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APPARATUS FOR STRESSING STRAND MATERIALS

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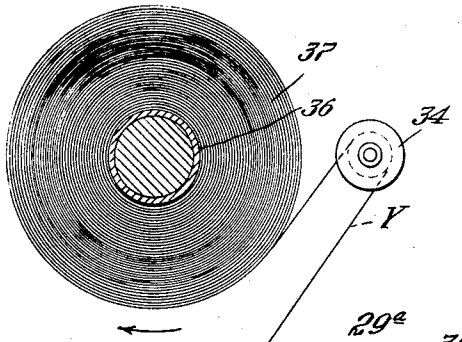


Fig. 1

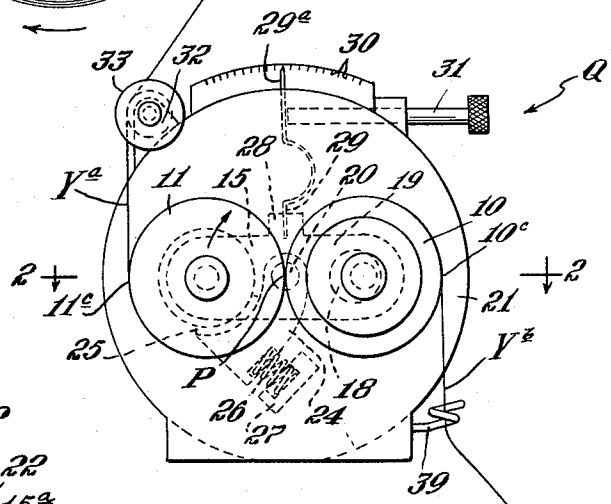
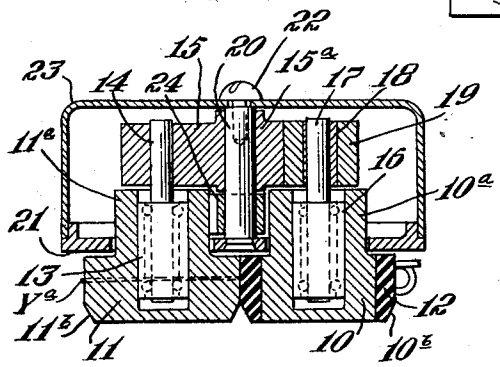


Fig. 2



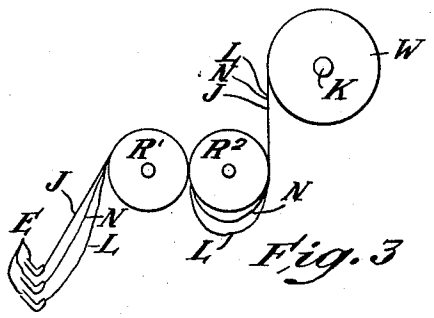
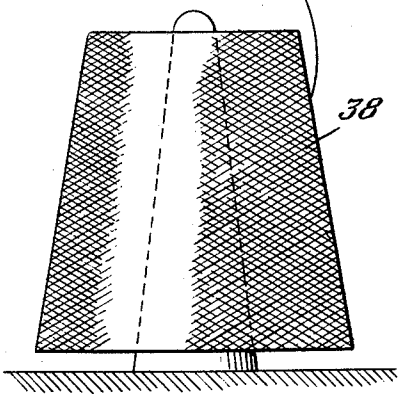


Fig. 3



Inventor
Frank Honig
by Roberts, Cushman & Grover
Att'ys.

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APPARATUS FOR STRESSING STRAND MATERIALS

Frank Honig, Edgewood, R.I.

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8 Claims. (Cl. 28—71.3)

This invention relates to novel apparatus used in the preparation of textile packages in which the wound strand may consist of one or a plurality of filaments and in which the package may be of self-sustaining type wound on a headless core. The strand which forms such a package may consist of staple fibers or of synthetic tow or other continuous filaments and may be supplied to the winding means, twisted or untwisted, from a previously wound supply package, or, when used in a continuous process, directly from the delivery end of a filament-forming apparatus.

