March 30, 1954 O. WILLIAMSON ET AL 2,673,385

APPARATUS FOR TENSIONING AND DRYING A WET THREAD

Filed March 18, 1948

3 Sheets-Sheet 1

FIG. 1.

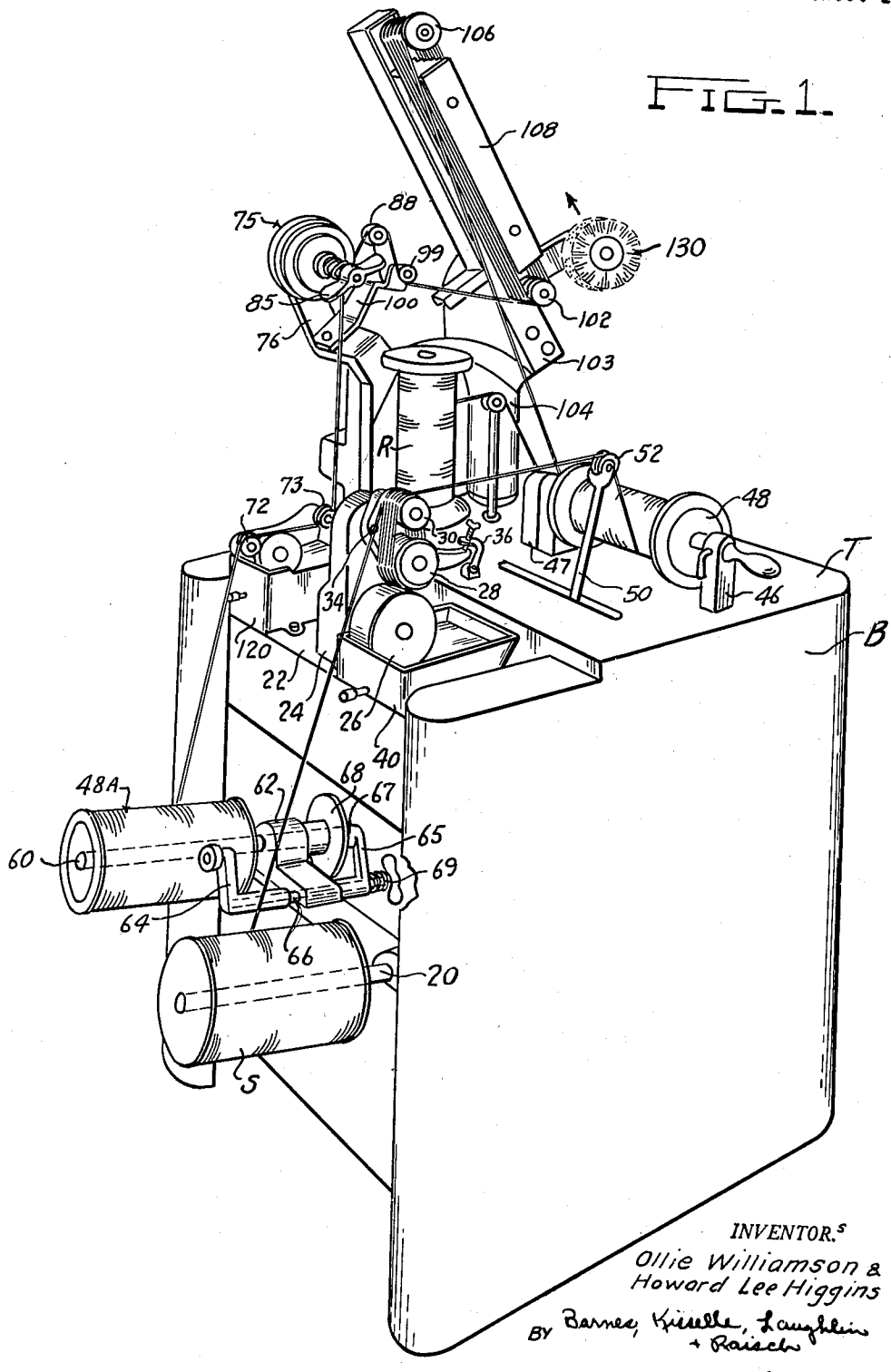

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FIG. 2.

