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2,204,603

APPARATUS FOR DRYING THREAD OR THE LIKE

Filed Sept. 7, 1937

2 Sheets-Sheet 1

FIG. 1

FIG. 2

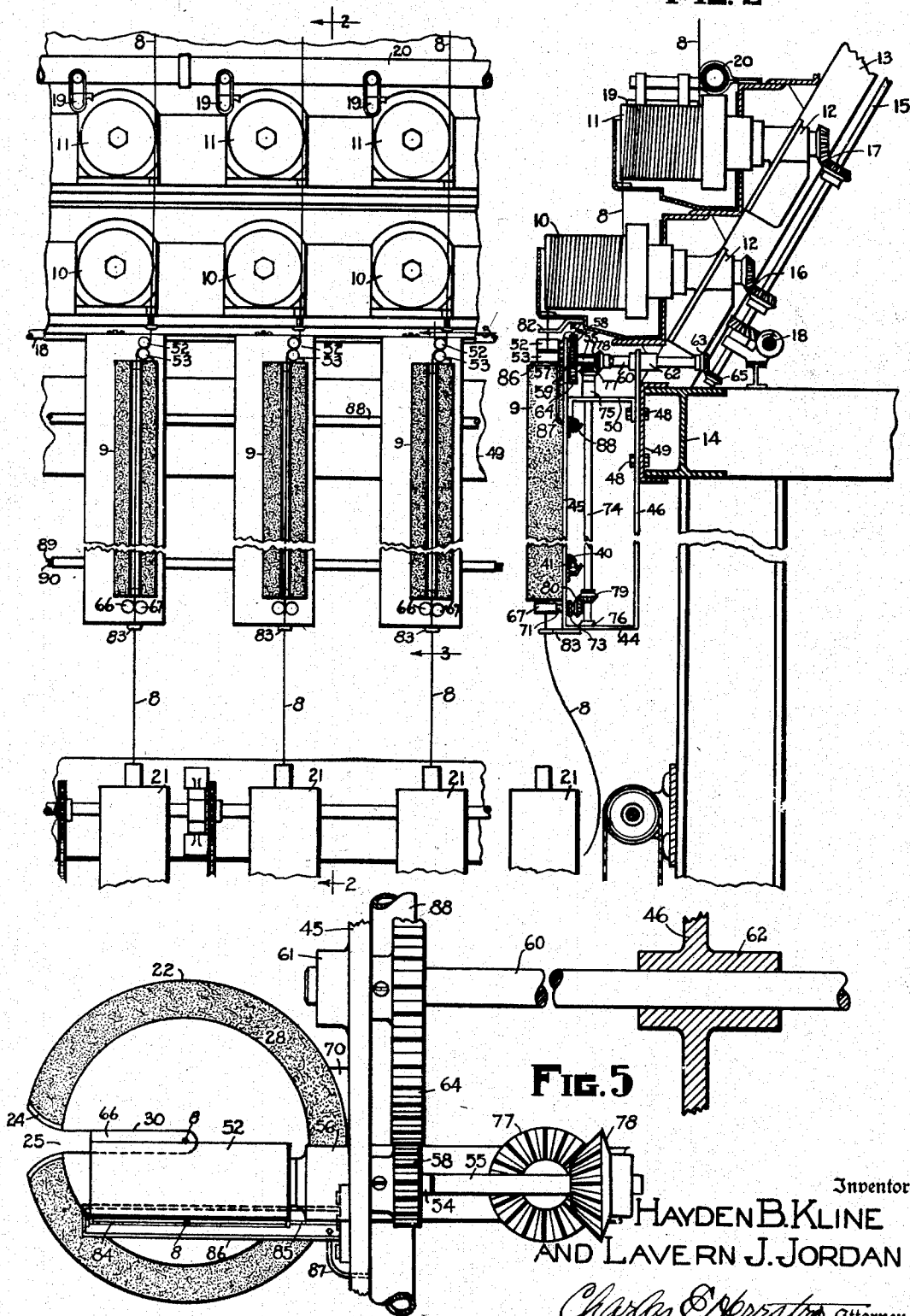


FIG. 5

