

Oct. 31, 1939.

H. B. KLINE ET AL

2,178,104

APPARATUS FOR HANDLING THREAD OR THE LIKE

Filed Oct. 26, 1936

2 Sheets-Sheet 1

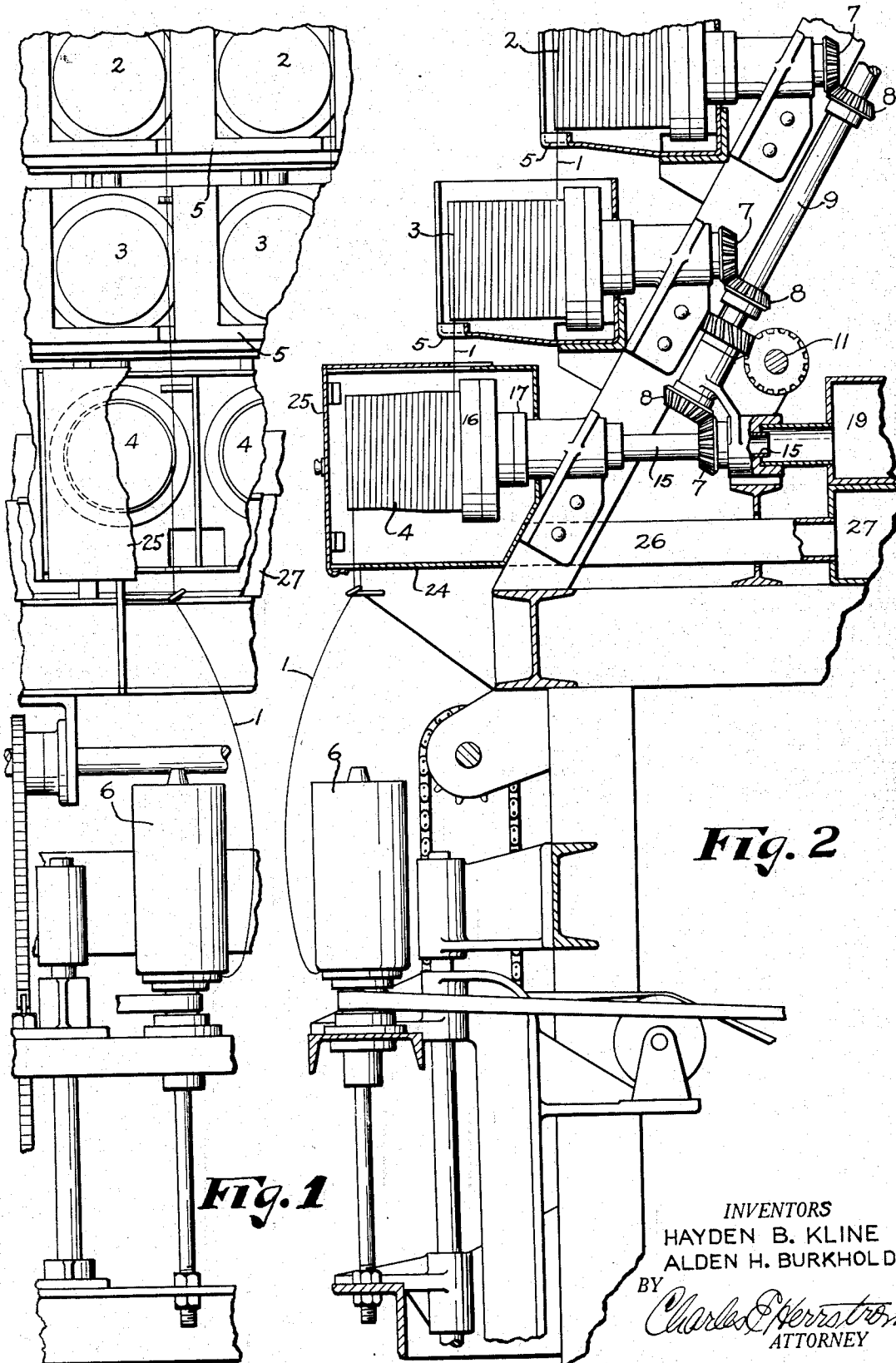


Fig. 1

Fig. 2

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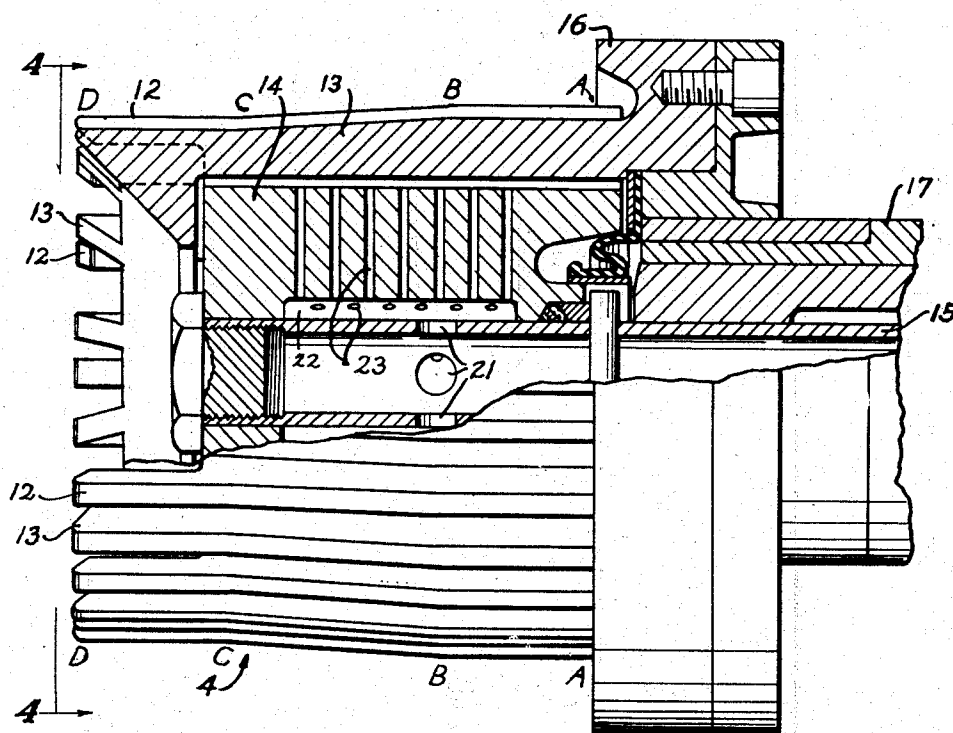


Fig. 3

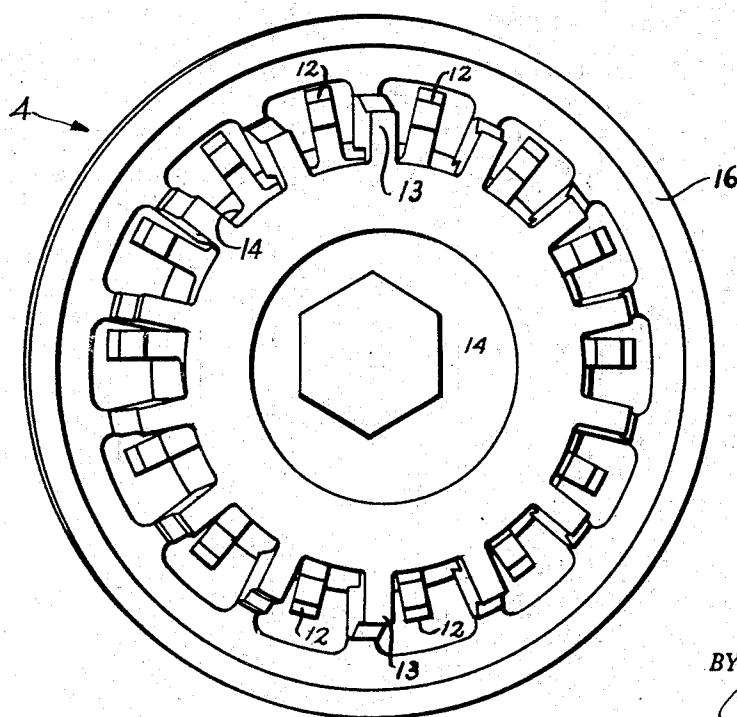


Fig. 4

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2,178,104

APPARATUS FOR HANDLING THREAD OR
THE LIKE

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Application October 26, 1936, Serial No. 107,666

10 Claims. (Cl. 34—29)

This invention relates to a drying reel on which, during rotation of the reel, thread or the like which is being subjected to a drying operation is advanced in a plurality of generally helical turns. More particularly, the invention relates to a cantilever drying reel; i. e., a drying reel supported and driven from one end only with its other end free and unobstructed, providing a controlled shrinkage of the thread or the like. Reels of this type are particularly well adapted to the drying of thread or the like, since they provide ease of manipulation of the thread or the like on the reel and since they impart desirable characteristics to the thread or the like as a result of the drying operation.

The drying of thread or the like, particularly artificial silk thread produced by a wet-spinning process, plays a very important part in determining the final characteristics of the finished product. For instance, uniformity or lack of uniformity of the drying treatment to which the thread or the like is subjected determines to a very large extent the degree of uniformity of the physical and physico-chemical characteristics of the thread or the like. Thus portions of the thread or the like which, during drying, were under more tension than other portions, or were prevented from shrinking to the same extent as other portions, or were not dried to the same extent as other portions, have characteristics markedly different from such other portions of the thread or the like. In the case of viscose artificial silk thread, such differences include variations in dye adsorption characteristics, tensile strength, and residual capacity to shrink.