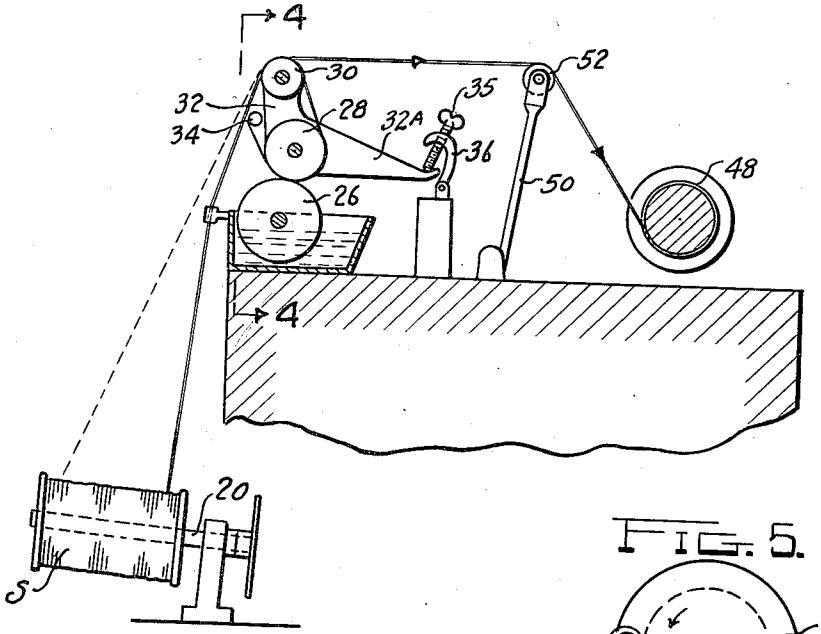


FIG. 5.

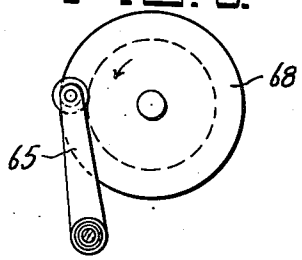
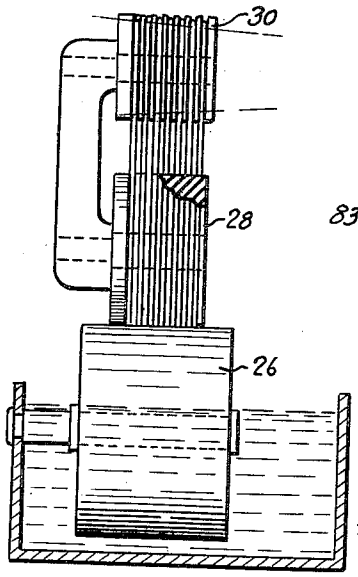


FIG. 3.



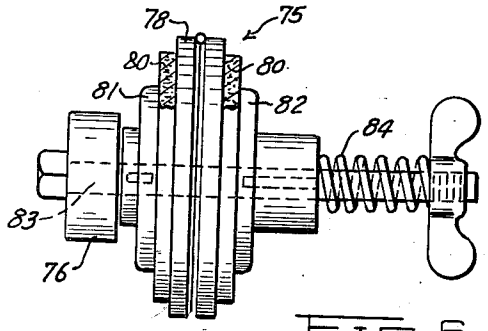


FIG. 6.

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FIG. 4.

