Dec. 19, 1944. W. REINERS ET AL 2,365,434

TRAVERSING MEANS FOR WINDING MACHINES

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Fig. 1.

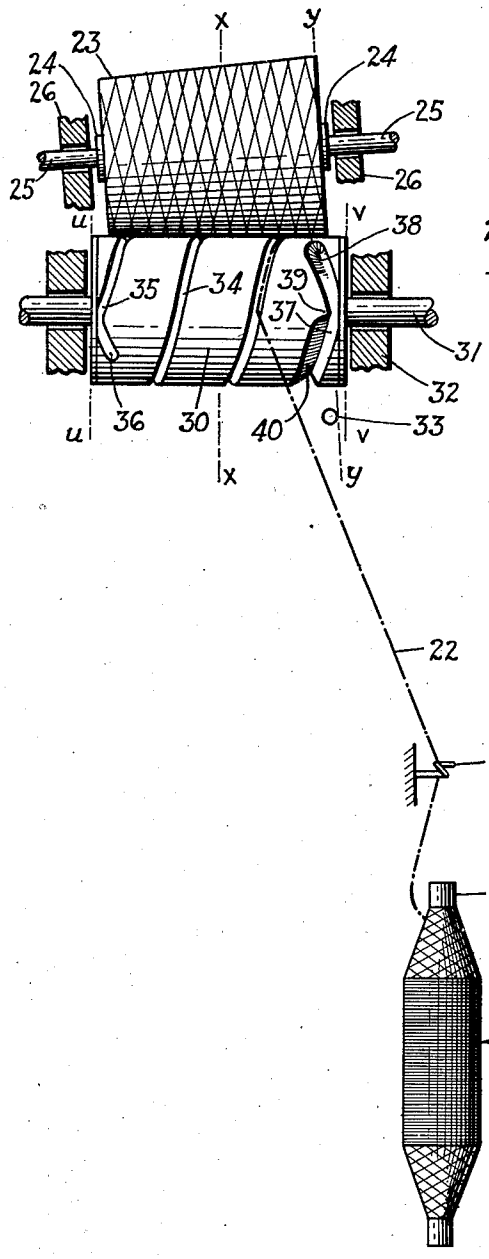
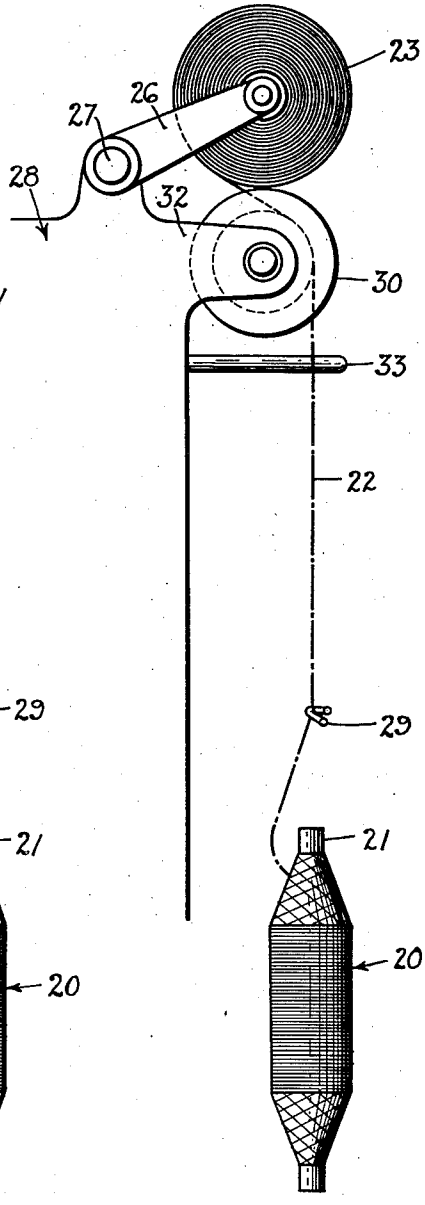


Fig. 2.



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Fig. 3.

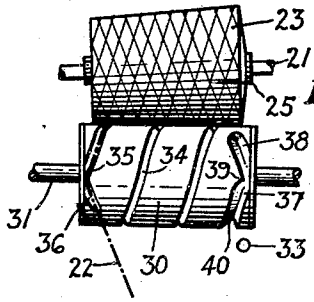


Fig. 4.

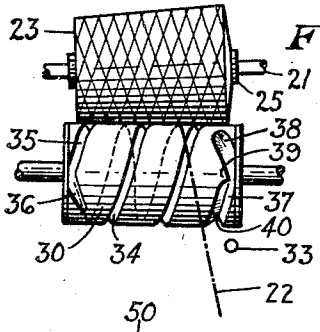


Fig. 5.

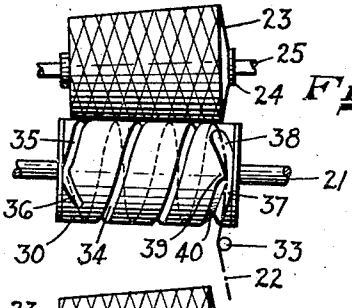


Fig. 6.

