

Aug. 23, 1960

J. V. KEITH
WINDING MACHINE

2,950,067

Original Filed May 4, 1954

3 Sheets-Sheet 1

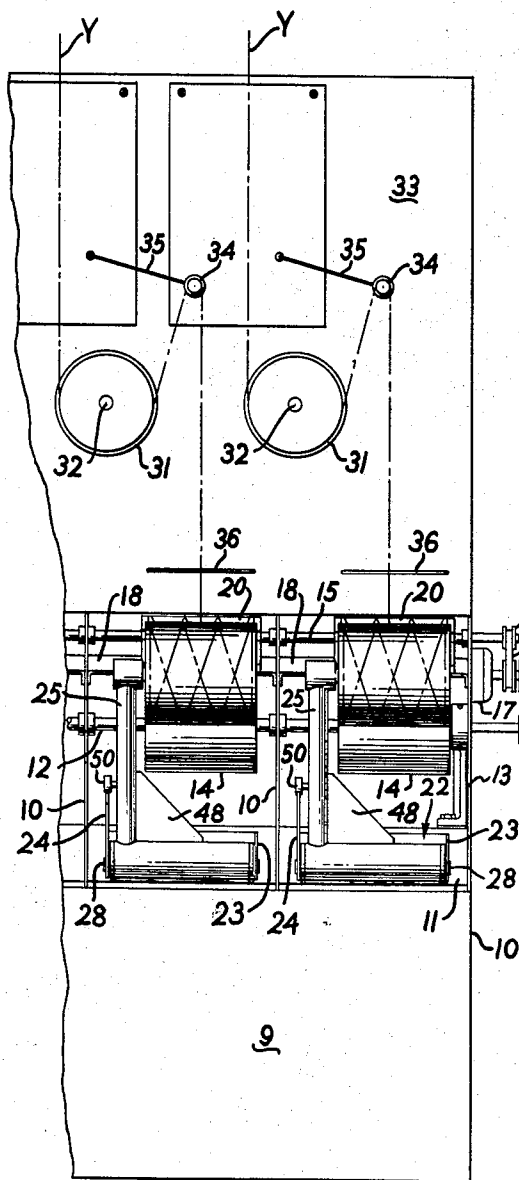


Fig. 1

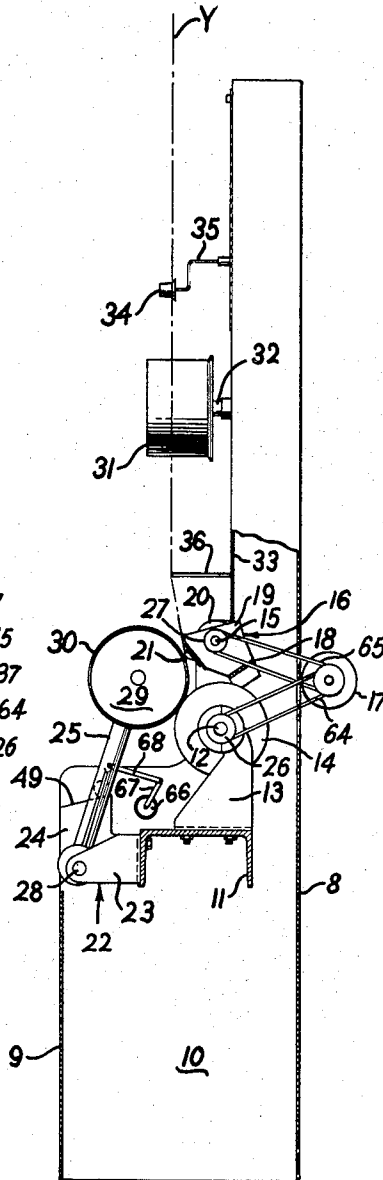


Fig. 2

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3 Sheets-Sheet 2

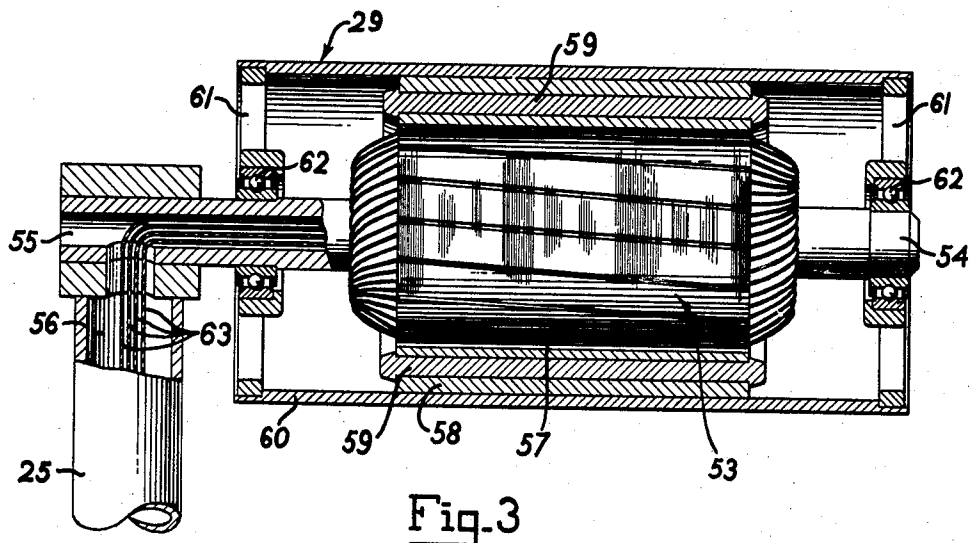


Fig. 3

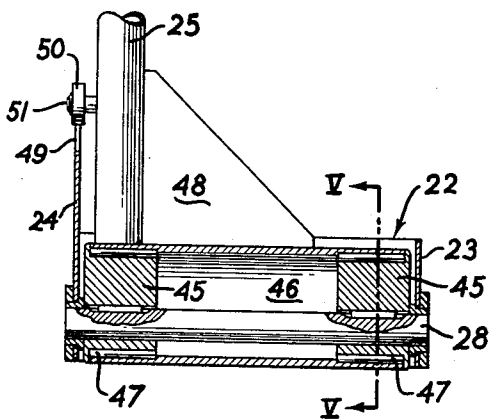


Fig. 4

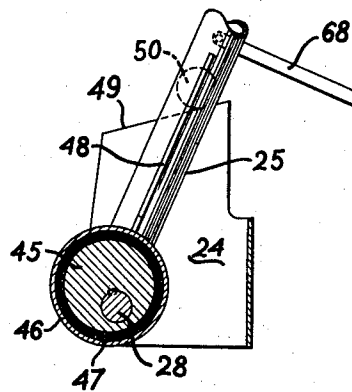


Fig. 5

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3 Sheets-Sheet 3

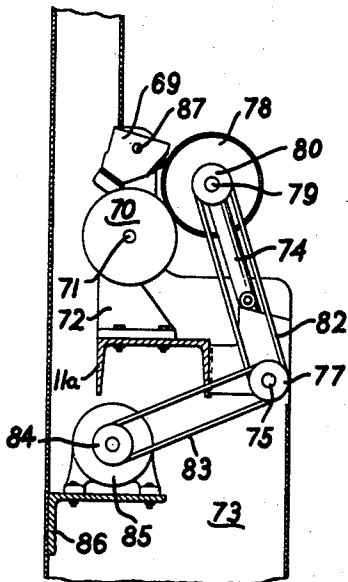


Fig-6

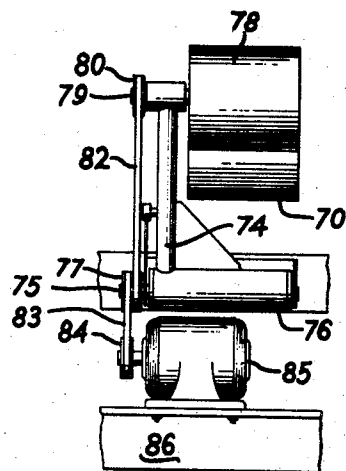


Fig-7

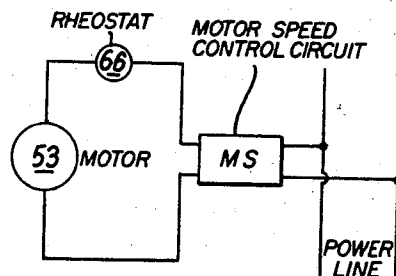


Fig.10

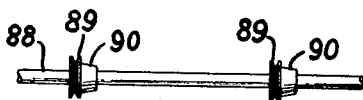


Fig-8

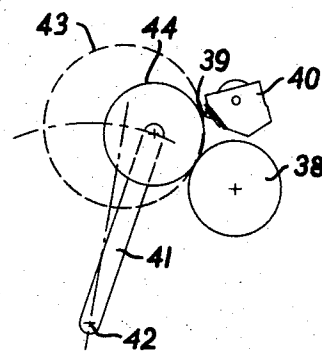


Fig-9

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1

2,950,067

WINDING MACHINE

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Original application May 4, 1954, Ser. No. 427,542, now Patent No. 2,778,578, dated Jan. 22, 1957. Divided and this application Sept. 4, 1956, Ser. No. 607,875

11 Claims. (Cl. 242—18)

The present invention relates to winding machines and more particularly relates to winding machines adapted to wind a strand of filamentary material at a high speed at substantially constant predetermined speed and at predetermined tension and is a division of my copending application Serial No. 427,542, filed May 4, 1954, now Patent No. 2,778,578, issued January 22, 1957.

In the present specification and claims, the terms "yarn" is used in a general sense to indicate any type of attenuated material, and the word "package" is intended to designate the wound mass of yarn whatever its form or shape.

Many of the synthetic yarns in use at the present time are capable of being manufactured at extremely high linear speeds, that is to say, linear speeds of the order of 1,000 yards per minute and higher. Yarn is produced at a uniform rate of speed and therefore the product of the spinning machines must be taken up or wound at a