

Sept. 19, 1944.

A. W. ARTERTON ET AL

2,358,294

YARN WINDING MACHINE AND METHOD

Filed Jan. 16, 1943

5 Sheets-Sheet 1

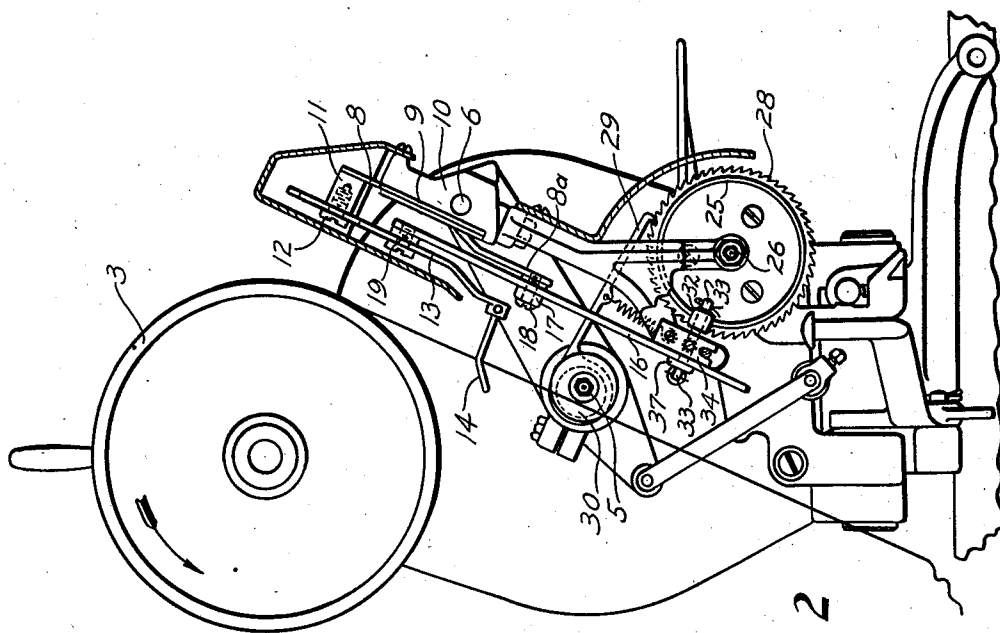


Fig. 2

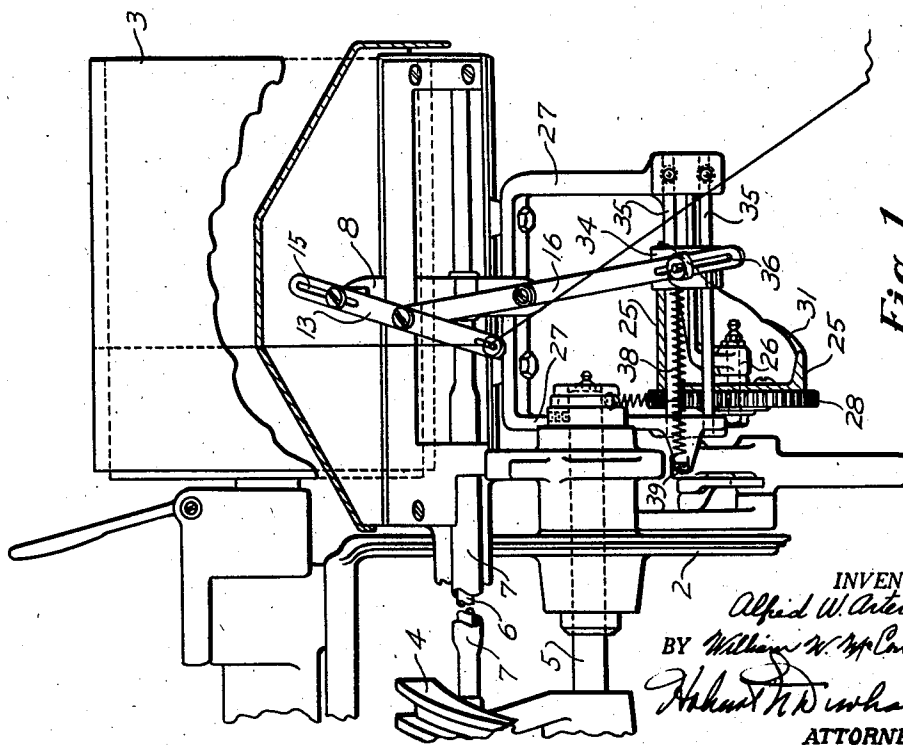


Fig. 1

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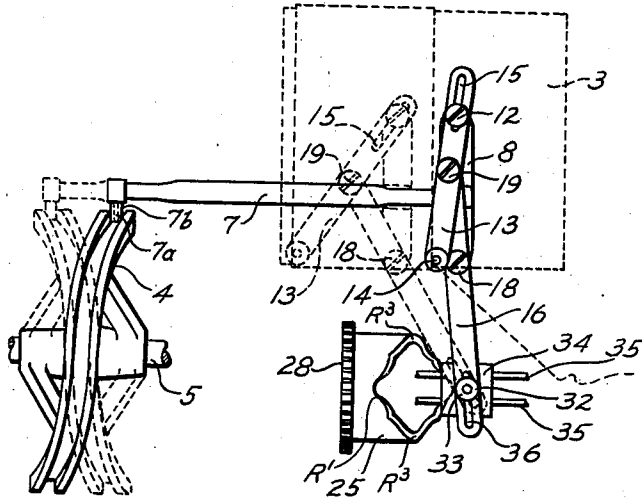


