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APPARATUS FOR MANUFACTURE OR CONVERTING OF TEXTILE YARN

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Fig. 1.

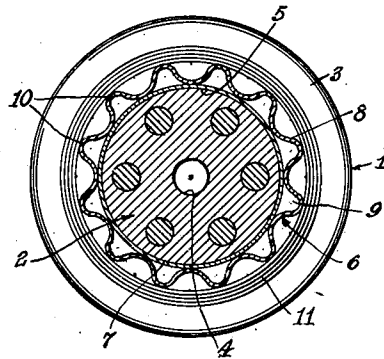


Fig. 2.

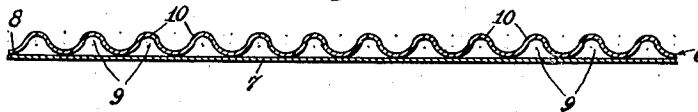
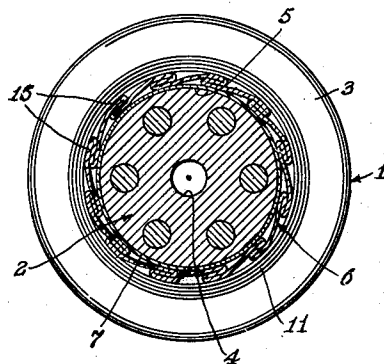


Fig. 3.



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APPARATUS FOR MANUFACTURE OR CONVERTING OF TEXTILE YARN

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3 Claims. (Cl. 28—1)

This invention relates to the manufacture and/or converting of textile strand material or yarn. More particularly, this invention relates to an apparatus and method of manufacturing and/or converting or throwing yarn which exhibits a tendency to shrink during any stage of manufacturing or throwing whereby improved yarns, and therefore improved fabrics made therefrom, are obtained.

The tendency of various yarns, both natural and artificial, to shrink during various stages of manufacture, shipping and storage interferes with the production of quality yarn and makes more complicated manufacturing operations necessary. Prior to this invention, it was customary in the throwing of silk, rayon (viscose, acetate, and cuprammonium), nylon, and other natural and artificial yarns to wind the yarn upon rigid, non-collapsible center supports or cores, such as bobbins, tubes, cones, pirns, shafts, spindles, etc., and to set the twist of the yarn so wound. During the setting of the twist, the yarn shrank and, because of the rigid support, the yarn shrank unevenly throughout the package thereof. As a consequence, a yarn of varying physicals, such as denier, size, dyeing properties, elongation, strength, shrinkage, residual shrinkage, torsion, etc., was obtained.

In the throwing of nylon core yarn used in the braiding of parachute shroud lines, after the final twisting is completed it is necessary to shrink the core yarn so that it has the required elongation and a very small residual shrinkage. Prior to this invention, when the core yarn was shrunk while wound on the last-time twisting bobbin, uneven and insufficient shrinkage was obtained. For example, in one test lot, the elongation of the nylon core yarn next to the bobbin barrel was 23% and the elongation of the nylon core yarn comprising an outer surface of the yarn package was 28%. Uneven and insufficient shrinkage, as well as non-uniformity in elongation, were obtained in the shrinking on the last bobbin of thrown nylon sleeve or cover yarn. Because of the inability to shrink nylon core yarn, nylon sleeve or cover yarn, etc., properly on any rigid support, it was the practice to reel the finished yarn into skeins and then shrink the yarn in skein form and finally rewind the skeins onto bobbins.

In the bobbin spinning of rayon, a viscous solution is spun into a coagulating and/or regenerating bath and subsequently wound onto bobbins which are usually perforated. The subsequent treatment of the yarn, such as washing, drying and desulphurizing, is generally performed without removing the yarn from the bobbin. However, when the yarn is dried or partially dried upon the bobbin, the rigid barrel or core thereof prevents shrinkage of the yarn adjacent it, and the degree of shrinkage of the yarn in the package

varies depending on the distance from the core, i. e. the further the distance, the greater the shrinkage.

An object of this invention is to overcome the above-mentioned defects and disadvantages and provide a method wherein yarn, having a tendency to shrink and wound on a rigid support, is shrunk without encountering any substantial resistance of said support and substantially uniformly throughout the wound package.

Another object of this invention is to provide an apparatus for carrying out the method previously set forth.