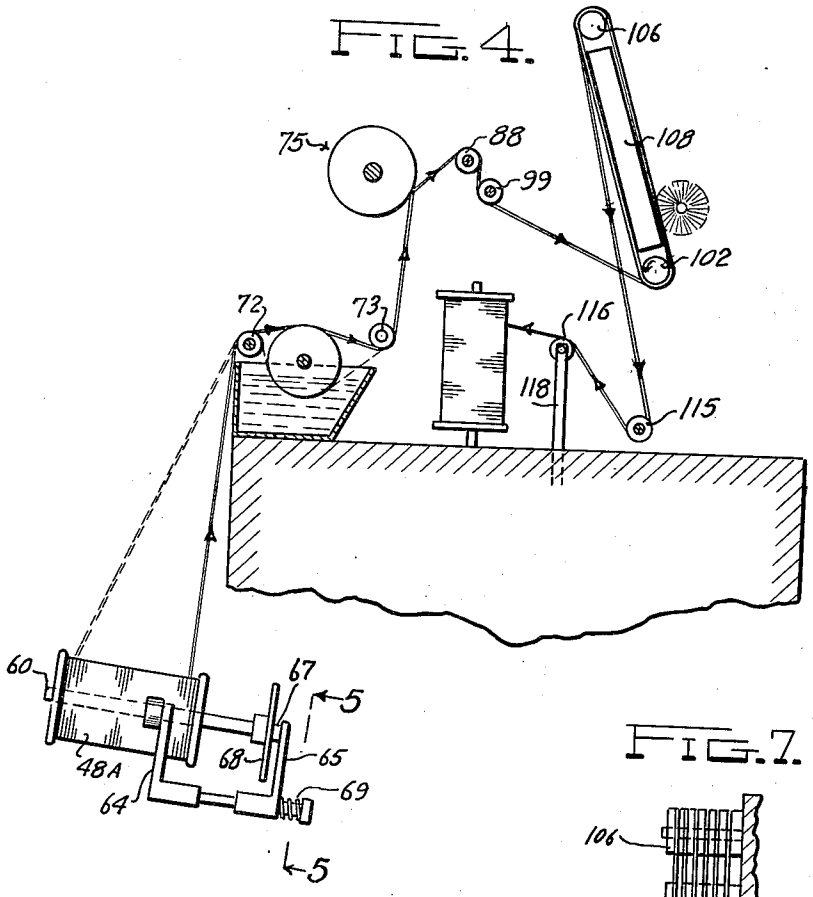
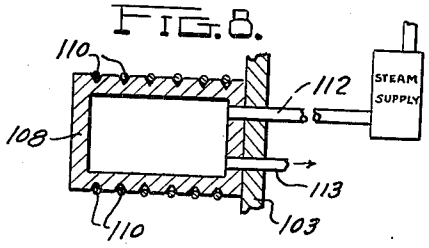


FIG. 8.



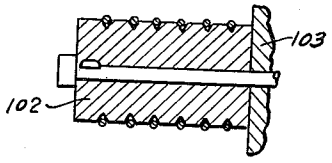
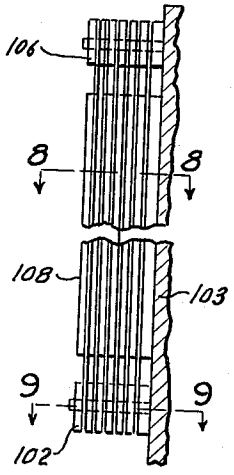


FIG. 9.

FIG. 7.



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2,673,385

UNITED STATES PATENT OFFICE

2,673,385

APPARATUS FOR TENSIONING AND DRYING A WET THREAD

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Application March 18, 1948, Serial No. 15,548

3 Claims. (Cl. 28—59.5)

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This invention relates to certain new and useful improvements in the apparatus for treatment and tensioning of textile yarns for the purpose of increasing their tensile strength, lowering their stretch and decreasing their gauge.

Production of high strength, low stretch, high density yarns has been accomplished successfully in the prior art by some treatment, such as, for example, the Jennings Patent 2,220,958, issued November 12, 1940, wherein the inventor shows treating the yarn first with a bonding agent in solution, emulsion, or dispersion, tensioning the yarn to a point approaching the breaking point and simultaneously drying and setting the bonding agent around the fibers of the yarn.

Practical application of the Jennings process and similar processes has presented many complex mechanical problems because precision apparatus is necessary to get thorough treatment of the yarn with the treating solution, minute adjustment is necessary to maintain tension approaching the breaking point of the yarn without having excessive end breakage, means must be provided for adjusting residual stretch variations in individual yarns and parts of each individual yarn, and means must be provided for maintaining smooth round dense yarns.