Fig. 3

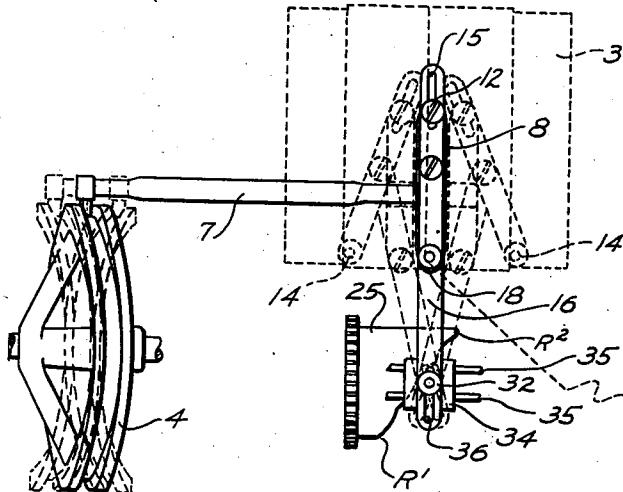


Fig. 4

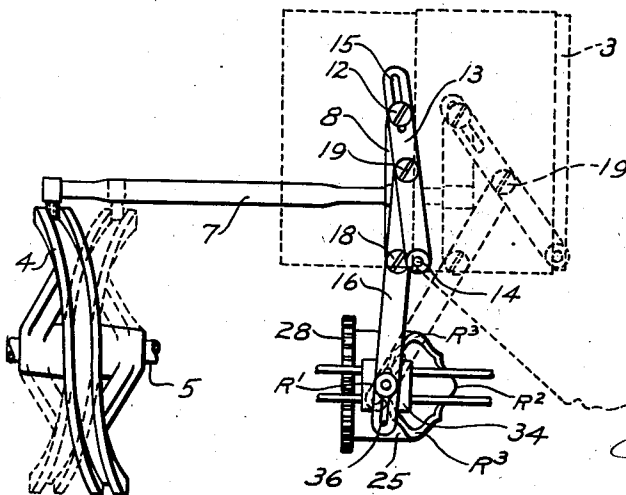


Fig. 5

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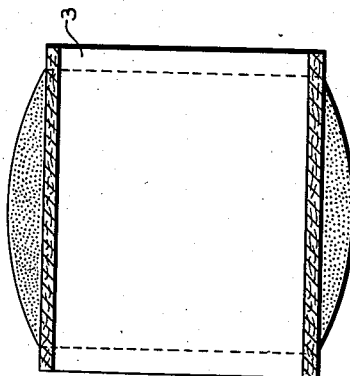


