The present invention relates to a method of and an apparatus for forming glass fibers and it has particular relation to apparatus for automatically drawing a plurality of continuous glass filaments from a molten bulk, combining the filaments into a strand and winding the strand on a rotating cylindrical support.

In this process a plurality of glass filaments are drawn through orifices in an electrically heated, platinum alloy bushing and gathered together in the form of a strand. The strand is wound upon a forming tube mounted on a rotating cylinder called a collett. As the strand is wound on the forming tube, it is traversed by suitable means so that succeeding turns cross each other at a slight angle and are not wound in parallel relation on the forming tube. Usually the traversing means will move the strand through a 3 inch throw as it is wound on the forming tube. The traversing means is axially reciprocated relative to the forming tube in order to wind the strand throughout a substantial portion of the length of the forming tube which may be 8 or more inches in length.

At the beginning of the fiber forming process, an operator pulls the individual filaments from the bushing by hand and groups them into a strand. The strand is passed over a gathering guide and is wound around one end of the collett beyond the forming tube. Rotation of the forming tube is then begun. It takes several seconds for the forming tube to come up to the proper drawing speed and during this time the strand which is wound on the collett is of too great a diameter. The strand which is formed during the start up is wound in a small area at the end of the collett and is held in this position by the operator. When the proper drawing speed is reached, the traverse is started and the strand is shifted by the traverse lengthwise of the tube so as to be wound during the remainder of the run in an area on the tube which is spaced from the strand formed during the start up on the end of the collett. When the forming run is completed, the strand is led back to the end portion of the collett containing the strand formed during start up and wound thereon as the forming tube rotation returns to zero. Thus, all of the off size strand is located at one place on the collett and off of the forming tube. The off size strand is cut from the collett and is discarded before the forming tube is removed from the collett.

There is no twist in the strand as it is thus formed and a size is applied to the filaments prior to the winding of the strand on the tube in order to bond them together and maintain the integrity of the strand. An open wind, rather than a parallel wind, is desired on the forming tube in order to aid removal of the strand from the tube. If a parallel wind is used, the unwound strand is very difficult to remove when the filaments become broken. In this event, successive turns of the strand become entangled and it soon becomes impossible to unwind the strand and remove it from the tube. The open wind is such that the strand is traversed the length of the tube by a relatively few turns of the tube, i.e., 2 to 5 turns or more turns for a 7 to 10 inch long package for each traverse of the length of the tube. With this type of wind the succeeding turns of strand cross each other at a minimum angle of at least 5°.

The spiral wire traverse shown in U.S. Patent No. 2,391,870 has proved to be satisfactory for traversing a strand at the very high rate of speed which is employed to wind the strand on a forming tube. This traverse, in addition to rotating about its own axis, is reciprocated axially in order to distribute the strand over the length of the tube. This type of traverse requires that there be a certain minimum tension on the strand as it passes over the cams of the traverse to hold it on the cams as they tend to push the strand toward either end of the forming tube. There is a natural tendency for the strand to return to the center of the forming tube, and there is a minimum tension which is required to overcome this tendency and maintain the strand at its proper position on the cam to produce the desired open wind. If this tension becomes too great, there is the problem of the individual filaments of the strand breaking at the gathering guide due to too much friction as they pass over the guide. As soon as one filament breaks, the whole strand usually breaks. This problem of tension on the strand has become aggravated by a desire to have the glass fiber process performed all on one floor; whereas, it has been previously conducted on two floors.

It is an object of the present invention to produce a glass fiber strand with a minimum amount of distance between the bushing and forming tube while imposing a minimum amount of tension on the strand during the fiber forming process. It is a further object of the invention to provide an automatic fiber forming process so as to minimize the time required for the operator to attend the fiber forming run. It is also an object of the invention to provide an automatic winder which is essentially free from maintenance problems.

These and other objects of the invention are accomplished by providing a winder for use with a strand forming apparatus which automatically collects the off dimension strand at start up at one end of the collett, shifts the winding to the forming tube for the winding of the on-size strand, oscillates the forming tube axially during the winding run while the strand is being traversed over a short distance on the forming tube, stops winding at the end of the run much faster than heretofore practical, shifts the collett and forming tube back to the start up position at the end of the run, holds the forming tube and collett in fixed position for the operator while he is cutting the off-size strand from the end of the collett, and holds the collett in fixed position while the operator replaces the filled forming tube with an empty forming tube.

