

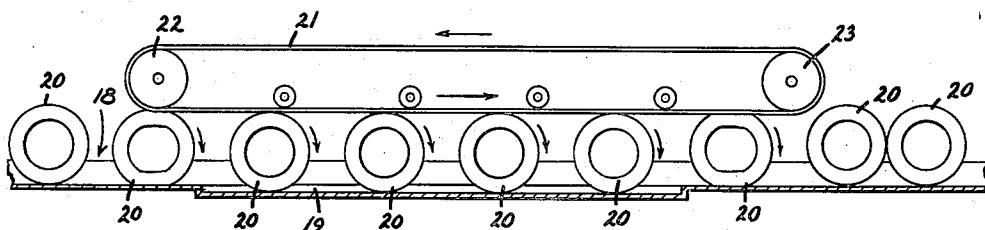
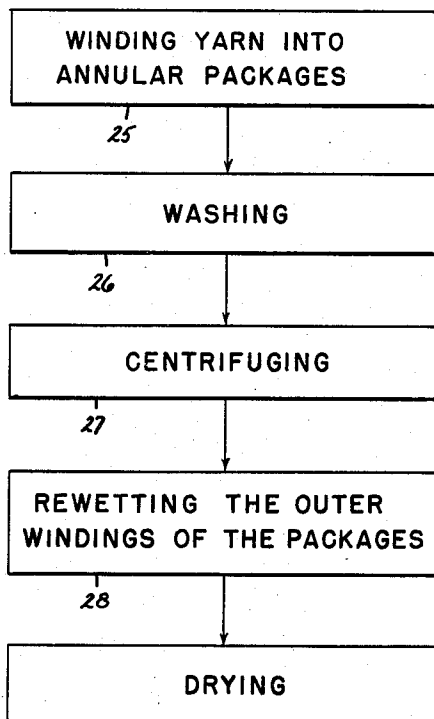
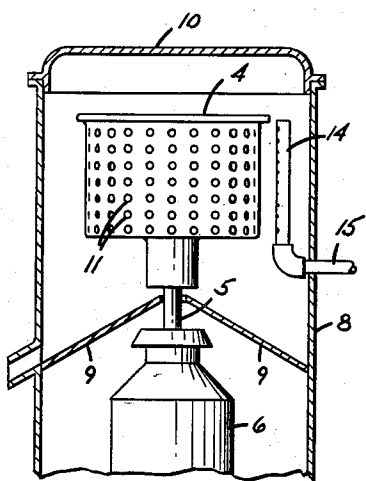
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DRYING WOUND TEXTILE PACKAGE

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DRYING WOUND TEXTILE PACKAGE

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The present invention relates to the treatment of annular wound strand packages and particularly to the production of regenerated cellulose yarn packages of which the quality of the yarn throughout each package is uniform. The manufacturing of yarn packages, such as cakes of centrifugally collected regenerated-cellulose yarn produced according to the viscose process, involves liquid treatments subsequent to the removal of the package from the spinning apparatus, such as the application of washing and desulphurizing liquids. When the cakes are washed free of unwanted materials, they are subjected to rapid rotation about their axes to centrifugally remove loosely held liquid. It is a common practice within the industry to place the cakes after the centrifuging step within a convection type dryer in which the liquid content of the packages is reduced to an acceptable percentage of the dry weight of the package.

However, in conventional convection drying processes greater evaporation occurs along the outer surface of an annular package than at the inner surface because of the greater area exposed and more efficient circulation of the fluid drying medium about the outer surface. The yarn shrinks as it dries and consequently the outer layers shrink under tension around the slower drying inner layers of the package. Greatest tension is developed in layers near the outer surface, and the layers of yarn having progressively smaller radii are subjected to progressively less tension as the drying proceeds inwardly from the outer surface. The residual shrinkage remaining in the various sections of the package corresponds to the difference in the tension at which the yarn is dried. As the residual shrinkage of the yarn affects the susceptibility of the yarn to later processing treatments, it is highly desirable to obtain dry yarn with uniform residual shrinkage.

