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Smith

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[54] **APPARATUS FOR PACKAGING LINEAR MATERIAL**

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[51] **Int. Cl.** **B65h 54/02**

[58] **Field of Search** ..242/18 R, 18 G, 18 DD, 18 CS, 242/43, 45

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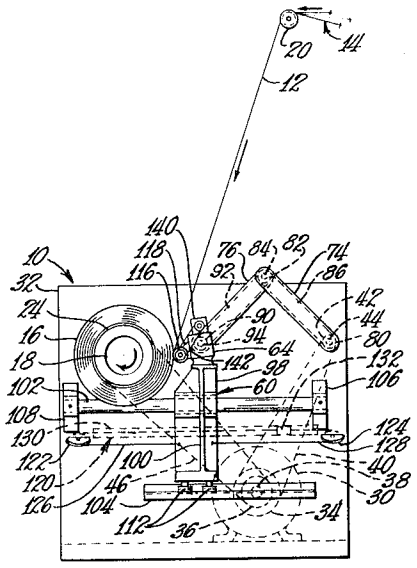
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[57] **ABSTRACT**

Apparatus for collecting linear material such as glass strand into a wound package on a rotating mandrel that uses a member exerting a constant pressure radially inwardly against the moving axial surface of the package during package build-up and that includes means responsive to the speed of the axial surface to control the rotating speed of the package.

