Dec. 8, 1970 H. M. HICKMAN 3,545,192

APPARATUS FOR WINDING ROVING

Original Filed June 29, 1966 3 Sheets-Sheet 1

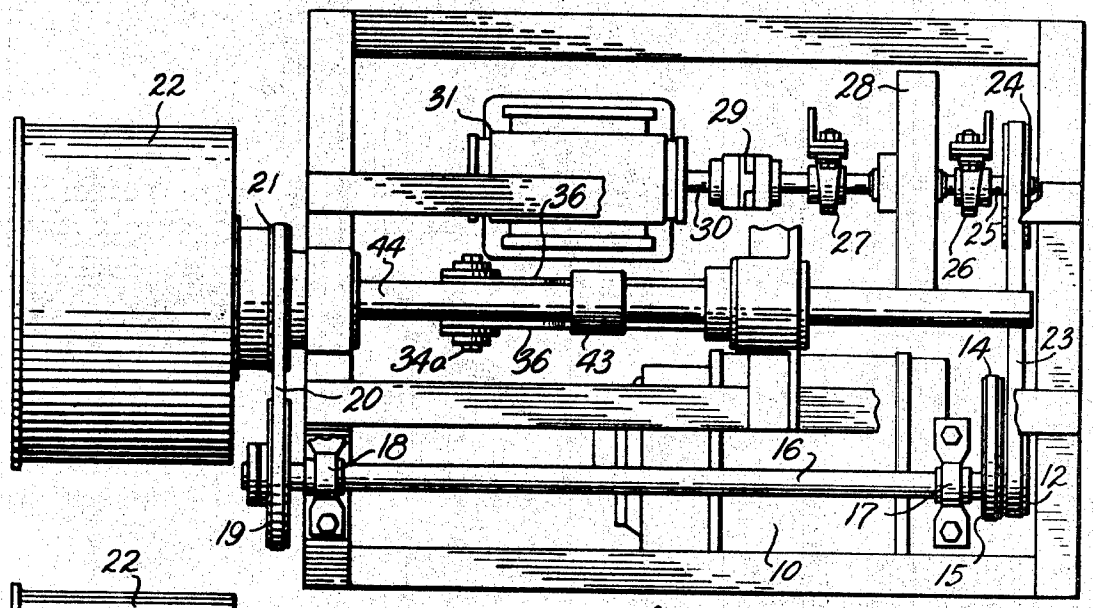

Fig. 1.