uniform speed equal to that at which the yarn is produced. The yarn also must be wound at a substantially uniform predetermined tension or at a uniformly decreasing tension to insure wound packages that will not damage the yarn and from which it will freely deliver for subsequent processing operations.

Prior to the present invention, no winding machine has been available that would wind the output of these high speed spinning machines into an acceptable package, at the desired speed and with the necessary precise tension control. Therefore, it has been necessary to wind the newly manufactured yarn into undesirable packages that caused considerable waste because of poor tension control and package formation and which also required additional rewinding steps to place the yarn in packages satisfactory for sales purposes or for subsequent manufacturing steps. An alternate to winding undesirable packages was to slow the speed of the spinning machine to one at which the yarn produced could be wound into satisfactory packages. In either event, much production was lost and the cost of the finished yarn was increased over what it would be, had a satisfactory winding mechanism been available.

It is, therefore, one object of the present invention to provide a winding machine capable of winding yarn at a uniform rate of speed.

Another object of the present invention is to provide a winding machine capable of winding yarn at a predetermined tension.

Another object of the present invention is to provide a drum driven winding machine wherein little or no slip occurs between the winding package and the driving drum.

Another object of the present invention is to provide a drum driven winding machine wherein a rotative force is applied to the winding package to supply the major portion of the force necessary to rotate said package and the remainder of the necessary rotative force is applied to said winding package by means of the driving drum.

