

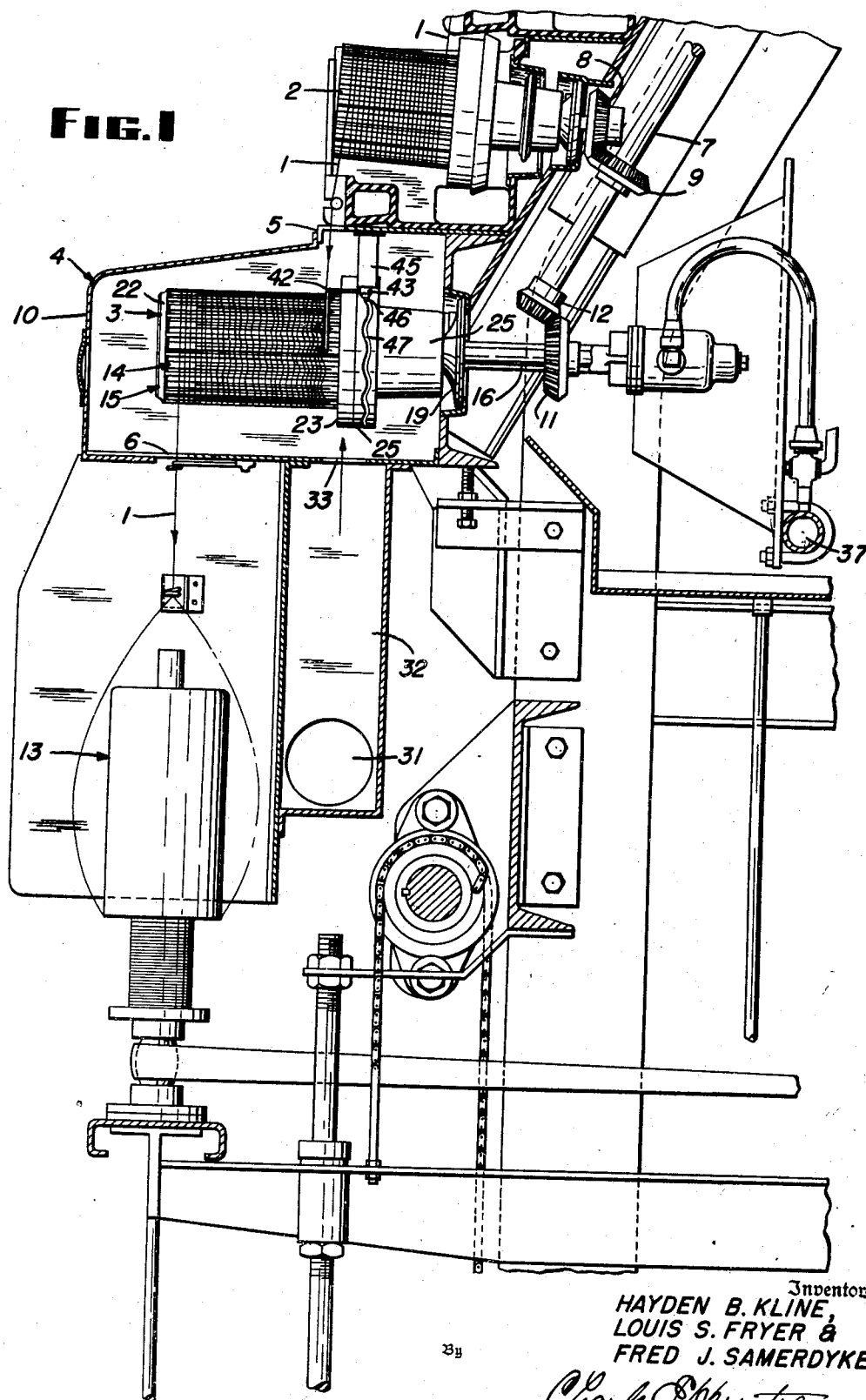
Dec. 7, 1943.

