Dec. 9, 1958 R. J. SHERWIN 2,863,612

CONTINUOUS FIBER WINDING APPARATUS

Filed Aug. 26, 1954 2 Sheets-Sheet 1

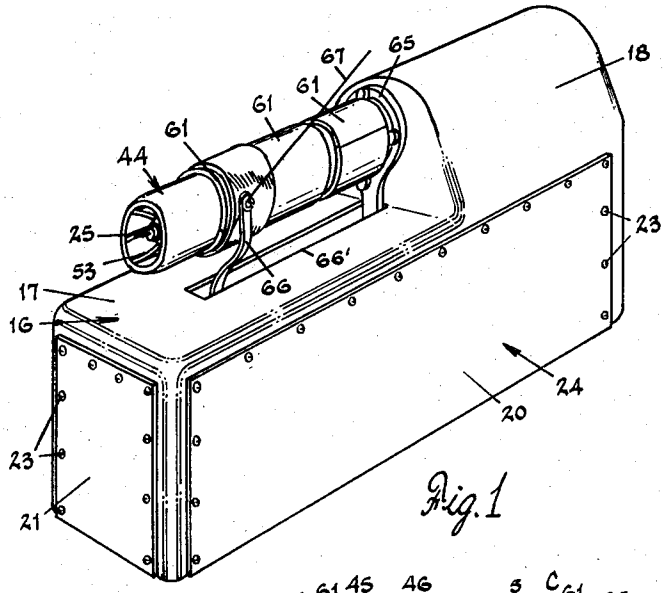


Fig. 1

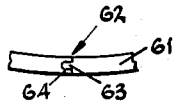


Fig. 6

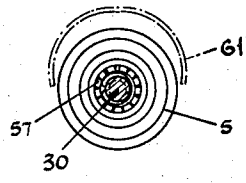


Fig. 5

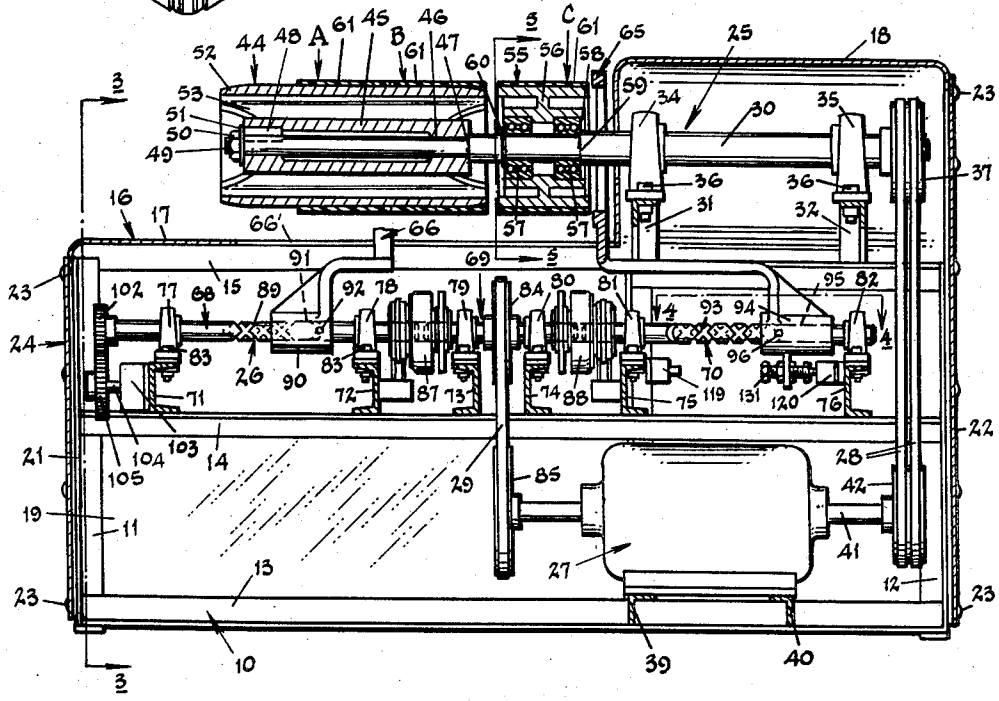


Fig. 2

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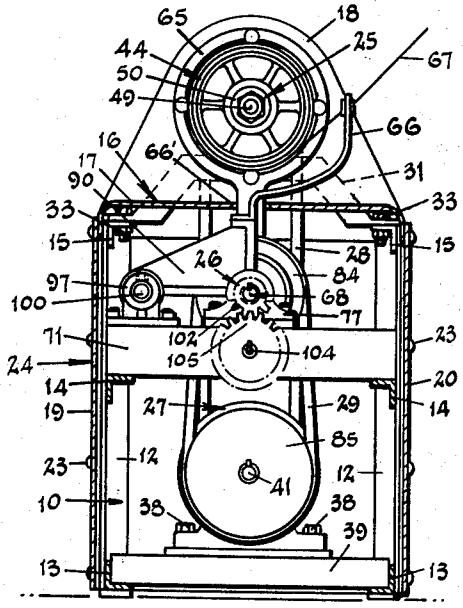


Fig. 3

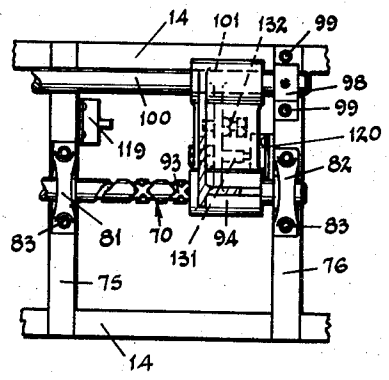


Fig. 4

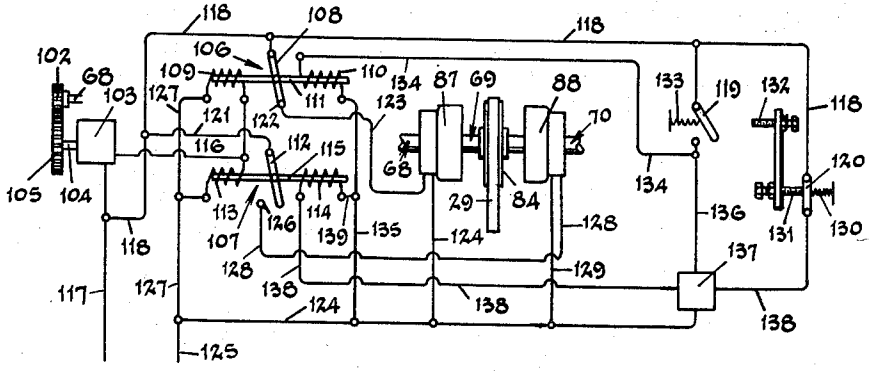


Fig. 7

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CONTINUOUS FIBER WINDING APPARATUS

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Application August 26, 1954, Serial No. 452,263

10 Claims. (Cl. 242—18)

This invention relates to the production of continuous filamentary materials. More particularly, the invention relates to an apparatus for continuously winding heat-softenable fibers during the continuous manufacture thereof.

Continuous glass filaments adaptable to stranding are useful for a variety of purposes including the production of woven glass fabrics. These filaments are commonly produced by flowing streams of molten glass from a feeder bushing and pulling said streams to attenuate them. Several attenuated filaments are gathered into a strand which is wound onto a cylindrical tube rotated at high speed, the rotating tube providing the pulling force by which said streams are attenuated into filament form.

Heretofore, it has been common practice to stop rotation of the tube when a desired amount of strand has been wound thereon and thus interrupt the attenuation process during an interval when an operator substitutes an empty tube for the filled one. It will be obvious that during the tube change interval the attenuation process is interrupted and strand production is lost. Also critical factors such as feeder bushing temperature, glass batch temperature, winding speed and the like are disturbed, which factors require adjustment one to the other to assure the production of filaments of uniform diameter.

Accordingly, it is an important object of the present invention to provide a machine for continuously winding glass fibers.

A further object of the present invention is to provide a machine for continuously winding heat-softenable fibers which is adapted to wind said fibers onto successive tubes without interrupting or varying the winding speed of said fibers.

A still further object of the present invention is to provide a machine for continuously winding heat-softenable fibers onto successive tubes whereby controlled amounts of fiber are wound on said tubes.