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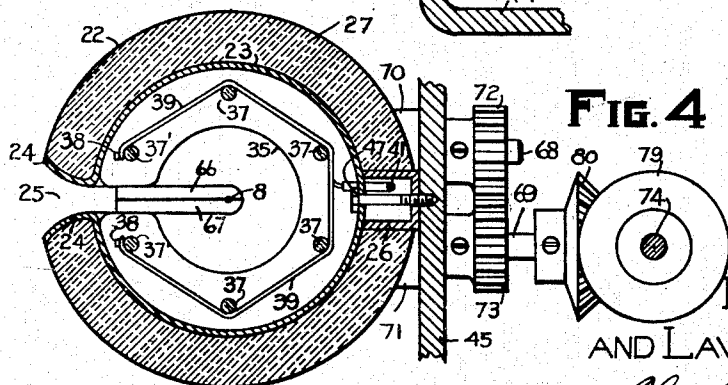
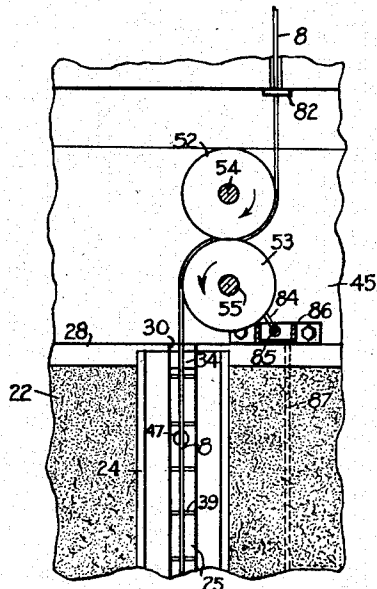
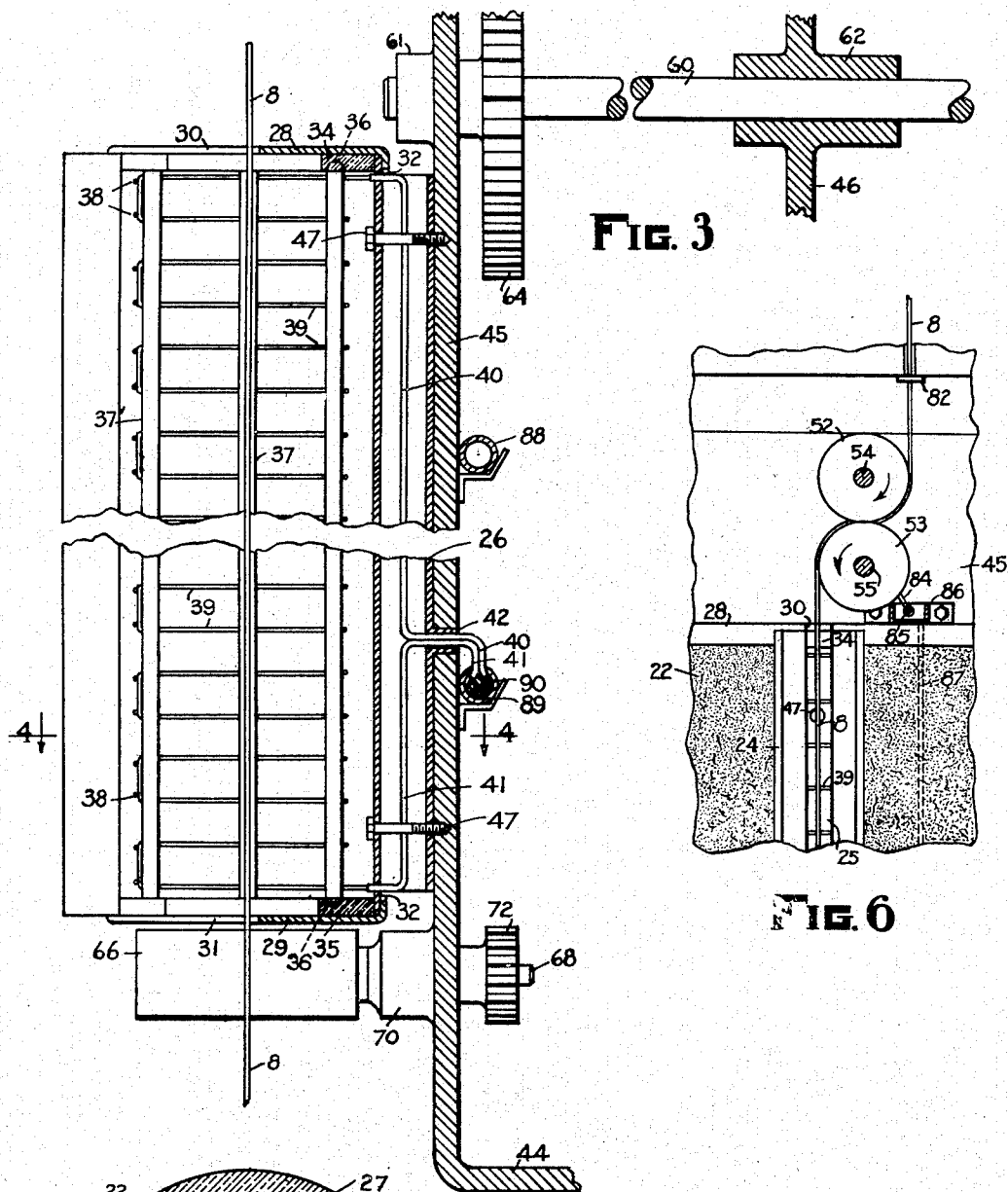
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APPARATUS FOR DRYING THREAD OR THE LIKE

