Sept. 12, 1939. L. J. JORDAN ET AL 2,173,002

DRYING REEL

Filed Oct. 4, 1937 2 Sheets-Sheet 1

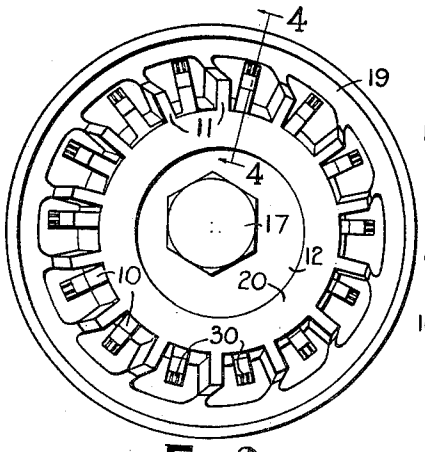



FIG. 2

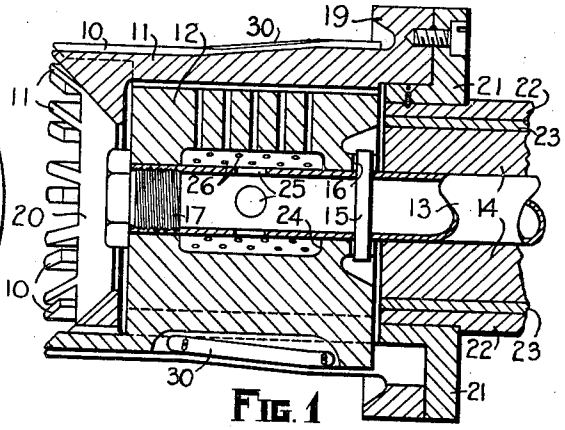



FIG. 1

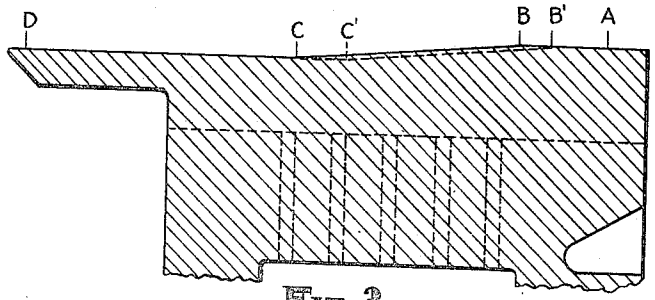



FIG. 3

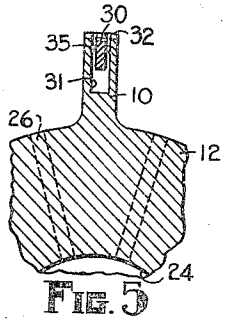



FIG. 5

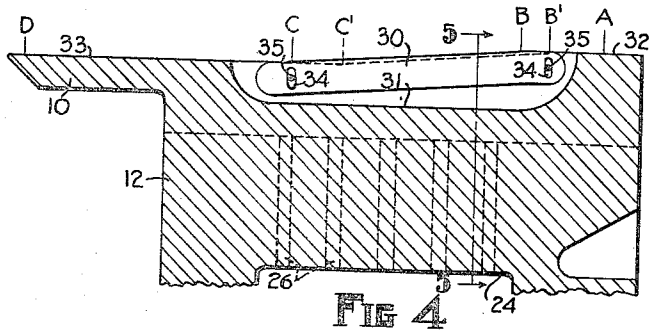



FIG. 4

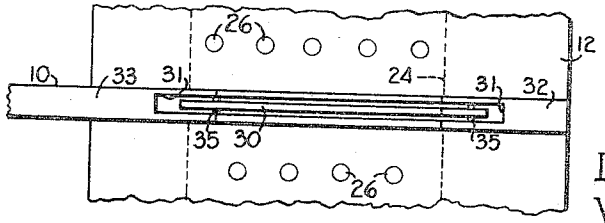



FIG. 6a.

