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Sears et al.

[54] **APPARATUS FOR PACKAGING STRAND**

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[52] **U.S. Cl.** .... **242/43,** 242/18 R, 242/18 G, 335/153, 335/207

[51] **Int. Cl.** **B65h 54/08,** B65h 54/28

[58] **Field of Search** .... 242/43, 18 G, 18 R, 36, 242/37 R; 335/153, 207

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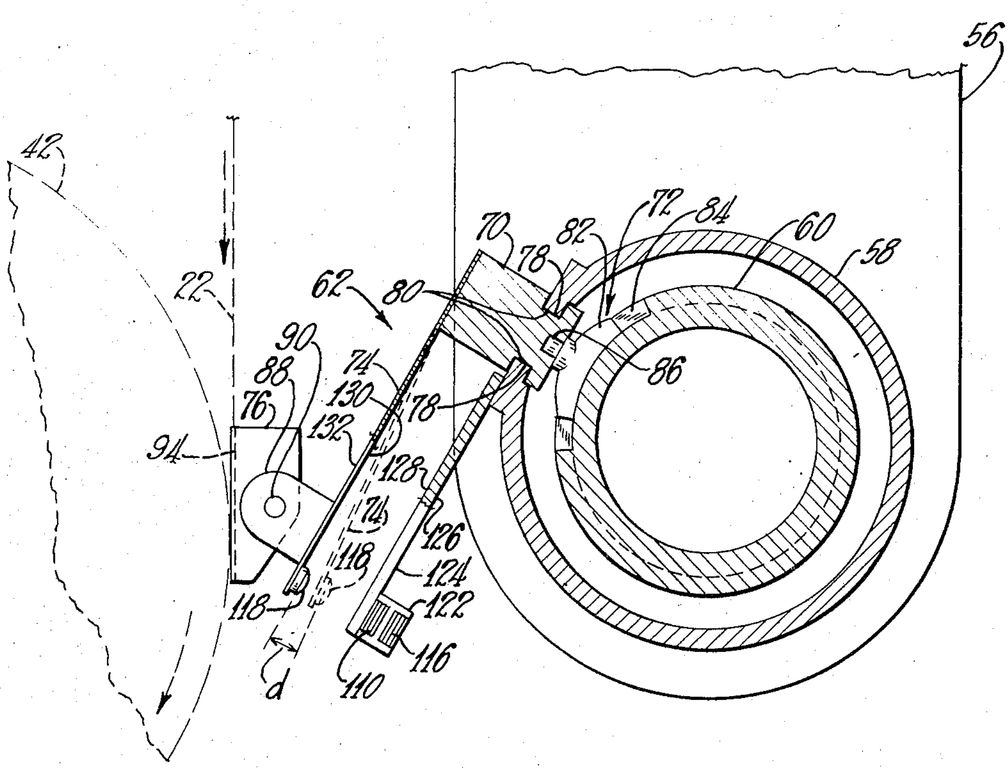
Attorney, Agent, or Firm—Staelin & Overman, Ronald C. Hudgens

[57] **ABSTRACT**

Apparatus for packaging strand as a wound package on a rotary collector including a movably mounted strand guide at the circumferential surface of the package; means for controllably moving the guide to keep it at the circumferential surface of the package during its formation, such means including a switch; means for sensing the size of the package as it increases in diameter and means responsive to the sensed size of the package effective to actuate the switch in selected proximity thereto.

