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3,120,731

METHOD AND APPARATUS FOR UNIFORMLY TWISTING FILAMENTARY MATERIAL

Filed Oct. 10, 1960

3 Sheets-Sheet 1

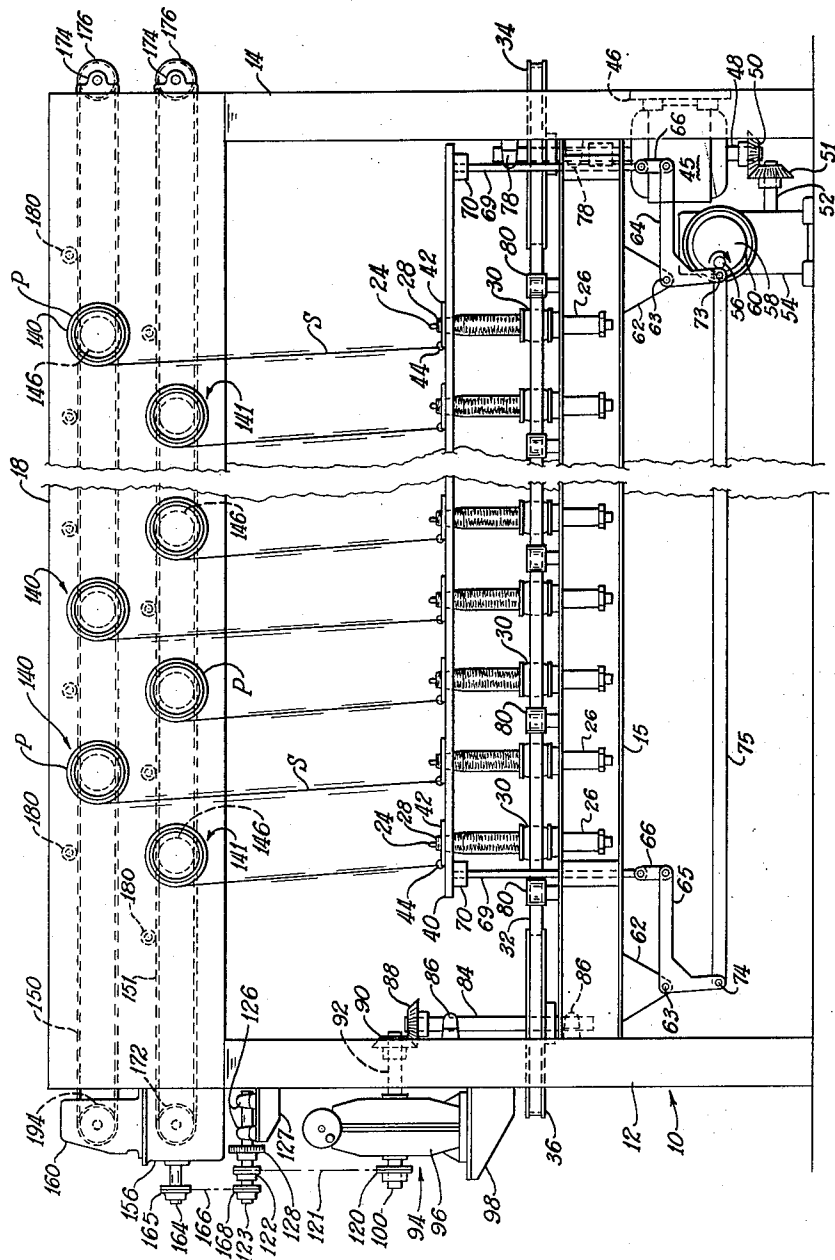


Fig. 1

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3 Sheets-Sheet 2

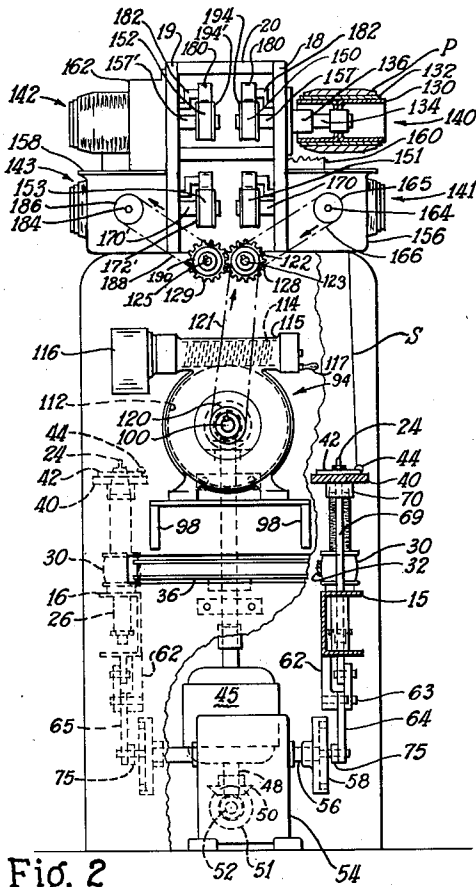


Fig. 2

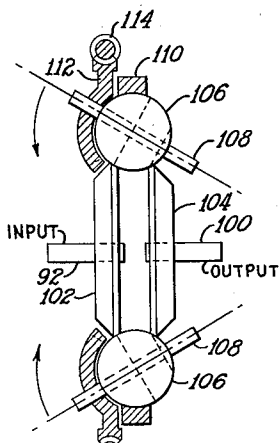


Fig. 3

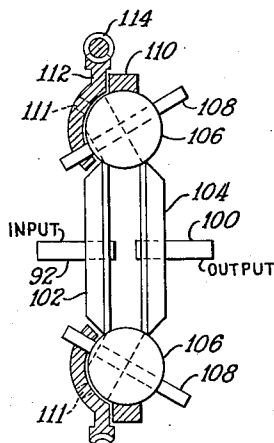


Fig. 4

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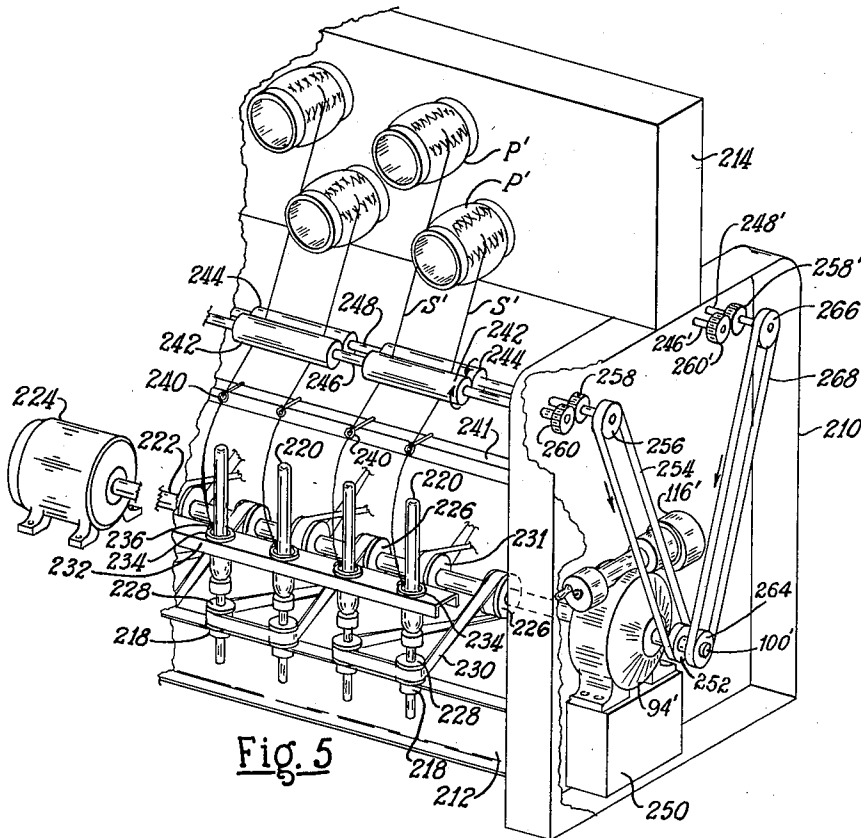


Fig. 5

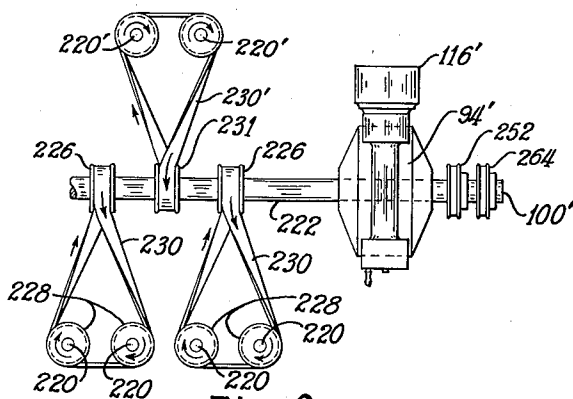


Fig. 6

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3,120,731 METHOD AND APPARATUS FOR UNIFORMLY TWISTING FILAMENTARY MATERIAL

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Filed Oct. 10, 1960, Ser. No. 61,653
14 Claims. (Cl. 57—94)

This invention relates to method of and apparatus for processing filamentary materials and more especially to a method and apparatus for winding or transferring filamentary or linear materials from packages or tubes onto bobbins or spindles and effecting or imparting a twist to the materials during the transfer or winding operations.

It has been conventional practice in the textile industry to transfer or wind filamentary or linear materials from packages onto bobbins or spindles rotating at high speeds and through the medium of a ring traveler or flyer to impart twist to the material as it is collected upon the bobbin or spindle. Due to the buildup of the filamentary material upon the bobbin or spindle whereby the package is progressively increased in diameter and the spindle or bobbin rotated at a constant speed, the twist or number of twists per unit of length of the filamentary material is non-uniform.

In endeavors to minimize the variations of twist in the collected material, a change gear mechanism of conventional character has been heretofore employed to reduce the variation in twist as the bobbin package increases in size. Such mechanism is only a partial corrective or compromise in effecting a reduction in the differential in twist per unit of length and the resulting product does not embody a uniform twist per unit of length and hence the quality of textile products fabricated from such materials is impaired.