The manner in which these and other objects of the invention are accomplished is described in further detail in conjunction with the drawings in which:

**FIGURE 1** is a diagrammatic elevation of the fiber forming apparatus;

**FIGURE 2** is a side view of **FIGURE 1**;

**FIGURE 3** is an elevation of the winder;

**FIGURE 4** is a plan view of the winder shown in **FIGURE 3**;

**FIGURE 5** is a section through the center of the collett;

**FIGURE 6** is an end view of **FIGURE 5**;

**FIGURE 7** is a schematic drawing of the pneumatic system of the winder, and

**FIGURE 8** is a schematic drawing of the electrical system employed in the winder.

In **FIGURES 1** and **2** of the drawing there is shown a glass melting container or forehearth thereof **10** containing a supply of molten glass **11** and having a resistance heated bushing **12** attached to the bottom of the container. The bushing is composed of an alloy containing about 90 percent platinum and 10 percent rhodium. The bushing **13** is provided with a series of orifices **13**.
which are defined by tips 14 suspended from the main portion of the bushing. The molten glass flows through the tips and forms in small cones 15 suspended from the tips. The orifices are aligned in four or more rows, having a great many tips in each row so that the total number of tips is about 200 to 400. A smaller or greater number of rows or tips may be present in the bushing.

Glass filaments 16 are pulled from the cones 15 of glass at a very high rate of speed, for example 5,000 to 20,000 feet per minute, usually 12,000 to 15,000 feet per minute, and wound on a rapidly rotating forming tube 18 mounted on a collett 19. The collett may be approximately 6 to 8 inches in outside diameter and may rotate at approximately 6,000 to 8,000 r.p.m., depending upon the size of the fiber to be produced. The glass filaments 16 are grouped into a strand 20 as they pass over a guide 22 prior to being wound on the forming tube 18.

As the strand 20 is wound on the tube 18, it is rapidly traversed in an open wind along the length of the tube by means of a traverse 25. The traverse 25 is composed of a spindle having a pair of complementary, spirally disposed wire cams mounted on it. The spindle is rotated at 1,500 to 2,500 r.p.m., and the cams push the strand back and forth across the face of the forming tube 18 while the tube is rotated a 2 to 3 inch throw for each revolution of the spindle. The strand is distributed throughout the length of the forming tube by the relative motion of the forming tube with respect to the traverse as caused by oscillating the forming tube and collett axially during the fiber forming run.

Usually an aqueous size containing a liquid binder and a lubricant such as a combination of starch and a vegetable oil is applied to the individual filaments of the strand as they pass over a moving applicator 27 which is mounted just above the guide 22. The applicator may be in the form of a roller 28 or moving belt having a film of size supplied to it. The filaments pass over the roller or belt at some tangential point for momentary contact with the sizing solution to transfer the solution from the applicator to the filaments. An example of a suitable size applicator is shown in U.S. Patent 2,875,718.

The winder, including the traverse 25 and the collett 19, is generally indicated at 30. It is composed of a base 32 and sheet metal framing enclosure 33 mounted on the base. A carriage 34 is mounted on the base on a pair of slides 36 which are mounted in supports 38 rigidly fastened to the base. Accordion-like sleeves 39 are attached to the supports 38 and the carriage 34 so as to protect the lubricated slides 36 from any dirt or other foreign substances.

The supports 38 act as mechanical stops for the reciprocating straight line motion of the carriage 34 on slides 36. The carriage is reciprocated by means of a piston rod 43 which is rigidly attached to the carriage at 45 and whose pistons 47 and 48 are mounted respectively in an oil cylinder 50 and air cylinder 52 mounted in tandem. The oil cylinder serves as a dash-pot for smoothing out the movement of the pistons as caused by the alternating air pressure on the piston 48 in the air cylinder 52. Air is supplied to opposite ends of the cylinder 52 by air lines 54 and 56 which are connected to a four way, two position, bleeder actuated, balanced, air valve 58. The details of the valve 58 and the means of controlling the air flow to the cylinder 52 are discussed further in conjunction with the description of the operation of the winder.

