TEXTILE THREAD WINDER WITH IMPROVED THREAD TRAVERSING MECHANISM

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ABSTRACT

A textile thread winding apparatus having a driven rotating drive roll, at least one freely rotatable package roll positioned for engagement with and to be driven by the drive roll for winding a package of yarn thereon, and a thread traversing mechanism for receiving thread from a source and guiding the thread to the package roll while traversing the thread longitudinally of the package roll for spiral winding of the thread. The thread traversing mechanism comprises devices for traversing the thread in successively different strokes during successive plural stroke cycles for forming successive spirally wound layers of thread on the package which are placed in different positions on the thread package for eliminating layering of the thread in the thread package and the formation of hard shoulders at each end of the thread package which occur when the thread is traversed in the same strokes during successive cycles.

6 Claims, 14 Drawing Figures
TEXTILE THREAD WINDER WITH IMPROVED THREAD TRAVERSING MECHANISM

This invention relates to the improvement in a textile thread winding apparatus of a thread traversing mechanism which traverses the thread in successively different strokes during successive plural stroke cycles for forming successive spirally wound layers of thread on the package being wound which are of unequal lengths and are placed in different positions and at different angles on the package for eliminating layering of the thread in the thread package and the formation of hard shoulders at each end of the thread package which occur when the thread is traversed in the same strokes during successive cycles.

In textile thread or yarn winding apparatus, particularly of the type including a driven rotating drive roll and at least one freely rotatable package roll positioned for engagement with the drive roll to be driven by the drive roll for the winding of a generally cylindrical package of yarn thereon, thread traversing mechanisms are normally utilized for receiving the thread from a source and guiding it to the package roll while traversing the thread back and forth longitudinally of the package roll for spiral winding of the thread on the package roll. These customarily used traversing mechanisms traverse the thread longitudinally from left to right during one stroke and then from right to left during a second stroke to complete a two stroke traversing cycle. Each of these traversing strokes are of generally the same length and each cycle causes the yarn to be wound onto the package roll in exactly the same manner which results in layers of thread being formed of the same lengths and placed in the same positions and at the same angles on the package resulting in layering of the thread, due to the threads being placed exactly on top of each other in alternate layers, and the formation of hard shoulders at the longitudinal ends of the package. Both of these features are undesirable in the spirally wound packages being formed and cause malfunctions and breakage of the thread.

Accordingly, it is the object of this invention to overcome the above problems and more specifically to provide an improved thread traversing mechanism for overcoming these problems.

It has been found by this invention that the above object may be accomplished by providing, in a textile thread winding apparatus having a driven rotating drive roll and at least one freely rotatable package roll positioned for engagement with the drive roll to be driven by the drive roll for the winding of a package of thread thereon, an improved thread traversing mechanism for receiving thread from a source and guiding the thread to the package roll while traversing the thread longitudinally of the package roll for spiral winding of the thread. The improved traversing mechanism comprises means for traversing the thread in successively different strokes during successive plural stroke cycles for forming successive spirally wound layers of thread on the package roll which are of unequal lengths and are placed in different positions and at different angles on the thread package for eliminating layering of the thread in the thread package and the formation of hard shoulders at each end of the thread package which occur when the thread is traversed in the same strokes during successive cycles.
FIG. 13 is a sectional view taken through the carriage assembly of FIGS. 11 and 12 and taken generally along the line 13-13 of FIG. 10; and FIG. 14 is a sectional detail showing the bolt screw and ball nut mechanism and taken generally along the line 14—14 of FIG. 13.

Referring now to the drawings, a specific form of winding apparatus in combination with an improved thread traversing mechanism according to this invention is illustrated therein and generally referred to by the reference numeral 10. The thread winder 10 illustrated in the drawings is adapted to wind thread T received from a thread source into wound packages P.

The winding apparatus 10 comprises a stationary, enclosed housing 12 of generally modular construction so that the winding apparatus 10 may be positioned individually or in banks or groups of such winders in a textile operation.

