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METHOD OF TREATING YARN

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FIG. 1.

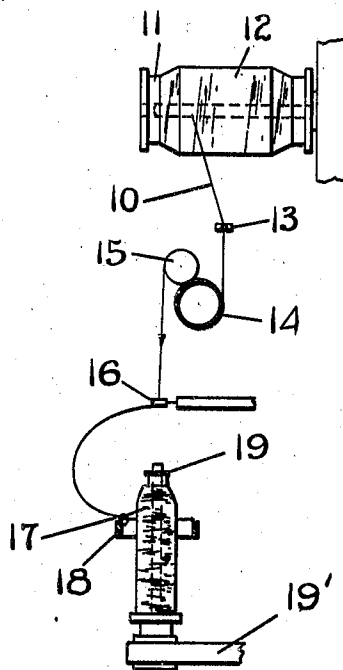
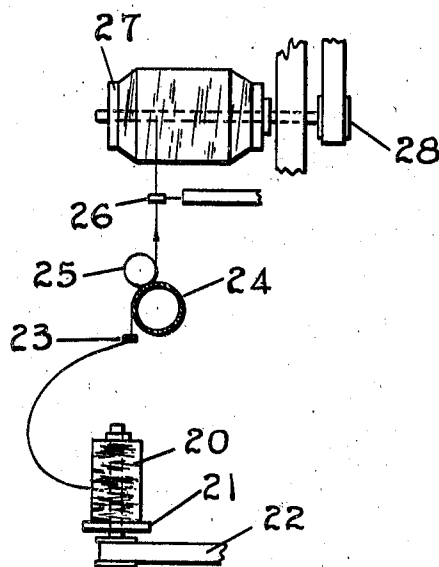


FIG. 2.



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METHOD OF TREATING YARN

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2 Claims. (Cl. 57—157)

This invention relates to the production of artificial threads and the like, and it pertains particularly to the manufacture of artificial threads and products produced therefrom, having improved physical characteristics.

According to one method of producing artificial thread by the viscose process, the thread, comprising untwisted filaments is collected on rotating bobbins (designated "spin bobbins" hereinafter, for convenience) and is permitted to dry in the form of a bobbin cake on a spin bobbin, or other rigid insert. This system of drying sets up internal strains in the thread which are not uniform throughout the cake since the intermediate layers of thread have greater freedom to shrink and do shrink to a considerably greater extent than the inner and outer layers of the thread. Yarn or thread which is dried under conditions which impose considerable strain has a somewhat higher tenacity and a noticeably lower elongation than does yarn which has had greater freedom to shrink during drying.

It is not surprising therefore that when yarn so produced is afterwards converted into fabrics, cords or other products, it exhibits a non-uniform appearance and other non-uniform physical characteristics. For example, when threads, strands, cords or in fact any type of plied structure are formed from high tenacity rayon by doubling and twisting operations, the twist in the plied structure is uneven and the strength is seriously impaired since, for a given strain, there is uneven distribution of the load in the elements of the twisted structure, loose loops or helixes failing to assume any portion of the load until the other elements have become heavily loaded or perhaps even broken.

It is important that artificial thread, such as regenerated cellulose thread produced by the viscose process, tends to shrink on drying, thereby setting up internal strains and should be dried under such conditions that if the thread is strained during drying, it will be strained uniformly. In order to produce a thread having substantially uniform shrinkage characteristics, substantially uniform tenacity, elongation and denier and other improved physical characteristics, it is preferred that no non-uniform strain be imposed during drying.

It is therefore an object of the present invention to produce artificial thread having improved physical properties.

A further object of the invention relates to the production of artificial thread having substantially uniform tenacity, elongation and denier.

Another object is to produce yarn which, in the form of cord or the like, will have improved durability.

Another object pertains to an improved process for twisting and drying high tenacity, high denier, artificial thread.

Other objects of the invention will appear hereinafter.

Referring to the drawing, Figure 1 illustrates diagrammatically one form of the invention as applied to down-twisting; while Figure 2 diagrammatically represents a form of the invention as applied to up-twisting.