Other objects of the invention will become apparent from the following description, appended claims, and accompanying drawing forming a part of this specification and wherein:

Figure 1 is a cross-section of a bobbin wound with yarn prior to shrinkage of the yarn and embodying the principles of this invention;

Figure 2 is a cross-section of a member employed in Figure 1; and

Figure 3 is a cross-section of the bobbin wound with yarn after shrinkage of the yarn.

In accordance with the general principles of this invention, a member, hereinafter more fully described, is disposed on the exterior peripheral winding-on surface of a support (bobbin, tube, cone, pirn, shaft, spindle, etc.) and the yarn thereafter wound thereon. The resulting yarn package, i. e. the support containing the yarn wound thereon, is subjected to the operation in which the yarn shrinks.

The member, which is disposed on the support, is preferably replaceable. It is normally sufficiently strong to support the wound yarn layers during and subsequent to the winding thereon but will collapse as a result of the shrinkage of the yarn alone or partly as a result of being made less stiff or rigid by water, heat, steam, water vapors, chemicals or other means, such as pressure, vacuum, electricity, infra-red rays, etc., depending on the nature of the collapsible member, to which the yarn package may be subjected. Thus, when the package of yarn, i. e. the yarn wound on the support provided with the collapsible member, is subjected to an operation wherein the yarn shrinks, the support is not collapsed (diminished in size) but the member is collapsed, with the result that the yarn is permitted to shrink without resistance and there is obtained a yarn having substantially uniform properties.

In one embodiment of the invention, the replaceable collapsible member is provided with a plurality of spaced ridges extending parallel to the horizontal axis of the spindle of the support. The number of ridges and the height thereof are designed in accordance with the normal shrinkage characteristics of the yarn wound thereon so that, when the yarn is shrunk, the ridges will be

collapsed sufficiently to permit substantially unrestrained shrinkage throughout the wound package of yarn. In another embodiment of the invention, the member may be formed of a material, with or without ridges, said material being of a size and nature which normally will support the wound yarn layers while being wound thereon and yet will collapse an amount sufficient to permit unrestrained shrinkage as a result of the shrinkage of the yarn alone or partly as a result of being made less rigid by water, heat, steam, water vapors, chemicals, pressure, vacuum, electricity, infra-red rays, etc.

The principles of this invention can be used in any textile process (either in the manufacture or converting) wherein yarn wound on a support is subjected to an operation wherein the yarn shrinks. Thus, for example, the invention can be applied to the bobbin process of manufacturing rayon, twisting, throwing or converting of any textile wherein the twist is set, etc.

The size, shape and form of the collapsible member are all regulated and designed to conform to the various artificial yarn manufacturing operations or artificial and natural yarn converting processes as desired, so that the yarn can be wound thereon without collapsing said member during winding to produce the desired package; and also, for example, when a package of wet yarn is subjected to a drying operation or when a package of dry wound yarn is subsequently wetted and dried or otherwise treated so as to cause the yarn to shrink, the member will collapse sufficiently to permit unrestrained shrinkage.

One very simple yet highly effective collapsible member that I have used with excellent results is corrugated paper, as shown in the drawing.

Referring now to the drawing wherein like reference numerals designate like parts, the reference numeral 1 designates a bobbin having a barrel 2 and provided with end flanges 3. The barrel 2 and the end flanges 3 are provided with a centrally aligned bore 4 whereby the bobbin may be disposed and carried on a spindle of, for example, a twisting mechanism. Wrapped around the winding-on surface 5 of the barrel 2 is a collapsible member, generally designated by the reference numeral 6, which, in the form shown, comprises a flat paper backing 7 having a corrugated paper 8 adhesively secured to one side of the backing 7. As shown in Figure 2, the corrugations provide air spaces 9 whereby a sponge-like effect is obtained.

In practice, a sheet of the corrugated material 6, of a width substantially equal to the length of the barrel 2 and of a length so that when it is wrapped around the surface 5 of the barrel 2 the ends thereof will abut, is wrapped around the barrel 2 and is secured in place in any convenient manner. In the preferred form of this invention, the corrugated paper 6, after being wrapped around the barrel 2 as above described, is secured in place by the first windings of the thread 11 wound thereon. For example, if the principles of the invention are utilized in a rayon throwing operation, the yarn is wound with twisting onto the twister bobbin provided with the corrugated member 6 until the desired size of yarn package has been obtained. The yarn package is then subjected to steam or heat and moisture to set the twist. These conditions cause the corrugations to soften and offer no resistance to the yarn which shrinks. As the yarn shrinks, the corrugations will be collapsed, as

generally shown in Figure 3 by the reference numeral 15. After the twist has been set, the yarn may be wound onto cones. After unwinding the yarn from the twister bobbin, the collapsed corrugated member is removed. A new corrugated member is then positioned and secured in place and the process repeated. The height of the corrugations 10 is sufficient to permit, upon collapse, the shrinkage desired in the yarn with substantially no resistance.

