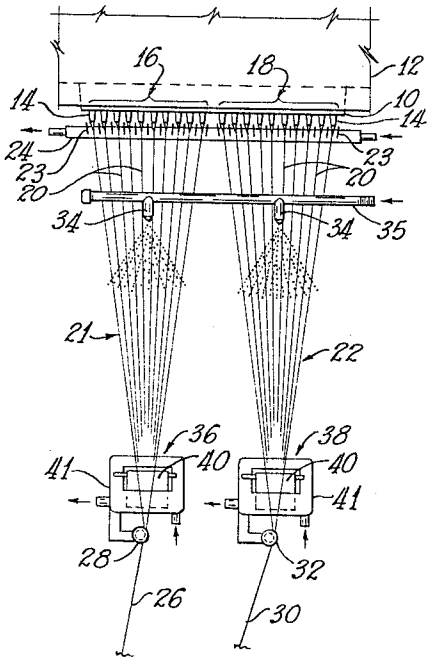
Oct. 25, 1966 S. W. LOWE, JR 3,281,224

APPARATUS FOR FORMING AND COLLECTING FILAMENTARY MATERIALS

Filed Dec. 14, 1962 4 Sheets-Sheet 1



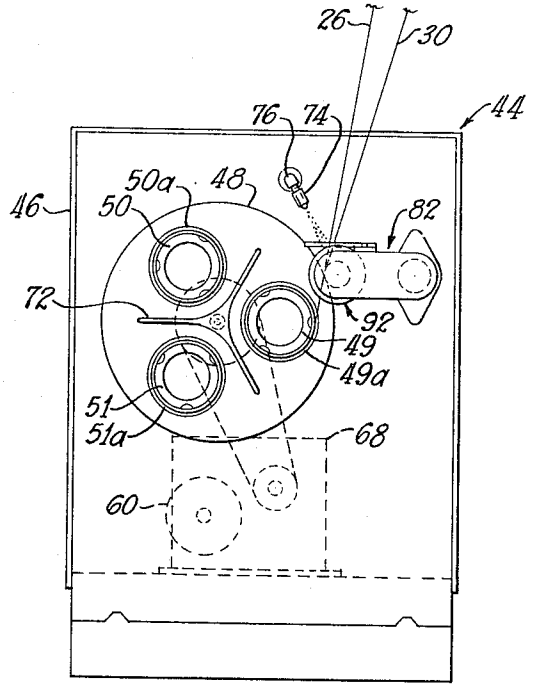


Fig. 1

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Oct. 25, 1966 S. W. LOWE, JR 3,281,224