3 Claims, 5 Drawing Figures



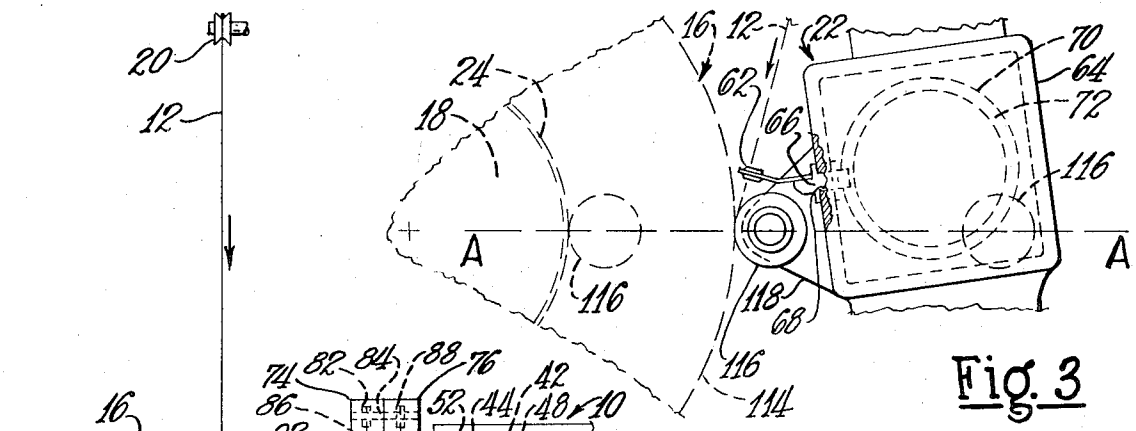


Fig. 3

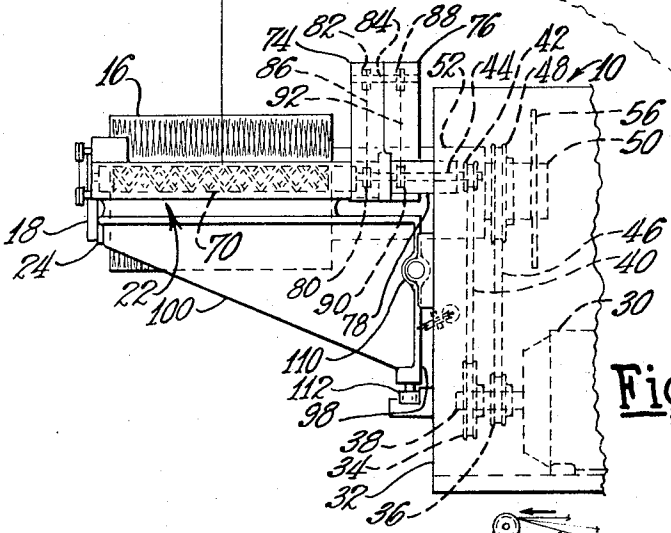


Fig. 2

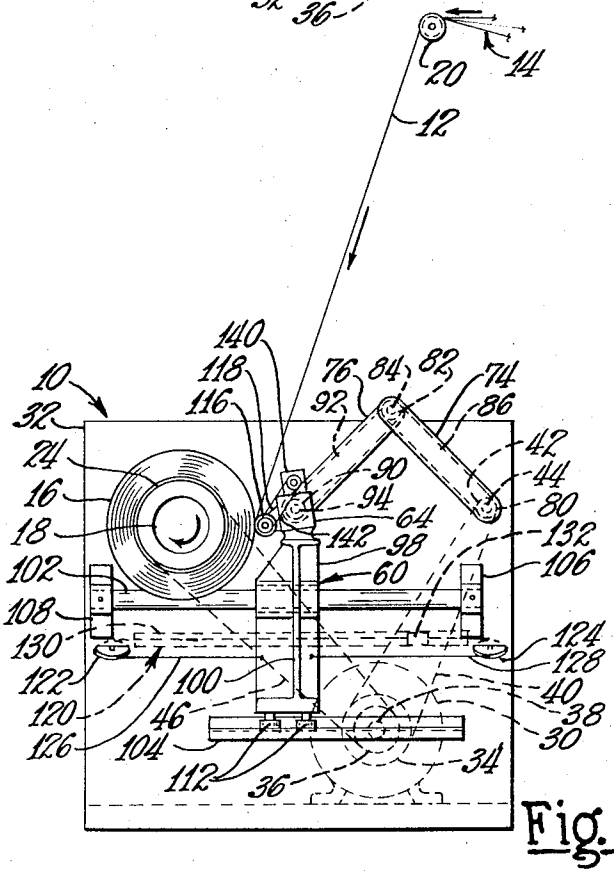


Fig. 1

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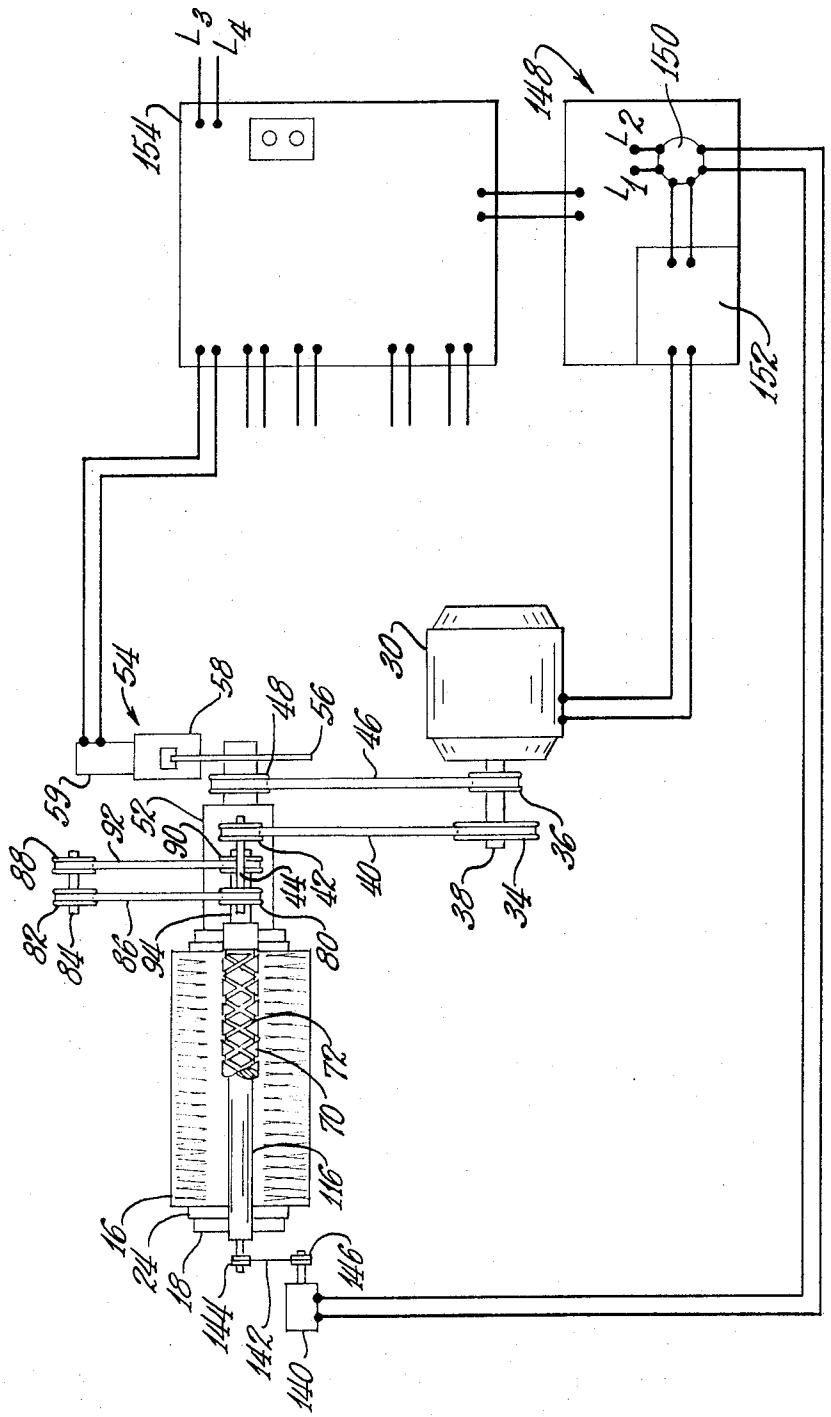


