

Feb. 1, 1944.

W. H. BRADSHAW

2,340,577

YARN TREATMENT

Filed July 11, 1942

2 Sheets-Sheet 1

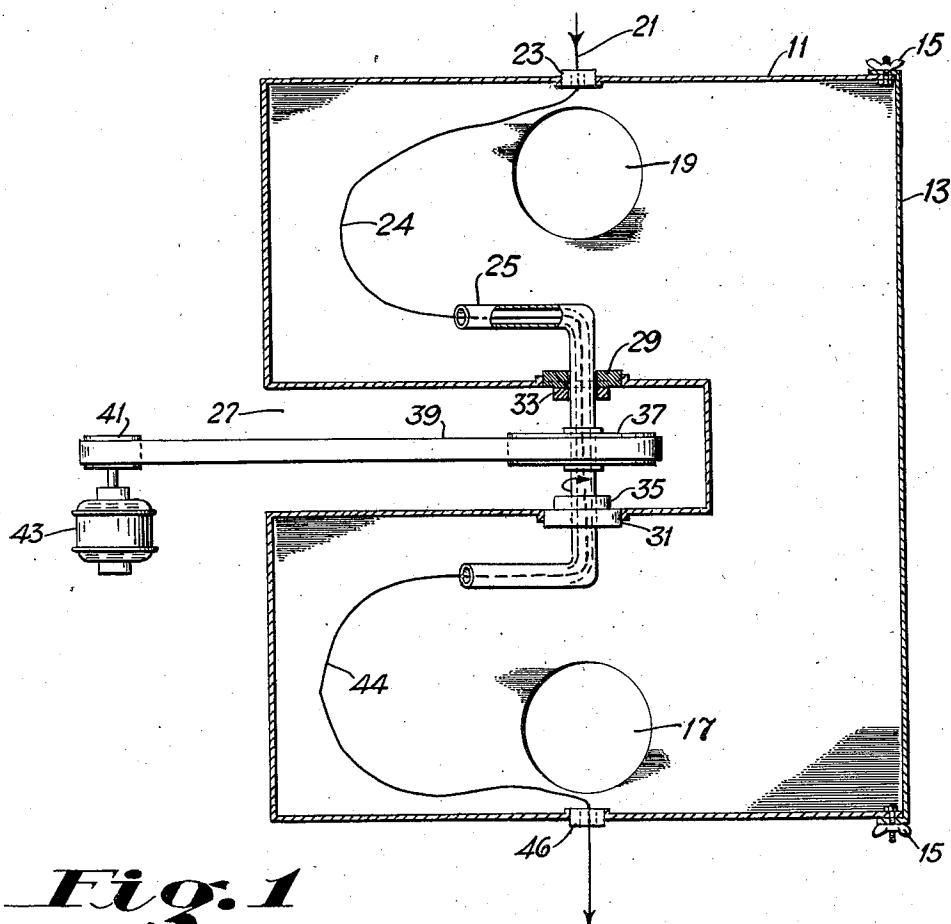


Fig. 1

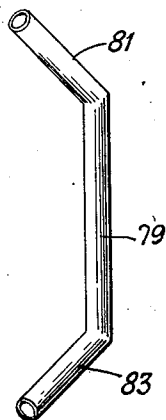


Fig. 3

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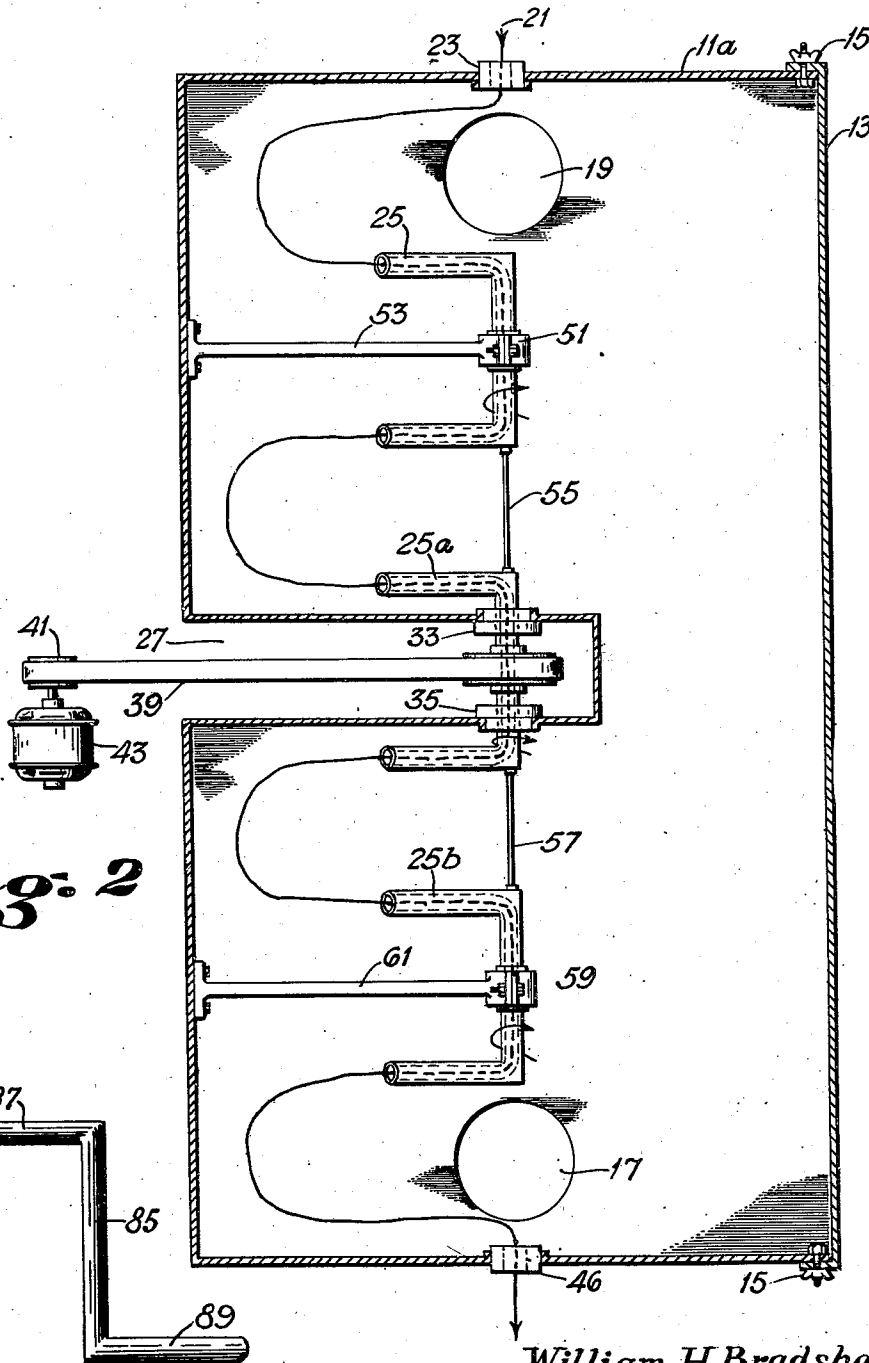


Fig. 2

Fig. 4

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2,340,577

YARN TREATMENT

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Application July 11, 1942, Serial No. 450,638

8 Claims. (Cl. 34—23)

This invention relates to an improved method and apparatus for uniformly drying yarn at high speed in a continuous manner. Yarns dried in accordance with the method and apparatus of the present invention will possess substantially uniform physical properties and dyeing characteristics throughout their length.

It has long been realized that the drying of yarn in package form leads to the formation of undesirable differences in yarn properties throughout the yarn package. These differences are most noticeable in the case of such yarn properties as elongation, residual shrinkage, and dyeing characteristics. They arise partly from the fact that the various portions of the yarn package do not encounter the same drying conditions and hence do not dry in a uniform manner. More importantly, because of the generally rigid form of the package, the yarn contained in its various portions is not afforded an equal opportunity to shrink. Thus, internal strains of varying degree are set up within the package and the dried yarn exhibits throughout its entire length undesirable, non-uniform dyeing characteristics and physical properties.