APPARATUS FOR FORMING AND COLLECTING FILAMENTARY MATERIALS

Filed Dec. 14, 1962 4 Sheets-Sheet 2

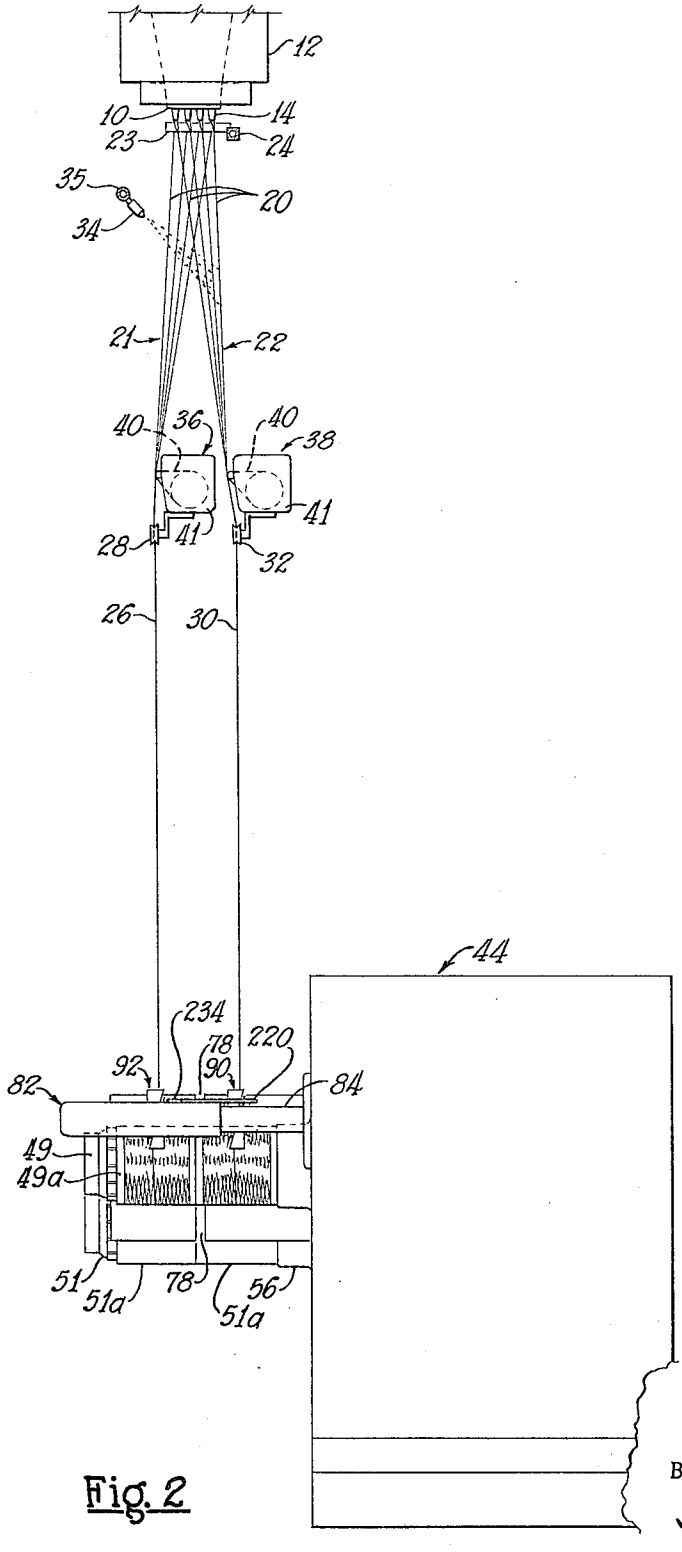

Fig. 2

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APPARATUS FOR FORMING AND COLLECTING FILAMENTARY MATERIALS

Filed Dec. 14, 1962 4 Sheets-Sheet 3

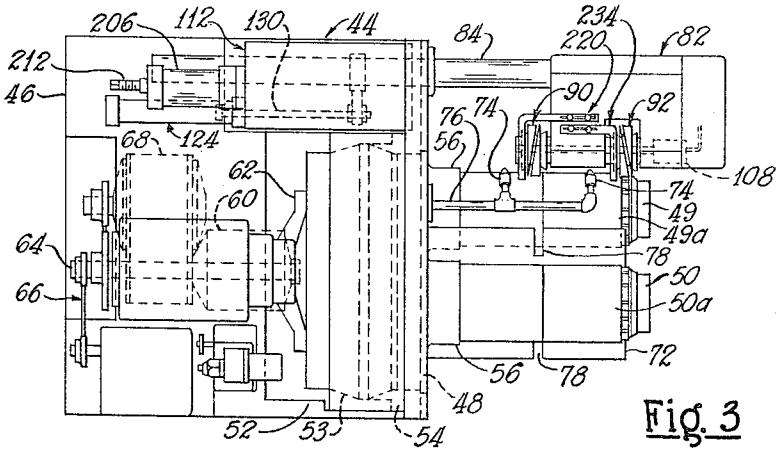

Fig. 3

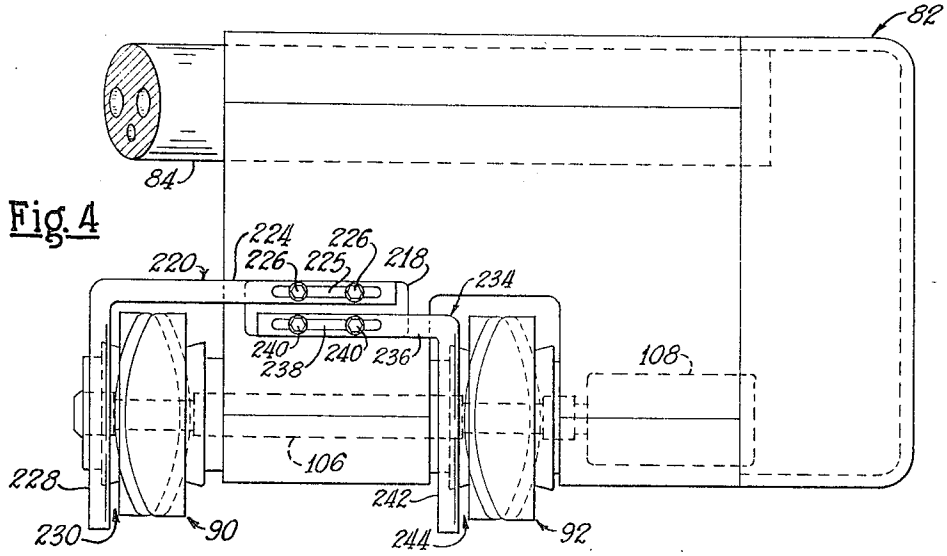

Fig. 4

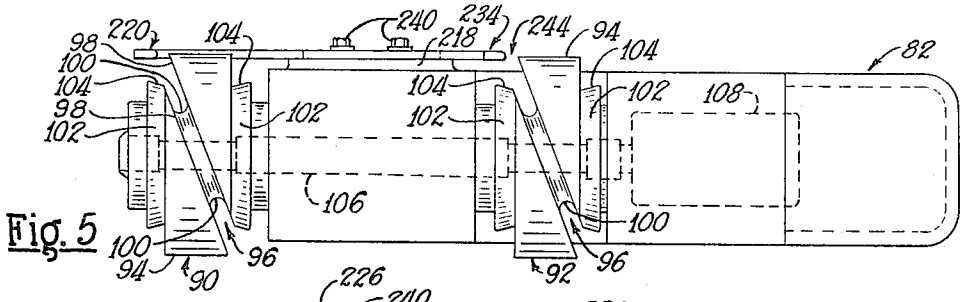

Fig. 5

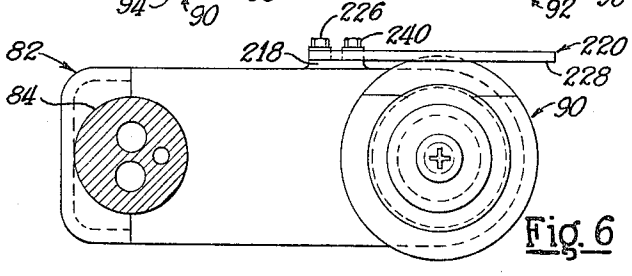

Fig. 6

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Oct. 25, 1966 S. W. LOWE, JR 3,281,224

