Aug. 20, 1940. E. V. LEWIS 2,211,954

APPARATUS FOR THE PRODUCTION OF ARTIFICIAL THREAD

Filed Jan. 2, 1936 3 Sheets-Sheet 1

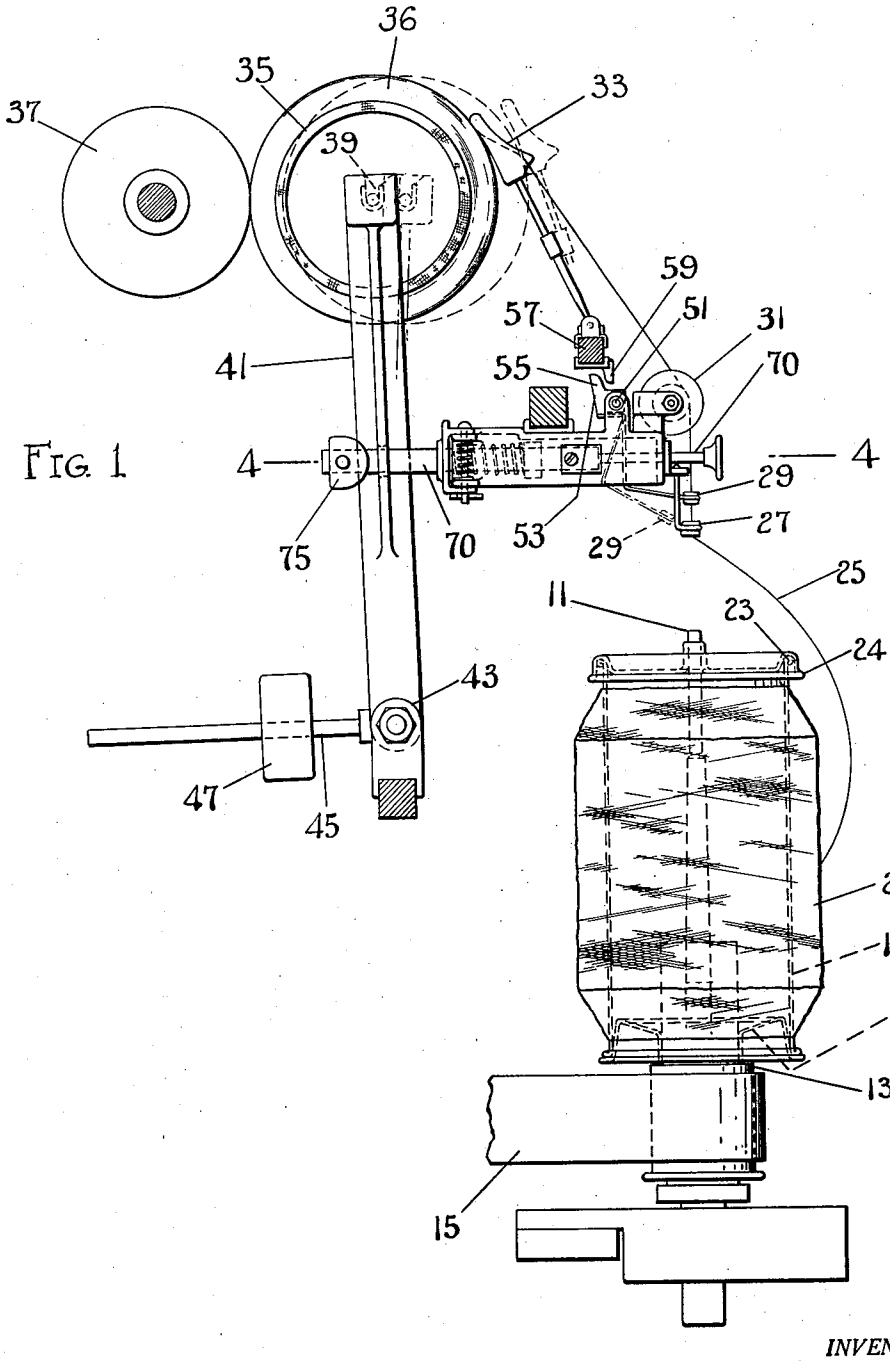


FIG. 1

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FIG. 2