H. B. KLINE ET AL
METHOD OF AND APPARATUS FOR CONTROLLING THE
SHRINKAGE OF THREAD OR THE LIKE
Filed May 2, 1941

2,336,019

3 Sheets-Sheet 1

FIG. 1



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FIG. 2

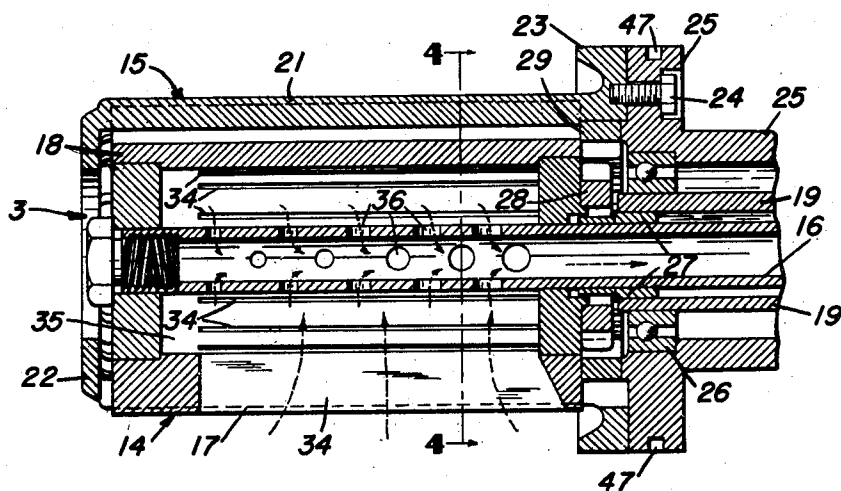
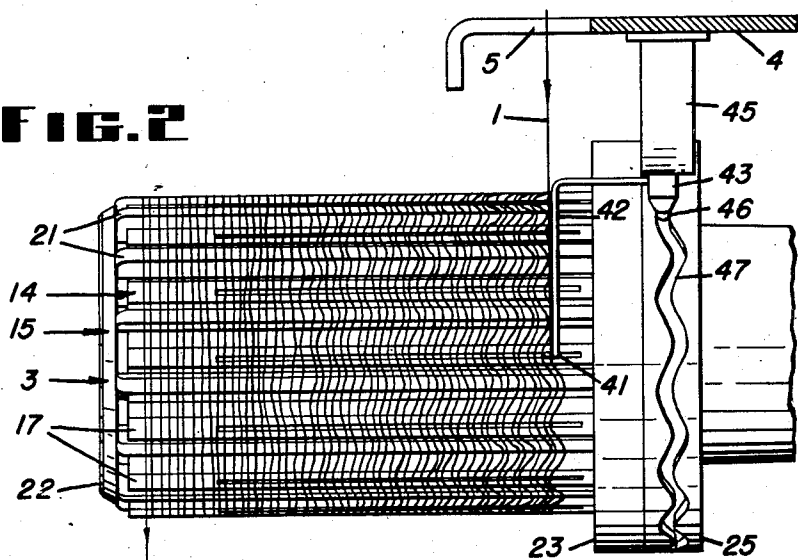