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9 Claims. (Cl. 34—48)

This invention relates to apparatus for uninterruptedly drying thread-like materials such as filaments, cords, bands, tapes, tubes, etc., hereinafter referred to as "thread."

Apparatus capable of uninterruptedly drying thread is of considerable importance, among other things, in the art of manufacturing artificial silk thread by continuous processes. Thread produced by such processes contains, upon the completion of the liquid processing steps, a considerable amount of moisture which must be removed to complete the processing of the thread. Apparatus which will dry the thread as rapidly as it is being produced is of especial value, since the thread may then be collected in final package form contemporaneously with its production. The present invention relates to thread-drying apparatus of this type which may be employed in a continuous thread processing machine between the last liquid processing stage and the means for collecting the thread in package form.

Although the invention is here disclosed in connection with a machine for producing multiple filament viscose artificial silk thread, it will be understood that the invention is not limited thereto, but may be utilized to dry artificial silk thread produced by other processes.

The apparatus of the invention combines advantages found in the drying of thread by passing it through a heated drying tube with other advantages to be had from utilizing electrical energy as the source of radiant heat. By passing the thread through a drying tube, the entire periphery of the thread may be exposed, since it is not necessary to support the thread by means within the body of the tube. Heat produced from an electric resistance wire is of value in the rapid drying of thread because of the great amount of heat which may be liberated in a small space. In accordance with the invention, the thread passing through the drying tube receives heat around its entire periphery from a substantially completely encircling electrical heating element in close physical relation to the thread.

To reduce the demands made upon the drying tube in the removal of moisture from thread passing therethrough, the invention provides means for removing excess liquid from the thread prior to its entrance into the tube: this feature makes it possible to utilize a shorter drying tube, a smaller consumption of electricity, or both. The invention further contemplates the provision of means for controlling shrinkage of the thread arising from removal of moisture from the thread during its passage through the drying tube. By

means of the invention, shrinkage of the thread may be arrested so that a definite residual capacity to shrink remains in the thread; in consequence, any desired residual capacity to shrink may be imparted to it.

A preferred embodiment of the invention is shown in the drawings, in which Figure 1 is a front elevation of the lower portion of a continuous thread-processing machine to which the thread-drying apparatus of the invention is applied. Figure 2 is a sectional elevation on line 2—2 of Figure 1. Figure 3 is an enlarged sectional elevation from the line 3—3 of Figure 1. Figure 4 is a section on the line 4—4 of Figure 3. Figure 5 is a plan of the device of Figure 3. Figure 6 is a front elevation of the upper portion of the device of Figure 3. In the drawings, like reference characters refer to like parts throughout.

Referring first to Figures 1 and 2, the thread 8 to be dried in the thread-drying apparatus 9 of the invention is received from a drip reel 10 preceded by a washing reel 11. Reels 10 and 11 are the last two of the several reels which ordinarily are present in a complete thread-processing apparatus for the performance of the liquid processing steps necessary to treat the thread. Each thread 8 is handled by a number of reels superposed to form a descending series and in a complete thread-processing apparatus a large number of these vertical series are arranged side by side as indicated in Figure 1. It is desirable that the thread-receiving portion of one reel be directly below the thread discharge portion of the reel immediately thereabove in order that the thread will pass directly from reel to reel.