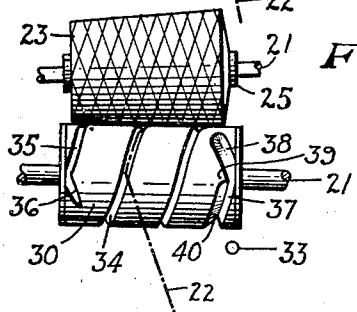


Fig. 7.

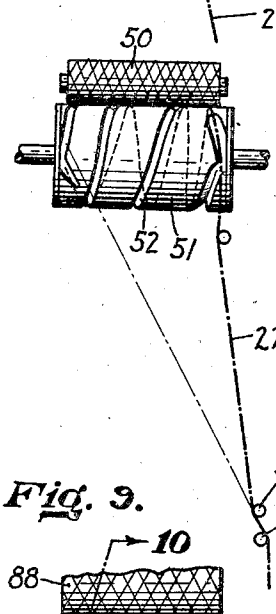


Fig. 8.

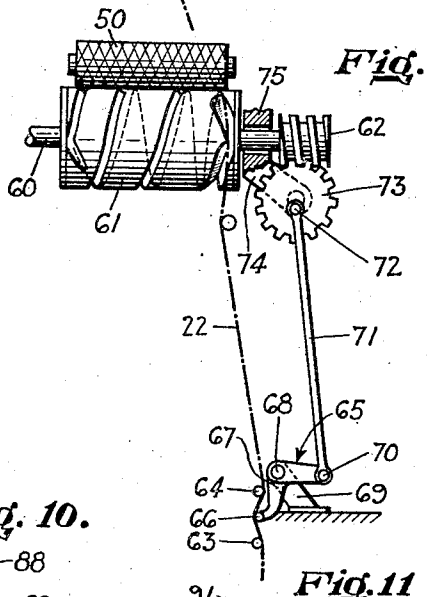


Fig. 9.

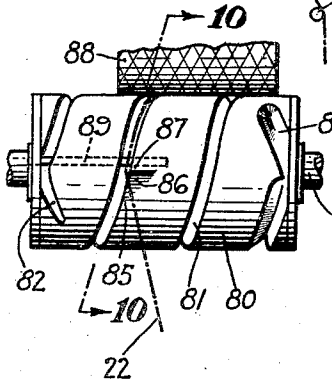


Fig. 10.

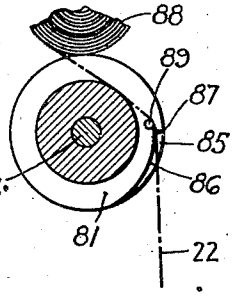
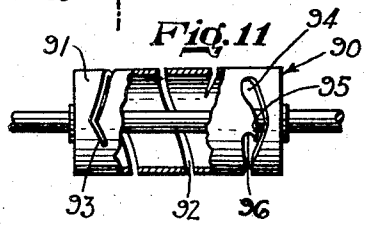


Fig. 11



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Fig. 12.

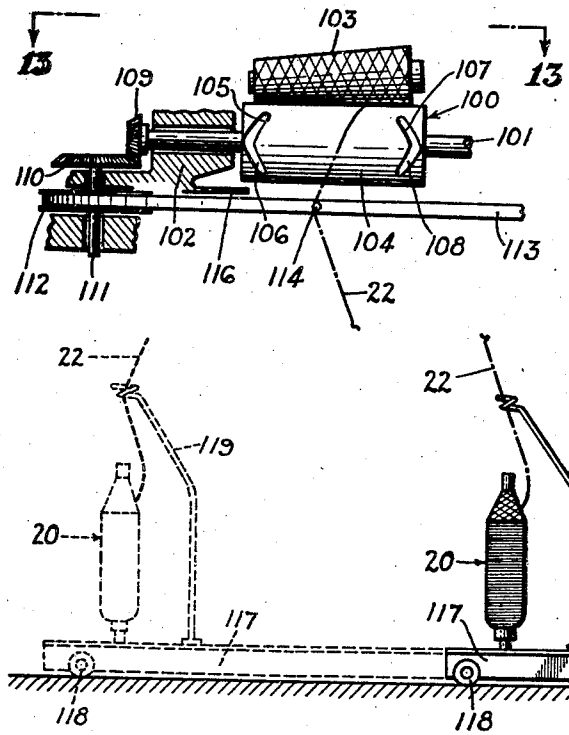


Fig. 14.

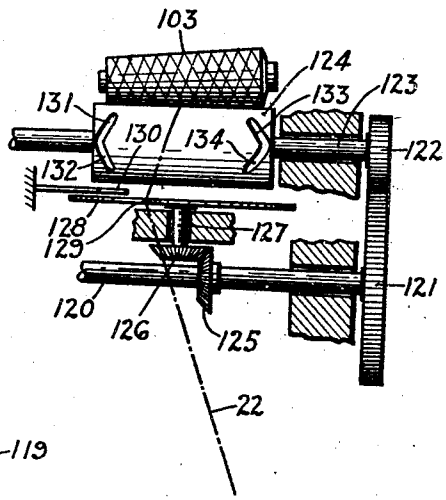


Fig. 15.