Prior art apparatus useful in stressing a twisted strand, either for winding a package, for elongating the filaments comprising the strand, or for attenuating the filaments comprising the strand to provide molecular orientation within the filaments, tended to abrade the strand filaments, to strip some filaments from the strand, or to back up the strand twist toward the package from which the strand was supplied. Back-up of a strand twist could be reduced by protective sizing or agglutination of the strand filaments, but this protective material later had to be removed and the process as a whole was therefore expensive.

One of the objects of the present invention is to provide means for use in winding a self-sustaining package from strand material such as above described, thereby to insure that each individual constituent filament of the tow or strand, whether or not the strand is comprised of twisted filaments, no matter what particular position such filament may occupy in a given convolution in a wound package, will be wound with a degree of tension such that each individual filament will effectively contribute to resist the bursting action of centrifugal force when the wound package is rotated at high speed.

Another object is to provide for the attenuating or winding, or both, of a strand comprising bunched or twisted filaments, staple fibers, or both, at any stress from zero (practically speaking) to a stress just below the breaking point of said strand, without requiring sizing or agglutinization of the strand, while maintaining the initial, substantially uniform twist throughout the entire length of said strand, that is, without backing up the twist in the strand towards the supply package, which, otherwise, would cause localized twist gradient or twist variation in sections of the strand.

Another object is to provide a resilient, positive, rolling gripping point for the strand or tow, and to locate said point in a neutral position with respect to the fluctuating longitudinal stresses in said strand or tow, so that it will always maintain a positive gripping action independently of any stress variation inherent in the strand or tow being operated on, that is to say, to provide a constantly shifting, positively gripping pinch zone capable of holding a filament or strand with any force from practically zero to the breaking point of the filament or strand without in any way damaging, as by abrasion, distortion, or otherwise, a continuous filament, and without removing any of the fibers from a strand comprising

staple fibers as by stripping, for example: in other words, a positive pinch zone which is neutral in its action.

A further object is to provide for the winding of a self-supporting package on a tubular core, without head or flanges, in such a way that said package may be mounted on and rotated by a spindle at a rotative speed equivalent to a centrifugal disrupting force produced by a peripheral speed of from say 150 to 400 miles per hour, more or less, on the outside periphery of the yarn package, without exploding said package.

Another object is to provide apparatus for tensioning yarn to be mercerized without backing up twist in the yarn towards the supply package and without stripping filaments or fibers from the yarn.

The novel apparatus, in accordance with the invention and for use in attaining the above objects, comprises a set of strand controlling rolls adapted to receive a strand therebetween at low and sometimes valuable stresses and to deliver the strand therefrom at higher and more uniform stress, and means which can be adjustably set, for determining the amount of stress in the delivered strand. The apparatus is preferably utilized where the operation is primarily of a winding or rewinding nature, in situations where a filament, tow, strand or yarn is wound up into a package at the takeup end of continuous yarn-spinning apparatus or where it is rewound from one type of package to another type of package as desired in processing such filament, tow, yarn or strand, and where the stresses to be exerted on the strands or filaments are relatively low. For example, the single set of rolls is useful when a comparatively small percentage of linear attenuation of some or all of the constituent filaments of a strand is desired either to equalize any length variation in the individual filaments of which the strand is comprised or to stress all filaments of a strand having filaments normally of equal length for winding the strand on a circular core; when it is desired to discharge or withdraw the strand at a uniform and predetermined higher stress than that at which it is received, and simultaneously to maintain substantially uniform twist throughout the entire length of the strand, withou backing up the twist towards the supply end of the strand being operated on; or when it is desired to prevent waste formation of staple fiber yarns or damage, as by abrasion for example, to continuous filaments.

