Nov. 6, 1934. G. N. TAYLOR 1,980,113

WINDING MACHINE

Filed Dec. 3, 1929 2 Sheets-Sheet 1

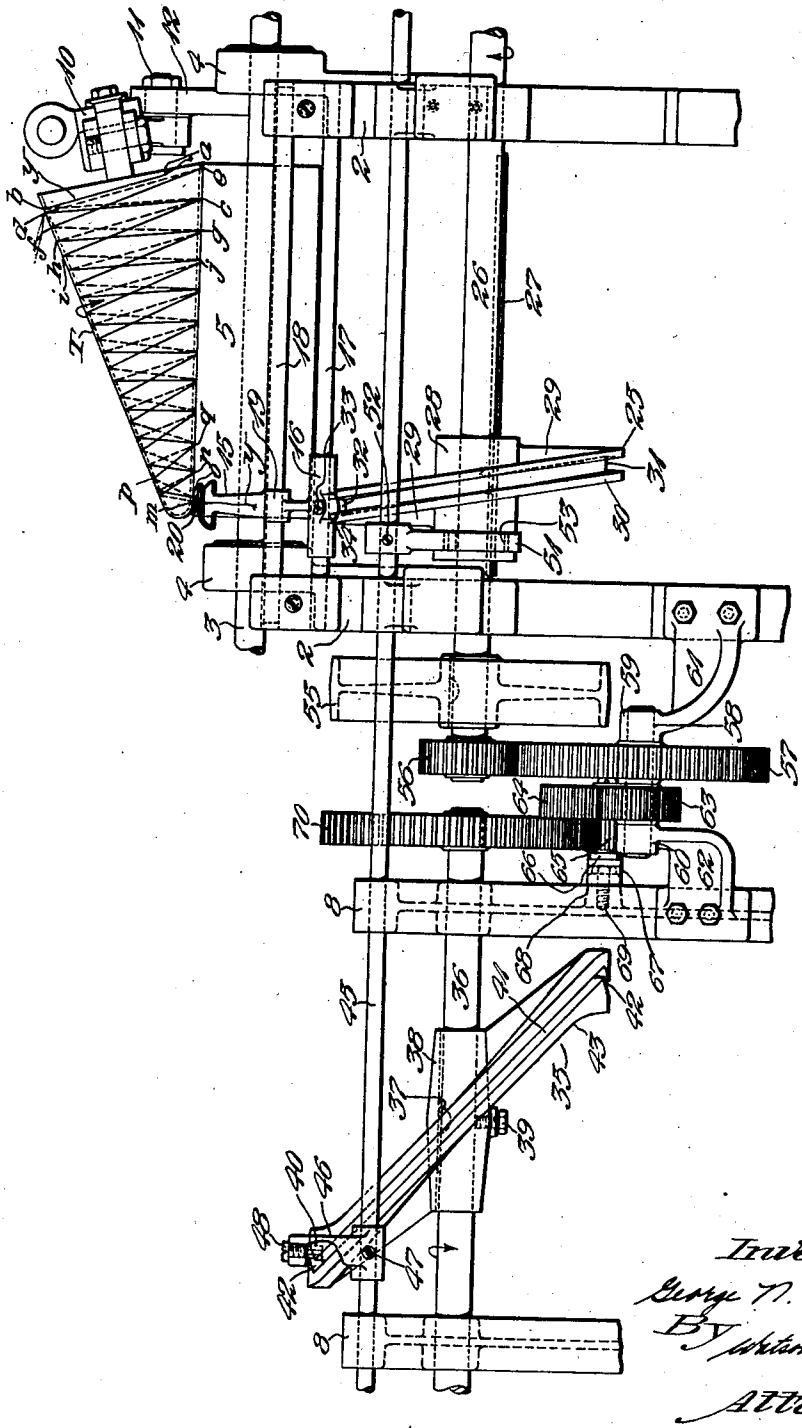


Fig. 1.