APPARATUS FOR FORMING AND COLLECTING FILAMENTARY MATERIALS

Filed Dec. 14, 1962 4 Sheets-Sheet 4

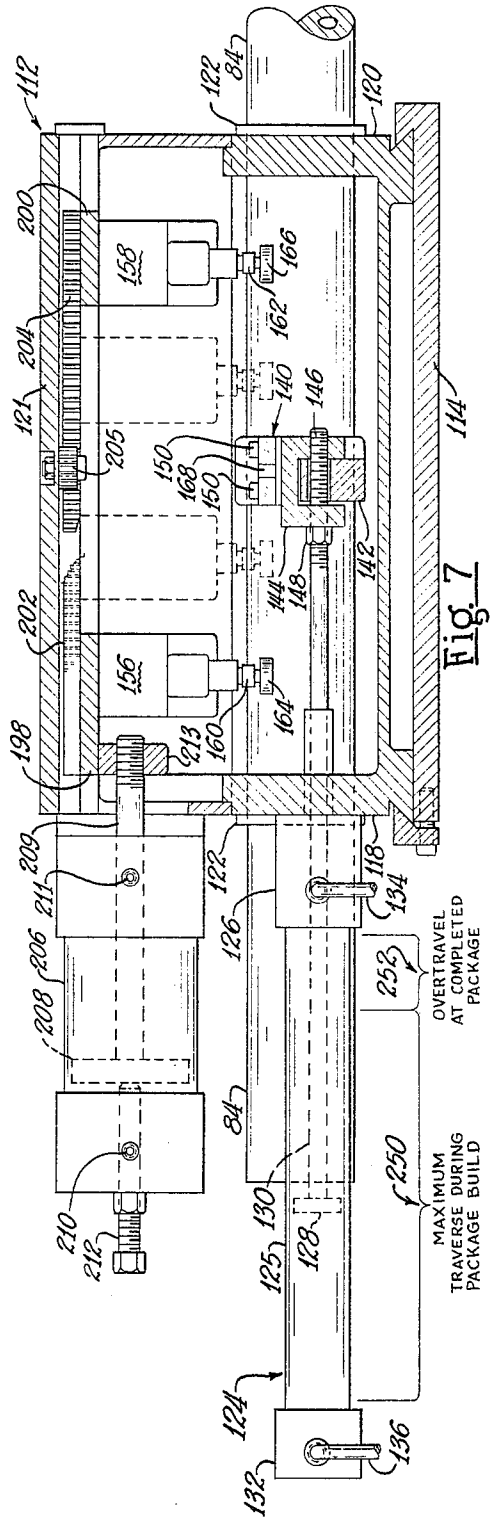

Fig. 7

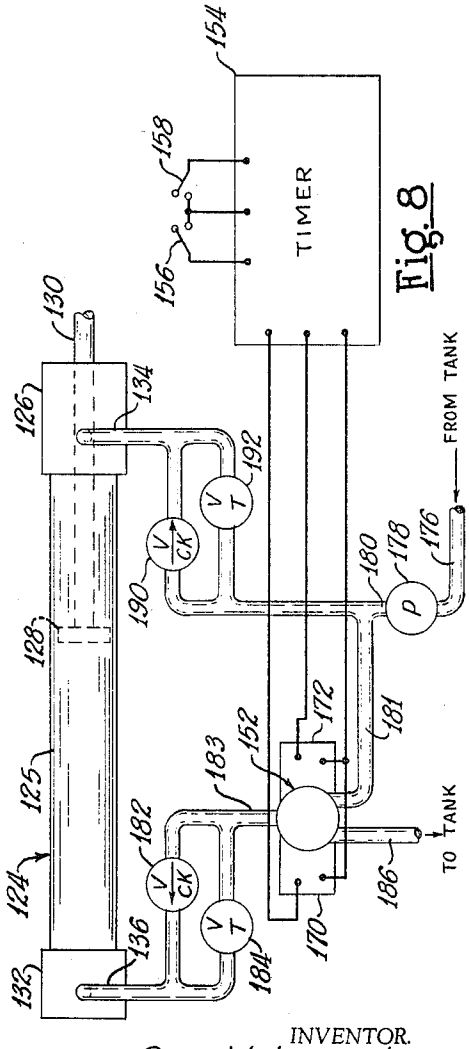

Fig. 8

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United States Patent Office

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Patented Oct. 25, 1966

3,281,224

APPARATUS FOR FORMING AND COLLECTING FILAMENTARY MATERIALS

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Filed Dec. 14, 1962, Ser. No. 244,614
8 Claims. (Cl. 65—11)

This invention relates generally to a method of forming and collecting filaments or fibers formed from attenuable material by attenuating streams of the material by winding one or more strands of the filaments or fibers on a collector wherein the strand or strands of filaments are traversed and distributed on the collector, the invention pertaining more especially to a method of collecting the strand during the doffing of a completed package of strand and the initiation of winding of the strand or strands upon an empty collector without interrupting the linear travel or attenuation of the filaments or fibers.

In attenuating heat-softenable mineral materials to fibers or filaments, such as heat-softened glass, it is essential to traverse or oscillate a strand of filaments in a manner to effect a crossing of the individual convolutions or wraps of the strand as it is being wound in package formation to avoid adhesion of the convolutions, as the filaments of the strand are usually provided with a coating or size as they are converged into strand formation.

Rotatable traverse means have been employed for oscillating a strand of filamentary material to effect crossing of the individual wraps and to distribute the strand lengthwise of a rotating collector in forming a package of strand. In strand packaging operations of this character it is desirable, if not essential, that the transfer of the strand from a completed package to an empty collector be effected at a strand transfer region and such region is usually at the end of the package.

Through the transfer of the strand at the end region of a package, the free end of the strand is available and may be easily identified in subsequent operations of paying out the strand onto a twister bobbin or spool or in operations involving unwinding the strand from the strand package. The transfer of the strand from a completed package to an empty collector must be accomplished without interruption of the linear travel of the strand as an interruption of strand movement involves disturbing the various factors which promote a formation of fine filaments attenuated at speeds of several thousand linear feet per minute.

The occurrence of break-outs of the filaments necessitates interruption of the attenuating of the filaments and results in considerable waste of filamentary material at a subsequent start up and appreciable loss of time in order to reestablish proper operating conditions.

The transfer of the strand from the completed package to an empty sleeve at a transfer station necessitates control of the strand upon its disengagement from the strand traversing medium until it moves into the influence of the traversing means to distribute the strand on an empty collector.

Heretofore it has been a practice to provide an arm or member movable lengthwise or transversely of the traverse means and independently thereof to disengage the strand from the traverse means and to promote reengagement of the strand with the traverse to effect winding upon an empty collector after the strand has been

transferred from the completed package. In one form, a reciprocable bar is moved lengthwise of the strand to bias the strand away from the traverse. In another form that has been heretofore used, a pivotally supported arm is oscillated into engagement with the strand to effect transfer of the strand. Arrangements of this character require elaborate timing means and operating mechanisms to effect diversion of the strand to a transfer region at the proper phase in the winding operation and to reengage the strand with the traversing means.

The present invention embraces a method of and apparatus for traversing a strand of filaments to distribute the strand on a rotating collector with the individual convolutions of strand in crossing relation and for effectively transferring the strand at the completion of a strand package onto an empty collector and thereafter reestablishing traverse of the strand on the empty collector.

An object of the invention resides in the provision of a method for traversing a strand of continuous filaments formed from heat-softenable material to distribute the strand in forming a package and for diverting the strand to a strand transfer position and maintaining the strand in transfer position while initiating winding of the strand on an empty collector.

Another object of the invention is the provision of a method of traversing a strand of continuous filaments to oscillate the strand to form crossing wraps and distribute the strand lengthwise of a collector to form a package and effecting relative movement of the strand to a strand transfer region and maintaining the strand at said region during transfer of the strand onto an empty collector and thereafter directing the strand into the influence of the traverse after completion of the transfer to effect a winding of the strand upon the empty collector.

Another object of the invention resides in a method of effecting relative movement between a completed package and a strand traverse to effect disengagement of the strand from the traverse at a transfer region to initiate winding on an empty collector at the completion of a strand package.

