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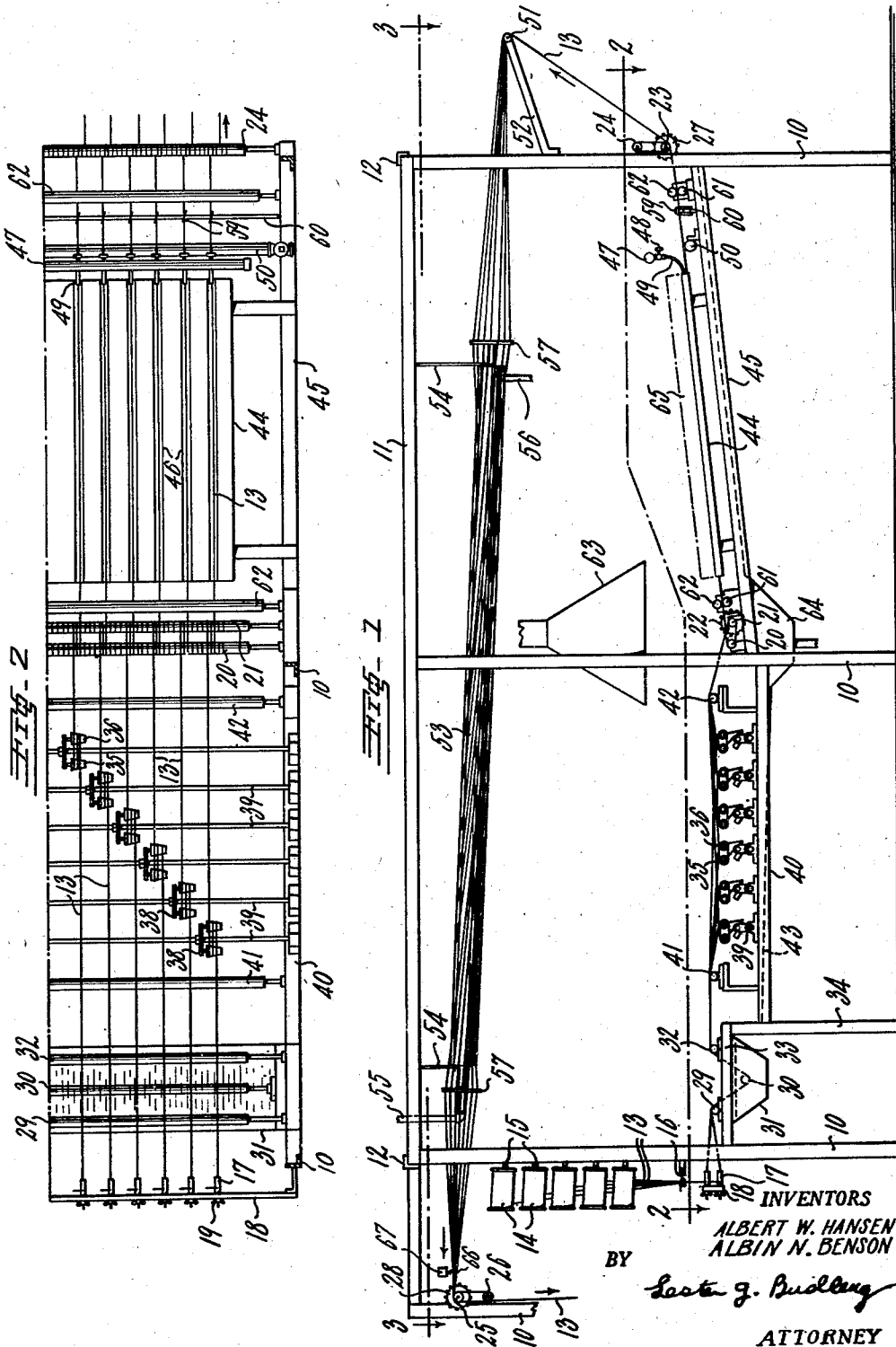
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