manufacture of crepe twist yarn are eliminated. As practiced heretofore, skein winding and skein doping followed by drying and then rewinding to spools from which the yarn was thrown were necessary steps. Previously, package sizes were limited to ½ lb. The cost of handling, rewinding and replacing on the twisters of so many units involved considerable expense and considerable degradation of the yarn during each and every step of the process. By the process of this invention, it is possible to wind large packages on headless cores and to transfer these directly to the up-twister using apparatus which protects the yarn during up-twisting from soilage. Considerable economy in time and equipment and a substantial increase in output is obtained.

Any departure from the procedure described herein which conforms to the principles of the invention is intended to be included within the scope of the claims below.

We claim:

1. A process for preparing a cylindrical yarn package of uniform thickness which comprises winding a yarn on a headless core by passing it through a traverse guide to said core, said guide having a complete stroke of about 5¾ inches and said guide and said core moving at rates of speed so that between 12.50+ and 13.50+ helices of yarn are laid down on said core for every complete stroke of said guide; applying a substantially constant tension on the said yarn winding on said package, the tension being a value between 0.17 and 0.38 gram per denier; accelerating the traverse guide at the reversals by about 25% and continuously displacing the movement of the said guide in small increments for a total displacement of about from $\frac{1}{32}$ inch to $\frac{3}{64}$ inch completing and reversing each displacement cycle in about 14.2 strokes of said guide.

2. A process for preparing a cylindrical yarn package of uniform thickness which comprises passing a yarn under a tension of 0.06 to 0.25 gram per denier to a traverse guide; snubbing said yarn about said guide and passing it therefrom at angle of from 45° to 100° to a headless core whereby the tension on said yarn winding on said package is substantially constant being a value between 0.17 to 0.38 gram per denier; rotating said core and traversing said guide at speeds whereby between 12.50+ and 13.50+ helices of yarn are laid down around said core for every complete stroke of said guide which stroke measures about 5¾ inches; completing between 25 and 741 complete traverse strokes before repeating any helix pattern; and accelerating the traverse guide at the reversals by about 25% and continuously displacing the movement of the said guide in small increments for a total displacement of about from $\frac{1}{32}$'' to $\frac{3}{64}$'' completing and reversing each displacement cycle in about 14.2 strokes of said guide.

3. A process for preparing a cylindrical yarn package of uniform thickness which comprises winding a yarn on a headless core by passing it through a traverse guide to said core, said guide having a stroke such that the lay down on said core has a helix angle of from about 11 to 16 degrees; applying a substantially constant tension on the said yarn winding of said package; accelerating the traverse guide at the reversals by about 25% and continuously displacing the movement of said guide in small increments for a total displacement of about from $\frac{1}{32}$'' to $\frac{3}{64}$'' completing and reversing each displacement cycle in about 14.2 strokes of said guide.

4. A process for preparing a cylindrical yarn package of uniform thickness which comprises winding a yarn on a headless core by passing it through a traverse guide to said core, said guide having a stroke such that the lay down on said core has a helix angle ranging from about 11 to 16 degrees; applying a substantially constant tension on the said yarn winding of said package; the tension being a value between 0.17 and 0.38 gram per denier; accelerating the traverse guide at the reversals by about 25% and continuously displacing the movement of said guide in small increments for a total displacement of about $\frac{1}{32}$'' to $\frac{3}{64}$'' completing and reversing each displacement cycle after about at least 14.2 strokes of said guide.

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