4 Claims, 6 Drawing Figures



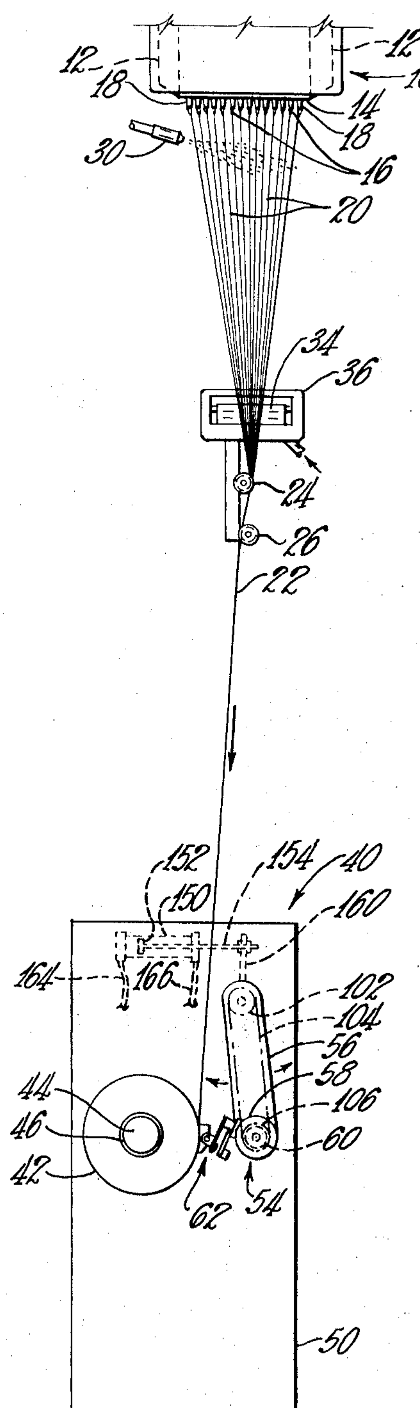

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Fig. 1

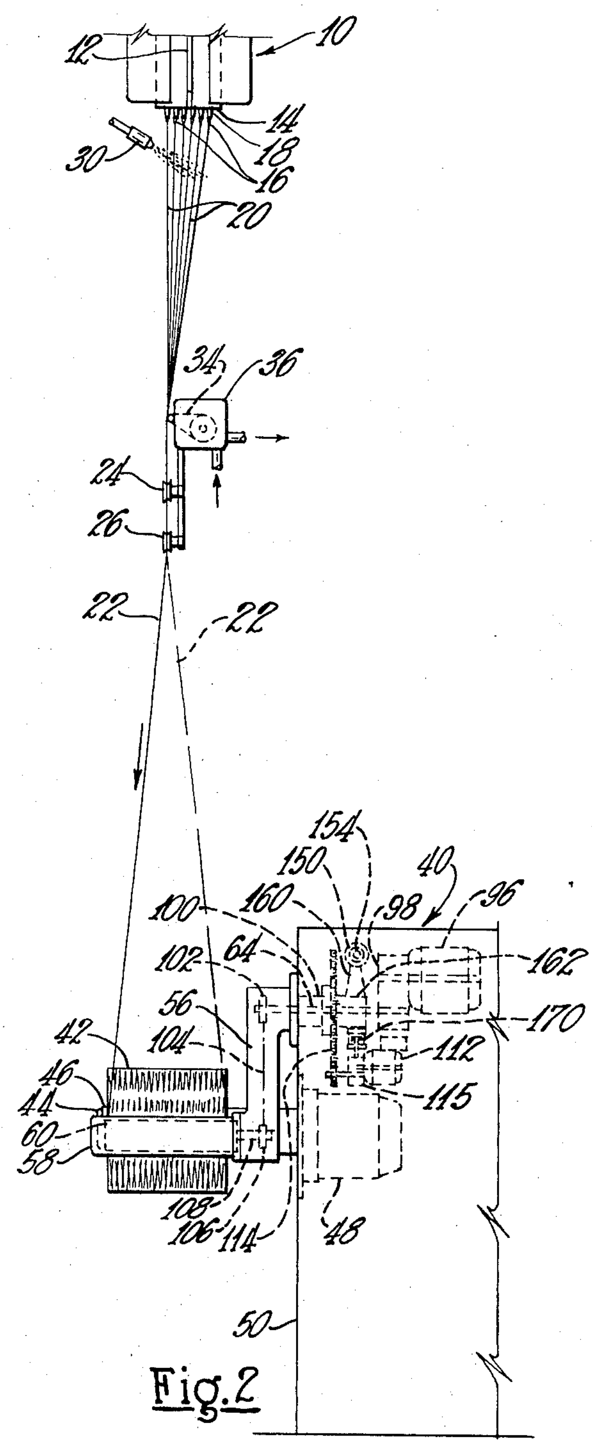
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Fig. 2