Many processes for drying yarn in a continuous manner have been proposed heretofore for the purpose of overcoming defects of package drying. Such previously known processes have been unsatisfactory in some respects, particularly when drying yarn of heavy denier containing a large number of filaments. This is primarily because yarn so treated does not have sufficiently uniform contact with the drying medium. Moreover, because of the slow relative movement of air past the yarn, the drying operation is quite slow. It has been proposed, heretofore, to dry a yarn as it passes from a package through a downtwister apparatus. The yarn dries as it balloons during the twisting operation, and since all portions of the yarn are subjected to identical treatment, the final twisted yarn has very uniform properties. This previously known process can only be operated while imparting a permanent twist to a yarn. Furthermore, it must be taken from a partially dried and conditioned cake.

It is an object of the present invention to provide a method and apparatus for the continuous drying of yarn by which all the filaments of the yarn bundle are dried at substantially the same rate and by which the resulting yarns will possess substantially uniform properties throughout their length.

It is a further object of the present invention

to provide a method and apparatus for the continuous drying of yarn by which all the filaments of a heavy denier yarn are dried at substantially the same rate and with uniform properties throughout their length without first subjecting the yarn to a preliminary conditioning or partial drying, or without imparting a permanent twist to the yarn.

Other objects of the invention will appear hereinafter.

The objects of the invention may be accomplished, in general, by continuously passing a wet yarn through a drying zone, ballooning said yarn as it passes through said drying zone, imparting a twist to said yarn and removing said twist from said yarn during the ballooning thereof whereby to obtain an intimate contact of the yarn with a relatively large volume of drying medium within a comparatively short period of time.

The details of the present invention will be more clearly understood by reference to the following description when taken in connection with the accompanying drawings, in which;

Figure 1 is a vertical sectional view showing one form of apparatus constructed in accordance with the invention.

Figure 2 is a vertical sectional view of a modified form of yarn drying apparatus constructed in accordance with the present invention.

Figures 3 and 4 are further modified forms of yarn guiding means.

Referring to Figure 1 of the drawings, reference numeral 11 designates a yarn drying chamber. The yarn drying chamber 11 is provided with a removable wall 13 by means of which access may be had to the interior of the chamber. The removable wall 13 may be fastened by means of thumb screws 15. The chamber is provided with drying medium inlet means 17 and drying medium outlet means 19. The yarn 21, drawn from any desired source such as a spool, bobbin or other package (not shown), is passed into the drying chamber through yarn guide 23 fixed in one end of the chamber. The yarn passes through the tubular yarn guiding means 25 and thence from the chamber through fixed yarn guide 46. The tubular yarn guiding means 25 comprises a substantially U-shaped tube which is positioned across a depression 27 in the drying chamber. Yarn guiding means 25 is supported in fixed bearing surfaces 29 and 31, and is maintained in a rotatable position in the chamber by means of collars 33 and 35 fixed to the tubular yarn guiding means. A small belt

pulley 37 is fixed on to the yarn guiding means between the collars 33 and 35. A prime mover, such as a motor 43, is adapted to rotate pulley 37 by means of belt 39 and belt pulley 41 mounted on one end of the motor shaft.

The apparatus operates substantially as follows: The removable wall 13 is removed from the chamber while the yarn is passed through guide 23 and threaded through tubular yarn guiding means 25. The yarn is then passed from the chamber through yarn guide 46 from which it may be passed on to any desired yarn collecting means (not shown). The removable wall 13 is then replaced and a drying medium such as air having a low relative humidity and an elevated temperature is passed into the chamber through inlet opening 17 and from the chamber through outlet opening 19. In the meantime, the motor 43 is set into operation thereby causing a rotation of the tubular yarn guide 25. The rotation of the yarn guide 25 causes the yarn 21 to balloon as shown at points 24 and 44. As the yarn is caused to balloon, a twist will be imparted thereto at the point where it enters the drying chamber. The twist will again be automatically removed from the yarn at the first bend in the yarn guide means 25. The ballooning of the yarn will cause the yarn filaments to be rapidly moved through the drying medium without imparting a permanent twist to the yarn. The yarn will thus very quickly dry as it is drawn through the chamber in a continuous manner. The linear speed of the yarn passing through the drying chamber can be adjusted to any desired speed depending on the desired first moisture content of the yarn.