Fig. 4

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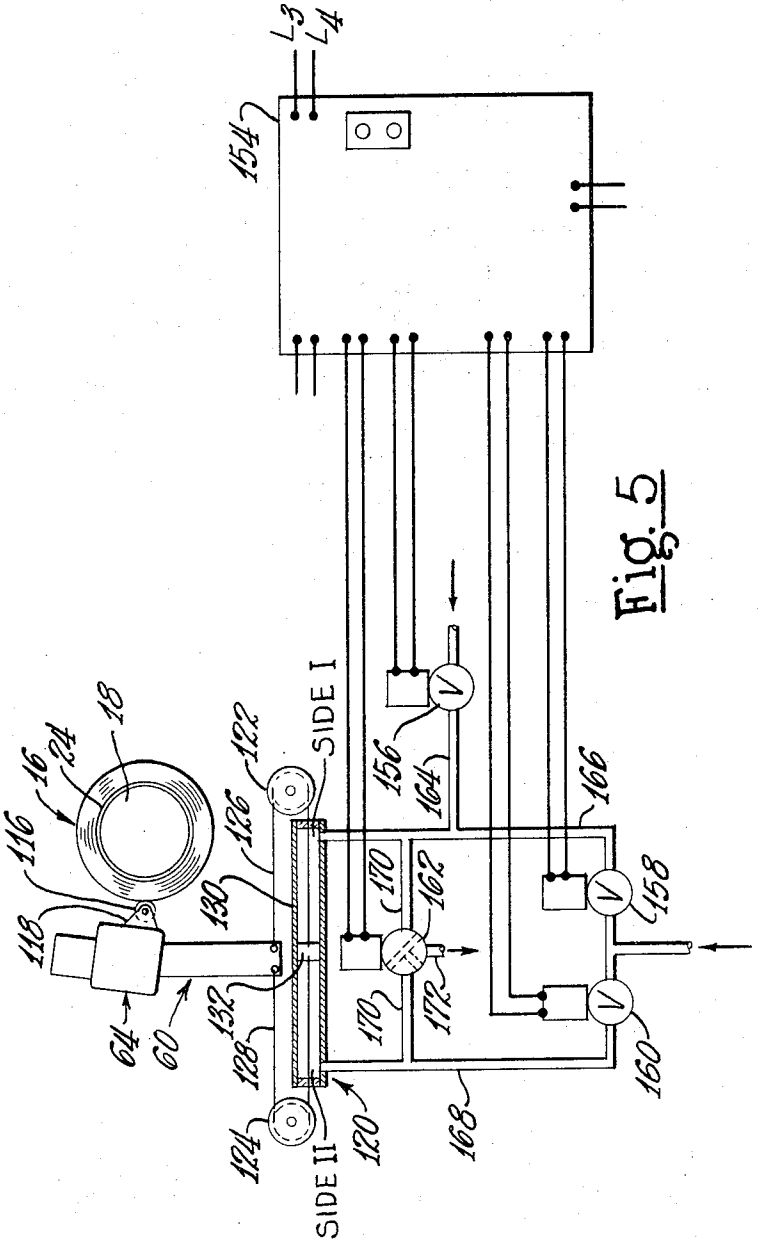


Fig. 5

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APPARATUS FOR PACKAGING LINEAR MATERIAL

BACKGROUND OF THE INVENTION

It continues to be a goal to increase the amount of textile material collected into a wound package. The goal is especially pursued in the glass fiber industry, both for wound packages in fiber forming operations and wound packages collected in subsequent processing operations. Unfortunately difficulties have continued to frustrate increases in the amount of textile material such as glass strand winding apparatus can collect into a wound package.