Inventor

LAVERN J. JORDAN AND

WALTER F. KNEBUSCH

Charles O'Herrstrom Attorney

Sept. 12, 1939. L. J. JORDAN ET AL 2,173,002

DRYING REEL

Filed Oct. 4, 1937 2 Sheets-Sheet 2

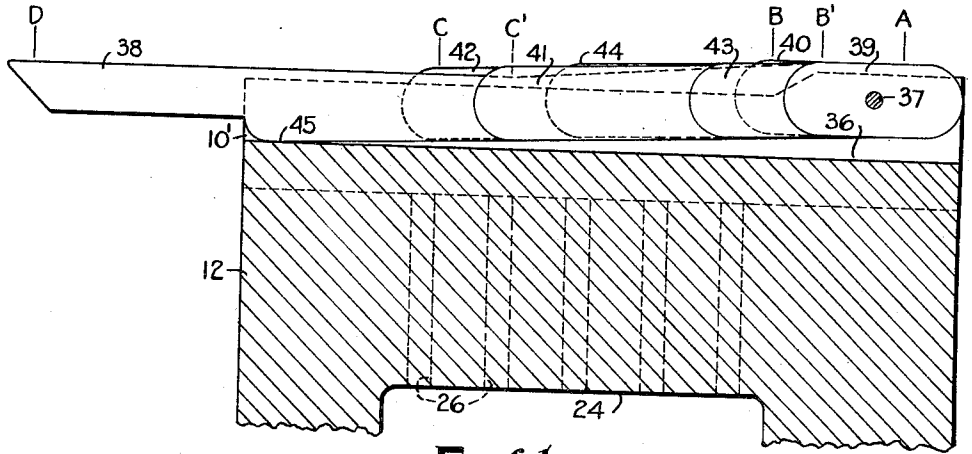



FIG. 6.

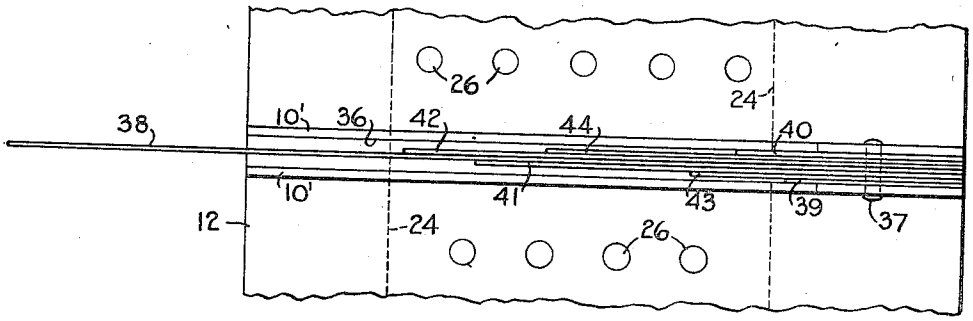



FIG. 7

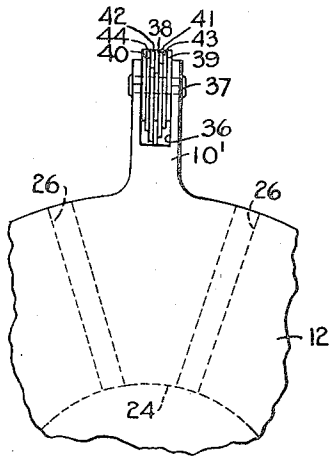



FIG. 8

Inventor

LAVERN J. JORDAN AND

WALTER F. KNEBUSCH

Charles E. Herrstrom Attorney

Patented Sept. 12, 1939

2,173,002

# UNITED STATES PATENT OFFICE

2,173,002

## DRYING REEL

Lavern J. Jordan, Fairview Village, and Walter F. Knebusch, Rocky River, Ohio, assignors to Industrial Rayon Corporation, Cleveland, Ohio, a corporation of Delaware

Application October 4, 1937, Serial No. 167,181

9 Claims. (Cl. 242—53)

This invention relates to a thread-storage, thread-advancing device, particularly of the nature of a self-threading reel, permitting changes to occur in the length of thread being handled.

In the processing of artificial silk thread, changes take place in the length of the thread. If the thread is to be of high quality, it is usually necessary that little, if any, resistance be offered to such changes. In processes utilizing thread-storage, thread-advancing devices, difficulty is experienced, in consequence of the virtual impossibility of maintaining strictly uniform processing conditions, in providing a device of this character that will freely accommodate itself to these changes. As an example of material which presents this problem and which may be handled by the device of the invention, mention may be made of artificial silk thread made by the viscose process.