Among the methods that have been proposed for treating yarn packages in such a manner as to avoid the variations in the shrinkage of the yarn is the one in which a gas-imperious elastic sleeve is applied to each package before being placed in the dryer. This process has the disadvantage of permitting access of the drying medium to the interior surface only of the package, thus substantially limiting the rate at which packages may be dried. The efficiency of drying equipment is thus impaired and a considerably greater amount of drying equipment is necessary to carry out a desired production program. Another method having as its objective

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the elimination of variations in residual shrinkage of the yarn involves rewetting the yarn after the cakes have been dried thus necessitating a second drying step and the various handling operations necessarily attendant thereto.

It is an object of the present invention to provide a procedure for drying wound textile strand packages whereby the packages may be obtained in a desired state of dryness without substantial variation between various portions of the packages in the shrinkage of the yarn. It is another object to produce regenerated cellulose yarn having uniform quality. It is still another object to provide a method of treating rayon cakes that is adaptable to present convection drying equipment. Other objects, features and advantages will be apparent from the following description of the invention and the drawing relating thereto in which

Figure 1 is a diagrammatic elevation of apparatus for carrying out the present invention;

Figure 2 is a diagrammatic elevation of other apparatus that may be used for carrying out the invention; and

Figure 3 is a flow diagram of the method of the invention.

In accordance with the present invention, annular wound strand packages may be obtained in the dried condition with conventional drying equipment by removing the loosely held liquid, such as by rotating each package rapidly about its axis, and then applying liquid to the radially outer layers of the package prior to the drying step, the objective of such a method being to increase the moisture held by the outer layers of the package over that contained by the inner layers to such a concentration that in spite of the more rapid evolution of moisture along the exterior surface of the package when being dried, the inner layers of the package would reach the desired state of dryness as quickly or more rapidly than the outer layers of the package.

Figure 1 illustrates apparatus which may be used to remove the loosely held liquid contained in a package after being subjected to liquid treatments. The apparatus comprises an annular vessel 4 which has perforated or otherwise liquid-pervious walls and is supported on a shaft 5 driven by a motor 6. The container 4 is enclosed by a housing 8, baffles 9, and a closure 10 for the housing. The container is provided with apertures 11. When a wet yarn cake is placed in the container and the container is rotated at high speed, liquid is discharged from the cake

through the apertures 11 and thrown against the inner surface of the housing. The container is ordinarily operated within the range of 6000 or 8000 revolutions per minute to carry out the centrifuging operation. The apparatus of Figure 1, although used to carry out the well-known step of cake centrifuging, is useful for carrying out another step of the method of the present invention, namely, the rewetting step occurring after the centrifuging step. Accordingly, one or more spray elements, such as the element 14, is supported within the housing adjacent the exterior surface of the container 4. The element 14 is connected by a tube or pipe 15 with a liquid supply source (not shown). In carrying out the rewetting operation, the rotation of container 4 is reduced to a slow speed at which the package will retain loosely held liquid immediately after the centrifuging step and the rewetting liquid is sprayed against container 4 and through apertures 11 into the outer layers of the cake supported within the container to accomplish rewetting the outer layers of the cake to any desired extent. The cake may then be removed from the container or transferred to a conventional dryer. In this manner, the rewetting operation may be performed without any handling of the cakes additional to that normally required in transferring packages from a centrifuging station to a drying station. The passage of liquid through the line 15 and the transmission of power to the motor 6 may be easily controlled to effect the rewetting operation by automatic control devices commercially available and readily applicable to the conventional equipment for centrifuging yarn cakes.

Figure 2 illustrates another apparatus by which the rewetting operation may be carried out. The cakes after being centrifuged in an apparatus such as illustrated in Figure 1 to remove substantially all of the loosely held liquid may be loaded or fed into a trough 13 having a shallow depression 19 in which is maintained a quantity of the rewetting liquid at shallow depth. The packages 20 are rolled into contact with a belt 21 traveling in the direction indicated by the arrows and supported on rolls 22 and 23. The belt rolls the packages through the depression 19 in which they pick up the liquid contained therein. The packages 20 collect at the opposite end of the belt 21 beyond the supporting roll 23. The cakes are thereafter placed in a dryer preferably of the convection type. In the practice of the invention, a liquid bath within the depression 19, having a depth of approximately $\frac{1}{4}$ of an inch is satisfactory, and depths of $\frac{1}{8}$ inch or less or even as much as $\frac{1}{2}$ inch or more may be used, the depth selected being varied depending on the size of the package. The length of the depression in which the liquid is supported is at least greater than the circumference of the package and preferably of a length which is approximately evenly divisible by the package circumference in order to provide substantially uniform distribution of the liquid.