Residual capacity to shrink may be defined as the amount which, in proportion to its original length, dry thread or the like will shrink upon being rewet and redried in unrestrained condition.

It is obviously desirable that the thread or the like have characteristics, including particularly residual capacity to shrink, as uniform as possible along its entire length, this in order that a fabric formed from the thread or the like will present a smooth, even appearance. Such uniformity is particularly desirable in the case of thread or the like formed into woven fabrics, in which, because of the construction thereof, variations in thread characteristics are particularly noticeable. Nevertheless, in conventional methods of manufacturing artificial silk thread by wet-spinning processes, the degree of uniformity of the conditions of drying necessary to insure reasonably complete uniformity in residual capacity

to shrink is, as a practical matter, virtually, if not actually, impossible to obtain.

In the conventional spool-spinning system, in which the thread or the like is extruded into a coagulating bath, collected on a spool, and dried while wound on the spool, the resulting residual capacity of the thread or the like to shrink varies widely at different points along the length of the thread or the like. For instance, portions of the thread or the like which are largely or entirely prevented from shrinking upon drying, such, for example, as portions wound directly on the spool and portions at the outer surfaces of the cake which dry more rapidly than the inner layers of the thread or the like will be found to have unduly high residual capacities to shrink, as much, sometimes, as 4½% of their original dry length. Other portions of the thread or the like which are permitted to shrink more or less freely, such as portions of the thread or the like in the central layers of the cake, will have relatively low residual capacities to shrink. Within a single length of thread or the like, therefore, portions may exist which will have residual capacities to shrink twenty times as great as those of other portions.

If thread or the like manufactured by the conventional pot-spinning system is dried in the cake in which it is collected, similar differences in residual capacities to shrink occur for wholly similar reasons. With a view to eliminating these factors as well as for other reasons hereinafter to be explained, a considerable part of the artificial silk thread produced by the pot-spinning system is unwound while wet from the cake in which it is collected and wound in skein form, in which form it is dried while hanging loosely. However, skein-dried thread or the like does not possess as high a degree of uniformity, either of residual capacity to shrink or of other characteristics, as might be desired, this being due to the fact that the weight of the thread or the like as it hangs from the skein-carrying rod while being dried may tend to stretch certain portions of the thread or the like and to the fact that all portions of the thread or the like in the skein do not dry at the same rate. Obviously, these same disadvantages apply to spool-spun thread or the like which, after being collected, is wound into skeins and dried.

Furthermore, such methods of producing thread or the like entail a large amount of handling of the thread or the like with attendant disadvantages of excessive breakage, high labor costs, and a large investment in machinery, plant

space, etc., in consequence of which fact skein-dried thread or the like is comparatively expensive.

As has been mentioned, such factors as uniformity of characteristics, particularly residual capacity to shrink, are especially desirable in thread or the like which is to be employed in the manufacture of woven, as opposed to knitted, fabrics. Due to the manner of making such fabrics, it is very important that the residual capacity to shrink be low. In the production of woven fabrics, the fabric is initially woven to a width substantially equal to or slightly greater than the finished fabric. In the finishing operations, the woven fabric, after being washed, dyed, etc., is dried in tentering frames which hold the fabric to the desired finished width. If the thread or the like of which the fabric is formed has a high residual capacity to shrink, tearing of the fabric may result during the drying operation, due to stresses set up in the fabric as it dries while thus being held in the tentering frames. For this reason it is imperative that the thread or the like of which the fabric is formed have a low residual capacity to shrink, particularly since the looms used in the weaving industry are of standard widths which do not admit of adjustment to compensate for excessive shrinkage or undue stress in the fabric.

Disadvantages inherent in the conventional methods of drying thread or the like are obviated by drying the thread or the like on reels of the kind provided by the present invention. By means of such a reel, the thread or the like may be dried while being continuously temporarily stored in a plurality of advancing generally helical turns. The thread or the like may meanwhile be permitted to shrink to an extent which results in imparting to the thread or the like the desired residual capacity to shrink. Such residual capacity to shrink may be as low as desired, as, for instance, of the slight order required in the weaving arts. Furthermore, since only a single layer of the thread or the like is subjected to the action of the drying medium, since each portion of the thread or the like passing over the reel is subjected to exactly the same drying conditions, and since, regardless of the length of the thread or the like, shrinkage to exactly the same extent is made possible, such characteristics of the thread or the like as are dependent on the drying treatment to which it is subjected are highly uniform. Also, by means of the reels of the present invention thread or the like of high quality may be produced at a much lower cost than heretofore possible.

