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2,628,405

APPARATUS FOR TREATING YARN

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2 SHEETS—SHEET 1

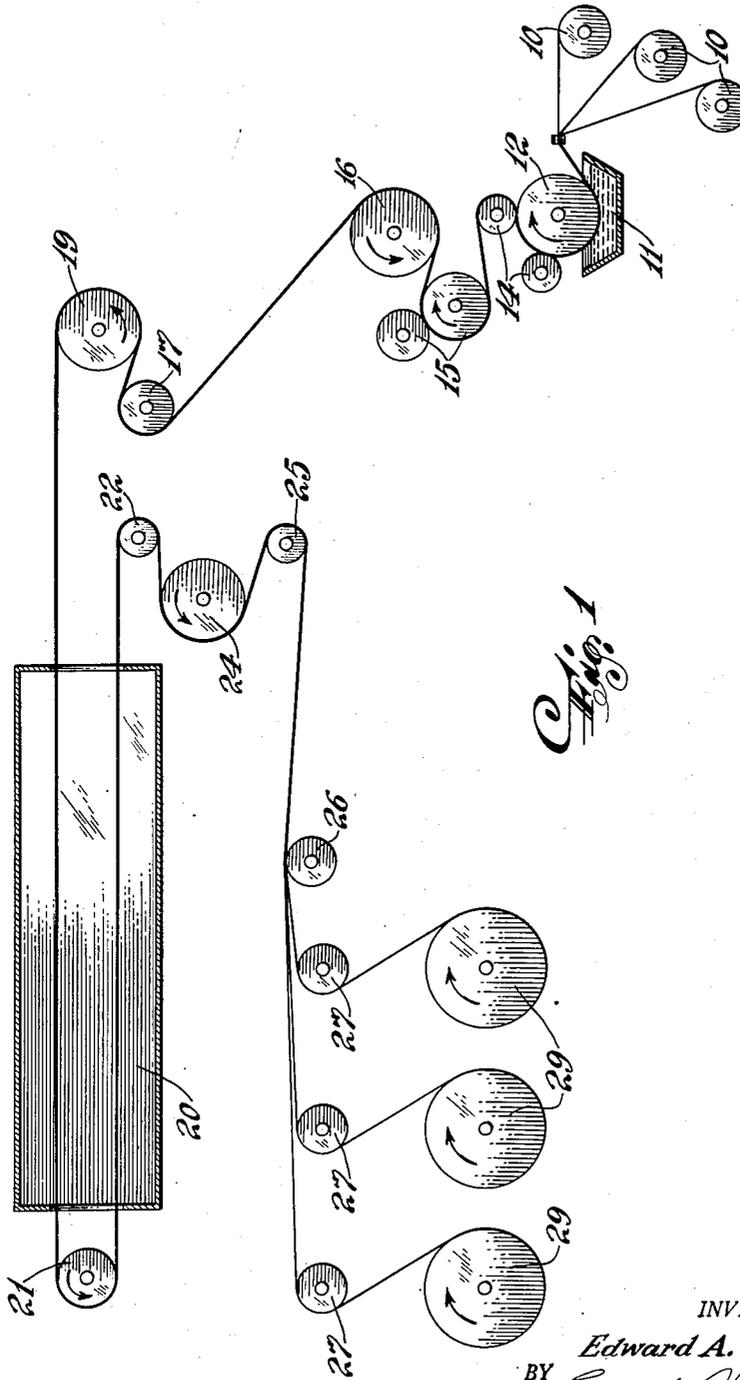


Fig. 1

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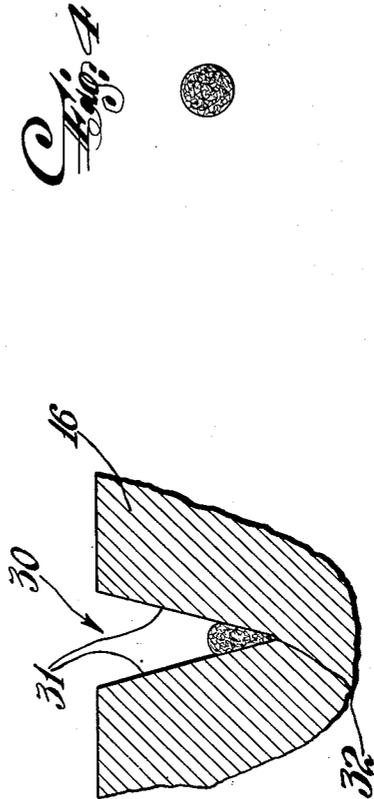
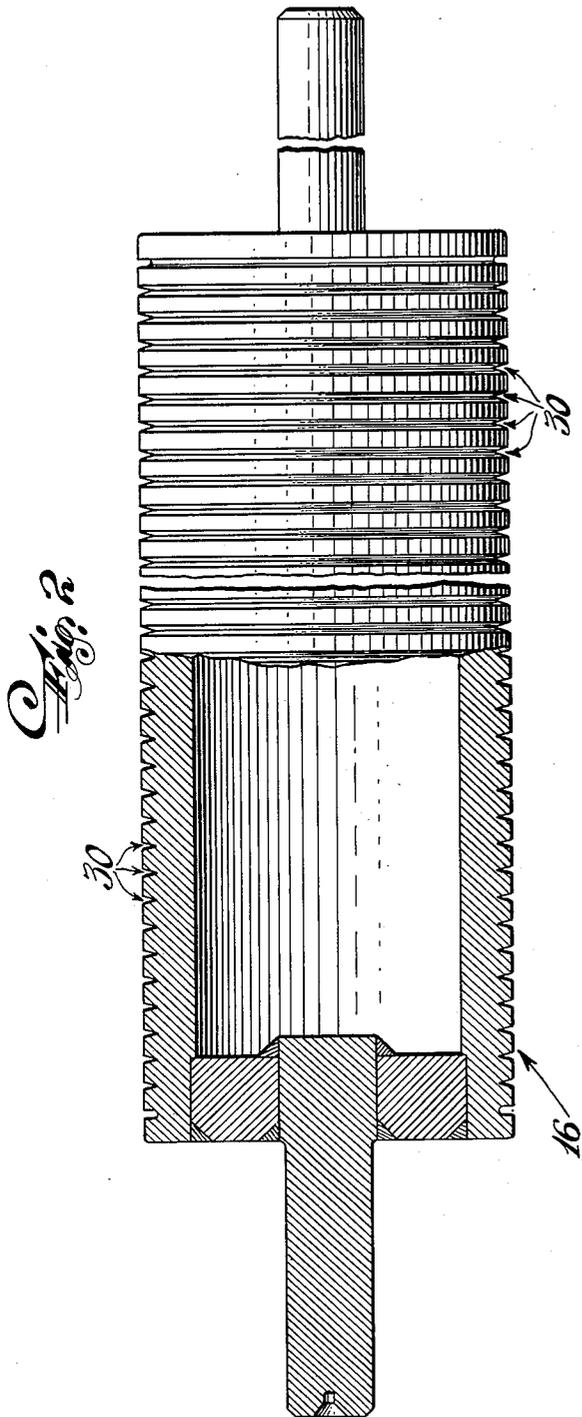
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2 SHEETS—SHEET 2



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APPARATUS FOR TREATING YARN

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3 Claims. (Cl. 28—71.3)

1

The present invention relates to apparatus for treating yarn and the like by wetting, stretching and drying the same to increase its tensile strength and to decrease the stretch thereof, and more particularly is concerned with apparatus for carrying out a process, such as disclosed in United States Patent No. 2,220,958 in an improved manner.

In the process disclosed in the aforementioned patent, cord, yarn or roving is impregnated with a bonding agent to permeate the same and the individual fibers thereof, is tensioned to stretch the same and to effect elongation thereof, and is dried while in stretched or elongated condition to set the bonding agent whereby the tensile strength of the yarn or the like is increased and the stretch thereof is decreased.

Accordingly, an object of the present invention is to provide apparatus for treating yarn generally in the foregoing manner to improve the quality of the processed yarn.