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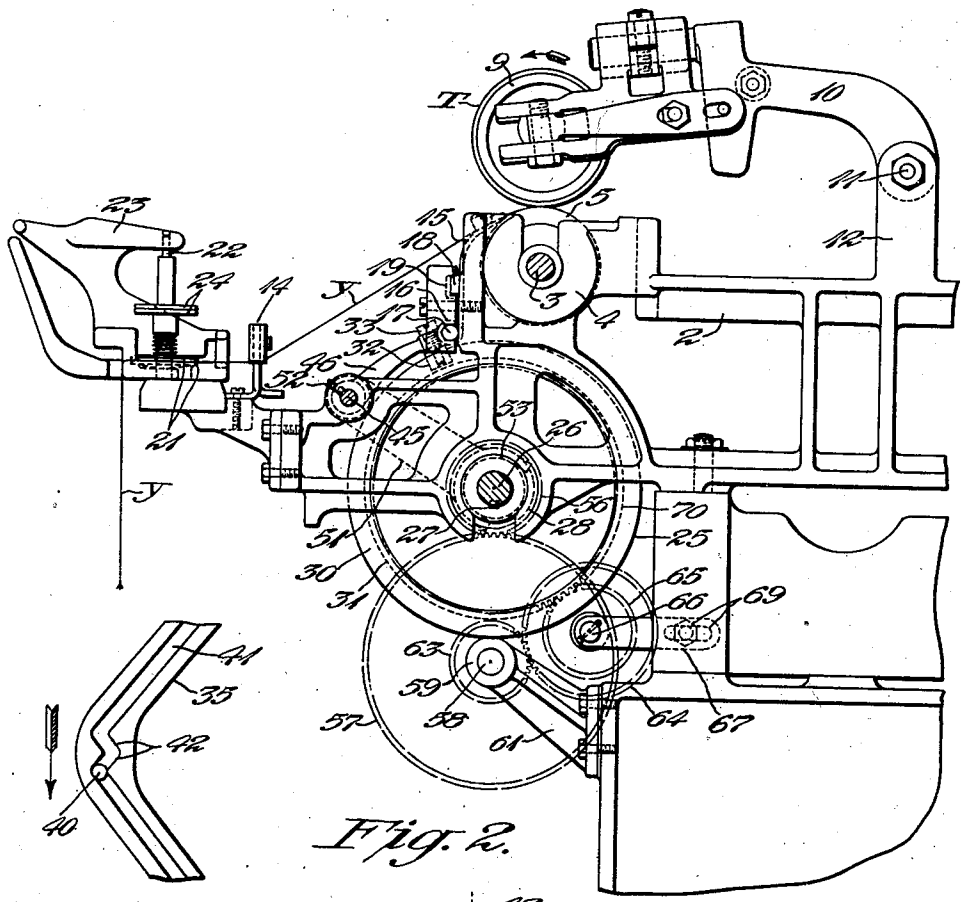


Fig. 2.

Fig. 3.

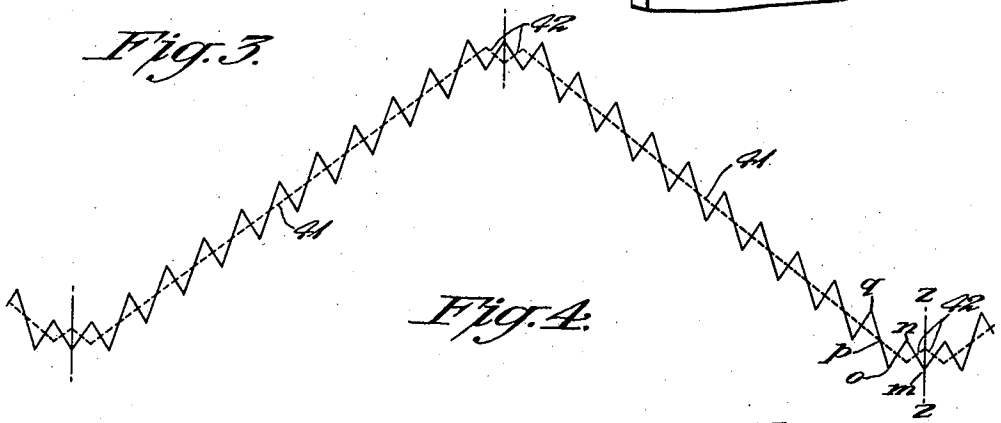


Fig. 4.

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UNITED STATES PATENT OFFICE

1,980,113

WINDING MACHINE

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Application December 3, 1929, Serial No. 411,355

16 Claims. (Cl. 242—43)

This invention relates to a novel method of winding thread, yarn, cord and other textile materials, hereinafter referred to generally by the term yarn, to produce an improved form of yarn body such as a cone, cop or other package; and to a novel construction of winding mechanism for carrying out the improved method.

In general, the new and improved method of winding consists in building up a yarn body of any preferred shape by laying the coils or turns of yarn or the like upon a cylindrical or conical surface with a relatively short traverse and progressively advancing the traverse along the axis of the mass from one end of the yarn body to its opposite end and then back again, and continuing this process until a definite number of layers are deposited in place to build the mass to the required size. The turns or coils of winding are deposited with a traverse of only a fraction of the full length of the whole yarn body and are advanced gradually from one end of the package to the other. The feed is then reversed with the turns of short traverse being advanced in the opposite direction until the starting point is reached, when the direction of its advance is again reversed, and so on throughout the winding.

One object of the improvement is to provide a yarn body with the individual turns or coils therein wound with a short traverse so that they overlap and interlock to hold them in place whereby the resulting mass is firmer and more stable with the yarn coils less liable to slip out of place or slough off.

Another object of the improvement is to provide a yarn body of the type specified from which the yarn will deliver with a more uniform tension without sudden variations therein and with less drag or resistance to the delivery in unwinding the yarn.