It has been a practice to wind textile material such as glass strands into packages having tapered end regions. While tapered end regions prevent textile material from sloughing off the ends of a package, the shape of the package limits the amount of material that can be wound on the package.

A cylindrically shaped package holds more material.

While recently developed winder apparatus using a roller bail builds a cylindrically shaped wound package of textile material, the apparatus has limitations. Although the roller bail presses against the surface of a winding package throughout its formation to lay the winding material onto the surface of the package, the support holding the roller bail moves the roller bail away from the increasing package along a non-radial path. The result is a changing radial component of pressure against the axial surface of the winding package even when the roller bail is urged against a package with uniform pressure. The changing radial component of pressure causes variations or nonuniformities in the degree of tightness that the winder apparatus lays the layers or convolutions of linear textile material wound onto the collecting package. Normally packages wound using prior methods tend to be generally softer in the outer layers. This package softness in the outer layers limits the package size the prior winder apparatus can collect.

Also, while prior winder apparatus reduces the speed of a collecting mandrel to minimize speed variations in linear material advancing to the mandrel, the changes in mandrel speed are programed and do not reflect actual surface speed of the winding package. The result is nonuniformity between wound packages, even wound packages collected on the same winder apparatus. In commercial operations such nonuniformity is undesirable and can be calamitous.

SUMMARY OF THE INVENTION

An object of the invention is improved apparatus for collecting linear textile material into a wound package.

Another object of the invention is apparatus for collecting linear textile material such as glass strand into a wound package having layers of substantially uniform tightness throughout all portions of the package.

Yet another object of the invention is an improved winder that can collect larger packages of cylindrical shape.

Still another object of the invention is a winder that winds a package having substantially uniform wound layers or convolutions using a component exerting a constant pressure redially inwardly against the axial surface of the winding package.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevation view of apparatus for packaging linear material according to the principles of the invention.

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

FIG. 3 is an enlarged front elevation view of the traversing arrangement and pressure member of the apparatus shown in FIGS. 1 and 2. VArious axial surface positions of a winding package are indicated by dashed lines. The small dashed line circles along the dashed line A—A indicate various locations of a pressure member against the axial surface of the collection package as the diameter of the package increases. The dashed line A—A indicates the path along which the pressure member travels as the winding package increases in size.

FIG. 4 is a schematic illustration of components of the winder apparatus shown in FIGS. 1 and 2. The figure shows a control arrangement for reducing the speed of a variable speed device that both drives the collecting spindle and drives the traversing arrangement of the apparatus.

FIG. 5 is a schematic illustration of a fluid supply and control arrangement regulating the biasing force urging the pressure member against the axial surface of a collecting package.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

While the apparatus of the invention is particularly valuable in collecting glass strands or groups of glass strands into a wound package, the apparatus is useful in packaging bundles of linear textile material generally. Accordingly, disclosure of the invention operating to collect a bundle of glass strand is only an example to explain the operation of the invention.

FIGS. 1 and 2 show a winder 10 that is collecting a bundle 12 of glass strands 14 into a cylindrical wound package 16 on a rotating collet or spindle 18. A gathering show 20 above the winder 10 combines the individual stands 14, which are supplied from a source such as a creel, into the bundle 12. As the bundle 12 speeds downwardly from the gathering show 20, a traversing arrangement 22 of the winder 10 reciprocates the advancing bundle 12 in a direction axially of the collecting package 16 to distribute the bundle lengthwise of the package. In FIGS. 1 and 2, the package 16 winds onto a suitable collector such as a tube or sleeve 24 that is telescoped over the spindle 18. It is possible to form a package on the spindle without a collector, e.g., sleeve 24.