Another object is to provide apparatus for treating yarn whereby tensioning and elongation of the yarn are facilitated.

Another object is to provide apparatus for treating yarn in the foregoing manner wherein tensioning and elongation can be more accurately controlled.

Another object is to provide apparatus for treating yarn wherein the yarn is tensioned and elongated in an improved manner in relation to the impregnating and drying steps.

Another object is to provide apparatus for accomplishing the foregoing which is simple, practical and economical in operation.

A further object is to provide apparatus adapted to handle a great number of strands of yarn without unduly increasing the size of the apparatus or complicating the same.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

In accordance with the invention, the foregoing objects are accomplished by providing apparatus whereby a strand of yarn is frictionally engaged at a plurality of zones between impregnation of the yarn and completion of the drying thereof in an improved manner to substantially eliminate or to prevent slippage thereof to an extent whereby the degree of stretch can be controlled effectively. The yarn is positively ad-

2

vanced at these zones at successively increasing rates to effect elongation thereof in relation to the tension effect which is desired to be created or maintained in the yarn. More particularly, the apparatus generally comprises two or more power driven pull rolls over which one or more strands pass, each roll having means formed thereon, such as annular V-shaped grooves, for frictionally engaging and wedging therein a strand of yarn to prevent slippage thereof in relation to the rolls and each roll being operated at a successively higher surface speed in increasing relation to the direction in which the yarn travels. These grooves further effect compression of the yarn upon being wedged therein to condition the fibers of the yarn for more facile subsequent tensioning and/or elongation.

A preferred embodiment of the invention has been chosen for purposes of illustration and description, and is shown in the accompanying drawings, forming a part of the specification, wherein:

Figure 1 is a schematic view of apparatus embodying the present invention and diagrammatically illustrating the treatment of the yarn.

Figure 2 is an enlarged fragmentary view, partly in elevation and partly in section, illustrating in detail the pull rolls utilized in the apparatus shown in Figure 1.

Figure 3 is a further enlarged fragmentary sectional view taken through one of the V-shaped grooves, illustrating a strand of yarn wedged therein.

Figure 4 is a sectional view illustrating the cross-section of a strand of yarn enlarged to the same scale as the strand shown in Figure 3 before being wedged.

Referring to the drawings in detail, and more particularly to Figure 1 thereof, apparatus for processing yarn in accordance with the invention is illustrated schematically which generally comprises means for supplying yarn to be treated, impregnating means, means for drying the yarn, winding means for packaging the treated yarn, a plurality of pull rolls for advancing and/or tensioning the yarn, and a plurality of guide rolls or idlers over which the yarn is passed. The apparatus shown is of the type adapted to simultaneously treat a large number of strands of yarn, for example fifty, three being shown by way of illustration, but its construction may be varied to treat single strands or any desired number of strands without departing from the present invention.

The yarn supply means comprises a plurality

of packages 10 from which yarn is stripped or unwound and is guided to the impregnating means herein shown as a receptacle 11 containing the bonding agent, a lower roll 12 for pulling the yarn from the supply into the bath whereby the bonding agent is applied to the yarn, and a pair of upper rolls 14 cooperating with the roll 12 to effect penetration of the bonding agent into the yarn. The yarn is then passed between snub and squeeze rolls 15 which control the amount of bonding agent left in the yarn. The roll 12 is driven at a higher surface speed than the rolls 15 to relax the yarn prior to passing between the rolls 15 and thereby further aid impregnation.

The rolls 15 deliver the yarn to the first of a series of pull rolls of substantially identical construction about to be described.

The yarn, so delivered, passes over a pull roll 16, an idler 17, and a second pull roll 19, through a drying chamber, such as an oven 20, over a third pull roll 21, back through the oven, over an idler 22, a fourth pull roll 24, an idler 25, a guide roll 26 and idlers 27 for guiding each strand individually to a package winder 29.

It will be understood that the yarn could be passed only once through a longer oven thus eliminating the need of the third pull roll, 21 or that the yarn could be passed through a shorter oven more than twice by increasing the number of pull rolls at the ends of the oven in accordance with the number of passes desired.