In the course of the drying of viscose artificial silk thread, considerable shrinkage occurs. The rate of shrinkage depends upon the rate of removal of moisture from the thread, which rate is itself variable. In actual practice, furthermore, it is impossible to maintain absolutely uniform drying conditions, with the result that the thread shrinks at varying rates. By employing a thread-storage, thread-advancing device of the kind contemplated by the invention, these varying rates of shrinkage will be accommodated, the thread being allowed to shrink without substantial restraint.

While for purposes of illustration the invention is here disclosed as employed in the drying of viscose artificial silk thread, the invention may be practiced not only in connection with the drying operation but with any other treatment in which it is desired to employ it. The thread may be either of natural or artificial origin; if the latter, it may be manufactured from casein, from cuprammonium cellulose solution, from cellulose acetate or the like. Moreover, the invention may be employed in connection with any thread-like material, such as filaments, tubes, tapes, bands and ribbons, all of which are intended to be comprehended by the term "thread" as herein used.

Several embodiments of the invention are disclosed in the accompanying drawings, in which Figure 1 is a vertical section through a thread-storage, thread-advancing reel embodying one form of the invention. Figure 2 is an elevation of the front end of the reel of Figure 1. Figure 3 is a diagrammatic representation of the variations in its contour necessary to enable a reel to conform to different shrinkage conditions in a thread. Figure 4 is a section on an enlarged scale on the line 4—4 of Figure 2. Figure 5 is a section on the line 5—5 of Figure 4. Figure 6*a* is a top plan view of the form of the invention illustrated in Figure 4. Figure 6*b* is a vertical section on an enlarged scale illustrating another form of the invention. Figure 7 is a plan corresponding to Figure 6*b*. Figure 8 is a view of the left-hand end of the device of Figure 6*b*

Referring first to Figures 1 and 2, the thread-storage, thread-advancing reel there illustrated comprises two sets of interdigitating bar members 10 and 11. The bar members 10 are carried upon the periphery and extend longitudinally of a cylindrical body 12 which is concentrically fixed to a hollow shaft 13 rotatably mounted in a bearing 14. To establish driving engagement between shaft 13 and body 12, a pin 15 carried by the shaft is disposed within slots 16 in body 12. To retain cylindrical body 12 upon shaft 13, a bolt 17 may be screw-threaded into the forward end of the shaft. Bolt 17, in addition to retaining cylindrical body 12 upon the shaft, serves as a closure member for the front end of the hollow shaft 13.

Bar members 11 are carried by an annular base member 19 at the rear ends of the bar members and an annular reinforcing member 20 at their forward ends. Annular member 19 is fixed to a ring 21 having secured within its central opening a bushing 22. Bushing 22 is rotatable upon a sleeve 23 which is carried upon the exterior of the supporting bearing 14 through which shaft 13 passes. The contact which exists between the two sets of bar members due to their interdigitating relation causes the bar members 11 to be driven from bar members 10.

The exterior of bearing 14 is eccentric with respect to the bore therethrough and due to this eccentricity the axis of rotation of the bar members 11 is offset laterally from the axis of rotation of the bar members 10. The axes of the inner and outer surfaces of sleeve 23 are at an angle with respect to each other and consequently the axis of rotation of the bar members 11 likewise is askew with respect to the axis of rotation of the bar members 10. The bar members 10 and supporting body 12 make up and may be termed the concentric reel member. The bar members 11 and supporting members 19 and 20 and affixed ring 21 may be termed the eccentric reel member. Due to this relation existing between the concentric and eccentric reel members, thread carried upon their exteriors will, upon rotation

of the reel, be advanced longitudinally thereof in a plurality of generally helical turns.

The reel may be said to be of cantilever form inasmuch as it is supported at one end only, bearing 14 at corresponding ends of both reel members providing the sole support for the reel. The end of the reel opposite bearing 14, being independent of any support, is freely accessible to an operator. The reel should be rotated in such a direction that the thread will be advanced thereover from the supported to the unsupported end, in which case the thread may easily be removed from the unsupported end due to the absence of obstructions. Since the bar members of the two sets 10 and 11 lie in interdigitating relation and the axis of the one set lies within the periphery of the other set, the reel as a whole may be said to be unitary.