The winder 10 packages linear material such as the bundle 12 of glass strands 14 supplied from a variety of sources. While it is usual to advance individual strands from packages held in a creel and combine them into a strand bundle, it is possible to use the winder 10 in a fiber forming operations, e.g. glass

A variable speed rotary electrical device such as a variable speed electrical motor 30 within the frame or housing 32 of the winder 10 both drives the traversing arrangement 22 and rotates the spindle 18. As shown, sheaves 34 and 36 are fixed on the output shaft 38 of the variable speed electrical motor 30. Accordingly,

the sheaves 34 and 36 rotate with the shaft 38. A belt 40 connects the sheave 34 with a sheave 42 on a shaft 44 that is located above the motor output shaft 38. The shaft 44 forms part of the drive system for the traversing arrangement 22. A belt 46 connects the sheave 36 with a sheave 48 on a drive shaft 50 that rotates the spindle 18. A gear box 52 rotatably holds the drive shaft 50 and spindle 18.

The rpm of the output shaft 38 of the variable speed electrical motor 30 determines the rotational speed of the spindle 18 and the speed of the traversing arrangement 22. The various sheaves lock the speed of the spindle 18 and the traversing arrangement 22 together in a predetermined fixed rotation. An operator can change the fixed ratio by changing sheave sizes.

The winder 10 uses a brake to stop rotation of the spindle 18 and movement of the traversing arrangement 22. FIGS. 2 and 4 show a disc brake 54 including a disc 56 on the drive shaft 50 and a clamp 58. In the embodiment shown solenoid control means 59 moves the clamp 58 into and out of engagement with the disc 56.

The traversing arrangement 22 is held by a support 60 that is movably mounted on the winder 10. As shown, the traversing arrangement 22 includes a traverse guide 62 slidably held adjacent to the axial or lengthwise surface of a winding package 16 and means for reciprocating the traverse guide 62 in a direction axial of the spindle 18.

As more clearly seen in FIG. 3, a cam housing 64 slidably holds a cam follower 66 in a slot 68 for movement back and forth along a straight line path lengthwise of both the spindle 18 and the package 16. The cam follower 66 carries the traverse guide 62.

A rotatably mounted cylindrical cam 70 within the cam housing 64 reciprocates the traverse guide 62. The cam follower 66 engages groover 72 in the lengthwise surface of the cam 70. As the cylindrical cam 70 rotates it moves the cam follower 66 and the traverse guide 62 back and forth along the slot 68 in a direction parallel to the axis of rotation of the spindle 18.

The driven shaft 44 rotates the cylindrical cam 70 through a drive system within connectors 74 and 76 that are on the winder housing 32. The connectors are in a toggle arrangement that movably joins together one end of each end of the connectors. The other end of the connector 74 pivotally mounts about a tube 78 through which the driven shaft 44 extends; the other end of the connector 76 pivotally joins with the cam housing 64. A sheave 80 within the lower portion of the connector 74 and fixed on the shaft 44 rotates a sheave 82 on a shaft 84 through a belt 86. As the shaft 84 rotates, the shaft rotates a sheave 88 carried by it within the connector 76. The rotating sheave 88 rotates a sheave 90 through a belt 92. The sheave 90 is on a shaft 94 that connects to drive the cylindrical cam 70.

The support 60 moves horizontally along a straight line path on the frame or housing 32 and includes a base section 98 and an extending portion 100. Two parallel guides, a rod 102 and a channel member 104 carry the support 60 on the housing 32. The rod 102 is above the member 104 but below the spindle 18 and is joined at its ends to the housing 32 by mountings 106 and 108 that hold the rod 102 adjacent to the housing 32. The rod 102 extends through a tubular portion 110 of the base portion 98 for slidable movement; guide feet 112 of the base portion 98 slidably engage the channel of the member 104. Accordingly the support 60 can slidably move horizontally along the rod guide 102 and channel member 104.

The extending portion 100 projects in a direction parallel to the spindle 18; the extending portion 100 carries the cam housing 64.

A longitudinal pressure member or component is against the lengthwise or axial surface 114 of the winding package 16 throughout the package build. The axial surface 114 extends in a direction parallel to the axis of rotation of the spindle 18. As shown, the longitudinal member is a cylindrical member 116 rotatably held by a bracket 118. The cylindrical member 116 extends in a direction parallel to the axis of rotation of the spindle 18. Because the cylindrical member 116 is against the moving axial surface 114 of the winding package 16, the axial surface 114 drives the cylindrical member 116 in rotation with a lengthwise surface speed equal to the axial surface speed of the package 16.

