July 5, 1966 J. R. DE RUIG 3,259,337

YARN PACKAGE AND WINDING METHOD

Filed Dec. 10, 1963 2 Sheets-Sheet 1

FIG. 1

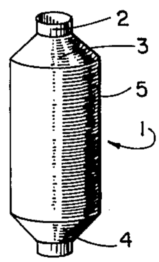


FIG. 2

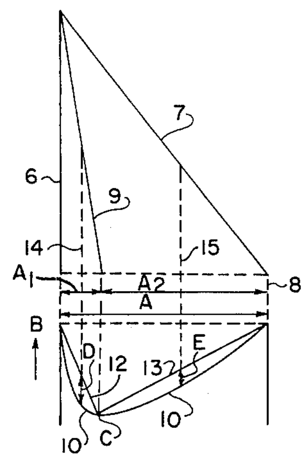


FIG. 3

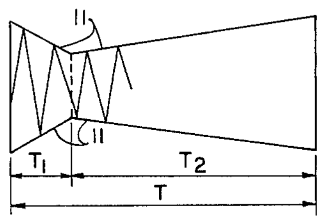


FIG. 4

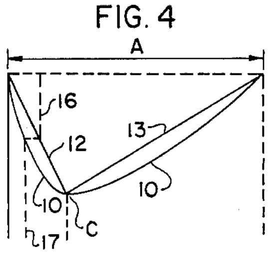


FIG. 5

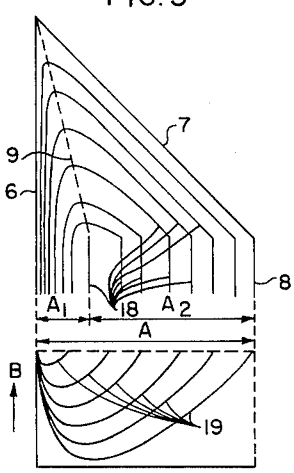


FIG. 6

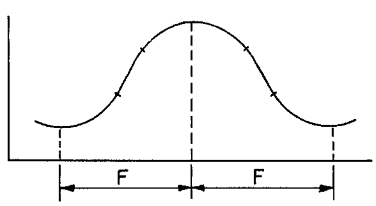


FIG. 7

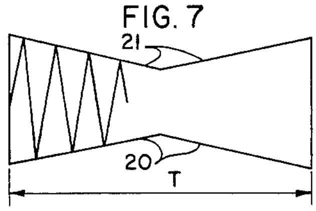
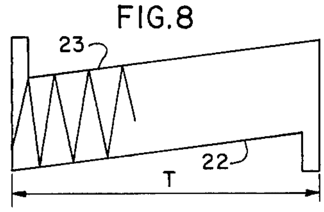


FIG. 8



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YARN PACKAGE AND WINDING METHOD

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FIG. 9

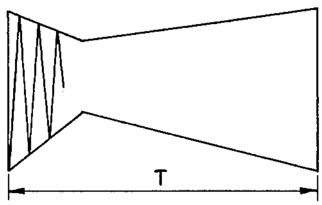


FIG. 10

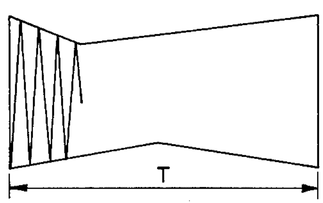


FIG. 11

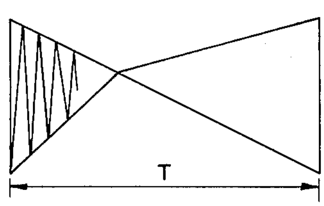


FIG. 12

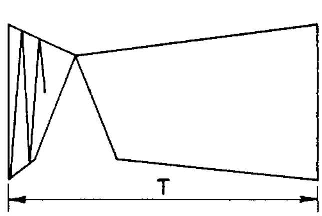


FIG. 13

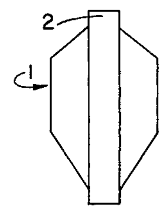


FIG. 14

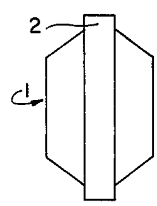


FIG. 15

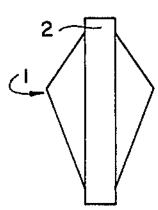
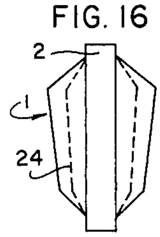