A generally cylindrical drive roll 14 is mounted for rotation on the housing 12 in a fixed position and extends generally horizontally outwardly therefrom, as may be seen in FIG. 1. The drive roll 14 may be constructed of a suitable smooth metal material or otherwise and is driven by a motor 15 mounted within the housing 12 on one wall of the housing by means of mounting plates 16, as shown in FIG. 10. The motor 15 includes an outwardly extending shaft 17 which carries a suitable pulley 18 for receiving an endless belt 19. The endless belt 19 also passes around a pulley 20 carried by a rotatable shaft 21 which is suitably mounted in a fixed rotatable position in the housing 12 and extends outwardly therefrom and is connected with the drive roll 14 so that the motor 15 may rotate the drive roll 14 in the direction of the arrows in FIG. 1 through the above-described belt and pulley arrangement. The portion of the housing 12 through which the shaft 21 passes for connection with the drive roll 14 is suitably sealed, for the reasons to be discussed below.

The winding apparatus 10 further includes an improved traverse mechanism 25 mounted on the housing 12 and extending outwardly therefrom generally parallel with the drive roll 14 and on one side thereof, as shown in FIG. 1, for receiving the thread T from a thread source and for guiding the thread around the drive roll 14 to a package roll (described hereinafter), while reciprocating or traversing back and forth along a path of travel which is generally parallel with the longitudinal axis of the drive roll 14 for traversing the thread T onto the package P being wound by the apparatus 10. This traverse mechanism 25 includes a motor 26 suitably mounted within the housing 12 and having a drive shaft 27 extending therefrom and operatively connected with the traverse mechanism 25 in a manner to be described below for operating same. The shaft 27 and traverse mechanism 25 also include suitable means for sealing the portion of the housing 12 through which the shaft 27 passes, for reasons to be discussed below.

The winding apparatus 10 of this invention, as illustrated in the drawings, further includes a pair of freely rotatable, linearly movable package rolls 30 for carrying package cores C to form a wound package thereon. The package rolls 30 extend generally horizontally outwardly from the housing 12 and are generally parallel with the drive roll 14 on the other side thereof from the traverse mechanism 25 to be driven by the drive roll 14, in a manner described below. The package rolls 30 receive thread T from the traverse mechanism 25 for simultaneous or alternative winding on package cores C on both or one of the package rolls 30.

The package rolls 30 are disposed above and below each other, as shown in FIG. 1, and are linearly movable away from the drive roll 14 along inclined paths of travel which form upwardly extending and downwardly extending acute angles, respectively, with a horizontal plane through the drive roll 14, as shown in FIG. 1, so that each of the package rolls 30 may be alternately or simultaneously moved into frictional, peripheral, driving engagement with the drive roll 14 for simultaneously or alternatively winding thread T on both of the package rolls 30.

The package rolls 30 are generally of the expandable, self-contained, chuck member type, which, as shown in FIG. 13, include bladder members 31 adapted to inflate and expand by the insertion of air from air line 32 on receiving of the package cores C and air brake means 33 for precluding rotation of the package rolls 30 before, after and during an initial or final winding operation by the insertion of air into the brake means 33 from air line 34. The specific details of the construction of these package rolls 30, per se, are given in U. S. Pat. No. 3,517,891, issued June 30, 1970 and assigned to the assignee of the present application.

Reference may be had to that patent for a complete disclosure of the operation of these package rolls.

Associated with each of the package rolls 30 is carriage assembly, generally designated by the reference numeral 40. These carriage assemblies are contained within the enclosed housing 12 and the carriage assembly for each of the package rolls 30 is substantially identically constructed, as may be seen in FIG. 10. FIGS. 11 and 12 are generally top plan views of the upper carriage assembly 40 of FIG. 10 and that carriage assembly will be described in detail below. Each carriage assembly will be given, where illustrated, like reference numerals inasmuch as like components are contained in each.

Each of the carriage assemblies 40 includes a stationary portion 42 which is generally rectangular and includes downwardly extending flange portions 42a around the outer periphery thereof and top plates 42b, as may be seen in FIGS. 10, 11 and 12. It is noted that the bottom carriage assembly 40, as shown in FIG. 10, is reversed and the flange members 42a extend upwardly and the plate members 42b are bottom plates. The stationary carriage portion 42 is mounted in a fixed position on the housing 12 by means of bolts 43, as shown in FIGS. 11 and 12 particularly. The stationary carriage portion 42 includes longitudinally extending carriage rods 44 mounted in flange members 42a.