Fig. 10

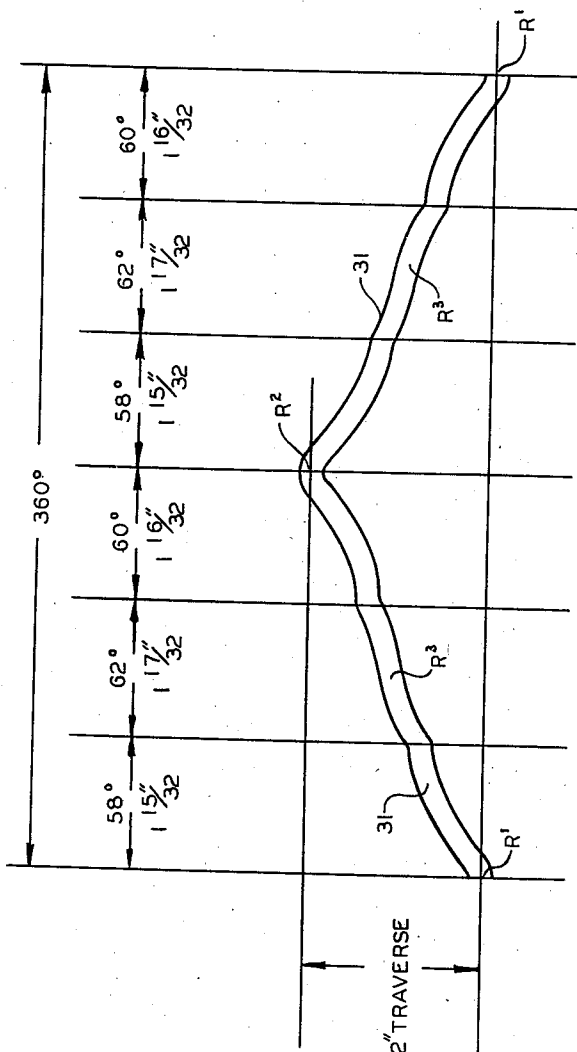


Fig. 8

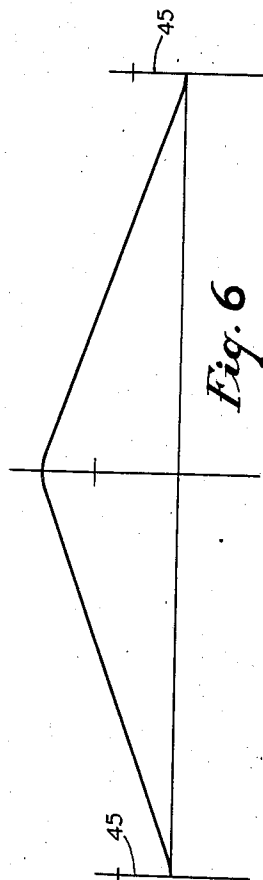


Fig. 6

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5 Sheets-Sheet 4

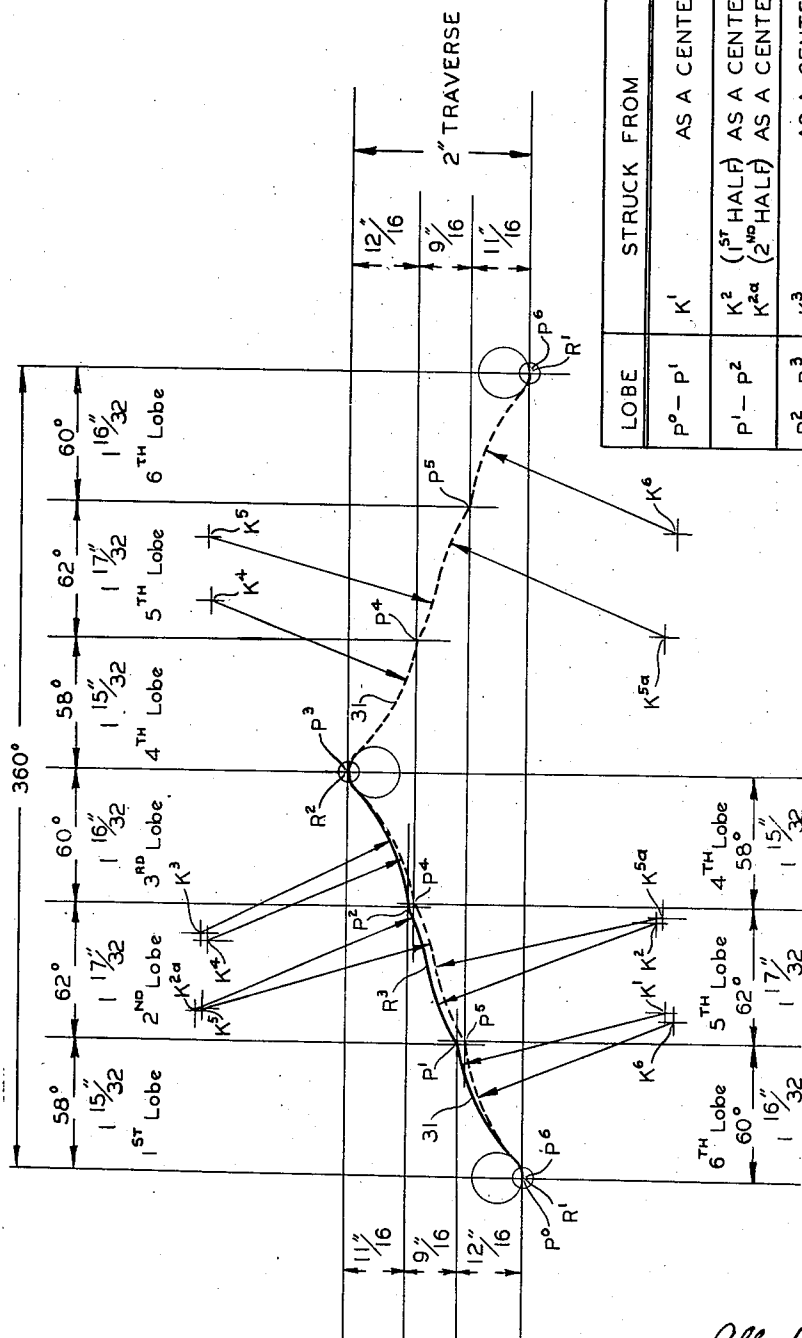


Fig. 7

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5 Sheets-Sheet 5

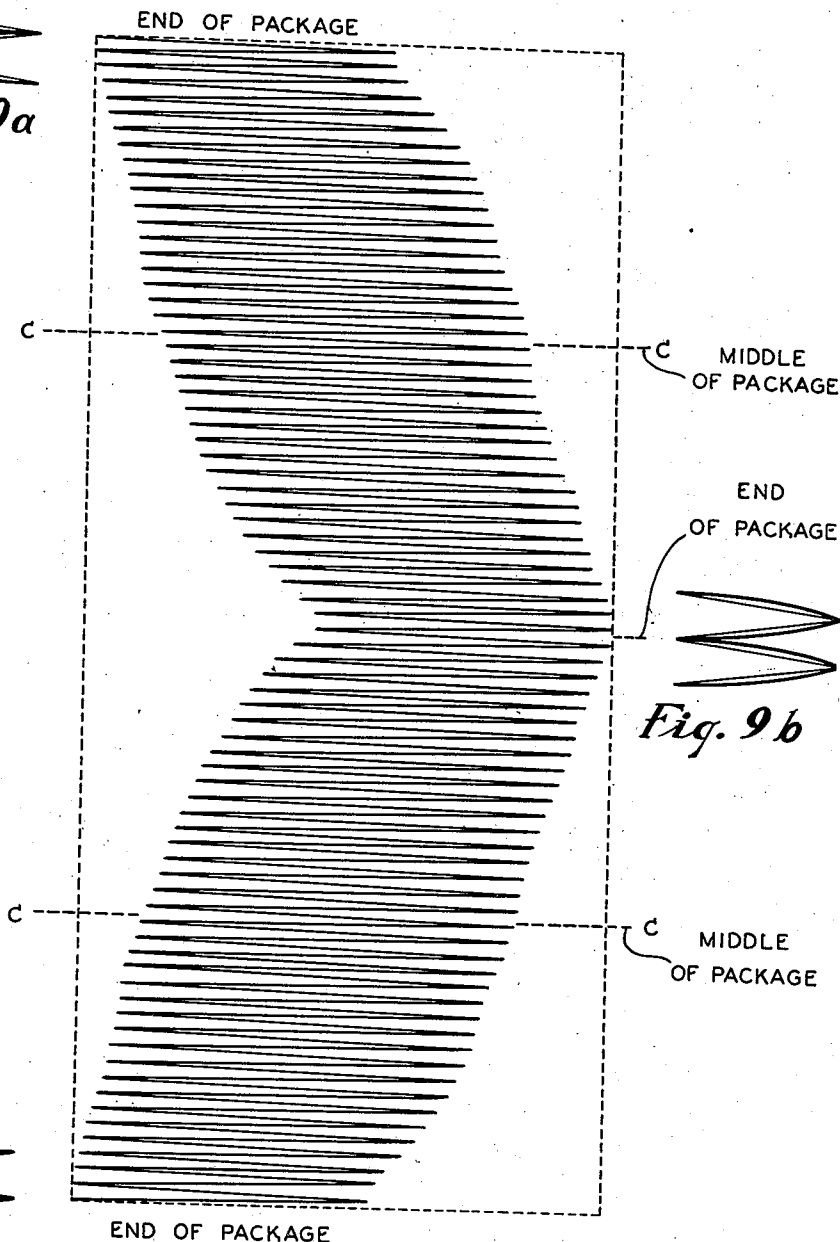


Fig. 9b



Fig. 9



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UNITED STATES PATENT OFFICE

2,358,294

YARN WINDING MACHINE AND METHOD

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Application January 16, 1943, Serial No. 472,542

18 Claims. (Cl. 242—43)

This invention is a method and apparatus for winding a yarn or thread in a package that is smoothly convex from end to end, having its greatest thickness in the middle and tapering gradually and progressively to quite thin edges at either end. The package is substantially barrel-shaped and may conveniently be designated as a barrel wind package.

One of the principal objects of the invention is to produce a package that will allow the unwinding strand to draw freely over the end. In order to insure this result the strand must not be allowed to cross over or drop down on the ends of the winding package nor to be enmeshed between the coils of yarn in the middle portion of the package. In the present invention, which is in contrast to packages with beveled or abruptly curved ends and packages with less angularity of the coils in the middle portion, such freedom in unwinding is attained. While the ends of the package are relatively thin, there is no decrease in the total length of yarn in the package, because the increase of thickness of the package in the middle compensates for the thinness at the ends. The lay or delivery of the thread as wound is such as to bind the end coils without objectionable crossings.