Another object of the improvement is to provide a yarn body from which the yarn may be delivered over the end at a high rate of speed with a uniform ballooning action to free the coils from the surface of the package, and without causing the balloon to vary in form and double up to impede the delivery and increase the drag or tension on the yarn.

Another object of the improvement is to provide a conical yarn body of the type specified in which the laying of the coils or turns of yarn may be varied to dispose a greater thickness of yarn at the base end of the cone whereby to increase the taper on its surface to further facilitate the unwinding of the yarn from the cone at its full or approximately full diameter.

A further object of the improvement is to provide a winding machine for winding a yarn body by the above described method with the winding mechanism of simple construction, automatic in operation and capable of running at high speed.

Other objects of the invention are set forth in the following specification which describes the improved method of winding and a preferred form of construction of the winding mechanism as illustrated by way of example in the accompanying drawings. In the drawings:

Fig. 1 is a longitudinal view of the winding mechanism showing it adapted for winding a yarn body or package of conical form;

Fig. 2 is an end view of the winding machine;

Fig. 3 is a detailed view of the feed-cam for the traverse mechanism of the winding mechanism, showing one end of the cam-groove to illustrate its peculiar formation at the point of reversal; and

Fig. 4 is a diagrammatic view indicating the path of travel of the reciprocating thread-guide which lays the coils of winding in place and its progressive movement from one end of the package to the other and back again.

In the present drawings I have preferred to illustrate the winding mechanism as embodied in a machine of the drum type in which the yarn body, hereinafter referred to as the package, is rotated by surface contact with a drive-roll or drum. It is to be understood, however, that the present invention, which includes a novel form of traversing-mechanism for depositing the yarn coils in place on the package, is applicable to other types of winding machines, for example, those in which the package is rotated by a positively driven mandrel or winding-spindle.

Referring first to Fig. 1 of the drawings, 2 designates the uprights or brackets of a suitable framework which carries bearings for the various rotating shafts of the winding mechanism. It will be understood that only one unit of the winding machine is herein illustrated, but usually the frame is extended to provide for mounting any suitable number of winding units thereon with all of them operated from a single driving-means.

A shaft 3 journaled in bearings 4 on the brackets 2 carries rotatable therewith a plurality of cylindrical drums or drive-rolls 5, one only being shown, which contact with the surface of the packages being wound to rotate the latter. As herein shown the package is wound on a conical tube or receiver T which may be in the form of a paper tube, and this, in turn, is supported from a suitable cop-holder or mandrel indicated at 9

in Fig. 2. The cop-holder 9 is carried at the end of a swinging arm 10 which is pivoted at 11 to an upstanding lug 12 on one of the brackets 2. The cop-holder 9 is swiveled to the end of the arm 10 with its axis disposed in the plane of the axis of the drive-roll 5, being thus mounted to adapt the surface of the cop-tube T to aline itself with the periphery of the roll whatever the form of the winding support or receiver may be. In some cases the cop-holder 9 is acted upon by means causing it to rock on the arm 10 whereby the axis of the conical package will be inclined gradually at an increasing angle to the surface of the drive-roll as the winding progresses and the yarn mass is built up on the tube or receiver T; such an arrangement being shown and described in United States Letters Patent No. 1,658,400, dated February 7, 1928, and the purpose being to increase the taper of the surface of the cone as the package increases in diameter.

The yarn is traversed on the cop-holder or receiver T by means of a suitable thread-guide 15, so-called, which is caused to reciprocate in a path parallel with the axis of the drive-roll 5. Conveniently, the thread-guide 15 consists of a sheet-metal arm carried by a slide or crosshead 16 constructed in the form of a tubular sleeve encircling a rod 17 on which it slides. The rod or track 17 is supported from the brackets 2 in parallel relation to the axis of the drive-roll 5. Above the rod 17 is another track or rail 18 supported at its ends in the brackets 2 and engaged by a loop 19 on the back of the guide 15. The guide 15 extends upwardly from the loop 19 and is curved forwardly to locate its head at a point adjacent the surface of the drive-roll 5, a thread-groove or slot 20 being provided in the end of the head to adapt the yarn *y* to draw therethrough as it feeds to the winding.

A sutiable tension-device is provided at the front of the machine for tensioning the yarn as it feeds from its source of supply to the thread-guide 15. As shown in Fig. 2, the tension-device consists of a pair of disks 21 supported on a vertical pin 22 held in a bracket 23. Suitable weights 24 are slidably mounted on the pin 22 to press the disks 21 together to cause them to bear against the yarn *y* drawing therebetween to apply resistance to the draft thereon, the arrangement of this part of the winding machine being in accordance with a known type of tension-device as generally used in the art.