Prior art has shown various tensioning devices, but as far as is known there is no apparatus capable of compensating for the variations in the natural unwinding tension as a thread leaves a spool. The pulling tension necessary for unwinding yarn is comparatively slight when the spool is full of yarn due to the fact that the yarn exerts considerable leverage as it is pulled from the spool tangent to the axis on which the spool turns, however, as the diameter of the yarn on the spool decreases, the moment of this force is decreased until by the time the yarn has reached the last few layers on the spool, this leverage is so reduced that the pulling tension necessary to remove the yarn has increased 100 per cent or more, depending, of course, on the diameter of the full spool. With such a variant existing in order to remove the yarn from the spool without rupture, it is necessary to have the tension very low when the spool is full so that the increased natural tension at the end of the delivery will not cause rupture.

It is an object of this invention to describe a device which will permit delivery of the yarn from the spool or bobbin under a uniform tension. It is a further purpose of this invention to provide a device which will so tension the yarn as delivered from the spool, that this device may

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be all that is needed to tension the yarn, and especially if it is a yarn of relatively fine size and low tensile strength.

To apply tension just short of the breaking point of a yarn it is necessary to have a device that can be adjusted to give precise control of tension. As the yarn approaches the drying apparatus it is necessary that it be given a maximum tension short of the breaking point and at the same time that it be held so that slight variations will not cause ruptures and breaks. It is necessary that such a device be capable of fine adjustment to any predetermined tension, and that it shall be so constructed that the traveling yarn slip enough to allow minor stretch variations but not enough to cause variations in the predetermined tension.

It is an object of this invention to provide a tensioning device that will snub a traveling yarn sufficiently to give any predetermined tension without causing frequent end breaks. It is a further object of this invention to provide an apparatus for applying the primary or main tension in an apparatus including two zones of tension, in which the initial zone of tension has been previously applied to eliminate residual stretch variations.

Thoroughly treating thread with moistening solution as in the Jennings patent has been difficult to accomplish, especially with heavier threads, due to the failure of the moistening solution to penetrate to the center of the thread. For best results in the aforementioned treatment, as many of the discrete fibers as possible must be first aligned and then bonded in that position. If the fibers in the center of the thread are not first treated wtih moistening solution, the effect of the subsequent stretching and drying is more detrimental than beneficial to those particular fibers. It is well known that by squeezing a once wet yarn and rewetting the same yarn will produce a greater absorption of any given moistening solution. It is also known that a slack yarn will absorb a wetting solution or the like better than a taut yarn.

With this invention it is important to apply thoroughly a controlled amount of any desired treating solution to a thread, yarn or the like, in a continuous process characterized by a plurality of successive untensioned wettings and squeezings of each individual end, and to provide means for successive slack treatments of a yarn.

It is necessary to have thorough drying in order to set the bonding agents so that the once

treated yarn will not relax and lose the benefits gained by the process. It is also desirable to have some means of "laying the fuzz" or smoothing down the ends of loose fibers in order to form a compact, smooth, round yarn that is suitable for weaving, braiding or any form of processing to which it may be subjected. Requirements of a suitable drying apparatus are: (1) it must dry in a continuous operation, (2) it must dry the yarns sufficiently to prevent mildewing which causes heavy losses in damaged or destroyed yarns, (3) it must set the bonding agent so that there is no chance of a loss in the increased tensile strength or gain in stretch, (4) it must compact and round the yarns while laying the loose fiber ends along the sides of the yarn.

It is an object of this invention to provide means for heating and drying yarns in accordance with the principles stated above. It is a further object of this invention to dry yarns under maximum tension short of breaking point without increasing the hazard of end breakage.

It is another object of this invention to provide a combination of the above devices in an apparatus for the purpose of treating yarns, threads, cords, and the like for the purpose of increasing their tensile strength, lowering their stretch and increasing their density.

Other objects and features of the invention will be apparent in the following description and claims.

Drawings accompany the following description and the various views may be briefly described as:

Figure 1, a perspective view of a machine assembly embodying the various features of the present invention.

Figure 2, a flow diagram showing the course of a yarn being treated with a solution.

Figure 3, an enlarged elevation of treating rolls.

Figure 4, a flow diagram of the tensioning and drying steps.

Figure 5, a view on line 5—5 of Figure 4.

Figure 6, an elevation of the primary tensioning device of Figure 4.

Figure 7, an elevation of a drying grid.

Figures 8 and 9, sectional views on lines 8—8 and 9—9, respectively, of Figure 7.