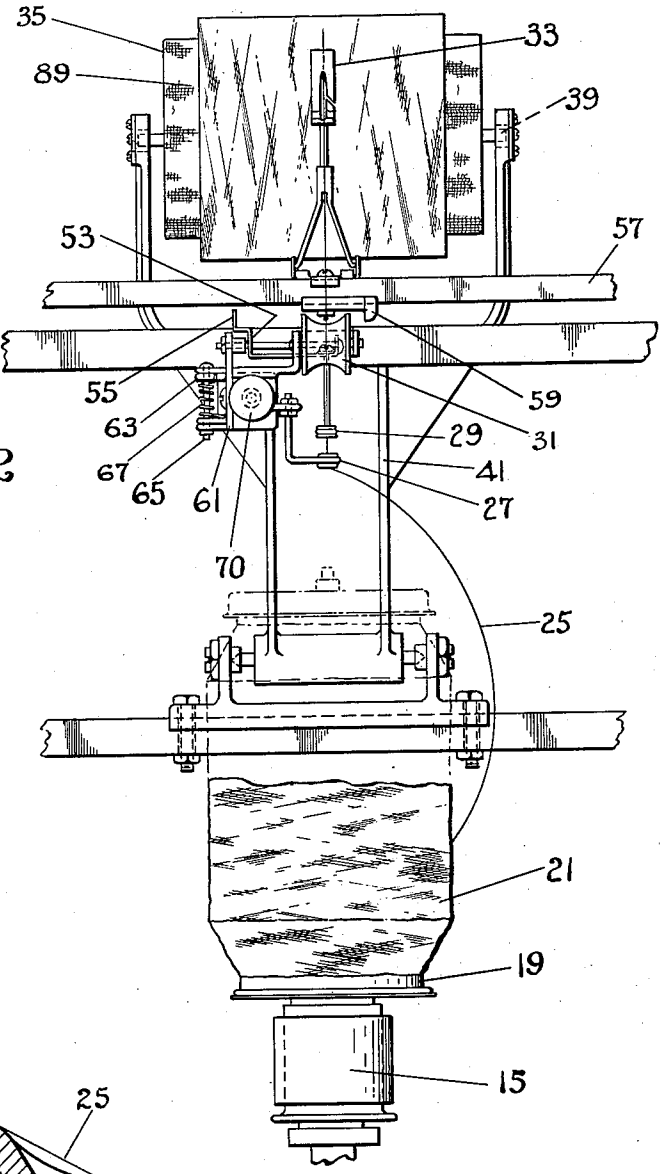
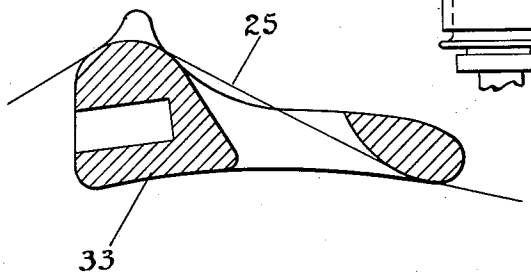


FIG. 7.



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FIG. 3.

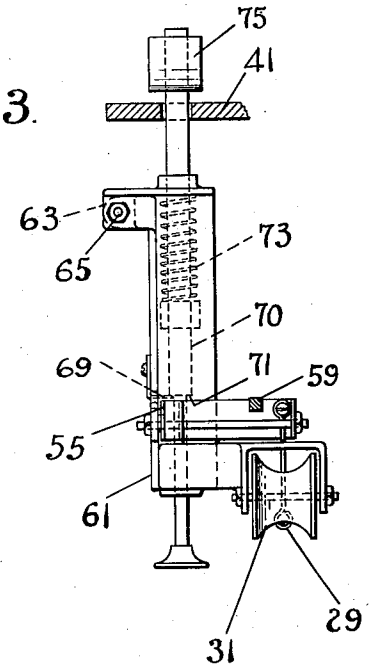


FIG. 4.