The thread-guide 15 is connected to be reciprocated from a helical cam 25 which is mounted on and rotated by a cam-shaft 26 journaled in suitable bearings in the brackets 2. The cam 25 is constructed with a hub 28 surrounding the shaft 26 and having spokes or arms 29 radiating therefrom to support its cylindrical rim 30. The rim 30 of the cam is formed with a helical groove 31 which is engaged by a roller or bowl 32 rotatable in the end of a screw 33 held in a lug 34 projecting from the side of the crosshead 16 which carries the thread-guide 15. It is usual in winding machines to reciprocate the thread-guide from a helical cam of the construction above described, but heretofore it has been the custom to employ a cam having a throw or traverse equal to the whole length of the yarn body to be wound or, in other words, of sufficient extent to traverse the thread-guide from one end of the package to the other and back again with the traverse repeated continuously to build up the yarn in superimposed concentric layers. As distinguished from this usual practice of winding the yarn from end to end of the package in a series of spiral turns or helices, the present improved method of winding consists in traversing the yarn for only a small fraction of the whole length of the package and then reversing the direction of the traverse to lead the yarn back to its starting point. At the next forward traverse the yarn is carried to a point in advance of the reversing point of the first coil or turn before it is reversed, and so on with a progressive advance of the traverse until the end of the package is reached when a similar series of traverses is advanced in the opposite direction.

To provide for this method of winding, the cam 25 instead of having a throw equal to the full length of the package to be wound has a throw of only a fractional part thereof. As shown in Fig. 1 the throw of the cam is equal to approximately one-fifth of the length of the package; more specifically, in the ratio of one to five and three-quarters, but this ratio is arbitrary and may be varied in accordance with conditions. To provide for extending the layers of winding throughout the whole length of the package the traverse of the thread-guide is progressively advanced from one end of the package to the other and back again, as above explained, and in the present embodiment of the winding mechanism the advance of the traverse is effected by shifting the cam 25 bodily in the direction of its axis. For this purpose the cam is slidable along its drive-shaft 26, the hub 28 of the cam being loose on the shaft but connected to rotate therewith through the means of a key 27 extending substantially the whole length of the shaft between the brackets 2 and engaging a suitable key-way in the hub.

The cam 25 may be slid on its shaft 26 to shift it axially first in one direction and then in the other through the use of any suitable means such as a second cam 35 herein termed the feed-cam. As shown in Fig. 1 of the drawings, the feed-cam 35 is mounted on a shaft 36 extending coaxially with the shaft 26, but constructed separate therefrom to adapt it to be driven at a different rate of speed. The shaft 36 is journalled in suitable bearings in brackets or uprights 8. The cam 35 is secured rotatively with the shaft 36 by means of a key 37 in its hub 38, being held fixedly in place longitudinally of the shaft by a set-screw 39. The cam 35 has a cylindrical rim 43 formed with a helical groove 41. The ends of the helix, that is where the part of the groove leading in one direction reverses and returns in the opposite direction, are of peculiar formation for a purpose as later explained.

Referring to Fig. 3 of the drawings, at the point of reversal at each end of the cam the groove 41 is formed with a short V-shaped return bend indicated at 42 to give it a zigzag course. In other words, the pitch of the groove is reversed sharply and then directed back again in the first direction before it is finally reversed in the portion which leads to the opposite end of the cam.

The cam 35 is connected to slide the cam 25 by means of a feed-rod 45 which extends horizontally through bearings in the brackets 2 and 8. An arm 46, secured to the feed-rod 45 at 47, reaches upwardly around the periphery of the cam 35 and carries a stud 48 disposed in line with the stud or screw 33 which connects the thread-guide with the traverse-cam 25. The stud 48 carries a bowl or roller 40 engaging the cam-groove 41 whereby to slide the rod 45 to shift the traverse-cam 25 back and forth along its

shaft 26. The rod 45 is connected to slide the cam 25 through the means of a forked arm 51 secured fast to the rod by a set-screw 52. As shown in Fig. 2, the sides of the forked portion of the arm 51 straddle the hub 28 of the cam and engage a suitable annular groove 53 therein. The cam 25 is thus free to turn with respect to the arm 51, but as the rod 45 is moved one way or the other the cam will be slid along its shaft 26 in the same direction.

The cam 25 rotates at a high rate of speed while the cam 35 has a relatively slow rate of angular velocity. It should be explained that the drive-roll 5 is driven from its shaft 3 through any suitable power connections at the end of the machine and the cam 25 as herein shown is driven from a pulley 55 keyed fast to the shaft 26. The cam-shaft 26 is connected to drive the feed-cam shaft 36 through reducing gears arranged in a train as next described.