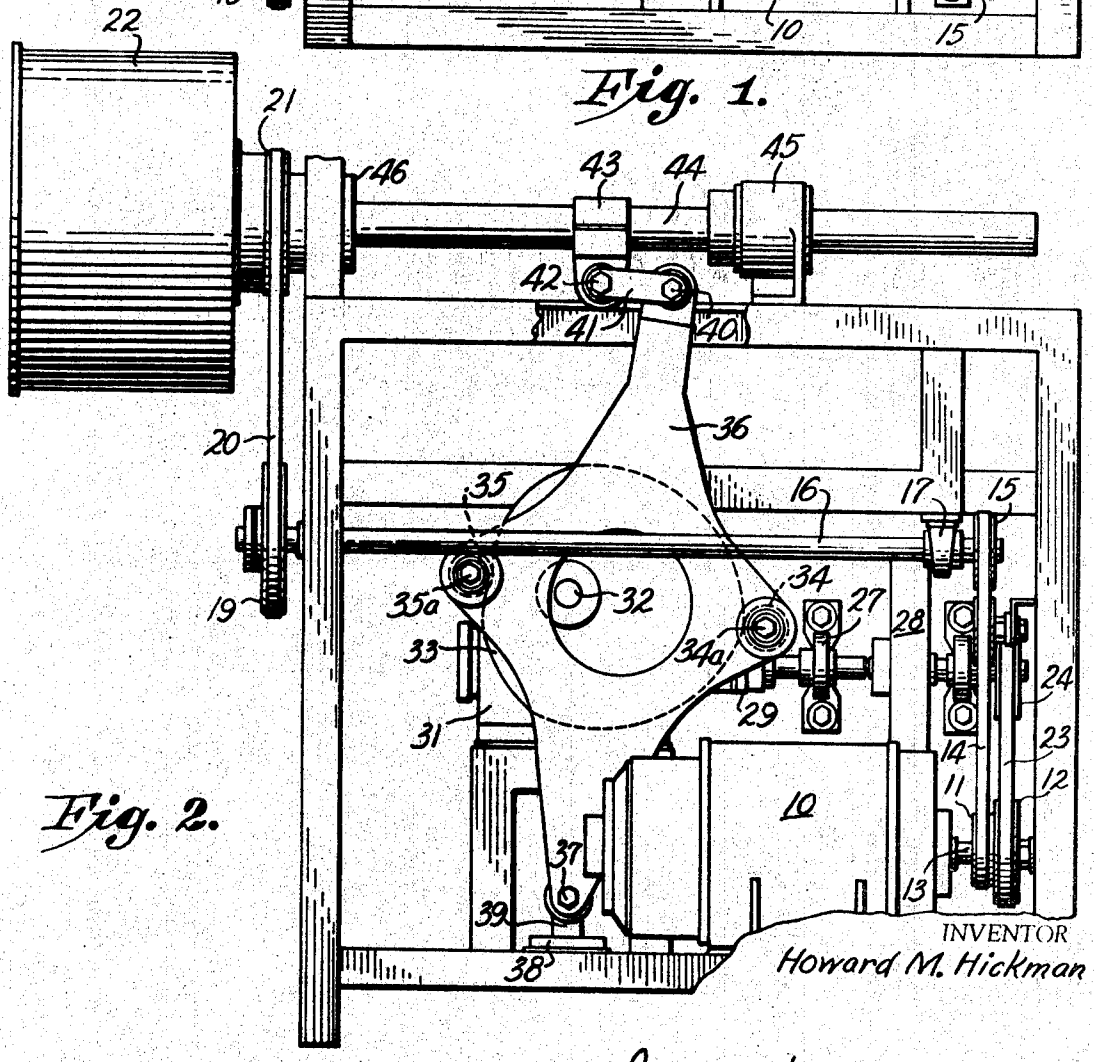

Fig. 2.

INVENTOR
Howard M. Hickman

BY Seufield, Kolisch, Seufield & Soave
ATTORNEYS

APPARATUS FOR WINDING ROVING

Original Filed June 29, 1966 3 Sheets-Sheet 2

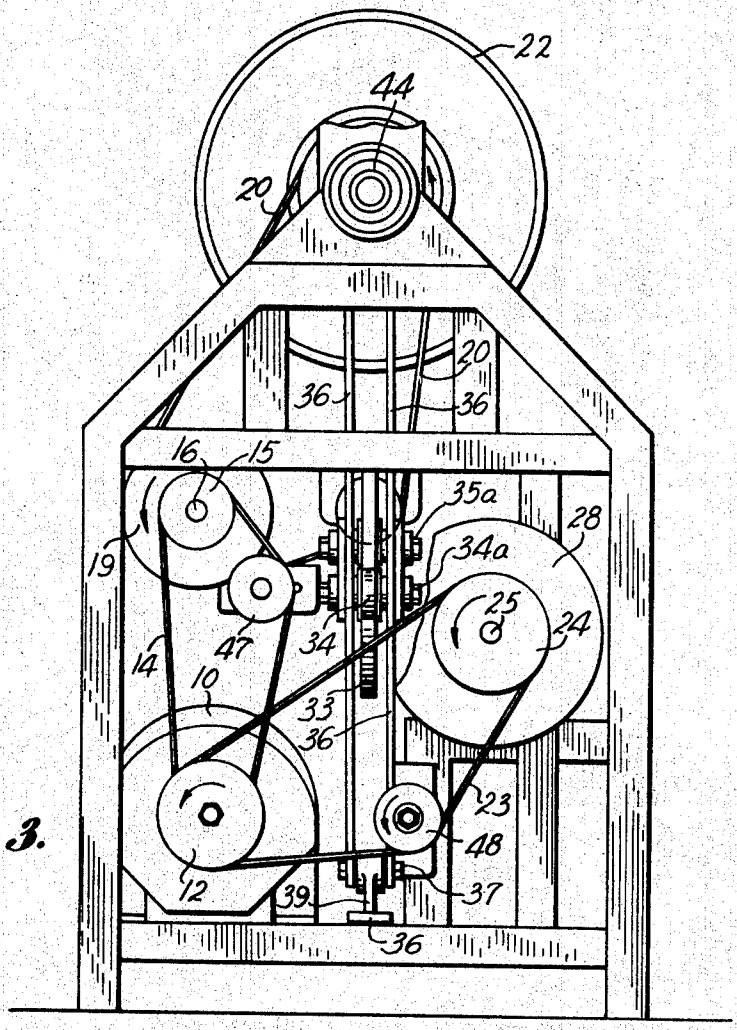

Fig. 3.