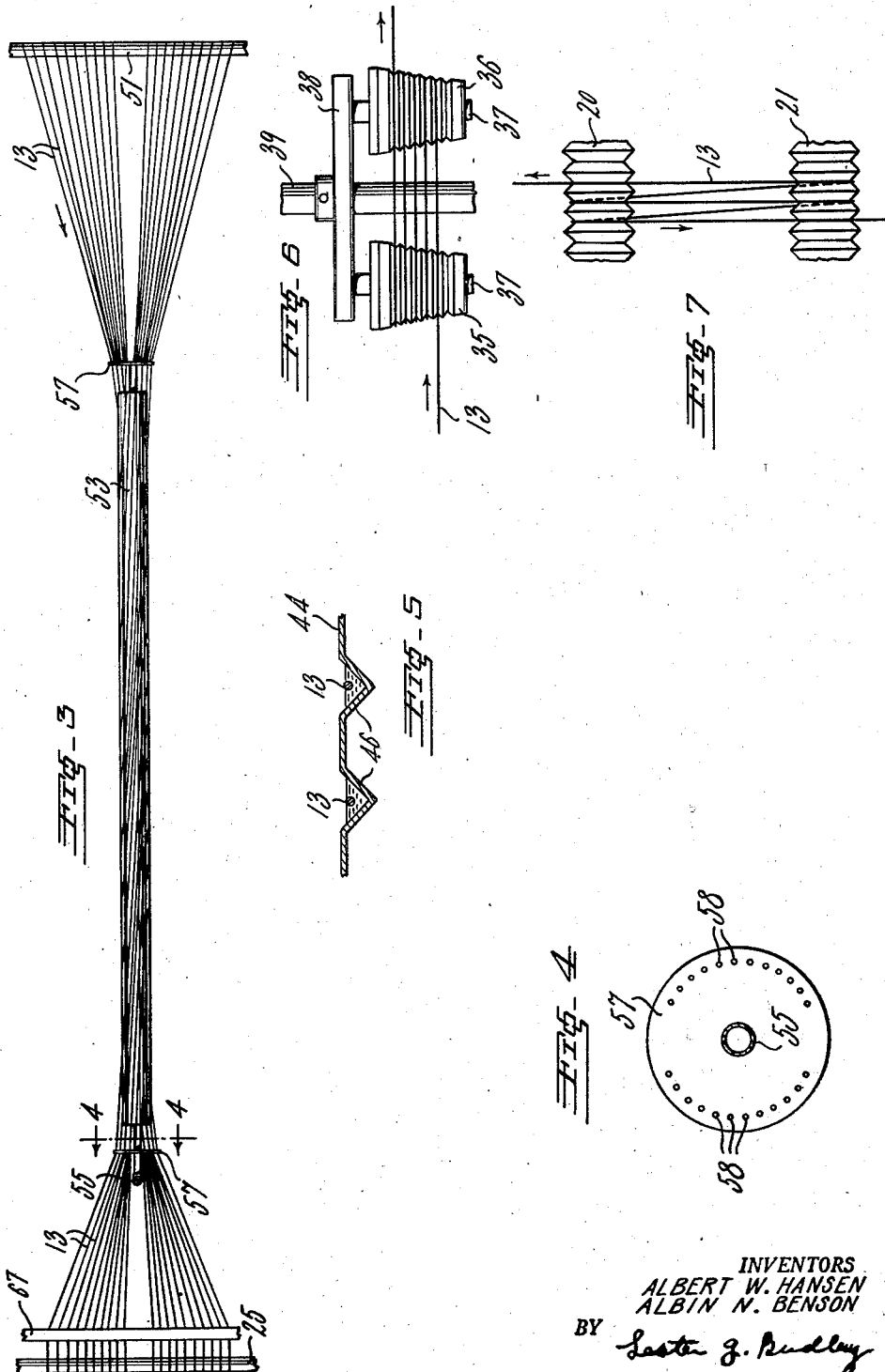
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METHOD OF AND APPARATUS FOR
TREATING YARN OR CORD