On the end of the cam-shaft 26 is a pinion 56 which meshes with an idler-gear 57. The idler-gear 57 is carried on a stud-shaft 58 journaled in bearings 59 and 60 formed as part of brackets 61 and 62 attached to the main frame of the machine. Fast with the gear 57 is a pinion 63 which meshes with one of a pair of change-gears 64 and 65. The change-gears 64 and 65 are connected to rotate together on a stud 66 which is carried at the end of an arm 67. The arm 67 is adjustably attached to a portion 68 of the main frame of the machine by means of a bolt-and-slot connection at 69, see Fig. 2, whereby the position of the stud 66 may be altered to accommodate gears of different diameters. The gear 65 which is fast with the gear 64 meshes with a larger gear 70 fast on the end of the cam-shaft 36. It will thus be seen that the camshaft 36 is driven from the shaft 26 through the train of gearing last described to materially reduce its speed, the ratio between the speed of the two shafts in the present construction being twenty-three to one. It is to be understood, however, that the ratio of the drive is arbitrarily determined and may be varied for different conditions of winding.

The drive-roll shaft 3 is driven at a constant rate of speed which has a predetermined ratio with respect to the speed of the traverse-cam 25 to determine the number of turns of yarn to be deposited on the package from end to end thereof during one traversing feed of the cam 25 throughout the full length of the package. As provided in the present construction the traverse-cam 25 turns eleven and one-half revolutions as it feeds from one end of the package to the other, and during this time the winding-mandrel carrying the cop-tube or yarn-receiver T is rotated twenty-three turns from its contact with the drive-roll 5. It will be understood that during this advance of the traverse-cam 25 from one end of the package to the other the feed-cam 35 makes one-half a complete turn and as it continues its rotation to complete one revolution the traverse-cam is carried back again to its starting point. The method of operation of the complete winding mechanism and the manner in which it functions to produce the peculiar and novel wind of the present invention is as next explained.

To prepare the machine for winding, a paper or fiber cop-tube T is placed on the cop-holder or mandrel 9 while the arm 10 is raised to facilitate this operation. The strand of yarn *y* is brought up from its source of supply, not herein illustrated, and drawn through the tension-device between the disks 21, as shown in Fig. 2. From the tension-device the yarn *y* leads through a slub-catcher 14 of any suitable construction and thence is drawn up to the thread-guide 15 and passed through its groove or slot 20. The end of the yarn is attached to the cop-tube T, for instance, by winding it several times therearound, and the cop-holder 9 is then lowered to bring the surface of the tube into contact with the periphery of the drive-roll 5. It is customary in machines of the present type to rotate the drive-roll 5 constantly and as the tube T is frictionally engaged with its surface the tube and the holder 9 will be rotated therefrom to wind on the yarn.

In Fig. 1 of the drawings, the parts of the machine are shown in position after the first advance of the thread-guide 15 from the base end of the tube T to its apex end, a series of coils or turns of the yarn *y* being represented as having been wound on the cop-tube. Assuming that the winding is started at the base end of the cone at the point designated *a*, as the tube T is rotated in the direction indicated by the arrow in Fig. 2 the first helix of the yarn will extend from this point *a* to the point *b* and continue around the surface of the tube as indicated by the dotted line to the point *c*. This traverse of the yarn is accomplished as the traverse-cam 25 turns throughout one-half of a revolution to reciprocate the thread-guide 15 to the extent indicated between the points *a* and *c*. It has been explained that the cam 25 is rotated with the shaft 26 which is driven by the pulley 55 and that the feed-cam 35 is also driven from the pulley 55 through the train of gearing 56, 57, 63, 64, 65 and 70, but at a much slower rate of speed.

With the cam 25 in position at the right-hand end of its feed and the thread-guide 15 opposite the point *a* on the tube T, the cam 35 will be in a corresponding position with the roll 40 engaging its groove 41 at the apex point of its short traverse portion 42. In other words, the cam 25 will be positioned with the roll 32 which reciprocates the thread-guide 15 at the right-hand end of the traverse-groove 31 while the cam 35 will be in the same relative position with the roll 40 on center at the end of the traverse-groove 41. Now as the traverse-cam 25 makes one-half a revolution the feed-cam 35 will turn just sufficiently to carry the roll 40 to the end of the short throw 42 of the groove in the cam 35. The cam 35 will, therefore, act through the roll 40 traveling in the portion 42 of the groove 41 to slide the cam 25 toward the right, as viewed in Fig. 1. The effect of this action will be to curtail the extent to which the thread-guide 15 is reciprocated. In the present construction the short traverse portion 42 of the groove 41 in the cam 35 is equal to substantially one-half of the full traverse of the cam 25 so that the first coil of yarn will be laid with one-half the extent of traverse as would be imparted thereto if the cam 25 were not shifted rearwardly with respect to the direction of the movement of the guide. The purpose of this retarding or holding back of the traverse at the ends of the package is to provide for building up as much yarn at the end of the mass as throughout its mid portion and the method of operation of this part of the mechanism will be more fully explained in connection with the explanation of the reversal in the feed of the cam 25 at the apex end of the cone.