Other objects and advantages of the invention will become more apparent during the course of the following description when taken in connection with the accompanying drawings.

In the drawings wherein like numerals are employed to designate like parts throughout the same:

Fig. 1 is a perspective view of a continuous winding machine made in accordance with the present invention;

Fig. 2 is a side view of the machine of Fig. 1 with parts broken away and in section;

Fig. 3 is a vertical sectional view taken along line 3—3 of Fig. 2;

Fig. 4 is a plan view taken along line 4—4 of Fig. 2;

Fig. 5 is a sectional view taken along line 5—5 of Fig. 2 showing a strand tube in dotted outline, being applied to the idler arbor;

Fig. 6 is an enlarged detail end view of the lock joint formed longitudinally in the periphery of a strand tube; and

Fig. 7 is a diagrammatic view of the electrical system of the machine of Fig. 1.

As shown in Figures 1, 2 and 3, the continuous strand winding machine of the present invention includes a frame, designated generally by the reference numeral 10, fabricated of angle-iron stock support members arranged to provide a pair of front vertically disposed posts 11, rear vertically disposed posts 12 and horizontally disposed pairs of side members 13, 14 and 15 all joined together as by welding, bolting or riveting into the shape of a rectangular box. The top surface of this box is enclosed by a horizontally disposed panel 16 having a slotted, forward planular surface 17 and a rearward arch-shaped hood portion 18, the panel being fixedly carried by the said vertical disposed posts 11 and 12. Side cover sheets or panels 19, 20, 21 and 22 are fastened to the frame members 11 and 12 as by screws 23, so as to form a housing 24 and to enclose the frame 10 and protect the working parts of the machine, supported upon said frame.

The three principal components of the machine include a spindle and mandrel assembly 25, a compound power shaft 26 and a motor unit 27. The motor 27 is adapted to be connected to the spindle and mandrel assembly 25 and the compound power shaft 26 by means of V-belts 28 and 29, respectively, for driving said spindle and said power shaft.

The spindle and mandrel assembly 25 includes a rotatable spindle 30. A pair of inverted, generally U-shaped support brackets 31 and 32, Figs. 2 and 3, are placed in transverse, bridging relation across the top support members 15 of frame 10 and are secured in position by bolts 33. Pillow bearings 34 and 35 are secured as by bolts 36 to the horizontally disposed, central portions of the respective support brackets 31 and 32 in coaxial alignment. The aforementioned spindle 30 is rotatably journaled in the bearings 34 and 35 in longitudinal relation with respect to frame 10. Spindle 30 is fitted at its right hand end, Fig. 2, with a double V-pulley 37. The motor 27 is secured as by bolts 38 to a pair of angle-iron supports 39 and 40, supported transversely of frame 10 between the lowermost pair of support members 13 and retained in position as by welding. Motor 27 includes a rotatable shaft 41 which is provided at its right hand end with a double V-pulley 42, and the pair of identical V-belts 28 are trained about the pulleys 37 and 42 to provide a driving connection therebetween. The sheet metal cover or hood 18 is secured over and around the right hand end of spindle 30, bearings 34 and 35 and pulley 37.

On the left hand end of spindle 30 there is secured a mandrel 44, comprised of a cylindrical sleeve or hub 45, which is provided with a bore 46 whereby said sleeve can be positioned upon spindle 30 with its right hand end abutting a shoulder 47 formed on the spindle. The left hand end of spindle 30 is adapted to receive a drive key 48 and is also provided with an outer, threaded end 49 and a nut 50 and washer 51 are placed thereon to secure mandrel 44 in position. The shell 52 of mandrel 44 is supported in coaxial, surrounding relation with respect to sleeve 45 by means of support ribs 53 extending between these two elements.