Figure 2 of the drawings illustrates a multiple yarn ballooning apparatus similar to that shown in Figure 1. A yarn drying chamber 11a is provided with a removable wall 13 and fixed yarn guides 23 and 46. The yarn 21 is passed through fixed guide 23, then through tubular yarn guiding means 25, then through tubular yarn guiding means 25a, then through tubular yarn guiding means 25b, and finally through the guide 46. The tubular yarn guiding means 25a is substantially identical to yarn guiding means 25 of Figure 1, and is rotated in substantially the same manner. Yarn guiding means 25 and yarn guiding means 25b are rotated by means of yarn guiding means 25a by rigid connecting means 55 and 57 respectively. Yarn guiding means 25 is provided with a journal bearing 51 which in turn is connected to a bearing support 53. Similarly yarn guiding means 25b is provided with a journal bearing 59 connected to bearing support 61. The operation of the apparatus shown in Figure 2 is obviously the same as the apparatus of Figure 1 above described, the only essential difference being that the yarn is ballooned at four spaced points instead of the two spaced points. As in Figure 1 the yarn is alternately twisted and untwisted during its passage through the device. At the same time, it is given a very rapid movement relative to the drying medium so that a very rapid drying action is obtained.

The modified form of yarn guiding means shown in Figure 3 comprises a substantially straight tubular central portion 79 and tubular arms 81 and 83 connected with the central portion 79 at an obtuse angle. The tubular means 79, 81 and 83 have a common opening through which the thread may be passed. This yarn guiding means will impart a modified form of balloon to the yarn.

Figure 4 illustrates a yarn guiding means comprising a substantially Z-shaped yarn guiding means comprising a substantially straight tubular central portion and tubular arms 87 and 89 connected in opposite directions to the central portion 85. The opening through the tubular members is connected so that the yarn may pass through the Z-shaped member in substantially the same manner as shown in the U-shaped member of Figure 1. In this modification, the two points at which the yarn is ballooned are spaced apart substantially 180°, thus giving a modified form of drying action. The exact shape of the yarn guiding means is immaterial so long as it is constructed to guide the yarn along a linear path deviating from a straight line whereby to impart a ballooning action to the yarn.

With reference to the above-described apparatus, it will be quite apparent that the dried yarn leaving the drying apparatus will possess substantially the same degree of twist as the wet yarn entering the same. If, as preferred, the yarn is untwisted as it passes into the yarn drying chamber, it will be untwisted as it passes from the drying chamber. The device is, therefore, particularly satisfactory for use in the drying of a yarn possessing substantially no twist throughout its entire length. The twisting and untwisting of the yarn passing through the device prevents the yarn from drying in a set condition and also subjects the various filaments throughout the yarn to substantially equal contact with the drying medium.

The drying apparatus of the present invention is particularly suitable for the drying of heavy denier yarns such as yarns having a denier of 500 to 4,000 and a filament count of from 200 to 1,500. By reason of the exceedingly desirable drying action of the apparatus of the present invention, a yarn may be passed through the drying chamber at a high linear speed. The yarn is preferably passed through the drying chamber at a speed between 1,000 and 10,000 inches per minute. The air in the drying chamber is preferably heated to between 80° C. and 150° C., and the relative humidity of the air is preferably maintained between 2% and 25% to obtain the most efficient drying conditions. In view of the exceptionally high linear speed with which the yarn may be passed through the device of the present invention, the drying medium may be heated to exceptionally high temperatures without causing yarn degradation.

The angular yarn guiding means which imparts a balloon to the yarn is preferably rotated at a high rate of speed, for example, between 1,000 and 15,000 revolutions per minute. The yarn, during the drying thereof, is maintained under a substantially constant and uniform tension as a result of the ballooning action of the yarn guiding means. The amount of tension imparted to the yarn is dependent upon the rotational speed of the yarn guiding means.

The rotatable yarn guiding means of the present invention has been described as tubular in form. Although this form of guiding means is preferred it is obviously not essential. The yarn guiding means may be provided with any desired passages or guiding elements which will guide the yarn in a linear path deviating from a straight line. Furthermore, any desired means for rotating the yarn guiding members may be employed.