The corrugated paper 6 may be of the conventional type or may be specially prepared (chemically treated) to impart thereto the necessary strength, stiffness, waterproofness, etc., as desired and as hereafter more fully explained.

The type and weight of the paper, the stiffness or chemical treatment of the paper comprising the corrugations, and the frequency and shape of the corrugations are all regulated and designed to conform to the various artificial yarn manufacturing operations and artificial and natural yarn converting operations so that the yarn may be wound thereon without collapsing the corrugations until desired, as, for example, when wet yarn is subsequently dried or when dry wound yarn is subsequently wetted and dried or otherwise so treated as to cause the yarn to shrink and the corrugations to collapse.

Conventional corrugated paper (any of the numerous types that are now made and sold for various purposes) is generally made in a form to provide air spaces and a sponge-like effect for the purpose of absorbing shocks when used as a packing material. Such corrugations serve, in the instant invention, to collapse and provide space for the shrinkage of the yarn wound thereupon.

If desired, the corrugated paper may be formed of a specific type of paper, such as bond, kraft, rice, Bible, Oxford, India, parchment, news, glazed, cardboard, strawboard, binder's board, tissue, waxed, etc.

No particular weight of paper is necessary. The corrugated paper may be of a weight or stiffness or rigidity to serve the purposes herein described. In the event that the corrugated paper does not normally possess the stiffness and rigidity required, it is chemically treated to provide the necessary stiffness and rigidity to withstand the normal winding operation. The chemical treatment, of course, is of a type which will not impair the property of the corrugated paper to collapse during shrinking alone or as a result of being made less stiff or rigid by water, heat, steam, water vapor, chemicals or other means. Such treatment may be obtained, for example, by treating, coating or impregnating the paper with solutions of resins, starches, gums, Irish moss, or proteins such as gelatin and caseins.

In some embodiments of this invention, it is desirable to permanently or temporarily employ a corrugated paper which is waterproof. This can be secured by treating the corrugated paper with various waterproofing coating compositions, such as, for example, resins, gums, waxes, and organic or inorganic salts.

Though corrugated paper has heretofore been described as a specific illustrative replaceable collapsible member, it will be apparent that innumerable materials may be used provided they are in suitable shape or form so that they can, with or without special treatment (chemical or otherwise), support the yarn wound thereon and yet collapse as a result of the shrinkage of the yarn alone or partly as a result of being made less stiff or rigid by heat, water, steam, water vapor,

chemicals, pressure, vacuum, electricity, infra-red rays, etc., after the yarn has been wound thereon.

As further illustrative examples of other materials which may be employed in this invention are mentioned the following:

(1) Collapsible members made of pastry dough, molded in ridged waffle, corrugated, etc., or sponge form and made rigid by baking or heat (chemical or other treatment). Such a member can be softened by steam so that it will collapse and permit shrinking of yarn wound thereon.

(2) Collapsible members made of chemical compositions such as resins, gums, waxes, organic and inorganic salts, starches, proteins such as gelatin and casein, Irish moss, etc., molded in ridged waffle, corrugated, etc., or sponge form, and which can be softened by heat, water, steam, water vapor, chemicals, pressure, vacuum, electricity, infra-red rays or the like, so as to permit uniform shrinkage of the yarn wound thereupon, with substantially no resistance.

(3) Collapsible members made of rubber and rubber-like plastics and polymers, such as Koroseal, neoprene, Thiokol, Buna S type, Buna N type, Hycar, cnyl resins, etc., in ridged, sponge-like or other collapsible formation and shaped to cover the supporting core, such as, for example, sponge rubber $\frac{3}{16}$ " x 5" x 8" to cover a bobbin barrel having a length of 5" and a circumference of 8". Such a soft sponge rubber or similar collapsible member should be such as to not normally support the yarn layers during winding but, by first immersing the strip of sponge rubber in a solution of gum arabic or other stiffening material and then drying before winding yarn upon the same, the sponge rubber will support the yarn during winding. It will collapse when the package is placed in water, which alone will destroy the stiffening quality of the gum arabic. However, by elevating the temperature of the water, the rubber itself becomes less stiff. By a proper regulation of the original softness of the rubber and the thickness of the rubber member used and the means and temperature of shrinking of the yarn wound thereon, it will offer substantially no resistance to the contraction of the yarn, and uniform shrinking results.