As best shown in Fig. 2, the medial portion of spindle 30, between the mandrel 44 and bearing 34, supports an idler mandrel 55 in freely rotatable relation. This idler mandrel 55 is comprised of a cylindrical shell 56 which is rotatably journaled upon spindle 30 by means of a pair of anti-friction bearings 57, which are held in position upon the stepped portion 58 of spindle 30 between a shoulder 59 and a conventional locking ring 60. Mandrels 44 and 55 are adapted to be fitted with tubes 61, such as il-

lustrated in Figs. 5 and 6, upon which selected amounts of fiber are wound to provide a so-called "package" for distribution in commercial channels. The tubes **61** are suitably fabricated of a semi-rigid plastic material or the like, in cylindrical form. As shown in the end view of Fig. 6, tube **61** is provided with a longitudinal seam **62** having mating tongue and groove edges **63** and **64**. It will be readily understood from the foregoing and as illustrated in Fig. 5 that tube **61** is simply spread open and snapped into position upon idler mandrel **55**.

A tube feeder, shown at **65**, is employed to transfer the tube **61** from the idler mandrel **55** to winding mandrel **44** in a manner to be more fully described hereinafter. Additionally, as shown in Fig. 1, a traversing head **66** of conventional configuration is employed to guide the strand **67**, Fig. 1, onto the tube **61** in a uniform manner. Tube feeder **65** and traversing head **66** are each driven from and partially supported on the compound power shaft **26** which is located centrally within the frame **10** and longitudinally thereof.

As best shown in Figs. 2 and 3, compound power shaft **26** is comprised of three aligned, distinct shaft units **68**, **69** and **70**. A series of six channel-iron supports **71**, **72**, **73**, **74**, **75** and **76** are positioned transversely of and upon horizontal frame members **14** and are secured as by welding. Pillow bearings **77**, **78**, **79**, **80**, **81** and **82** are secured in aligned relation upon the respective channel supports **71** to **76** inclusive by means of bolts **83** and shaft elements **68**, **69** and **70** are journaled in said bearings in aligned relation. Shaft **69** is the driving shaft with respect to shafts **68** and **70** and is fitted medially with a V-pulley **84**. The left hand end of motor shaft **27** is fitted with a V-pulley **85** and the V-belt **29** is trained about said pulleys **84** and **85** to provide a driving relation therebetween.

The ends of shaft **69** are operatively connectable to shafts **68** and **70** by means of magnetic clutch and brake devices **87** and **88** respectively. The medial portion of shaft **68** is provided with a multiple thread **89**. The aforementioned traversing head **66** is vertically disposed to reciprocate in the slot **66'** of panel **16** and therebeneath is provided with an annular base portion **90** having a cylindrical bore **91** that is adapted to slidably interfit with shaft **68** and by means of a pin **92**, engaging the thread **89** is adapted to be reciprocally propelled in a to-and-fro manner when shaft **68** is rotated for guiding the strand **67** upon the tube **61**.

The medial portion of shaft **70** is provided with a multiple thread **93** in a manner similar to shaft **68** and, as best shown in the plan view of Fig. 4, the tube feeder **65** has a base **94** having a bore **95** equipped with a pin **96** adapted to engage the multiple thread **93** so that said feeder will be propelled in a to-and-fro manner when shaft **70** is rotated. A pair of bored brackets **97** and **98** are secured to channel support members **71** and **76** respectively by means of bolts **99**, and a guide shaft **100** is secured therein in parallel relation to compound shaft **26**. The base portion **94** of tube feeder **65** (Fig. 4) is provided with a bore **101**, parallel to bore **95** whereby it is adapted to be movably supported upon shafts **100** and **70** and by means of the pin **96**, engaging thread **93**, is moved to-and-fro by rotation of shaft **70**. Construction of traversing head **66** is similar to tube feeder **65** in the use of the base **90** riding upon shafts **68** and **100**.

Timing and operation of traversing head **66** and tube feeder **65** are controlled by a timer-actuated electrical system illustrated schematically in Fig. 7. A gear **102** is secured to the left hand end of shaft **68**. A timer mechanism **103** is secured to channel support **71**, and is provided with a shaft **104**, parallel to shaft **68**, to which is secured a gear **105** adapted to intermesh in driving relation with the gear **102** of shaft **68**. A conventionally actuated switch (not shown) is an integral component of timer **103** which completes a circuit from the usual sources of electrical energy.