For these reasons, drying reels embodying the present invention find wide application in various methods of and apparatus for processing thread or the like. As examples, artificial silk thread may be unwound from the spool package or spinning cake, as the case may be, dried on a winding reel of the type provided by this invention, and collected in any suitable way. Likewise, artificial silk thread may, simultaneously with the formation of the thread, be dried on a reel of the type provided by the present invention, for example, on apparatus of the type shown, described and claimed in prior copending application Serial No. 7,114, filed February 18, 1935. For the purposes of convenience and illustration, but in no sense of limitation, the invention will be hereinafter described in connection with the drying of viscose artificial silk thread on a reel forming part of a machine for the continuous manufacture of arti-

ficial silk thread of the general type disclosed in the above-mentioned application Serial No. 7,114.

In the drawings, Figure 1 is a front elevation of a portion of a machine embodying the present invention.

Figure 2 is a side elevation of the same machine, parts being broken away.

Figure 3 is a side elevation, partly in axial section, of a reel embodying the invention.

Figure 4 is an end elevation of the reel on line 4-4 of Figure 3.

In the apparatus illustrated in Figures 1 and 2, thread is passed in series to and over each of a number of suitable thread-storage, thread-advancing reels on each of which it is advanced in a plurality of generally helical turns. Three such reels, bearing reference numerals 2, 3 and 4, are shown in the drawings. On reel 2 the thread may be subjected to a liquid processing operation such as washing with water showered down on the reel by any suitable means, such liquid being caught in a trough 5 extending longitudinally of the machine and serving a number of reels in a horizontal series. On reel 3 the thread may be stored for the purpose of allowing excess liquid to drip from the thread. Reel 4 is a reel of the type contemplated by the present invention, on which the thread is dried before being collected by suitable means such as cap-twister 6. Reels 2, 3 and 4 may, as illustrated, be of cantilever form, in which case the reels may be disposed in a stepped arrangement, as illustrated. Such an arrangement is advantageous in that it provides ready access to the reels for threading up, inspection, replacement, repair, etc. Each of the reels in a vertical series may be driven as illustrated through gears 7 and 8 from a drive shaft 9 which is driven from a main drive shaft 11 extending longitudinally of the machine.

The several reels other than reel 4 may be generally similar in construction and thread-advancing function to reel 4, wherefore only reel 4, which is illustrated as embodying the invention and which is shown in detail in Figures 3 and 4, will be described in detail.

This reel consists of two sets of interdigitating bar members 12 and 13. Bar members 12 are disposed upon the periphery of a cylindrical body 14 concentrically mounted on shaft 15. The bar members 13 are carried by a flange member 16 rotatably mounted upon frame bracket 17 through which shaft 15 passes. The axis of rotation of the set of bar members 13 is offset from and askew to the axis of rotation of the set of bar members 12. Because of this relation, thread wound about the reel during rotation thereof is caused to advance in spaced generally helical turns along the length of the reel. Reels of this general construction are shown, described and claimed in copending application Serial No. 652,089, filed January 16, 1933, to which reference may be had for a more detailed explanation of the principle of operation.

Reels embodying the invention include a thread-bearing periphery of which certain successive perimeters, taken on planes at right angles to the axis of the reel, diminish axially of the reel toward the free end of the reel to provide for shrinkage of the thread as it is dried. Preferably, the reel has a thread-bearing periphery comprising an initial portion defining a body uniform in cross section throughout its length, on which portion the thread starts on the reel;

merging therewith, an intermediate portion having perimeters which, similarly taken on planes at right angles to the axis of the reel, diminish progressively, thus allowing the thread to shrink as it is dried; and a terminal portion extending to the free end of the reel defining a body of uniform cross section throughout its length, the perimeters of said terminal portion being less than the perimeters of said first-mentioned portion by an amount corresponding to which it is desired to allow the thread to shrink. As seen from Figure 3, the preferred embodiment of the invention in a reel of this type has a periphery comprising two substantially cylindrical portions A—B and C—D, the latter of which is of less diameter than the former and is disposed at the free end of the reel, and, merging with said substantially cylindrical portions, an intermediate portion B—C having regularly varying diameters which decrease from the diameter of portion A—B to the diameter of portion C—D. The portion B—C may, as illustrated, take the form of a frustum of a cone.

The proportions of generally cylindrical portion A—B of the reel are preferably such that the thread starting on portion A—B of the reel, either at point A or at some point nearer point B, has had sufficient moisture removed therefrom to cause substantial shrinkage thereof to commence when it reaches point B. From point B to point C the periphery of the reel diminishes in diameter, allowing the thread to shrink as it is advanced therealong while being subjected to drying medium. Proportions of portion B—C of the reel are such that the thread is allowed to shrink the desired amount by the time it reaches the portion C—D of the reel. The drying of the thread may be completed on portion C—D of the reel. Since the thread may not be completely dried when it starts on portion C—D of the reel, shrinkage of the thread may be halted, as a result of which fact a definite residual capacity to shrink may be imparted to the thread.