Another object of the present invention is to provide a drum driven winding machine wherein the surface of the winding package maintains the same relative position with respect to the yarn guide throughout the entire growth of said package.

2

Another object of the present invention is to provide movable means for supporting a winding package wherein said package will move in a substantially straight line as it increases in diameter.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the apparatus possessing the construction, combination of elements and arrangement of parts, and the process involving the several steps and the relation and the order of one or more of such steps with respect to each of the others, which are exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention reference should be had to the following detailed description taken in connection with the accompanying drawings wherein:

Fig. 1 is a front elevation of two winding stations in a winding machine embodying the present invention;

Fig. 2 is a side elevation corresponding to Fig. 1;

Fig. 3 is a fragmentary sectional view of a preferred form of winding arbor including means for imparting a rotative force to said arbor;

Fig. 4 is a fragmentary front elevation to an enlarged scale showing the manner in which the winding arbor is pivotally mounted on the winding machine;

Fig. 5 is a fragmentary sectional view taken on the line V—V of Fig. 4;

Fig. 6 is a side elevation with a modified form of the present invention;

Fig. 7 is a fragmentary front elevation corresponding to Fig. 6;

Fig. 8 illustrates a line shaft that may be substituted for the package driving motors of Figs. 6 and 7;

Fig. 9 is a diagrammatic sketch illustrating the manner in which the relationship of the yarn guide to the surface of the winding package changes when the winding arbor is pivotally mounted in the manner customary in the prior art; and

Fig. 10 is a diagrammatic showing of the electric circuit employed to control the torque applied to the spindle driving motor.