FIG. 3

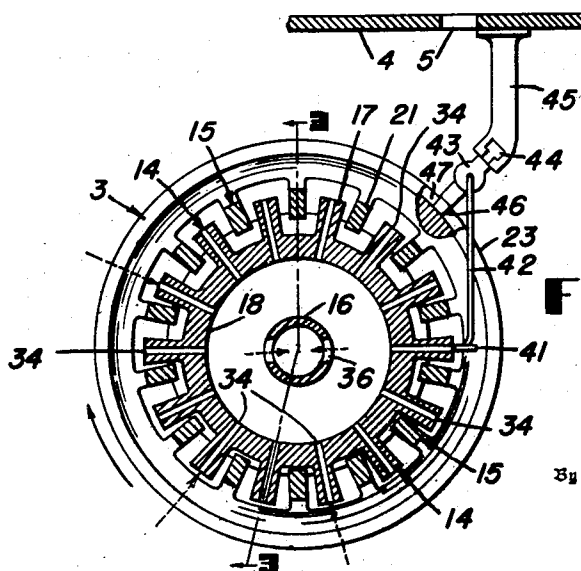


FIG. 4

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FIG. 5

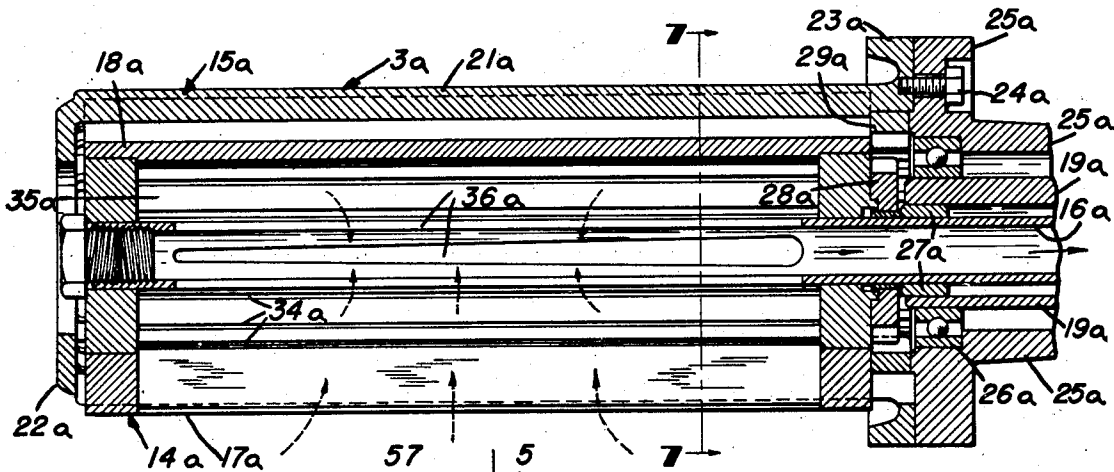
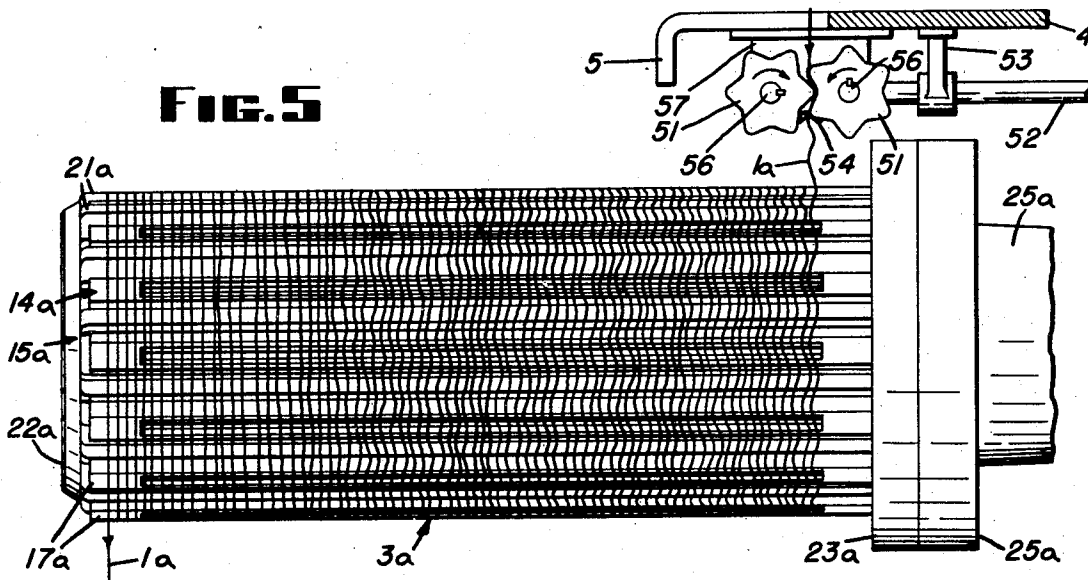