The reels of each descending series are carried by castings 12 fastened to slanting support 13, which forms part of the framework of the machine. The supports 13 necessary to accommodate the several series of reels are carried upon a longitudinally extending rail 14. To rotate the several reels making up each descending series, a power driven shaft 15 extending upward at the rear of the reels is connected by gearing 16 and 17 to reels 10 and 11, respectively. The several shafts 15 are driven by a common drive shaft 18 disposed longitudinally of the apparatus.

The reels 10 and 11 are representative of any unitary helix-forming device which serves to advance axially thereof thread fed thereto at the supported end thereof. The reels here shown comprise two reel members having their axes disposed in offset and inclined relation and hav-

ing the axis of one reel member lying within the periphery of the other reel member. Each reel member includes a plurality of longitudinally extending bar members, the bar members of the two reel members being disposed in interdigitating relation. It is not necessary, however, to the practice of the invention that reels of this particular construction be employed; indeed, it is contemplated that the thread-drying apparatus of the invention may, if desired, be associated with any other means supplying wet thread.

In advancing in helical form over the surface of reel 11, the thread is subjected to a washing treatment by water showered upon the reel from distributor 19. The several distributors 19 are supplied with water from a pipe 20. In passing over reel 10, a considerable amount of the external moisture upon the thread is removed by dripping therefrom, but even upon leaving reel 10 the water content of the thread may be as high as 300%. The thread-drying apparatus 9 of the invention removes from the thread all or as much as is desired of its internal moisture content, so that the thread may be collected in finished package form as upon cap twister 21.

The thread-drying apparatus 9 comprises a tubular member 22 through the center of which the thread is passed. This tubular member 22 includes an internal metal sheet 23 having a highly polished inner surface. This metal sheet is curved to form a partial cylinder, the ends 24 of the sheet being flared outward to provide an entrance 25 for thread into the interior of the tubular member. On the exterior of the metal sheet 23 and opposite from the opening 25 is a longitudinally extending channel 26.

To retain heat within the tubular member the exterior surface of the sheet 23 may be covered with a thick layer of heat insulating material 27 extending between the flared ends 24 and the channel 26. To close the upper and lower open ends of the tubular member, plates 28 and 29 are provided, each having therein slots 30 and 31 which extend inward from the periphery to the center of the plates. These plates are so located upon the tubular member that the opening to the slots 30 and 31 will register with the opening 25 between the flared ends 24. The plates 28 and 29 may be held in position by any desired means such as welding at 32.

Within the tubular member and seated against the end plates 28 and 29 are ring members 34 and 35, preferably made of some electric insulating material such as porcelain. Seated within recesses 36 in the ring members 34 and 35 and extending between them are the rods 37 and 37' preferably of the same insulating material. Rods 37 and 37' are circumferentially disposed about the axis of the tubular member. The rods 37' near the entrance 25 to the tubular member are preferably formed with projections 38 at spaced intervals therealong.

An electrical resistance wire 39 is wound as shown about the rods 37 and 37'. In installing such wire, it is first hooked upon the uppermost two of the projections 38 of one of the rods 37' and then is brought away from opening 25 and laid around the several rods 37 until the other rod 37' is reached. The wire is then hooked over the uppermost two projections 38 of the rod 37' so reached; so that a nearly complete circle is formed. Thereafter the wire is brought toward the rear of the tubular member and around the several rods 37 until it reaches the rod 37' upon which the wire was first hooked. The wire is

then hooked upon the next two lower projections 38 of this rod and is again carried around the several rods 37 until the other rod 37' is reached.

By carrying the wire back and forth in this manner, the entrance 25 and the slots 30 and 31 in the end plates are not obstructed and the thread may readily be introduced into the tubular member. Also, due to the winding of the wire about the axis of the tubular member, the thread which is passing longitudinally through the center of the tubular member is exposed over virtually its entire periphery to the radiant heat emitted by the resistance element. Projections 38 not only enable the wire to be wound about the interior of the tubular member in the manner noted but serve to maintain the spacing between the turns of the wire.

The ends 40 and 41 of the resistance wire 39 lead into the channel 26 and pass out through opening 42 therein for connection to line wires 89 and 90.