The objects of the invention are accomplished, in general, by taking a yarn package, such as a spin bobbin of washed but undried, regenerated cellulose yarn which preferably has been centrifuged to remove the excess water, unwinding the thread from the package preferably by mounting the package on a pin creel and allowing the thread to unroll from the package although the package may be maintained stationary and the thread withdrawn therefrom over the end, and then twisting the thread on a down-twister of any suitable type, such as for instance a ring twister, a cap twister, or a flyer twister including gear driven flyer type twisters, on to a spool or bobbin (hereinafter called "twister" bobbins for convenience), the thread between the spin bobbin and the twister bobbin passing over or in contact with a heated member such as a roller heated to from 70–180° C.

It will be understood, of course, that the mode of procedure may be varied, depending on the condition and type of thread being twisted, more care being necessary in twisting a gel thread than if the thread has previously been dried. The invention is not only applicable to twisting a single thread, but is also advantageously used in connection with the plying of threads, for instance in the production of strands or cords. The invention can also be used to some advantage in the up-twisting of single, dried threads, for instance, to impart a higher degree of twist to the thread although generally a down-twisting apparatus is preferred.

This invention is especially useful in the application of finishes, sizes, adhesives, or other liquid compositions to yarns, threads, cords or the like which are being further twisted because very uniform application of the liquid can be made and dried in a relatively short travel to produce more uniformly coated threads.

The following examples represent modes of

applying the invention and are to be construed as illustrative and not limitative.

Example I

Referring to Figure 1 of the drawing, regenerated cellulose thread 10 of 275 denier-120 filament size, produced from viscose in the usual manner, and wound on a spin bobbin 11 is washed acid free in any suitable manner and the yarn then finished by forcing a solution containing one or more materials such as soap, vegetable oils, gums and other similar materials through the cake. The yarn cake 12, wound on the bobbin 11, is wrung for 5 minutes at 5,000 R. P. M., the cake of yarn and bobbin then placed on a pin creel (as shown) where the yarn can be freely unwound by unrolling from the bobbin, the bobbin being free to rotate on the creel. The wet thread is conducted through a guide 13 and around a relatively large diameter roller 14 heated to 140° C. by means of an electrical heating unit, steam pipes or other suitable means, and thence around an idler roll 15 to the usual thread guide 16 and through the traveler 17 which mounted for rotation about ring 18 of the ring spinner, being then collected on bobbin 19 mounted for rotation by means of driving belt 19'. With the room temperature at 90° F., the relative humidity at 30% and the time of contact of the thread with the heated roll about 1 second, the yarn as it is wound on the twister bobbin contains in the neighborhood of 9-10% moisture. With a spindle speed of 5,000 R. P. M. and a thread speed of 700 inches per minute, a twist of about 7 turns per inch is imparted to the thread. At this thread speed a single pass around the heated roll, which is in the neighborhood of 4 inches in diameter is sufficient to contact the thread with the heated roll for about 1 second.

Example II

A yarn of 900 denier-390 filament count which has been spun and wound on to perforated bobbins, washed, finished and centrifuged as described in Example I is placed on a pin creel and down-twisted as described in the previous example. In this case the spindle speed is in the neighborhood of 2,400 R. P. M. and the thread speed about 800 inches per minute to produce a thread with 3 turns per inch twist. Since the wet yarn on the bobbin contains in the neighborhood of 125% moisture, based on the bone dry weight of the yarn and since this is a much heavier denier thread than in the previous example, it is necessary, in order to dry down to equilibrium moisture, to increase the time the thread contacts with the heated roll, or to increase the temperature of the roll. I prefer to increase the time of contact with the roll either by using a larger diameter roll, for instance a roll about 8 inches in diameter and making a single pass therearound, or by putting two or three passes of yarn around a roll of about 4 inches or less in diameter. Using an 8 inch diameter roll with one pass of the thread therearound, the time of contact of the thread with the roll is in the neighborhood of 2 seconds, and with the roll heated to 150° C. Sufficient drying takes place so that when the yarn is wound up on the twister spool, it contains in the neighborhood of from 10-14% moisture.