FIG. 16



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3,259,337

Patented July 5, 1966

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3,259,337
YARN PACKAGE AND WINDING METHOD

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Filed Dec. 10, 1963, Ser. No. 329,497
Claims priority, application Netherlands, Dec. 19, 1962, 286,992
8 Claims. (Cl. 242—178)

This invention relates to improved yarn packages and particularly to yarn packages which are wound on tubes using a ring twister, together with a method for winding same.

In yarn packages wound from freshly drawn, synthetic filament yarns such as from polyamide or polyester yarn wound on tubes, it has been found the elasticity modulus of the yarn is not constant throughout the package. It is known that variations in elasticity modulus are caused by contraction of the yarn, a greater contraction resulting in a lower elasticity modulus. Yarn laid on the tube surface cannot contract and thus retains a high elasticity modulus. Contraction of yarn inside the package is fairly high since it lies on a relatively soft underlayer and in addition is subject to pressure from the outer windings of the package. Accordingly, the elasticity modulus of such inner windings of yarn is low. Yarn on or near the surface of the package also lies on a soft underlayer. However, it is not subject to external pressure and thus it retains a higher elasticity modulus.

One disadvantage of conventional yarn packages wound by means of a ring twister is that the yarn has a relatively high variation in elasticity modulus in the sections which have been wound in one traverse stroke in addition to the aforementioned modulus variations radially through the package. These variations in elasticity modulus in individual traversing layers may cause streakiness (barré) in a fabric or rings or variations in length in stockings. They occur because one end of each traversing stroke layer lies on the tube with the other being over a relatively soft underlayer. It is known that streakiness (barré) may be avoided by winding yarn on cross-wound bobbins, in which there are no appreciable variations in modulus in the individual layers of yarn because of the straight build-up of the package. However, yarn wound in this manner is not twisted so that special procedures, i.e., tangling, twisting, etc., must be utilized to make it suitable for further processing.

Accordingly, it is an object of this invention to provide yarn packages not having the aforementioned disadvantages together with a method for producing same.

Another object of this invention is to provide yarn packages in which variations in elasticity modulus in individual layers of yarn are minimized.

Still another object of this invention is to provide yarn packages in which variations in elasticity modulus radially through the package are substantially reduced.

A further object of this invention is to provide a method for winding yarn packages using a ring twister in which variations in elasticity modulus in each layer of yarn are minimized.

Another object of this invention is to provide a method for winding yarn using a ring twister in which variations in elasticity modulus radially through the package are substantially reduced.

These and other objects will become more apparent from the following detailed description and drawings.

In accordance with this invention, the advantages of a ring twister may be combined with those of winding on a cross-wound bobbin. The invention comprises winding a yarn package in such a way that substantially all individual

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layer reversing points obtained as a result of traversing are covered by the innermost and outermost layers of the yarn. This is accomplished by programming the yarn package buildup in such a way that at least an intermediate portion of the yarn package is wound using a stroke shortening cycle immediately followed by a stroke lengthening cycle. Thus, since the reversing points of the layers applied during this stroke length varying period lie in an intermediate portion of the package and are neither immediately on the tube surface nor on the outer surface of the package, variations in elasticity modulus in a layer of yarn wound in one traverse stroke will only be small and, consequently, acceptable.