By varying the angularity of the lay or wind of the yarn, continually changing with every stroke in its accelerated and decelerated movement, and varying lengths of the strokes in their accelerated-decelerated movements, the yarn is laid with greater transverse angularity in the middle portion of the package, where the greatest mass of yarn builds up and also the yarn is laid with less transverse angularity at the outer end portions of the package, where the least amount of yarn builds up thereby providing a method where no two successive adjacent strands or coils lie parallel or close together or are interlaced and the strand may be freely drawn off from the package, over the end or otherwise with no drag or catching.

Another object of the invention is to provide mechanism in which the lay of the thread is effected by progressively varying the length of and changing the location of the stroke of the thread guide and simultaneously varying the speed of the strokes of the thread guide, to produce a package in which the coils of the thread are

crossed and staggered and so are "broken up" and do not form ridges by repeating the same wind at the same place in the package.

The invention also involves a new method of winding to produce a barrel-shaped package wherein the thread guide has imparted to it simultaneously two movements, which movements, in combination, produce the novel shaped package. The first of these movements is a traverse movement wherein the successive strokes of the thread guide vary continually in length and each successive stroke being varyingly displaced. The second of these movements is an alternate acceleration and deceleration of the travel of the thread guide. This is particularly important; more specifically, the thread guide, as it moves from one end of the package toward the middle, is accelerated, while as it moves from the middle toward the end, it is decelerated. As it comes back toward the middle, it is accelerated again until it reaches the middle, and then decelerated toward the other end. These alternate accelerated and decelerated movements, in cooperation with a traverse stroke which is continually varied in length and longitudinally displaced, and wherein each stroke is somewhat less than the length of the package, produce the novel barrel wind package of the present invention.