Another object of the invention resides in a method of disengaging a strand of continuous filaments from a strand traverse means at the completion of a strand package by effecting relative movement between the completed package and the traverse means whereby the angularity of the strand with respect to the traverse means is effective to promote the disengagement of the strand from the traverse means to effect transfer of the strand to an empty collector.

Another object of the invention resides in a winding apparatus for packaging a strand of filaments in a wound package on a collector involving relative movement of a traverse oscillator for distributing the strand on a package and an indexing movement of the completed package at a transfer region and holding the strand by means associated with the traverse for rendering the traverse ineffective to distribute the strand until winding is initiated on an empty collector.

Another object of the invention resides in a means mounted by a carrier for a strand oscillator for engaging and maintaining the strand in a strand transfer position during the period of movement of a completed package away from the winding station and the initiation of winding of the strand upon an empty collector at the winding station.

Another object of the invention resides in a winding apparatus embodying a carrier supporting strand oscillators or traverse means for effecting distribution of strands of filaments upon collectors to form wound packages in combination with members supported by the carrier arranged to maintain the strands, during transfer of the strands from completed packages to empty collectors, out of the influence of the strand traverse oscillators until winding of the strands on empty collectors is initiated.

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 combination 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 front elevational view illustrating an apparatus for forming and collecting continuous filaments of heat-softenable material embodying an arrangement of the invention;

FIGURE 2 is a side elevational view of the apparatus illustrated in FIGURE 1;

FIGURE 3 is a top plan view of the winding apparatus embodying the invention;

FIGURE 4 is an enlarged top plan view of a portion of the construction illustrated in FIGURE 3;

FIGURE 5 is an elevational view of the construction shown in FIGURE 4;

FIGURE 6 is an end view of the construction shown in FIGURE 4;

FIGURE 7 is an elevational view, partly in section, of mechanism for distributing the strands in forming the packages and moving the strands to a transfer region at the completion of packages, and

FIGURE 8 is a schematic view of the actuating and control arrangement for the mechanism shown in FIGURE 7.

While the method and apparatus of the invention are particularly usable in traversing and packaging strands of newly formed fibers or filaments of glass or other heat-softenable material, it is to be understood that the method and apparatus may be utilized in forming wound packages of other linear filamentary materials.

Referring to the drawings in detail and initially to FIGURES 1 and 2, there is illustrated a feeder **10** arranged to contain heat-softened filament-forming material, such as molten glass, which is supplied from a melting furnace (not shown) provided with a forehearth **12** to which the feeder is secured. The floor or bottom wall of the feeder **10** is fashioned with a comparatively large number of depending tips or projections **14** arranged in rows, each tip or projection being formed with an orifice or outlet through which the flowable glass in the feeder is discharged as fine streams. In the embodiment illustrated, the projections **14** are arranged in two groups designated **16** and **18** from which the streams of glass are attenuated into fine continuous filaments **20**, the filaments being arranged in two converging fan-like groups **21** and **22**.

The feeder **10** may be formed of an alloy of platinum and rhodium or other material which will withstand the intense heat of the molten glass. The feeder may be connected with a source of electric energy controlled to maintain the glass in the feeder at a desired viscosity so that the streams of glass delivered through the orificed projections **14** will be substantially uniform. The viscosity of the streams of glass may be stabilized or increased through the use of heat absorbing fins **23** mounted on a manifold **24** through which a heat transfer fluid such as water is circulated.

The group of filaments **21** is converged into a multifilament strand **26** by a gathering or compacting shoe or member **28** and the filaments **22** are gathered into a strand **30** by means of a filament compacting or gathering shoe **32**.

It is desirable to establish a moist environment for the groups of filaments. Nozzles **34** connected with a water supply manifold **35** are arranged to project fine sprays of water onto the groups of filaments. A lubricant, size or other coating material may be applied to the respective groups of filaments by applicators **36** and **38**.

Each applicator is inclusive of an applicator member or belt **40** arranged for movement in the liquid coating or size circulated through and contained in receptacles **41**, the applicator members acquiring films of the coating or size which is transferred by wiping action to the groups of filaments through the engagement of the filaments with the applicator members.

The glass streams are attenuated to the fine filaments **20** by winding the strands **26** and **30** upon collectors, packaging sleeves or tubes carried by rotatable collets of an automatic winding apparatus. Two packages are formed simultaneously and, upon completion of two strand packages, a collet supporting head is indexed to move the packages away from the winding station and move a pair of empty collectors or tubes into winding position at the winding station. During collection of the strands on the collectors, the strands are oscillated to effect crossing of individual wraps or convolutions of the strands and traversed to distribute the strands lengthwise on the collectors.

At the completion of a pair of strand packages, the strands are diverted to transfer regions and maintained in the transfer regions during initial winding of the strands upon the empty collectors without interrupting filament attenuation.

The winding apparatus **44** is inclusive of a housing or support structure **46**. Rotatably supported by the housing is a circular member, turret or head **48** adapted to be indexed to multiple positions in the performance of strand winding and processing operations.

In the embodiment illustrated, there is journally supported upon the indexible member or head **48** three winding collets or mandrels **49**, **50** and **51** spaced circumferentially equal distances apart with their axes at the same radial distances from the axis of rotation of the indexible head **48**. Mounted within the housing **46** is a frame member **52** formed with a frusto-conically shaped surface **53**, shown in FIGURE 3, providing a journal support for the indexible turret or head **48**. A ring **54** engages a second frusto-conically shaped surface on the head **48** providing a bearing means preventing endwise motion of the turret.

While the winding apparatus illustrated in the drawings embodies an indexible head equipped with three package supporting collets or mandrels, the winder may be fashioned with an indexible head mounting two winding collets or mandrels arranged in diametrically opposed relation. The frontal plate of the indexible head **48** is provided with bosses **56**, each boss being provided with bearing means journally supporting one of the winding collets or mandrels. Each of the winding collets **49**, **50** and **51** is driven or rotated by individually operable, electrically energizable motors (not shown) mounted within the head **48**.

The indexible head **48** is adapted to be moved or rotated at each indexing cycle through one-third of a revolution by means of an indexing motor **60**. The head **48** is secured to a member or spider **62** mounted upon a shaft **64** which is connected through chain and sprocket mechanism **66** with a gear reduction mechanism contained within a housing **68**, the gear reduction mechanism being driven by the motor **60**. Through this arrangement the head **48** is indexed at a comparatively slow speed.