Further components of the electrical system include a normally closed switch **106** and a normally open switch **107**. The switch **106** controls the energization of the magnetic clutch and brake **87** while the switch **107** similarly controls the energization of the magnetic clutch and brake **88**. More particularly, the movable contact **108** of switch **106** is actuated by means of a pair of solenoids or coils **109** and **110** and, for this purpose, is medially and pivotally connected to a common armature **111**. The movable contact **112** of switch **107** is likewise actuated by a pair of solenoids **113** and **114** being connected to the common armature **115**. The solenoids **109** and **113** are connected to the timer **103** by line **116**, said timer being connected to one side of the electrical source by line **117**. Line **118** from source line **117** extends to movable contact **108** of switch **106** and thence to limit switches **119** and **120**. Line **118** by line **121** also connects to movable contact **112** of switch **107**. During the normal winding sequence of operation, the switch **106** is closed to complete a circuit from one side of the electrical source by lines **117** and **118**, movable contact **108**, fixed contact **122**, line **123** to magnetic clutch **87** to energize the same and thence by line **124** to the opposite source of supply **125**. At the same time, movable contact **112** of switch **107** is disengaged from its associated fixed contact **126**.

Operation of the electrical sysem and its control of the traversing head **66** and tube feeder **65** is as follows:

With tubes **61** positioned respectively upon the medial portion A and a right hand end portion B of winding mandrel **44** and a third tube C positioned upon idler mandrel **55**, a strand **67** is started by hand upon the tube A. Motor **27** is then started and the winding operation is initiated, with the clutch **87** activated, the shaft **68** is caused to turn concomitantly with turning of tube A, by connection to the drive shaft **69** and motor **27**. Traversing head **66** is moved to-and-fro by multiple thread **89** of shaft **68** and strand **67** is guided into a uniform wind upon tube A. This is the position of the electrical system **102** as shown in Fig. 7. After a selected number of turns of shafts **68** and **104** through gears **102** and **105**, representing a desired amount of strand wound upon tube A, the switch of timer **103** is momentarily closed and a circuit therethrough is completed by lines **116** and **117** from one side of the electrical source to solenoids **109** and **113** and to the opposite source side **125** by line **127**. Upon activation of the solenoid **109**, the armature **111** is moved inwardly thereof and operates to disengage contacts **108** and **122** thereby de-energizing clutch **87**. Disengagement of the shafts **68** and **69** and the braking of shaft **68**, thus halts lateral motion of the traverser **66**.

Simultaneously the clutch **88**, upon engagement of contact **112** of switch **107** with contact **126** to complete a circuit from lines **118** and **121**, to line **128** and clutch **88**, thence by lines **129** and **124** to the opposite source **125**, is energized to drive shaft **70** by the continuously driven shaft **69**. This causes the feeder **65** to advance to the left from its rest position of Fig. 2. Such movement of tube feeder **65** causes the tube C, supported by idler mandrel **55**, to be slidably moved from the idler mandrel toward winding mandrel **44**. When the left hand end of the tube C engages the right hand end of tube B, idler mandrel **55** through friction engagement of tubes B and C is caused to rotate at the speed of winding mandrel **44**. Further movement of tube feeder **65** forces all three tubes A, B and C to the left until C occupies the position of B, B occupies the position of A, and A is in position to be removed from the left hand end of mandrel **44**. Prior to removal from mandrel **44**, a suitable cutting intrument such as a knife blade is inserted between tubes A and B to sever the single strand **67**, fed as a continuation between the two tubes. During tube movement, traversing head **66** is stationary and tube B in being moved acts to provide a simulated traversing, uniform wind thereacross.

Referring to Figs. 7 and 2, it will be seen that move-

ment of tube feeder casting 54 from its right hand position causes switch 120, by spring 130, to open upon disengagement with adjustment screw 131 carried by the feeder base 94. At the limit of its leftward motion as determined by the multiple thread 93, as viewed in the above-mentioned figures, a second adjustment screw 132 carried by base 94 closes limit switch 119 against the influence of spring 133. The switch 119, by supply line 118, completes a line 134 to solenoid 110 of switch 106 and thence by line 135 to line 124 and the opposite side 125 of the electrical source. Consequently, the movable contact 108 is moved into re-engagement with fixed contact 122 to re-establish the circuit of the magnetic clutch 87 between lines 118 and 123. The traverser 66 thus resumes its reciprocal motion while the feeder 65 is caused to travel rearwardly toward its rest position of Fig. 2.