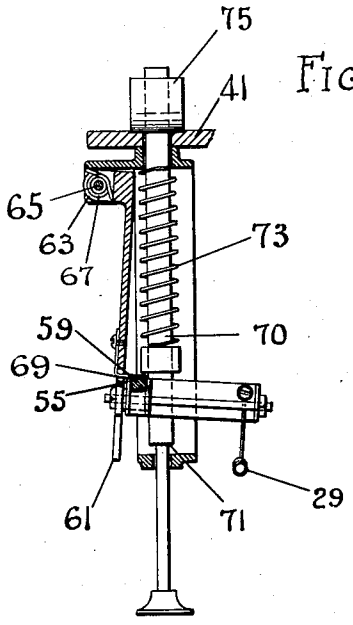
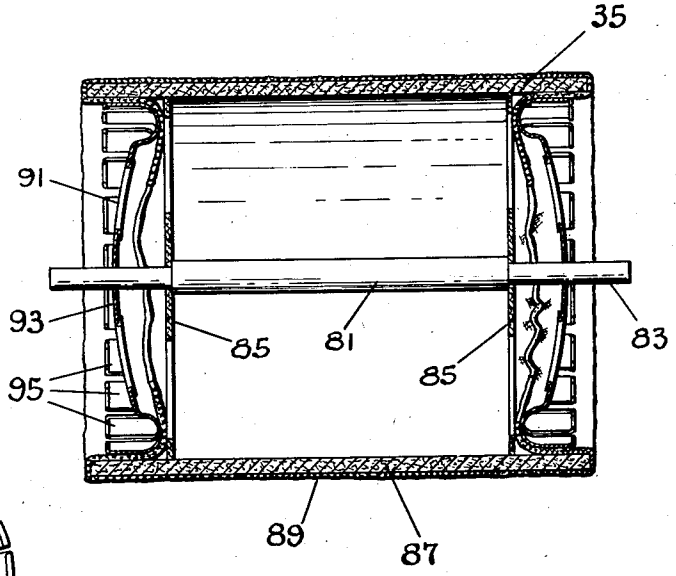


FIG. 5.



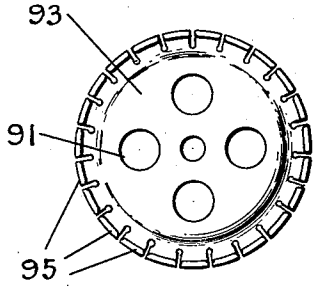


FIG. 6.

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2,211,954

UNITED STATES PATENT OFFICE

2,211,954

APPARATUS FOR THE PRODUCTION OF ARTIFICIAL THREAD

Everett Vernon Lewis, Richmond, Va., assignor, by mesne assignments, to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware

Application January 2, 1936, Serial No. 57,075

7 Claims. (Cl. 242—18)

This invention relates to the production of artificial threads and filaments and more particularly, it relates to improvements in apparatus and processes for the production of artificial threads and filaments having sufficiently uniform shrinkage characteristics to make them suitable for use in woven fabrics.

This invention will be described with particular reference to the production of regenerated cellulose threads and filaments produced from viscose by the bobbin process. It is to be understood, however, that the invention is generally applicable to the production of artificial threads and filaments by the bobbin process from viscose, cuprammonium cellulose solution or solutions of esterified or etherified cellulose.

The production of regenerated cellulose threads by the bobbin process comprises the steps of drawing the freshly spun yarn from the coagulating bath and collecting the same on bobbins rotating at a constant peripheral speed in the form of a wound package of continuous, parallel filaments. The yarn so collected is saturated with spinning bath and by-products of its manufacture.

The spinning bobbin is usually perforated to permit subsequent pressure or vacuum liquid treatment of the yarn package wound thereon, since the yarn must be free from acid and certain by-products of its manufacture before it can be used. Inasmuch as the filaments comprising the yarn are in parallel relationship and not twisted together, the yarn is not capable of withstanding excessive handling or treatment without deleteriously affecting it, and the tightness of the cake makes purification difficult. It is therefore common practice to subject the bobbin of yarn as it comes from the spinning machine merely to a washing treatment to remove the bath liquor contained in the yarn, after which the yarn is dried on the bobbin.