In Figure 2, the first pull roll 16 is shown in detail and serves to illustrate the pull rolls 19, 21 and 24 as well. The roll is generally cylindrical and has a plurality of lengthwise, equally spaced, V-shaped annular grooves 30 formed on the outer surface thereof, the number of grooves corresponding to the number of strands of yarn to be simultaneously treated by the apparatus, each groove being adapted to receive a single strand.

As shown in Figure 3, the grooves 30 are provided by surfaces 31 meeting at an included angle approximately 30 degrees. In practicing the invention, it is preferred that the grooves are about $\frac{1}{4}$ inch in depth and that the surfaces 31 meet sharply at the bottom 32 of the grooves with a radius therebetween not exceeding .01 inch. Such grooves are of a size and shape to enable them to accommodate a large variety of yarns of varying diameter.

In accordance with the invention, these grooves cause the yarn to be wedged therein whereby the yarn is gripped frictionally to prevent slippage in relation to the pull rolls. This enables the rolls to positively advance or pull the yarn through the processing apparatus and stretch or tension the yarn a predetermined degree between rolls arranged in sequence. Generally, this is accomplished by causing the rolls to be rotated at surface speeds at the bottom of the grooves which successively increase in relation to the direction in which the yarn travels.

For example, in operating the apparatus in its preferred manner, the roll 19 has a sufficiently greater surface speed than the roll 16 to thereby advance the yarn at the zone provided by the roll 19 at a more rapid rate than the yarn is advanced at the zone provided by the roll 16 and to thereby effect elongation and tensioning of the yarn to almost its breaking point while advancing between the rolls 16 and 19. The roll 21 has a sufficiently greater surface speed than the roll 19 and the roll 24 has at least the same or sufficiently greater surface speed than the roll 21 to advance the yarn at the zones provided by

these rolls at a rate to take up any slack in the yarn due to stretching or relaxing of the fibers thereof while advancing between these rolls during the drying operation, while at the same time tensioning the yarn at a value sufficient to retain the elongation imparted to the yarn between the rolls 16 and 19.

In practice, it is desirable and advantageous that the rolls 16, 19, 21 and 24 be power driven from a common source and be positively interconnected by gearing and/or chains and sprockets so that the rolls at all times are locked and driven in synchronism at definite predetermined related speeds without accidental slippage between rolls. Thus, by reason of the yarn being gripped positively by the grooves in the rolls and the drive interconnection of the rolls, the yarn can be subjected to definite, accurately controllable conditions of elongation and tension to carry out the process in an improved manner.

In practice, the relative speeds of the rolls are varied in predetermined increments by change gears or variable drive connections (not shown) to obtain the desired elongation to process the yarn. For example, the roll 19 is operated at a constant speed while the roll 16 is operated at a lower speed which is varied in relation to the speed of the roll 19; the roll 21 is operated at a higher speed than the roll 19; and the roll 24 is operated at the same or a higher speed than the roll 21 which speed is varied in relation to the speed of the roll 19, while the speed of the roll 21 is varied in relation to the speed of the roll 24. The winders 29 are operated at speeds to take up the yarn and form wound packages at the rate the yarn is supplied by the roll 24.

In illustrating the apparatus, the interconnected drive for the rolls and the speed changing arrangement has been omitted for simplicity, because it is believed that those skilled in the art will understand the invention without such showing and description thereof in detail.

Another feature of the pull rolls, particularly the rolls 16 and 19, is that the wedging action of the yarn into the groove causes compressive forces to be applied to the yarn to squeeze it from its normal circular cross-sectional shape, as shown in Figure 4, to an oval cross-sectional shape, as shown in Figure 3. Such compressive action is believed to be beneficial in aiding impregnation and arranging the fibers of the yarn to improve elongation and subsequent bonding of the fibers to increase the strength of the yarn and minimize the stretch thereof. The wedging action has no harmful effect on the yarn.