FIG. 6

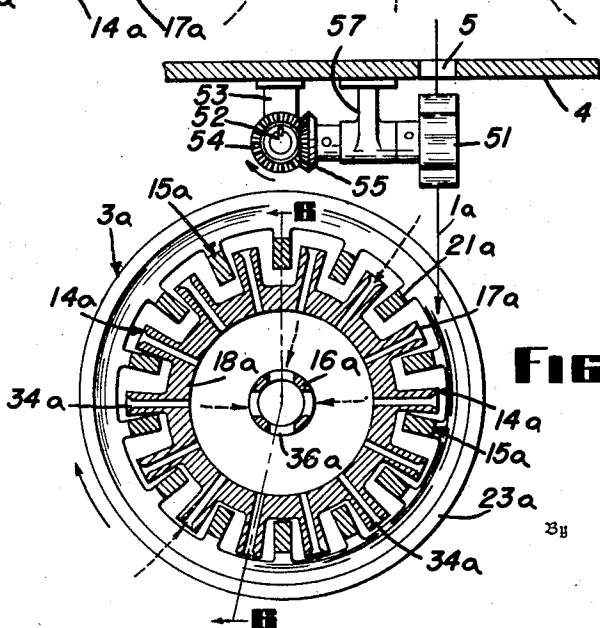


FIG. 7

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2,336,019

METHOD OF AND APPARATUS FOR CONTROLLING THE SHRINKAGE OF THREAD OR THE LIKE

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Application May 2, 1941, Serial No. 391,536

9 Claims. (Cl. 34—23)

This invention relates to methods of and apparatus for controlling the shrinkage of filaments, bands, ribbons, thread or the like, hereinafter referred to as "thread."

The shrinkage capacity of thread is dependent upon the conditions under which the thread is produced, processed and finished. Because of the nature of the methods employed in their manufacture, many types of thread are characterized by a comparatively high shrinkage capacity when dried for the first time, usually because such drying takes place under conditions which restrain shrinkage. It is known that when free shrinkage of the thread is restrained during the first drying operation, there develops in the dry thread an undesirably high "residual shrinkage capacity."

The term "residual shrinkage capacity" is used herein to indicate the amount by which a thread once dried under conditions which restrain shrinkage will shrink when rewet and redried under conditions permitting unrestrained shrinkage.

For the purpose of illustrating the present invention, the invention will be described hereinafter as employed in the drying of regenerated cellulose artificial silk thread; e. g., multiple filament viscose artificial silk thread. Preferably, such thread is dried under conditions of substantially unrestrained shrinkage, thereby reducing the residual shrinkage capacity of the thread. The thread produced according to the teachings of the invention will be found to be characterized by a low but uniform residual shrinkage capacity, as a result of which fact it can be used commercially for practically all textile purposes.

Heretofore it has been possible to dry thread under conditions providing partially restrained shrinkage by advancing the thread over the periphery of a thread-advancing reel in a manner such that the turns of thread decrease in diameter as the thread progresses from the thread-receiving and to the thread-discharge end of the reel. While producing a uniform thread, this procedure does not allow the thread to be dried without some restraint. Moreover, the restraint against shrinkage tends to occur in the critical zone in which the drying operation is characterized by a relatively rapid shrinkage rate.

The present invention provides an apparatus for controlling the shrinkage of thread which comprises a thread-advancing thread store device characterized by at least two elements which are mounted for rotation about axes offset and inclined with respect to each other and which

cooperate to advance thread therealong in a plurality of generally helical turns; the apparatus includes means for laying the thread on the periphery of the device in undulate form, and means for drying the thread as it is advanced along the thread-advancing thread store device.