To dry the thread being advanced along the reel a heating medium such as hot air from any suitable source may be supplied through hollow shaft 13 to the interior of the reel. A chamber 24, formed centrally of the body 12, receives the heated air from shaft 13 through openings 25 in the shaft and distributes it through radially extending ports 26 to the periphery of the reel. Bar members 11 are heated to approximately the same temperature as bar members 10. The thread is dried not only by contact with the exterior of the heated reel, but by the heated air issuing from ports 26.

The thread to be dried on the reel may be supplied from any source. For example, the thread may come from a package into which it was collected while wet. Such a package may be that formed on the usual collecting spool or in the ordinary centrifugal spinning pot. However, the wet thread may, if desired, come from apparatus which is continuously processing the thread, in which event the drying reel here shown may follow the liquid processing stages of the apparatus. After being dried, the thread may be collected by any suitable winding device or it may be twisted and then collected.

For the reasons and in the respects hereinafter explained, the reel of the invention is formed to allow substantially free shrinkage of the thread being dried thereon.

At the completion of the liquid processing steps, viscose artificial silk thread contains as much as 300% moisture by weight. Approximately half of this moisture is upon the exterior of the thread and must be removed before the remaining half of the moisture, which apparently is internal moisture, may be removed. The external moisture may be removed rapidly and during its removal the thread probably will undergo less than one-half of one per cent shrinkage. Removal of the internal moisture, however, requires a relatively long length of time, since this moisture must be removed largely by diffusion. In the course of the removal of the internal moisture, the thread, if allowed to shrink without restraint, may shrink as much as 6% of initial length of the thread. For various reasons, it is desirable that substantially free shrinkage be permitted to take place during removal of the internal moisture. Thread so dried commands a higher price, having a wide acceptance in the weaving and knitting industries. It gives rise to no difficulties arising out of excessive shrinkage on the tentering frames. It dyes uniformly, color variations from unit to unit along the thread being minimized.

It is desirable, however, that complete shrinkage of the thread be prevented by arresting a shrinkage of the thread when nearly complete shrinkage has occurred. By preventing complete shrinkage of the thread, it retains a slight residual capacity to shrink. In accordance with the invention, substantially unrestrained shrinkage of the thread is permitted during removal of nearly all of its internal moisture, but is arrested before complete shrinkage has occurred.

In the drying of thread upon a reel, moisture may be removed from different portions of the thread at different rates due to variations occurring from time to time in the temperature of the same portion of the reel. Also, the rates of removal of external and internal moisture may vary either together or independently of each other; i. e., the internal moisture and external moisture may be slowly removed, rapidly removed, or removed more rapidly in the case of one than in the case of the other. These different drying conditions require different formations of the thread-bearing surface of the reel if the thread is to be allowed to shrink without substantial restraint.

Figure 3 illustrates the different formations which a bar member should have along its length if it is to conform to variations imposed by the drying operation.

Thread delivered to the reel may make contact with the bar member at a point A adjacent the supported end of the reel. In advancing toward the unsupported end of the reel, the thread will, if external moisture is removed at the lowest rate to be expected, reach the point B on the bar member by the time all external moisture has been removed. The portion A—B over which the thread passes may be parallel with the axis about which the bar members turns, since the shrinkage which the thread undergoes in passing over this portion is only very slight. In travel of the thread beyond point B, internal moisture being assumed to be removed from the thread at the lowest rate to be expected, the thread reaches the point C by the time only the desired residual capacity to shrink remains in the thread. As shown, portion B—C is tapered to permit substantially unrestrained shrinkage of the thread to take place. From point C the thread is advanced without provision for shrinkage to a point D on the bar member from which point the thread is led off.