In assembling the tubular member, rings 34 and 35 are located upon opposite ends of rods 37 and 37' and the resistance wire 39 is wound about the rods in the formation described. This assembly is then inserted through one of the open ends of the cylindrically formed metal sheet 23 and is held in proper position therein by securing the plates 28 and 29, as by weld 32, upon the ends of the metal sheet 23. The lead wires 40 and 41 are next brought out through the opening 42 and the channel 26 is then positioned against the exterior of the metal sheet 23.

To retain tubular member 22 upon the frame of the apparatus, it may be and preferably is secured to a bracket 44 having arms 45 and 46. Tubular member 22 is secured to arm 45 by screws 47 passing through the wall of metal sheet 23 and through the rear wall of the channel 26. In this manner the channel 26 is clamped against the exterior of metal sheet 23. Arm 46 of bracket 44 is secured by bolts 48 to a channel member 49 secured to the rail 14. Extending between the arms 45 and 46 is a spacer member 50 serving to tie together the free ends of these arms.

Immediately above tubular member 22 is disposed a pair of squeeze rollers 52 and 53 carried upon shafts 54 and 55 respectively. Shafts 54 and 55 are rotatable in bosses 56 and 57 carried upon the arm 45 of bracket 44. To rotate the rollers 52 and 53 at the same speed they are connected together by gears 58 and 59 mounted upon the projecting ends of the shafts. To drive rollers 52 and 53 from the inclined shaft 15 which drives the reels 10 and 11, they are connected to the shaft 15 through an intermediate shaft 60. Shaft 60, which is rotatable in bearings 61 and 62 carried upon opposite arms of bracket 44, carries at one end a bevel gear 63 and at the other end a spur gear 64. Bevel gear 63 meshes with bevel gear 65 upon shaft 15 while spur gear 64 meshes with gear 59 which is mounted upon the shaft 55 for the squeeze roller 53.

Immediately below tubular member 22 is a pair of squeeze rollers 66 and 67, the shafts 68 and 69 of which are rotatable in bosses 70 and 71 carried by the arm 45 of bracket 44. Upon the projecting ends of shafts 68 and 69 are gears 72 and 73 which drive rollers 66 and 67 at the same peripheral speed. Shaft 69 is driven by shaft 55 through the vertical connecting shaft 74 which is rotatable in bearing 75 carried by the cross piece 50 and the bearing 76 at the lower part of bracket 44. Shafts 55 and 74 are connected together through bevel gears 77 and 78 and shaft 75

74 is connected to shaft 69 through bevel gears 79 and 80.

Squeeze rollers 52 and 53 are so disposed that the periphery of the roller 53 is in line with the axis of tubular member 22, as shown in Figure 6. Because of this relationship, thread leaving roller 53 passes directly into slot 30 in upper plate 28. Squeeze rollers 66 and 67 are so located below the tubular member 22 that the contacting portion between them is vertically below slot 31 in lower end plate 29. Due to this relationship, the thread is drawn axially through the tubular member 22; consequently, by varying the ratio between gears 79 and 80 and gears 77 and 78, it is possible to cause squeeze rollers 66 and 67 to have a peripheral speed different from the peripheral speed of squeeze rollers 52 and 53.

It is possible, for example, to have the squeeze rollers 66 and 67 rotate at a slower speed than rollers 52 and 53, so that a definite amount of shrinkage will be permitted in the thread between the two pairs of rollers. In this manner it is possible to permit the thread to shrink to the full extent to which it will normally shrink if unrestrained or, if preferred, it is possible to limit this shrinkage by rotating the rollers 66 and 67 at a greater rate of speed than the speed of rotation which they should have if unrestrained shrinkage were to occur. It will be apparent that if rollers 66 and 67 are rotated at the same peripheral speed as rollers 52 and 53 no shrinkage of the thread passing through the drying tube is permitted.

Between drip reel 10 and the pair of rollers 52 and 53 is a guide eye 82 and immediately below the pair of rollers 66 and 67 is a similar guide eye 83. Guide eye 82 serves to deliver thread to that portion of rollers 52 and 53 which will result in entrance of the thread at the axis of tubular member 22. Guide eye 83 serves to prevent the movement of the thread imposed upon it by cap twister 21 from reaching squeeze rollers 66 and 67.

To remove from roller 53 fluid which collects thereon after being squeezed from the thread passing between rollers 52 and 53, a wiper blade 84 may bear forcibly upon the roller 53. Wiper blade 84 is carried upon a rod 85 held in opposite ends of a trough 86 which is carried by arm 45 of bracket 44. Water collected in the trough 86 may be conducted through pipe 87 to a common discharge conduit 88 extending longitudinally of the machine.