In practicing the method of controlling shrinkage of thread in accordance with the invention, the thread is given a temporary undulate form, wound upon the periphery of a thread-advancing thread store device, advanced along the periphery of the device in a plurality of generally helical turns each of which is characterized by a plurality of undulations, and subjected to a medium which induces shrinkage, thereby eliminating the undulations from the thread.

For the purposes of the present invention, thread-advancing reels are particularly suitable; however, spaced rollers adapted to advance thread in helical form may be employed, if desired. It is possible to store relatively long lengths of thread on such reels to accomplish complete drying of the thread while the thread is continuously but temporarily stored in substantially helical turns. The thread-advancing function in the reels of the present invention is the same as in reels heretofore employed, but the reels are especially designed for the purpose and the mode of operation of the reels is somewhat different.

Apparatus in which the invention is embodied is illustrated in the drawings, wherein Figure 1 is an elevation, with parts in section, of thread processing apparatus including means by which multiple filament viscose thread may be dried for the first time under conditions permitting substantially unrestrained shrinkage. Figure 2 illustrates on an enlarged scale a side elevation of a portion of the apparatus shown in Figure 1. Figure 3 is a sectional elevation of the apparatus shown in Figures 2 and 4, the section being taken along line 3—3 of Figure 4. The cross section of the apparatus illustrated in Figure 4 is taken through line 4—4 of Figure 3.

Figure 5 illustrates, on the same scale as Figures 2 to 4, inclusive, a side elevation of apparatus constituting an alternative embodiment of the invention. Figure 6 is a sectional elevation of the apparatus shown in Figure 5, the section being taken along line 6—6 of Figure 7. The view shown in Figure 7 is a cross section of the same apparatus taken through line 7—7 of Figure 6. Figures 5, 6 and 7 correspond to Figures 2, 3 and 4, respectively, but have to do with a device in-

tended for use under somewhat different conditions.

In the apparatus illustrated in Figure 1, thread 1 proceeds from a suitable source; e. g., forming means, a spinning pot, a spool, a skein or the like, through one or more intermediate liquid processing stages to thread-advancing reel 2. On the latter, the thread is continuously but temporarily stored in closely spaced, substantially helical turns which are continuously advanced from the thread-receiving end to the thread-discharge end of the reel. Inasmuch as the thread reaching reel 2 is still wet with processing liquids from the intermediate processing stages, the excess liquid is allowed to drip therefrom as the thread advances across the periphery of the reel, thus appreciably reducing the moisture content of the thread.

From the thread-discharge end of reel 2 the thread passes to the thread-receiving end of reel 3, which is adapted to dry the thread under conditions permitting substantially unrestrained shrinkage to take place. Reel 3 is surrounded by an enclosure 4 to maintain the drying conditions as nearly constant as possible. In the top of the enclosure is a slot 5 through which thread 1 passes from reel 2 to reel 3. In the bottom of the enclosure, slot 6 allows for passage of the thread from the thread-discharge end of reel 3 to a cap twister 13 disposed outside the enclosure. A hinged door 10 on enclosure 4 provides access to the interior of the enclosure for threading up the apparatus, for inspection, repair, etc.

Reels 2 and 3 are driven by means of an inclined drive shaft 7 from a suitable power source (not shown). Reel 2 is driven by means of a bevel gear 8 from another bevel gear 9 mounted on inclined drive shaft 7. Reel 3 is driven by means of a bevel gear 11 from bevel gear 12 also mounted on inclined drive shaft 7. Although reels 2 and 3 are of the same diameter, reel 3 for reasons hereinafter explained is rotated at a peripheral speed slightly less than that of reel 2. This may be done in any suitable way, preferably by employing gears having the desired gear ratios.

The reels 2 and 3 are broadly of the type shown, described and claimed in Knebusch et al. Patent 2,225,642: their structural features differ somewhat, but their thread-advancing functions are the same.