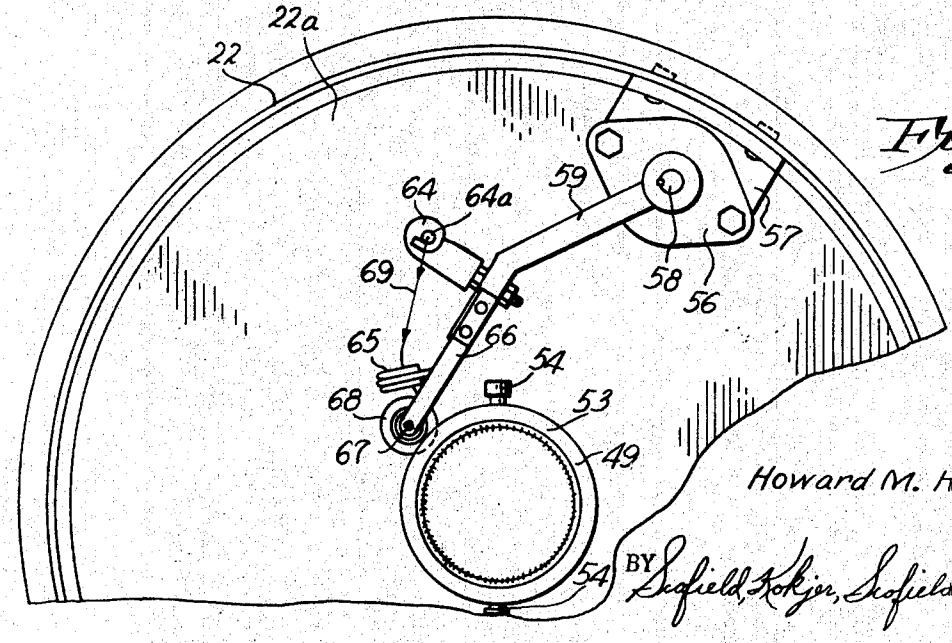

Fig. 4.