In practice, the yarn is impregnated with a solution or emulsion containing a bonding agent or the like, is gripped and advanced by the pull rolls 16, 19, 21 and 24 at successively higher speeds in increasing relation to the direction of travel, is stretched to almost its breaking point between the rolls 16 and 19, is dried between the rolls 19 and 21 and the rolls 21 and 24, and is then wound into packages by a suitable winder.

By the term "yarn," as used herein, is meant yarns composed of bundles or interconnected individual fibers of animal, vegetable or mineral matter, natural or synthetic, which yarns are capable of improvement in quality by processes generally comprising wetting, stretching and drying of the yarn.

From the foregoing description, it will be seen that the present invention provides an improved apparatus for treating yarns and the like to enhance their physical characteristics. The ap-

5

paratus is simple in construction and practical and economical in operation and produces yarn which is processed in an accurately controlled manner.

As various changes may be made in the form, construction and arrangement of the parts herein, without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in any limiting sense.

I claim:

1. In apparatus for treating a plurality of individual ends of yarn to increase the tensile strength thereof, the combination of a pull roll, power driven means for rotating said roll at a given surface speed, a second pull roll, power driven means for rotating said second roll at a higher surface speed than said first roll, said rolls each having a plurality of lengthwise spaced, annular, V-shaped grooves provided by surfaces meeting at an included angle of approximately thirty degrees for frictionally engaging and wedging the yarn therein to prevent slippage thereof in relation to said rolls, said grooves of each of said rolls corresponding in number and being arranged to cooperate for handling individual ends of yarn corresponding in number to the grooves of each of said rolls, and means arranged for guiding each individual end of yarn about each of said rolls for substantially less than one complete turn but at least about one half turn.

2. In apparatus for treating a plurality of individual ends of yarn to increase the tensile strength thereof, the combination of a pull roll, power driven means for rotating said roll at a given surface speed, a second pull roll, power driven means for rotating said second roll at a higher surface speed than said first roll, a third pull roll, power driven means for rotating said third pull roll at a higher surface speed than said second roll, said rolls each having a plurality of lengthwise spaced, annular, V-shaped grooves provided by surfaces meeting at an included angle of approximately thirty degrees for frictionally engaging and wedging the yarn therein to prevent slippage thereof in relation to said rolls, said grooves of each of said rolls corresponding in number and being arranged to cooperate for handling individual ends of yarn corresponding in number to the grooves of each of said rolls and means arranged for guiding each individual end of yarn about each of said rolls for substantially less than one complete turn but at least about one half turn.

3. In apparatus for treating a plurality of individual ends of yarn to increase the tensile strength thereof, the combination of a pull roll,

6

power driven means for rotating said roll at a given surface speed, a second pull roll, power driven means for rotating said second roll at a higher surface speed than said first roll, a third pull roll, power driven means for rotating said third pull roll at a higher surface speed than said second roll, a fourth pull roll, power driven means for rotating said fourth pull roll at a higher surface speed than said third roll, said rolls each having a plurality of lengthwise spaced, annular, V-shaped grooves provided by surfaces meeting at an included angle of approximately thirty degrees for frictionally engaging and wedging the yarn therein to prevent slippage thereof in relation to said rolls, said grooves of each of said rolls corresponding in number and being arranged to cooperate for handling individual ends of yarn corresponding in number to the grooves of each of said rolls, a guide roll adjacent to said first pull roll, a second guide roll between said first and second pull roll positioned to cooperate with said first guide roll for guiding each individual end of yarn about said first pull roll for substantially less than one complete turn but at least about one half turn, said second pull roll and said second guide roll being positioned to cooperate with each other for guiding the ends of yarn about said second pull roll for substantially less than one complete turn but at least about one half turn, a third guide roll between said third and fourth pull rolls positioned to cooperate with said second pull roll for guiding the ends of yarn about said third pull roll for substantially less than one complete turn but at least about one half turn, and a fourth guide roll adjacent said fourth pull roll, said third and fourth guide rolls being positioned to cooperate with each other for guiding the ends of yarn about said fourth pull roll for substantially less than one complete turn but at least about one half turn.

EDWARD A. WENTZ.

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