The present invention comprises a high speed winding machine having a driving drum or roller rotated at a constant speed and which is adapted to be engaged by the periphery of the winding package to rotate said package at a surface speed substantially equal to the surface speed of said roller. Means are provided, in addition to the driving drum, for imparting a rotating force to the winding package so that the rotation thereof is not completely dependent upon the frictional engagement of its surface with said drum. The additional means for rotating the package preferably takes the form of a constant torque electric motor connected to the arbor carrying the winding package. The rotating force applied to the winding arbor and package by the constant torque motor is less than the force required to rotate the package at the predetermined desired speed, i.e. a speed such that its peripheral speed will be equal to the linear speed of the advancing strand of yarn, and the driving drum imparts the additional rotating force necessary to drive the arbor and package at the desired speed. By so removing most of the rotating load from the driving drum, very little if any slip occurs between the periphery of said drum and the periphery of the winding package. The absence of slip between the driving drum and the winding package makes it possible to accurately predetermine and control the winding speed of the winding machine of the present invention and furthermore, the absence of such slip also prevents damage to the yarn wound on the package and results in a higher quality product.

The winding machine of the present invention is provided with a reciprocating yarn guide positioned adjacent the driving drum to engage the winding strand of yarn and to lay it on the winding package in a predetermined manner. As the winding package increases in diameter the curvature of its periphery changes, and to compensate for this change, so that the surface of the winding package will remain in the same relationship to the reciprocating yarn guide from the start of the winding cycle to its completion, the winding arbor is carried by an arm capable of combined pivotal and longitudinal movement. The longitudinal movement of said arm is controlled by means of a cam and cam follower in such a manner that as the arm is pivoted due to the growth of the winding package, it is also moved longitudinally so that the winding arbor instead of describing an arc moves through a substantially straight line path. The result of this straight line movement is that the relationship between the reciprocating yarn guide and the periphery of the winding package remains substantially constant from the start to finish of the winding cycle.

The winding machine of the present invention is particularly adapted for use in multiple units. That is to say, a plurality of identical units can advantageously be mounted side by side on a common base and have certain of their elements driven from one common source of power. Inasmuch as all of the winding units are the same, only one unit will be explained in detail hereinafter.

Referring now to Figs. 1 through 5 and the preferred embodiment disclosed therein. The winding apparatus and its controls are preferably mounted on a supporting structure comprising a plurality of spaced vertical L-shaped frame members 10. Frame members 10 are connected together along their front edges by horizontally extending vertically spaced upper and lower panels 33 and 9 respectively, and along their rear edges by panel 8. A plurality of inverted U-shaped beds 11 are connected to vertical frames 10 adjacent the opening between panels 9 and 33. A horizontal shaft 12 is journaled in frame members 10 above bed 11 and in vertical brackets 13 secured to bed 11 adjacent each end of the supporting structure. Driving drums or rolls 14 are fixedly secured to horizontal shaft 12 between vertical frames 10. A transverse mechanism 16 is positioned adjacent driving drum 14 and is fixedly secured to horizontal bar 18 that in turn is secured to vertical frames 10. A horizontal shaft 15 passes through and is journaled in vertical frames 10 and also passes through the housing 19 of transverse mechanism 16. A multi-grooved traverse cam 20 is located in housing 19 and is fixedly secured to shaft 15 for rotation thereby. A reciprocating yarn guide 21 is carried by housing 19 and has a cam follower, not shown, engaged in the groove of cam 20 in a manner old and well known in the art, whereby said guide 21 is reciprocated by said cam upon rotation of said cam by shaft 15. Shafts 12 and 15 are driven at appropriate speeds by any convenient source of power, but preferably by an electric motor 17 connected to a double groove drive pulley 37 which, in turn, is connected to pulleys 26 and 27 by means of belts 64 and 65 respectively. Pulley 26 is fixed on shaft 12 for rotation therewith and pulley 27 is similarly fixed for rotation on shaft 15.