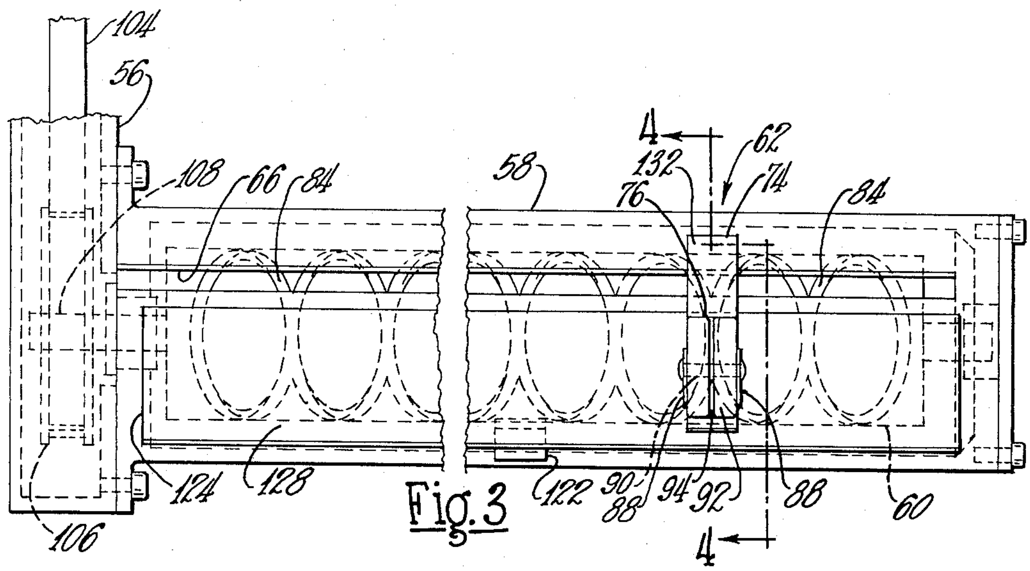
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Fig.3

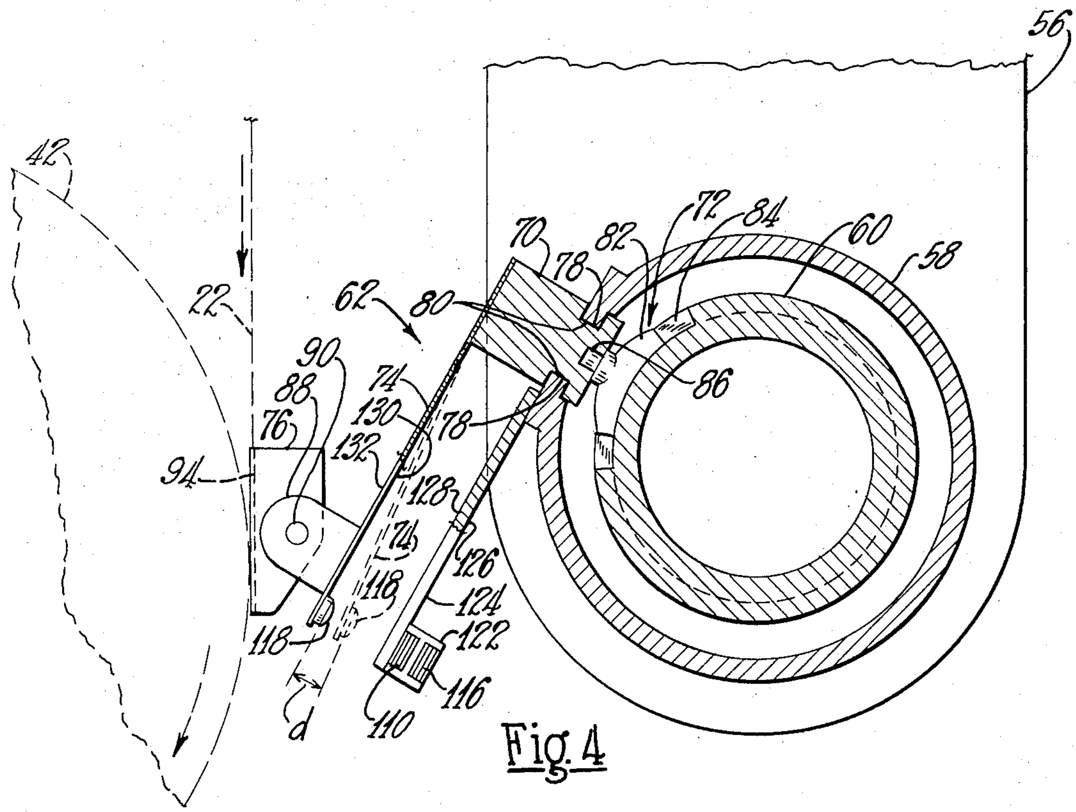
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Fig.4