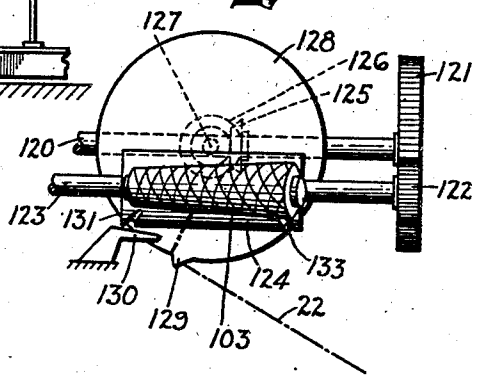
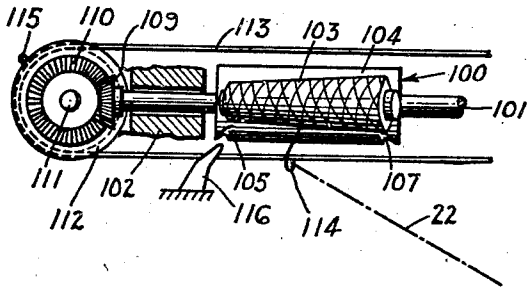


Fig. 13.



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TRAVERSING MEANS FOR WINDING MACHINES

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Application June 9, 1938, Serial No. 212,674
In Germany July 1, 1937

12 Claims. (Cl. 242—43)

This invention relates to means for winding yarn, thread, wire or similar strand materials and refers more particularly to machines for winding yarn into cops, cones, coils, packages, or the like, the strands of which extend crosswise or in helical coils.

Cops and packages of this type are now made on quickly rotating machines by traverse-rolls or drums which serve as the means for guiding the yarn or other strand material. The yarn supplied to these rolls is guided by them and is wound in the form of packages which are usually rotated by frictional engagement wtih the same rolls.

The point of contact between the yarn and the roll is usually situated substantially in a middle plane intersecting at right angles to the axis of the traverse-roll, and, therefore, it was found necessary to use additional guiding means for the yarn, in order to cause it to move alternatively to the right and to the left of the middle plane. It was customary to use separate thread guides for that purpose, which carry out a rotary reciprocating or oscillating movement, and/or to provide special guiding grooves or slots in the traverse-rolls.

An object of the present invention is to simplify the making of cops, cones, or packages by providing a traverse roll or drum having inclined surfaces which are so arranged that they suffice to cause the yarn or other strand to move in one direction from its middle position and to wind itself upon the cone or package in the form of a helix of predetermined length, whereupon certain additional guiding means are used for the purpose of causing the yarn to reverse the direction of its movement and to return back into its original position.

Another object of the present invention is to utilize the discovery that in winding machines known in prior art the thread has the tendency to move back into the middle plane of the winding as soon as it is free to do so, said discovery being made use of by means of a device which, theoretically, causes the shifting of this middle surface to which the yarn tends to move, toward one end of the winding, thus providing means for automatically returning the yarn to an original position from which it has been moved by the traverse-roll.

A further object is to improve the winding of cones by causing the yarn returning to said original position to be wound in the form of a helix having a slightly diminishing angle of inclination, due to the fact that this diminution of the angle of inclination in a direction toward the wider end of the cone causes larger amounts of yarn to be wound at that end and thereby furthers the formation of the cone.

A still further object of the present invention is to provide an automatic balancing of the yarn tension which is accomplished by using a thread guide to stretch the yarn in a direction which is incylined toward the wider end of the cone, so that the yarn while being wound upon the wider portion of the cone, has not only the greatest speed but is also subjected to the smallest possible friction in the thread guide, and is subjected to greater frictional forces in the thread guide although moving at a lesser speed, while being wound upon the narrow portion of the cone, due to the fact that the angles of inclination of the yarn are smaller at that time.

Still another object of the present invention is the provision of a single machine by means of which the cones can be so wound that their wider sides are situated upon any one of the two sides of the machine.

In prior art traverse-rolls were often used in pairs, the grooves of the second roll causing the return movement of the yarn. Such constructions eliminate the necessity of providing intersecting grooves upon a single roll but increase the costs of installation to a considerable extent; furthermore, the yarn is subjected to great tension due to the fact that it had to be shifted from the groove of one roll to a groove of the other roll at a high speed. A further object of the present invention is to eliminate such drawbacks by providing separate inexpensive and effectively operating means for automatically causing a return movement of the yarn.

The above and other objects of the present invention may be realized by means of a construction which, in its broadest aspect, comprises the combination of means for moving the yarn in one direction and for causing it to return to its original position. In accordance wth some of the embodiments of the invention, such means comprise the combination of a traverse-roll having a groove or slot moving the yarn in one direction, with a thread guide which constitutes the means for automatically moving the yarn backwards and which is situated outside of the space limited by planes extending through the side surfaces of the traverse rolls; the groove or slot upon the traverse-roll is, preferably, a helical one, the inclination of the helix corresponding to the direction of the winding of the thread upon the

roll, in the case of a free rearward movement of the thread upon that roll.

The groove or slot upon the traverse-roll should extend in one direction and not intersect any other groove or slot; preferably, one end of the groove or slot should be connected with a special feed groove or slot while the opposite end of the guiding groove or slot is connected with a separate groove or slot for reversing the inclinatin of the yarn.

Furthermore, in accordance with the present invention, the feed groove or slot and the adjacent portion of the helical guide are widened and are provided with an inclined surface or slot for the purpose of catching the yarn. By means of this arrangement which can be used in combination with a separate abutment limiting the extent of the movement of the yarn, the latter is automatically guided into the groove or slot of the traverse-roll.

When the yarn is being wound in the form of cones, as is customary nowadays, the thread guide determining the inclination of the yarn, is, preferably, situated at the side of the widest end of the cone.