The support 60 holds the cylindrical member for radial movement with respect to the axial of rotation of the spindle 18 (collector 24). Such movement is more clearly seen in FIG. 3 where the dashed line A—A indicates a horizontal straight path along which the support 50 carries the cylindrical member 114 as the axial surface 114 of the package 16 pushes the cylindrical member 114 radially outwardly of the axis of rotation of the spindle 18.

The winder 10 includes biasing means for urging the cylindrical member 116 against the moving axial surface 114 of the package 16 with a uniform pressure throughout formation of the package 16. In the embodiment shown with biasing means including a fluid biasing means such as an air motor 120 within the housing 32, rotatably mounted disc guides 122 and 124 and cords or cables 126 and 128. The fluid biasing means can be purchased commercially from Tol-O-Matic, Inc. under the designation "Cable Cylinder." The air motor 120 includes a cylindrical vessel 130 and with in the vessel 130 that divides the interior of the vessel 130 into two sides, i.e., a side I and side II as seen in FIG. 5 a piston 132. Each cord secures to the piston 132 at one of its ends. The cords extend lengthwise within the vessel 130 to leave the vessel 130 at opposite ends. The cords extend axially outwardly of the vessel 130 and then turn on the rotatably mounted disc guides 122 and 124 to leave the interior of the housing 32 and to extend outside the housing 32 along a path proceeding in a direction axially inwardly of the vessel 130. The other end of each of the cords secures to the lower region of the support 60.

When the air under uniform pressure from an appropriate source enters the cylindrical vessel 130 to fill side I, the air urges the piston 132 to move to the left as seen in FIG. 5. The moving piston 132 exerts a force on the cord 126 that pulls the support 60 towards the spindle 18. The air motor includes an air release arrangement exiting air at a rate providing constant pressure resisting movement of the piston 32. Consequently the pneumatic biasing means urges the cylindrical member 116 into continuous uniform contact with the moving axial surface 114 of the winding package 16. Because the axial surface 114 of the building package 16 pushes

the cylindrical member 116 radially outwardly along the path A—A, the member 116 exerts a constant pressure radially inwardly against the axial surface 114 as successive layers of material are wound into the package.

The rotating cylindrical member 116 drives a generator 140 located on the upper surface of the cam housing 24. As shown, a belt 142 runs between a sheave 144 on the cylindrical member 116 and a sheave 146 on the shaft of the generator 140. As the speeding axial surface 114 of the winding package 16 drives the cylindrical member 116, the member 116 rotates the shaft of the generator 140 through the belt 142. As the diameter of the winding package 16 increases, the speed of the axial surface 114 increases. Because the lengthwise surface of the member 116 moves at the same speed as the engaging surface 114, increases in the speed of the surface 114 brings corresponding increases to the member 116 that increases the output voltage of the generator 140. The generator 140 connects with an electrical control 148 that regulates electrical power to the variable speed electrical motor 30.

As the package 16 winds on the spindle 18, an electrical control arrangement, including control 148, reduces the rotational speed of spindle 18 to keep the axial surface 114 of the package 16 at a given speed. A uniform axial surface speed maintains the linear speed of the advancing bundle 12 essentially constant. Because the speed of the traversing arrangement 22 reduces proportionately with the rotational speed of the spindle 18, the winder 10 maintains a uniform disposition to the bundle 12 throughout the various layers of the package 16.

The winder is responsive to the lengthwise surface 114 of the package 16 by sensing the actual speed of the surface 114 to regulate the rotational speed of the variable speed electrical motor 30 and consequently the speed of the spindle 18 and traversing arrangement 22 to maintain the speed of the surface 114 substantially constant. As seen in FIG. 4 a comparator section 150 within the control 148 compares the electrical voltage from the generator 140 with a reference voltage applied at L_1 and L_2. When the voltage from the generator 140 and reference voltage are equal and opposite, there is no error signal and the electrical power to the motor 30 remains constant. When the electrical voltage from the generator 140 is greater than the reference voltage but opposite thereto, the output error signal of the comparator 150 causes the control 148 to modify electrical power to the variable speed electrical motor 30 to reduce the speed of the motor, i.e., reduce the rpm of the output shaft 38. The control 148 uses an amplifier section 152 to amplify the electrical signal from the comparator 150 for use in modifying the electrical power to the variable speed electrical motor 30. The control 148 receives electrical power from a control box 154 that receives its electrical power through leads L_3 and L_4.