Other objects, advantages and details of construction will be more fully described by reference to the accompanying drawings in which:

Fig. 1 is a more or less diagrammatic front elevation, showing an embodiment of the invention in which a single pair of rolls is used, the apparatus being illustrated as in use for a rewinding operation suitable for the preparation of a package subsequently for use to be mounted on a high speed twisting spindle or similar apparatus;

Fig. 2 is a section on the line 2—2 of Fig. 1; and

Fig. 3 is a diagram illustrative of a situation in which the present invention is of particular utility.

Referring to the drawings, Fig. 3 diagrammatically illustrates a condition which commonly occurs in the preparation of synthetic filament tow. Three spinnerets E are shown as extruding the filaments J, N and L, respectively, which pass between the rolls R^1 and R^2 and are then wound on the winding spindle K to form the package W. Among the three filaments illustrated, the one designated J is taut between the spinneret and its point of contact with the roll R^1, and in consequence this filament is wound under constant tension into the package W. Filament N is not taut between the spinneret and the roll R^1, while the filament L is still more slack. Consequently, the filaments N and L, as wound into the package W, are not under the same tension as the fila-

ment J and if, at some later time, the package W is rotated at high speed only the filament J is effective to resist centrifugal bursting forces. The apparatus provided by this invention is designed to change the length of the filaments comprising such bunch so that, while the bunch is wound in convoluted form on a core, each filament will be tensioned to effectively contribute to resisting the bursting action of centrifugal force when the wound package is subsequently rotated at high speed. When all of the filaments are thus wound under substantially the same tension, they all effectively and concomitantly resist centrifugal bursting force so that the package is able to withstand high speed rotation without disintegrating.

Referring to Fig. 1, the convolute tension equalizing unit Q is shown as comprising a yarn-receiving roll **10** and a yarn-discharging roll **11**. Roll **10** is provided with a resilient, yarn-contacting covering or tire **12** (Fig. 2), preferably made of some natural or synthetic rubber compound, cork or similar material, and which is fixed to the roll **10** by any conventional means.

The roll **11** is usually made of hardened steel or some equivalent material, and may be chromium plated on its periphery to prevent corrosion which would damage the delicate filaments coming in contact therewith. Roll **11** is rotatably mounted on a double-row, anti-friction bearing **13** (Fig. 2) which has its inner stud **14** press-fitted into one arm **15** of a balance scale beam **15a**.

The roll **10** is rotatably rounted on a double-row, anti-friction bearing **16** (Fig. 2) with its inner stud **17** press-fitted into an eccentric **18**. The eccentric **18** is rotatable in the arm **19** of balance scale beam **15a**. The arrangement is such that by rotating the eccentric **18** the axis of the roll **10** may be moved toward or from that of roll **11** so that the resilient tire **12** of roll **10** may be pressed into pinching relation with the periphery of roll **10** to provide a pinch or nip point P (Fig. 1) for the yarn Y.

The balance scale beam **15a** is freely pivoted on a stationary stud **20** riveted at its forward end into a rigid housing **21** (Fig. 2). A screw **22**, having threaded engagement with an axial bore in the rear end of stud **20**, serves to fasten a cupped back cover plate **23** to the housing **21**. The axes of the rolls **10** and **11** are in the same plane with the axis of stud **20** so that the pinch point P is in a neutral position with respect to any movement or lack of movement of the scale beam **15a**. Variation in pinching pressure between the rolls or variation in stresses in the yarn Y, as it passes through this point, will have no effect on the movement or lack of movement of the scale beam **15a**.

The rolls **10** and **11** have elongate hub portions **10a** and **11a**, respectively, which pass freely through horizontally elongate slots in the housing **21**.

An arm **24** (Figs. 1 and 2) is pivoted on stud **20** at a point between the scale beam **15a** and the housing **21**. The free lower end of arm **24** is provided with a friction brake lining **25** (Fig. 1) which may bear against the periphery of hub **11a** of roll **11**, being urged toward said hub by a compression spring **26** whose lower end is supported on a fixed lug **27** projecting from the housing **21**.