As shown in Figures 2 to 4, inclusive, reel 3 is made up of a first reel member 14 and a second reel member 15, which, although rotating about mutually displaced axes, occupy substantially the same space. Reel member 14 is termed the concentric member inasmuch as it is rigidly mounted on a hollow shaft 16 for rotation about the axis of the shaft. Reel member 15 which is substantially circular in cross section embodies a series of longitudinally extending bar members 17 which are formed integrally with and project radially from cylindrical body portion 18 of the reel member.

Reel member 15, which is mounted on a stationary supporting member 19 for rotation about an axis offset from and inclined to that of reel member 14, is termed the eccentric member. Like reel member 14, it is of substantially circular cross section, its periphery being made up of longitudinally extending bar members 21 which are alternately disposed with respect to bar members 17 of reel member 14. Bar members 21 are supported at the thread-receiving end of the reel

by a collar 23; at the thread-discharge end of the reel, by an annular reinforcing ring 22.

Bolts 24 hold collar 23 against a flanged hub 25 which is carried in offset and inclined relation to concentric member 14 by means of one or more anti-friction bearings 26 mounted upon a stationary supporting member 19. Hollow shaft 16 rotates in stationary supporting member 19; accordingly, bearings 27 are provided to support the shaft. A spur gear 28 is mounted on one end of concentric member 14 for the purpose of driving eccentric member 15 indirectly from concentric member 14; i. e., through an annular gear 29 which meshes with spur gear 28. During rotation of the reel as a whole, the bar members of reel members 14 and 15 are maintained out of contact with each other by means of gears 28 and 29.

As indicated in Figure 1, heated air or other suitable fluid adapted to remove moisture from the thread is drawn from supply duct 31, through conduit 32, through aperture 33, and into reel enclosure 4. The fluid is drawn thence into a chamber 35 in body portion 18 of reel 3, passing into such chamber through longitudinally extending slots 34 in bar members 17. From chamber 35 the fluid is exhausted through ports 36 in hollow shaft 16, the path of the fluid being indicated by the arrows in Figures 3 and 4. For the purpose of removing the heating fluid from the reel, hollow shaft 16 communicates with a conduit 37 which in turn communicates with suitable exhaust and recirculating means (not shown).

The suction produced as above described tends to hold the thread turns on the reel, a feature which is employed to advantage in the manner more fully described hereinafter.

As already stated, the apparatus of the invention is designed to facilitate the winding of the thread on the reel in undulate form, thus permitting the thread to dry under conditions which do not substantially restrain shrinkage of the thread. Viscose thread usually tends to shrink by a total value in the neighborhood of 6%; consequently, for complete shrinkage the thread must be supplied to reel 3 at a linear speed approximately 6% greater than the linear speed of the thread leaving reel 3. This difference is provided for by imparting an undulate form to the thread, eliminating the difference in length by shrinkage of the thread between the points at which it starts upon and leaves the reel.

The desired undulate form may be imparted to the thread in many different ways; for example, compressed air, electrical vibrating apparatus or mechanical reciprocating means may be employed. Where mechanical reciprocating means are employed, it is possible to use a guide which reciprocates with respect to the reel or to reciprocate the reel with respect to the guide. In still another form, crimping means acting on the thread itself may be employed to introduce undulations into the thread.

Preferably, the undulations are imparted to the thread by the apparatus shown in Figures 2 and 4, in which, as reel 3 rotates, the point at which thread 1 is laid on the reel is moved to and fro in such manner that the length of thread stored in the first helical turn is approximately 6% greater than the circumference of the reel. Thread 1 passes through guide eye 41 mounted on an arm 42 rigidly mounted in a carrier block 43 which is reciprocated in a channel 44 formed in bracket 45. The reciprocation is effected

through a lug 46 formed integrally with block 43, which lug rides in undulate cam groove 47 in the periphery of flange portion of hub 25. The undulate turns so formed are held against the bar members of the reel by the suction created as hereinabove described.