Switch 119, by lines 134 and 136, also causes a timer relay 137 to function and complete a line 138 between switch 120 (presently open) and solenoid 114 of switch 107. Upon completion of movement of the feeder 65 rearwardly, or to the right, the screw 131 on feeder base 94 closes switch 120 to complete a temporary circuit from line 118, line 138, and timer relay 137 to solenoid 114 and by line 139 to lines 135 and 124. This causes armature 115 to move contact 112 out of engagement with fixed contact 126 thereby de-energizing clutch 88 and halting shaft 70 and feeder 65. Since the switch 120 is normally maintained closed by screw 131 during the rest interval of the feeder 65, setting of timer relay 137 is preferably adjusted to substantially instantaneously close and then open line 138 between said switch and solenoid 114. The circuit is thus set for recycle. For continued operation of the machine, empty tubes 61 are snapped over idler mandrel 44 in the manner previously described.

It will thus be obvious that the present invention provides for continuous winding and tube change synchronized therewith, resulting in improved quality of strand and economy of operation and increased production from a single glass melting furnace.

It is to be understood that the form of the invention herewith shown and described is to be taken as a preferred embodiment of the same, but that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

I claim:

1. A continuous winding machine including a frame, a rotatable shaft journaled on said frame, a first mandrel secured to said shaft for powered rotation therewith, and a second mandrel freely rotatably journaled on said shaft, said first and second mandrels being positioned in adjacent end-to-end relation, power means for rotating said shaft, a tube adapted to be placed upon said second mandrel, and means for slidably moving said tube from said second mandrel onto said first mandrel.

2. A continuous winding machine including a frame, a winding mandrel rotatably journaled on said frame and power means for driving said mandrel, an idler mandrel journaled on said frame for free rotation, said mandrels being axially aligned and positioned in adjacent end-to-end relation, a pair of tubes adapted to be positioned in abutting end-to-end relation on said winding mandrel and a third tube adapted to be positioned upon said idler mandrel, and means for axially shifting said third tube onto said winding mandrel while said pair of tubes is axially shifted.

3. A continuous winding machine including a frame, a winding mandrel journaled on said frame for powered rotation and means for driving said mandrel, an idler mandrel journaled on said frame for free rotation, said mandrels being axially aligned and positioned in adjacent end-to-end relation, a pair of tubes adapted to be positioned in abutting end-to-end relation on said winding mandrel and a third tube adapted to be positioned upon said idler mandrel, and means for axially shifting said third tube onto said winding mandrel while said pair of tubes is axially shifted.

4. A continuous strand winding apparatus including a frame, a spindle rotatably journaled on said frame, power means operatively connected to said spindle and adapted to rotate the same, a first mandrel journaled on said spindle for free rotation, and a second mandrel carried by said spindle for rotation therewith, said mandrels having peripheral surfaces of substantially identical dimensions, a tube having an interior configuration adapted to snugly engage the exterior of said mandrels, and means for moving said tube from said first mandrel to said second mandrel, whereby said first mandrel is caused to rotate at a speed equal to the speed of said spindle upon initial contact of said tube with said second mandrel, and subsequent movement of said tube is effected while said mandrels are both rotating.

5. A continuous winding machine including a frame, an idler mandrel journaled on said frame for free rotation, and a winding mandrel journaled on said frame for powered rotation, said mandrels having equal outside diameters, said mandrels being axially aligned and positioned in adjacent end-to-end relation, power means operatively connected to said winding mandrel and adapted to rotate the same, a tube adapted to be placed upon the idling mandrel in frictional contact therewith, and means for moving said tube from said idling mandrel onto said winding mandrel, whereby said idling mandrel is caused to rotate at a speed equal to the speed of said winding mandrel upon initial contact of said tube with said winding mandrel, and subsequent movement of said tube is effected while said mandrels are rotating.