This invention has for an object the provision of a method of correlating or programming the feed rate of a strand of fibers or other filamentary material, yarn or thread to a collecting spindle or bobbin through the medium of a traveler or flyer whereby the feed rate is continuously varied concomitantly with the collection of the strand or filamentary material on a rapidly rotating bobbin whereby the amount of twist per unit of length of the material is maintained substantially constant.

An object of the invention resides in a method of feeding or advancing a strand or linear filamentary material from a supply package at a controlled rate to a rotating bobbin or collector whereby the amount of twist or number of twists per unit of length of the strand or material is maintained substantially constant notwithstanding the progressive decrease in diameter of the supply package and the progressive increase of the size or diameter of the collected strand or material on the bobbin.

An object of the invention resides in a method of automatically controlling the rate of advance or feed of a strand of linear material from a supply whereby the amount of twist or the number of twists per unit of length of the strand or material may be controlled and the selected amount of twist or number of twists per unit of length maintained substantially constant throughout the collected material.

Another object of the invention is the provision of a twisting apparatus or twister embodying a means for controlling or regulating the rate of feed or advancement of the strand or filamentary material from a supply package to a traveler or flyer and bobbin collector which automatically correlates the rate of feed or advancement of the strand or material to compensate for the decrease in size of the supply package and the increase in size of the collected package and to maintain constant the amount of

twist or the number of twists per unit of length of the strand or material.

Another object of the invention is the provision of a twister embodying a variable drive for packages of strand or filamentary material or for a feeding means for the strand or filamentary material for advancing or delivering the strand or filamentary material to a twister spindle at a rate whereby the strand or material collected upon a collector or bobbin is endowed with a uniform number of twists per linear unit of length, the apparatus embodying an adjustable automatic control for the variable drive to adjust, vary or regulate the amount of twist or the number of twists per unit of length and maintain constant the desired amount of twist irrespective of the size of the collected package of strand or filamentary material.

Another object of the invention resides in a method of and apparatus for programming or controlling the differential in the rate of linear travel of a linear body advanced from a supply onto a rotating collector or surface whereby a substantially uniform twist per unit of length is continuously imparted to the linear body as it is collected.

Further objects and advantages are within the scope of this invention such as relate to the arrangement, operation and function of the related elements of the structure, to various details of construction and to combinations of parts, elements per se, and to economies of manufacture and numerous other features as will be apparent from a consideration of the specification and drawing of a form of the invention, which may be preferred, in which:

FIGURE 1 is a side elevational view of a portion of a twister mechanism or apparatus embodying an arrangement for carrying out the method of the invention;

FIGURE 2 is an end view of the apparatus illustrated in FIGURE 1;

FIGURE 3 is a schematic view illustrating a method and apparatus for establishing a variable drive for the packages of strand or filamentary material;

FIGURE 4 is a view similar to FIGURE 3 illustrating the arrangement adjusted for a different output shaft speed;

FIGURE 5 is a fragmentary isometric view of a portion of another form of twister embodying an apparatus for carrying out the method of the invention, and

FIGURE 6 is a top plan view illustrating the drive for the spindles and the variable speed drive for feed rolls for strands or filamentary material.

While the forms of apparatus for carrying out the method of the invention are illustrated as particularly adapted for winding a single strand or filamentary material onto each bobbin or collector and imparting twist thereto, it is to be understood that the method and apparatus of the invention may be utilized with other forms of winding apparatus for combining strands or threads into yarns, or plying yarns, or wherever it is desirable to maintain substantially constant the amount of twist or the number of twists per unit of length of the strand or linear material being processed.

Referring to the drawings in detail, and initially to the form of apparatus illustrated in FIGURES 1 through 4 for carrying out the method of the invention, the twister is inclusive of a frame 10 having end frame or plate members 12 and 14 joined by longitudinally extending frame members 15 and 16 and longitudinally extending plates 18 and 19, the plates forming supports for supply packages and means for driving the strand packages. The plates 18 and 19 are supported at their end regions by the upright frame members or plates 12 and 14 and are held in spaced relation by bridge members or bars 20, one of which is shown in FIGURE 2.

The longitudinally extending bars 15 and 16 form bolster rails supporting the bolster constructions of the twister spindles. Each winding spindle 24 is revolvably

supported upon a bolster member 26 secured to the adjacent bolster rail. Each of the spindles 24 is adapted to accommodate a spool or bobbin 23 upon which the strand or filamentary material is to be wound.

Each spindle is provided with a whorl 30 driven by direct contact with a driving belt 32 which takes over a driving pulley 34 journally supported at one end of the twister construction and over a pulley 36 journally supported at the opposite end of the twister construction.

As particularly shown in FIGURE 2, the twister apparatus includes two rows of spindles 24 arranged in parallelism and preferably spaced at each side of a median plane lengthwise of twister. The twister includes a ring rail 40. Mounted upon the ring rail 40 adjacent and surrounding each spindle 24 is a ring 42 supporting a traveler or flyer 44 which is freely rotatable around the spindle in a circular orbital path provided by the ring 42 as a track for the traveler. A strand S is supplied from a strand package P for each of the bobbins 28, the drive for the strand packages being hereinafter described.