In the area where and when the most yarn would be normally delivered the traversing guide progressively moves into and out of that area relatively fast, and conversely, in the area where and when the least yarn would be normally delivered, the traversing guide progressively moves into and out of that area relatively slow. Since the timing of each stroke is controlled by the teeth in the ratchet wheel the duration of each stroke is the same, although the longer strokes travel faster and the shorter strokes travel slower.

Objects and advantages of the invention will be set forth in part hereinafter and in part will be obvious herefrom, or may be learned by practice with the invention, the same being realized and attained by means of the instrumentalities and combinations pointed out in the appended claims.

In the drawings:

Figure 1 is a side view of a portion of a winding machine according to the present invention;

Figure 2 is a side view of Figure 1, looking from the right;

Figure 3 is a fragmentary side view showing the traverse mechanism and its associated cams and showing the thread guide in its middle and left-hand positions;

Figure 4 is a view similar to Figure 3, showing the thread guide in its middle or vertical position;

Figure 5 is a similar view showing the thread guide and associated parts in the middle and right-hand positions;

Figure 6 is a development showing the characteristics of the main traverse cam;

Figure 7 is a diagram showing the characteristics of the auxiliary cam;

Figure 8 is a diagram very similar to Figure 7, showing a development of the actual cam groove of the cam of Figure 7;

Figure 9 is a diagrammatic conventional drawing showing the general distribution of the helical coils and the developed pattern outline of the structure of the built up package.

Figures 9A and 9B show the peculiar formation or shape of the decelerated outer end coils and the accelerated inner end coils respectively in diagrammatic exaggerated forms.

Figure 9C shows a similar diagram of the coils in the middle portion of the package.

Figure 10 is a view, in section, of the barrel-shaped package.

Referring now to these drawings, in which similar reference characters indicate similar parts, the frame of the machine indicated generally at 2 supports a rotatable cylinder 3 preferably of Bakelite or the like, on which the thread is wound. The main traverse cam 4 having a traverse of about $1\frac{1}{2}$ inches, is carried by shaft 5, the drive for the cylinder 3 and shaft 5 being geared so that they rotate at definite relative speeds, as is well understood in this art. The groove of cam 4 is a smooth, uniform curve. Carried in suitable bearings in the framework of the machine is a fixed guide rod 6 and surrounding this rod and movable on it as an axial bearing is the traverse tube 7, this tube 7 being provided with a pin 7a and whirl 7b which engages the groove of cam 4, whereby there is imparted to the traverse tube 7, by cam 4, a uniform reciprocatory motion. Secured to the right-hand end of traverse tube 7 is a cross-head 8 which slides on the machined surface 9 of the fixed frame element 10.

The upper end of cross-head 8 carries a stud 11 in which engages a screw 12 and oscillatably and slidably engaged by this screw is the thread guide lever 13 carrying a thread guide 14 at its lower end. The upper end of lever 13 engages with the screw 12 through the medium of a slot 15, so that the thread guide lever has a compound movement, oscillatably and longitudinally of itself. By depending the thread guide lever 13 from its upper end and putting the thread guide at its lower end, the thread guide may be traversed in a substantially straight horizontal path and the thread may be run onto the winding package tangentially without putting any bends in the thread. Both of these features are very desirable.

The lower portion of cross-head 8 is offset, as at 8a, and pivoted on the lower end of offset 8a is a second or actuating lever 16. The offset carries a hollow stud 17 and pivot screw 18 providing a pivot for the lever 16. The upper end of lever 16 is pivoted to thread guide lever 13,

intermediate the ends of such lever, by a pivot screw 19.

The auxiliary cam

The auxiliary cam now to be described is one of the important features of the present invention in that, in cooperation with the parts just described, there is imparted to the thread guide 14 successive traverse strokes which continually vary in length, these traverse strokes being alternately accelerated and decelerated; as the thread guide moves from either end of the package toward the middle it is progressively accelerated, while as it moves from the middle toward either end it is progressively decelerated.

This auxiliary cam 25 is a cylindrical cam and rotates on a shaft 26 substantially parallel to shaft 5; shaft 26 is carried by a supporting bracket 27. The cam 25 is provided with an external gear 28, the teeth of this gear being engaged by a pawl 29 operated by an eccentric 30 fixed to the main shaft 5 of the traverse cam. One revolution of the traverse cam shaft 5 causes the auxiliary cam 25, through the medium of the pawl 29, to be moved at least one notch.

In the preferred embodiment of the invention, the auxiliary cam 25 is attached to gear 28 which has seventy-six teeth so that when the main traverse cam completes seventy-six revolutions, the auxiliary cam completes one revolution. This gear ratio, of course, may be changed, as desired.

Cam 25 may be an edge cam, as shown in Figures 3, 4 and 5, or its equivalent, a grooved cam, as in Figure 8. The cam groove or cam edge 31 of cam 25 engages and actuates a whirl or roller 32. Whirl 32 is mounted on a pin 33 carried by a follower block 34. This follower block is slidably mounted on a pair of guide rods 35 carried by bracket 27. The lower end of lever 16 is slotted, as at 36 and this slot is slidably engaged over pin 33 and held by nut 37. Whirl 32 is held in operative engagement with cam edge 31 by a spring 38, Figure 1, attached at one end to the block 34 and at the other end to stud 39 on the frame.