Compression spring **26** has a limited amount of extension so that it will follow the swinging movement of scale beam **15a** with decreasing, resilient pressure of the brake lining against the hub **11a** (up to the end of its limited movement) when the movement of said beam is clockwise. Beyond that point the hub **11a** will no longer contact the brake lining of the arm **24**. When the motion of the beam **15a** is counterclockwise, the arm **24** will follow such motion with increasing resilient pressure of the brake lining against the hub **11a** of roll **11**. Of course any other conventional means for applying the retarding or braking action on the roll may be used, in lieu of the spring and brake lining just mentioned.

The balance beam **15a** is provided with a lug **28** near its central portion (Fig. 1) into which is fastened a spring **29** of flat steel. The other end **29a** of spring **29** projects through an opening (not shown) in the rim of the cover **23** and serves as an indicator of the pressure or load on the scale beam **15a**. Indicator scale graduations are formed on a part of cover **23**, as indicated at **30**. An adjusting thumb screw **31** is provided for applying any desired load within the capacity of the particular embodiment to the scale beam **15a**, and (by reason of the retarding action of the brake lining) to the strand material passing between the rolls **10** and **11**.

The housing **21** is provided with an integral lug **32** (Fig. 1) which supports a freely rotating, grooved idler roll **33** adapted to guide the yarn Y away from the mechanism.

A freely rotating yarn-guiding, grooved idler roll **34** (Fig. 1), carried by a conventional reciprocating distributor arm (not shown) of a winder, serves to distribute the yarn Y as it is being wound on a headless core **36** to form the desired type and size of yarn packaged indicated at **37**. The supply package is indicated at **38** and it may be a cone, as shown, or any other form of supply package desirable or convenient. Any other suitable supply may be employed. For example, the yarn may be received directly from the filament-forming apparatus.

As illustrated, the yarn is taken from a non-rotating package over-end through a conventional guide **39** fast to housing **21**. This imparts a slight twist, one twist for each convolution taken from package **38**. The yarn wraps the roll **10** with about one-half a turn, then passes between the rolls at the pinch point P, and then wraps roll **11** with about one-half a turn. It then passes up over the grooved guide idler **33** and distributing idler **34** and is wound up on core **36** which is driven by any conventional winding machine mechanism (not shown). To permit rapid threading of the device, the rolls **10** and **11** are provided with rounded taper front ends, as indicated at **10b** and **11b** (Fig. 2).

In operation the pinch point P (Fig. 1) is at a neutral or zero point, that is to say, at the fulcrum of the beam **15a**. In effect, the tangent points of the yarn with rolls **10** and **11**, indicated at **10c** and **11c**, define the leverage length of the scale beam **15** through which the stresses are balanced by the yarn being operated on.

By this arrangement a gradually increasing or decreasing retarding force is applied by the rolls **11** and **10**. The change in the retarding force is very smooth and gradual and yet so sensitive in response to rapid stress surges that winding speeds well above 3,000 feet per minute may be employed. Very satisfactory packages may be made with as high as 10,000 feet per minute winding velocity when winding certain strand materials.

For example, assuming that the desired loading stress has been set by the screw **31**, the delivery portion Y^a of the yarn will be pulled through the device under that stress. Should there be, for some reason, an increase in the stress at Y^a it will lift up or rock the roll assembly about pivot **20** clockwise and thus reduce the normal retarding force of the friction brake lining **25**.

On the other hand, should there be a stress increase (resistance to travel) in the incoming yarn end Y^b, this part of the yarn will likewise rock the roll assembly clockwise about pivot **20** and reduce the normal retarding force of the friction brake lining **25**. Thus, stress uniformity may be controlled by either or both the incoming or outgoing portions of the strand material, independently of one another or jointly, as the case may be.