The washed and dried yarn is next twisted. For instance, according to one method of twisting, the bobbin of dried, untwisted yarn is mounted on a vertical spindle and rotated thereon at several thousand revolutions per minute while the thread is drawn from the end of the bobbin and wound up on a surface driven, horizontal, take-up bobbin at constant linear speed. The take-up bobbin is supported and driven by a constant speed driving roller made of cast iron and covered with a layer of cork or leather of uniform thickness so that the surface contacting with the package of twisted yarn is even and uniformly smooth. The spools of twisted yarn formed on machines of this type are quite compact or dense and cannot be uniformly purified or otherwise uniformly treated in this form. The function of this step is to add twist and thus give the yarn greater resistance to degradation. It has therefore been customary to rewind the twisted yarn from this take-up spool or bobbin into skeins for subsequent processing, such as desulfuring, bleaching and if desired, dyeing or otherwise finishing.

The skein processing of yarn is undesirable in that the yarn is subject to degradation due to the repeated handling of the yarn necessitated by this process. If the yarn is subsequently to be marketed in the form of cones or other precision wound packages, it is necessary in order to produce high quality, final packages, to rewind the purified skeins on to spools and then rewind again on to cones or the like. It will be readily apparent that these numerous operations are not only expensive, but there is great opportunity for the thread to become damaged thereby. Furthermore, when the yarn is first dried on the spinning bobbins, inequalities of the shrinkage of the thread result and part of the thread comprising the original spun cake is permitted to shrink to a considerably greater extent than other parts of this cake. As a result, when skeins of such yarn are wetted, for instance, during purification, various parts of the yarn comprising the skein shrink differently with the result that the yarn can be rewound only with difficulty and with serious loss in yarn quality. Such skeins are commonly referred to as tight and loose skeins, the production of which is avoided as much as possible.

Many attempts have been made prior to the present invention to eliminate the skein processing of yarn, whereby to eliminate the serious degradation encountered in this process. Such prior attempts involved the winding of the yarn, with or without twisting into unsupported packages for the subsequent treatment thereof, in a package form. Such previously attempted processes, however, have certain inherent disadvantages which render them unsuitable for the production of yarn having uniform shrinkage characteristics to the extent which will permit their use in the production of woven fabrics. Therefore, these prior attempts at elimination of the skein processing of yarn were limited in their application.

It is therefore an object of the present invention to provide a method for the production of artificial threads having sufficiently uniform

shrinkage characteristics to permit their use in woven fabrics without excessive handling of the thread.

It is another object of the present invention to provide a method for winding an artificial thread on a throwing machine in such a manner that the package produced is uniformly soft and will readily permit the penetration of various treating solutions therethrough.

It is a further object of the present invention to provide a method for drying of yarn on a spinning bobbin entirely from the external surface thereof so that the yarn on the bobbin will have a moisture content ranging from about 20–60% on the outside to about 100–175% and preferably 130–170% on the inside, and subsequently winding said thread on a throwing machine so that the package produced will be uniformly soft and will readily permit the penetration of various treating solutions therethrough.

It is a still further object of the present invention to provide apparatus for carrying out the methods set forth in the above-described objects.

Further objects of the invention will appear hereinafter.

The objects of the invention may be accomplished, in general, by twisting yarn having a substantial moisture content and winding the same into a package so that subsequently it can be uniformly treated with purifying solutions and dried without causing non-uniform shrinkage characteristics to result. This includes a novel method of winding up the thread on a throwing machine so that the package produced is uniformly soft and will readily permit the penetration of various treating solutions therethrough and can then be dried under suitable conditions without the yarn shrinking non-uniformly.

The winding and twisting operation is preferably preceded by drying of the yarn on the spinning bobbin entirely from the external surface thereof so that the yarn on the bobbin will have a moisture content gradient from about 20–60% on the outer layers thereof to about 130–170% on the internal layers thereof.

Bobbins of freshly spun, untwisted yarn are washed to remove the acid of the coagulating bath and the products formed in the coagulation thereof and are subjected, while still in the gel state to a partial drying from the outside only by plugging of the bobbin ends, in accordance with the invention described and claimed in the copending application, Serial No. 57,074, of E. V. Lewis and S. W. Brainard filed on even date herewith, now Patent No. 2,122,290. It is preferred that the very outside layers of yarn contain about 20–30% moisture, based on the dry weight of the thread, at the beginning of the throwing step. Since it takes from 10–20 hours to complete the winding of one cake of yarn from the spinning bobbin which is being rotated at from 2,000–5,000 R. P. M., substantial drying out of the yarn comprising the inner windings takes place in situ as the yarn is rotated and as it balloons from the throwing bobbin and as it is passed to the take-up bobbin. It is therefore important if the gel throwing process is to be most advantageously carried out that the inner windings of yarn have sufficiently greater moisture content than the outer windings at the beginning of the winding operation so that when inner windings are drawn from the spinning bobbin, they will not already have dried and shrunk against the rigid bobbin, or the compact layers of thread underneath.