Machines manufactured in accordance with the present invention, may be advantageously employed for the purpose of winding not only cones, but cylindrical packages as well. In that case, however, it is necessary that the inclination of the helical groove or slot should diminish to the same extent to which the inclination of the yarn is diminished in the course of its return movement, the helix determining the inclination of the yarn being its path upon the smooth surface of the traverse-roll in the course of its return movement. By this arrangement the changes in the inclination of the helically wound thread balance each other in the course of the back-and-fourth movement of the yarn, with the result that the yarn is wound in uniform and evenly distributed layers in the form of a cylindrical package. The tension of the yarn may be balanced automatically in that case particularly at the time when the angle of inclination of the yarn and, therefore its tension are diminished, through the provision of additional immovable or movable projections which increase correspondingly the friction of the stretched yarn as soon as the angle of inclination of the yarn is diminished. Due to this arrangement, the differences in the yarn tension are also automatically balanced in the course of the winding of cylindrical packages.

In order to be able to use the same traverse roll for the winding of packages of different lengths, the groove which guides the thread is provided with cutout portions of smaller depth at those places at which the yarn should begin its return movement. In order that the yarn should be compelled to start its return movement at one particular cut-out portion, special means are provided for the purpose of covering the deeper adjacent portions of the guiding groove.

In order to wind cones the wide end of which is situated upon any one of the two sides of one and the same machine, the thread guide which determines the inclination of the yarn is made movable in the direction of the axis of the traverse-roll. The original spool from which the yarn is unwound may be made movable along with the thread guide. Through this arrangement, the yarn is always maintained in an inclined position, the direction of which is toward the wider end of the cone.

In certain embodiments of the present invention, the device by means of which the yarn is maintained in its position, is caused to carry out a reciprocatory movement and is caused to change its inclination at the time it changes the direction of its movement, it comprises a bendable supporting surface carrying a number of thread guides, and passing a plurality of spools, although it is also possible to mount separately a thread guide for each spindle or spool and cause this guide to carry out a turning motion in the same direction. Whenever such constructions are used, the yarn may be returned automatically to its original position merely by a reversal of the direction of movement of a thread guide.

The invention will appear more clearly from the following detailed description when taken in connection with the accompanying drawings showing by way of example preferred embodiments of the inventive idea.

In the drawings:

Figure 1 shows a device constructed in accordance with the principles of the present invention in front elevation;

Figure 2 is a side elevation of the device shown in Figure 1;

Figures 3 to 6 are detail views showing the yarn in various positions upon the traverse-roll;

Figure 7 shows a grooved traverse-roll cooperating with an immovable friction regulator;

Figure 8 is somewhat similar to Figure 7, but shows a movable friction regulator;

Figure 9 shows a traverse roll provided with means for winding packages of different lengths;

Figure 10 is a section along the line 10—10 of Figure 9;

Figure 11 shows a traverse-roll provided with slots instead of grooves;

Figure 12 shows a winding device of somewhat different construction in front elevation;

Figure 13 is a top view along the line 13—13 of Figure 12;

Figure 14 shows another winding device of a different form; and

Figure 15 is a top view of the device shown in Figure 14.

Figures 1 and 2 of the drawings show a spool 20, consisting of a support 21 upon which the thread 22 is wound. A winding device constructed in accordance with the principles of the present invention is used for unwinding it in the form of a helical or cross-winding upon a bobbin 23, which has the form of a support 24 carried by a shaft 25 and rotatable along with the shaft.

The shaft 25 is rotatably mounted upon one end of a pair of arms 26, the opposite ends of which are pivotally mounted at 27 upon a frame 28. The frame 28 may be immovable or may be mounted upon rails in the usual manner (not shown).

As shown in the drawings, the bobbin 23 is in frictional contact with the traverse-roll 30, so that it may be rotated by that roll. Due to the provision of swingable arms 26, the bobbin 23 is always in engagement with the roll 30, while the yarn is being wound upon the bobbin. The traverse-roll 30 is firmly connected with a shaft 31, which is mounted upon projections or supports 32 of the frame 28. The shaft 31, which is firmly connected with the roll 30, is driven by any suitable mechanism not shown in the drawings.

Obviously, several spools 20 and traverse-rolls 30 may be situated side by side in the plant, and

the rolls 30 may be mounted upon the same driving shaft 31 or upon separate shafts.

In accordance with the present invention, the spool 20 and the thread guide 29 which stretches the yarn 22, are situated to the right of a vertical plane passing through the middle of the roll 30 and indicated diagrammatically by the letters x—x in Figure 1 (looking in the direction of Figure 1). Furthermore, it is preferable and even advisable to arrange the spool 20 and the thread guide 29 in such manner that they are situated to the right of a plane passing through the right-hand side surface of the bobbin 23, said plane being indicated diagrammatically by the letters y—y in Figure 1.

According to another definition, the spool 20 and particularly the thread guide 29 should be located outside of the space which is limited by two planes passing through the two side surfaces of the traverse roll 30. These two planes are diagrammatically indicated in Figure 1 by the lines u—u and v—v.

It has been found that when the thread guide is disposed in this manner, the yarn 22 will assume the most advantageous angle of inclination and may be easily and conveniently wound upon the bobbin 23 without the necessity of using any oscillating guiding means or traverse rolls of a complicated form.