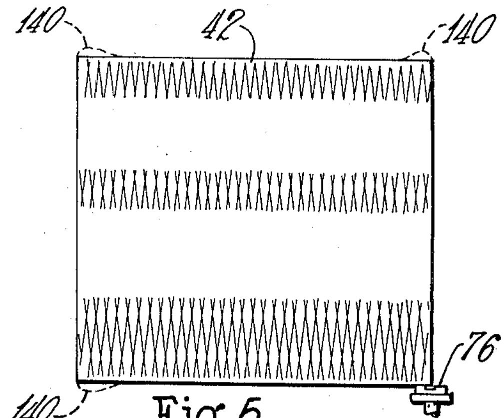

Fig. 5

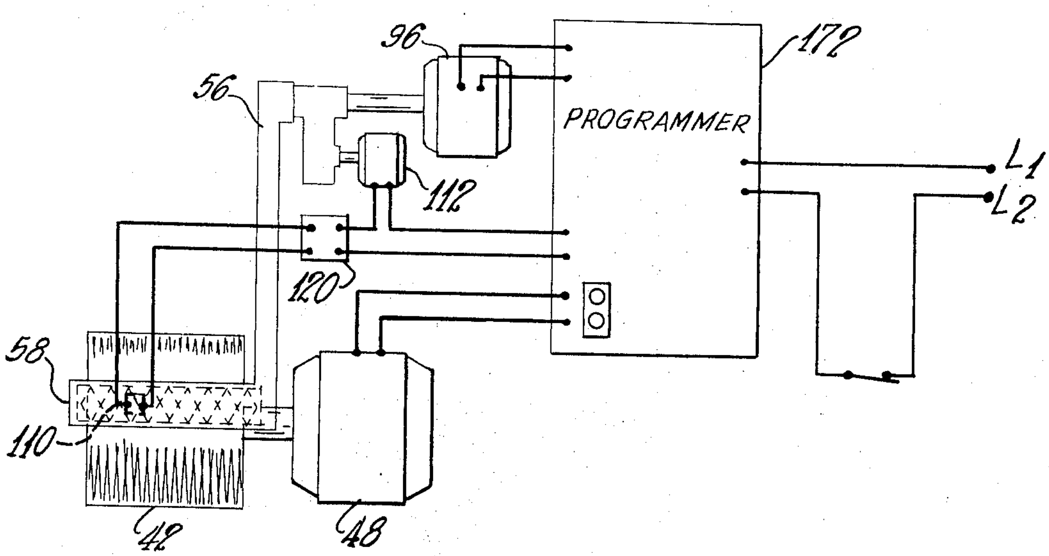

Fig. 6

APPARATUS FOR PACKAGING STRAND

BACKGROUND OF THE INVENTION

It is a practice in the textile industry to collect continuous multifilament linear elements such as yarn, strand and roving into wound packages on a winder. The traversing arrangement of the winder reciprocates a collecting linear element lengthwise of the package by a guide to distribute the element on the package during collection.

Recent developments in textile winders forming cylindrically shaped packages control the position of the traverse guide during package formation to continuously keep the guide at the circumferential surface of the package. But these winders tend to build packages having wound layers of nonuniform densities. And also these winders have mechanical traverse guide positioning arrangements that effect nonuniformities in packages wound by them. The irregularties are aggravated in wet environments such as found in glass filament forming operations.

SUMMARY OF THE INVENTION

An object of the invention is improved apparatus for packaging linear elements.

Another object of the invention is improved apparatus for guiding strand onto a collecting package where the location of a strand traverse guide close to the package is controlled during package formation to continuously maintain the guide at the circumferential surface of the package.