As above set forth, the throwing step may last up to 20 hours, usually about 15 hours, and during this time considerable drying down of the yarn takes place, especially if the room humidity is maintained at a value low enough to dry the yarn down to about 20% moisture in its travel from the throwing bobbin to the take-up bobbin. The moisture gradient obtained in the drying procedure previously described operates against the tendency for the inner windings of yarn to dry down and prevents them from drying to a point where substantial shrinkage would tend to take place and set up internal strains in these yarn layers. This improvement enables the yarn to be unwound from the spinning cake under more uniform conditions of moisture content and the yarn wound on the take-up bobbin will possess very desirably uniform shrinkage characteristics.

The winding and twisting of the thread from the spinning bobbin to a take-up bobbin, in accordance with the present invention, involves the step of winding the thread on a surface drive apparatus in which the pressure between the bobbin and the surface drive roller is maintained substantially constant and in which the thread is evenly laid down on the take-up bobbin by means of a suitable traverse guide. The means for carrying out the winding and twisting of the thread from the throwing bobbin to the wind-up bobbin is furthermore preferably provided with a suitable throw-out mechanism for disconnecting the surface drive roller and the bobbin, upon breakage of the thread passing from the throwing spindle.

The details of the invention will be more clearly apparent by reference to the following detailed description, taken in connection with the accompanying illustrations in which:

Figure 1 is a side, elevational view, partially in section, showing a winding and twisting mechanism constructed in accordance with the present invention;

Figure 2 is a front, elevational view of the winding and twisting mechanism disclosed in Figure 1;

Figure 3 is a plan view of a detail of the throw-out mechanism, partially in section, showing the plunger of the mechanism in closed position.

Figure 4 is a section taken along line 4—4 of Figure 1, showing the plunger throw-out mechanism in open position;

Figure 5 is a vertical sectional view showing the details of a take-up bobbin constructed in accordance with the present invention.

Figure 6 is an elevational view, showing a take-up bobbin sleeve retainer.

Figure 7 is an enlarged sectional view of a thread guide suitable for use in the present invention.

Referring to the drawings, reference numeral 11 designates the spindle of a throwing machine, which may be driven by means of a belt 15 or the like, passing over the whorl 13. The throwing spindle 11 is provided with a clamping mechanism 17 fixedly connected thereto for firmly holding a spinning bobbin 19, containing a thread cake 21, for rotation on the spindle 11. The spinning bobbin 19 is also preferably supported on the spindle 11 by means of the spacing element 23 which is preferably provided with an overhanging, smooth edged skirt 24 for guidance of the thread from the upper portion of the bobbin. The artificial thread 25 balloons from the thread cake 21

and passes through thread guides 27 and 29, over roller 31, thence through the thread guide 33 of the traverse mechanism and on to the take-up bobbin 35. The take-up bobbin 35 is rotated by means of the surface drive roller 37 which is rotated at constant speed by any desired means.

The take-up bobbin 35 containing yarn 36 is mounted in the U-shaped groove 39 of a yoke 41, which yoke is pivoted at 43 to allow for the yarn built up on the take-up bobbin as it is rotated by the surface drive roller 37. The yoke member 41 is provided with an integral, horizontally disposed member 45 upon which is suspended a weight 47. The weight 47 is preferably adjustable along the rod 45 so as to permit the varying of the pressure between the surface drive roller and the take-up bobbin. As the thread on the take-up bobbin builds up, the yoke 41 will be swung over to the right and the rod 45 with its weight 47 will be swung upwardly in such a manner that the moment of force pressing the take-up bobbin against the surface drive roller 37 will be decreased as the thread builds up, thereby progressively decreasing the pressure of the drive roller on the yarn wound on the take-up bobbin. It will be obvious that the rod 45 may be connected to the yoke 41 at any desired angle, whereby to increase the moment of force pressing the take-up bobbin against the drive roller or to decrease the moment of force so pressing these two elements together.