The amplitude of the undulations in cam groove 47 determines the amplitude of the undulations in the first turn of thread on reel 3. Preferably, the amplitude is such that gradual shrinkage of the thread during drying will contract the thread to an extent sufficient to remove all undulations from the thread by the time it passes from the reel. However, even if deeper or more numerous undulations are formed than are needed, no difficulty is encountered so long as the collecting apparatus; i. e., cap twister 13, functions to withdraw the dried thread from the reel 3 under tension.

The spacing between thread turns on reel 3 is determined to some extent by the character of the undulations: if the amplitude is greater than the pitch of the helix, undulations in successive turns should occur at coincidental points on the periphery of the reel so that adjacent turns will not tangle.

The apparatus illustrated in Figures 5 to 7, inclusive, constitutes an embodiment of the invention suitable for drying threads which consist of or are coated ("sized") with a mucilaginous substance. As shown in Figures 5 to 7, inclusive, thread 1a passes between corrugated rollers 51 so that a temporary crimp is imparted to the thread. At the same time reel 3a rotates, but at a peripheral speed somewhat less than the linear speed of the thread prior to crimping. The difference in speed is compensated for by undulations introduced into the thread by the crimping operation.

In this apparatus, crimping rollers 51 are rotated by means of a shaft 52 connected to and driven from inclined shaft 7. Shaft 52, which is shown as supported by a bracket 53, carries at the end thereof a double-faced bevel gear 54. Gear 54 meshes with two like gears 55 connected through two like shafts 56 mounted in a common bracket 57 with the crimping rollers 51. In this manner, crimping rollers 51 are maintained out of contact, yet are driven at a speed bearing the desired relation to the speeds of reels 2 and 3.

Inasmuch as relatively firm undulations can be formed in mucilaginous thread, the thread turns may, if desired, be relatively tightly wound about reel 3a; also, instead of drying the thread by drawing a small volume of warm fluid through housing 4, a larger volume of fluid at a lower temperature; e. g., room temperature, may be used. Shown as having a long thread-bearing periphery, reel 3a differs from reel 3 principally in that it is designed to provide for the circulation of a greater quantity of drying medium.

Hollow shaft 16a of reel 3a is adapted to conduct the drying fluid; e. g., air at ordinary room temperatures, from the interior of reel member 14a to an exhaust conduit. As indicated by the arrows, the fluid passes through slots 34a in bar members 17a into a chamber 35a formed in body 18a of concentric member 14a. The fluid is exhausted from chamber 35a through slots 36a in hollow shaft 16a. Preferably, slots 34a are flared near the periphery of the reel to permit the suction developed in the reel to act over a greater portion of the thread-bearing periphery of the reel.

Except in respect of such differences as have

already been pointed out, the reel of Figures 5, 6 and 7 functions in much the same way as that of Figures 2, 3 and 4. In both cases, undulations are introduced into the thread, such undulations being temporarily retained with the aid of suction developed within the reel. In each case, the first stages of the operation are characterized by the removal of surface moisture without substantial shrinkage; accordingly, undulations are present in the thread over a considerable part of the thread-bearing periphery of the reel. Later, upon removal of internal moisture, substantial shrinkage takes place with the result that toward the discharge end of the reel the thread is free of undulations.

Either of the two hereinabove described embodiments of the invention may be employed to produce thread of low but uniform residual shrinkage capacity. Although the methods and apparatus described herein are particularly adapted to the production of viscose artificial silk thread, other types of thread including threads of natural as well as of synthetic origin may be treated in accordance with the invention. The structural features of the apparatus may be modified as needed to conform to the use to which the apparatus is to be put.

Reels 3 and 3a, for instance, are preferably made of aluminum or other metal of high heat conductivity, but may, if desired, be made of other materials. Corrugated rollers 51 may be made of metal, hard rubber, plastics or other suitable substances. If desired, the reels may be so designed as to be capable of exhausting air through bar members of both the concentric and eccentric reel members, in which case the bar members of the eccentric reel member may be hollow but provided with suitable openings on the thread-bearing portion thereof.