Assuming that the traverse-cam 25 has advanced the thread-guide 15 to the point *c* on the cone-tube T and that the roll 40 which slides the rod 45 has reached the end of the reverse groove

42 in the cam 35, subsequent turning movement of the feed-cam will effect a continuous advance of the cam 25 to the left as viewed in Fig. 1. As the cam 25 turns through the next half revolution the yarn *y* will be guided from the point *c* to the point *d* in a course represented by the full line, and thence to the point *e* as indicated by the dotted line in Fig. 1. It will be understood that during this reverse or backward stroke of the guide 15 while the cam 25 turns through the second half of a complete revolution it is being advanced by the action of the feed-cam 35, but as this advance is relatively slow the thread-guide 15 will be carried back to an extent equal to approximately one-half of the full traverse of the cam 25.

At the next half revolution of the cam 25, the thread-guide 15 is carried forward to the full extent of the throw of the cam 25 and the length of traverse of the guide 15 is augmented by the feed of the cam 25 to the left while the cam 35 turns through a fraction of a revolution. In other words, there is a "gain" in the traverse at this point so that the yarn *y* is led from the point *e* to the point *f* on the opposite side of the cop-tube T, and thence around to the point *g*, the full extent of movement of the guide 15 being from point *e* to point *g*. Now as the cam 25 still continues to turn to reverse the throw of the guide 15 the yarn will be led from the point *g* back in the direction indicated by the full line to the point *h* and thence back to approximately the point *c*. The traverse of the guide in this movement is shortened to substantially one-half the full throw of the cam 25 because, as before explained, the cam 25 is being advanced during this interval by the action of the cam 35. At the next half revolution of the cam 25, the yarn is fed from the point *c* to the point *i* and thence to the point *j*, and at the next reversal of the guide 15 it is returned again to approximately the point *g*, it being observed that the forward traverse of the guide 15 is substantially twice the length of its rearward traverse. Stated another way, the movement of the guide 15 toward the apex end of the cone is accelerated by the action of the cam 35 in feeding the cam 25 to the left along its shaft 26 while, on the other hand, the movement of the guide toward the base end of the cone is retarded as the cam 25 continues its advance in the direction of its axis.

The cycle of operations as above explained is continued with the thread-guide 15 advancing progressively toward the apex end of the cone, the result being to lay the yarn on the surface of the cop-tube T in helical coils which extend toward the apex end of the coil with a relatively long traverse and then return toward the base of the cone with a shorter traverse thus gradually shifting or advancing toward the tip end of the cone.

Fig. 3 illustrates the profile of the cam-groove 41 with the cam 35 turned to the position shown in Fig. 1, or at the point where the feed of the cam 25 is reversed to carry the guide 15 back to the base end of the cone. Referring to Fig. 1, as the guide 15 reaches the extreme of its forward advance the roll 40 which shifts the cam 25 will be in the position as illustrated in Fig. 3. Now as the cam 35 continues to turn in the direction indicated by the arrow in this view, the roll 40 is given a short reverse motion in the V-shaped portion 42 of the cam-groove 41 and then carried forward again before it starts the main feed of the cam 25 back to the base end of the cone. In other words, the axial movement of the cam 25 is reversed for a short period and the cam then carried forward again before it is finally reversed to return the guide 15 to the base end of the cone. The purpose of this action is to hold the cam 25 at the end of the package while the guide 15 makes several traverses of the yarn on the cone so that the same number of courses will be deposited at the ends of the cone as throughout its mid portion. During the normal action of the cam 25 as it is being fed in either direction the yarn is led forwardly and then doubled back on itself, then carried forward to a greater extent and fed back, so that in effect there are three complete turns disposed in overlying relation within a certain distance. At the ends of the cone one of these turns would be missing if the guide immediately started to feed back in the opposite direction and, therefore, the zigzag course 42 of the cam-groove 41 is provided to hold the thread-guide 15 at this point until a sufficient number of turns have been laid to equalize the amount of yarn deposited at the ends of the package with that laid throughout its mid portion; the result being to form the package of uniform density throughout its whole length with its ends firm and stable. However, it has been demonstrated that this "zigzag" portion or "dip" in the groove of the feed cam is not essential; satisfactory packages being accomplished without its use.

The coaction of the two cams 25 and 35 in traversing the thread-guide 15 will best be understood by reference to the diagram in Fig. 4 of the drawings. Assuming that the thread-guide 15 has reached the end of its feed at the apex end of the cone, indicated by the line *z—z* in this view, as the roll 40 which operates the shifter-rod 45 travels in the zigzag portion 42 of the groove 41 of the cam 35 the yarn will be given a relatively short traverse between the points *m* and *n* which is the equivalent of a similar short traverse laid while the roll 40 is traveling in the other short portion 42 of the cam-groove 41. The traverse of the yarn is then reversed from the point *n* to the point *o* as the roll 40 starts to feed through the return portion of the groove 41, this traverse of the yarn being relatively short as compared to the next traverse from *o* to *q* while the cam 25 feeds to the right as viewed in Fig. 1. The last described traverse of the yarn is represented in Fig. 1 as extending from the point *m* to the point *n*, thence back to the point *o* and then returning, as indicated by the dotted line to the point *p*, and thence to the point *q* where the yarn is reversed once more and then advanced again toward the base end of the cone.