The thread guide 27 is fixedly positioned under the thread roller 31 and the thread guide 29 is fixed to a tripping mechanism 53 which mechanism is pivotally mounted at 51 on a pin connected to member 61. When the thread 25 breaks, the thread guide 29 will drop to the position shown in dotted lines in Figure 1 and thereby rotate mechanism 53 whereby trigger 55 is positioned in the path of the reciprocating member 59 which is fixed to the traverse bar 57. As the traverse bar 57 is moved to the left-hand side, as illustrated in Figure 2 of the drawings, the member 59 will contact the trigger 55 and push the same to the left, which member in turn will push pivoted element 61 to the left to effect a release of the plunger rod 70 as set forth in detail below.

Referring to Figures 3 and 4 of the drawings, the pivoted element 61 is pivoted at 63 by means of the pin 65. The element 61 is further provided with a fixed latch member 69 which is adapted to catch on shoulder 71 of the plunger rod 70. The element 61 is normally forced into its closed position as shown in Figure 3 by means of coiled spring 67 (see Figure 2). When element 59 pushes trigger 55 to the left as shown in Figure 4, the element 61 is also swung to the left about the pivot 63 thereby causing latch member 69 to disengage from shoulder 71 and release plunger rod 70, which will be caused to fly downwardly to its open position as shown in Figure 4 by means of coiled spring 73. As plunger rod 70 is released to its open position, the yoke engaging member 75 will contact yoke 41 and pull the same away from the surface drive roller 37 as clearly illustrated by the dotted lines in Figure 1.

Referring to Figure 5 of the drawings, the take-up bobbin 35 comprises a shaft 81 fixedly positioned in supporting members 85. Shaft 81 is provided with journal bearings 83 projecting from the ends of the bobbin. The supporting members 85 are fixedly positioned within the cylindrical member 87. The cylindrical member 87 preferably has a diameter of about 5 inches and is slightly tapered to permit the removal of the package from the take-up bobbin after it has been formed thereon. The take-up bobbin, prior to its being positioned within groove 39 of the yoke 41 as illustrated in Figure 1, is preferably covered with a knitted fabric 89, or the like, which is tucked in at the end of the bobbin against the supporting members 85 and held in place therein by means of the spring sleeve retainer 93 which is firmly held within the internal periphery of the ends of the bobbin by means of the resilient prongs 95 thereof. The spring sleeve retainers are also preferably provided with a number of finger holes 91 to permit the ready removal thereof from the ends of the bobbin.

The apparatus is designed to function as follows: The bobbin 19 containing thread cake 21 is positioned on the spindle 11 on which it is firmly held in place by means of clamp 17 and spacer 23. As the thread 25 is thrown from the package 21 by rotation of the spindle 11, which spindle rotates at a speed of 2,000–5,000 R. P. M., it is drawn through stationary thread guide 27 and pivoted thread guide 29 over thread roller 31 on to the take-up bobbin 35, upon which the thread is evenly laid by means of the traverse guide 33. The take-up bobbin 35 is rotated by means of surface drive roller 37. The take-up bobbin 35 is pressed against the surface drive roller 37 by the moment of force created by rod 45 and the weight 47 integral with yoke 41 which is pivoted at 43. As the thread builds up on the take-up bobbin, the pressure is somewhat reduced between the take-up bobbin and the surface drive roller so as to form a uniformly soft, and liquid pervious package on the take-up bobbin.

Obviously, if the thread should break and the surface drive roller 37 contact the outer layers of thread on take-up bobbin 35 for a continued period of time, this outer layer of artificial thread would soon become so degraded as to be of little or no value. Therefore, means are provided for disconnecting the surface drive roller from the take-up bobbin soon after the breaking of the thread or the emptying of the spinning bobbin. This disconnection of the surface drive roller 37 from the take-up bobbin 35 is accomplished by the pivoted thread guide 29, which, upon breakage of the thread will drop to the position shown by the dotted lines in Figure 1, causing the trigger 55 of the tripping mechanism to be rotated within the path of the member 59 which is connected to the traverse bar 57 and which will cause the trigger 55 to force the element 61 to be swung outwardly on its pivot 63, which action will disengage latch 69 from the shoulder 71 of the plunger rod 70 and cause a springing of the plunger rod to its open position, carrying with it yoke 41 by means of contact member 75.