The drive for the collett 19 is motor 60 which is adjacent mounted on the carriage 34. The collett 19 is mounted on a spindle 62 which is supported in a cylindrical bearing on an upright portion 65 of the carriage 34. The spindle 62 is rotated by means of a belt 68 which is connected to and driven by motor 60. The motor 60 is equipped so that it can be plugged to reduce its speed and can be stopped and held stationary by a magnetically controlled, mechanical brake 70 mounted at the end of the motor. The motor 60 operates on alternating current and the plugging is achieved electrically by reversing two of the three current leads to the motor so as to apply reverse torque to the motor, thus reducing the speed of its rotation prior to application of the brake 70.

The collett 19 is shown in detail in FIGURES 5 and 6. The collett is composed of a cylindrical body portion 75 in the form of a sleeve which fits snugly onto the end of the spindle 62. The spindle 62 is provided with integral keys 78 and the collett body 75 has corresponding recesses in it so that the collett will rotate with the spindle. The collett body 75 is held in place at both ends by the collet 76 which are attached to the end of the collett body 75 by means of bolts 81. The collar 80 is provided with forwardly facing annular depressions 82 and 84. A ring 86 is fastened to the front or outer end of the collett body 75 by means of bolts 87. The ring 86 has a forwardly facing annular depression 89 in it which is of the same size as the depression 82 and which is aligned axially with depression 82.

The bolts 81 and 87 which hold the collar 80 and ring 86 on to the collett body also hold in place a series of guide blades 92 with lugs 96 on their ends fitting into depressions 82 and 89. These bars are held in place on the collett by means of the lugs 96 which are slightly smaller than the depressions 82 and 89 so as to permit radial movement of the bars in the depressions. The bars are held in their outermost position as limited by the annular projections 98 and 99 on the collar 80 and ring 86 respectively and are held thereagainst by a series of compression springs 100 spaced circumferentially around the collett between the lugs 96 and the collett body 75. In cross section, the bars 95 are arcuate on the top so as to form a substantially continuous cylindrical surface on the outside of the collett. Their side meeting faces taper inwardly corresponding to radial lines drawn from the axis of the spindle 62. The bottom surface of the bars are flat. Intermediate the ends of each bar in their bottom surface is a groove corresponding in shape to guide blade 92.

A slight space is left between the adjacent bars 95 to permit supports 38 rigidly fastened to the supports 38 to extend through two hollow cylindrical bearings in projections 118 extending downwardly from the plate 115. A pair of guides 120 mounted on the spindle provides radial movement of the spindle in the bearings 118. The alignment of the traverse is such that the axis of the traverse spindle 110 is parallel to the axis of the collett spindle 62. The traverse is slightly above and to one side of the collett. Spindle 110 is driven by means of a belt 121 which is connected to and driven by the motor 116. The traverse
The air valve 58 is composed of a casing 130 providing a chamber 132 to which air under high pressure is constantly supplied through an inlet port 133 connected by pipe 134 to an air pressure source. A spool or plunger 135 is mounted within the chamber 132 for movement lengthwise of the chamber. The spool 135 is provided with pistons 137 and 138 at each end; the pistons in combination with the walls of the chamber 132 act to separate the chamber into three sections, a central section 139 into which the air under pressure is continuously provided, and sections 140 and 141 at the ends of the chamber. The central section of the chamber is connected to the end sections 140 and 141 by small ports 142 and 143 in the piston 58 to provide for eventual equalization of the pressure in the three sections of the chamber 132. This permits the spool 135 to be in a balanced position within the chamber 132. The spool is moved lengthwise in the chamber by exhausting the air from either end portions 140 or 141 to temporarily unbalance the air pressure within the sections of the chamber and thus cause the spool to move toward the end of the valve from which the air has been exhausted.

One wall of the central portion of the chamber 132 provides a seat for a slide valve 145 connected with the spool 135 to allow the air in or out of the central section 139 of the chamber and it causes air under pressure to be directed toward one or the other side of the pistons 48 in the air cylinder 52. The third passageway is connected by a suitable line 151 to the atmosphere through muffler 152 and serves as an exhaust. In one position of the slide valve the passage 146 communicates with the central section 139 of the chamber and it causes air under pressure to be directed toward one or the other side of the piston 48 in the air cylinder 52. In this position the passage 147 is connected through the valve 145 and passage 150 to the atmosphere and thus serves as an exhaust of the air from the other side of the piston 48 in cylinder 52. In the other position of the slide valve 145, the passage 147 communicates with the central section 139 of the chamber 132 and the passage 146 communicates with the atmosphere through valve 145 and passage 150.