The following example is illustrative of a preferred method for practicing the present invention.

Example

A purified but undried viscose rayon yarn produced by the bobbin process and possessing a denier of 1100 and a filament count of 480 is unwound from a bobbin containing the same and passed through a device of the type shown in Figure 1 of the drawings. Drying air is passed through the drying chamber at a rate of approximately 20 cubic feet per minute. The drying air is heated to a temperature of 95° C. and possesses a relative humidity of 5%. The tubular yarn guiding means through which the yarn passes is rotated at approximately 10,000 revolutions per minute whereby the yarn is caused to balloon as shown in Figure 1 of the drawings. The yarn is drawn through the drying chamber to a take-up device at a speed of approximately 5,000 inches per minute. The yarn passing from the drying chamber and collected on a take-up spool is uniformly dried to a moisture content of about 11% and possesses a soft hand. The tenacity and elongation of the yarn is exceptionally uniform throughout the length thereof.

The present invention provides a method and apparatus capable of drying a wet yarn in a satisfactory and uniform manner and at a high speed without imparting permanent twist to the yarn. The method and apparatus of the present invention is adapted to dry a yarn while maintaining the various filaments of of the yarn bundle under substantially constant and uniform drying conditions and imposes on the yarn a constant and desired tension during the drying procedure.

Since it is obvious that many changes and modifications can be made in the above-described details without departing from the nature and spirit of the invention, it is to be understood that the invention is not to be limited to the details described herein except as set forth in the appended claims.

I claim:

1. The method of drying yarn which comprises continuously passing a wet yarn through a drying medium, ballooning the said yarn as it passes through said drying medium, imparting a twist to said yarn and removing said twist from said yarn during the ballooning thereof.

2. The method of drying yarn which comprises continuously passing a wet yarn through a drying zone containing air maintained at a temperature between 80° C. and 150° C. and at a relative humidity between 2% and 25%, ballooning said yarn as it passes through said drying zone, imparting a twist to said yarn and removing said twist from said yarn during the ballooning thereof.

3. The method of drying yarn which comprises continuously passing a wet yarn through

a drying zone at a linear speed of between 1,000 and 10,000 inches per minute, the drying zone containing air maintained at a temperature of between 80° C. and 150° C. and at a relative humidity between 2% and 25%, ballooning said yarn as it passes through said drying zone, imparting a twist to said yarn and removing said twist from said yarn during the ballooning thereof.

4. A yarn drying apparatus comprising a drying chamber, means for leading a yarn into said chamber and means for leading said yarn from said chamber, a yarn guide means in said chamber, said guide means constructed to guide said yarn along a linear path deviating from a straight line, and means for rotating said guide means to balloon said yarn as it passes through said chamber.

5. A yarn drying apparatus comprising a drying chamber, means for leading a yarn into said chamber and means for leading said yarn from said chamber, a yarn guide means in said chamber, said guide means comprising a tubular member constructed to guide said yarn along a linear path deviating from a straight line, and means for rotating said guide to balloon said yarn as it passes through said chamber.

6. A yarn drying apparatus comprising a drying chamber, means for leading a yarn into said chamber and means for leading said yarn from said chamber, a yarn guide means in said chamber, said guide means comprising an angular tubular member open to said chamber and adapted to guide said yarn along a linear path deviating from a straight line, and means for rotating said guide to balloon said yarn as it passes through said chamber.

7. A yarn drying apparatus comprising a drying chamber, means for leading a yarn into said chamber and means for leading said yarn from said chamber, a yarn guide means in said chamber, said guide means comprising a U-shaped tubular member open to said chamber and adapted to guide said yarn along a linear path deviating from a straight line, and means for rotating said guide to balloon said yarn as it passes through said chamber.

8. A yarn drying apparatus comprising a drying chamber, means for leading a yarn into said chamber and means for leading said yarn from said chamber, a plurality of yarn guide means in said chamber, each of said yarn guide means comprising a U-shaped tubular member open to said chamber and adapted to guide said yarn along a linear path deviating from a straight line, and means for rotating said plurality of guide means to balloon said yarn as it passes through said chamber.

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