A rod or abutment 33 is carried by the frame 26 and is used for the purpose of limiting the movement of that portion of the yarn 22 which is close to the traverse roll 30, toward the right. The abutment 33 is preferably situated underneath the traverse roll 30 and close to the surface v—v passing through the right-hand side surface of the roll 30.

The traverse roll 30 is provided with a groove 34 extending in the form of a single uninterrupted and unintersected helix substantially from one side surface of the roll 30 to the opposite end. The left-hand end portion 35 of the helical groove 34 is in communication with a short groove 36 extending in an opposite direction to the groove 35 and constituting a means for reversing the direction of inclination and of movement of the thread 22.

The opposite end 37 of the helical groove 34 is in communication with another short groove 38, which extends in substantially the same direction as the reversing groove 36 and which may be designated as the receiving groove. The two grooves 36 and 38 are comparatively short, they do not have the form of a helix and in no way approach or intersect the helical groove 34.

Due to the fact that the groove or cavity 38 extends at an angle to the helical groove 34 and its end portion 37, a projection or abutment 39 is formed, one edge of which is leveled off to provide an inclined surface 40 constituting one of the surfaces of the end portion 37 of the groove 34 and serving the purpose of receiving the thread 22.

Due to this arrangement, the grooves formed upon the roll 30 easily receive the thread 22 and hold it securely, and the direction in which the thread 22 extends can be changed easily and conveniently even though the roll 30 may be driven at a high speed.

The manner in which the thread 22 is guided by the traverse-roll 30 is indicated in Figures 1 and 3 to 6 of the drawings. The yarn 22 engages the end 37 of the helical groove 34 and is guided by this groove, as shown in Figure 1, until it completes its movement from right to left and reaches the end 35 of the groove 34. This end position at which the yarn 22 is shifted from the end portion 35 of the helical groove 34 into the groove 36 and begins its return movement, is illustrated in Figure 3.

Due to the location of the thread guide 29 to the right of the traverse-roll 30, the guide 29 causes the yarn 22 to assume an inclined position upon the roll 30 and pulls it out of the grooves, whereupon the yarn will carry out its return movement upon the smooth surfaces of the roll. After the roll has been rotated twice the yarn 22 will have the position shown in Figure 4, the path of the yarn upon the smooth surfaces of the traverse-roll 30 being shown by broken lines in Figures 4 and 5.

Then after one more revolution of the traverse-roll 30 the yarn will reach the right-hand end of the roll thus completing its return movement and will then be caught in the groove 36. The rod 33 which limits the movement of the yarn to the right, will change the direction of the yarn as soon as it is in contact with it and will facilitate the insertion of the yarn into the groove 36. This position is shown in Figure 5. Then the yarn is guided again in the groove 34 and is caused by that groove to move toward the left, Figure 6 showing the yarn in the course of its forward movement after the traverse-roll has completed two revolutions.

It will be noted that the position of the thread guide 29, which determines the direction in which the yarn 22 extends, forces it to be wound helically upon the winding 23 in the course of the return movement of the yarn. The helical line which represents the path of the yarn 22 upon the smooth surfaces of the traverse-roll 30, has a pitch or angle of inclination which diminishes somewhat toward the right-hand end of the roll 30.

Therefore, due to the described cooperation of the helical groove 34 which moves the yarn in one direction and the thread guide 29 which due to its position, pulls the thread in a different direction as soon as it leaves the groove 36, the yarn is wound in substantially uniform cross windings which result in the formation of a cone 23.

This arrangement may be advantageously used for the purpose of winding cylindrical packages 50, illustrated in Figures 7 and 8. In order to wind the yarn 22 in the form of a cylindrical package, it is necessary to provide a traverse roll 51 having a helical groove 52 the angle of inclination of which diminishes in the direction away from the thread guide 53, for example, in the constructions shown in Figures 7 and 8, toward the left side of the traverse-roll.

The winding of cylindrical packages as compared to the winding of cones, has the disadvantage that in the course of the former the differences in the tensions of the yarn do not balance each other automatically, although such automatic balancing takes place in the course of the making of cones, due to the inclined position of the yarn in the course of the winding. Therefore, when winding cylindrical packages, it was found desirable to provide a second thread guide 54 which is situated closely to the thread guide 53 in the position shown in Figure 7, and which cooperates with the thread guide 53 for the purpose of balancing the thread tension.

This balancing is attained by the two thread guides 53 and 54 due to the fact that the yarn is subjected to greater frictional forces when it is

situated upon the right-hand end of the traverse roll 51, while at the same time it has the smallest angle of inclination. On the other hand, when the yarn 22 is situated upon the left-hand side of the roll 51 and has the greatest angle of inclination, it practically does not touch the thread guide 54 at all and is subjected to considerably smaller frictional forces.

Obviously, the effect attained by using two thread guides 53 and 54 may be further enhanced by employing whenever necessary a larger number of thread guides.

The device shown in Figure 8 comprises a traverse-roll 61 which may be used for the purpose of winding a cylindrical package 50. The traverse-roll is rotatable along with the shaft 60 which carries a worm 62.