These and other objects are attained by apparatus for packaging strand on a collector including a movable strand guide at the circumferential surface of the package and means for controllably moving the guide to keep the guide at the region of strand entry onto the package during package formation, such means including a switch. The apparatus further includes means for sensing the size of the enlarging package and means responsive to the sensed size of the package effective to actuate the switch when in selected proximity thereto.

These and other objects will become apparent as the invention is hereinafter described in more detail with reference made to the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevation view of apparatus according to the principles of the invention collecting glass strand as a wound package in a glass filament forming operation.

FIG. 2 is a side elevation view of the apparatus illustrated in FIG. 1.

FIG. 3 is an enlarged front elevation view of the package size sensor and strand guide carried by guide reciprocating means shown in FIG. 1.

FIG. 4 is a sectional view taken along the lines 4—4 in FIG. 3.

FIG. 5 is an elevation view of a package formed on the apparatus shown in FIGS. 1 and 2.

FIG. 6 is a schematic illustration of components of the apparatus for packaging strand shown in FIGS. 1 and 2 and controls therefore.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The method and apparatus of the invention are particularly useful in processes for forming filaments of heat-softened mineral material such as glass where apparatus combines individual glass filaments in the process to form a glass strand that is wound into a package. But the method and apparatus is useful in other processes that package other types of filament bundles, such as yarn, cord, roving, etc., made from glass or other filament forming materials such as nylon and polyesters. Hence, disclosure of packaging glass strand in a glass filament forming operation is only an example to explain the operation of the invention. Therefore, the term strand as used in the specification and claims includes any bundle of filaments, including continuous or discontinuous synthetic filament bundles with or without twist, in-addition-to bundles of natural filaments.

FIGS. 1 and 2 show a process of forming continuous glass filaments from heat-softened glass. Apparatus combines the glass filaments into a bundle or strand and collects the strand as a wound package. As illustrated, a container **10** holds a supply of molten glass. The container **10** may connect to a forehearth that supplies molten glass from a furnace or may connect to another means for supplying glass, such as marbles that are reduced to a heat-softened condition in a melter associated with the container **10.** Terminals **12** are at the end of the container **10.** The terminals **12** connect to a source of electrical energy to supply heat by conventional resistance heating to glass held in the container **10** to maintain the molten glass at proper fiber forming temperatures and viscosities.

The container **10** has a bottom wall **14** including orifices or passageways for delivering streams **16** of molten glass from the container **10.** As shown in FIGS. **1** and **2** the openings in the bottom **14** comprise rows of spaced apart depending orificed projections or tubular members **18.**

The molten streams **16** are attenuated into individual continuous glass filaments **20** and are combined into a filament bundle or strand **22** by a gathering shoe **24** located below the container **10.** The strand **22** turns on a shoe **26.**

Normally apparatus supplies both water and a liquid sizing or other protective coating material to the filaments **20.** As shown, a nozzle **30** adjacent to the bottom wall **14** of the feeder **10** directs water spray onto the continuous glass filaments **20** before the shoe **24** combines them into the glass strand **22.**

A sizing applicator **34** movably held within a housing **36** just above the gathering shoe **24** applies a liquid sizing or other coating material to the swiftly traveling continuous glass filaments **20.** The applicator **36** may be any suitable type of applicator known to the art; however, the applicator **34** is shown as an endless belt moved through liquid held in the housing **36.** As the continuous glass filaments **20** speed in touching relationship across the surface of the moving endless belt applicator **34,** some of the liquid on the surface transfers to them.

A winder **40** collects the strand **22** as a wound package **42** on a driven rotable collet or mandrel **44.** The package **42** forms on a collector such as a tube **46** telescoped onto the collet **44.**

Advancement of the strand 22 downwardly to the package during collet rotation attenuates the glass streams 16 into the continuous glass filaments 20.

An electric motor 48 within the housing 50 of the winder 40 rotates the collet 44. Controls explained hereinafter vary the speed of the motor 48 to reduce the rotational speed of the collet 44 as the size of the package 42 increases during package build. The controls effect a substantially constant linear strand collection speed that attenuates glass filaments of uniform size during formation of the package 42.

Traversing apparatus 54 moves the advancing strand 22 back and forth axially of the collet 44 (package 42) to distribute the strand 22 on the package 42. In the embodiment shown the traversing apparatus 54 includes a hollow support or arm 56 with a tubular housing 58, traverse actuating means in the form of barrel cam 60 and a strand guide assembly 62.