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This invention relates to a method of and apparatus for treating yarn, thread or cord to increase its tensile strength, and more particularly to a method and apparatus whereby an advancing yarn, thread or cord is subjected successively to a series of treatments that accumulatively improve its tensile strength, with the result that a total tensile improvement as high as 70% or higher can be secured.

This invention may be employed to increase the tensile strength of yarn, thread or cord formed of cotton, flax, hemp, jute or other fibers of vegetable origin, but has been developed more particularly to treat plied yarn formed of grey cotton fibers. The term "yarn" will be hereinafter used broadly in the specification and claims to include all of these textile strands unless otherwise limited by the wording used.

In carrying out the present invention the yarn is stretched in successive stages as it is advanced along a predetermined path of travel, and the yarn is preferably treated prior to the first stretching operation with an aqueous solution containing a wetting agent that will increase its tensile strength. The treated yarn is then partially stretched so as to reduce the remaining capacity of the yarn to stretch. It is then saturated with hot water that is close to the boiling point and while in this hot wet condition is stretched close to the breaking point. It is then quickly dried while retained in this highly stretched condition. As a result of these successive treatments very little capacity to stretch remains in the yarn but its tensile strength is greatly increased. Large quantities of plied cotton yarn treated in this manner have been given a tensile improvement of the order of 70% when tested at 70° F. and 60% relative humidity.

It has been known heretofore that the tensile strength of cotton yarn could be increased a few percent by stretching it either dry or when wet with water, and it also was known heretofore that the tensile strength of cotton yarn could be increased by stretching the yarn in hot water. Such prior treatments however do not give a tensile improvement anywhere near as high as the successive treatments contemplated by the present invention.

The present method and apparatus provide for the treatment of a number of yarns simultaneously by passing them along parallel paths in slightly spaced relation to each other. The treating of the yarns with the aqueous solution above mentioned preferably consists in wetting the yarns with water containing a wetting agent

which is capable of increasing the tensile strength of the yarn. The treating solution used may be one of those described in the Buckwalter Patent No. 2,297,536 as having the property of materially increasing the tensile strength of yarn, and as described in said patent the operation of wetting the yarn or cord with this solution may be practiced at room temperature.

The present invention will be more fully understood from the following description when read in connection with the accompanying drawings illustrating one good practical form of apparatus embodying the features of the present invention and adapted to treat yarn in accordance with the present method.

In the drawings:

Fig. 1 is a side elevation on a greatly reduced scale of apparatus for simultaneously treating a number of yarns in accordance with the present invention.

Fig. 2 is a section taken on the line 2—2 of Fig. 1, most of the parts being shown in plan view.

Fig. 3 is a similar view taken on the line 3—3 of Fig. 1, and showing the drying apparatus.

Fig. 4 is a section taken on the line 4—4 of Fig. 3 and shows a face view of a yarn guiding disc for guiding the yarns from the drying drum.

Fig. 5 is a transverse sectional view through a portion of the inclined drain board to be described.

Fig. 6 is a top plan view of a pair of tapered free-running yarn stretching rolls to be described, and;

Fig. 7 is a plan view of a pair of grooved yarn advancing rolls or lease rolls.

While the apparatus used to carry out the present invention may be varied considerably, that shown in the drawings has been employed to treat a large number of yarns simultaneously and continuously so that the unstretched yarns may be unwound from supply spools, and then treated on the apparatus as best shown in Fig. 1 and dried and wound up on take-up means, not shown.