When water is used to render the collapsible member less rigid, the results may be obtained by subjecting the yarn package containing the collapsible member to emersion, emersion and the application of pressure to the water, or by first creating a partial vacuum in a closed container in which the yarn packages are placed to remove air from the yarn package wound upon the collapsible member and then admit water which will thus more readily and rapidly penetrate to the collapsible member.

When steam or water vapor is used to render the collapsible member less rigid, the results may be accomplished by placing the yarn package wound upon the collapsible member into a chamber and then admit the steam or water vapor, or by first creating a partial vacuum before admitting the steam or water vapor, or by using steam or water vapor under pressure, whereby the steam or water vapor will penetrate to the collapsible member and render it less rigid.

When untreated or treated (stiffened) corrugated paper or other collapsible member is used, it may be rendered less rigid by the use of water, steam, water vapor, electricity, infra-red rays or chemicals such as penetrating agents or wetting out agents, or surface tension reducers such as the sulphated higher alcohols and various sul-

phonated and otherwise modified hydrocarbons, with or without the aid of heat, pressure or vacuum.

When treated (waterproofed) corrugated paper or other collapsible member is used, it may be rendered less rigid by the use of heat, steam, water vapor, electricity, infra-red rays or chemicals such as hydrocarbon fractions such as petroleum distillates, aromatic organic solvents such as benzol, toluol, xylene, etc., or chlorinated solvents such as carbon-tetra-chloride or perchloroethylene, with or without the aid of heat, pressure or vacuum.

The rendering of the collapsible member less stiff to permit substantially unrestrained shrinkage of the yarn may be effected either prior to or simultaneous with the shrinking operation.

Example.—Corrugated member

Hereafter is set forth an illustrative embodiment wherein a corrugated collapsible member of sufficient rigidity to withstand the normal winding operation is employed:

100 denier-3 turn rayon as received from the rayon producer is wound onto conventional winder-spinner bobbins. A sheet of corrugated paper, previously cut to exact size, is wound one convolution around the barrel of the twister take-up bobbin. The yarn from the winder-spinner bobbin is up-twisted 32 turns and wound on the twister take-up bobbin. When a desired size package of twisted yarn is obtained, the twist is set by subjecting the package containing the twisted yarn for 2 hours in an atmosphere of 180° F. dry bulb temperature and 170° F. wet bulb temperature. The conditions for setting the twist cause the corrugated paper to soften and offer substantially no resistance to but are collapsed by the shrinking of the rayon, whereby uniform shrinking and uniform set of the twist are obtained. After setting of the twist, the thrown yarn is coned. When all the yarn has been unwound from the twister take-up bobbin, the collapsed member is removed and a new corrugated member is positioned in place and the operation repeated.

Example

One convolution of corrugated paper having $\frac{3}{8}$ " corrugations and flat backing on one side only is wrapped around the last-time twisting bobbin on which nylon core yarn used in the braiding of parachute shroud lines is wound. After the desired size package of nylon core yarn has been obtained, the resulting package is subjected to a shrinking operation such as is usually employed with nylon core yarn. During the shrinking operation, the corrugations collapse and offer substantially no resistance to the shrinkage of the nylon.

The nylon core yarn, treated as described immediately preceding, was found by test to be uniform throughout the package and equal in quality and uniformity to the same yarn that was skein-shrunk. Such nylon core yarn showed an elongation of $31.5\% \pm 0.5\%$ from inside to outside of the package, whereas bobbin-shrunk yarn without the collapsible member showed an elongation of 23% next to the bobbin barrel and 28% on the outer layers.

Example.—Stiffened corrugated member

Conventional corrugated paper, which is normally not sufficiently stiff to adequately support the wound yarn layers during winding, is im-

mersed in a solution of 75 parts of gum arabic and 25 parts of gelatin. The treated corrugated paper is dried and then wrapped (one convolution) around the barrel of a bobbin. Rayon yarn is wound upon this corrugated paper covering the bobbin barrel. After the desired size package is obtained, it is subjected in a steam box for a period of 2 hours to an atmosphere of 190° F. dry bulb temperature and 180° F. wet bulb temperature. The steam causes the chemically stiffened paper to become so limp as to offer substantially no resistance to the tendency of the yarn to shrink, whereby the rayon shrinks uniformly.