The arm 56 is mounted for movement about the axis of a shaft 64 in the housing 50. The tubular housing 58 has its longitudinal axis parallel to the axis of rotation of the collet 44.

The barrel cam 60 is rotably held within the housing 50 with its axis of rotation parallel to the axis of rotation of the collet 44.

The tubular housing 58 slidably carries the strand guide assembly 62. As one can more clearly see in FIGS. 3 and 4, the housing 58 includes a slot 66 along which moves the strand guide assembly 62. The slot 66 opens substantially the entire length of the housing 58 along the wall portion of the housing facing towards the collet 44.

The traverse assembly 62 includes a slide block 70, cam follower 72, spring 74 and strand guide 76. The support 56 locates the assembly with the strand guide 76 lightly touching against the circumferential surface of the package 42. The guide 76 is reciprocated at a comparatively slow speed together with comparatively slow speed filament attenuation. The slower speeds substantially eliminate abrasion and other impairment of the strand 22 by the guide 76.

The slide block 70 includes a groove 78 accommodating the lengthwise edge portions 80 of the slot 66. The portions 80 are guide ways that fit into the grooves 78 in slide fit relationship.

The cam follower 72 connects the slide block 70 and the barrel cam 60. The follower 72 includes an arcuate portion 82 that fits into cam grooves 84 in the circumferential surface of the barrel cam 60 and a tenon 86 that pivotally fits into the slide block 70. The pivotal connection of the follower 72 with the slide blocks 70 allows swivel or pivotal movement of the follower 72 at the turn around or reversal regions of the cam grooves 84 at the ends of the cam 60.

The slide block 70 supports the spring 74, which is disposed downwardly from the block 70. Mountings 88 are at the other end of the spring 74; the mountings 88 carry a mounting pin 90 that movably holds the strand guide 76 on the spring 74.

The strand guide 76 has a smooth flat guide surface 92 with a recess or slot 94 that accommodates the speeding strand 22. In operation, the strand guide 76 reciprocates axially of the package 42 with its guide surface 92 lightly pressed (by the spring 74) against the circumferential surface of the package 42.

Rotation of the barrel cam 60 reciprocates the strand guide assembly 62 (strand guide 76) along the slot 66. The reciprocating speed of strand guide 76 is directly proportional to the angular speed of the barrel cam 60.

Referring to FIG. 2, a motor 96 and drive within the winder 40 rotates the cam 60 and hence, reciprocates the strand guide 76. The motor 96, through a suitable transmission 98, rotates the horizontally disposed shaft 64. The shaft 64 extends through a hollow portion 100, which is a portion of the arm 56 extending into the winder 40. The portion 100 is mounted in bearings (not shown) within the winder 40. On one end of the shaft 64 is a sprocket 102 within the upper portion of the hollow arm 56. The sprocket 102 connects by a belt 104 to a sprocket 106 on a shaft portion 108 of the barrel cam 60 within the lower portion of the arm 56. Hence, the motor 96 rotates the barrel cam 60 independently of the position of the arm 56.

In the embodiment shown the strand traversing assembly 54 on the tubular housing 58 senses the size of the enlarging package 42 during package formation. Hence, as the diameter of the package 42 increases, the circumferential surface of the package 42 moves the guide 76 away from the collet 44 against the resilient urging of the spring 74.

It is possible to use other means for sensing the size of the package 42 during package build. For example, one might use pneumatic means for sensing the size of the package 42 during package formation. Here a device might measure back pressure of an air stream impinging the growing circumferential surface of the package 42 as an indication of package size.

Traverse guide positioning apparatus controllably moves the support 56 during package formation to keep the strand guide 76 at the circumferential surface of the package 42 throughout package formation. Hence, the traverse guide positioning apparatus is responsive to the increasing size of the package 42 during package formation. The apparatus moves or positions the arm 56 to accommodate for the enlarging size of the package 42 while maintaining the strand guide 76 at substantially the same relative position adjacent the circumferential surface of the package 42 throughout package formation.