In the construction shown the operating parts are supported by the rectangular frame which may be formed of angle irons and having the uprights 10, the horizontally extending rails 11 and the transversely extending rails 12. The yarns 13 to be treated are supplied by the spools 14 that are rotatably mounted upon the slightly inclined spindles 15. The arrangement is such that these spools may rotate upon the spindles 15 as the yarn is drawn therefrom and the spools may be prevented from rotating too freely by causing one

end of each spool to rest against a leather washer or other friction means. Five spools 14 are shown disposed in a row one above the other, and a number of such rows may be provided transversely of the machine so that a large number of yarns may be treated simultaneously. These yarns as shown pass downwardly from their respective spools 14 through the pigtaills 16, and then to the porcelain guides 17 each having a side opening through which the yarn enters the guide and a longitudinal central opening through which the yarn leaves the guide. The guides 17 are preferably so mounted upon the transversely extending supporting rail 18 that each guide may be rotated through an angle with respect to its longitudinal axis to vary the tension of the yarn and then clamped in the desired position of angular adjustment by tightening up the wing nut 19. This provides a convenient means for independently increasing or decreasing the tension of the different yarns.

The yarns 13 are positively pulled forward from the supply spools 14 by the pair of grooved pull rolls or lease rolls 20 and 21, disposed about half-way along the machine. One of these rolls 20 is free running and the other 21 is positively driven by the sprocket wheel 22. The arrangement is such that each yarn 13 is passed around these spaced grooved rolls two or more times, as best shown in Fig. 7, to thereby avoid slippage of the yarns about the rolls, and since one roll is positively driven the other roll will be rotated by the belt-like action of the runs of yarns passing from one roll to the other.

The first pair of lease rolls 20 and 21 is as shown in Figs. 1 and 2 disposed about midway between the ends of the machine. A second and similar pair of lease rolls 23 and 24 is provided near the right-hand end of the machine, and a third pair of lease rolls, 25 and 26, is provided at the left-hand end of the frame and near the top of the frame as shown in Fig. 1. Each pair of lease rolls has one roll thereof positively driven by a sprocket wheel such as 22 for the roll 21, 27 for the roll 23 and 28 for the roll 25. The arrangement is such that the roll 21 is positively driven at a predetermined speed and the roll 23 is driven at a slightly higher speed, whereas the roll 25 is driven at the same speed as 23. The effect of this is to subject the yarns to a substantial stretching action as they pass from the pair of lease rolls 20, 21, to the second pair of lease rolls 23, 24, and then maintain the yarns in this stretched condition as they travel from the lease rolls 23, 24 to the third pair of lease rolls 25, 26.

As the yarns 13 are pulled forward from the supply spools 14 by the first pair of lease rolls 20 and 21, they pass from the porcelain guides 17 over a free-running roller 29 and then downwardly under the free-running roller 30 mounted in the tank 31 below the level of the liquid in this tank and then upwardly over the free-running roller 32. The tank and rollers are shown as supported by the horizontally extending rails 33 and uprights 34.

The tank 31 preferably contains an aqueous solution of alkali rosinate, or other solution proposed by the Buckwalter patent above cited. Such a solution has good penetrating properties and will thoroughly wet the yarns even when they are passed rapidly through the liquid in the tank 31.

The yarns may be stretched slightly or not, as desired by the porcelain guides 17. The yarns are then preferably stretched a substantial

amount, say approximately 5% for a yarn having a known stretch capacity of about 10% to 12%. An extremely satisfactory way to impart this stretch to the yarns is to provide the grooved free-running tapered rolls 35 and 36 which are best shown in Fig. 6. Each of these rolls is rotatably supported by a spindle 37 projecting laterally from a bracket 38 that is secured to a transversely extending supporting bar 39, which bar is mounted between the longitudinally extending side rails 40 of the machine frame as shown in Fig. 1. The arrangement is such that each yarn to be stretched approaches these free-running rolls near their smaller ends and then advances around the pair of tapered rolls in successive runs towards their larger ends to gradually stretch the yarn as it is pulled forward from the source of supply by the lease rolls 20 and 21. The amount of stretch imparted to the yarn may be increased or decreased by varying the number of such yarn runs. The operation of these free-running groove rolls is more fully disclosed and claimed in the Killette Patent No. 2,148,162, Apparatus for stretching cords.