In threading up the apparatus, the thread is drawn from the drip reel 10 and is passed at once to cap twister 21. Thereafter the thread is looped into eyes 82 and 83, the thread being allowed at this time to pass over the exterior surface of tubular member 22. It is then possible to pass the thread between the upper pair of rollers 52 and 53 and between the lower pair of rollers 66 and 67 and to allow the thread to enter through opening 25 into the interior of the tubular member 22.

In passing between the squeeze rollers 52 and 53 a considerable amount of the surface moisture upon the thread is squeezed out and is collected in the trough 86. This serves to relieve the burden imposed upon the tubular member 22 of reducing the moisture content to the desired minimum amount. By regulating the amount of electrical energy supplied to the heating wire 39 and by properly proportioning the length of tubular member 22 to the electrical energy supplied and the total fluid to be removed from the

thread, the thread may be dried to any desired extent so that upon issuing from the tubular member 22 it may be immediately collected upon cap twister 21 as a dry or nearly dry thread.

It will be understood that the invention is not limited to the precise details of construction illustrated in the accompanying drawings. For example, the invention contemplates the substitution of an equivalent element for any element of the structure herein disclosed. Furthermore, omissions may be made from the complete drying apparatus represented in the drawings without impairing the functioning of the remaining portion of the apparatus. Thus, it is possible to eliminate one or both of the pairs of rollers 52, 66 and 67, utilizing the drying tube alone to remove moisture from the 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. Apparatus for drying wet thread comprising, in combination, a unitary helix-forming device on the periphery of which the thread is continuously but temporarily stored in a large number of closely spaced generally helical turns; means for mounting said helix-forming device for rotation about its own axis; and, cooperating with said helix-forming device in the removal of moisture from the thread, an elongated drying chamber through which the thread is passed endwise in a generally longitudinal path.

2. Apparatus as in claim 1 in which said elongated drying chamber includes means for drying the thread by radiant energy.

3. Apparatus as in claim 1 in which said elongated drying chamber includes an electrical resistance element for drying the thread by radiant energy.

4. Apparatus for drying wet thread comprising, in combination, a unitary helix-forming device on the periphery of which the thread is continuously but temporarily stored in a large number of closely spaced generally helical turns, said device being so arranged as to permit a substantial part of the moisture content of the thread to drip therefrom; means for mounting said helix-forming device for rotation about its own axis; and, for removing at least the greater part of the balance of the moisture from the thread, an elongated drying chamber through which the thread is passed endwise in a generally longitudinal path upon its discharge from said helix-forming device.

5. Apparatus for drying wet thread comprising, in combination, a unitary helix-forming device mounted for rotation about its own axis on the periphery of which the thread is continuously but temporarily stored in a large number of closely spaced generally helical turns, said device being so arranged as to permit a substantial part of the moisture content of the thread to drip therefrom; an elongated drying chamber for removing at least the greater part of the balance of the moisture from the thread through which the thread is passed endwise in a generally longitudinal path upon its discharge from said helix-forming device; and means for withdrawing the thread from said elongated drying chamber at a linear speed less than that at which it is fed into said chamber.

6. The process of drying wet thread comprising removing the first part of the moisture under one set of dehydrating conditions with the

thread continuously but temporarily stored on a thread-advancing device in the form of a traveling helix made up of a single layer of closely spaced generally helical turns and at least the greater part of the balance of the moisture under a different set of dehydrating conditions as the thread is passed endwise in a generally longitudinal path.

7. The process of claim 6 in which liquid clinging to the thread is allowed to drip therefrom in the course of the removal of the first part of the moisture from the thread.

8. The process of claim 6 in which, in order to compensate for stresses developed in the thread as a result of its tendency to shrink, the tension upon the thread is relaxed in the course of the removal of its internal moisture.

9. The process of drying wet thread comprising removing part of the moisture under one set of dehydrating conditions with the thread continuously but temporarily stored on a thread-advancing device in the form of a traveling helix made up of a single layer of closely spaced generally helical turns and part of the moisture under a different set of dehydrating conditions as the thread is passed endwise in a generally longitudinal path, simultaneously relaxing the tension on the thread to compensate for stresses developed in the thread as a result of its tendency to shrink upon the removal of its internal moisture.

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