The carriage assemblies 40 further include movable portions 46 mounted on the stationary portion 42 and particularly the rods 44 thereof by any suitable bearings for reciprocating linear movement along the longitudinal axes of the stationary rods 44. The movable portion 46 of the carriage assembly 40 is secured to and carries the respective package rolls 30 for linear movement therewith, as may be seen in FIGS. 11 and 12. The package rolls 30 include suitable bearings for
rotation thereof with respect to the movable carriage portions 46. The carriage assemblies 40 are generally disposed in the inclined paths of travel which the package rolls travel. Accordingly, the carriage assemblies 40 carry the package rolls 30 along their upwardly and downwardly inclined paths of travel toward and away from the drive roll 14.

The winding apparatus 10 further includes mechanisms contained within the housing 12 and operatively associated with each of the package rolls 30 for maintaining a desired predetermined pressure relationship between the drive roll 14 and the respective package rolls 30 and for linearly driving the respective package rolls 30.

Each of the mechanisms comprises a reversible, variable torque motor 50 mounted within the housing 12 on one wall thereof, as shown in FIG. 10. The torque motor 50 has an outwardly extending driven shaft 51 which is connected to one end of a universal joint 52 and the other end of the universal joint 52 is connected to and drives a ball screw shaft 53 having spiral, ball receiving grooves 54 therein. The ball screw shaft 53 is suitably rotatably mounted in bearings 55 and 56 carried by the stationary carriage portion 42, as may be seen in FIG. 12. Accordingly, rotation of the torque motor 50 causes rotation of the ball screw shaft 53 through the bearings 55 and 56.

The movable carriage portion 46 has a ball nut 60 secured thereto, as shown in FIGS. 12 and 14. The ball nut 60 comprises a housing 61 containing a plurality of balls therein arranged in such a manner that the ball screw shaft 53 passes through the ball nut 60 and the balls 62 engage the grooves 54 so that rotary movement of the screw shaft will be converted into linear movement of the ball nut 60 and thereby cause linear movement of the movable carriage portion 46 and the respective package rolls 30 carried thereby. Accordingly, rotation of the torque motor 50 in opposite directions will cause opposite linear movement of the package rolls 30 toward and away from the drive roll 14 through the above-described connections.

Each of the mechanisms for driving the respective package rolls and for maintaining a predetermined pressure relationship includes a bi-directional damper apparatus 65 operatively connected with the ball screw shaft 53 and each comprising generally a torque brake 66 which may be of any suitable form and including an outwardly extending shaft 67 carrying a pulley 68. The pulley 68 carries a belt 69 which also passes around a pulley 70 mounted on the ball screw shaft 53. The bi-directional dampers 65 prohibit excessive acceleration of the movable carriage portions 46 and the respective package rolls 30 when being driven from one extreme linear position to the other. The dampers 65 also minimize any tendency toward vibration of the package rolls during the winding operation.

There is further provided a hydraulic shock absorber 75, as shown particularly in FIG. 12, for each of the carriage assemblies 40. These hydraulic shock absorbers 75 each comprises a cylinder 76 secured to a flange portion 42a of the fixed or stationary carriage portion 42 and a piston 77 extending from the other end thereof. The piston 77 includes an extending rod 78 which is fixed to the movable carriage portion 46. The cylinder 76 includes an adjustment knob 79. These shock absorbers 75, by the above arrangement, control the rate of contact between the drive roll 14 and the package rolls 30. There are also provided bumper type shock absorbers 82 secured to the fixed carriage portions 42, as shown in FIG. 12, and adapted to be contacted by an extension of the movable carriage portions 46 for buffing the travel of the package rolls 30 and the movable carriage portions 46 as they reach the end of their paths of travel away from the drive roll 14.