The purpose of indexing the collets **49**, **50** and **51** is to successively move completed strand packages away from winding position, illustrated in FIGURE 1, and

move empty or strand-free sleeves or collectors into winding or strand collecting position. Each of the collets **49**, **50** and **51** is adapted to accommodate strand collectors **49***a*, **50***a* and **51***a* and, in the embodiment illustrated, each collet is adapted to support two collectors or sleeves in end-to-end relation. Each of the motors arranged to provide an individual drive for each of the winding collets is of a type in which the speed thereof may be varied by conventional means for the purpose of progressively reducing the speed of rotation of the collet at the winding station as the strand packages being wound increase in diameter by reason of the accumulating strand.

As shown in FIGURE 1, baffle means **72** comprising radially arranged portions is supported by the frontal plate of the head **48**, the radial portions extending between adjacent collets to confine water sprayed onto the strand oscillators from the nozzles **74** in the region of the strand package being formed, the nozzles being carried by manifold **76** connected with a water supply. The radial portions of the baffle means **72** are provided with slots **78** providing clearance for one of the strands during strand transferring operations.

The winding apparatus illustrated includes primary strand traverse means for distributing the strands lengthwise of the packages and secondary traverse means in the form of rotating oscillators fashioned with means to guide or oscillate the strands in alternate angular directions to effect a crossing of the individual wraps or convolutions of the strands as they are wound on the collectors or sleeves.

The strand distributing arrangement includes means for reciprocating a carrier mounting the strand oscillators by a reducing stroke builder motion or primary traverse of low frequency and high amplitude and with the low amplitude high frequency oscillation of the strands, form strand packages of a generally uniform thickness with tapered ends to prevent sloughing of the strands at the ends of the package and with individual wraps of strand in crossing relation.

The winding apparatus is provided with a carriage of carrier **82** upon which the strand oscillators are rotatably journaled, the carriage **82** being mounted upon a rod or shaft **84**, preferably of circular cross-section, supported and guided by suitable means contained in the housing **46**. A rotatable strand oscillator or short time traverse means is provided for each of the strands **26** and **30**, the oscillators being designated **90** and **92** and arranged to be driven at very high speeds.

The oscillators are of identical construction. Each oscillator is of circular shape and includes a circular cylindrical body or section **94** in which is fashioned a peripheral angular slot or groove **96** having parallel side walls **98**, the bottom of the groove being defined by a fillet or curved region **100** providing a hub structure as an integral portion of the circular cylindrical body **94** which, in effect, is partially bisected by the angular slot or recess **96**. The angular slot **96** provides harmonic motion and functions to guide and oscillate the strand during each revolution of the oscillator over a restricted area of the adjacent strand collecting sleeve to establish a crossing strand pattern of deposition on the collector.

Projecting axially from each side of the cylindrical body **94** is a shoulder or portion **102**, the peripheral surface **104** of each of the shoulders being of frusto-conical shape as particularly shown in FIGURES 4 and 5, the taper of each pair of the surfaces **104** on an oscillator being in convergent relation.

The frusto-conical regions on each oscillator are identical in order to attain perfect balance of the oscillators as only one of the surfaces **104** of each oscillator is engaged by a strand during strand transfer operations.

The purpose of the frusto-conically shaped surface **104** is to bias the strand or linear material toward the angular slot **96** for reentrance into the slot at the completion of a strand transfer operation from a completed strand package to an empty sleeve or collector. The oscillators **90** and **92** are mounted upon a shaft **106** journaled in suitable bearings (not shown) in the carrier or carriage **82**, the shaft being driven by a motive means **108** which may be a hydraulically actuated rotary motor or an electrically actuated motor.

The traverse or oscillator means **90** and **92** are preferably fashioned of layers of fabric or textile bonded into a solid integrated mass by a suitable resin such as phenol-formaldehyde. A material of this character known commercially as Micarta has been found to be satisfactory for high speed strand oscillators, this material resisting "licking" or adherence of the strands to the oscillators.

The traverse carrier or carriage **82** is reciprocated concomitantly with the high speed rotation of the strand oscillators **90** and **92** in order to distribute the strands lengthwise of the collector sleeves or tubes.

The arrangement includes means whereby, at the completion of the strand packages at the winding station, the traverse carrier **82** is moved through an additional distance or overtravel lengthwise of the strand packages in order to effect transfer of the strands from the completed packages onto the end regions of empty collectors spaced from the package winding region.

An arrangement for accomplishing the normal reciprocating motion and overtravel of the carrier **82** and oscillators is illustrated in FIGURES 3, 7 and 8. The mechanism for accomplishing these functions is contained within the housing **46** and supported by a casing **112** mounted upon a frame plate **114**.

The end walls **118** and **120** of the casing or housing **112** are bored to accommodate bearings or bushings **122** in which the shaft **84** is supported for slidable movement. The shaft or bar **84** and the carrier **82** are reciprocated by a motive means such as a hydraulic actuator **124** comprising a cylinder **125** provided with an end head **126** secured to the end wall **118**.

A piston **128** mounted on a piston rod **130** is reciprocable in the cylinder **125**. The distal end of the cylinder **125** is provided with a head or fitting **132**. The end heads **126** and **132** are respectively connected with tubes **134** and **136** with solenoid actuated valve means **152** of conventional construction supplied with oil or other fluid under pressure for reciprocating the piston **128**, member **84** and the traverse carrier **82**.

Surrounding the shaft **84** is a clamp **140**, one portion **142** of the clamp member projecting forwardly and engaging a lengthwise extending abutment (not shown) to prevent relative rotation of the shaft **84** and the carrier **82**. A U-shaped member **144** straddles the portion **142** of the clamp and is provided with a threaded opening to accommodate a threaded portion **146** of the piston rod **130**. The piston rod may be adjusted relative to the member **144** by rotating the piston rod, the latter being locked in adjusted position by a locking nut **148**.

Through this arrangement, reciprocation of the piston **128** and rod **130** effects corresponding reciprocation of the member **84** and the traverse carrier **82**. The clamp **140** may be adjusted relative to the member **84** and locked in adjusted position by means of screws **150**. Through this adjustment a proper relation may be established between the oscillators mounted by the carrier and the strand collectors.

The solenoid operated fluid control valve **152**, illustrated schematically in FIGURE 8, is arranged to be actuated and controlled through a timer mechanism **154** by two limit switches **156** and **158**. The housing of the limit switch **156** journally supports a switch actuating arm **160** and the housing of the limit switch **158** journally supports a similar arm **162**. The arm **160** is equipped with a roller **164** and the arm **162** equipped with a roller **166**.