Several of these pairs of free-running stretching rolls are shown in Figs. 1 and 2, and in Fig. 2 they are shown in staggered relation to each other so as to accommodate a large number of yarns. In practice a much larger number of these rolls may be employed than shown. These rolls can be operated to remove any desired portion of the total stretch capacity of the yarns and the stretching at this point serves also to force out of the yarns the excess liquid absorbed while passing through the tank 31. As the yarns approach these tapered stretching rolls they pass over the free-running roller 41 and as they leave the stretching rolls they pass over a second free-running roller 42. The purpose of these rollers is to hold the yarns elevated so that they will not drag upon the stretching rolls 35, 36. As the yarns leave the tank 31 they will carry with them some of the treating solution from the tank and the solution which drops from the yarns will fall upon the drain apron 43.

The partially stretched yarns 13 pass directly from the roller 42 to the lease rolls 20 and 21 the latter of which is positively driven at a slower speed than the lease roll 23 as above mentioned. This serves to stretch the portion of each yarn passing from one pair of lease rolls 20, 21 to the other pair of lease rolls 23, 24, say somewhere near 5%, depending upon the stretch capacity of the yarn and other conditions.

It is known that in order to produce a high tensile improvement it is important to stretch the yarns as near to the breaking point as possible, without producing so many breaks in the yarn as to seriously interfere with the operation of the apparatus. Applicants have found that if the chemically treated yarns are stretched in two or more stages and are thoroughly saturated with hot water while undergoing the final stretching stage, they can be stretched very close to, and in some cases, slightly beyond the known stretch capacity of the yarn, since the hot water increases the tensile strength of the yarns and may make them more ductile so as to increase their capacity to stretch, and the stretching in successive stages gives better control of the critical tension and has other advantages.

In order to treat these yarns with extremely hot water during the high stretching operation, and also to wash from the yarns any excess amount of the treating solution which may re-

main on the surface thereof, the inclined grooved wash board 44 is provided which is mounted between the first and second pairs of lease rolls and is supported by the inclined rails 45 as shown in Figs. 1 and 2. The wash board 44 is provided with the water receiving grooves 46 as best shown in Fig. 5, the arrangement being such that one yarn 13 travels upwardly along each groove in slightly spaced relation to the floor thereof while the hot water flows down such groove, to saturate the yarn and wash it with clean hot water. The hot water which preferably has a temperature above 160° F. is conveniently supplied to each of these grooves 46 from the hot water pipe 47 having the adjustable cocks 48 and tubes 49 extending from this pipe into each groove 46. These grooves may be placed closer together than shown in the drawings.

As the yarns 13 leave the upper end of this wash board, it is desirable to remove the excess hot solution therefrom to increase the speed at which the yarns can be dried and reduce the solids deposited on the yarn surface. This may be done by providing the vacuum pipe 50 having slots formed in its upper wall to receive each yarn 13. The yarns then pass around the lease rolls 23, 24 and from the lower roll 23 they pass upwardly around the free-running roller 51 which is supported by the brackets 52 at some distance from the right-hand end of the machine frame as shown in Fig. 1. The purpose in spacing the free-running roller 51 a substantial distance from the end of the machine frame is to permit the highly tensioned yarns to travel a substantial distance from the roller 51 in as near a straight line as possible as they converge inwardly, as shown in Fig. 3, to a position to contact the long tubular drying drum 53, to be dried as they travel against the outer surface of this drum.

In the machine in use the drum 53 is formed of a steel tube many feet long and about 4 inches in diameter and the outer surface has a smooth non-corroding finish over which the yarns slide in direct contact therewith. This drying drum is shown in Fig. 1 as supported at a slight inclination by the rods 54 extending downwardly from transverse bars, not shown, but carried by the longitudinally extending rails 11. The diameter of this drum is exaggerated in the drawings.