6. A continuous winding machine including a frame, an idling mandrel journaled upon said frame for free rotation and a winding mandrel rotatably journaled on said frame for powered rotation, said mandrels being of equivalent outside diameter, said mandrels being axially aligned and positioned in adjacent end-to-end relation, a motor operatively connected to said winding mandrel and adapted to rotate the same, a split tube adapted to be positioned upon the idling mandrel in frictional contact therewith, a tube feeder movably supported on said frame and adapted to move said tube from said idling mandrel to said winding mandrel, whereby upon initial engagement of said tube with said winding mandrel, rotation is imparted to said idling mandrel and subsequent movement of said tube is effected while said mandrels are rotating.

7. Apparatus for continuously winding heat-softenable fibers comprising a frame, a spindle rotatably journaled on said frame and carrying a tube in frictional engagement upon which the fibers are adapted to be wound, power means operatively connected to said spindle for applying a rotative force thereto, an idler mandrel freely rotatably journaled on said frame in coaxial, adjacent end-to-end relation with said winding mandrel, said idler mandrel also being adapted to frictionally support a tube, a traversing head and a tube feeder movably mounted on said frame, said traversing head and said tube feeder being operably connectable to said power means for movement thereby, said traversing head being normally movable in synchronization with rotation of said winding mandrel and said tube feeder being normally at rest, and control means for interrupting movement of said traversing head concurrent with initiation of movement of said tube feeder followed by recommencement of movement of said traversing head and subsequent neutralization of said tube feeder, whereby upon initial frictional engagement of said tube carried by said idler mandrel with said winding mandrel, rotation equal to the speed of said winding mandrel is imparted to said idler mandrel and subsequent movement of said tube is effected while said mandrels are rotating.

8. Apparatus for continuously winding fibers comprising a frame, an idler mandrel freely rotatably journaled on said frame, a winding mandrel rotatably journaled on said frame, power means operatively connected to said winding mandrel for applying a rotative force thereto, said idler mandrel and said winding mandrel being coaxially aligned, a first tube adapted to fit upon said winding mandrel and a second tube adapted to fit upon said idler mandrel, a traversing head and a tube feeder supported upon said frame for to-and-fro movement parallel to the axis of said mandrels, said traversing head being normally movable in synchronization with the rotation of said winding mandrel and said tube feeder being normally at rest, a first clutch for operatively connecting said traversing head to said power means and a second clutch for operatively connecting said tube feeder to said power means, and means for controlling said clutches comprising a timer electrically connected to each of said clutches, first and second switches engageable by said tube feeder, whereby operation of said timer is effective to disconnect said first clutch and stop said traversing head, and said timer concomitantly activates said second clutch to move said tube feeder and push said second tube into the position occupied by said first tube on said winding mandrel, initial movement of said tube feeder being effective to open said first switch and subsequent movement of said feeder arm being effective to close said second switch to reactivate said first clutch and resume movement of said traversing head and still subsequent movement of said tube feeder being effective to close said first switch and reset said electrical system for recycle.

9. The process of winding a continuous strand comprising, positioning an empty tube in frictional engagement upon a freely rotatable mandrel, sliding said tube from said freely rotatable mandrel into frictional engagement upon a driven mandrel coaxially aligned with the freely rotatable mandrel, positioning a second empty tube upon said freely rotatable mandrel and transferring

said second tube from said freely rotatable mandrel onto the driven mandrel to concomitantly move the first tube into a winding position on the driven mandrel, winding a strand upon said first tube, positioning a third empty tube upon said freely rotatable mandrel and transferring said third tube from said freely rotatable mandrel onto the driven mandrel whereby movement of the tubes is effective to transfer the strand from the first tube to the second tube while both tubes are positioned in abutting end-to-end relation upon the driven mandrel, and repeating the cycle.

10. The process of winding continuous glass fibers comprising, positioning a freely rotatable mandrel and a driven mandrel in end-to-end coaxial relation, positioning an empty tube in frictional engagement on the first mandrel and slidably transferring said tube from said first mandrel into frictional engagement with the driven mandrel and repeating this operation whereby said first tube is transferred to a winding position upon the driven mandrel, winding a glass strand upon the first tube in said winding position on the driven mandrel, and displacing said tube from the driven mandrel by repeating the step of positioning an empty tube upon the freely rotatable mandrel and slidably transferring the empty tube from said mandrel onto said second mandrel.

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