Due to the geometry of the upwardly extending and downwardly extending inclined paths of travel of the package rolls 30, which form acute angles with respect to the horizontal, forces are introduced which must be canceled if proper package roll to drive roll predetermined pressure is maintained throughout the winding operation. Accordingly, compensating mechanisms 84 and 85 are provided for the upper package roll and carriage assembly and the lower package roll and carriage assembly, respectively. The upper package roll compensating mechanism 84, as best shown in FIG. 11, comprises a coiled roller spring 86 carried by the stationary carriage portion 42 and having a cable 87 extending therefrom and attached to a counterbalance cam 88 also mounted on the stationary carriage portion 42. The counterbalance cam 88 includes another cable 89 extending therefrom and around guide pulley 90 and 91 carried by stationary carriage portion 42. The other end of the cable 89 is secured to the movable carriage portion 46, as shown in FIG. 12.

The counterbalance cam profile 88 is determined by combining forces due to package weight increase, forces due to gravity, forces due to the change in tangent point between package and drive rolls as the wound package diameter increases, and forces due to the drive roll to package roll pressure reduction that is necessary.

The compensating mechanism 85 for the downwardly moving lower package roll and the carriage assembly 40, as best shown in FIG. 10, comprises a constant force extension spring 95 having one end thereof secured to the housing 12 and the other end thereof attached to a cable 96 which passes around a guide pulley 97 mounted on the housing 12 and is attached at its other end to the movable carriage portion 46 of the lower carriage assembly 40.

As shown in FIG. 1, the winding apparatus housing 12 has slots therein for the linear travel of the upper and lower package rolls 30 which include sealing means for sealing off the interior of the housing 12 from the exterior thereof. Each of these sealing means for each of the package rolls comprises a belt 100, as shown particularly in FIGS. 12 and 13, which passes around rollers 101 and 102 at each end of the slots in the housing and has its ends attached to a cable 103 which passes around pulleys 104 (only one of which is shown in FIG. 13) to form an endless arrangement. The belt 100 is attached to and surrounds the connecting portion between the package roll 30 and the movable carriage portion 46 to move therewith as these mechanisms move in their linear path of travel. Suitable rubber seals may be mounted on the housing 12 for rubbing engagement with the belt 100 to complete the seal. Thus, the entire housing 12 is enclosed and sealed from a hostile environment that may surround the exterior of the winding apparatus 10 so as to protect the interior components of the housing 12.
Additionally, there is provided a solenoid operated latch mechanism 110 for the lower carriage assembly 40, as shown in FIG. 10, comprising a solenoid 111, a latch member 112 pivotally mounted on the stationary carriage portion 42 and connected to solenoid 111 to be controlled thereby, and a latch member 113 mounted in fixed position on the movable carriage portion 46. The latch mechanism 110 is adapted to latch the carriage portions 42 and 46 together at the position illustrated in FIG. 6 for dopping of a wound package P.

In accordance with this invention, the improved thread traversing mechanism 25 comprises a stationary hollow housing 120 secured to said winding apparatus housing 12 in any suitable manner such as by plate and bolts, as shown in FIG. 1. The hollow housing 120 includes a longitudinally-extending slot 121 defined by two guide rails 122 on the front thereof for receiving a thread guide device 123 which is traversed longitudinally of the thread traversing mechanism along the slot 121. The thread guide device 123, as may be seen in FIGS. 3–6, comprises a body portion 124 having slots therein for engaging the guide rails 122 for movement along the slot 121. The thread guide device 123 further comprises a guide member 125 positioned on the front of the body portion 124 for receiving and guiding the thread T being wound, in the manner shown in FIGS. 2 and 3. The thread guide device further comprises a cam follower portion 126 which is secured to the body portion 124 by a forwardly extending stud and sleeves, as shown in FIG. 4.

The thread traversing mechanism 25 further includes an elongate, generally cylindrical, rotating cam 127 which is suitably mounted within the hollow housing 120 and is connected with the shaft 27 from the motor 26 for rotation of the cam 127.