A bracket 22 having parallel forwardly extending arms 23 and 24 is fixedly secured to the front face of bed 11. A generally upstanding arm 25 is pivotally carried by bracket 22 by means of shaft 28 rotatably journaled in and extending between arms 23 and 24. The upper end of arm 25 carries winding arbor 29 for rotation thereon. Arbor 29 is adapted to removably carry a package core 30, which preferably is a fibre or plastic tube well known to those skilled in the art, upon which the package of yarn will be wound. Arm 25 is of such a length that when it is moved rearwardly the periphery of package core 30, or a supply of yarn wound thereon, will en-

gage the surface of driving drum 14 so that said arbor and package core will be rotated by said drum in the manner well known in the art. Traverse mechanism 16 is positioned relative to driving drum 14 so that its guide 21 lightly contacts, or is positioned closely adjacent to, the surface of package core 30 or the yarn wound thereon.

The strand of yarn Y to be wound on the apparatus of the present invention is drawn from a source of supply, preferably the output end of a spinning machine but which can be the output of a yarn treating machine or a previously wound yarn package, by means of a godet wheel 31. Godet wheel 31 is carried by shaft 32 journaled in panels 8 and 33 carried by vertical frame members 10 above the previously described winding mechanism. Godet wheels 31 may be driven by synchronous motors, not shown, or through suitable gearing, not shown, by the same source of power that rotates driving roll 14 and traverse cam 20. After passing around godet wheel 31, strand of yarn Y passes over roller 34 carried by compensator arm 35 prior to its engagement by guide 21 and being wound on package core 30. A guide bar 36 is carried by panel 33 between roller 34 and guide 21 to engage strand Y to maintain the proper thread line leading to guide 21.

Fig. 9 is a diagrammatic illustration of the manner in which the growth of the winding package will effect and change the relationship between the yarn guide and the surface of the winding package if the package supporting arm is only mounted for pivotal movement. In Fig. 9, 38 is a driving drum and 39 is a reciprocating yarn guide carried by traverse mechanism 40 all similar to the corresponding elements disclosed in Figs. 1 and 2. Package supporting arm 41 is pivoted at 42. The diameter of the package core, i.e. the starting diameter of the package is indicated by the numeral 44, and 43 represents the diameter of the completed package of yarn. It will be noted that traverse mechanism 40 must be positioned relative to driving drum 38 so that guide 39 will lightly contact, or be closely adjacent to, the surface of the completed package. When traverse mechanism 40 is so positioned, as it necessarily must be when arm 41 is journaled on a fixed pivot, guide 39 is spaced a considerable distance from the periphery of package core 44 at the start of the winding cycle. This spacing between the surface of the winding package and the yarn guide seriously affects the quality of the package produced and in many cases results in a package from which the yarn can not be withdrawn without breakage or plucking which seriously affects the quality of the fabric produced therefrom.

Upstanding package supporting arm 25 of the present invention is mounted for pivotal and longitudinal movement so that arbor 29 can recede from driving drum 14 and yarn guide 21 in a straight line so that the distances from the axis of said arbor to said yarn guide and to said driving drum increase by equal amounts. As a result, traverse mechanism 16 of the present invention can be located relative to driving drum 14 in such a position that yarn guide 21 will contact, or be closely adjacent to, package core 30 at the start of the winding cycle and said guide will remain lightly in contact with, or closely adjacent to, the surface of the winding package throughout the winding cycle. Shaft 28 is pivotally journaled in arms 23 and 24 of bracket 22 and has spaced eccentric members 45 fixedly secured thereto. Sleeve 46 is rotatably journaled on eccentrics 45 by means of anti-friction bearings 47. Arm 25 is rigidly attached to sleeve 46 at right angles thereto, at the left-hand end thereof adjacent bracket arm 24 and is suitably braced by means of web member 48 welded or otherwise secured to said arm and said sleeve. The left-hand arm 24 of bracket 22 extends upwardly to a greater extent than arm 23 and has its upper edge downwardly and forwardly inclined to provide a cam surface 49. A cam following roller 50 is pivotally carried by stud 51 fixed to arm 25 to engage cam surface 49. It