If, on the other hand, external moisture of the thread is removed at the most rapid rate to be expected, this may be fully accomplished by the time the thread has reached a corresponding point B', from which point the bar member should have a tapered configuration. If, starting at the point B', the internal moisture also is removed at the most rapid rate to be expected and if shrinkage of the thread is to be permitted until only the desired residual capacity to shrink remains in the thread, the point C' will have been reached somewhat sooner than point C in the example given in the preceding paragraph. The portion C'—C must in such case be a continuation of the portion C—D; i. e., having an approximately cylindrical surface. The net effect, therefore, of drying under the conditions stated is to require a change in the location of the tapered portion B—C, so that it assumes the dotted line position B'—C'.

In either case, the diameter of the portion C—D or C'—D preferably bears such relation to the diameter of portions A—B or A—B' that the

desired residual capacity to shrink is left in the thread.

The portion of the bar member upon which external moisture is removed from the thread may be of relatively short extent inasmuch as the external moisture may be rapidly removed from the thread. The portion of the bar member upon which internal moisture is removed from the thread will necessarily be of relatively long extent since considerably more time is required for removal of this moisture. The terminal portion of the bar member upon which the thread is set with the desired residual capacity to shrink may likewise be of relatively long extent to assure complete dryness or equilibrium moisture conditions in the thread.

If, therefore, both the external moisture and the internal moisture are removed slowly, the bar members of a reel which will correspond to this drying condition should have a contour corresponding to the solid line A—B—C—D appearing in Figure 3. If the external and internal moistures are both rapidly removed, bar members determined by the line A—B'—C'—D will be required. Variations in the relative rates of removal of external and internal moisture will call for a formation of the bar members falling between the limits of the solid line and the dotted line between points B' and C. In accordance with the present invention, means are provided to permit alterations to occur in the contour of the bar member in response to variations in the rate of removal of both the external moisture and the internal moisture.

In the several embodiments of the invention herein disclosed, the means permitting alterations to occur in the contour of the bar members are incorporated in only one of the two sets of bar members. It has been found that satisfactory results may be attained if these means are thus incorporated in one set only. It is preferable in such case that the bar members **10** embody the means of the invention since these bar members are supported by the rigid body **12** and alterations necessary to be made in the bar members do not result in undue weakness of bar members **10**. If desired, however, the bar members of both sets may be constructed as herein contemplated.

In the embodiment of the invention disclosed in Figures 4, 5 and 6*a*, the bar member **10** is provided with a slat **30** which may move to a position partly outside of recess **31** in which it is located, so as to support thread above the surface of the bar member **10**. The surface of bar member **10** has a thread-receiving portion **32** which is generally parallel with the axis of the reel member **12**. This portion extends to a point B' corresponding to the point B' in Figure 3. The terminal portion **33** of the thread-carrying surface of the bar may likewise be generally parallel with the axis of reel member **12** and may extend from a point C' to the end of the bar member. Point C' corresponds to point C' in Figure 3. Between points B' and C' in Figure 4 the surface of the bar member slopes to correspond to the sloping line B'C' in Figure 3.

Slat **30** is of sufficient length to extend between the points B' and C and recess **31** must be long enough to accommodate the slat. To retain the slat in recess **31**, the slat is provided at its ends with openings **34** through which pass pins **35** carried by the bar member **10**. Openings **34** preferably are elongated transversely of the slat **30** so that the slat may have a limited movement in a direction generally radially of the reel member **12**. These openings should permit the slat to move outward to a position in which its outermost surface forms a connecting line between the points B' and C and to an inner position in which its outer surface will be substantially flush with the surface of the bar member between points B' and C'. The upper surface of slat **31** should be shaped with a portion between points B' and B which will constitute a prolongation of surface **32** when the slat is in an outer position. From point B to point C the surface of the slat may be straight.

During rotation of the reel member **12** the slat **30** will tend to move outward due to centrifugal force. When thread is being dried upon a reel having bar members provided with slats **30**, the slats will move outward into contact with the thread to positions determined by the lengths of the turns of thread about the reel. For example, if the external moisture is being slowly removed and the thread reaches point B before marked shrinkage occurs, the end of each slat at point B of the bar members may move outward so as to continue the generally cylindrical shape of surface **32** of the reel member **12**. However, if the external moisture is rapidly removed so that marked shrinkage occurs at approximately point B' of the bar members, the ends of slats **30** adjacent that point will be forced inward to allow the shrinkage to occur.