The drum 53 is heated by superheated steam to a temperature around 280° F., and to this end there is provided the inlet pipe 55 and outlet pipe 56. It is found desirable to cause the yarns to pass spirally with a long pitch about the drum 53 so as to cause them to remain in firm contact with the outer surface of the drum as they travel from one end thereof to the other. To this end there is provided at each end of the drum a guide disc 57 having formed therein the yarn guiding apertures 58 shown in Fig. 4. The yarns 13 pass through the apertures 58 in one disc as they approach the drum and then spirally about this drum through an angle of approximately 360° and then outwardly through the apertures in the second disc 57 as they leave the drum, whereupon they pass to the third lease rolls 25 and 26, which as above stated are operated at the same speed as the lease rolls 23 and 24 so as to prevent the yarns from shrinking while they are being dried.

The yarns upon leaving the third lease rolls 25, 26 are finished so far as the present method is concerned and should be sufficiently dry to be wound into packages.

It is difficult to stretch the various yarns close to the breaking point without having a yarn break occasionally. Such breakage usually occurs in the vicinity of the wash board 44 due to the high tension of the yarns in this area. In order promptly to stop the machine when a break occurs, it is desirable to provide each yarn with a drop wire 59 associated with a transversely extending bar 60 which is connected to a source of electric energy and operates in a well-known manner to stop the machine when a yarn breaks and permits its drop wire 59 to drop into contact with the upper edge of the bar 60.

When a yarn breaks it is desirable to prevent the same from becoming unwound from the free-running stretching rolls 35, 36, and also from the spaced lease rolls, as it takes time to rewind a yarn about such rolls by hand. To this end there is provided a pair of yarn holding rollers near each end of the wash board 44, and consisting of a metal lower free-running roller 61 and an upper rubber roller 62 which rests upon the yarns to hold the loose ends of a yarn between these rollers when it breaks.

In order to carry off the steam and hot moist air from the wash board it is desirable to provide the steam hood 63 positioned above the lower end of the wash board, and also provide the drain basin 64 into which the water from the board 44 may escape. A cover 65 disposed over the wash board 44 helps to lessen the cooling of the hot water and to reduce the escape of the hot moisture therefrom.

All three pairs of lease rolls are preferably driven from a single source of power, not shown, to make sure that the proper speed ratio will be maintained between these rolls throughout the operation of the machine.

In order to bring the yarns 13 into a single horizontal plane upon leaving the drying drum 53 and to cause them to diverge as shown, each yarn is led through a pigtail guide 66 secured to the fixed bar 67 disposed near the upper lease roll 25.

The apparatus described is extremely well adapted to treat yarn in accordance with the present invention, since the first pair of lease rolls 20, 21, second pair of lease rolls 23, 24 and third pair of lease rolls 25 and 26 accurately control the stretch of the yarn during the hot water and drying stages, and the free-running stretching rolls 35 and 36 will stretch the yarn any desired amount depending upon the number of runs of the yarn that are placed around a pair of such rolls. The rolls 35 and 36 may be used to remove the stretch from the yarn until there remains only a known definite percent, and the first and second pairs of lease rolls will then remove a further definite percent of stretch so that the amount of stretch that still remains in the yarn can be accurately controlled, and the stretch of the yarn brought close to the breaking point. For example a yarn having a known stretch capacity of 11% may be stretched 5% by the free-running stretching rolls and 5% by the lease rolls so that the finished yarn will have about a 1% stretch capacity.

The treatment of the present invention may also be used to remove a large percent of the treating solution absorbed by the yarn from the tank 31, since the free-running stretching rolls 35 and 36 will force a considerable portion of the absorbed solution to the surface of the yarn where it will drop off, and the hot water washing will leave the surface of the yarn relatively

free of such solution, so that the present high increase in tensile strength can be secured without coating the yarn or appreciably increasing its content of added solids. Furthermore the stretching of the yarn reduces its diameter so that the finished strengthened yarn is smaller than the original untreated yarn.