The winding continues in the manner as above explained and as the coils are deposited in place on the cop-tube T they build up in layers which form a conical yarn mass of approximately the same taper as that of the surface of the tube which supports the package. In some cases where it is desired to build a cone body of gradually increasing taper the cam 35 is provided with a traverse-groove having a differential pitch or lead so that the feed of the cam 25 will be retarded toward the base end of the cone and accelerated toward its apex end. In this way more yarn may be deposited at the base end of the cone than toward its apex end so that the taper on its surface increases as it grows in diameter.

It should be explained that as the yarn mass builds up on the tube T its increase in diameter will alter the speed ratio between the cop-holder

9 and the drive-roll 5. In other words, the speed of rotation of the package will be gradually decelerated as the yarn body increases in diameter and hence the yarn will be laid with a gradually decreasing number of turns. Notwithstanding this fact, however, the method of winding remains the same, that is, with the traverse of the yarn relatively short in extent as compared to the length of the package and with the turns being carried forward and back to overlap each other while making a gradual advance from one end of the package to the other. In this way the coils of yarn are caused to overlap and interlock to hold them in place to prevent slippage whereby a much firmer and more stable mass is formed.

With the present improved method of winding a package is produced which will deliver the yarn with a more uniform tension without sudden variations in the drag or resistance as the yarn is unwound over the end of the package.

As the yarn unwinds from the package it has a tendency to balloon, that is, the coils or turns will fly out under the effect of centrifugal force. This ballooning tendency frees the coils from the surface of the package so that they will not drag thereacross, but where the resistance to the draft increases intermittently the balloon will vary in form. That is to say, with a normal resistance the yarn will fly out in a circle, but where the resistance is increased the balloon is doubled in the form of a "figure eight" and this will cause further drag or resistance so that the tension becomes irregular and excessive and the material will not deliver at high speed without strain and breakage. With the present improved method of winding the yarn body is composed of a series of yarn coils all of substantially the same extent of traverse so that in unwinding the yarn the resistance remains substantially constant and the balloon will be regular in form without tendency to whip and double up as is the case where the yarn must traverse from one end of the package clear to the other end to free a coil length.

It is to be understood that while the present application describes the method of winding as applied to produce a conical form of package, the invention is not limited in this respect, as parallel-sided or cylindrical yarn bodies may be wound in the same manner to attain the same advantageous results.

It is also to be understood that while the present specification describes and illustrates a certain form of construction of the winding mechanism to effect the improved method of winding by advancing the traverse of the yarn from one end of the package to the other and back again, this part of the invention may be embodied in other forms of construction adapted to function to effect the same result. Therefore, without limiting myself to the precise method of winding as herein explained or to the exact form of the winding mechanism as described and illustrated, I claim:

1. An improved method of winding yarn packages consisting in depositing the yarn on a receiver with a traverse of only a small fractional part of the length of the package to be produced and advancing the traverse along the axis of the receiver throughout the full length of the package first in one direction and then in the other to build a yarn body having relatively flat ends formed by the ends of the overlying layers which are coextensive with the length of the package and composed of overlying coils which overlap and interlock to hold them in place to secure a firm and stable mass.

2. An improved method of winding a yarn package consisting in depositing the yarn in coils on a support with a traverse extending throughout only a small fractional part of the full length of the package to be wound and progressively advancing the traverse axially of the support throughout the full length of the package, first in one direction and then in the other, and continuing the operation to build up a package of any desired size having relatively flat ends as defined by the ends of the superimposed layers which are coextensive with the full length of the package.

3. An improved method of winding a yarn package consisting in traversing yarn back and forth on an axial support with a traverse of only a small fractional part of the length of the package to be produced and progressively advancing the traverse from one end of the support to the opposite end and back again throughout the full length of the package and continuing the operation to build a yarn body with relatively flat ends having the turns therein extending only a fractional part of the full length thereof and reversed to cross and recross each other to bind the yarn in place to secure a firm and stable mass.

4. A winding machine comprising means for winding yarn on a support to produce a package having substantially flat ends, means for traversing the yarn axially of the support with a traverse equal to only a small fractional part of the full length of the package to be produced, and means for advancing the traverse throughout the full length of the package first in one direction and then in the other longitudinally of the support to build a yarn body with its flat ends substantially perpendicular to the surface on which the winding is performed.

5 A winding machine comprising means for rotating a yarn-support, means for traversing yarn on said support with a traverse of only a small fractional part of the length of the whole package to be produced, and means for advancing the traversing-means throughout the full length of the package first in one direction and then in the opposite direction axially of the support to build up a yarn body with substantially flat ends.

6. In a winding machine, the combination of means for rotatively supporting a yarn package, means for traversing yarn back and forth on said support with a traverse equal to only a small fractional part of the length of the package, and means for advancing the traversing-means axially of the yarn body throughout the full length of the package first in one direction and then in the opposite direction to produce a yarn mass having substantially flat ends.