While I prefer to use my twisting apparatus in a room of controlled humidity, especially in the twisting of high denier threads in order to

get additional drying from the spin bobbin and from the thread in its travel through the air, this is not necessary and very good results can be secured by following my specific procedure in a room of uncontrolled atmospheric conditions which normally would mean higher humidity and somewhat lower temperature. Yarn twisted according to my invention is exceptionally uniform in twisted formations, there being no corkscrew, nubs or uneven portions or any substantial deviation in the helix angle of the filaments, threads or strands comprising the structure. I attribute this very desirable thread, strand or cord formation to the fact that the thread, strand or the like is twisted while hot, for I have found that the best results are secured when the thread travels between the heated roll and the point of twisting a very short distance, and in general, the shorter the better.

In some instances it may be found desirable in addition to whizzing the spin bobbins at high speed, to subject the bobbins of yarn to conditioning for a while so as to reduce the moisture content of the yarn down, say, to about 50% or even less, based on the bone dry weight of the yarn. This may be accomplished, for instance, by merely placing the cakes in a room maintained at 95° F. and about 30% relative humidity for 2, 3, 4 hours or even longer. Cakes so conditioned will have a lower moisture content on the outer layers, being generally in the neighborhood of 15 to 30 or 40% while the middle portion and inner windings will contain in the neighborhood of from 50-70% moisture.

Good results can also be secured by twisting dried yarn in the manner herein described, as distinct from gel thread, i. e., thread that still contains considerable moisture, but in this case since there is no moisture to be removed but merely to properly heat the dried thread so that the thread being twisted will be heated, say, to a temperature of from 60-100° C., or possibly more or less and in this case only a very short time of contact with the thread with the heated roll is necessary. For instance, if the roll is heated to 150° C., the time of contact need be no more than about 0.1 second or perhaps even less. The time of contact can, of course, be shortened by increasing the temperature of the roll and good results can be secured by using roll temperatures of 160-170° C. or even as high as 180° C., provided the time of contact of the thread with the roll is very short. In some cases it is desired to use a longer time of contact in order to more uniformly heat the thread or cord, in which case the temperature of the roll can, of course, be reduced, say, to 120, or even 100° C., or possibly even as low as 80 or 70° C.

It is to be understood, of course, that instead of using driven rollers, freely rotatable heated rollers may be used which may or may not be turned by the thread, depending upon the tension on the thread passing therearound, or stationary heated surfaces may be used, as for instance a pipe of suitable diameter, a member with an arcuate surface, or other suitably shaped surface, so that the thread may have sufficient contact therewith by merely passing thereover.

In the case of bucket yarn and also some bobbin-spin yarn, elongation is sometimes relatively high and for certain uses, such as for tire cord, it is desirable to have the elongation no greater than about 10% at the breaking point. High elongation gel yarn may therefore be dried by contacting a heated surface while held under ten-

sion, for instance, while being stretched between two sets of drawing rolls to produce yarn of lower elongation. The use of drawing rollers need not be limited to stretching for, in some instances, it may be necessary only to keep the thread from contracting during drying in which case the two sets of drawing rollers will turn at the same peripheral speed. If it is desired to preserve the elongation then allowance should be made for the normal contraction of yarn during drying and the second set of drawing rollers run slower than the first set.

Yarn may be twisted from packages of any description by my invention. For instance, instead of using gel rayon wound on spinning bobbins, gel rayon in the form of bucket cakes, or even dried rayon in the form of bucket cakes which may or may not have been treated with a suitable finish may be used. The yarn may be wound in other suitable forms, such as spools, cones, cheeses or the like and may be either gel, dry or rewetted, for instance by a size, finish, adhesive composition or the like.

The invention is admirably suited for treating thread on the run with a suitable liquid composition such as a finish, size, adhesive, dye or the like which preferably should be dried before the thread is wound up again and where additional twist is to be imparted to the thread because the small space needed to carry out the operation and because uniformly treated and twisted structures result.

Although I have generally confined the discussion of my invention heretofore to the twisting of threads on a down-twister, my invention is not so limited and an up-twister may be used, especially where the yarn to be twisted is dried and wound on a suitable spool or support for mounting on a twister spindle. In this case the hot surface with which the thread contacts will be located as close to the balloon as is practical, being either immediately above or immediately below the pigtail through which the thread first runs in its travel from the twister spool to the take-up bobbin. Thus, referring to Figure 2, the thread cake 20 wound on a bobbin 21 and mounted for rotation by means of a driving belt 22, may be up-twisted, passing through a thread guide 23, into contact with a heated roller 24 which may be freely rotatable or driven, the arc of contact of the thread on the roll preferably being 90° or less, as shown, the thread then passing in contact with an idler roll 25, up through a thread guide 26, then being wound on a take-up spool 27 rotatably driven by a pulley 28, which is driven by a belt 29.