INVENTOR

Howard M. Hickman

BY Schfield, Kokjer, Schfield & Lowe

ATTORNEYS

Dec. 8, 1970 H. M. HICKMAN 3,545,192

APPARATUS FOR WINDING ROVING

Original Filed June 29, 1966 3 Sheets-Sheet 3

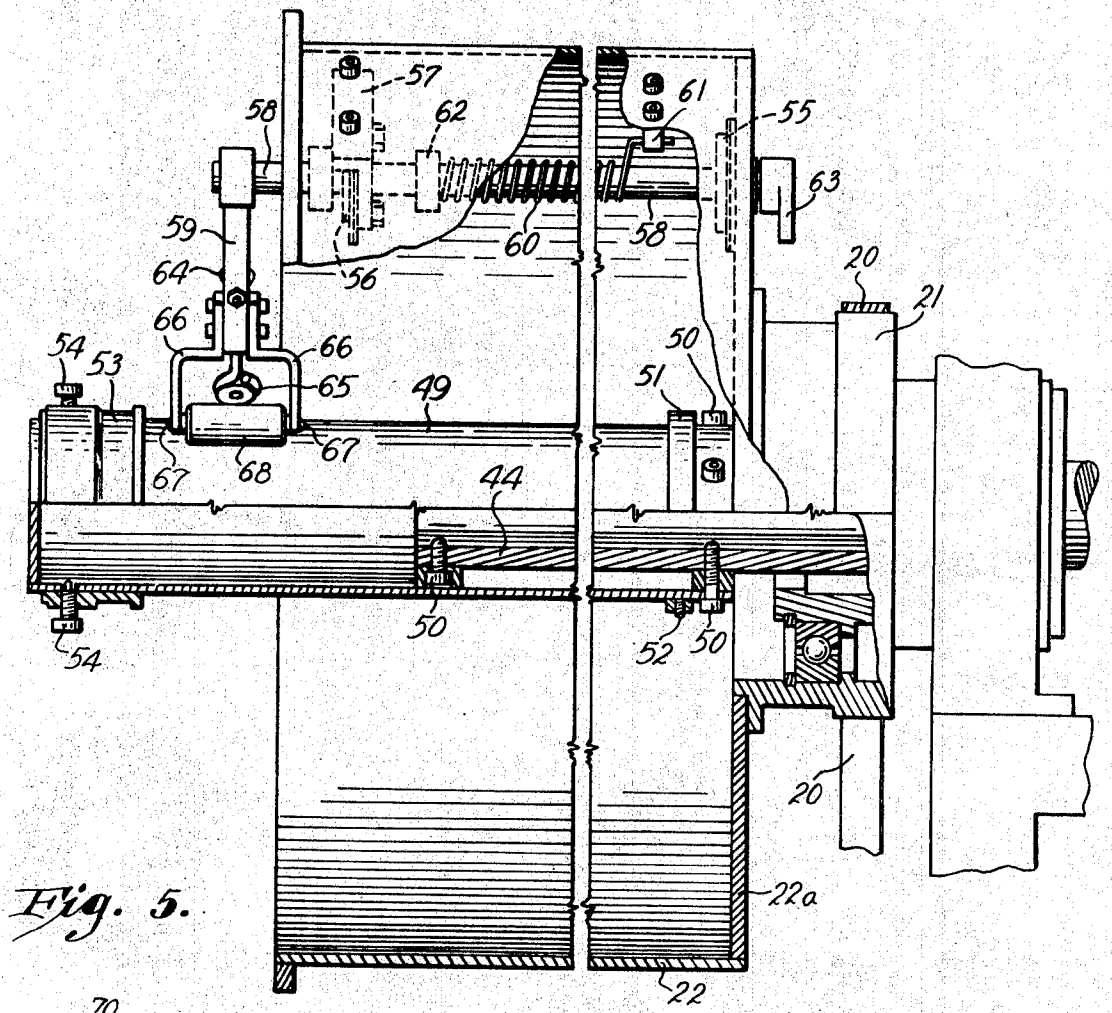

Fig. 5.

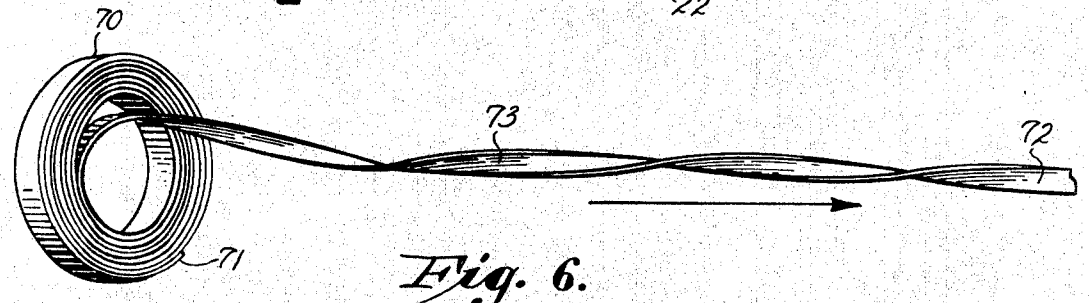

Fig. 6.

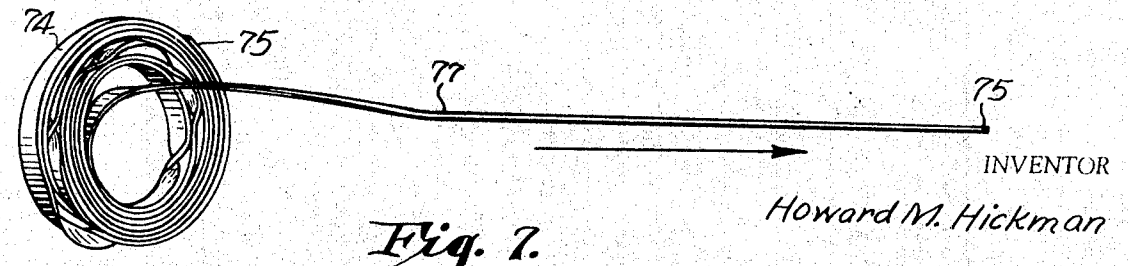

Fig. 7.

INVENTOR

Howard M. Hickman

BY Scofield, Kokjer, Scofield & Lowe

ATTORNEYS

United States Patent Office 3,545,192 Patented Dec. 8, 1970

3,545,192

APPARATUS FOR WINDING ROVING

Howard M. Hickman, Overland Park, Kans., assignor, by mesne assignments, to Certain-Teed Products Corporation, Ardmore, Pa., a corporation of Maryland

Original application June 29, 1966, Ser. No. 561,477, now Patent No. 3,383,851, dated May 21, 1968. Divided and this application Mar. 7, 1968, Ser. No. 711,364

Int. Cl. B65h *55/00;* D01h *1/04*

U.S. Cl. 57—71 5 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for winding a strand of roving into a roving package formed on a nonrotatable, reciprocal mandrel. A guide member mounted on a rotatable cylindrical drum guides the strand onto the roving package and imparts a 360° twist to the strand per each revolution of the guide member around the mandrel to provide a package of roving in which the strand may be withdrawn without the twist.