The cam 127, as shown particularly in FIGS. 7 and 8, includes four separate continuous spiral grooves G–1, G–2, G–3 and G–4 for receiving the cam follower portion 126 of the thread guide device 123. The particular shape of the thread guide cam follower portion 126 of the specific thread guide device 123 illustrated in the drawings requires a double depth groove of generally T-shaped configuration in cross-section and such shaped grooves have been illustrated in FIG. 7. However, it is to be understood that a single depth groove and a generally rectangular cross-sectional shaped cam follower might be utilized. In the diagrammatic illustration of FIG. 8, which is a view of the cam profile opened up, only a single depth groove has been illustrated for clarity.

The four grooves G–1 through G–4 in the cam 127 define two different paths of travel for the thread guide 123 in one longitudinal direction of the cam (from left to right as viewed in FIG. 7) and two different paths of travel in the other longitudinal direction of the cam (from right to left as viewed in FIG. 7) constituting two cycles of two strokes each of traversing movement of the thread guide device 123. The first groove G–1 which starts from the point a in the illustration of FIG. 8 defines the first path of travel in the one longitudinal direction (left to right in FIG. 8) and is connected with the second groove G–2 at point b in FIG. 8. The second groove G–2 defines the first path of travel in the other longitudinal direction (right to left in FIG. 8) and is connected with the third groove G–3 at point c in FIG. 8. The third groove G–3 defines the second path of travel in the one longitudinal direction (left to right in FIG. 8) and is connected with the fourth groove G–4 at point d in FIG. 8. The fourth groove G–4 defines the second path of travel in the other longitudinal direction (right to left in FIG. 8) and is connected with the first groove G–1 at point a of FIG. 8 to complete the two cycles of two strokes each of traversing movement of the thread guide 123.

Inasmuch as the connection points between the grooves G–1 through G–4, namely points a, b, c and d in FIG. 8, vary with respect to position on the cam and inasmuch as the connection point b between the first and second grooves G–1 and G–2 is closer to one longitudinal end of the cam 127 than the connection point d between the third and fourth grooves G–3 and G–4 and the connection point c between the second groove and third groove G–2 and G–3 is closer to the other longitudinal end of the cam 127 than the connection point a between the fourth groove and first groove G–4 and G–1, the respective spirally wound layers of thread formed by the traversing mechanism 25 will be of unequal lengths and positions. Also, the grooves G–1 and G–3 are disposed in different helix angles and, as illustrated, are convergent; whereas, the grooves G–2 and G–3 are disposed in different helix angles and, as illustrated, are divergent. This disposition of the grooves results in the thread being disposed at different angles in the respective spirally wound layers.

Referring to the diagrammatic illustrations of the thread layers formed as a result of the various grooves shown in FIG. 9, it may be seen that the groove G–1 extending from connection point a to connection point b will lay down a layer of thread on the package being wound which extends from one longitudinal end to the other longitudinal end of the package. The groove G–2 which extends from connection point b to connection point c will lay down a layer of thread on the package being wound which extends at angles opposite to the previously formed layer and which extends from the right-hand longitudinal end of the package and stops short of the left-hand longitudinal end of the package. The groove G–3 which extends between the connection points c and d will lay down a thread layer extending in the opposite direction and from a point short of the left longitudinal end of the package to a point short of the right longitudinal end of the package. The groove G–4 which extends between connections d and a will lay down a layer of thread on the package being wound which extends from a point short of the right longitudinal end of the package to the left longitudinal end of the package. Moreover, the thread in the layer formed by the groove G–1 is disposed at a different angle than the thread in the layer formed by the groove G–3 and the thread in the layer formed by the groove G–2 is disposed at a different angle than the thread in the layer formed by the groove G–4.

Thus it may be seen that the novel thread traversing mechanism of this invention traverses the thread being wound in successively different strokes during successive two stroke cycles for forming successive spirally wound layers of thread on the package P which are of unequal lengths and placed in different positions and at different angles (see FIG. 9) on the thread package P for eliminating layering of the thread in the thread package and the formation of hard shoulders (each
layer is not continued to the ends of the package) at each end of the thread package, both of which occur when the thread is traversed in the same strokes during successive cycles.