In the embodiment illustrated in FIGURES 1 and 2, a single motor 45 provides a driving means for rotating the spindles 24 and bobbins 28, for vertically reciprocating the ring rail 40, the rings 42 and the flyers 44, and for driving the strand supply packages P through a variable speed mechanism. The motor 45 is secured to a mounting plate 46 carried by the frame member 14 of the twister apparatus. One end of motor shaft 48 is equipped with a bevel gear 50 which meshes with a similar bevel gear 51 mounted upon a driven shaft 52.

The driven shaft 52 extends into a gear housing 54 containing speed reducing gearing for rotating an output shaft 56. Fixedly mounted upon each end of the output shaft 56 is a member or cam plate 58 provided with a cam groove 60 which, in the embodiment illustrated, is circular and is eccentric with respect to the axis of its operating shaft 56. Secured to the longitudinally extending frame members 15 and 16 are brackets or supports 62 provided with shafts 63 which pivotally support bell crank levers 64 and 65, a set of bell crank levers being provided for each ring rail assembly.

One arm of each of the pairs of bell crank levers is pivotally connected by a link 66 to the end regions of vertically reciprocable operating rods or shafts 69, the upper ends of which are secured in boss portions 70 carried by the ring rail 40. The opposite arms of the bell crank levers 64 and 65 are provided with pivot pins 73 and 74 which are joined by longitudinally extending rods or links 75, as shown in FIGURE 1. The pins 73 carried by the bell crank levers 64 are equipped with rollers (not shown) which extend into the circular cam grooves 60 in the respective cam plates.

Rotation of the cam plates 58 through the reduction gearing contained in the gear housing 54 is effective through the bell crank levers 64 and 65 to reciprocate the ring rails 40 in vertical directions at a comparatively slow rate whereby the strand is distributed upon the bobbins or collectors 30 during the winding-twisting operations.

The opposite end region of the motor shaft 48 is journaled in bearings 78, this end of the shaft supporting the sheave or drive pulley 34 engaged by the belt 32 for establishing a drive to all of the whorls 30 of both rows of the bobbin supporting spindles 24.

Spaced lengthwise of the frame member 15 are pressure rolls 80 which normally bias the belt 32 into engagement with the whorls 30 driving the bobbins. Each of the pressure rolls 80 is individually adjustable toward and away from the belt 32 to disestablish or interrupt the friction drive with the belt 32 to a particular spindle or spindles if desired.

The apparatus is inclusive of variable speed means associated with the drive for the strand supply packages P in order to control the rate of feed of strand or filamentary material from the supply packages to the twister spindles in order to maintain substantially the amount of twist or

the number of twists in the strand per inch or per unit of length imparted to the strand as it is wound or collected upon the bobbins 28.

The shaft 84 supporting the sheave or pulley 36 is mounted in bearings 86 supported by the vertical frame member 12. The shaft 84 is equipped with a bevel gear 88 meshing with a bevel gear 90, the latter being fixed upon an input shaft 92 of a variable speed unit 94 of the infinitely variable type of conventional construction of the character shown in the patent to Kopp 2,469,653. The unit 94 is inclusive of a housing 96 carried by shelf-like members or brackets 98 secured to the upright member 12.

The variable speed mechanism of the unit 94 is such that the same is controlled through cam means to continuously vary or program the speed of the output shaft 100 of the unit 94 for continuously changing or varying the speed of the feed of the strand supply packages P to fully compensate for the constantly reducing diameter of the strand supply packages as the strand is fed from the packages and the increasing size of the collected package. Means in the variable speed unit 94 for varying the speed of the output shaft 100 is illustrated schematically in FIGURES 3 and 4.

The input shaft 92 is equipped with a power transmission disc or wheel 102 and the output shaft 100 provided with a similar driven disc 104. Disposed peripherally of the discs 102 and 104 are spherically shaped members or balls 106 each of which is equipped with a diametrically arranged axle or shaft 108, each shaft 108 extending into an angularly arranged cam slot 111 provided in a gear wheel 112, the balls being retained in contact with the peripheries of the discs 102 and 104 by an annularly shaped race or retainer 110.

The angular positions of the axles or shafts 108 are controlled by the cam slots 111 as the gear wheel 112 is slowly rotated by a worm 114 contained within a longitudinally extending casing or housing 115 formed as a part of or secured to the circular housing 96 of the variable speed unit 94. The worm 114 is driven by means as, for example, a synchronous motor contained in a casing 116 secured to the casing 115. The synchronous motor is connected with the worm 114 through speed reducing gearing (not shown) contained in the motor housing 116.

During rotation of the gear wheel 112, the angularly arranged cam slots 111 in the gear wheel 112 effect a continuous progressive change in the relative angular position of the shafts 108 causing a continuous progressive change in the speed ratio between the input shaft 92 and the output shaft 100 through the changing regions of contact of the balls 106 with the driving disc 102 and the driven disc 104.

The synchronous motor may be of the type rotating at comparatively low speed, as for example, 75 revolutions per minute. Hence through the medium of the speed reducing gearing in the housing 116 and the speed reduction effected through the worm 114 and the worm wheel 112 and the variable drive illustrated in FIGURES 3 and 4, the output shaft 100 of the variable speed unit 94 is rotated at variable speed depending upon the relative angular positions of the power transmitting ball members 106 in contacting driving and driven engagement with the discs 102 and 104.