The rollers **164** and **166** carried by the switch arms

are disposed in a longitudinal path of a projection 168 mounted on the clamp 140.

Thus during reciprocation of the piston 128 and the rod 130 the clamp 140 is moved lengthwise whereby the abutment or projection 168 alternately engages the rollers 164 and 166 to alternately actuate limit switches 156 and 158 which, through the timer 154, alternately energize solenoids 170 and 172 for controlling the flow of fluid into the ends of the cylinder 125 to reciprocate the piston 128.

A schematic view of the hydraulic circuit and control for the solenoid 152 through the timer 154 is illustrated in FIGURE 8. A pipe 176 connects a fluid pump 178 with a reservoir (not shown) of oil or other fluid for the actuator 124. Pipes 180 and 181 convey pressure fluid from the pump 178 to the solenoid controlled valve 152. A pipe 183 connected with the solenoid valve 152 is in communication with the pipe 136 leading into the distal end of the cylinder 125 through dual valves 182 and 184.

One-way check valve 182 prevents the flow of fluid into the pipe 136 but permits reverse flow of fluid from the left-hand end of the cylinder through pipe 183 for returning fluid to the reservoir or tank through pipe 186 connected with a valve 152. The valve 184 is a manually controlled needle valve for metering the flow of fluid through pipe 136 to admit oil to the distal end of the cylinder 125 to force the piston 128 in a right-hand direction, as viewed in FIGURE 8. The pipe 180 from the pump 178 is connected with the pipe 134 leading into the opposite end of the cylinder 125 through a check valve 190 and a metering valve 192.

The check valve 190 prevents flow of fluid into the cylinder 124 but permits free flow of fluid in the opposite direction. The manually adjustable needle valve 192 meters the flow of fluid from the pipe 180 into the rod end of the cylinder 125. The area of the piston 128 facing the left-hand end of the cylinder 125 as viewed in FIGURE 8 is substantially greater than the area of the opposite surface or rod end as the cross-sectional area of the piston rod accounts for the difference in the areas subject to fluid pressure.

The fluid pump 178 establishes pressure in both pipes 180 and 181. When the fluid under pressure flows through the solenoid valve 152 and pipe 183 into the left end of the cylinder 125, as viewed in FIGURE 8, against the free end of the piston 128, the piston is moved in a right-hand direction because of the differential in piston areas so that the fluid at the right side of the piston is forced back into the tube 134 past the check valve 190 and into the pipe 180.

When the solenoid controlled valve 152 is actuated through the medium of the limit switch 158, the valve 152 is shifted so that the fluid under pressure in pipe 180 flows through the metering needle valve 192 through pipe 134 into the rod end of the cylinder 125. The solenoid valve 152 is in a position to connect the pipe 183 with the distal end of the cylinder through pipe 136 and the check valve 182 to provide for substantially unrestricted flow of fluid out of the left end of the cylinder through the pipe 186 to the fluid reservoir or tank (not shown). The cycle is repeated upon actuation of the solenoid operated valve 152 alternately by the limit switch 156 and 158.

The limit switch mechanisms 156 and 158 are mounted for relative movement for the purpose of progressively reducing the length of strand distribution on a collector tube as the package increases in size in order to build a tapered end package and prevent sloughing off of the strand at the ends. The limit switch 156 is mounted upon a slidable plate 198 and the limit switch 158 is mounted on a slidable plate 200. A toothed rack 202 is secured to the plate 198 and a second toothed rack 204 is secured to the slidable plate 200.

Journally supported upon a cover 121 of the casing 112 is a pinion 205 and the teeth of the racks 202 and 204 are in engagement with diametrically opposite regions

of the pinion whereby movement of the plate 198 effects corresponding movement of the plate 200 in the opposite direction. Secured to the end of the casing 112 is a cylinder 206 accommodating a piston 208 secured to a connecting rod 209. Depending from the plate 198 is a lug 213 connected with the piston rod 209. The respective ends of the cylinder 206 are provided with tubular fittings 210 and 211 to accommodate flow of fluid, preferably oil, into and away from the cylinder.

An adjustable abutment or screw 212 is supported at the distal end of the cylinder for initially positioning the piston 208 at the start of a package winding operation. An adjustable fluid metering valve (not shown) is connected with the fitting 210 to regulate or meter the flow of fluid into the distal end of the cylinder.

When the piston 208 is moved by pressure fluid in a right-hand direction as viewed in FIGURE 7, the plates 198 and 200 and the limit switches 156 and 158 carried by the plates will be moved toward each other, and the longitudinal distance traversed by the oscillator carrier or carriage 82 is progressively shortened, thereby reducing the longitudinal travel of the oscillators and the lengthwise area of distribution of the strands on the collector tubes to fashion tapered ends on the packages. At the completion of a package, fluid under pressure is delivered through the fitting 211 against the right-hand side of the piston 208 to return the piston to its initial position for subsequent winding operations.

The apparatus of the invention is inclusive of an arrangement and method for moving the oscillator carrier 84 to a strand transfer position, that is, a position of overtravel in which the dual strands are moved by the oscillators to a position wherein, during transfer of the strands from completed packages onto empty tubes or sleeves, disengagement of the strands from the oscillators occurs and the strands held in such transfer position during initiation of winding of the strands on the empty collectors which have been moved into the winding station.

As particularly shown in FIGURES 4 and 5, the carriage or carrier 82 is fashioned with a boss 218. Mounted upon the boss 218 are members 220 and 234 which may be referred to as strand hold-off members or means.

The member 220 is of L-shaped configuration, one leg 224 being provided with a lengthwise slot 225 to accommodate securing bolts 226 threaded into threaded bores formed in the boss 218. The other leg 228 of the strand hold-off member 220 projects forwardly at a region adjacent the oscillator 90.

The member 220 is adjusted by manipulating the screws 226 to provide a space of sufficient width designated 230 between the leg 228 and the side face of the cylindrical portion 94 to accommodate the strand which is maintained in engagement with the shoulder or portion 104 by the leg 228 of member 220. A second strand hold-off means or member 234 is of L-shaped configuration, one leg 236 thereof engaging the boss 218 is provided with a slot 238 accommodating screws 240 which extend into threaded bores in the boss 218 for securing the member 234 to the carrier. The member 234 is adjustable by manipulation of the screws 240 to a position wherein the leg 242 provides a space 244 between the leg and the adajcent shoulder or portion 104 of the oscillator 92.