If, after a slow removal of external moisture, the internal moisture of the thread is slowly removed, so that point C is reached by the time only the desired residual capacity to shrink remains in the thread, the end of slat **30** adjacent point C on surface **33** is reached. However, if external or internal moisture has been rapidly removed, the end of slat **31** may move inward under the influence of the shrinkage thread so that its surface crosses below surface **33** at some point between points C' and C. The limiting conditions will be that in which the external and internal moistures are so rapidly removed that the slat **30** will be forced entirely within the recess **31** so that the thread bears upon the entire surface A—B'—C'—D of the bar member.

In this manner the slat may assume any of a variety of positions depending upon the speeds with which the external and interior moistures are being removed. The outward force which is exerted by slat **30** against the thread is so slight that it does not undesirably tension the thread with the result that substantially unrestrained shrinkage of the thread occurs in passing over the slat. The thread, upon reaching surface **33**, has the desired residual capacity to shrink irrespective of the speeds with which the external and internal moistures have been removed. Upon passing over surface **33** this residual capacity to shrink becomes set in the thread and either the thread will be thoroughly dried or the moisture content will reach equilibrium conditions at all portions along its length.

In the embodiment of the invention disclosed in Figures 6*b*, 7 and 8, the entire thread-bearing surface is provided by a plurality of slats **38** to **44**, inclusive, of different lengths arranged side by side and lying in a groove **36** extending throughout the length of the bar member **10'**. The ends of the slats are flush with each other near the thread-receiving portion of the bar member and through these ends is passed a pivot pin **37** carried by the bar member. Preferably, the central slat is the longest and should be as

long as the usual bar member so that thread will be carried out to the point D, corresponding to point D in Figure 3. Since slat **38** will carry the thread to point D from which it is withdrawn from the reel, the bar member **10'** may be only as long as the reel member **12**. The upper surface of bar member **10'** should lie well below the surface of slat **38** when this slat is in its innermost position.

Successive slats alternating on opposite sides of this longest slat **38** may be progressively shorter, as is best shown in Figure 6*b*, so that the shortest two slats **39** and **40** are outermost. Slat **39**, which is the shortest, should preferably be of such a length that its uppermost surface ends at a point B' correspond to point B' appearing in Figure 3. Slat **40** should have its upper surface terminating at point B which corresponds to point B in Figure 3. Slats **41** and **42** which are next to and on opposite sides of slat **38** should have their upper surfaces extending respectively to points C' and C corresponding to points C' and C in Figure 3. As here shown, there is a slat **43** of intermediate length between slats **39** and **41**, and a slat **44** of intermediate length between slats **40** and **42**. Slats **43** and **44** may, however, be omitted, or if desired, there may be two or more different length slats in the spaces they respectively occupy.

Since the several slats are side by side and the outermost slats **39** and **40** lie against the inner walls of groove **36**, the inner slats receive lateral support from the next adjacent outer slat. In this manner lateral deflection of the slats is minimized without interfering with the radial movements of the slats. The longest slat **38** preferably should have a portion **45** which will strike the bottom of groove **36** to limit inward movement of this slat and when the slat is at its innermost position, its upper surface between points C' and D should be approximately parallel with the axis of rotation of reel member **12**. The radial dimensions of cylindrical surface C'—D should bear the necessary relation to the approximate radial dimension to surface A—B' on slat **39** to give rise to the desired residual capacity to shrink.

Upon rotation of reel member **12**, the several slats are urged outward by centrifugal force. They are, however, drawn inward to the extent necessary to assume positions determined by the shrinkage in the turns of the thread being advanced. If external moisture is slowly removed, slat **40** may move outward to a position such that its upper surface carries forward in a substantially straight line the upper surface of slat **39**, so that point B will be reached. However, if external moisture is rapidly removed so that marked shrinkage occurs at B', slat **40** may be urged inward, so that its upper surface is inclined inward toward the reel member and shrinkage starting at point B' will be permitted.

In the event that both external and internal moistures are slowly removed, the thread will be carried by slat **52** up to point C. If, however, either external or internal moisture is rapidly removed, slat **42**, as well as the remaining shorter slats, is urged inward so that the thread contacts with the upper surface of slat **38** between points C' and C. The limiting condition for rapid drying is that in which the thread reaches the upper surface of slat **38** at point C'.