Rotation of the worm 114 and the driven worm wheel 112 through the cam mechanism controlling the relative angularity of the axles or shafts 108 of the speed changing balls 106 continuously varies the drive ratio between the input shaft 92 and the output shaft 100 to vary the rate of feed of the strand from the strand packages P. The output shaft 100 of the variable speed unit is provided with a sprocket 120 which is connected by means of a chain 121 with a sprocket 122 mounted upon a shaft 123.

Disposed adjacent and in parallelism with shaft 123 is a second shaft 125, the shafts 123 and 125 being sup-

ported in bearings 126 mounted upon a supporting bracket 127. Mounted upon the shafts 123 and 125 respectively are spur gears 128 and 129 which are in mesh as illustrated in FIGURE 2 and through the medium of which the shafts 123 and 125 are simultaneously driven in opposite directions.

As there are two sets of winding spindles 24 disposed at opposite sides of a central plane longitudinally through the machine, two package supply creel units are mounted upon the upper portions of the apparatus for feeding strands to the two rows of winding spindles. As shown in FIGURE 2, each package support or creel 130 is fashioned of sheet metal and is adapted to frictionally support a package of strand or filamentary material. Each package is inclusive of a cylindrical tube or sleeve 132 upon which the strand of filaments or filamentary material has been previously collected.

It will be noted from FIGURES 1 and 2 that the package supports 130 are arranged in four rows, two at each side of the central longitudinal plane of the apparatus and the package supports of adjacent rows staggered to facilitate delivery of the several strands to their respective collector bobbins. Each package supporting member 130 is secured to and mounted by a shaft 134 individual to each member, the shafts being journally supported in the suitable bearings contained within bearing support members 136 secured to the frame plates 18 and 19 of the creel drive section.

The individual rows of packages are designated 140, 141, 142 and 143 in FIGURES 1 and 2. The rows of packages 140 and 141 supply the strands or linear material which are wound upon the bobbins at the right-hand side of the twister apparatus as viewed in FIGURE 2, and the packages of the rows 142 and 143 supply strands which are wound upon the bobbins at the left-hand side of the apparatus. Each of the shafts 134 is provided with a whorl or sheave 146.

As shown in FIGURES 1 and 2, each of the rows of packages are driven by belts individual to each row, viz. the belts 150, 151, 152 and 153 providing the driving means for the respective rows of packages 140, 141, 142 and 143. The driving arrangement for all of the strand packages is through the variable speed reducing means provided by the unit 94 through suitable power transmission gearing. As shown in FIGURE 2, housings 156 and 158 are mounted on plates 18 and 19, the housings being of substantially identical construction.

Mounted upon the housings 156 and 158 respectively are housings 160 and 162. An input shaft 164 journaled in the housing 156 is provided with a sprocket 165 connected by a chain 166 with a sprocket 168 carried by the shaft 123, the latter driven by the output shaft 100 of the variable speed unit 94 by a chain 121. Journaled in and extending from the housing 156 is a shaft 170 driven through suitable power transmission gearing contained in the housing 156. A driving pulley 172 is fixedly secured on the shaft 170. Mounted in journal bearings 174, shown in FIGURE 1, is a pulley 176. A belt 151 takes over the driving pulley 172 and the pulley 176 as shown in FIGURE 1.

Each of the whorls 146, on the shafts 134 of the lower right-hand row of shafts as viewed in FIGURE 2, are engaged with one flight of the belt 151 and all of the package supports 130 in the row designated 141 are driven thereby.

A plurality of pressure rolls 180 carried by adjustable arms 182 are spaced lengthwise of the package driving flight of the belt 151 to effect efficient friction driving engagement of the belt with the several whorls 146 providing for rotation of the strand packages and hence the advancing or feeding of the strand from the packages to the collector bobbins 28.

Disposed at the opposite side of the apparatus and secured to the plate 19 is a similar housing 158 enclosing power transmission gearing for driving the lower row 143 of the strand packages through the medium of the belt

153. The input shaft 184 journaled in the housing 158 is equipped with a sprocket 186 driven by a chain 188 from a sprocket 190 mounted upon the shaft 125 which is driven through the variable speed unit 94. The output shaft 170', driven through the gearing contained in the housing 158, drives the belt 153 through the medium of a driving pulley 172'.

Mounted upon the housings 156 and 158 respectively are housings 160 and 162 which enclose suitable power transmission gearing for establishing a drive to each of the rows of packages 140 and 142. The gear mechanisms in each of the housings 160 and 162 are connected with and driven from the gearing contained in the housings 156 and 158. The output shafts 157 and 157' extending from the housings 160 and 162 respectively are provided with drive pulleys 194 and 194' for driving the belts 150 and 152.

A plurality of pressure rolls 180 are disposed in spaced relation lengthwise of the upper or driving flights of each of the belts 150, 152 and 153 for establishing an effective friction drive with the whorls 146 associated with each of the package or tube supporting creels or members 130. The power transmission gearing arrangements in the housings 156, 158, 160 and 162 are such as to drive all of the package supporting creels or members at the same speed.