The residual capacity to shrink which is thus imparted to the thread is determined by the relation between the diameters of portion C—D and portion A—B. By varying the diameter of portion C—D with respect to the diameter of portion A—B of the reel, the residual capacity of the thread to shrink may be varied. For instance, by decreasing the diameter of generally cylindrical portion C—D of the reel the residual capacity of the thread to shrink may be decreased. By increasing the diameter of said generally cylindrical portion C—D, the residual capacity of the thread to shrink may be increased. The length of portion C—D of the reel is preferably such as to allow the thread to dry to the desired condition. It is also preferably of sufficient length to enable the thread to reach a state of drying equilibrium; i. e., become "set" in a final condition, before it leaves the reel and passes to the collecting device. If the thread is being twisted, as in a case where the drying reel is employed in apparatus of the type of Figures 1 and 2, it may be desirable not to dry the thread to a bone dry condition, but to a state in which it possesses a moisture content in the neighborhood of 10%.

Although the thread on the reel may be subjected by various means to the action of a drying medium, in the embodiment shown the reel is provided with a hollow drive shaft 15 to which heated air may be supplied, as in the apparatus

of Figures 1 and 2, from chamber 19. The latter may be extended longitudinally of the machine and serve like drying reels in a horizontal series. The heated air passes through holes 21 in drive shaft 15 to a space 22 within the cylindrical body 14 of the reel whence it passes through holes 23 in the wall of said cylindrical body. These holes 23 may terminate in opposite relation to the spaces between the bars 12.

It has been found that the drying of the thread is materially aided by conduction of heat if the reel is made of some metal having good heat conductivity, such as aluminum, and if the construction of the reel is such that the bars on which the thread is supported are of appreciable mass. In the illustrated reel, the solid bar members 12 and 13 and the cylindrical body 14 are sufficiently massive to become heated by the passage of the heated air through the reel and retain the heat, and thus all thread-bearing portions of the periphery of the reel are heated. This aids materially in the drying of the thread wound on the reel. Therefore the reel stores heat to a certain extent, in consequence of which fact momentary fluctuations in the temperature of the heated air supplied to the reel do not affect the rate of drying of the thread. This assists in the obtaining of the desired uniformity of drying conditions.

To aid in the drying of the thread by providing better control over the drying conditions as well as to conserve the heated air, a suitable housing 24 may surround the drying reel 4, said housing being provided, if desired, with a door 25 by means of which access to the reel may be obtained for threading up, inspection, repair, etc. The air may pass from housing 24 through a return duct 26 to an exhaust manifold 27 which, in the apparatus Figures 1 and 2, may extend longitudinally of the machine and serve like drying reels in a horizontal series, whence the air may pass to suitable reconditioning or reheating means not shown, after which it may be recirculated to supply manifold 19.

The cantilever construction of the drying reels of the present invention also provides numerous advantages in the operation of such reels.

The cantilever construction, for instance, obviates numerous difficulties attendant upon the operation of starting the thread on drying reels. The most convenient way of threading up reels of the general type described is to bring the wet thread into contact with the bars of the reel as it is rotated. Since the thread is wet, it adheres to the bars. As the reel is rotated, succeeding turns of thread are formed and advanced axially of the reel. However, for obvious reasons, it is desirable in the great majority of cases that the reel be threaded up while it is operating under drying conditions, since it would be both difficult and uneconomical to shut off the supply of drying medium or allow the reel to cool every time it is desired to thread up the reel.

However, when, while being threaded up, the reel is operated under drying conditions, the thread becomes dry as it is progressed axially of the reel and consequently the leading end of the thread may not adhere to the bars of the reel but may leave the reel, in which case the thread will leave the reel before the reel is completely threaded up. If this should occur in the threading up of the cantilever drying reel of the present invention, on which reel the thread is advanced from the rear of the reel toward the free end thereof, it is a simple matter for the operator

either to wind the remaining turns of thread on the reel over the free end of the reel or to re-engage the free end of the thread on the reel over the free end of the reel, and allow the threading up of the reel to proceed to completion. This is made possible by the free and unobstructed end of the cantilever drying reel of the present invention. It would be difficult, if not impossible, to perform such operations on a reel supported from both ends.