Figure 6 is a development showing the characteristics of the main traverse cam 4, which is a uniform cam having a traverse of $1\frac{1}{2}$ inches. Being a uniform cam, its development is in straight lines, as shown.

The auxiliary cam 25 is a cylindrical, double acting, trilobate cam, with circular base curves. One section of the cam, during a part of a revolution, moves the follower block 34 and lower end of lever 16 in a substantially outward direction, and the other section, during the rest of the revolution, moves the follower back in a reverse or substantially inward direction. Each of the cam sections is composed of a group of three lobes, each lobe possessing different characteristics from either of the other lobes in the same group; the second group of three lobes functions in the same order as the first group of three lobes, causing the follower 34, lever 16, thread guide lever 13 and thread guide 14, to be successively actuated by six different movements during six different intervals of time, the thread guide distributing a strand of yarn on winding cylinder 3 during each complete reciprocation of the yarn guide.

Each individual lobe, or short groove corresponding thereto, is in the form of an accelerated-decelerated cam, the end most accelerated of each lobe or groove joining the end most decelerated in the next lobe or groove, making a group of

accelerated-decelerated short grooves or lobes to form one generally accelerated-decelerated cam groove.

The characteristics of cam 25 are shown in the development, Figures 7 and 8, and certain values thereof are expressed in the following table:

	Angle of groove	Length of groove	Traverse
	Degrees		Inches
First lobe.....	58	$1\frac{1}{2}$	$\frac{3}{4}$
Second lobe.....	62	$1\frac{1}{2}$	$\frac{9}{16}$
Third lobe.....	60	$1\frac{1}{2}$	$1\frac{1}{16}$
Fourth lobe.....	58	$1\frac{1}{2}$	$\frac{3}{4}$
Fifth lobe.....	62	$1\frac{1}{2}$	$\frac{9}{16}$
Sixth lobe.....	60	$1\frac{1}{2}$	$1\frac{1}{16}$
	300	9	2

Similar values are shown in Figure 8, which is a development of an actual groove in a cylindrical cam, where a groove is used instead of an actuating edge 31.

The successive lobes or grooves blend into one another so as to form a continuous groove.

Referring to the above table, it will be noted that the values of the first three lobes, forming the first group, are the same as the values of the second three lobes, forming the second group. No lobe in one group has the same characteristics as any other lobe in that group. Similar lobes in the respective groups are diametrically opposite one another.

Point R₁, Figures 3, 4 and 5, may be considered as the "low point" of the cam, R₂ as the "high point", and R₃ as the "mid-point." The corresponding points are shown on Figures 7 and 8.

In connection with the foregoing dimensions of cam 25, it will be recalled that the main traverse cam has a traverse of $1\frac{1}{2}$ inches and a speed about seventy-six times that of the cam 25.

Operation

In the following description and throughout this specification, all quantitative data, as to number of revolutions, length of traverse and the like, are purely illustrative and apply to the illustrated embodiment of the invention. The invention is not to be restricted to the values given, but may be carried out in other ways, falling within the scope of the claims.

The movement of the thread guide 14 is the resultant of the uniform back and forth movement of traverse mechanism, given by main traverse cam 4, of the successively different traverse and angular movements applied to the lower end of lever 16 by the successively different lobes of the auxiliary cam, and to the interaction of the interconnected, slotted levers 13 and 16. The resultant lay of the yarn is shown in the development of Figure 9, showing the lay of the yarn for seventy-six revolutions of the traverse mechanism, and for the corresponding single revolution of the auxiliary cam 25. The length of the package is the distance between the lines 45-46, that is the length of the body of yarn wound on the core, as shown in Figure 6. Successive traverse strokes of the thread guide vary successively from about $4\frac{1}{4}$ to $5\frac{1}{2}$ inches. The longer strokes of the thread guide occur when the guide is feeding back and forth at approximately equal distances on either side of the middle, the strokes getting progressively shorter as the guide is working more and more to one side or the other of the center.

Due to the cooperation and interaction of the interconnected, slotted levers 13 and 16 reciprocated back and forth by the main traverse cam 4, and the successively different movements applied to the lower end of lever 16 by auxiliary cam 25, the fastest movement of the thread guide occurs when the levers 16 and 13 are vertical, as in full lines in Figure 4. As the traverse mechanism moves to the left, as in Figure 3, or to the right, as in Figure 5, the thread guide is progressively decelerated, while as it returns toward the middle from either end, the thread guide is progressively accelerated.

The thread guide is therefore alternately accelerated and decelerated, as follows:

Progressively accelerated from one end to middle of package.

Progressively decelerated from middle to other end.

Progressively accelerated from other end back to middle.

Progressively decelerated from middle back to first end.

Accompanying the foregoing changes of speed of the thread guide is the described continual and progressive change in the traverse stroke, and the result is a package as shown in Figure 10, substantially barrel shaped, smoothly convex from end to end, with maximum thickness in the middle and no beveled or shouldered ends.

Assuming that, as illustrated, the complete cycle is composed of seventy-six strokes, there are thirty-eight pairs of strokes of different lengths, two strokes of a given length are produced in the cycle of seventy-six strokes, all seventy-six strokes are in different positions, and only one stroke in a given position is produced in the cycle of seventy-six strokes.