BACKGROUND AND SUMMARY OF THE INVENTION

This is a division of application Ser. No. 561,477, filed June 29, 1966, now Pat. No. 3,383,851, issued May 21, 1968.

The manufacture of glass fiber roving commences with the drawing of filaments from a bushing to form strands. Typically, 204 filaments are drawn from a bushing and wound as a single strand on a cardboard tube in what is typically referred to as a forming tube package. This process is typically disclosed in the patent to M. A. Case, No. 2,955,772, issued Oct. 11, 1960 entitled "Textile Fiber Winder." These individual filaments are themselves not twisted. Each strand is composed of 204 filaments and is contained in a forming tube package, in the shape in which it is drawn from the bushing.

Glass fiber roving is commonly made by simultaneously winding a number of strands in parallel on a rotating mandrel. Most frequently, the roving contains 60 strands, but it may have a greater or a lesser number. The forming tube packages are typically placed on shelves and do not rotate. One strand is pulled from the center of each package. This withdrawal imparts a slight twist (one 360° twist per circumferential length withdrawn) to the individual strands. Thus, the strands within the roving itself are twisted with respect to one another on the conventional winder in the roving. However, this individual strand twist is not objectionable, for the purposes of the instant invention.

In typical commercial uses of glass fiber roving, same may be used chopped into relatively short lengths or as long lengths thereof drawn from the roving package. In the first type of use (short lengths), there is no twist problem. In the second use, typically involved in filament winding processes or pultrusions, twist effects may well become significant and undesirable. Thus, when the roving is used by the molder, in, say, filament winding processes or pultrusions, it is typically withdrawn from the inside of a nonrotating cylindrical package of roving (comparable to the strand withdrawal from the forming package in the roving makeup process). This action imparts a slight twist to the roving (one 360° twist per circumferential length of roving withdrawn from the package). This roving twist is objectionable because it interferes with wetting of same by the molding resin and, in the case of filament wound products, or other products requiring parallel strands, does not allow the individual strands to be properly aligned to resist the stresses imposed in service.

The conventional method of forming glass fiber roving involves simultaneously winding a number of strands in parallel on a rotating mandrel, as previously mentioned. This results in a cylindrical roving package wherein the strands within the roving itself are not twisted as applied to the package. It is the withdrawal of the roving for further use from a static roving package which results in the application of one 360° twist per circumferential length of roving withdrawn from the package.

The instant improvement winds the aggregate strands making up the roving on a nonrotating mandrel. The mandrel reciprocates, but as mentioned, does not rotate. This winding method imparts a twist to the strands of the roving equivalent to one 360° twist per circumferential length of strands wound on the roving package (or nonrotating mandrel), which applied twist operates to counteract the twist given to the roving by the conventional removal from the roving package. Consequently, when the roving is used by the molder, it has no twist therein.

It is possible to unwind a conventional roving package from the outside with the packages rotated. This results in no twist in the roving in use, but the speed of unwinding is limited and the process is hard to handle.

An object of the invention is to provide an improved glass fiber roving package for use in continuous lengths thereof which, when unwound from a nonrotating package, does not impart a twist to the roving.

Another object of the invention is to provide apparatus for glass fiber roving manufacture adapted to wind glass fiber strands made up of drawn filaments on a mandrel in such manner as to preapply a twist to the strands whereby, when the roving is withdrawn from a static roving package in conventional manner, the roving will not be twisted.

Another object of the invention is to provide methods of handling glass fiber strands in the formulation of glass fiber rovings therefrom whereby ultimately used lengths of glass fiber roving will be optimal for impregnation and wetting with resin thereby faciiltating and optimizing results in filament winding processes, pultrusions, etc. wherein such rovings are employed.

Another object of the invention is to provide methods of and apparatus for winding any desired number of glass fiber strands made up of drawn filaments thereof into a roving package whereby to be able to draw nontwist roving from said package, either outside or inside thereof in conventional static roving package manner with the resultant roving having no twist.