FIGS. 3 and 4 more clearly show the traverse guide positioning apparatus to include a normally open reed switch 110, a motor 112, a transmission mechanism 114 and a speed reducing mechanism 115. The switch 110 is in a circuit supplying electrical energy to the motor 112; the motor 112 (through the speed reducing mechanism 115) drives the transmission mechanism 114, which moves the support 56.

The traverse guide positioning apparatus includes means responsive to the sensed size of the package 42 effective to actuate the switch 110 in selected proximity to the switch 110. And in the apparatus shown in FIGS. 1 and 2 such switch actuating means is a magnetic means in the form of spaced apart natural magnets 116 and 118 disposed with opposing ends having the same polarity. Magnet 116 is fixed and magnet 118 moves with the guide 76 (spring 74).

The motor 112 is of a slow speed synchronous type rotating at about 70 RPM when electrically energized. The power transmission mechanism 114 and speed reducing mechanism 115 may be a planetary type, but may be any suitable transmission mechanism that effects high ratio reduction between the motor 112 and the power transmission mechanism.

A timer or time delay relay **120** (shown in FIG. **6**) regulates the time the motor **112** is electrically energized upon actuation or closing the contacts of the reed switch **110** by the magnets **116** and **118**. The relay **120** permits the motor **112** to move the guide **76** (arm **56**) a slight distance away from the package in increments. An increment of movement takes place each time the magnets **116** and **118** actuate the switch **110** during package formation.

As shown, the switch **110** and magnet **116** are held in fixed location in a plastic housing **122** carried by a stationary longitudinal support member **124** carried by the tubular housing **58**. The member **124** is made of a nonmagnetic material such as a resin-textile laminate commercially known as Micarta. The resin component of Micarta is phenolic resin, which bonds layers of fibrous material together. The fibrous components can be fine linen, coarse cotton duck, glass fabric, which can be chopped glass strand or woven cloth.

The tubular housing **58** carries the support **124** with its longitudinal dimension disposed horizontally. The major surfaces **126** and **128** of the member **124** are in a plane extending in a direction parallel to the major surfaces **130** and **132** of the spring **74**. The housing **122** is secured on the major surface **126**, which is facing away from the spring **74** and strand traverse guide **76**. Hence, the reed switch **110** and magnet **118** are stationary. The housing **122** is shown in a preferred location at the mid-length of the member **124**, which is also the mid-length of the reciprocating stroke for the strand guide **76**.

The magnet **118** is on the spring **74** (major surface **130**). Hence, during operation the magnet **118** reciprocates with the spring **74**.

One can more clearly see the movement of the spring **74** and magnet **118** by the dashed lines shown in FIG. **4**. As the diameter of the package **42** increases, the circumferential surface of the package pushes the strand guide **76** (and hence the spring **74**) towards the reed switch **110**. The contacts of the switch **110** feel the influence of the magnets **116** and **118** as the magnet **118** approaches the switch **110**. In selected proximity magnetic power from the magnets **116** and **118** snap close the normally opened contacts of the switch **110**. Hence, the influence of the magnetic force from the magnets **116** and **118** effect closure of the contacts of the switch **110** without physical contact. Therefore, the pressure exerted in the circumferential surface of the package **42** by the spring **74** (through the guide **76**) is substantially constant throughout package build. A wound package of substantially uniform density results.

One can control the amount of displacement of the guide **76** needed to actuate the switch **110**. Such displacement is indicated by the space denoted *d* in FIG. **4**. The location of the magnets **116** and **118** can be changed to actuate the reed switch **110** from different proximity locations. Also, one can use magnets of different magnetic strengths to control the switch **110**.

Further, it is possible to use other types of switches and switch actuating means. For example, one might use a light sensitive switching arrangement capable of being actuated by selected light intensity together with a light source responsive to the sensed size of a winding package for actuating the light sensitive switching arrangement. Then too, one might use a high frequency energy beam or pneumatic arrangement to actuate a switch in close proximity thereto in response to enlargement of a winding package. Also, it is possible to use other types of magnetic members, e.g. electromagnetic devices, to actuate a switch like the reed switch **110**.

It has been found that winding a package of single strand without radial pressure at the end regions of the package forms a package having larger diameter end regions, such as the end regions **140** indicated by the dashed lines on the package **42** in FIG. **5**. The strand portions at the end regions **140** tend to slough off the package **42** and hence are undesirable.