Furthermore, the free and unobstructed end of the reel of the present invention is extremely advantageous in providing a means of control of the drying treatment to which the thread is subjected while stored on the reel. For instance, as has been previously indicated, for easier handling of the thread it is often desirable to have a definite moisture content in the thread after it has been subjected to the drying step, which moisture content may be in the neighborhood of 10%. It is possible, due to the variations in the drying conditions, such, for example, as variations in the temperature of the heating air, that if the thread proceeds to the extreme end of the reel it may be subjected to drying medium for a period longer than that necessary to reduce the moisture content of the thread to the desired condition, in which case the moisture content of the thread may be reduced to too low a point. Because of the free and unobstructed end of the reel of the invention, it is, however, a simple matter for the operator, without breaking the thread, to reduce the number of turns of thread stored on the reel by drawing the desired number of turns of thread off the free end of the reel.

Conversely, if the thread is not being advanced to the end of the reel but is leaving the reel at some point back of the free end of the reel and it is desired for any reason to increase the number of turns of thread on the reel, as, for example, to increase the length of time to which the thread is subjected to drying medium to more completely dry the thread, it is a simple matter for the operator to wind more turns of thread on the reel over the free end of the reel without breaking the thread or interrupting in any way the continuous travel of the thread or the operation of the reel or collecting device. Such steps, which are obviously of great advantage in controlling and adjusting the drying operation to which the thread is subjected, cannot be performed in any form of drying reel other than a cantilever drying reel. Therefore, as a result of the cantilever construction of the drying reel of the present invention, it is possible to obtain greater uniformity of drying treatment to which the thread is subjected with consequent greater uniformity of the characteristics of the thread.

The exact proportions and sizes of the various parts of the thread-bearing periphery of the drying reels of the present invention are of course dependent on the kind of thread being dried; the amount of residual shrinkage desired; the kind, size, and speed of operation of the reel; the kind and intensity of drying medium, etc. All of these factors must be considered in designing the reel. The following illustrative examples, to which the present invention is in no way intended to be restricted, are indicative of the use of reels of the kind embraced by the present invention:

Example A.—Viscose artificial silk thread of 150 denier, 40 filaments, is dried on a reel of the above-described type having reel members provided with generally cylindrical portions A—B 5" in diameter and generally cylindrical portions

C—D 4.8" in diameter. The total length of the reel from A to D is 5". The length of portion A—B is 1.75", the thread starting on the reel approximately $\frac{3}{8}$ " from point A. The length of portion B—C is 2.25", such portion being frusto-conical in form. The thread is advanced along the reel in a plurality of generally helical turns spaced approximately $\frac{1}{4}$ " apart, being dried by heated air supplied from the interior of the reel at about 185° F. at a static pressure of about 6" of water. Thread so dried has been found to have a residual capacity to shrink in the neighborhood of 2½% and to be substantially uniform along the entire length of the thread.

Example B.—Viscose artificial silk thread of 150 denier, 40 filaments, is dried on a reel of the above-described type having reel members each of which is provided with a generally cylindrical portion A—B 4.95" in diameter and a generally cylindrical portion C—D 4.7" in diameter. The total length of the reel from point A to D is 5". The thread travels $\frac{3}{4}$ " on portion A—B before reaching point B. The length of portion B—C of the reel is 1.25", portion B—C of the reel being frusto-conical in form. The thread is advanced in a plurality of generally helical turns spaced approximately $\frac{1}{4}$ " apart, being dried by heated air supplied from the interior of the reel at about 185° F. and at a static pressure of about 6" of water. Tests made at periodic intervals along the length of thread so dried have been found to reveal that the residual capacity to shrink is at all times less than 1%, the average residual capacity to shrink being in the neighborhood of .6% with a variation therefrom plus or minus of less than .4%.

It has been found, further, that the amount of tension, in the wet thread at the commencement of the drying operation determines to an appreciable extent the amount of residual capacity to shrink imparted to the thread when it is dried on the reels of the present invention. Thus if the thread is under substantial tension at the beginning of the drying operation, the residual capacity to shrink imparted to the thread will be higher than if the thread is under little or no tension at the commencement of the drying operation. For this reason, it is desirable that, at the commencement of the drying operation, the thread be under as little tension as practicable for satisfactory operation of the reel.

Where the thread is dried on an individual drying reel, as in the illustrated embodiment of the invention, this may be accomplished by providing a peripheral speed of that portion of the drying reel on which the thread first starts on the reel; i. e., portion A—B of the reel, which is less by a suitable amount than the linear speed at which the thread is supplied to the reel from the source of thread. Thus, in the illustrated apparatus in which the thread passes from a preceding reel to the drying reel, the peripheral speed of portion A—B of the drying reel may be less than the peripheral speed of the discharge end of the preceding reel. This may be accomplished, for instance, by making the portion A—B of the drying reel and the discharge end of the preceding reel of the same diameters and rotating both reels at different angular speeds, or by making the diameter of portion A—B of the drying reel less than that of the discharge end of the preceding reel and driving both reels at the same speed, or by a combination of these methods. As a result, any tension in the thread will be released, the thread, if it is at all stretched, being

allowed to contract as it starts on the drying reel.