The yarn 22 is guided by two immovable thread guides 63 and 64 and a movable thread guide 65 which comprises a projection or rod 66 mounted upon one end of a double-armed lever 67 which is rotatably mounted upon a pivot 68 carried by a support 69. The opposite end of the lever 67 is pivotally connected at 70 with a rod 71 which is eccentrically mounted at 72 upon a toothed wheel 73 meshing with the worm 62. The gear wheel 73 is rotatably mounted upon a support 74 which may be integral with the support 75 for the shaft 60.

The yarn 22 usually is engaged by the thread guides 63 and 64 while the action of the movable thread guide 66 upon the yarn 22 is an intermittent one. The worm 62 which rotates along with the shaft 60 of the roll 61 reciprocates the rod 71 carried by the gear 73, thereby swinging the double-armed lever 67 around its pivot 68. In the course of this oscillating movement the thread guide 66 engages the yarn 22 and then recedes again, this movement depending upon the position of the traverse roll 61 in the course of its rotation.

The device is set in such manner that the movable thread guide 66 exerts its greatest frictional force upon the yarn 22 at a time when the thread has its smallest inclination, namely, when it is at its right-hand position which is indicated in Figure 8. On the other hand with the movement of the yarn toward the left and with the increase of the angle of inclination of the yarn, the movable guide 66 gradually recedes until it is practically or entirely out of contact with the yarn at a time of the latter's greatest inclination, namely, when it is at the left end of the traverse-roll.

Figures 9 and 10 illustrate a device by means of which it is possible to vary the length of the winding. In the constructions illustrated in Figures 1 to 8, the length of the conical winding 23 or of the cylindrical package 50 is determined by the length of the traverse-roll, so that whenever a package of a different length is desired it is necessary to use a different traverse-roll. On the other hand, by means of the construction shown in Figures 9 and 10, it is possible to wind packages of different lengths by means of the same traverse-roll.

The traverse-roll 60 shown in Figures 9 and 10 comprises grooves 81, 82 and 83 which are substantially similar to the grooves of previously described traverse-rolls. The roll is mounted upon a shaft 84 which is rotated by any suitable mechanism, the other details of the winding mechanism being substantially similar to those described. In accordance with the present invention, a portion of the wall 85 of the helical groove 81 is planed off, thus providing a somewhat flattened surface 86 which terminates in a raised flat projection 87. The projection 87 is situated at a point at which the direction of the yarn 22 may be reversed whenever it is decided to wind a package 88 which is shorter than the normal length of the roll.

As is shown in Figure 10, the yarn 22 is not affected by the projection 87 and is not caused to reverse its movement so long as it is situated at the bottom of the groove 81.

However, in accordance with the present invention, the yarn 22 may be raised from the bottom of the groove 81 by means of a rod 89 which may be inserted into a suitable opening or bore hole which extends parallel to the shaft 84 across one or more windings of the helical groove 81.

Whenever the rod 89 is situated within its opening, the yarn 22 is raised from the bottom of the groove 81 and caused to engage the projection 87, thereby slipping out of the groove 81 and reversing its direction.

Due to this arrangement, simple and effective means are provided for the purpose of limiting the length of the package. Obviously, any number of projections 87 may be provided in suitable places upon one single traverse-roll and rods of different lengths may be used for the purpose of causing the yarn 22 to reverse its direction at any suitable portion of the roll.

The heretofore described traverse-rolls consist of a cylindrical body the outer surfaces of which are provided with the guiding grooves. However, such rolls may be conveniently substituted by hollow rolls, one of which is illustrated in Figure 11 of the drawings. The roll 90 of Figure 11 is hollow and comprises an outer casing 91 having a helical slot 92 extending from one side of the casing to the other and functioning in substantially the same manner as the groove 34 of the traverse-roll 30 shown in Figure 1.

One end of the helical slot 92 is in communication with a short reversing slot 93 while the opposite end of the slot 92 is in communication with a wider receiving slot 94. The two slots 93 and 94 operate in substantially the same manner as the grooves 36 and 38 of the roll 30 (Figure 1).

The roll 90 is also provided with a hook-shaped projection 95 which is situated close to the point of juncture of the slots 94 and 92. A catching slot or recess 96 is provided close to the projection 95 and is used for the same purpose as the inclined surface 40 (Figure 1), namely, for the purpose of receiving the yarn.

The device shown in Figures 12 and 13 of the drawings comprises a traverse-roll 100 which is rotatably mounted upon a shaft 101. The shaft 101 is carried by a support 102 which may constitute a part of the frame. The roll 100 is used for the purpose of guiding the yarn 22 which is wound in a cone 103. This roll is provided with a smooth cylindrical surface 104 and has no helical grooves at all. In accordance with this form of the invention, the reversal of the direction of movement of the yarn is caused by short grooves 105 to 108 which are situated in pairs upon opposite sides of the roll 100.

The shaft 101 carries a gear wheel 109 which meshes with the horizontal gear wheel 110. The gear wheel 110 is rotatably mounted upon the vertical shaft 111 so that the shafts 101 and 111 rotate simultaneously, the shaft 101 being driven by any suitable mechanism not shown in the drawings.

A disk or pulley 112 is rotatably mounted upon the shaft 111 and may have the form of a swift the diameter of which can be changed at will. An endless belt 113 only one side of which is shown in the drawings, passes over the disc 112. The speed of travel of the endless belt 113 may be easily varied by means of the swift 112. The belt 113 carries a number of thread guides 114 and 115 which move along with the belt. Another immovable thread guide 116 has the form of a hook which extends above the endless belt 113 and below the left-hand side surface of the traverse roll 106.