Since the yarn is held by the pinching action of the rollers in a rolling contact (as contrasted with a frictional pressure), located in a neutral position, any twist initial in the yarn will remain undisturbed, that is to say, it will not be backed up towards the supply package **38**, as happens when a twisted strand is passed between frictional retarding elements, or an element with 360 or more degrees of wrapping thereon; thus, the initial distribution of twist is maintained in the yarn of wound package **37**.

In the arrangement shown in Figs. 1 and 2, the oper-

ating power is transmitted from the driven core 36 through the yarn end Y^a. This arrangement is, in general, used when the attenuation of the filament is to take place for temporary circumferential length equalization purposes, or when the total attenuation is held to a low point, say about 1% to 5%, more or less, depending on the size and on the particular material which is to be equalized.

When using this arrangement, the yarn being discharged is always under some stress, depending on the adjustment. It is thus particularly advantageous for use in re-winding the yarn from one form of package to another form of package where some stress in the package is desirable, such, for example, as when the package is to be used in subsequent twisting operations at very high speeds, or for the mercerization of cotton yarn.

This application is a division of my copending application Serial No. 295,439, filed June 25, 1952, now U.S. Patent #2,738,144.

While certain desirable embodiments have herein been illustrated and described, it is to be understood that the invention may have various embodiments without departing from the spirit and scope of the invention as set forth in the appended claims.

I claim:

1. In apparatus of the class described wherein yarn from a supply passes between two rolls which turn about parallel axes on its way to a power-driven winding device, the rolls being mounted on the opposite arms, respectively, of a scale beam, means guiding the yarn from the supply so that it first contacts one roll at a point which is in a plane passing through the axes of the two rolls, means guiding the yarn to leave the other roll at a point which is in the aforesaid plane, a brake for retarding the rotation of the latter roll, a spring arm fixed to the scale beam, and adjustable means for applying force to said spring arm thereby to rock the scale beam in a direction to cause the brake to apply a predetermined normal retarding force, the parts being so constructed and arranged that abnormal tension in the yarn which leads from the supply or in the yarn which leads to the winding device creates force tending to swing the scale beam oppositely to the direction in which it is urged by said spring arm.

2. In combination in apparatus of the class described wherein yarn from a supply mass passes between two rolls which turn about parallel axes, a bearing for each roll, a centrally fulcrumed scale beam supporting said bearings at opposite sides of and at substantially equal distances from the fulcrum, a brake for retarding rotation of one of said rolls, means urging the scale beam in a direction to create pressure between the brake and the roll with which it cooperates, and means for guiding yarn from the supply mass in a direction to approach and tangentially to contact one of said rolls at a point adjacent to one end of the scale beam and to leave the other roll at a tangent point adjacent to the other end of the scale beam, the force exerted by the strand in leaving the latter roll being so directed as to tend to swing the scale beam in a direction to reduce the brake pressure.

3. In combination in apparatus wherein strand from a supply is wound upon a rotating core, a pair of rolls turning about parallel axes, the strand passing between the rolls on its way from the supply to the core, the axes of the rolls being so spaced apart that the yarn is pinched in passing between the peripheral surfaces of the rolls, means, comprising a member mounted to rock about a fixed axis parallel to the axes of the rolls, for supporting said rolls for bodily, concomitant equal motion in opposite directions, means guiding the yarn from the supply into contact with one roll at a point such that the resistance to withdrawal of the yarn from the supply creates a force tending to move the last-named roll bodily in one direction, means guiding the yarn to leave the other roll at a point such that the tension exerted by the rotating core creates a force tending to move the second roll bodily in a direction opposite to that in which the first roll tends to move, means for adjustably opposing such bodily motion of the rolls, brake means comprising a surface coaxial with one of said rolls and spaced from the yarn-contacting surface of said roll, and a movable brake-shoe co-operable with said brake surface and whose position, with respect to said brake surface, varies in accordance with the position of the member which supports the rolls.

4. Apparatus, according to claim 3, further characterized in that the support for the two rolls is a centrally fulcrumed scale beam having the rollers mounted adjacent to its opposite ends and at equal distances from its fulcrum.