The auxiliary cam also provides for the compound levers and thread guide to be positioned during relatively longer periods of time when winding at the middle portion of a package and to be positioned during relatively shorter periods of time when winding at the ends of a package.

So when the winding coils or helices are decelerated the most, due to the swing of the levers, the said levers stay in such position the shortest time periods due to the accelerated action of the auxiliary cam, and conversely, when the winding coils or helices are accelerated the most, due to the swing of the levers, the said levers stay in such position the longest time periods, due to the decelerated action of the auxiliary cam.

The further away either side of a central vertical position that the guide is swung by both of the levers, moves the guide at a progressively decelerated rate of motion.

The auxiliary cam, regardless of its developed motion, causes a displacement, of a series of displacements of the positions of the compound levers, and the different positions of the compound levers produce different lengths of movement of thread guide, while the design of the auxiliary cam determines the timing of the levers and guide in their various positions.

Thus the guide is given its swinging traversing movement by the kind of a motion produced at the delivery end of the compound levers, reciprocated by the uniform traverse cam, and the position of the levers is progressively changed to give varying lengths of traverse to the guide and, also to give prescribed intervals of time for the guide in its various positions.

Thus compound levers plus a uniform traverse cam produce the traverse movement; an auxiliary cam alters and displaces the traverse movement, and also controls the time allotted to each displaced traverse.

While the preferred embodiment of the invention has been described in some detail, it should be understood that the invention is not limited to this exact disclosure, but may be carried out by other mechanism as defined within the scope of the following claims.

What we claim is:

1. The method of winding thread or yarn to produce a barrel shaped package, comprising the steps of laterally traversing and feeding the yarn onto a rotating core, continually varying the length of the lateral traverse stroke as the yarn is fed to the core, and accelerating the lateral feed of the yarn as it winds toward the middle of the package, and decelerating the lateral feed as it winds toward the ends of the package.

2. In a winding machine, the combination of traverse mechanism, movable back and forth at a substantially uniform rate, a thread guide carried thereby, an auxiliary cam connected to operate in timed relation with the traverse mechanism, a lever pivotally connected to the thread guide and operatively engaged with the auxiliary cam, said cam operating through said lever to cause periodical changes in the relative positions of the inter-connected parts of the traverse mechanism during the winding of a package, said traverse mechanism moving the thread guide in an accelerated movement in its travel toward the middle of the package, and in a decelerated movement in its travel toward either end of the package.

3. In a winding machine, the combination of traverse mechanism, a thread guide carried by the traverse mechanism and an auxiliary cam serving to control the extent of the periodic changes in the position of the traverse mechanism to give lesser degrees of change as the guide moves successively faster in its travel toward the middle of the package, and to give greater degrees of change as the thread guide moves successively slower in its travel toward the ends of the package.

4. In a winding machine, the combination of traverse mechanism, a thread guide carried by the traverse mechanism, and auxiliary means operating in timed relation with the traverse mechanism and operatively connected to the thread guide, and serving to control the changes in the position of the traverse mechanism, the thread guide moving successively faster as it travels toward the middle of the package, and successively slower as it travels toward the ends of the package.

5. In a winding machine, the combination of traverse mechanism movable back and forth at a substantially uniform rate, a thread guide carried by the traverse mechanism, an auxiliary cam connected to the traverse mechanism and operating in timed relation therewith, means connecting said auxiliary cam with the thread guide, said auxiliary cam having lobes which control the changes in the position of the traverse mechanism, whereby the thread guide is moved successively faster by the traverse mechanism as the guide travels toward the middle of the package, and successively slower as it travels toward the ends of the package.

6. In a winding machine, the combination of traverse mechanism, movable back and forth at

a substantially uniform rate, a thread guide carried thereby, an auxiliary cam connected to operate in timed relation with the traverse mechanism, a lever pivotally connected to the thread guide and operatively engaged with the auxiliary cam, said cam cooperating with said lever whereby different accelerated and decelerated movements of the thread guide are produced by the traverse mechanism when it is moving the guide toward the middle of the package, and when it is moving the guide toward either end of the package, respectively.

7. In a winding machine, the combination of traverse mechanism, a pair of levers, each pivoted to the traverse mechanism, a thread guide carried by the first of said levers, the second of said levers being pivotally connected to the first lever, and an auxiliary cam, operated in timed relation with the traverse mechanism, and operatively connected with said second lever, said parts cooperating to produce a barrel shaped package, convex from end to end.

8. In a winding machine, the combination of traverse mechanism, a pair of pivotally connected levers each pivoted to the traverse mechanism, a thread guide carried by the first of said levers, and an auxiliary cam, operated in timed relation with the traverse mechanism and operatively connected to said second lever, said parts cooperating to produce a barrel shaped package, convex from end to end.

9. In a winding machine, the combination of traverse mechanism operating back and forth at a substantially uniform rate, a first lever pivoted at one end to the traverse mechanism, a thread guide at the other end of said first lever, a second lever, pivoted to the traverse mechanism and also pivoted at one end to said first lever, between the thread guide and the pivot of the first lever, and an auxiliary cam, operating in timed relation with the traverse mechanism, operatively connected with the other end of said second lever, said parts cooperating to produce a barrel-shaped package, convex from end to end.