Referring to Figure 1 the various features of the invention are embodied in a working machine which has a base B provided with a belt high top surface T. A supply spool S is mounted on a spindle 20 in a suitable mount on base B. Directly above the supply spool S on a depressed surface 22 is a vertical mount stand 24 which serves to support an immersion or dip roll 26, a squeeze roll 28 and a grooved roll 30. The squeeze roll 28 and the grooved roll 30 are mounted in spaced relation for free rotation on a bell crank 32 which in turn is pivoted at 34 to the upright 24. This mounting is best shown in Figure 2 and an adjustment is provided for the bell crank 32 which will be described in detail later. The immersion roll 26 is driven by a suitable mechanism not shown.

Below immersion roll 26 is a reservoir 40 positioned to maintain liquid which may have a level substantially above the lower periphery of roll 26.

On top T are two upright journals 46 and 47 which support a take-up spool 48. A traversing arm 50 leads thread to spool 48 over roll 52 to effect even winding on the spool by reason of motion imparted to the arm 50 by a suitable mechanism mounted in base B and not shown.

Spool 48 is driven in a winding motion by an adjustable slip clutch, not shown, which drives the roll with a very light force to prevent cutting in and squeezing force on the thread or yarn being wound. Spool 48 is removably mounted on journals 46 and 47 so that when full it may be placed on a spindle 60 mounted in spaced relation to spindle 20 in a journal bearing 62. A tension equalizer is provided on the spindle 60 in the form of a follower arm 64 and a brake arm 65, which are mounted for simultaneous movement on a shaft 66. Details of this tension equalizer are to be found in co-pending application Serial No. 16,168, filed March 22, 1948, now Patent 2,592,595. Briefly, it consists of a braking pad 67 on arm 65, which braking pad is urged against the surface of a disc 68 on spindle 60 by the action of a spring 69. The braking pad 67 will exert its greatest braking force when it is near the periphery of disc 68 and at the time that the roll 48–A is full of treated yarn. As follow arm 64 moves inward with the decrease in residual yarn, braking pad 67 will also move toward the center of disc 68, thereby decreasing the friction in proportion to the decrease in radial distance in center of disc 68.

Yarn from spool 48–A is carried over roll 72 and under roll 73 to a primary tensioning device or snubber 75 which is mounted on an angled arm 76 rising vertically from the base B. The main element of the primary tensioning device is a grooved roll 78 (Fig. 6). This grooved roll is preferably formed of a metal such as Oilite or some similar metal which has a low coefficient of friction, preferably metal of the porous type impregnated with a lubricating compound. On each side of the roll 78 are circular felt discs 80 supported by a pressure plate 81 at one side and a pressure plate 82 at the other side. All of these parts are mounted on a stud 83 which is mounted on arm 76. A spring 84 adjustable on stud 83 by a thumb screw 85 bears against pressure plate 82 to urge the parts together in frictional contact. Plates 81 and 82 are keyed on stud 83 to prevent rotation while permitting axial movement.

From the primary tensioning device 75 yarn passes over a roller 88 and under a roller 89 mounted on a bracket 100 to a driven roll 102 provided with a plurality of grooves shown best in Figure 9. Driven roll 102 is mounted on a support arm 103 which in turn is mounted on an upright 104 extending from the base B. Suitable means are provided in the upright 104 for driving the roll 102 from a power source in base B, not shown. At the top of arm 103 is a free running grooved roll 106 and between the rollers is a drying grid 108 which has a plurality of spaced parallel V-grooves 110. The inside of the grid 108 is heated by the passage of steam therethrough or by a suitable thermostatically controlled electrical resistance unit. The particular construction shown in Figure 8 shows steam feed line 112 and an exhaust line 113.

The sectional dimension between the working sides of grid 108 is preferably greater than the diameter of the grooves in rolls 102 and 106. The ends of the grooves adjacent the rolls are tapered slightly to prevent scraping. The thread or yarn leaves roll 106 and is led to a positioning roll 115 and then to a traversing roll 116 mounted on a reciprocating shaft 118 to which suitable traversing movement is imparted by a mechanism, not shown, in base B. The fully treated thread or yarn is then taken up on a roll R which is driven by a slip clutch not shown

from base B. A secondary treating bath container 120 is provided between rolls 72 and 73 for use when an optional secondary dip is desired or when continuous treatment is provided from spool 48–A in certain limited cases.