5. In combination in apparatus wherein strand from a supply is wound upon a rotating core, a pair of rolls turning about parallel axes, the strand passing between the rolls on its way from the supply to the core, means comprising a centrally fulcrumed scale beam for supporting said rolls for bodily, concomitant equal motion in opposite directions, means guiding the strand from the supply into contact with one roll at a point such that the resistance to withdrawal of the strand from the supply creates a force tending to move the last-named roll bodily in one direction, means guiding the strand to leave the other roll at a point such that the tension exerted by the rotating core creates a force tending to move the second roll bodily in a direction opposite to that in which the first roll tends to move, spring means for adjustably opposing such bodily motions of the roll, and bearings for the respective rolls arranged at opposite ends of the centrally fulcrumed scale beam, said spring means opposing tipping of the scale beam in response to the force exerted by the strand.

6. In combination in apparatus wherein yarn from a supply is wound upon a rotating core, a pair of rolls turning about parallel axes, the yarn passing between the rolls on its way from the supply to the core, means comprising a centrally fulcrumed scale beam for supporting the rolls for bodily, concomitant equal motion in opposite directions, means guiding the yarn from the supply into contact with one roll at a point such that the resistance to withdrawal of the yarn from the supply creates a force tending to move the last-named roll bodily in one direction, means guiding the yarn to leave the other roll at a point such that the tension exerted by the rotating core creates a force tending to move the second roll bodily in a direction opposite to that in which the first roll tends to move, means for adjustably opposing the bodily motion of the rolls, bearings for the respective rolls which are mounted on opposite arms of the centrally fulcrumed scale beam, and means for bodily adjusting one of said bearings toward the other, thereby to vary the distance between the rolls.

7. In combination in apparatus wherein strand from a supply is wound upon a rotating core, a pair of rolls turning about parallel axes, the strand passing between the rolls on its way from the supply to the core, means for supporting said rolls for bodily, concomitant equal motion in opposite directions, means guiding the strand from the supply into contact with one roll at a point such that the resistance to withdrawal of the strand from the supply creates a force tending to move the last-named roll bodily in one direction, means guiding the strand to leave the other roll at a point such that the tension created by the rotating core creates a force tending to move the second roll bodily in a direction opposite to that in which the first roll tends to move, means for adjustably opposing such bodily motion of the rolls, the roll from which the yarn is delivered to the winding core having a hub, a brake-shoe for applying frictional pressure to the hub, and a spring which urges the brake-shoe toward the hub, the parts being so constructed and arranged that the roll which has the hub is movable bodily

away from the brake-shoe in response to abnormal tension exerted by the yarn leading to the winding core.

8. In combination in apparatus wherein yarn from a supply is wound upon a rotating core, a pair of rolls turning about parallel axes, the yarn passing between the rolls on its way from the supply to the core, means comprising a scale beam for supporting said rolls for bodily, concomitant equal motion in opposite directions, means guiding the yarn from the supply into contact with one roll at a point such that the resistance to withdrawal of the yarn from the supply creates a force tending to move the last-named roll bodily in one direction, means guiding the yarn to leave the other roll at a point such that the tension exerted by the rotating core creates a force tending to move the second roll bodily in a direction opposite to that in which the first roll tends to move, spring means for adjustably opposing such bodily motion of the rolls, the rolls being mounted at opposite ends of the scale beam, the roll from which the yarn is delivered to the winding core having a hub, a pivoted arm carrying a brake-shoe for applying retarding pressure to the hub, and a spring which normally urges said arm in a direction to contact the brake-shoe with the hub, said spring having a limited range of action so that the hub may, at times, move completely out of contact with the brake-shoe, said first spring means urging the scale beam in a direction to move the hub toward the brake-shoe, the parts being so constructed and arranged that abnormal resistance to withdrawal of the yarn from the supply swings the beam in opposition to said first spring means.

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