In accordance with the present invention, the spool 20 from which the yarn 22 is unwound may be mounted upon a carriage 117 mounted upon wheels 118. The carriage 117 may be moved mechanically or by hand and may have the form of elongated rails carrying several spools 20, each spool being provided with a separate thread guide 119 which is also mounted upon the carriage 117 and which performs the same function as the thread guide 29 shown in Figure 1.

When the device is in operation the spool 20 should be situated in the position shown in full lines in Figure 12. The yarn 22 is originally guided by the groove 108. At the same time the thread guide 114 engages the yarn 22 and due to its movement along with the endless belt 113 shifts the yarn gradually toward the left, while it is being wound in helical coils upon the cone 103. When the yarn 22 reaches the groove 105 it is compelled to reverse its direction by the groove 106 and at the same time the yarn is brought into engagement with the thread guide 116 which slips the yarn 22 off the thread guide 114. Then due to the inclination of the yarn 22 caused by the position of spool 20, the yarn is again wound in helical windings which intersect the original windings, until it reaches the grooves 107 and 108. At that time another thread guide carried by the endless belt 113 is brought into engagement with the yarn and the operation is repeated.

While Figures 12 and 13 are intended to show the formation of a left-hand spool body, Figures 14 and 15 show the formation of a right-hand spool body, with thread guides of a somewhat different type.

The device in Figures 14 and 15 comprises a horizontal driving shaft 120 which is operated by any suitable mechanism not shown in the drawings. The shaft 120 carries a toothed wheel 121 which meshes with the toothed wheel 122 carried by the shaft 123 of the traverse-roll 124 which is substantially similar to the traverse-roll 106 (Figure 12). By means of this arrangement the shaft 120 drives the traverse-roll 124 which is in frictional engagement with the winding or package 103.

The driving shaft 120 also carries a conical gear wheel 125 which meshes with a gear wheel 126 carried by the vertical shaft 127. The shaft 127 carries a horizontal disk or table 128 the outer circumference of which is provided with a projection constituting a thread guide 129. Another projection 130 has the form of a hook and is situated adjacent the left-hand end of the traverse-roll 124.

The operation of this device is substantially similar to that of the device described in Figures 12 and 13. The thread guide 129 of the table 128 shifts the yarn 22 from right to left until the left end edge of the traverse-roll 124 is reached and until the yarn 22 is situated in the grooves 131 and 132 of the roll. At that time the hook-shaped thread guide 130 causes the yarn 22 to slide off the thread guide 129 and due to the inclined direction of the thread caused by the position of the spool, the yarn is wound in a direction toward the right-hand side of the roll 124 until it reaches the grooves 133 and 134 of that roll. At that time the projection 129 is again brought into engagement with the yarn 22 and shifts it again toward the left, thus repeating the operation.

It is apparent that the specific illustrations shown above have been given by way of illustration and not by way of limitation and that the structures above described are subject to wide variations and modifications without departing from the scope of the invention. For example, the constructions shown in Figures 12 to 15 may be used in connection with individual or movable spool bodies and any suitable thread-guiding device may be used for the purpose of shifting the yarn along a traverse-roll in one direction, the return movement being accomplished by the described position of the spool creating a suitable inclination of the yarn. All of such and other variations and modifications are to be included within the scope of the present invention.

The terms "yarn" and "thread" as used in this specification and claims are intended to include wire and other strand material, while the terms "winding" and "package" are intended to include cops, cones, coils and the like.

What is claimed is:

1. Strand winding mechanism comprising an arbor, a cylindrical roll for winding a strand of material upon said arbor through frictional engagement with the wound material, a stationary strand guide, means for feeding said strand under tensile stress from said guide directly to said roll at a gradually diminishing angle to a plane disposed normal to the axis of rotation of the roll, and a helical guideway carried by said roll for intermittently feeding said strand at a gradually increasing angle to said plane.

2. Strand winding mechanism comprising an arbor, a cylindrical roll for winding a strand of material upon said arbor through frictional engagement with the wound material, a stationary strand guide, means for feeding said strand under tensile stress from said guide directly to said roll at a gradually diminishing angle to a plane disposed normal to the axis of rotation of the roll, whereby the strand is spirally wound upon said arbor in one direction, a stationary abutment disposed in the angular path of travel of said feeding strand and cooperating with said roll to reverse the angularity of that portion of the strand in contact with the roll whereby the strand is spirally wound upon said arbor in the opposite direction, and a helical guideway carried by said roll for feeding that portion of said strand disposed between said guide and said roll at a gradually increasing angle to said plane.

3. Strand winding mechanism comprising an arbor, a cylindrical roll for winding a strand of material upon said arbor through frictional engagement with the wound material, a stationary strand guide, means for feeding said strand under tensile stress from said guide directly to said roll at a gradually diminishing angle to a plane disposed normal to the axis of rotation of the roll, whereby the strand is spirally wound upon said arbor in one direction, means for reversing the angularity of that portion of the strand in

contact with the roll whereby the strand is spirally wound upon said arbor in the opposite direction, and a helical guideway carried by said roll for feeding that portion of said strand disposed between said guide and said roll at a gradually increasing angle to said plane.