After the yarn has been twisted and wound up on the take-up bobbin to form a cake of ½ inch or more in thickness, it may be removed from the slightly tapered take-up bobbin, together with the knitted fabric thereon, which knitted fabric may be wrapped about the package which is then suitable for subsequent purification treatments.

To further illustrate the applicant's invention reference is made to the following specific example which is in no way to be considered as limitative of the invention:

Example.—A cake of 100 denier—40 filament yarn on the spinning bobbin after it has been gradient dried as described above is placed on the throwing spindle for twisting according to the

invention. The thread is drawn from the bobbin, passed through and over the guides located between the throwing and the take-up bobbin and is finally wound on a large diameter, slightly tapered, take-up bobbin in the form of a cross wound cake about 4½ inches long. The yarn is twisted to 4 turns per inch by revolving the bobbin on its spindle at 3,500 R. P. M. and drawing the thread therefrom at the necessary speed of about 800 inches per minute. The twisting and winding step is carried out in a room kept at constant temperature and humidity such as, for example, a temperature of 75° F. and 75% relative humidity. These conditions may be varied somewhat according to the character and size of the yarn being thrown, but generally should be maintained at 70°–80° F. and from 65–85% relative humidity. Preferably, two spinning bobbin cakes totalling 0.8 pound are thrown in succession to form one take-up bobbin package although the number and poundage of the cakes may be varied in any desired manner. Due to the balloon of the thread as it unwinds from the throwing bobbin, the yarn dries down so that when it is wound up on the take-up bobbin, it contains about 20–25% moisture, based on its dry weight. This moisture content will vary somewhat, however, depending on the exact conditions under which the twisting step is carried out. These conditions should be such that the moisture content is not less than 20%, nor greater than about 30%, based on the dry weight of the yarn. A reasonably fast traverse stroke is used in laying the thread on the take-up bobbin in order to give an open wind, for instance, the ratio of bobbin R. P. M. to traverse speed being about 1.20:1, the traverse stroke being such as to produce a cake which will permit easy and rapid penetration by liquids in subsequent processing. Obviously, the wind will be sufficiently close so as to prevent the production of a poorly formed package which will not hold the yarn in place during subsequent processing treatments.

When the winding of the cake is completed, the cake and bobbin are removed from the machine, the spring clips are removed therefrom and the ends of the knitted sleeve of cotton or other fabric may be drawn out around the outer periphery of the cake to cover it completely. The wrapped cake is then removed from the bobbin by forcing it off the smaller end thereof, which may easily be done by reason of the slight taper of the bobbin. This taper preferably amounts to about $\frac{1}{16}$ inch reduction in diameter over the entire length of the bobbin, but this will be found to be sufficient to enable the cake in its wrapper to be slipped off the bobbin without permanently compressing the structure of the cake.

The purification of the yarn cake in its wound and twisted form is carried out in a manner similar to that described in copending application, Serial No. 38,441, filed August 27, 1935, by Bradshaw, Fonda and Filson, now Patent No. 2,094,579. The yarn cakes on the other hand may be treated with any desired standard purification liquid in any known or conventional manner to obtain a package which will have substantially uniform purification and shrinkage characteristics.

By reason of the fact that the cakes are formed with a uniformly soft, pervious open wind and because the thread has dried to about 25% moisture content, or less, based on the dry weight of the thread, which reduces the swelling of the thread when again wetted, as compared to threads which have never been dried to below 100% moisture content, rapid penetration of the cakes by the treating solution is possible and therefore uniformity of treatment is obtained. On the other hand, since the cakes have not been dried substantially below 20% moisture content, based on the dry weight of the thread, the yarn is more readily acted upon by desulfuring and bleaching solutions than when the thread has been dried substantially below equilibrium and allowed to regain to about 12% moisture content, and substantially complete sulfur removal and uniform bleaching of the yarn without deleteriously affecting it results.

Obviously, many changes and modifications can be made in the above detailed description without departing from the nature and spirit of the invention. It is therefore to be understood that the invention is not to be limited except as set forth in the appended claims.