Although the invention is especially useful in connection with the twisting of heavy denier threads, such as 200, 500, 900, 1200 denier or more, especially in connection with the twisting of these threads from wet spinning bobbin cakes, the invention is nevertheless advantageously used with finer denier threads such as 150, 100 denier or even 75 or 60 denier threads.

The heated roller or thread contacting heated surface may be made of any suitable material such as stainless steel, aluminum, nickel, Hastelloy, titanium or other suitable metals or alloys. If desired, the roller or other heated surface can be insulated over the portion with which the thread does not contact in order to conserve heat and prevent excess radiation. Instead of using an auxiliary roll for this purpose, steam may be passed through a pipe or pipes, serving as one or more feed rollers and the temperature thereof

controlled by regulating the steam pressure in the pipe or pipes.

Not only is the invention applicable to the twisting of regenerated cellulose threads produced by the viscose process, but it is also suited to the drying and twisting of regenerated cellulose threads made by the cuprammonium process, or to the twisting of lowly substituted cellulose derivative threads such as lowly etherified cellulose ethers, as glycol, ethyl or methyl; or lowly esterified cellulose acetate or other cellulose esters, or other textile threads which have a tendency to shrink during drying.

From the foregoing, it is apparent that the invention is not merely directed to the idea of drying the thread on the run and twisting it because unusually good twisted structures are secured by hot twisting threads which have already been dried. Twisted structures produced according to this invention are free from any corkscrew formation which frequently results from twisting of threads in the ordinary manner and the twisted structures are unusually uniform and of high quality. To be sure, the invention is especially advantageous in the drying and twisting of gel rayon taken directly from the wet spinning bobbin cake, but I am of the opinion that the extremely good results are not due to the fact that the yarn is merely dried under uniform conditions and then twisted, but is due to the fact that the yarn is heated and twisted while hot and this, I believe, is the essence of my invention.

The advantages that accrue from the use of this invention are many and varied, but some which readily occur to me are mentioned hereinbelow. Prior to this invention, it was found necessary to carefully control the humidity of the twisting room in order to get uniform and high quality twisted structures. This added expense and careful control is unnecessary with my invention and good results can be secured under any humidity conditions normally prevailing. Yarn may be twisted to any number of turns which may involve a very wide range of thread speeds with very good results and without lowering the spindle speed by merely altering the temperature of the heated roll or thread contacting surface, or altering the period of contact of the thread with this surface. By following my invention, yarn can be wound up on a twister spool of any degree of moisture. Very heavy denier threads which are being twisted from the gel spinning package can be dried down uniformly without slowing down the thread speed and thus greatly reducing the production. In the twisting and doubling of dried yarn, more uniformly twisted structures are produced than have been possible heretofore. Yarn of improved quality results because the thread or the like passing through the ring traveler is dry and warm and the frictional resistance is believed to be substantially reduced.

Another advantage of this invention is the production of uniform and high quality yarn. Because the yarn is unwound from the spinning bobbin in the gel condition there are fewer broken filaments since there is no tangling of filaments and stray filaments are not caught and firmly held under previously wound threads as it frequently happens when the yarn is dried down to equilibrium moisture or less on the bobbin and then the caught filaments finally broken during the twisting step. This advantage is especially noticeable in the case of high tenacity yarn wound onto bobbins under very high tension for when dried on the bobbins this yarn will tend to

shrink and build up still higher tensions or strains.

It is to be understood that the invention is susceptible of considerable variation, any modification which conforms to the spirit of the invention is intended to be included within the scope of the claims.

I claim:

1. The process of twisting threads, strands, cords and the like composed of artificial filaments

which comprises passing said threads, strands, cords and the like over a rotatable heated roller, and twisting the same while hot.

2. The process of twisting threads, strands, cords and the like composed of regenerated cellulose filaments which comprises passing said thread, strands, cords and the like, containing moisture, over a rotatable heated roller, and twisting the same while hot.

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