4. Strand winding mechanism comprising an arbor, a cylindrical roll for winding a strand of material upon said arbor through frictional engagement with the wound material, a stationary strand guide, means for feeding said strand under tensile stress from said guide directly to said roll at a gradually diminishing angle to a plane disposed normal to the axis of rotation of the roll, whereby the strand is spirally wound upon said arbor in one direction, means for reversing the angularity of that portion of the strand in contact with the roll whereby the strand is spirally wound upon said arbor in the opposite direction, and means for feeding that portion of said strand disposed between said guide and said reversed strand portion at a gradually increasing angle to said plane.

5. Strand winding mechanism comprising an arbor, a cylindrical roll for winding a strand of material upon said arbor through frictional engagement with the wound material, a stationary strand guide, means for feeding said strand under tensile stress from said guide directly to said roll at a gradually diminishing angle to a plane disposed normal to the axis of rotation of the roll, a helical guideway carried by said roll for intermittently feeding said strand at a gradually increasing angle to said plane, and means for exerting a tension upon said strand inversely proportional to said strand angularity.

6. Strand winding means, comprising the combination of an arbor upon which a strand is adapted to be wound into a package, a cylindrical rotary traverse roll frictionally engaging said package along a tangential line to wind said strand, a strand guiding means situated outside the space bounded by two parallel planes passing on opposite sides of said package and also passing at right angles to said line of engagement, said traverse roll having a helical groove in the periphery thereof into which said strand is fed directly from said guiding means, means for rotating said roll to cause said strand to traverse said package in a direction away from said guiding means to form a spiral winding, and means for releasing said strand from said groove, the direction in which the strand is fed being such that the released strand is wound spirally on the package reversely to the first named spiral winding under the control of said traverse roll.

7. Strand winding means, comprising the combination of an arbor upon which a strand is adapted to be wound into a package, a cylindrical rotary traverse roll frictionally engaging said package along a tangential line to wind said strand, a strand guiding means situated outside the space bounded by two parallel planes passing on opposite sides of said package and also passing at right angles to said line of engagement, said traverse roll having a helical groove in the periphery thereof into which said strand is fed directly from said guiding means, means for rotating said roll to cause said strand to traverse said package in a direction away from said guiding means, and means carried by said roll for reversing the direction of traverse of said winding strand at each end of said groove.

8. Strand winding mechanism comprising an arbor, a cylindrical roll for winding a strand of material upon said arbor through frictional engagement with the wound material, a stationary strand guide, said strand following a path extending directly from said guide to said roll and in a direction transversely of the axis of rotation of the latter, said roll having a helical groove in the periphery thereof, means operable upon the rotation of said roll in one direction for directing the strand into said groove to thereby permit the groove to move the strand at one end of said path in a direction parallel to the axis of rotation of the roll and means operable upon the continued rotation of said roll for releasing said strand from said groove to allow the strand to be moved in a direction opposite to the first named movement under the strand tension component acting parallel to the axis of rotation of the roll.

9. Strand winding mechanism comprising an arbor, a cylindrical roll for winding a strand of material upon said arbor through frictional engagement with the wound material, a stationary strand guide, said strand following a path extending directly from said guide to said roll and in a direction transversely of the axis of rotation of the latter, said roll having a helical groove in the periphery thereof, means operable upon the rotation of said roll for moving the strand at one end of said path in a direction parallel to the axis of rotation of the roll and means operable upon the continued rotation of said roll for releasing said strand from said groove to allow the strand to be moved in a direction opposite to the first named movement under the strand tension component acting parallel to the axis of rotation of the roll.

10. Strand winding mechanism comprising in combination, a rotatable arbor upon which a strand is adapted to be wound, a cylindrical rotary traverse roll for rotating said arbor through frictional contact with said wound strand thereby winding said strand into a package, a guide positioned and arranged to guide the strand in a path such that it is drawn from the guide to the roll in a direction at an angle to a plane which is normal to the axis of the roll, means for rotating said roll to cause said strand to traverse the roll under the natural tendency of the strand to meet the roll at right angles, said roll having a helical groove for traversing said strand in the opposite direction, and means for reversing the direction of traverse of said strand at each end of said groove, said groove increasing in pitch as said angle increases whereby that portion of the package adjacent the increased groove pitch will have a smaller diameter than that portion disposed adjacent the smaller groove pitch.

11. Strand winding mechanism comprising in combination, a rotatable arbor upon which a strand is adapted to be wound, a cylindrical rotary traverse roll for rotating said arbor through frictional contact with said wound strand thereby winding said strand into a package, a guide positioned and arranged to guide the strand in a path such that it is drawn from the guide to the roll in a direction at an angle to a plane which is normal to the axis of the roll, means for rotating said roll to cause said strand to traverse the roll under the natural tendency of the strand to meet the roll at right angles, said roll having a helical groove for traversing said strand in the opposite direction, and means for reversing the direction of traverse of the strand at each end of said groove, said groove decreas-

ing in pitch as said angle increases whereby a substantially cylindrical package will be wound.

12. Strand winding mechanism comprising an arbor, a cylindrical roll for winding a strand of material upon said arbor through frictional engagement with the wound material, a stationary strand guide, means for feeding said strand under tensile stress from said guide directly to said roll at a gradually diminishing angle to a plane disposed normal to the axis of rotation of the roll, a helical guideway carried by said roll for intermittently feeding said strand at a gradually increasing angle to said plane, and means controlled by said strand angularity for controlling the strand tension.

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