Another object of the invention is to provide winding apparatus and methods for winding roving packages of any desired size, weight and diameter wherein the roving withdrawn therefrom at any desired speed will be entirely without twist of the individual strands thereof.

Another object of the invention is to provide methods of and apparatus for applying twist to the glass fiber strands being wound in a roving package, said twist applied in uniform manner whereby each circumferential wind of roving in the package has one 360° twist of the strands making up the roving of the package.

Other and further objects of the invention will appear in the course of the following description thereof.

In the drawings, which form a part of the instant specification and are to be read in conjunction therewith, embodiments of the invention are shown and, in the various views, like numerals are employed to indicate like parts.

FIG. 1 is a top view of a roving winding apparatus embodying the instant invention with parts cut away to better illustrate the various items of the operative assembly.

FIG. 2 is a side view of the apparatus of FIG. 1, taken from the lower side of FIG. 1 looking upward on the page of drawings.

FIG. 3 is a rear view of the apparatus of FIGS. 1 and 2, namely, taken from the right-hand sides of FIGS. 1 and 2 looking to the left in the views.

FIG. 4 is an enlarged detail of the drum seen to the left in the views of FIGS. 1 and 2, the view looking from the left to the right in those views (actually a view taken looking from the left to the right in the view of FIG. 1).

FIG. 5 is a side-sectional detail of the drum in the upper left-hand corner of FIG. 2, parts shown in dotted lines, full lines and cutaway to better illustrate the various relationships of the parts to one another. FIGS. 1–3 do not contain the details of structure seen in FIGS. 4 and 5.

FIG. 6 is a three-quarter perspective view of a tape or a lead ribbon which is wound on itself and so configured unwound in the view as to illustrate the problem which the present invention wishes to solve.

FIG. 7 is a view of a tape or ribbon like to that of FIG. 6, but illustrating the tape wound on itself in the manner adopted in the present invention to solve the problem.

Referring first to FIGS. 6 and 7, therein are shown schematic views of cloth tapes or lead ribbons, so configured as to clearly illustrate the problems and solutions involved in the instant invention. Broad flat tapes or ribbons are employed, rather than cylindrical cables so that twisting, or the lack of same, of the tapes along their longitudinal axis may be clearly seen. As previously mentioned, the conventional manner of forming glass fiber roving involves simultaneously winding a number of strands in parallel on a rotating mandrel. This results in a roving package wherein the strands within the roving itself are not twisted. Thus, at **70**, in FIG. 6, one sees that the circumferential lengths of tape or ribbon are concentrically wound on one another without any twisting of the tape with respect to the package. In an actual roving package, the roving itself, which would be roughly cylindrical in transverse section, and involve or comprise a number of individual strands of the character previously described lying parallel to one another, would lie both wrapped around and lying along the length of a winding mandrel with successive loops thereof lying at an angle to one another due to traverse of the mandrel, the gathering loop, or both with respect to one another. Thus, each successive roving loop would not lie strictly circumferentially outside the one preceding or inside of the one following. However, for ease of visualization, the tape in this case is shown coiled around itself with each circumferential length thereof lying flatly over the inward one thereof. The flatness of the tape itself illustrates the fact that individual lengthwise threads or strands making up the flat band of the tape are parallel to one another in FIG. 6.

However, one can see that roving analogue tape **70** has two ends, **71** and **72**. End **71** may be employed for unwinding or withdrawing the tape, but, as is conventional, end **72**, from the center of the roving, has been employed and withdrawn from left to right in the view. This withdrawal of the tape or ribbon with the end **72** fixed in position and the tape roll **70** static, as it conventionally would be in the roving unwinding process, results in one 360° twist in every circumferential length of the tape withdrawn, as may be seen in the view in the tape length **73**.

On the other hand, in FIG. 7, where the body of the roving analogue tape or ribbon is seen at the left, generally designated **74**, with outer end **75** and inner end **76**, the tape or ribbon has been wound on itself with one 360° twist input, in the same direction, for every 360° circumferential length wound around the axis. This results, when the length **77** is withdrawn from the package in the correct direction, namely, opposite to the direction of input of the roving to the roll in the winding process, in the production of an untwisted tape or ribbon. In the case of a cylindrical, twisted roving package, the same manner of withdrawal would result in an untwisted roving or a roving having no twist of the strands in the withdrawn or pulled out roving length. The phrase "in the correct direction" in the last sentence refers to the fact that, if the draw is in the opposite direction from that shown, a double twist would be put into the tape length **77**. Comparing to FIG. 6, one will see that however one draws from the package of FIG. 6, either end **71** or end **72**, and in the opposite direction from the draw shown, there will be an equal and opposite twist to the tape or ribbon to that shown. On the contrary, with respect to FIG. 7, if one draws either end **75** or end **76** in the direction shown, the roving or tape will not have a twist, but if either end **75** or **76** is drawn in the opposite direction, there will be a double twist to the tape or ribbon.