10. In a winding machine, traverse mechanism movable back and forth at a substantially uniform rate, a lever pivoted at one end to the traverse mechanism by a slotted pivotal connection, a thread guide at the other end of said lever, a second lever, pivoted to the traverse mechanism and also pivoted to the first lever intermediate the ends thereof, and an auxiliary cam, operating in timed relation with the traverse mechanism, said second lever being operatively connected to the auxiliary cam by a slotted pivotal connection, said auxiliary cam having a plurality of lobes of successively different characteristics, said parts cooperating to produce a barrel-shaped package.

11. In a winding machine, the combination of traverse mechanism operating back and forth at a substantially uniform rate, a cross-head carried by said traverse mechanism, a first lever pivoted at one end to said cross-head by a pivotal slot therein, a thread guide at the other end of said first lever, a second lever pivoted to said cross-head and pivoted at one end to the first lever, intermediate its ends, and an auxiliary cam, operating in timed relation with the traverse mechanism, the other end of said second lever being operatively connected with said auxiliary cam by means including a slot in the end of the second lever, said parts cooperating to produce a barrel-shaped package, convex from end to end.

12. In a winding machine, traverse mechanism

movable back and forth at a substantially uniform rate, a pair of compound levers, pivoted to the traverse mechanism and to each other, a thread guide carried by one of said levers, and an auxiliary cam operating in timed relation with said traverse mechanism, and operatively connected to the other of said levers, said auxiliary cam being provided with a plurality of lobes of successively different characteristics to control the changes in the position of the traverse mechanism, said traverse mechanism moving to accelerate the movement of the thread guide as it moves toward the middle of the package and to decelerate its movement as it moves from the middle toward the ends of the package, to produce a barrel-shaped package, convex from end to end.

13. In a winding machine, traverse mechanism operated at a substantially uniform rate, a thread guide carried thereby, an auxiliary cam, operated in timed relation with the traverse mechanism, means operatively connecting the auxiliary cam to said thread guide, said auxiliary cam having a plurality of lobes, each of which has different characteristics from the other lobes, to control the changes in the position of the traverse mechanism, said traverse mechanism moving to alternately accelerate and decelerate the movement of the thread guide.

14. In a winding machine, traverse mechanism, operated at a substantially uniform rate, a thread guide carried thereby, an auxiliary cylindrical rotatable cam, operated in timed relation with the traverse mechanism, means operatively connecting the auxiliary cam to the thread guide, said auxiliary cam having a plurality of lobes, each of which has a traverse and an angular length different from its adjacent lobe, to control the changes in the position of the traverse mechanism, said traverse mechanism moving to alternately accelerate and decelerate the movement of the thread guide.

15. In a winding machine, traverse mechanism, operated at a substantially uniform rate, levers pivotally carried by the traverse mechanism, a thread guide carried by one of said levers, an auxiliary cylindrical rotatable cam, operated in timed relation with the traverse mechanism, means operatively connecting the other of said levers with said auxiliary cam, said auxiliary cam having a plurality of lobes, each of which has a traverse and an angular length different from its adjacent lobe to control the changes in the position of the traverse mechanism, said traverse mechanism moving to alternately accelerate and decelerate the movement of the thread guide.

16. In a winding machine, traverse mechanism, operated at a substantially uniform rate, levers pivotally carried by said traverse mechanism, one of said levers carrying a thread guide at one end and having its pivot at the other end, the other of said levers being pivoted to the first lever intermediate the ends of the first lever, an auxiliary cam operated in timed relation with the traverse mechanism, said auxiliary cam having a plurality of lobes, each of which has a traverse and an angular length different from its adjacent lobe to control the changes in the position of the traverse mechanism, said traverse mechanism moving to alternately accelerate and decelerate the movement of the thread guide.

17. In a winding machine, traverse mechanism operated at a substantially uniform rate, levers pivotally connected to the traverse mechanism, a thread guide carried by the first of said levers, the second of said levers being pivoted to the first lever intermediate its ends, an auxiliary cam, operated in timed relation with the traverse mechanism, having lobes of successively different characteristics, means operatively connecting the auxiliary cam and said second lever, each of said levers including a slotted pivotal connection as a part thereof, said cam operating through said levers to control the changes in the position of the traverse mechanism, said traverse mechanism moving to vary the length of successive strokes of the thread guide and alternately to accelerate and decelerate the movement of the thread guide.

18. In a winding machine, traverse mechanism operated at a substantially uniform rate, a cross-head carried thereby, a lever pivoted at one end to said cross-head by a pivotal slot connection, a thread guide at the other end of said lever, a cylindrical auxiliary cam having a plurality of lobes, each lobe having characteristics different from an adjacent lobe, a second lever, pivoted to the traverse mechanism, and to the first lever, intermediate the ends thereof, and means, including a pivotal slot connection, operatively connecting the second lever and said auxiliary cam, said cam operating through said levers to control the changes in the position of the traverse mechanism, said traverse mechanism moving to vary the length of successive strokes of the thread guide and also to alternately accelerate and decelerate the movement of the thread guide, to produce a barrel-shaped package.

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