As previously stated, it is an object of the present invention to provide an apparatus which will perform a combined treating and tensioning process such as described for example, in the Jennings Patent No. 2,220,958.

The first item in this operation is subjecting the thread or yarn to a treating solution which will thoroughly moisten all the fibers. Yarn is led from the supply spool S to the roller 30 which is provided with a plurality of spaced annular grooves which decrease in diameter from left to right as viewed in Figure 3. The yarn is wound progressively around roll 30 and roll 28 until all the grooves are filled after which the yarn is led to guide roll 52 and take-up spool 48. The driven immersion roll 26 is preferably formed of stainless steel or some other non-corrosive material and this roll carries treating solution from bath 40 to the bottom of the squeeze roll 28 where it is applied to the thread as it passes around the roll. The squeeze roll 28 is driven by frictional contact with the dip roll 26.

To obtain a thorough moistening it is preferable that the yarn being treated be repeatedly moistened and squeezed and that such yarn be in a relatively slack condition at this time. Carrying the yarn around the grooved roll 30 and the squeeze roll 28 in a plurality of successive loops causes multiple contact of the thread at a plurality of points as it passes the dip roll 26. The progressively deeper grooves in roll 30 serve to create a slack condition as the thread progresses from left to right as viewed in Figure 3. As previously described rolls 28 and 30 are mounted on a bell crank 32. This bell crank is so pivoted that pressure on arm 32–A (Fig. 2) moves squeeze roll 28 toward the dip roll 26. This pressure can be adjusted by a thumb screw 35 mounted on a swinging pivot 36. Pivot hook 36 can be released from arm 32–A to permit the arm and rolls 28 and 30 thereon to be moved clear of dip roll 26 for cleaning and threading.

The squeeze roll 28 is preferably formed of a material such as rubber, plastic, leather or the like, which is hard enough to prevent cutting or wearing where the threads contact the roll but soft and pliable enough to give a thorough squeezing without allowing the treating solution to flow between the rolls. The amount of pressure between rolls 26 and 28 determines the pick-up of the treating solution and thereby determines the quality of the end product.

The wet yarn is wound from the applicator rolls to the take-up roll 48. In some cases it may be desirable to permit this wet yarn to age for a specified period before continuing with the tensioning treatment which is to be described. When the tensioning process is to be applied to the yarn the spool 48 is applied to spindle 60 and the yarn is snubbed around the tensioning roll 75. The grooves in the metal roll 78 are preferably formed with sides which meet at a relatively sharp angle at the bottom so that the yarn or thread is gripped on the sides of the grooves. The yarn is wrapped around the roll 78 for almost 360° contact and comes to the roll at approximately the same point that it leaves it. It is important that there be no overlapping of the yarn in the groove. This is best shown in Figure 4. Yarn is then wound around rolls 102 and 106 in progressive loops, the long sides of which are based in the grooves of grid 108; the end is led to the take-up roll R.

The entire driving force for the tensioning steps between the roll 48–A and the take-up roll R is provided by roll 102 which is positively driven. There are two zones of tension in this particular step in the operation. One occurs between the braked roll 48–A and the snub roll or primary tensioning device 75. The tension between these rolls should be sufficient to remove residual stretch from the yarn and sufficient to exert a snubbing force around the roll 78 in the V-groove to the extent that a maximum tension can be exerted between the primary tensioning device 75 and the driven roll 102. The tension to be applied to the treated yarn between the device 75 and the roll 102 is preferably just short of the breaking point, in which condition the yarn is dried and set. By having the driving force applied with the lower roll 102 each loop of the yarn is gripped and pulled as it travels over the grid, and there is thus eliminated the effect of a drag or high tension at the end of the drying operation and a relatively low tension at the beginning of this high friction area such as would be present if the entire drive were exerted on the last loop of the series. The variation in the effective width of the grid 108 and the effective diameter of the grooves and the rolls 102 and 106 insures that the yarns are constantly in contact with the grid for a more perfect drying. The V-grooves in the grid serve several functions. First, they hold the yarn in a definite position and avoid any mutual rubbing or entangling. Secondly, they exert on the yarn a compression action in which the yarns are drawn down into the bottom of the V-groove and thereby compressed to a high density and low gauge. At the same time the loose fiber ends or fuzz are laid of desirable hand. Another important function of the grooves in the grid is to afford a thorough drying by having the heated metal contact a maximum periphery of the moving yarn, thereby giving it a maximum heat exchange.