Stroke length variation may be practiced throughout the entire package buildup; or, alternatively, an initial amount of innermost layers of yarn and a final amount of outermost layers of yarn may be formed on the package using a constant stroke length. If a constant stroke length is used during the innermost and outermost layer buildup, the innermost layers of yarn should not contain more than 25 percent by weight of the package and the outermost layers not more than 45 percent by weight of the package. Preferably, the entire layer of yarn lying on the surface of the tube is wound in the first traverse stroke, and the yarn layer forming the outer surface of the package is wound in the last traverse stroke. Yarn which has been subjected to heat treatment prior to winding is preferably used for package building. The yarn packages of the present invention decrease in diameter toward each end. For example, they have a cylindrical central portion with tapered or substantially conical ends. Preferably, practically all of the reversing points are located inside the tapered end portions of the package. Ideally, the reversing points in each package end lie along a conical line between the conical outer surface and the yarn layer lying on the tube. As used herein, conical is intended to mean exactly conical or slightly off from conical, i.e. concave or convex.

In one embodiment of the invention in which the yarn package is formed using stroke length variation throughout the entire package, a yarn package is wound consisting of a first portion starting from the tube surface in which the traverse stroke is gradually reduced and a second portion in which the traverse stroke is gradually increased to approximately its original length, the portion built up with the stroke being lengthened completely covering the portion obtained with the stroke being shortened. If the last stroke of the portion obtained using stroke lengthening is a little longer than the first traverse stroke of the portion built up using stroke shortening, then the entire package is covered and in the event of the package getting damaged or contaminated only the outermost yarn layer is wasted. Preferably, the transition from the portion of the package wound with stroke shortening to the portion of the package wound with stroke lengthening is approximately at the point in the package where the elasticity modulus is lowest relative to the variation thereof radially through the package. The differences in elasticity modulus most favorably influence the quality of the package if the portion wound with stroke shortening forms at least 10 percent and not more than 55 percent by weight of the package and preferably about 30 percent by weight of the package.

In accordance with the invention a yarn package may be obtained in which the yarn wound in each traverse stroke has only slight variances in elasticity modulus if in the completed package practically all the points of each yarn layer wound including the reversing points are substantially in that area in which the forces that influence yarn package quality, particularly elasticity modulus, are constant. Such a package is obtained if the speed of the traverse motion between two successive reversing points is gradually changed, depending on the shape of the area with constant elasticity modulus in package. For example, the stroke is slower at the ends in the area of the reversing points and faster in the middle.

The invention will be further described by reference to the attached drawing wherein

FIGURE 1 is a perspective view of a yarn package and tube holder wound according to the invention;

FIGURE 2 is a schematic view in cross section of one end of a yarn package together with the curve of the elasticity modulus radially through the package;

FIGURE 3 is a diagrammatic view of traverse stroke variance with the package building time for the package of FIGURE 2;

FIGURE 4 is also a diagrammatic view of the curve of the elasticity modulus radially through the yarn package of FIGURE 2;

FIGURE 5 is a cross sectional diagrammatic view of one end of a package build-up and the curves of elasticity modulus;

FIGURE 6 is a curve of the traverse motion as a function of time during one particular stroke;

FIGURES 7 and 8 are diagrammatic views of different traverse patterns in relation to package building time;

FIGURES 9, 10, 11, and 12 are diagrammatic views of still other traverse patterns in relation to time; and

FIGURES 13, 14, 15 and 16 are views in cross section of packages wound according to the traversing patterns of FIGURES 9, 10, 11, and 12, respectively.

In FIGURE 1 yarn package **1** is wound on tube **2**. The package **1** has conical top and bottom ends **3** and **4**, respectively, and a cylindrical central portion **5**. Freshly drawn synthetic filament yarns are often wound into packages corresponding to the contour of the package depicted in FIGURE 1, the weight of which may range from 500 to 2000 grams.