The sliding of valve 145 is accomplished by alternately bleeds air from the end sections 140 and 141. This is accomplished by means of poppet valves 153 and 154 which are connected to end sections 140 and 141 respectively through air lines 155 and 156 connected to passages 157 and 158 in the end walls of the casing 130. The spring biased, normally closed, solenoid valve 128 is located in the air line 156 connecting the passage 158 with poppet valve 154.

The poppet valves 153 and 154 are mounted on the base 32 of the winder 30 in a line parallel to the travel of the carriage and the collet. A bar 159 is rigidly attached to the side of the carriage 34 and as the carriage moves back and forth, the bar 159 alternately contacts the poppet valves to open them and cause the end sections 140 and 141 of the chamber 132 to be exhausted alternately to the atmosphere. The oil cylinder 50 connected to the air cylinder 52 causes the movement of the carriage to be smooth rather than abrupt. The cylinder 50 contains oil and this oil bleeds through an opening 160 in the piston 47 mounted on the piston rod 43 which extends through the oil cylinder to the air cylinder, and on which the piston 48 is also mounted.

The solenoid valve 128 controls the operation of air valve 58 to determine whether or not the carriage 34 returns to and remains in its innermost starting position or whether it oscillates between two positions which are spaced outwardly from the innermost starting position. When the solenoid valve 128 is closed, the line 156 connecting passage 158 to poppet valve 154 is closed and
no air can escape from end section 141 whether the poppet valve 153 is open or not. If the carriage 34 is in its innermost position and the solenoid valve 128 is closed, the carriage will stay in that position. When the carriage is in the innermost position, the bar 159 holds the poppet valve 154 open; however, the carriage 34 cannot move forward because valve 128 is opened to communicate through the exhaust line 156 and the end section 141 with poppet valve 154. The various valves and pistons in the pneumatic system are shown in FIGURE 8 in their position at start up with the piston 48 in cylinder 52 being in the first or innermost position indicated adjacent the cylinder 52.

The operation of the winder with respect to the oscillation of the carriage 34 and collett 18 is now described. As established in the above description of the electrical diagram in FIGURE 7, the collet starts to rotate and the strand initially formed is wound at the end of the collet tube for a timed interval until the collett gets up to the desired winding speed. After this interval, the normally open contact 1TR-1 closes energizing solenoid SV-1 of the solenoid valve 128. The valve 128 opens and exhaust line 156 is now open to valve 154. The balanced condition of air valve 58 is upset and the spool 135 and slide valve 145 move to reverse the flow of air through lines 54 and 56 to the cylinder 52 to cause the piston 48 and carriage 34 to move forward.

As the carriage 34 approaches its second or outermost position, the bar 159 engages poppet valve 153 to exhaust air through line 155 from end section 140 of the chamber 132 and unbalance the collett 58. The spool 135 and valve 145 are moved to their alternate position and the flow of air in lines 54 and 56 to the cylinder 52 is again reversed to stop the carriage at the second or outermost position and reverse its movement. A similar process is followed when the bar 159 engages poppet valve 154 on the return motion of the carriage and the carriage is stopped and reversed at a third position intermediate the first and second position.

The balancing and unbalancing of the air valve 58 causes the carriage and collett to move automatically slowly back and forth through a fixed distance between the second and third positions as determined by the location of the poppet valves and bar 159. The oscillation of the collett between the second and third positions determined by the poppet valves permits the on-size strand to be wound on the forming tube separately from the ejection of the collett where the off-size strand formed during the start up of the run is collected.

As described above the collett motor 60 was first started to rotate collett 19 and then after a delay through timer 1TR and its contact 1TR-1, the valve 128 was opened to initiate the movement of carriage 34 toward the outermost position. Because timer 3TR is inhibited at the time that solenoid SV-1 is energized, the timer 3TR after its delay (about 1 to 2 seconds) closes a normally open contact 3TR-1 of the on-delay type. Thus, after a short delay the coil 2M of the starter relay for traverse motor 116 is energized to begin rotation of the traverse. With this arrangement the traverse does not begin to rotate until the on-size strand is being wound on the forming tube.