When the speed of the output shaft 100 is progressively varied through the variable speed unit 94, all of the package driving whorls are uniformly reduced or increased in speed in proportion to the reduction or increase of speed in the output shaft 100. Through this method and means of variable drive for the supply packages or tubes of strand or linear material, the rate of feed or delivery of the strand from the packages or tubes to the winding bobbins is programmed or controlled to impart a uniform twist per unit of length in the material throughout its collection upon a bobbin even though the diameters of the packaged filamentary materials on the supply tubes are progressively diminished while the diameters of the packages of material collected on the bobbins are progressively increasing as winding continues.

Through this method, the filamentary material is advanced or fed to the collecting bobbins at a constantly increasing linear rate so that the number of twists in the filamentary material per inch or other unit of length will be substantially constant throughout the length of material collected on the bobbins.

By adjusting the relative initial positions of the power transmitting spherical members 106 through modification of the angular positions of the shafts 108 by the cam means provided by the gear 112 in the unit 94, the initial rate of rotation of the strand supply packages may be changed or altered whereby the number of twists per unit of length in the filamentary material may be changed merely by changing or controlling the range of operation of the variable speed unit 94 and hence the linear rate of feed or delivery of the strand to the collecting bobbins. A crank 117 is connected with the worm 114 for adjusting the initial position of the cam means for initially determining the angularity of the axles 108 to predetermine the range of progressive speed increase of the output shaft 100 of the unit 94.

The flyer or traveler 44 will rotate in its orbit or circular path around a bobbin at a varying rate dependent upon the differential in the rate of linear feed of the strand to the collecting bobbins, but the number of twists per unit of length imparted to the strand as it is collected on the bobbins will be substantially constant through the variable speed drive provided by the unit 94. The linear rate of feed of the strand from the supply packages is continuously increased automatically by reason of the rotation of the worm 114 of the speed varying unit 94 driven by the synchronous or constant speed motor contained within the housing 116.

In order to effectively utilize the twister apparatus with the variable speed package creel drive, in preparing

the apparatus for operation, all of the tube supports 130 are provided with strand supply packages having substantially uniform amounts of strand of filamentary material, and all of the spindles are provided with empty bobbins so that the strand materials from all of the packages are delivered or fed to the bobbins whereby the strand on all of the supply packages is simultaneously diminished at substantially the same rate and the material collected or accumulated on the bobbins at a uniform linear rate.

The apparatus requires little attention during winding operations as all of the bobbins are being filled with the same amount of material at the same rate. In twister apparatus in use prior to this invention, the feed of strands from the supply packages was not coordinated as to the amounts of strand on the packages, but the packages were rotated at a constant rotative speed and hence the strands were fed at variable linear rates of speed whereby the twist per unit of length varied throughout the length of material collected on the bobbins.

In the event of breakage or break out of a strand or linear body of filamentary material, the operator may adjust the rolls 180 adjacent the strand package in which the break out occurred to interrupt the drive to the said package without necessitating stopping the apparatus. After the material on strand packages has been collected on the bobbins, the operation of the apparatus is stopped so that all of the full bobbins may be removed at one time and replaced with empty bobbins and the empty sleeves 132 of the strand packages removed from their creels or supports and replaced with full packages of strand.

FIGURES 5 and 6 illustrate the arrangement of the invention embodied in or utilized with a form of twister apparatus wherein the feeding or advancing of the strands or filamentary materials from supply packages is obtained by rotatable feed rolls in engagement with the strands or filamentary materials. The twister apparatus shown in FIGURE 5 is inclusive of end frame plates 210, one of which is shown in FIGURE 5, connected by frame members 212, one of which is shown in FIGURE 5. The end frames 210 support a central member of section 214 which is provided with rotatable package supporting means or creels similar to that shown in FIGURE 2.

The package supports in this form of twister construction, are mounted in journal bearings but are not connected with a driving means. The twister apparatus includes a bolster plate, which in the form illustrated, is provided by the frame member 212 supporting bolsters 218 in which spindles 220 are journally mounted for rotation. Extending lengthwise of the apparatus and mounted in suitable bearings (not shown) carried by the end plates 210 is a driving shaft 222 driven by a motor 224.

A speed changing mechanism may, if desired, be disposed between the shaft of motor 224 and the driven shaft 222 to regulate the speed of the spindle driving shaft. Mounted upon the shaft 222 are pulleys or whorls 226. Each of the spindles is provided with a whorl 228. In the embodiment illustrated a belt 230 engages a whorl 226 mounted on the driving shaft and takes over the whorls 228 of a pair of adjacent spindles whereby two spindles are driven or rotated by each of the belts 230. The apparatus includes a ring rail 232 which supports rings 234, there being a ring surrounding each spindle.

Each ring forms a circular track for a flyer or traveler 236 which travels around the spindle. A guide eye 240 carried by a longitudinally extending frame member 241 is provided for each strand or linear body of filamentary material S'. The feed or material advancing means in this embodiment comprises pairs of feed rolls, each pair including rolls 242 and 244. Each pair of rolls is adapted to advance dual strands or linear bodies of material from two supply packages P'.