7. In a winding machine, the combination of a rotatable support for a yarn package, guiding-means for feeding the yarn onto the support, means for effecting a relative reciprocation between the guiding-means and yarn-support to traverse the yarn thereon with a traverse of considerably less than half the length of the package being wound, and means to cause a relative advance of the guiding-means axially of the support to an extent equal to the full length of the package whereby to build a yarn body with substantially flat ends.

8. In a winding machine, the combination of a rotatable yarn-support, means for guiding the yarn to deposit it in coils on the support, means for effecting a relatively short traverse between the yarn-support and guiding-means,

means for effecting a relative advance of the guiding-means axially of the yarn-support first in one direction and then in the opposite direction, and means for retarding the advance of the guiding-means at the ends of the yarn body being wound.

9. In a winding machine, the combination of a rotatable holder, means for rotating said holder, a thread-guide reciprocable axially of the holder, means to reciprocate the thread-guide with a traverse considerably less than half of the axial length of the holder, and means to progressively feed the thread-guide back and forth between the ends of the holder coextensively with the full length of the package being wound to deposit the yarn in a series of reversely-extending overlapping coils forming a yarn body with flat ends.

10. In a winding machine, the combination of a rotatable holder for the package to be wound, a thread-guide reciprocable axially of the holder, means for reciprocating the thread-guide with a throw of considerably less than half the length of the package to be produced, and means for advancing the thread-guide during its reciprocation to feed it back and forth between the ends of the holder with a traverse coextensive with the full length of the package to produce a yarn body having layers of yarn composed of overlapping reverse coils of less extent than the full length of the package.

11. In a winding machine, the combination of a rotating winding-mandrel, a thread-guide reciprocable axially of said mandrel, a traverse-cam for reciprocating the thread-guide, means for axially moving the cam first in one direction and then in the opposite direction to progressively advance the thread-guide from one end of the package to the other and back again, and means for imparting a short to-and-fro motion to the cam at the ends of its feeding movement.

12. In a winding machine, the combination of a rotatable winding-mandrel, a thread-guide reciprocable axially of said mandrel, a traverse-cam for reciprocating the thread-guide with a relatively short traverse, and a feed-cam for moving the traverse-cam first in one direction and then in the opposite direction longitudinally of the winding-mandrel, said feed-cam adapted to shift the traverse-cam back and forth with a short to-and-fro motion at the ends of its feeding movement.

13. In a winding machine, the combination of a rotatable winding-mandrel, a thread-guide reciprocable axially of said mandrel, a helical traverse-cam for reciprocating the thread-guide, a feed-cam, means for driving the cams with a differential speed ratio, and means operated from the feed-cam to shift the traverse-cam first in one direction and then in the opposite direction to cause the guide to advance from one end of the package to the other end and back again during its traversing motion with respect thereto.

14. In a winding machine, the combination of a rotatable winding-mandrel, a thread-guide reciprocable axially of said mandrel, a traverse-cam having a throw of considerably less than one-half the axial length of the package, means connecting the traverse-cam to reciprocate the thread-guide, a feed-cam having a throw substantially equal to the axial length of the package, and means connecting the feed-cam to shift the traverse-cam to move the latter bodily first in one direction and then in the opposite direction to cause the yarn to be traversed to a short extent in one direction and back in the opposite direction with said short traverses progressing from one end of the package to the other to build a yarn mass having flat ends and a periphery substantially parallel with the peripheral surface of the core on which it is wound.

15. In a winding machine, the combination of a conical yarn-receiver, means for rotating the receiver, a thread-guide reciprocable longitudinally of the axis of the receiver, a traverse-cam having a throw of only a small fractional part of the length of the package to be wound, means connecting said cam to reciprocate the thread-guide, a feed-cam having a throw substantially equal to the full length of the package to be wound, and means connecting the feed-cam to move the traverse-cam first in one direction and then in the opposite direction a distance equal to the full length of the package to be wound whereby to cause the yarn to be traversed back and forth in short steps advancing progressively from one end of the package to the other and back again to build a yarn mass having flat ends perpendicular to its axis and a peripheral surface conforming to the conical shape of the yarn-receiver on which it is wound.

16. In a machine for winding conical packages of yarn or the like, the combination of means for rotating a frusto-conical yarn-receiver, a thread-guide adapted to be reciprocated longitudinally of the axis of the receiver, a cam having a throw of considerably less than one-half the full length of the package, means for connecting the cam to reciprocate the thread-guide, and means to move said traverse-cam first in one direction and then in the opposite direction to an extent equal to the full length of the package whereby to build the package with the traverse of the yarn advancing and retreating in short steps from one end of the yarn-receiver to the other to form the yarn mass with flat ends and a conical periphery conforming substantially to the shape of the yarn-receiver.

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