In FIGURE 2 the tube surface is represented by line **6**, the conical outer surface of the package end by line **7**, and the cylindrical outer surface of the package by line **8**. The thickness of the package is indicated by the distance A. The package is wound such that all the reversing points lie along conical inner line **9**, i.e., in the portion of the package between the innermost layer of yarn on the tube surface **6** and the outermost layer of yarn **7**, forming the outer surface of the package. In the lower part of FIGURE 2 the curve **10** indicates the average variation in elasticity modulus radially through the thickness A of the package, the elasticity modulus being plotted vertical and increasing in the direction of the arrow B. The curve **10** is not always identical for different yarn packages, but its shape and the eccentric position of the minimum elasticity modulus C relative to the thickness of the package are practically the same. In FIGURE 3 the traverse motion pattern for obtaining the package represented in FIGURE 2 is shown. Package building time is plotted horizontally and the length of the yarn package vertically. T is the time required for building an entire package having thickness A. Line **11** refers to the variations in the length of the traverse stroke and the position thereof while the package is being formed. Thus, FIGURE 3 shows that the entire layer of yarn lying on the surface of the tube is wound in the first traverse stroke, and that the layer of yarn forming the outer surface of the package is laid in the last traverse stroke. Moreover, the package consists of a first portion starting from the tube surface in which the traverse stroke is gradually reduced during period T_1 and a second portion in which, during period T_2, the traverse stroke is gradually increased to its initial length. The package portions formed during periods T_1 and T_2 are referred to in FIGURE 2 by A_1 and A_2, respectively. The periods T_1 and T_2 are so chosen that the yarn layer wound with the shortest traverse stroke is in the area or layer of the package with the lowest

elasticity modulus. In other words, in FIGURE 2 the distance from point C to the tube surface **6** is approximately equal to the distance A_1. From the FIGURES 2 and 3 it can be seen that the elasticity modulus of the reversing points on line 9 theoretically lie on lines **12** and **13**. The variations in modulus occurring in yarn wound in one traverse stroke are represented in FIGURE 2 by the vertical distance between the lines **12** and **13** and line **10**. In reference to the position of the minimum elasticity modulus C, the portion A_1 should contain at least 10 percent and not more than 55 percent by weight of the yarn package and preferably 30 percent by weight of the package. The lines **12** and **13** being relatively close to the line **10**, the difference in elasticity modulus caused by the reversing points are relatively small. For two layers of yarn **14** and **15** in the case of a substantially linear main stroke, the differences in modulus are indicated by D and E, respectively.

The best yarn packages are obtained if the differences in elasticity modulus in yarn wound in one traverse stroke and caused by the reversing points, are practically equal to zero. This happens theoretically if, as shown in FIGURE 4, the reversing point of the yarn layer **17** is in line with the yarn layer **16**, the points of intersection of the lines **16**, **17** with the modulus lines **12** and **10**, respectively, thus having the same modulus. FIGURE 4 shows the curve of the elasticity modulus radially through the package in the same manner as FIGURE 2, like reference numerals referring to like parts. FIGURE 5 diagrammatically shows the build-up and position of yarn layers **18** in a package in which the reversing points do not cause any variations in elasticity modulus. Lines **18** also indicate the shape of the surfaces or areas in the package in which the moduli are constant. Lines **18** are construed in the lower part of FIGURE 5 as lines **19** to indicate the average variation in modulus at various points in the conical end of the package. The package of FIGURE 5 substantially corresponds to that of FIGURE 2, like reference numerals referring to like parts. Both packages may be wound using a traverse motion pattern in the shape of an asymmetrical hour glass as shown in FIGURE 3. However, in order to obtain such a package, the speed of the traverse motion between two successive reversing points at the ends of the package must be changed in each stroke depending on the shape of the areas **18** having constant elasticity modulus. Such a variation of the traverse motion as a function of time is diagrammatically shown in FIGURE 6 for a layer of yarn in the portion of the package built up with stroke shortening, the time being plotted horizontal and the stroke vertical. The distances F represent the time required for making one given traverse stroke. Thus, it is apparent that the speed of the stroke is slower at ends and faster in the middle. It should also be noted that in the package of FIGURE 5 all the reversing points lie approximately along line **9**.