I claim:

1. In an apparatus suitable for the winding of artificial thread to form a uniformly soft and liquid permeable thread package, a freely rotatable take-up bobbin, means for passing the thread to said take-up bobbin, thread traversing means for moving the thread across the face of said bobbin, a roller for driving said bobbin by contact with the wound surface thereof, a weighted swing arm, said bobbin mounted on said weighted swing arm which will press said bobbin against said driving roller, said weighted swing arm being pivoted with the weight on said arm in such a position that the moment of force pressing the bobbin against the roller will decrease as the thread builds up on the bobbin.

2. In an apparatus suitable for the winding of artificial thread to form a uniformly soft and liquid permeable thread package, a freely rotatable take-up bobbin, means for passing the thread to said take-up bobbin, thread traversing means for moving the thread across the face of said bobbin, a roller for driving said bobbin by contact with the wound surface thereof, a weighted swing arm, said bobbin mounted on said weighted swing arm which will press said bobbin against said driving roller, said weighted swing arm being pivoted with the weight on said arm in such a position that the moment of force pressing the bobbin against the roller will decrease as the thread builds up on the bobbin, and means for disengaging the bobbin from the roller upon discontinuation of the passage of thread to said bobbin.

3. In an apparatus suitable for the winding of artificial thread to form a uniformly soft and liquid permeable thread package, a freely rotatable take-up bobbin, a thread guide, means for passing the thread through said thread guide to said take-up bobbin, thread traversing means for moving the thread across the face of said bobbin, a roller for driving said bobbin by contact with the wound surface thereof, a weighted swing arm, said bobbin mounted on said weighted swing arm which will press said bobbin against said driving roller, said weighted swing arm being pivoted with the weight on said arm in such a position that the moment of force pressing the bobbin against the roller will decrease as the thread builds up on the bobbin, a trip mechanism and means connected to said thread guide for actuating said trip mechanism whereby to disengage said roller from said bobbin.

4. In an apparatus suitable for the winding of artificial thread to form a uniformly soft and

liquid permeable thread package, a freely rotatable take-up bobbin, means for passing the thread to said take-up bobbin, thread traversing means for moving the thread across the face of said bobbin, a roller for driving said bobbin by contact with the wound surface thereof, a swing arm, said bobbin mounted on said swing arm, a weighted arm connected to said swing arm to press said bobbin against said roller, said swing arm and said weighted arm being positioned in such a manner that the moment of force pressing the bobbin against the roller will decrease as the thread builds up on the bobbin.

5. In an apparatus suitable for the winding of artificial thread to form a uniformly soft and liquid permeable thread package, a freely rotatable take-up bobbin, means for passing the thread to said take-up bobbin, thread traversing means for moving the thread across the face of said bobbin, a roller for driving said bobbin by contact with the wound surface thereof, a swing arm, said bobbin mounted on said swing arm, a weighted arm connected to said swing arm to press said bobbin against said roller, said weighted arm having a weight adjustably positioned thereon, said swing arm and said weighted arm being positioned in such a manner that the moment of force pressing the bobbin against the roller will decrease as the thread builds up on the bobbin.

6. In an apparatus suitable for the winding of artificial thread to form a uniformly soft and liquid permeable thread package, a freely rotatable take-up bobbin, means for passing the thread to said take-up bobbin, thread traversing means for moving the thread across the face of said bobbin, a roller for driving said bobbin by contact with the wound surface thereof, a substantially vertically positioned swing arm, said bobbin mounted on said substantially vertically positioned swing arm, a weighted arm connected to said swing arm at such an angle that it will project from said swing arm in a horizontal or upwardly directed line to press said bobbin against said roller.

7. In an apparatus suitable for the winding of artificial thread to form a uniformly soft and liquid permeable thread package, a freely rotatable take-up bobbin, means for passing the thread to said take-up bobbin, thread traversing means for moving the thread across the face of said bobbin, a roller for driving said bobbin by contact with the wound surface thereof, a weighted swing arm, said bobbin mounted on said weighted swing arm which will press said bobbin against said driving roller substantially along the line of a horizontal plane bisecting said roller, said weighted swing arm being pivoted with the weight on said arm in such a position that the moment of force pressing the bobbin against the roller will decrease as the thread builds up on the bobbin.

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