Example.—Stiffened and waterproofed corrugated member

I have found that when conventional untreated corrugated paper is used, wet rayon wound thereon softens the corrugated paper so that it is not sufficiently stiff to support the wound yarn layers while being wound. Hereafter, in the illustrative embodiment set forth, carnauba wax is employed to waterproof the corrugated paper so that the paper does not absorb water from the wet rayon but rather remains dry and stiff and supports the wet wound yarn layers while being wound. Then, when the rayon is dried at 200° F., the carnauba wax loses its stiffening quality and the shrinking of the rayon while drying readily collapses the corrugations, thus permitting uniform shrinking of the rayon throughout the bobbin.

Conventional corrugated paper is immersed in a solution of carnauba wax and, after evaporating the solvent from the treated paper, is wrapped (one convolution) around the barrel of a bobbin. Wet rayon yarn is wound upon this corrugated paper covering the bobbin barrel until the desired size yarn package is obtained. The rayon is dried at 200° F. while still wound upon the bobbin.

Example

In the bobbin spinning of viscose rayon, the take-up bobbin is provided with a replaceable collapsible member of any of the previously described types which is capable of supporting the wet wound yarn layers during winding and yet readily collapsible as the yarn tends to shrink. Thus, when the rayon on the bobbin is processed and dried and the yarn shrinks, the collapsible member will be rendered soft and limp whereby during the shrinking of the yarn substantially no resistance will be offered, with the result that substantially uniform shrinkage will be obtained.

The invention herein described is applicable to any yarn which has a tendency to shrink. Herein and in the claims, the expression "converting" is intended to cover any textile process wherein the yarn shrinks.

From the foregoing, it is apparent that this invention is capable of many different embodiments. Not only is the invention applicable to the production of substantially uniform yarn in package form, but is also capable of being employed during certain stages of converting or manufacturing during which it has been previously impractical to shrink the yarn.

Yarn which has a tendency to shrink may shrink after it leaves the producer or converter and prior to use. When such yarn is wound on the so-called one-time shipping cores, such

as cones, tubes, etc., the cores will restrain shrinkage of the yarn adjacent thereto and, if shrinkage does take place, it will be non-uniform throughout the package. This can be avoided by providing the shipping core with a collapsible member of the type herein described which will collapse upon shrinkage of the yarn.

Since it is obvious that various changes and modifications may be made in the above description without departing from the nature or spirit thereof, this invention is not restricted thereto except as set forth in the appended claims.

I claim:

1. An apparatus for use in shipping, manufacture or converting of yarns having a tendency to shrink, comprising a non-collapsible rigid center support having on its peripheral wall a wrapped-around replaceable covering on which the yarn is to be wound to form a yarn package, said covering having been treated with a stiffening composition which renders said covering normally sufficiently strong and rigid to support, while on said peripheral wall, the yarn during winding without collapsing and which becomes ineffective when the package is subjected to an operation involving shrinking the yarn in the package whereby said covering becomes less rigid and offers substantially no resistance to retard shrinkage of the yarn in the package when the package is subjected to an operation involving shrinking the yarn in the package.

2. An apparatus for use in shipping, manufacture or converting of yarns having a tendency to shrink, comprising a non-collapsible rigid center support having on its peripheral wall a wrapped-around replaceable covering on which the yarn is to be wound to form a yarn package, said covering being formed of corrugated paper treated with a stiffening composition which renders said covering normally sufficiently strong and rigid to support, while on said peripheral wall, the yarn during winding without collapsing and which becomes ineffective when the package is subjected to an operation involving shrinking the yarn in the package whereby said covering becomes less rigid and offers substantially no resistance to retard shrinkage of the yarn in the package when the package is subjected to an operation involving shrinking the yarn in the package.

3. An apparatus for use in shipping, manufacture or converting of yarns having a tendency to shrink, comprising a non-collapsible rigid center support having on its peripheral wall a wrapped-around replaceable covering on which the yarn is to be wound to form a yarn package, said covering being formed of rubber or rubber-like plastic treated with a stiffening composition which renders said covering normally sufficiently strong and rigid to support, while on said peripheral wall, the yarn during winding without collapsing and which becomes ineffective when the package is subjected to an operation involving shrinking the yarn in the package whereby said covering becomes less rigid and offers substantially no resistance to retard shrinkage of the yarn in the package when the package is subjected to an operation involving shrinking the yarn in the package.

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