The function of the members 220 and 234 is to assure that the strands are maintained adjacent the slots 96 of the oscillators in strand transfer position at the completion of a pair of strand packages and to maintain the strands in strand transfer position until winding of the strands on the empty tubes or sleeves, moved by the indexing head 48 into winding position, has begun and prior to the return of the carrier 82 into its successive reciprocatory movements in distributing the strand on the sleeves in forming packages.

With reference to FIGURE 7, the distance indicated at 250 is the maximum travel of the strand lengthwise of a sleeve or tube during the formation of a package, the

traverse being moved through progressively reduced distances controlled by progressive movements of the limit switches **156** and **158** to form a package having tapered ends. The timer **154** includes circuit control means arranged to overlie the limit switch **158** at the completion of strand packages to maintain the solenoid control valve **152** in a position whereby fluid continues to flow into the left end of the cylinder as viewed in FIGURES 7 and 8 causing an overtravel of the piston **28** through a distance indicated at **252** in FIGURE 7, moving the carriage or carrier **82** the additional distance to strand transfer position.

The timer **154** is arranged to then index the head **48** to move the completed packages on the sleeves **49***a* away from winding position and to move the collet **50** carrying empty collectors **50***a* into winding position. The operations of the arrangement in transferring the strands from a completed package to empty collectors moved into winding position are as follows: Assuming a pair of strand packages being formed on collectors or sleeves **49***a* on the collet **49** are nearing completion with the limit switches **156** and **158** in positions which they are closest to one another defining the outermost and shortest strand layers lengthwise in each of the packages.

At this time a switch means actuated by the timer **154** overrides the limit switch **158** whereby the latter becomes ineffective to actuate the solenoid control valve **152**. Under these conditions, the valve **152** remains in a position whereby fluid under pressure is delivered through the valve through pipes **183** and **136** into the left end of the cylinder **125** to move the piston **128** and hence the shaft **84** and oscillator carrier **82** and oscillators **90** and **92** through an additional distance indicated at **252**, being the overtravel of the carrier at the completion of the package.

This travel continues until the piston **128** bottoms out at the right end of the cylinder, as viewed in FIGURES 7 and 8, in which position the carrier or carriage **82** is moved to its extreme outermost or strand transfer position. As the carrier **82** moves to this extreme position, the strands **26** and **30** are disengaged from the guide grooves **96** of the oscillators **90** and **92**.

This disengagement may be effected in the following manner: If the angularity of the strands **26** and **30** between the oscillators and the gathering shoes **28** and **32** is substantial as the oscillators approach their limit of movement at strand transfer position, the strands will automatically move out of the guide grooves **96** and engage the legs **228** and **242** of the members **220** and **234** and are thereby held, during strand transfer operations, in the spaces **230** and **244** between the hold-off members **220** and **234** and the side surfaces of the cylindrical portions of the oscillators, hence interrupting the oscillations of the strands at the strand transfer positions.

When the carrier **82** reaches its extreme position of overtravel in strand transfer position, the timer **154** initiates indexing movement of the head **48** in a clockwise direction, as viewed in FIGURE 1, to move the head through one-third of a revolution. This movement of the head carries the completed packages on the sleeves **49***a* at the winding position to the position occupied by the collet **51** in FIGURE 1 and moves the empty sleeves **50***a* carried by the collet **50** into the winding position previously occupied by the collet **49** and sleeves **49***a*.

During this movement of the indexing head, the movement of the completed package away from winding position effects an angular change in the strands **26** and **30** whereby the strands are moved radially away from the oscillators and out of the grooves **96** of the oscillators. Thus the strands may be disengaged from the grooves **96** of the oscillators by the angular relationship of the strands to the oscillators at the extreme position of overtravel of the oscillators and carriage, or the strands are disengaged from the oscillators by the movement of the completed packages away from the winding station.

The strands are maintained in strand transfer position by the members **220** and **234** and the strand wound upon the end regions of the empty collectors now moved into winding position and are not yet under the influence of the traverse oscillators **90** and **92**.

As the collet **49** carrying the completed packages moves away from winding position, the timer **154** actuates a braking means in a conventional manner for rapidly slowing down the motor driving the collet **49** to rapidly bring this collet and completed packages to rest. Prior to the completion of the packages on sleeves **49***a*, the timer has initiated rotation of the collet **50** carrying the sleeves **50***a*.

As the collet **50** is rapidly rotating at the time it is moved toward winding position and, as the collet **49** bearing the completed packages is rapidly slowing down under the influence of braking forces, slack regions in the strands occur between the empty sleeves **49***a* on the collet **50** and the completed packages on the collet **49**. The slack regions of the strand in strand transfer position, are adjacent the peripheries of the end regions of the empty sleeves on the collet **50**, and allow the strands to adhere or "lick" to the peripheries of the empty sleeves whereby initial winding of the strands on the empty sleeves **50***a* is begun.

The strands adhere to the empty sleeves and the initial convolutions are snubbed by succeeding convolutions or wraps setting up tension in the regions of the strands between the completed strand packages and the initial strands on the sleeves **50***a* causing the strands to break or fracture between the completed packages and the empty sleeves. This action frees the completed packages which are brought to rest by the braking forces applied to the drive motor for the collet **49**, permitting the operator to remove the completed packages from the collet and apply or telescope empty sleeves onto the collet.

After these operations have been completed, the timer **154** actuates the solenoid control valve **152** to initiate flow of fluid under pressure through the pipes **180** and **134** into the right-hand end of the cylinder **125**, as viewed in FIGURES 7 and 8, to move the piston **128** in a left-hand direction together with the shaft **84**, carrier **82** and the oscillators. This movement of the carrier **82** effects a change in the angularity of the strands between the gathering shoes and the strand hold-off members **220** and **234** whereby the strands automatically move into the influence of the oscillators and into the grooves **96** thereof, and oscillation of the strands and winding thereof on the regions of the sleeves to form packages is begun.

Valve means controlled by the timer **154** effects a resetting of the piston **208** controlling the limit switches **156** and **158** to move the latter to their maximum positions of travel so that thereafter the distribution of the strand lengthwise of the empty sleeves is controlled by the limit switches and the individual convolutions or wraps of strand are deposited in crossing relation under the influence of the high speed rotation of the oscillators **90** and **92**. Rotation of the oscillators is not interrupted during strand transferring operations.

Winding of packages upon the empty sleeves at the winding station is continued until the packages are completely formed and the cycle of operations hereinabove described again repeated to move the strands by the carrier **82** to strand transfer positions, the completed packages away from winding position and empty sleeves into winding position.