The rolls 242 are fixedly secured on a longitudinally extending shaft 246, and the rolls 244 are fixedly secured on a longitudinally extending shaft 248, the shafts being

in parallel relation. The shafts are journaled in bearings carried by the end frame plates 210. Mounted upon a support 250 adjacent one of the end frames 210 is a variable speed unit 94' which is of the same construction as the unit 94 hereinbefore described and illustrated in FIGURES 1 through 4.

The cam mechanism of the variable speed unit 94' is driven by a synchronous motor through speed reducing gearing contained in a housing 116'. The motor driven shaft 222 is the input shaft for the variable speed unit 94', the latter being provided with an output shaft 100'. Mounted upon the output shaft 100' is a drive pulley 252 which is connected by means of a belt 254 with a pulley 256 mounted upon the shaft 248. The shaft 248 is provided with a spur gear 258 which meshes with a spur gear 260 mounted upon the shaft 246.

The gears 258 and 260 are of the same size in order to rotate the rolls 242 and 244 of each pair in opposite directions at the same speed. It is to be understood that the pulleys 252 and 256 may be replaced with sprockets connected by means of a driving chain in lieu of the belt 254.

The opposite side of the twister apparatus is provided with a longitudinally extending bolster rail and a plurality of bolsters (not shown) each mounting a rotatable spindle 220' and each pair of such spindles rotated by a belt 230' driven from a pulley or whorl 231 mounted upon the shaft 222 as shown in FIGURE 6. The spindle arrangement at the opposite side of the apparatus is provided with a ring rail, rings and flyers (not shown) of the same construction illustrated at the forntal side of the apparatus in FIGURE 5.

A pair of shafts 246' and 248' are disposed lengthwise of the apparatus and are provided with pairs of feed rolls (not shown) for feeding or advancing strands or linear bodies of filamentary material from supply packages (not shown) supported at the opposite side of the central section 214. The shafts 248' and 246' are respectively provided with spur gears 258' and 260' whereby the shafts are simultaneously driven in opposite directions.

The output shaft 100' of the variable speed unit 94' is provided with a second pulley 264 which drives a pulley 266 mounted on shaft 248' through the medium of a belt 268. Both sets of spindles disposed at opposite sides of the apparatus are driven or rotated at a substantially constant speed by the motor 224.

Through the provision of the variable speed unit 94', the feed rolls 242 and 244 of both sets are rotated at progressively increasing speeds as the material is collected upon the bobbins carried by the spindles 220 as the collected material on the bobbins increases in diameter.

The variable speed means 94' is rotated by the synchronous motor contained within the housing 116' or other motivating means to continuously actuate the cam arrangement in the unit 94' so that a uniform number of twists per unit of length of the linear material is formed in the material. The number of twists per unit of length may be varied by adjusting the range of ratio of speed change in the unit 94' to regulate or control the number of twists per unit of length in the collected material. With the arrangement of the invention as disclosed herein, the amount of twist per unit of length imparted to the material may be regulated or controlled and uniform twist maintained.

It is apparent that, within the scope of the invention, modifications and different arrangements may be made other than as herein disclosed, and the present disclosure is illustrative merely, the invention comprehending all variations thereof.

We claim:

1. Apparatus of the character disclosed, in combination, rotatable means upon which linear material is adapted to be collected, means for driving said rotatable means at a substantially constant speed, a traveler arranged for rotational movement around the rotatable

means and adapted to be engaged by the linear material, means for feeding linear material to the rotatable means, variable speed means for driving said material feeding means, and means for continuously varying the rate of the variable speed means for establishing a uniform twist in the collected material.

2. Apparatus of the character disclosed, in combination rotatable means upon which linear material is adapted to be collected, a traveler arranged for rotational movement around the rotatable means and adapted to be engaged by the linear material, means for feeding linear material to the rotatable means, variable speed means for driving said material feeding means, means for continuously varying the rate of the variable speed driving means for establishing a uniform twist in the collected material, and a motor arranged to rotate the rotatable material collecting means at a substantially constant speed and drive the variable speed means.

3. Apparatus of the character disclosed, in combination, a rotatable bobbin upon which linear filamentary material is adapted to be wound, means for rotating said bobbin at a substantially constant speed, a traveler arranged for rotational movement around the rotatable means and adapted to be engaged by the linear material, means for feeding linear material to the rotatable bobbin, a variable speed mechanism for said feeding means, and synchronous motor actuated means for continuously varying the ratio of the variable speed mechanism to control the linear rate of travel of the material whereby a substantially constant number of twists per unit of length is established in the material as it is wound on the bobbin.

4. Apparatus of the character disclosed, in combination, a plurality of twister spindles adapted to support bobbins upon which linear materials are adapted to be wound, a traveler arranged for rotational movement around each of the twister spindles and adapted to be engaged by the linear material, means for feeding linear materials to the bobbins, variable speed means for driving said material feeding means, means for continuously varying the rate of the variable speed means for feeding the linear materials at controlled linear speeds to the bobbins, and a motor arranged to simultaneously rotate the spindles at a substantially constant speed and drive the variable speed means.