The heat within the grid 108 may be varied to give any desired amount of drying to the yarn. Temperatures from 300° F. to 590° F. have been used, depending on the particular resin to be cured and the amount of drying necessary. The size of the yarn will, of course, be a factor in determining the drying time. The brief time that the yarns leave the grid and travel over the end rolls of each end of the grid assembly will furnish sufficient cooling to prevent any damaged yarn from excessive heat.

From the heating grid the yarn can be wound onto the take-up spool R without any critical tension since the resin is set and there is no danger of its relaxing at this point in the operation. A brush 130 is mounted adjacent grid 108 for movement toward and away from the grid. When moved to contact the grid it serves to contact the threads passing the grid and is rotated to brush the threads in a direction opposite to the movement of the thread. This supplements the smoothing and condensing action of the grid itself.

It would not be expected that this application should be limited to treatment of yarn when it is equally adaptable to thread, roving, spun threads, plied yarns and any natural or synthetic linear fibrous elements. The words yarn, cord, and thread are used interchangeably in this specification to refer broadly to single filaments, twisted filaments, braided strands and any continuous

linear element which is to be treated with a liquid, tensioned and dried.

What we claim is:

1. Apparatus for tensioning and drying a thread wet with a treating compound which comprises a mounting for a winding of such thread, means to equalize tension on thread being unwound from said mounting by the pull of the thread itself in a primary tension stage, a snub roll to receive thread from said winding having means to apply retarding friction thereto, a driven roll to pull thread from said winding over said snub roll in a secondary tension stage, and drying means interposed between said driven roll and said snub roll to effect complete drying in the secondary tension stage.

2. Apparatus for tensioning and drying a thread wet with a treating compound which comprises a rotatable mounting for a winding of such thread, means at said rotatable mounting to equalize tension on thread being unwound from said mounting by the pull of the thread itself which comprises a follower for the unwound yarn, a braking surface in the plane transverse to the mounting axis to rotate with the winding, a braking pressure pad in contact with the braking surface to move with the follower toward the axis of the mounting as the thread unwinds, a snub roll to receive thread from said winding comprising a main rotatable member having at least one flat end and a peripheral V-groove, friction surfaces bearing on at least one flat end of said main rotatable member, and adjustable means to apply pressure between said member and friction surfaces to retard the rotation of said rotatable member, a driven roll to pull thread from said winding over said snub roll in a secondary tension stage, having a plurality of spaced peripheral grooves therein, and drying means interposed between said driven roll and said snub roll to effect complete drying in the secondary tension stage comprising a grid having spaced parallel surfaces each provided with V-grooves to receive thread, said V-grooves being spaced similarly to the peripheral grooves of the driven roll whereby thread may be wrapped in progressive loops around said driven roll and grid for progression thereover, and means for heating said grid to a drying temperature.

3. Apparatus for tensioning and drying a thread wet with a treating compound which comprises a rotatable mounting for a winding of such

thread, means at said rotatable mounting to equalize tension on thread being unwound from said mounting by the pull of the thread itself, which comprises a friction surface to rotate on an axis normal thereto with the rotatable mounting, means to apply pressure to said surface at a localized point, and means responsive to the amount of thread on the winding to move said pressure applying means in a path toward the center of the surface at a rate proportioned to the decrease in diameter of the winding, a snub roll to receive thread from said winding, comprising a main rotatable member having a peripheral V-groove and means to applying a retarding friction to said rotatable member in varying amounts, a driven roll to pull thread from said winding over said snub roll in a secondary tension stage, and means interposed between said driven roll and said snub roll to effect complete drying in the secondary tension stage which comprises a second grooved roll spaced from but parallel to said driven roll, each roll having approximately the same diameter, and a drying grid between said rolls having spaced surfaces, each provided with grooves to align with the roll grooves, the distances between the apices of the respective grooves of the respective surface being slightly greater than the diameter of the roll grooves, and means to supply heat to said grid to dry and cure the wet thread.

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