Radial pressure exerted against the package **42** at its end regions by the spring mounted strand guide **76** compacts the end regions **140** to form a cylindrically shaped package **42**. The package **42** is more plainly seen in FIG. **5**. With its compacted end regions, the cylindrical package **42** is a self-supporting package.

The winder **40** includes means for pivoting the arm **56** (strand guide **76**) away from the completed package **42** to assist removal of the package **42** from the collet **44** and for pivoting the arm **56** to move the traverse guide **76** close to an empty collector **46** on the collet **44** at the beginning of package formation.

Referring to FIGS. **1** and **2**, pneumatic means for moving the support **56** is shown that includes a cylinder **150**, a piston **152**, and a piston rod **54**. The piston rod connects with a member **160** secured to an extending portion **162** of the support arm **56**. Supply tubes **164** and **166** convey fluid, such as compressed air, from a source to the cylinder **150**. Fluid under pressure supplied to the cylinder **150** through the supply tubes **164** and **166** actuates the piston **152** and piston rod **154** to effect movement of the support **56** either towards or away from the collet **44**.

The winder **40** also provides means for releasing the planetary ring of the speed reducing mechanism **115**. In the embodiment illustrated, a cylinder and piston rod assembly **170** actuate a clutch means (not shown) for engagement and disengagement with the planetary speed reducing mechanism between the motor **112** and the support **56** to enable the fluid under pressure introduced into the cylinder **150** to move the support **56** independently of the drive motor **112** and speed reducing mechanism **115**.

FIG. **5** schematically shows the circuits and programmer for the winder **40**. A programmer **172** controls the speed of the collet drive motor **48**, the speed of the traverse drive motor **96** and electrical energy to the traverse arm actuating motor **112**. The programmer **172** may be of a character disclosed and described in U.S. Pat. No. 3,109,602. The programmer **172** gradually reduces the speed of the motor **48** as the package **42** increases in diameter; the programmer **172** gradually reduces the speed of the motor **96** to maintain the uniform pattern of strand orientation onto the package **42**. The rate of progressive decrease in angular speed of the motor **48** is programmed to maintain a substantially constant linear strand speed. The linear strand speed attenuates continuous glass filaments of uniform diameter. The traverse motor **96** proportionately reduces in speed to facilitate formation of a cylindrically-shaped package **42**.

We claim:

1. Apparatus for packaging strand comprising:

a rotatable collector upon which strand is collected as a wound package;

means for rotating the collector;

a movably mounted support means movable toward and away from the circumferential surface of the package;

a strand guide for engaging strand along its path to the package;

means mounting said strand guide on said support means for resilient contact of the strand guide with the circumferential surface of the package at the region of strand entry thereon during formation of the package;

means on said support means for reciprocating the strand guide mounting means axially of the collector;

said mounting means including an elongated spring mounted at one end with said means for reciprocating the mounting means, the strand guide being mounted at the free end of the spring, the elongated spring being disposed so that it is bent along its lengthwise dimension during movement of the guide away from the axis of the collector by the circumferential surface during package formation;

means for controllably moving the movable support means away from the axis of the collector during package formation, such means including an electric motor and a switch in the circuit supplying electric energy to the motor, the switch being fixed at a location on the support means adjacent the path of reciprocation of the strand guide; and

means to actuate the switch when in selected spaced apart relationship thereto including a magnetic member mounted on the elongated spring at its free end for movement with the strand guide and a stationary magnetic member on said support means each at opposite sides of the switch, movement of the movable magnetic member during reciprocation of the strand guide intermittently bringing the movable magnetic member into sufficiently close relationship with the stationary magnetic member to actuate the switch to energize the motor for positioning the movable support means, the intermittent energizing of the motor moving the support means successively through small increment distances to maintain the strand guide in substantially the same relative position at the circumferential surface of the package throughout package formation.

2. Apparatus of claim 1 in which the magnetic members are permanent magnets.

3. The apparatus of claim 1 in which the switch is located adjacent the path of reciprocation of the strand guide at a position substantially at the mid-length of the reciprocation stroke length.

4. The apparatus of claim 1 in which the elongated spring is a thin uncoiled member.

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