Inasmuch as the outward force exerted by the slats against the thread is negligible, the thread is allowed to shrink substantially without restraint. Drying of the thread is assisted by the contact which necessarily exists throughout the length of the reel between the thread and the several slats. Upon passing over the projecting portion of the longest slat **38**, the thread is set with the desired residual capacity to shrink and this is uniform throughout the thread, irrespective of the rapidity with which either external or internal moisture has been removed.

The several embodiments of the invention disclosed have in common the provision of slats which are substantially rigid but which are mounted upon the reel in such manner as to be individually movable to different angular positions determined by the rate of shrinkage of thread upon the reel. Modifications may be made in the constructions herein disclosed without detriment to the function contemplated by the invention and such modifications will occur to those skilled in the art. 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. A thread-storage, thread-advancing device comprising a plurality of thread-advancing members of substantially circular cross section which cooperate to advance the thread in a plurality of spaced, generally helical turns, at least one of which is rotatably mounted; a plurality of inflexible thread-supporting elements disposed about the periphery of said rotatably mounted thread-advancing member; and means for mounting said inflexible thread-supporting elements for individual movement in response to changes in the lengths of the thread turns wound about said thread-advancing members.

2. Apparatus of the character described in claim 1 in which said inflexible thread-supporting elements extend lengthwise of said rotatably mounted thread-advancing member.

3. Apparatus of the character described in claim 1 in which said inflexible thread-supporting elements are pivotally mounted.

4. Apparatus of the character described in claim 1 in which the means for mounting said inflexible thread-supporting elements permits substantially radial movement of said thread-supporting elements.

5. A thread-storage, thread-advancing device comprising a plurality of thread-advancing members of substantially circular cross section which cooperate to advance the thread in a plurality of spaced, generally helical turns at least one of which is rotatably mounted, said rotatably mounted thread-advancing member being of different diameters at its opposite ends; a plurality of inflexible thread-supporting elements disposed about the periphery of said rotatably mounted thread-advancing member providing thread-bearing surfaces diminishing in diameter from one end to the other of said rotatably mounted thread-advancing member; and mounting means for said thread-supporting elements permitting the thread-bearing surfaces of said thread-supporting elements to move substantially radially of said rotatably mounted thread-advancing member to vary its contour in response to changes in the length of the thread turns wound about said thread-advancing members.

6. A thread-storage, thread-advancing device comprising a plurality of thread-advancing members which cooperate to advance the thread in a plurality of spaced, generally helical turns, at least one of said thread-advancing members being

rotatably mounted; a plurality of thread-supporting surfaces each comprising several overlapping inflexible elements extending lengthwise of said rotatably mounted thread-advancing member; and supporting means for said inflexible elements permitting movement thereof substantially radially of said thread-advancing member in response to changes in the length of the thread turns wound about said thread-advancing members.

7. A rotatable thread-storage, thread-advancing reel comprising two interdigitating reel members made up of longitudinally extending bar members; means for causing the bar members of said reel members to cooperate during rotation thereof to advance the thread lengthwise thereof in a plurality of generally helical turns; inflexible thread-supporting elements comprising at least a portion of the thread-bearing surfaces of the bar members of one of said reel members; and means for mounting said inflexible thread-supporting elements on said reel member for individual movement in response to changes in the length of the thread turns wound about said reel members.

8. Apparatus of the character described in claim 7 in which said inflexible thread-supporting elements are pivotally mounted.

9. A rotatable thread-storage, thread-advancing reel comprising two interdigitating reel members made up of longitudinally extending bar members; means for causing the bar members of said reel members to cooperate during rotation thereof to advance the thread lengthwise thereof in a plurality of generally helical turns; a plurality of overlapping inflexible thread-supporting elements extending over at least a portion of the length of each of the bar members of one of said reel members; and mounting means for said thread-supporting elements permitting individual movement of said thread-supporting elements substantially radially of said reel member to vary the contour thereof to correspond to changes in the length of the thread turns wound about said reel members.

LAVERN J. JORDAN.
WALTER F. KNEBUSCH.