Although a specific cam 127 has been described above, this cam is only illustrative of a cam constructed in accordance with this invention and other arrangements of grooves on a cam may be utilized within the concept of this invention. In this regard, the grooves G-1 and G-3 could be divergent and the grooves G-2 and G-4 could be convergent as long as the angular disposition of the grooves extending in the same direction are different and as long as an interconnected path of travel for the cam follower exists through all of the grooves. Also, the cam could utilize more than four grooves depending upon the size of the cam and the package being formed.

The winding apparatus 10 may be provided with any suitable control circuit and, while the details of such a control circuit will not be given herein or specifically described, an exemplary operation will be briefly described.

The winding apparatus 10 may include a control panel 130, as illustrated in FIG. 1, having buttons thereon for initiating the operation thereof. The three adjacent buttons at the top of control panel 130 are for controlling the upper package roll 30 and the three adjacent buttons at the bottom of control panel 130 are for controlling the lower package roll 30. The control circuit (not shown) includes suitable switches adapted to be operated by the movable carriage portion 46 of the carriage mechanism 40 and these switches are indicated in FIG. 12 and given the reference characters X, Y and Z.

Referring particularly to FIG. 1, when both package rolls 30 are in the retracted or doff position which is the linear position at the extreme end of the path of travel away from the drive roll 14, an operator will press the "START" button S1 on the control panel and adjust the speeds of the drive roll 14 and the traverse mechanism 25 from any suitable adjustments to the drive motors thereof. Empty package cores C are then placed on the package rolls 30.

The operator then depresses the "READY" button R for one or both of the package rolls. This energizes the latch solenoid 111 for the lower carriage assembly 40 to disengage the latch mechanism 110 and initiates operation of the torque motors 50 to move the package rolls 30 from the doff positions toward the drive roll 14. Also, air pressure from the package roll brake means 33 will be removed to allow rotation of the package rolls 30 and air pressure will be applied to the bladder members 31 for expanding the same and holding the cores C in fixed positions on the package rolls 30.

As the package rolls 30 reach the halfway point of their path of travel toward the drive roll 14, switch Z will be actuated by the movable carriage portion 46 to reduce the voltage on the upper torque motor only to slow down the travel of the downwardly moving upper package roll 30. When the package rolls 30 reach the drive roll 14, they will frictionally engage the drive roll 14 and accelerate to the desired winding speed.

The operator then depressed the "THREAD RUN" button TR, as shown in FIG. 1, for the desired package roll 30 upon which a winding operation is to be performed. Operation of this button will switch the voltage to the torque motor 50 to that preselected for the winding operation and will de-energize the latch solenoid 111 to allow the latch member 112 to drop back down into its lower position for again engaging the latch member 113 when the lower carriage portion 46 has again reached the doff position.

The wound package of thread then begins building on the cores C on the package rolls 30. This moves the package rolls 30 against the predetermined torque exerted by the motors 50 to stall the torque motors and maintain the predetermined pressure relationships therebetween. The voltage applied to the torque motors 50 may be varied during this winding operation to produce a variable torque, as desired.

As the packages P build up on the package rolls 30 and the package rolls 30 reach the halfway point of their travel away from the drive roll 14, the switch Z will again be engaged and reset.

After the package P has been completely formed and doffing is desired, the operator depresses the "DOFF" button D, as shown in FIG. 1, for the desired package roll and the torque motor voltage reverses polarity and drives the desired package roll 30 away from engagement with the drive roll 14 toward the doff position at the extreme end of its path of travel. When the package rolls 30 reach the doff position, switches X and Y are actuated which remove power from the torque motors 50 and allow the lower carriage to latch into position by the latch mechanism 110.

With package rolls 30 in the doff position, suitable timers are initiated following which the air pressure to the package roll brake mechanism 33 will be supplied to brake the package rolls 30 and cause the same to stop rotating and air pressure will be removed from the bladders 31 to allow the wound packages P to be removed from the package rolls 30. The above operation may then be repeated for one or both of the package rolls 30.

Thus, it may be seen that this invention has provided a winding apparatus including an improved thread traversing mechanism.

In the drawings and specification there have been set forth preferred embodiments of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation.