The method of the invention, as set forth graphically by the flow diagram of Fig. 3, is an economical and simple procedure for producing dried annular wound packages which have very low differences in residual shrinkage between the yarn of the various portions of the package after it has been dried. By delaying the drying of the outer windings of a package to a desired state of dryness until the inner windings have reached

that state, i. e. by rewetting the outer windings, all of the windings of the package are dried while relaxed and therefore undergo normal shrinkage in accordance to amount of moisture removed from the yarn. Consequently, the residual shrinkage of yarns produced in accordance with the present invention is uniform and low in magnitude. The first step of the method, indicated by numeral 25 of the flow diagram may be carried out, e. g. by centrifugally collecting packages or "cakes" of yarn in spinning buckets as commonly done in the viscose or cuprammonium processes of rayon manufacturing, or by winding the yarn onto collapsible bobbins which are removed from the packages to facilitate the other steps of the method. The washing step, indicated by numeral 26, is applicable generally to rayon yarn to remove unwanted materials from the yarn. In the viscose process, for example, the washing step may include a plurality of stages including washing with warm water, then a desulphurizing solution such as a dilute alkaline solution of sodium sulfide, and then with more water. The washing step may further include a bleaching treatment wherein the regenerated cellulose yarn is subjected to a solution of sodium hypochlorite, then a souring treatment effected by a dilute solution of hydrochloric acid, then a thorough washing with water, and finally a sizing treatment with a soap or the like. In the cuprammonium process, the washing step may comprise merely a thorough washing of the packages with plain water to remove acid and copper.

The packages after being thus washed are subjected to a centrifuging step 27 which may be carried out in a machine such as described in the patent to Harrison et al., No. 1,986,434, or this machine modified to accomplish the rewetting step 28 as described with respect to Fig. 1. Rewetting of the packages, i. e. step 28 of the flow diagram, may be accomplished by either of the procedures hereinabove described with respect to Figs. 1 and 2. The rewetting liquid is generally aqueous and may simply be water. However, if it follows a sizing or softening step, such as with a soap, it is desirable that the rewetting liquid contains a small amount of such sizing or softening material, so that the rewetting liquid does not leach out this material in the outer windings but maintains it at substantially the same concentration.

Thereafter, the packages are subjected to the drying step 29 which is accomplished usually within convection drying equipment comprising a closed compartment in which the packages may be stored, and a system for heating a gaseous medium and circulating the medium through the compartment. Although the rewetting step may be employed in a method wherein drying is accomplished by heating the packages by radiation such as by infra-red rays, or by dielectric heating, the present method has been provided to overcome disadvantages of the conventional manufacturing practice involving the use of convection drying equipment and the advantages of rewetting in accordance with the present method are under present conditions most fully realized when drying is accomplished by convection drying equipment.

While preferred embodiments of the invention have been shown and described, it is to be understood that changes and variations may be made without departing from the spirit and scope of the invention as defined in the appended claims.

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I claim:

1. A method of drying a wound annular package of yarn comprising the steps of rotating the package rapidly about its axis to remove loosely held liquid, immediately thereafter rotating the package at a slow speed while applying liquid to the radially outer surface of the package to increase the concentration of liquid held in a layer of the package adjacent and concentric to said surface to an extent substantially greater than that in concentric portions of the package adjacent its inner surface, and then drying the package within a gaseous drying medium.

2. A method of drying a wound annular package of yarn comprising the steps of rotating the package rapidly about its axis to remove loosely held liquid, thereafter rotating the package at a slow speed at which it will retain loosely held liquid and applying liquid to the radially outer surface of the package to raise the concentration of the liquid carried in the layer concentric and adjacent to said surface substantially above the concentration of liquid within the concentric portions of the package adjacent its inner surface, said package being continuously supported for rotation through the above-named steps, and thereafter drying the package in a gaseous medium.

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3. A method of drying a wound annular package of yarn comprising the steps of rotating the package rapidly about its axis to remove loosely held liquid, reducing the rotation of the package to a slow speed and applying a liquid to the radially outer surface to raise the concentration of the liquid carried in a layer concentric and adjacent to said surface substantially above the concentration of liquid within concentric portions of the package adjacent its inner surface, and thereafter drying the package in a gaseous medium.

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