The embodiment described in FIGURES 1 to 6, inclusive, is preferred for producing yarn packages having the most desirable build-up. Other embodiments of the invention also comprise yarn packages which are wound using a traverse motion pattern according to the FIGURES 7 or 8. Lines **20** to **23**, inclusive, indicate the variation in the stroke length and the position of the stroke as a function of time, T being the time required to build up the entire package. In FIGURE 7, the first half of the package is wound with the stroke gradually being shortened, and the second half with the stroke gradually being increased. In FIGURE 8 a number of yarn layers are first wound, which preferably form about 9 percent of the package, use being made of a traverse stroke which is about equal to the total length of the package so as to form a relatively soft underlayer on the tube for the rest of the package. Thereafter, practically the entire package is wound on such underlayer using a smaller traverse stroke the position of which is gradually shifted over the package. Finally, the outer yarn layers, which form about 18 percent of the weight of the package, are wound using a traverse stroke which has about the same length as the initial stroke and also the same position, so that the entire package is covered.

FIGURES 9 to 16 diagrammatically show a number of different traverse motion patterns in conjunction with their corresponding packages **1** on tubes **2** shown in FIGURES 13 to 16. T again indicates the time required for winding the entire package. In FIGURE 16 broken line **24** indicates the approximate position of the reversing points in the package. The bottom end of a package may be inclined less than the top end to prevent the windings from sloughing off.

From the foregoing description, it can be clearly seen that the yarn packages of FIGURES 7 to 16, as well as those of FIGURES 2 and 5, have an inner and an outer portion, with all of the reversing points obtained as a result of traversing positioned inside the package.

Other variations and modifications within the scope of the invention will be apparent to those skilled in the art. Accordingly, the invention is intended to be limited only to the extent set forth in the following claims.

What is claimed is:

1. A yarn package wound on a tube and having minimal variations in the elasticity modulus of the yarn radially through said package as well as in the individual layers of yarn forming said package, said package comprising a first plurality of yarn windings wound in progressively decreasing traverse strokes from a maximum to a minimum forming an inner portion of said package, a second plurality of yarn windings covering said first plurality of yarn windings and forming an outer portion of said package, said second plurality of yarn windings beginning with the layer of yarn wound in minimum traverse stroke and increasing to a maximum traverse stroke equal to the length of said yarn package, said first and second pluralities of yarn windings being joined at a transition point where the elasticity modulus of the yarn is a minimum as determined radially through said yarn package.

2. The yarn package of claim **1** wherein the first plurality of yarn windings contains between 10% and 55% by weight of the package.

3. The yarn package of claim **2** wherein the first plurality of yarn windings contains approximately 30% by weight of the package.

4. The yarn package of claim **1** wherein the yarn consists of a synthetic linear polycondensation product selected from the group consisting of polyamides and polyesters.

5. A method for winding a yarn package on a tube, said package having minimal variations in the elasticity modulus of the yarn radially therethrough as well as in the individual layers of yarn, comprising winding a first plurality of yarn layers on said tube in progressively decreasing traverse strokes to form an inner portion of the package and thereafter winding a second plurality of yarn layers in progressively increasing traverse strokes to cover said first plurality of yarn layers and form an outer portion of said package, the initial one of said progressively increasing traverse strokes being made at the point in the package where the elasticity modulus of the yarn is approximately the minimum as determined radially through the package.

6. The method of claim **5** wherein said winding of said first plurality of yarn layers continues until said package contains between 10 and 55% by weight of the package when completely formed.

7. The method of claim **5** wherein said winding of said first plurality of yarn layers continues in progressively decreasing traverse strokes until the package contains about 30% by weight of the complete package to be formed.

8. The method of claim **7** further including gradually changing the speed of traverse motion between two successive reversing points to maintain the elasticity modulus of the yarn in each layer of yarn substantialy constant.

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