The present invention, as above stated, was developed primarily for the treatment of cotton yarn, but it may be employed to improve the tensile strength of yarns, threads or cords formed of various vegetable fibers.

Having thus described our invention, what we claim and desire to protect by Letters Patent is:

1. Apparatus for treating yarn to increase its tensile strength comprising in combination, a source of yarn supply, a power driven pull roll for pulling the yarn forward from the source of supply, means for wetting the yarn with water containing a wetting agent, free-running stretching rolls adapted to be operated by the advancing pull upon the yarn to partially stretch the wet yarn, means for saturating the partially stretched yarn with hot water, a second pull roll operated at a higher surface speed than the first roll to stretch the hot wet yarn close to the breaking point, a heated drier, and a third pull roll for advancing the yarn past the drier and operable to keep the yarn stretched as it dries.

2. Apparatus for treating simultaneously a number of yarns to increase their tensile strength comprising in combination, a power driven pull roll for pulling the yarns forward in parallel relation from their sources of supply, means for wetting the yarns with water containing a wetting agent, stretching units for the wet yarns disposed in staggered relation to each other and each unit comprising a pair of free-running tapered rolls adapted to be operated by the advancing pull upon its yarn to partially stretch the yarn, means for saturating the partially stretched yarns with hot water, a second pull roll operated at a higher surface speed than the first roll to stretch the hot wet yarns close to the breaking point, a heated drier, and a third pull roll for advancing the yarns past the drier under tension.

3. Apparatus for treating simultaneously a number of yarns to increase their tensile strength comprising in combination, a power driven pull roll for pulling the yarns forward in parallel relation from their sources of supply, stretching units for the yarns disposed in staggered relation to each other and each unit including a pair of free-running tapered rolls adapted to be operated by the advancing pull upon its yarn to partially stretch the same, means for saturating the partially stretched yarns with hot water, a second pull roll operated at a higher surface speed than the first roll to stretch the hot wet yarns close to the breaking point, a heated drier, and a third pull roll for advancing the yarn past the drier in a stretched condition.

4. Apparatus for treating simultaneously a number of yarns to increase their tensile strength comprising in combination, a power driven pull roll for pulling the yarns forward from their sources of supply, free-running stretching rolls adapted to be operated by the advancing pull upon the yarns to partially stretch the yarns, means for saturating the partially stretched yarns including inclined troughs down which streams of hot water flow as the yarns travel up these troughs, a second pull roll operated at a higher surface speed than the first roll to stretch

the hot wet yarn close to the breaking point, a heated drier, and a third pull roll for advancing the yarn past the drier under tension.

5. Apparatus for treating yarn to increase its tensile strength comprising in combination, a pair of spaced pull rolls about which the yarn is wound in successive runs and one of which rolls is power driven to pull the yarn forward from a source of supply, a pair of tapered free-running stretching rolls about which the yarn is wound in successive runs and adapted to be operated by the advancing pull upon the yarn to partially stretch it, means for saturating the partially stretched yarn with hot water, a second pair of said pull rolls operated at a higher speed to stretch the hot wet yarn close to the breaking point, a heated drier for said yarn, and a third pair of said pull rolls adapted to pull the yarn past the drier and maintain it stretched.

6. Apparatus for treating a continuously advancing yarn to increase its tensile strength comprising in combination, a source of yarn supply, a power drive pull roll for pulling the yarn forward from the source of supply, a pair of tapered free-running stretching rolls adapted to be operated by the advancing pull upon the yarn to stretch the yarn sufficiently to reduce its capacity of stretch to a definite selected percent, means for wetting this yarn with hot water, a second power driven pull roll operable to stretch the hot wet yarn a predetermined amount close to the breaking point, and means for drying the advancing stretched yarn under sufficient tension to keep it from contracting appreciably, whereby an increase in tensile strength of over 50% is secured.