will be seen that the tendency of arm 25 is to move downwardly in a longitudinal direction due to its weight and the fact that it is riding on eccentric 45. Such downward longitudinal movement of arm 25 is prevented by cam follower 50 and cam 49. However, as the winding package increases in diameter to pivot arm 25 in a counterclockwise direction as viewed in Figs. 2 and 5, cam follower 50 will move along the downwardly inclined face of cam 49 permitting a predetermined amount of longitudinal movement to arm 25. The slope and configuration of cam surface 49 is such that it will compensate for the change in curvature that takes place in the periphery of the winding package and for the arc through which the winding package would travel if arm 25 were pivoted to a fixed axis. As a result, the winding package 30 moves away from guide 21 and driving drum 14 at the same rate of speed.

To prevent all, or substantially all, slippage between driving drum 14 and the winding package, the present invention provides means for applying a rotating force to arbor 29 that is slightly less than the rotating force required to rotate said arbor and the winding package at the desired speed. By so applying a rotating force to arbor 29 it is only necessary for driving drum 14 to apply a slight force to the winding package to cause it to rotate at the desired peripheral speed. Inasmuch as the rotating force which must be transmitted frictionally to the winding package by drum 14 is low as compared to the total rotating force required, very little if any relative slip occurs between said drum and package. Fig. 3 illustrates a preferred arrangement for applying a rotating force to arbor 29 comprising an inverted constant torque electric motor 53 carried by spindle 54. Spindle 54 is fixed at one of its ends to the end of up-standing arm 25 to project therefrom at substantially right angles and parallel to the axes of shafts 12 and 15. The fixed end of spindle 54 is provided with a bore 55 that communicates with a bore 56 in arm 25. A cylindrical motor stator 57 is fixedly secured to spindle 54 and has the electrical leads 63 thereto carried through bores 55 and 56 in spindle 54 and arm 25. The rotor of motor 53 comprises a cylindrical shell 58 provided with a cast winding 59. Rotor 59 is supported about stator 57 by means of tube 60 inside of which it is fixedly secured and which forms the package core receiving element of arbor 29. Tube 60 is rotatably journaled on spindle 54 by means of discs 61 and anti-friction bearings 62.

A rheostat 66, Fig. 2, is secured to end frame 10 adjacent arm 25 and has a lever 67 connected to its operating shaft. A link 68 has one of its ends pivotally connected to the end of lever 67 and its other end pivotally connected to arm 25 whereby movement of arm 25 will change the effective resistance of rheostat 66. A motor speed control circuit MS which may be of any convenient type but which preferably is similar to the motor speed control device disclosed in my co-pending application Serial No. 373,465, filed July 8, 1953, for "Winding Machine," now Patent No. 2,752,105, is located behind panel 33 and actuated by compensator arm 35 to control the torque applied by motor 53 to arbor 29. The leads for motor 53 pass out of arm 25 and up to the control mechanism located behind panel 33. Rheostat 66 may be connected in series with one of the motor leads between the speed control device and said motor 53, see Fig. 10, or rheostat 66 may be connected to one of the elements of the speed control apparatus. In any event rheostat 66 is so connected that as arm 25 moves away from driving drum 14 and traverse mechanism 16, the current supplied motor 53 will be decreased so that less torque will be applied to arbor 29 and the winding package to permit a slight amount of slip between said package and drum 14 so that said package will be rotated at a slightly lower speed to thereby decrease the tension at which the strand of yarn Y is

wound on said package. Compensator arm 35 is arranged so that an increase in tension in the winding strand of yarn Y will pivot said compensator arm downwardly to cause the speed control mechanism to decrease the current supplied motor 53 to cause said motor to exert less rotating force on arbor 29 whereupon said arbor will slow down slightly to thereby relieve the excessive tension. It will be understood that spring means, not shown, are provided to urge compensator arm 35 upwardly against the downward pull of strand of yarn Y.