Referring to the drawings of the apparatus of FIGS. 1–5, inclusive, it will be noted that the entire apparatus is mounted on a suitable frame of metal beam members operative to structurally support the operating members of the apparatus assembly with respect to one another. The details of these frame members will not be described, as they may be varied considerably. Many of such have been cut away in various of the views to give better visual access to components therepast or therebelow, and the like.

Electric motor **10** drives two pulleys, **11** and **12**, on its rotating shaft **13**. Pulley **11**, through belt **14** and pulley **15**, rotates countershaft **16**. The latter, received in bearings **17** and **18**, in turn rotates pulley **19**. Pulley **19**, through belt **20** and pulley **21**, rotates drum generally designated **22**. Drum **22** rotates but does not move axially.

Pulley **12**, the second pulley on shaft **13** of electric motor **10**, through belt **23** and pulley **24**, rotates countershaft **25**. Countershaft **25**, rotatably mounted in suitable bearings **26** and **27** is provided with a flywheel **28**. Flywheel **28** stores inertial energy and serves to smooth out cyclical variations in load.

Countershaft **25** is connected, through flexible coupling **29** to high speed shaft **30** (FIG. 1) of speed reducer **31**. Low speed shaft **32** (FIG. 2) of speed reducer **31** rotates heart-shaped cam **33**. Rotating cam **33**, through cam followers **34** and **35**, moves paired arms **36** back and forth about lower pivot point or pin **37**. Cam followers **34** and **35** are mounted between arms **36** on pins or shafts **35***a* and **34***a* in rotatable fashion, and pivot pin or point **37** is held in a vertical slot in member **38** via downwardly extending arms **39** which allows pivot point or pin **37** to move vertically, but not horizontally.

The upper ends of arms **36** are connected, through pin **40**, link **41** and pin **42**, to clamp **43**. Clamp **43** encircles and is fixedly connected to elongate tube **44**. Tube **44** is supported by linear bearings at **45** and **46** fixedly mounted on the upper portion of the frame. As arms **36** rock back and forth about lower pivot **37**, tube **44** reciprocates axially, but does not rotate.

Idler pulley **47** is mounted on a slotted support and can be adjusted to keep belt **14** tight. Likewise, idler pulley **48** can be adjusted to keep belt **23** tight. All of the pulleys, as well as the drum **22**, rotate in the same direction as shown by the arrows.

Particularly referring to FIG. 5, mandrel **49** is connected, by cap screws **50**, to tube **44**, and consequently reciprocates with it. A collar **51** is attached to the inboard end of mandrel **49** with set screw **52**. Another collar **53** is attached to the outboard end of mandrel **49** by set screws **54**.

Referring particularly to the upper portion of FIG. 5, bearing **55** is bolted to the end platt **22***a* of drum **22**, while bearing **56** is attached, via bracket **57**, to the cylindrical inside portion of drum **22**. Shaft **58** is carried in bearings **55** and **56**. At the outboard end of shaft **58** is keyed arm **59**. Shaft **58** is free to rotate in bearings **55** and **56**, but cannot move axially.

Torsion spring **60** encircles shaft **58**. One end of spring **60** is attached by bracket **61** to the cylindrical inner face of drum **22**. The other end of spring **60** is attached to a collar **62** which is locked on shaft **58** by means of a set screw (not seen). Torsion spring **60** tends to rotate shaft **58** in a counterclockwise direction (as seen in FIG. 4) and urges arm **59** toward mandrel **49**. Handle **63** is keyed to shaft **58** and may be used to manually overcome force of the spring **60**, thereby pulling arm **59** away from mandrel **49**.

Pigtail roving guide **64** (FIG. 4) is bolted to arm **59**. Brackets **66** are bolted to arm **59** and carry shaft **67**. Roller **68** is free to rotate on shaft **67**. Roving **69** is brought through pigtail guide **65** from a creel (not seen). It should be understood that, before the roving **69** passes through the eye **64***a* of pigtail guide **64**, same comprises separate strands being drawn from forming tube packages positioned on the creel. Once same are gathered through the eye of pigtail guide **64**, same are a single roving cable, so to speak, and pass into circular roving guide **65** as such. Roving **69** then passes through, as mentioned, circular guide **65**, under roller **68**, and is wrapped on mandrel **49**.