5. Apparatus of the character disclosed, in combination, a first rotatable means upon which linear material is adapted to be wound, means for driving said rotatable means at a substantially constant speed, a traveler arranged for rotational movement around the rotatable means and adapted to be engaged by the linear material, a second rotatable means adapted to support a supply package of linear material to be advanced and wound upon the first rotatable means, variable speed means for driving said second rotatable means, and means for continuously changing the rate of speed of said variable speed means whereby the linear material from the supply package is fed to the first rotatable means at a controlled linear rate to establish uniform twist in the linear material as it is wound on the first rotatable means.

6. Twister apparatus including, in combination, a first rotatable means upon which linear filamentary material is adapted to be wound, a traveler arranged for rotational movement around the rotatable means and adapted to be engaged by the linear material, a second rotatable means adapted to support a supply package of the linear material to be advanced and wound upon the first rotatable means, variable speed means for rotating said second rotatable means, a synchronous motor, means actuated by the synchronous motor for continuously varying the rate of speed of said variable speed means whereby the linear material from the supply package is fed to the first rotatable means at a progressively increasing linear rate, and a second motor for concomitantly rotating said first rotatable means at a substantially constant speed and driving said variable speed means.

7. Twister apparatus including, in combination, a first rotatable means upon which linear material is adapted to be wound, a traveler arranged for rotational movement around said rotatable means, a second rotatable means arranged to advance linear material to said first rotatable means, variable speed changing mechanism associated with said second rotatable means, means for continuously varying the rate of rotation of the variable speed changing mechanism for controlling the speed of said second rotatable means to maintain substantially constant the number of twists per unit of length imparted to the material as it is wound on the first rotatable means, and single means for concomitantly rotating one of said rotatable means at a substantially constant speed and rotating the other through the variable speed changing mechanism.

8. Twister apparatus comprising a rotatable strand feeder, a twister spindle arranged to support a bobbin, variable speed mechanism arranged to rotate the strand feeder for feeding strand to the bobbin supported by the spindle, electrically energizable means for driving said spindle at a substantially constant speed and said variable speed means, a ring surrounding the spindle, a traveler mounted by the ring for orbital movement around the spindle, the strand arranged to engage the traveler prior to its collection on the bobbin, and means for continuously varying the speed of the variable speed means whereby the strand is fed to the bobbin at a differential linear rate to establish uniform twist per unit of length in the strand.

9. Twister apparatus comprising a spindle section and a creel section, a plurality of spindles arranged to support spools upon which linear material is adapted to be wound, a plurality of rotatable supports at the creel section, each of said supports being adapted to carry a package of linear material, a twister ring surrounding each of the spindles and having a traveler movable thereon, said traveler being arranged to receive linear material from a package, a motor arranged to rotate all of the spindles simultaneously at a substantially constant speed, speed changing mechanism connected with and driven by said motor, an output shaft driven by the speed changing mechanism, said speed changing mechanism arranged to vary the speed of the output shaft, means for driving the rotatable package supports at the creel section by the output shaft of the speed changing mechanism, a synchronous motor, and means driven by the synchronous motor for continuously varying the speed of the output shaft whereby the speed of the rotatable package supports is continuously modified to advance the linear material to the spools on the spindles at a linear rate to provide uniform twist per unit of length in the linear material.

10. Twister apparatus comprising a spindle section and a creel section, a plurality of spindles arranged to support spools upon which linear material is adapted to be wound, a plurality of rotatable supports at the creel section, each of said supports being adapted to carry a package of linear material, a twister ring surrounding each of the spindles and having a traveler movable thereon, said traveler being arranged to receive linear material from a package, a motor arranged to rotate all of the spindles at a substantially constant speed, speed changing mechanism connected with and driven by said motor, an output shaft driven by the speed changing mechanism, a synchronous motor associated with the speed changing mechanism for varying the speed of the output shaft, means for driving the rotatable package supports at the creel section by the output shaft of the speed changing mechanism, the speed of the output shaft being continuously changed at a rate whereby the speed of the rotatable package supports is continuously modified to advance the linear material to the spools on the spindles at a differential rate of speed to provide uniform twist per unit of length in the linear material.

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11. A method of feeding filamentary material to a material collecting surface on a twister spindle including the steps of rotating the collecting surface at a substantially constant speed, rotating a supply body of filamentary material to deliver the material through a traveler to the collecting surface, and continuously increasing the speed of rotation of the supply body to establish a uniform amount of twist per unit of length in the filamentary material.

12. A method of establishing uniform twist in filamentary material including rotating a material collecting spool at a substantially constant speed, rotating a package spool of the material to advance the material through a traveler to the collecting spool, and continuously increasing the rate of rotation of the package spool for controlling the linear rate of advancement of the material to establish uniform twist in the material as it is collected.

13. A method of feeding filamentary material to a collecting surface on a twister spindle including rotating the collecting surface at a substantially constant speed, rotating a filamentary material feeder to deliver the mate-

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rial through a traveler to the collecting surface, and continuously increasing the speed of rotation of the material feeder to establish a uniform amount of twist per unit of length in the collected filamentary material.

14. A method of feeding filamentary material to a collecting surface on a twister spindle including rotating the collecting surface, rotating a filamentary material feeder surface to deliver the material through a traveler to the collecting surface, and continuously varying the relative rotational speed of one of the surfaces with respect to the other while maintaining substantially constant the rotational speed of the other surface to establish a uniform amount of twist per unit of length in the collected filamentary material.

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