Figs. 6 and 7 illustrate a modified form of the present invention that differs from the above described modification in that the constant torque electric motor for applying a rotating force to the winding arbor is not located within the arbor. The modification includes a traverse mechanism 69 and driving drum 70 similar to traverse mechanism 16 and drum 14 respectively. The traverse mechanism 69 is driven by shaft 37 and drum 70 is carried and rotated by shaft 71. Shafts 71 and 87 are journaled in bracket 72 and vertical frame members 73 in the same manner that the comparable components are assembled in the modification of Figs. 1 and 2. Up-standing arm 74 is eccentrically mounted on shaft 75 in the same manner that arm 25 is eccentrically mounted on shaft 28 by means of sleeve 76. Shaft 75 differs from shaft 28 in that it extends to the left past its mounting bracket, viewed in Fig. 7, and has double pulley 77 rotatably mounted thereon. Arbor 78 is secured to spindle 79 that in turn is rotatably journaled in the upper end of arm 74. A pulley 80 is fixedly secured to the end of spindle 79 and is connected to one side of pulley 77 by belt 82. The other side of pulley 77 is connected by means of belt 83 to pulley 84 that is secured to the output shaft of constant torque electric motor 85 carried by bracket 86 secured to the framework of the machine beneath bed 11a. Torque is transmitted from motor 85 to arbor 78 by means of belts 82 and 83 acting through pulleys 84, 77 and 80. Motor 85 is connected to the speed control apparatus, actuated by compensator arm 35, and/or rheostat 66 in the same manner that motor 53 is connected thereto.

Shaft 88, Fig. 8, carrying pulleys 89 connected thereto by means of clutch 90 may be substituted for motors 85 and pulleys 84 by journaling said shaft in vertical frame members 73 beneath bed 11a. Shaft 88 is preferably driven through suitable gearing by the same source of power that rotates drum 70 and operates traverse member 69. Clutch 90 may be a mechanical clutch having a slipping frictional engagement with shaft 88 or a clutch face driven by said shaft. Preferably, clutch 90 is a magnetic hysteresis type clutch wherein the magnets may be preset to deliver a predetermined torque value to arbor 78 throughout the complete winding cycle. Obviously if a friction type clutch or a hysteresis type clutch is employed to drive arbor 78, the amount of torque transmitted thereby can not be varied during the winding cycle to provide a decreasing or differential tension as the package increases in diameter and cannot be varied to compensate for any fluctuations in the tension of the strand being wound. For many types of yarn, principally yarns of high strength and heavy denier, the control offered by a friction or hysteresis type clutch is adequate. In the event greater control is desired an electro-magnetically actuated clutch, such as are well known to those skilled in the art, may be employed and the electrical current to energize said clutch can be varied by compensator arm 35 and/or rheostat 66.

Since certain changes may be made in the above process and apparatus without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A winding machine for winding a strand of yarn

at a substantially constant predetermined speed comprising the combination of a rotatable arbor for holding a winding yarn package, means for applying a rotating force to said arbor, said force having a magnitude less than that required to rotate said arbor and a winding package at said predetermined speed, a rotatable drum, means for rotating said drum at a speed such that its surface speed is substantially equal to the predetermined winding speed, means supporting said arbor for movement towards and away from said drum whereby the periphery of said winding package can contact said drum to permit said drum to apply a rotating force to said package and arbor supplementing said first mentioned rotating force to drive said package and arbor at the predetermined winding speed, means actuated by the tension in the winding strand of yarn for decreasing and increasing the rotating force applied to said arbor by said first mentioned means as said tension increases and decreases, and means for traversing said strand of yarn across the winding package.

2. A winding machine for winding a continuously advancing strand of yarn at substantially constant tension comprising the combination of a rotatable arbor for holding a winding yarn package, a constant torque electric motor for applying a rotating force to said arbor, said force applied by said motor having a magnitude less than that required to rotate said arbor and a winding package at said predetermined speed, a rotatable drum, means for rotating said drum at a speed such that its surface speed is substantially equal to the predetermined winding speed, means supporting said arbor for movement towards and away from said drum whereby the periphery of said winding package can contact said drum to permit said drum to apply a rotating force to said package and arbor supplementing said first mentioned rotating force to drive said package and arbor at the predetermined winding speed, means actuated by the tension in the winding strand of yarn for decreasing and increasing the torque applied by said motor as said tension increases and decreases, and means for traversing said strand of yarn across the winding package.