7. The method of subjecting a cotton yarn to a series of treatments that accumulatively improve its tensile strength in one continuous operation, which consists in pulling a cotton yarn forward from a source of supply and wetting it with an aqueous solution at approximately room temperature and which contains as an ingredient thereof a chemical wetting agent capable of increasing the tensile strength of the yarn and stretching the advancing yarn approximately half of its capacity to stretch while wet with such solution, then subjecting the yarn to water at a temperature ing point while hot and wet, and then drying the yarn while it is advancing under sufficient tension to prevent appreciable shrinkage, to thereby impart to such yarn as it travels between two distant points an increased tensile strength of over 50% and a low capacity to stretch after such treatment.

8. The method of subjecting a grey cotton yarn to a series of treatments that accumulatively improve its tensile strength in one continuous operation, which consists in pulling such yarn forward from a source of supply and wetting it with an aqueous solution at about room temperature and which contains as an ingredient thereof a chemical wetting agent capable of increasing the tensile strength of the yarn and stretching the advancing yarn approximately half of its capacity to stretch while wet with such solution, then subjecting the yarn to water at a temperature far above that of the aqueous solution and above 160° F. and stretching close to the breaking point while hot and wet, and then drying the yarn while it is advancing under sufficient tension to prevent appreciable shrinkage, to thereby impart to such yarn as it travels between two distant points an increased tensile strength of over

50% and a low capacity to stretch after such treatment.

9. The method of subjecting yarn formed of fibers of vegetable origin to a series of treatments that accumulatively improve its tensile strength in one continuous operation, which consists in pulling such yarn forward from a source of supply and wetting it with an aqueous solution at about room temperature and which contains as an ingredient thereof a chemical wetting agent capable of increasing the tensile strength of the yarn and stretching this advancing wet yarn a substantial amount, then subjecting the yarn to water at a temperature far above that of the aqueous solution and above 160° F. and stretching close to the breaking point while hot and wet, and then drying the yarn by exposing it to a high temperature while it is advanced under sufficient tension to prevent appreciable shrinkage, to thereby impart to such yarn as it travels between two distant points an increased tensile strength of over 50% and a low capacity to stretch after such treatment.

10. The method of subjecting yarn formed of fibers of vegetable origin to a series of treatments that accumulatively improve its tensile strength in one continuous operation, which consists in pulling such yarn forward from a source of supply and wetting it with an aqueous solution at about room temperature and which contains as an ingredient thereof a chemical wetting agent capable of increasing the tensile strength of the yarn and stretching this advancing wet yarn a substantial amount, then washing and stretching this yarn by advancing it under high tension against a stream of water flowing in the opposite

direction and which has a temperature far above that of the aqueous solution and near the boiling point, and then drying the yarn by exposing it to a high temperature while it is advanced under sufficient tension to prevent appreciable shrinkage, to thereby impart to such yarn as it travels between two distant points an increased tensile strength of over 50% and a low capacity to stretch after such treatment.

11. The method of subjecting yarn formed of fibers of vegetable origin to a series of treatments that accumulatively improve its tensile strength in one continuous operation, which consists in positively advancing the yarn along a predetermined path and successively stretching the yarn in not less than two stages along such path so that its final tension is close to the breaking point, wetting the yarn as it travels along said path with an aqueous solution at about room temperature and which contains as an ingredient thereof a chemical wetting agent capable of increasing the tensile strength of the yarn and stretching a substantial amount, then wetting the yarn with water at a temperature above 160° F. and far above that of the aqueous solution so that it will be wet and hot and further stretching close to the breaking point, and then drying the yarn by exposing it to a high temperature while it is advanced under sufficient tension to prevent appreciable shrinkage, to thereby impart to such yarn as it travels between two distant points an increased tensile strength of over 50% and a low capacity to stretch after such treatment.

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