As an example of the effect of the initial tension of the thread on the residual capacity to shrink imparted to the thread the following is illustrative:

Viscose artificial silk thread is dried according to the above-outlined method on an aluminum reel of the type above described. The reel is 5' long and has reel members 5" in diameter at the end at which the thread is started on the reel. The difference in the diameters of portions A—B and C—D of the reel is $4\frac{1}{2}\%$, the reel being rotated at 165 R. P. M. The thread is dried by heated air supplied from the interior of the reel at 185° F. The diameter of portion A—B of the reel is the same as that of the discharge end of the preceding reel and both reels are driven at the same speed. Consequently, no attempt is made to release any tension existing in the thread. The residual capacity to shrink of the thread so dried is in the neighborhood of 1.6%.

Thread of the same kind is dried on a reel of the same general dimensions as the reel of the preceding example, the only difference being that the diameter of portion A—B of the reel is 1% less than the diameter of the discharge end of the reel immediately preceding it. In this case, as in the preceding case, there is a difference of $4\frac{1}{2}\%$ between the diameters of portions A—B and C—D of the reel. Both the reel in question and the reel immediately preceding it are rotated at 165 R. P. M., the thread being dried by heated air at 185° F. supplied from the interior of the drying reel. The residual capacity to shrink is in the neighborhood of .5%.

The above-described embodiments of the invention being purely illustrative, it is obvious that numerous modifications may be made therein without departing from the spirit of the invention. The invention may, for example, be applied to reels operated on other principles than that illustrated. Furthermore, whereas in the embodiment illustrated the reel is shown as having a periphery which includes a frustro-conical portion, the periphery of the reel may have any one of a number of other contours. The invention may be employed in any of the known processes for manufacturing artificial silk thread, including the viscose, nitro-cellulose, cuprammonium and cellulose acetate processes. Furthermore, reels embodying the invention may be employed in other forms of apparatus and for the drying of other kinds of thread or the like than artificial silk thread.

It is intended that the patent shall cover, by suitable expression in the appended claims, whatever features of patentable novelty reside in the invention.

What is claimed is:

1. In apparatus for drying thread or the like, a unitary, self-threading drying reel of cantilever construction which is made up of a plurality of interdigitating cage members, which is supported from one end thereof in such manner that the other end of the reel is not only unsupported but substantially unobstructed, and which presents lengthwise of the reel a thread-bearing periphery of substantially circular cross section along which the thread or the like is advanced in a large number of generally helical turns toward the unsupported end of the reel, said thread-bearing periphery having perimeters taken on cross sections of the reel which diminish in the direction of advance of the thread or the like; means providing relative movement of the thread-

bearing surfaces of said cage members; and means for subjecting the thread or the like to drying conditions as it is being advanced on the reel.

2. In apparatus for drying thread or the like, a unitary, self-threading drying reel of cantilever construction which is made up of a plurality of interdigitating cage members, which is supported from one end thereof in such manner that the other end of the reel is not only unsupported but substantially unobstructed, and which presents lengthwise of the reel a thread-bearing periphery of substantially circular cross section along which the thread or the like is advanced in a large number of generally helical turns toward the unsupported end of the reel, said thread-bearing periphery including a portion adjacent the supported end of the reel characterized by substantially uniform cross sections and, merging therewith, a portion characterized by perimeters taken on cross sections of the reel which diminish in the direction of advance of the thread or the like; means providing relative movement of the thread-bearing surfaces of said cage members; and means for subjecting the thread or the like to drying conditions as it is being advanced on the reel.

3. In apparatus for drying thread or the like, a unitary, self-threading drying reel of cantilever construction which is made up of a plurality of interdigitating cage members, which is supported from one end thereof in such manner that the other end of the reel is not only unsupported but substantially unobstructed, and which presents lengthwise of the reel a thread-bearing periphery of substantially circular cross section along which the thread or the like is advanced in a large number of generally helical turns toward the unsupported end of the reel, said thread-bearing periphery including a portion characterized by perimeters taken on cross sections of the reel which diminish in the direction of advance of the thread or the like and, merging therewith, a portion adjacent the unsupported end of the reel characterized by substantially uniform cross sections; means providing relative movement of the thread-bearing surfaces of said cage members; and means for subjecting the thread or the like to drying conditions as it is being advanced on the reel.