That which is claimed is:

1. The combination of:
   textile thread winding apparatus having a driven rotating drive roll, at least one freely rotatable package roll positioned on one side of said drive roll for engagement therewith to be driven thereby for the winding of thread and mounted for linear movement away from said drive roll as the thread package builds thereon, carriage means including a stationary portion and a movable portion carried by said stationary portion for reciprocating linear movement and being secured to and carrying said package roll for reciprocating linear movement therewith, and means for maintaining a desired predetermined pressure relationship between said drive roll and said package roll and for linearly driving said package roll and comprising a variable torque reversible motor, a screw shaft connected
to and rotated by said torque motor and a nut secured to said movable carriage portion and receiving said screw shaft therethrough for converting rotary movement of said screw shaft into linear movement of said movable carriage portion and package roll carried thereby; and

a thread traversing mechanism positioned on the other side of said drive roll for receiving the thread from a source and guiding the thread around said drive roll to said package roll while traversing the thread longitudinally of said package roll for winding the thread, said traversing mechanism comprising means for traversing the thread in successively different strokes during successive plural stroke cycles for forming successive spirally wound layers of thread on said package roll which are of unequal lengths and are placed in different positions and at different angles on the thread package for eliminating layering of the thread in the thread package and the formation of hard shoulders at each end of the thread package which occur when the thread is traversed in the same strokes during successive cycles.

2. In a textile thread winding apparatus, as set forth in claim 1, in which said means for traversing the thread in successively different strokes during successive plural stroke cycles comprises an elongate, generally cylindrical, rotating cam having a plurality of separate interconnected, continuous, spiral grooves thereon, and a thread guide means having a portion for receiving and guiding the thread being wound and a cam follower portion positioned in said grooves for causing said thread guide to traverse longitudinally of said cam during rotation of said cam, said plurality of grooves in said cam defining different paths of travel in one longitudinal direction of said cam and different paths of travel in the other longitudinal direction of said cam constituting two cycles of plural strokes each of traversing movement of said thread guide and in which a first groove defining a first path of travel in the one longitudinal direction is connected with a second groove defining a first path of travel in the other longitudinal direction which in turn is connected with a third groove defining a second path of travel in the one longitudinal direction which in turn is connected with a fourth groove defining a path of travel in the other longitudinal direction.

3. In a textile thread winding apparatus, as set forth in claim 1, in which said means for traversing the thread in successively different strokes during successive plural stroke cycles comprises an elongate, generally cylindrical, rotating cam having four separate interconnected, continuous, spiral grooves thereon, and a thread guide means having a portion for receiving and guiding the thread being wound and a cam follower portion positioned in said grooves for causing said thread guide to traverse longitudinally of said cam during rotation of said cam, said four grooves in said cam defining two different paths of travel in one longitudinal direction of said cam and two different paths of travel in the other longitudinal direction of said cam constituting two cycles of two strokes each of traversing movement of said thread guide and in which said first groove defining the first path of travel in the one longitudinal direction is connected with the second groove defining the first path of travel in the other longitudinal direction which in turn is connected with the third groove defining the second path of travel in the one longitudinal direction which in turn is connected with the fourth groove defining the second path of travel in the other longitudinal direction which in turn is connected with the first groove to complete the two cycles of two strokes each of traversing movement of said thread guide.

4. In a textile thread winding apparatus, as set forth in claim 3, in which said connection between said first and second grooves is closer to one longitudinal end of said cam than said connection between said third and fourth grooves and in which said connection between said second and third grooves is closer to the other longitudinal end of said cam than said connection between said fourth and first grooves for forming successive, spirally wound layers of thread on the package of unequal length and position.

5. In a textile thread winding apparatus, as set forth in claim 3, in which said traversing mechanism further comprises a stationary hollow housing substantially enclosing said rotating cam and including a longitudinally-extending guide slot, and in which said thread guide means is positioned within said slot for longitudinal traversing movement along said slot as said cam rotates.

6. In a textile thread winding apparatus, as set forth in claim 5, in which said cam grooves are generally T-shaped in cross-section and said cam follower portion of said thread guide is generally T-shaped in cross-section for added stability.

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