Fig. 5 shows the air supply arrangement for the air motor 120. The control box 154 regulates electrical power to various solenoid operated valves that control air supply to the air motor 120. As shown, suitable air supply means supplies both biasing air and higher pressure command air to the cylindrical vessel 130 through a control arrangement including a biasing air control valve 156, command air control valves 158 and 160 and three way vent valve 162. The biasing air control valve 156 is in a line 164 supplying biasing air to a supply tube 166 that communicates with side I of the cylindrical vessel 130. The command air control valves 158 and 160 regulate air to supply tube 166 and a supply tube 168 that carries air to side II of the cylindrical vessel 130. The vent valve 162 is in a line 170 communicating with both the supply tube 166 and the supply tube 168. Because the vent valve 162 is a three way valve, it can position itself to release air from both side I and side II of the cylindrical vessel 130 to the atmosphere through a vent tube 172.

When the winder 10 is building the package 16, both the command air control valves 158 and 160 are closed the biasing air control valve 156 is open. Accordingly biasing air fills side I of the cylindrical vessel 130 and the three way vent valve 162 is in position to release air from side II to the atmosphere through the vent tube 172. During the time the winder 10 builds the package 16 the pressure of the air against the piston 132 within the cylindrical vessel 130 urges the cylindrical member 116 against the moving axial surface 114 of the package 16 with uniform pressure.

When the winder 10 completes the package 16, the air control arrangement moves the support 60 away from the completed package by stopping biasing air to the side I of the vessel 130 and providing higher pressure command air to side number two of the vessel 130. The arrangement provides these conditions by opening command air control valve 160 and closing biasing air control valve 156. Command air control valve 158 remains closed. Further, the arrangement positions the three way vent valve 162 to release air to the atmosphere from side I of the vessel 130 through vent tube 172. When the command air control valve 160 is open, command air enters side II of the cylindrical vessel 130 through supply tube 168. Air under pressure operates against the piston 132 to move the support 60 away from the completed package 16. When the support 60 moves away from the package 16, it carries the traversing arrangement 22 with it and permits an operator to remove the completed package 16.

When the winder 10 begins a new package, the control arrangement supplies command air to side I of the cylindrical vessel 130 to move the support 60 towards the spindle 18 and to bring the cylindrical member 116 into contact with the axial surface 114 of the winding package 16. Under such conditions command air control valve 158 is open; both the biasing air control valve 156 and the command air control valve 160 are closed. The arrangement orients the vent valve 162 to release air to the atmosphere from side II of the cylindrical vessel 130.

It has been useful to use command air having a pressure from 20 to 40 psig; moreover, biasing air of from 10 to 20 psig is normally employed.

I claim:

1. Apparatus for packaging linear material comprising:

a mounting;

a horizontal collector rotatably mounted about a fixed axis onto which advancing linear material is wound into a package;

means for rotating the collector;

a support member on the mounting extending lengthwise of the collector;

a traverse guide for the linear material adjacent to the collector;

means for reciprocating the traverse guide to distribute the linear material on the package;

a cylindrically shaped pressure member extending parallel to and in the same horizontal plane as the collector carried by the support member;

means movably mounting the support member on the mounting to permit horizontal movement of the cylindrical member along a straight line path away from the axis of rotation of the collector comprising a horizontally disposed fixed straight rod on the mounting spaced from and oriented to extend in a direction transversely of the collector, a horizontally disposed fixed longitudinal channel member on the mounting in a vertical plane with the rod and on the same side of the collector as the rod, the channel member being spaced a greater distance from the collector than the rod, the support member including a tubular portion telescoped on the rod for movement along the rod and two horizontally disposed spaced apart guide feet engaging the channel member for movement along the channel; and

means for urging the cylindrically shaped member against the axial surface of a winding package with a substantially uniform force throughout formation of the package, the axial surface of the winding package moving as the package increases in diameter to push the cylindrically shaped member radially from the axis of rotation of the collector.

2. Apparatus of claim 1 where the cylindrical member is rotatably mounted.

3. Apparatus of claim 1 in which channel member is below the rod.

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