4. In apparatus for drying thread or the like, a unitary, self-threading drying reel of cantilever construction which is made up of a plurality of interdigitating cage members, which is supported from one end thereof in such manner that the other end of the reel is not only unsupported but substantially unobstructed, and which presents lengthwise of the reel a thread-bearing periphery of substantially circular cross section along which the thread or the like is advanced in a large number of generally helical turns toward the unsupported end of the reel, said thread-bearing periphery including an initial portion adjacent the supported end of the reel characterized by substantially uniform cross sections, an intermediate portion characterized by perimeters taken on cross sections of the reel which diminish in the direction of advance of the thread or the like, and a terminal portion adjacent the unsupported end of the reel characterized by substantially uniform cross sections, the perimeter of said terminal portion being less than the perimeter of said initial portion; means providing relative movement of the thread bearing surfaces of said cage members; and means for sub-

jecting the thread or the like to drying conditions as it is being advanced on the reel.

5. In apparatus for drying thread or the like, a unitary, self-threading drying reel of cantilever construction which is made up of a plurality of interdigitating cage members, which is supported from one end thereof in such manner that the other end is not only unsupported but substantially unobstructed, and which presents lengthwise of the reel a thread-bearing periphery of substantially circular cross section along which the thread or the like is advanced in a large number of generally helical turns toward the unsupported end of the reel, said thread-bearing periphery comprising two spaced, generally cylindrical portions of different diameters of which the portion of smaller diameter is adjacent the unsupported end of the reel and, intermediate said cylindrical portions, a portion of frusto-conical form; means providing relative movement of the thread-bearing surfaces of said cage members; and means for subjecting the thread or the like to drying conditions as it is being advanced on said reel.

6. In combination with means providing relative movement of the thread-bearing surfaces thereof, a unitary, self-threading reel of cantilever construction which is made up of a plurality of interdigitating cage members, which is supported and driven from one end thereof in such manner that the other end is not only unsupported but substantially unobstructed, and which presents lengthwise of the reel a thread-bearing periphery of substantially circular cross section along which the thread or the like is advanced in a large number of generally helical turns toward the unsupported end of the reel, said thread-bearing periphery including a portion extending over a substantial part but not all of the reel having perimeters taken on cross sections of the reel which vary progressively in the direction of advance of the thread or the like.

7. In combination with means providing relative movement of the thread-bearing surfaces thereof, a unitary self-threading reel of cantilever construction which is made up of a plurality of interdigitating cage members, which is supported from one end thereof in such manner that the other end is not only unsupported but substantially unobstructed, and which presents lengthwise of the reel a thread-bearing periphery of substantially circular cross section along which the thread or the like is advanced in a large number of generally helical turns toward the unsupported end of the reel, said thread-bearing periphery including a portion adjacent the supported end of the reel characterized by substantially uniform cross sections and, merging therewith, a portion characterized by perimeters taken on cross sections of the reel which vary progressively in the direction of advance of the thread or the like.

8. In combination with means providing rela-

tive movement of the thread-bearing surfaces thereof, a unitary, self-threading reel of cantilever construction which is made up of a plurality of interdigitating cage members, which is supported from one end thereof in such manner that the other end is not only unsupported but substantially unobstructed, and which presents lengthwise of the reel a thread-bearing periphery of substantially circular cross section along which the thread or the like is advanced in a large number of generally helical turns toward the unsupported end of the reel, said thread-bearing periphery including a portion characterized by perimeters taken on cross sections of the reel which vary progressively in the direction of advance of the thread or the like and, merging therewith, a portion adjacent the unsupported end of the reel characterized by substantially uniform cross sections.

9. In combination with means providing relative movement of the thread-bearing surfaces thereof, a unitary, self-threading drying reel of cantilever construction which is made up of a plurality of interdigitating cage members, which is supported from one end thereof in such manner that the other end is not only unsupported but substantially unobstructed, and which presents lengthwise of the reel a thread-bearing periphery of substantially circular cross section along which the thread or the like is advanced in a large number of generally helical turns toward the unsupported end of the reel, said thread-bearing periphery including an initial portion adjacent the supported end of the reel characterized by substantially uniform cross sections, an intermediate portion characterized by perimeters taken on cross sections of the reel which diminish in the direction of advance of the thread or the like, and a terminal portion adjacent the unsupported end of the reel characterized by substantially uniform cross sections, the perimeter of said terminal portion being less than the perimeter of said initial portion.

10. In combination with means providing relative movement of the thread-bearing surfaces thereof, a unitary, self-threading reel of cantilever construction which is made up of a plurality of interdigitating cage members, which is supported from one end thereof in such manner that the other end is not only unsupported but substantially unobstructed, and which presents lengthwise of the reel a thread-bearing periphery of substantially circular cross section along which the thread or the like is advanced in a large number of generally helical turns toward the unsupported end of the reel, said thread-bearing periphery comprising two spaced, generally cylindrical portions of different diameters and, intermediate said cylindrical portions, a portion of frusto-conical form.

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