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. Apparatus for controlling shrinkage of thread comprising a thread-advancing thread store device characterized by at least two elements which are mounted for rotation about axes offset and inclined with respect to each other and cooperate to advance thread therealong in a plurality of generally helical turns; means for supplying thread to said device at a linear speed greater than the peripheral speed of the device; means for laying the thread on the periphery of said device in undulate form; and means for drying the thread as it is advanced along said device.

2. Apparatus for controlling shrinkage of thread comprising a thread-advancing thread store device characterized by at least two elements which are mounted for rotation about axes offset and inclined with respect to each other and cooperate to advance thread therealong in a plurality of generally helical turns; guide means through which the thread passes at a linear speed greater than the peripheral speed of the device; means for reciprocating said guide means axially of the device to impart an undulate form to the helical turns of thread wound on the periphery of the device; and means for drying the thread as it is advanced along said device.

3. Apparatus for controlling shrinkage of thread comprising intermeshing elements between which the thread passes for forming un-

undulations in said thread; a thread-advancing thread store device for receiving the thread after it has passed between said intermeshing elements, said thread-advancing thread store device being characterized by at least two elements which are mounted for rotation about axes offset and inclined with respect to each other and cooperate to advance thread therealong in a plurality of generally helical turns of undulate form; and means for drying the thread as it is advanced along said device.

4. Apparatus for controlling shrinkage of thread comprising a hollow thread-advancing thread store device characterized by a plurality of interdigitating cage members which cooperate to advance thread therealong in a plurality of generally helical turns; passages in said device through which fluid may be drawn from the exterior to the interior thereof; means for drawing fluid through said passages; means for laying the thread on the periphery of said device in undulate form, the turns of thread wound on the periphery of the device being held in contact with said periphery by the pressure of fluid drawn thereinto; and means for drying the thread as it is advanced along said device.

5. Apparatus for controlling shrinkage of thread comprising a hollow thread-advancing thread store device characterized by a plurality of interdigitating cage members which cooperate to advance thread therealong in a plurality of generally helical turns; means for laying thread on the periphery of said device in undulate form; an enclosure surrounding said device; means for supplying a drying fluid to said enclosure; passages in said device through which said drying fluid may pass from said enclosure to the interior of said device; and means for withdrawing the fluid from the interior of said device.

6. Apparatus for controlling shrinkage of thread comprising a thread-advancing thread store device characterized by at least two elements which are mounted for rotation about axes offset and inclined with respect to each other and cooperate to advance thread therealong in a plurality of generally helical turns; means for supplying thread having a high resid-

ual shrinkage capacity to said device at a linear speed greater than the peripheral speed of said device; means for laying said thread on the periphery of the device in undulate form; and means for subjecting the thread to a medium which induces shrinkage thereof as it is advanced along said device.

7. The method of controlling shrinkage of thread comprising the steps of imparting to the thread a temporary undulate form; winding the thread upon the periphery of a thread-advancing thread store device; advancing the thread along the periphery of said device in a plurality of generally helical turns each of which is characterized by a plurality of undulations; and subjecting the thread to a medium which induces shrinkage thereby eliminating the undulations from the thread.

8. The method of controlling shrinkage of thread comprising the steps of imparting to the thread an undulate form; winding the thread upon the periphery of a thread-advancing thread store device; advancing the thread along the periphery of said device in a plurality of generally helical turns of substantially equal diameter, each of said turns being characterized by a plurality of undulations; and subjecting the thread to a medium which induces shrinkage thereby eliminating the undulations from the thread without changing the diameter of the helix.

9. The method of controlling shrinkage of thread comprising the steps of imparting a plurality of temporary undulations to a wet thread; winding the thread upon the periphery of a thread-advancing thread store device; advancing the thread along the periphery of said device in a plurality of generally helical turns each of which is characterized by a plurality of undulations; and subjecting the wet thread to a drying medium whereby the shrinkage of the thread induced by the drying medium eliminates the undulations from the thread as it is advanced along the periphery of the thread-advancing thread store device.

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