3. A winding machine as set forth in claim 2 wherein said constant torque electric motor is incorporated in said arbor.

4. A winding machine as set forth in claim 2 having means for fixedly mounting said constant torque electric motor in spaced relation to said arbor, and a driving connection between said motor and said arbor.

5. A winding machine for winding a strand of yarn at a substantially constant predetermined speed and at a decreasing tension comprising the combination of a rotatable arbor for holding a winding yarn package, a constant torque electric motor for applying a rotating force to said arbor, said force applied by said motor having a magnitude less than that required to rotate said arbor and a winding package at said predetermined speed, a rotatable drum, means for rotating said drum at a speed such that its surface speed is substantially equal to the predetermined winding speed, means supporting said arbor for movement towards and away from said drum whereby the periphery of said winding package can contact said drum to permit said drum to apply a rotating force to said package and arbor supplementing said first mentioned rotating force, means actuated by movement of said arbor away from said drum as the winding package increases in diameter to decrease the rotating force applied to said arbor by said motor, and means for traversing said strand of yarn across a winding package.

6. A winding machine as set forth in claim 5 wherein said constant torque electric motor is incorporated in said arbor.

7. A winding machine as set forth in claim 5 having means for fixedly mounting said constant torque electric motor remote from said arbor, and a driving connection between said motor and said arbor.

8. A winding machine for winding a continuously advancing strand of yarn at a substantially constant predetermined speed and at a decreasing tension comprising the combination of a rotatable arbor for holding a winding yarn package, a constant torque electric motor for applying a rotating force to said arbor, said force applied by said motor having a magnitude less than that required to rotate said arbor and a winding package at said predetermined speed, a rotatable drum, means for rotating said drum at a speed such that its surface speed is substantially equal to the predetermined winding speed, means supporting said arbor for movement towards and away from said drum whereby the periphery of said winding package can contact said drum to permit said drum to apply a rotating force to said package and arbor supplementing said first mentioned rotating force, means actuated by the tension in the winding strand of yarn for decreasing and increasing the torque applied by said motor as said tension increases and decreases, means actuated by movement of said arbor away from said drum as the winding package increases in diameter to decrease the rotating force applied to said arbor by said motor, and means for traversing said strand of yarn across a winding package.

9. The method of winding a strand of yarn at a substantially constant predetermined speed and at a decreasing tension comprising the steps of applying a predetermined torque to a winding package, said torque having a value smaller than the torque required to rotate said package at said predetermined speed, rotating a drum at a peripheral speed substantially equal to said predetermined speed, holding the periphery of said winding package in contact with said drum to thereby rotate said winding package at said predetermined winding speed and decreasing the torque applied to said winding package as said package increases in diameter.

10. The method of winding a continuously advancing strand of yarn at a predetermined tension comprising the steps of applying a predetermined torque to a winding package, said torque having a value smaller than the torque required to rotate said package at the speed necessary to wind said strand at said predetermined tension, rotating a drum at a peripheral speed substantially equal to the speed of said strand, holding the periphery of said winding package in contact with said drum, and decreasing and increasing the value of said predetermined torque as the tension in said strand increases and decreases to vary the slip between said package and said roll to thereby increase or decrease the winding speed.

11. The method of winding a continuously advancing strand of yarn at a substantially constant predetermined speed and at a decreasing tension comprising the steps of applying a predetermined torque to a winding package, said torque having a value smaller than the torque required to rotate said package at the speed necessary to wind said strand at said predetermined tension, rotating a drum at a peripheral speed substantially equal to the speed of said strand, holding the periphery of said winding package in contact with said drum, decreasing and increasing the value of said predetermined torque as the tension in said strand increases and decreases to vary the slip between said package and said roll to thereby increase or decrease the winding speed, and decreasing the value of said predetermined torque as the winding package increases in diameter.

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