From the foregoing it will be seen that the strands **26** and **30** during strand transfer operations are maintained by the strand hold-off members **220** and **234** in a position adjacent to but out of the influence of the oscillators **90** and **92**. These results are attained without the use of members movable independently of the oscillator carrier **82** and provide a positive means for holding the strands

in strand transfer position until subsequent winding operations are begun upon empty sleeves at the winding station.

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.

I claim:

1. A strand controlling means for a winding apparatus wherein strands of filamentary material are concomitantly wound on rotatable collectors to form packages of strand, a support, a carriage receiprocable lengthwise of the rotatable collectors, a rotatable strand guiding oscillator individual to each strand mounted on the carriage arranged to oscillate the strands to effect a crossing of the individual wraps of strand on the respective collectors, means for moving the carriage and oscillators to a strand transfer position at which the strands are wound on end zones of the respective collectors, and means mounted by the carriage arranged to maintain the strands adjacent to and out of the influence of the oscillators at the strand transfer position during transfer of the strands from completed packages onto other collectors.

2. A strand controlling means for a winding apparatus wherein a strand of filamentary material is wound on a rotatable collector to form a package of strand, a support, a carriage reciprocable lengthwise of the rotatable collector, a strand guiding oscillator mounted on the carriage arranged to oscillate the strand to effect a crossing of the individual convolutions of strand on the collectors, means for moving the carriage and oscillator to a strand transfer position at which the strand is wound on a zone of the collector adjacent the package winding region, and means mounted by the carriage arranged to engage and maintain the strand adjacent to and out of the influence of the oscillator at the strand transfer position.

3. A strand controlling means for a winding apparatus wherein dual strands of filamentary material are wound on rotatable collectors to form packages of strand, a support, a carriage reciprocable lengthwise of the rotatable collectors, strand guiding oscillators mounted on the carriage arranged to oscillate the strand to effect a crossing of the individual wraps of strand on the collectors, means for moving the carriage and oscillators to a strand transfer position at which the strands are wound on zones of the collectors spaced from the package winding region, and means mounted by the carriage individual to each strand and engageable therewith at the strand transfer position arranged to maintain the strands adjacent the oscillators out of the influence of the oscillators at the strand transfer position during transfer of the strands from completed packages onto other collectors.

4. Strand control for winding apparatus arranged to wind filamentary material onto a rotatable collector to form a package including, in combination, a support, a carriage mounted on the support and reciprocable lengthwise of the collector, a rotatable oscillator mounted on the carriage engageable with a strand for effecting crossing of the individual convolutions as the strand is wound on the collector, means for moving said carriage away from the package winding region to a strand transfer position at the completion of a package of strand, and means on said carriage engageable with the strand when the carriage is in strand transfer position arranged to maintain the strand adjacent to and out of the influence of the oscillator.

5. Strand control for winding apparatus arranged to wind filamentary materials on rotatable collectors to form packages including, in combination, a support, a carriage mounted on the support and reciprocable lengthwise of the collectors, a rotatable oscillator individual to each strand mounted on the carriage engageable with a strand for effecting crossing of the individual convolutions as the strands are wound on the collectors, means for moving said carriage away from the package winding region whereby the oscillators convey the respective strands to strand transfer positions at the completion of packages of strand, and means on said carriage individual to each strand and engageable therewith when the carriage is in strand transfer position arranged to maintain the strands adjacent to and out of the influence of the respective oscillators.

6. Apparatus of the character disclosed, in combination, a frame, an indexible head journaled on the frame, a plurality of winding collets mounted by said head, means individual to each collet for rotating the same, each of said collets being arranged to support a plurality of collectors upon which strands of filaments are wound to form packages, means for distributing the strands on the respective collectors at a winding station including a reciprocable carrier mounted on the frame, a rotatable traverse oscillator individual to each strand journally supported on the carrier arranged to be engaged by the strands, means for reciprocating the carrier and oscillators to effect collection of the strands lengthwise of the collectors with successive convolutions in crossing relation, timer means effective upon completion of a package for initiating movement of said carriage to a position to divert the strands by the oscillators to transfer regions disengaging the strands from the oscillators and effecting indexing movement of the head, and means mounted by the carrier engageable with the strands at the transfer regions arranged to maintain the strands adjacent to and out of the influence of the traverse oscillators until winding of the strands has begun on empty collectors and reciprocation of the carrier resumed to form new packages of strand.

7. Apparatus of the character disclosed, in combination, a frame, an indexible head journaled on the frame, a plurality of winding collets mounted by said head, means individual to each collet for rotating the same, each of said collets being arranged to support a collector upon which a linear bundle of fibers is wound to form a package, means for distributing the linear bundle on the collector at a winding station including a reciprocable carrier mounted on the frame, a rotatable traverse oscillator journally supported on the carrier arranged to be engaged by the linear bundle, means for reciprocating the carrier to effect collection of the oscillating linear bundle lengthwise of the collector on a package winding region thereof with the individual convolutions in crossing relation, means effective upon completion of a package for initiating movement of said carriage to a position beyond the normal range of reciprocation of the carriage during a package winding operation to divert the strand by the oscillator to a transfer region and index the head, and means mounted by the carrier engageable with the linear bundle at the transfer region arranged to maintain the linear bundle at the transfer region out of the influence of the oscillator until winding of the linear bundle has begun on another collector and normal reciprocation of the carrier resumed to form a new package.

8. Apparatus of the character disclosed, in combination, a frame, an indexible head journaled on the frame, a plurality of winding collets mounted by said head, means individual to each collet for rotating the same, each of said collets being arranger to support a collector upon which a linear bundle of fibers is wound to form a package, means for distributing the linear bundle on the collector at a winding station including a reciprocable carrier mounted on the frame, a rotatable traverse oscillator journally supported on the carrier arranged to be engaged by the linear bundle, means for reciprocating the carrier to effect collection of the linear bundle lengthwise of the collector, timer means effective upon com-

pletion of a package for initiating movement of said carriage to a transfer region beyond the normal range of reciprocation of the carriage and effect disengagement of the linear bundle from the oscillator and establish indexing movement of the head, and means mounted by the carrier engageable with the linear bundle at the transfer region arranged to maintain the linear bundle adjacent to and out of the influence of the oscillator until winding of the linear bundle has begun on an empty collector and normal reciprocation of the carrier resumed to form a package.

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