As previously mentioned, drum **22** rotates. It carries with it arm **59**, roving guides **64** and **65** and roller **68**. Mandrel **49** does not rotate, but reciprocates axially. This combination of motions deposits the roving on the mandrel forming a cylindrical package. The machine is so dimensioned that the roving is deposited between the two collars **51** and **53**. Mandrel **49** is typically three inches in diameter and the finished package approximately 10 inches in diameter. As the packages builds up, the roller **68** is in contact with its periphery. The arm **59** pivots on shaft **58** and accommodates to this changing diameter. When the package has reached the desired diameter, the machine is stopped and the collar **53** at the outboard end of the mandrel is removed. The package is then slid off the mandrel. The mandrel has a polished surface and a slight taper, approximately 0.50 inch in its length of about 10 inches, to facilitate this. As the package is removed, the roller **68** is held away from its surface by means of the handle **63**.

The action of drum **22** in rotation clockwise in FIG. 4, with the strands of the roving coming from the observer's viewpoint in FIG. 4 into eye **64***a* and thence turning at right angles and passing down through guide **65**, operates to put a single 360° twist in each circumferential length of roving wrapped around the rotationally static mandrel. The roving strands are coming from the left in FIG. 5 and thence passing downwardly around the axially reciprocating mandrel **49**. If the twist wrapped roving package is removed from the mandrel and maintained with its axis parallel to the mandrel, without reversal of the ends, and the roving is withdrawn from the end of the nonrotating package, the following conditions will obtain:

(1) When the roving is withdrawn from the inside to the right it will have no twist;

(2) When the roving is withdrawn from the inside to the left it will have a twist;

(3) When the roving is withdrawn from the outside to the right it will have a twist;

(4) When the roving is withdrawn from the outside to the left it will have no twist.

As pointed out above, it is desirable to have no twist in the roving as it is taken from the package and it is more practical to take it from the inside of the package.

Although this machine shows a reciprocating mandrel and a nonreciprocating guide to deposit the roving on the mandrel, it is also possible to have the fiber guide reciprocate and the mandrel not reciprocate. The effect will be the same—to distribute the roving along the length of the mandrel.

From the foregoing, it will be seen that this invention

is one well adapted to attain all of the ends and objects hereinabove set forth together with other advantages which are obvious and which are inherent to the process.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim:

1. A device for winding a strand of roving, having a plurality of fibers, from a feed source into a roving package and for imparting a twist to the strand of roving per each winding of said strand onto said package whereby the strand may be withdrawn from said package without said twist, said device comprising:

a supporting frame,

a nonrotatable mandrel connected to said frame and having a cantilevered outer end on which said roving package is formed,

a guide carrier rotatably mounted on said frame and positioned radially outwardly from said mandrel whereby the axis of rotation thereof coincides with the longitudinal axis of said mandrel,

drive means operable to rotate said carrier,

guide means pivotally mounted on said carrier to receive said strand of roving from a feed source located beyond the outer end of said mandrel and to apply said strand to said mandrel whereby to impart a twist to said strand per each revolution of said carrier around said mandrel regardless of force applied to said guide means by tension in said strand of roving,

said guide means also operable to radially move outwardly from said mandrel and toward said carrier with the increasing diameter of said package as same is formed on said mandrel.

2. The device as in claim **1** including reciprocatory means mounted on said frame and connected with said nonrotatable mandrel to move said mandrel in reciprocal fashion along the longitudinal axis thereof in order to distribute the strand of roving along the length of said mandrel.

3. The device as in claim **1**, said guide means including a roller member circumferentially engaging said roving package to bias said strand of roving to said package as said strand is applied thereto.

4. The device as in claim **1**, wherein said nonrotatable mandrel is tapered inwardly toward the outer end thereof in order to facilitate the removal of a completed roving package from the outer end of said mandrel.

5. The device as in claim **1**, said mandrel including collar means associated with the outer end thereof to assist said guide means in forming a cylindrical roving package, said collar means removable from said mandrel to facilitate the removal of a completed roving package from the outer end of said mandrel.

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STANLEY N. GILREATH, Primary Examiner

U.S. Cl. X.R.

242—159