At the same time that the traverse motor is started, a synchronous motor timer 4TR is energized, because timer 4TR is in parallel with coil 2M and in series with contact 3TR-1. This timer is set for example, for 10 minutes. At the end of 10 minutes timer 4TR times out to close its normally open contact 4TR-1 so that a warning light L in series with contact 4TR-1 in a circuit is lit to indicate to the operator that the run is complete. The operator then presses on the foot switch 125 to open contact FS-2. This de-energizes coil 1M of collett motor 60. At the same time the operator leads the strand by hand off the end of the tube and collett. This breaks the strand and the fiber forming is terminated.

When the foot switch 125 is depressed, the solenoid SV-1 of valve 128 is de-energized because contact 1M-2 is opened by the de-energization of coil 1M. This closes exhaust line 156 and prevents the exhausting of air to the atmosphere from end section 141 of the air valve 58. If the carriage 34 is moving inwardly at the time the solenoid SV-1 of valve 128 is de-energized, the outward travel will continue until the poppet valve 153 is contacted. When poppet valve 153 is contacted, the air valve 58 will be unbalanced, the air to the cylinder will be reversed to stop carriage 34 and start it moving inwardly. The carriage 34 will continue past the position defined by poppet valve 154 to its innermost position.

As mentioned above, the solenoid B was energized by the closing of contact 1M-3 in series with the solenoid B upon the energization of coil 1M. At the time that coil 1M is de-energized by the opening of contact FS-2 through the depression of switch 125, a coil PC of a plugging relay for motor 60 is energized to provide a reversing torque for collett motor 60 so that the rotation of motor 60 and collett 19 decreases. The relay containing coil PC at this time closes a normally open contact PC-2 in parallel with contact 1M-3 and in series with contact 1M. coil PC is in series with normally closed contact 1M-1 and a normally open contact 2TR-1 of time delay relay 2TR. Upon the energization of coil 2TR during start up of operations contact 2TR-1 was closed. As a result, coil PC is energized through the closing of contact 1M-1 upon the de-energization of coil 1M. However, the de-energization of coil 1M opens contact 1M-2 for de-energization of solenoid SV-1 also de-energizes coil 2TR so that contact 2TR-1 opens after its delay of about 5 seconds to de-energize coil PC. This stops the reversing torque and at the same time de-energizes solenoid B so that the brake 70 moves into its braking position. With this arrangement the braking is accomplished only after the spindle has been reduced to a slow speed of rotation.

During de-energization of coil PC to provide the reversing torque the energization of coil 1M is prevented because normally closed contact PC-1 is open as soon as coil PC is de-energized contact PC-1 closes. The operator must keep switch 125 depressed to keep contact FS-2 open in order that coil 1M remains de-energized.

Otherwise, contact 1M-3 would close to energize solenoid B which would prevent the operation of the brake. Also the closing of contact FS-2 would start motor 60 through energization of coil 1M. This above described method of stopping motor 60 is faster and more positive than previous systems employed in glass fiber winders.

This decreases the time required between runs and increases the time which the winder is available for fiber forming. The plugging of the motor permits use of the mechanical brake at low speeds only and this prevents overheating of the brake and reduces maintenance which would otherwise be required for repairing the brake.

If the length of the motor spindle in fixed position, the collett in turn is held steady at the end of the run. This facilitates the removal of the off-size strand from the end of the collett and the removal of the forming tube from the collett. The operator cuts the off-size from the collett prior to the removal of the forming tube and this can be done more easily without danger of the operator cutting himself during the severing of the strand. The forming tube can be removed and a new one in
sarted on the collett more easily when the collett is held stationary. When the operator releases his foot from the foot switch 125, the contact FS-2 is closed and a fiber forming run as described above is ready to begin again. If the operator wishes to discontinue the fiber forming operation and start a new run, the manual stop button PB-1 can be pressed rather than the foot switch at the end of the run.

Obviously, mechanical and electrical equivalents may be substituted for certain of the elements of the apparatus and some modifications of the apparatus can be made to obtain the results and objectives hereinafter set forth. For example, the winding operation may be made completely automatic by relocating the contact 4TR-1 so that it is in series with the stop button PB-1 instead of as shown and described. In this case the collet is stopped and moved to its innermost position at the end of the run automatically rather than requiring the operator to depress the foot switch to stop the fiber forming operation. It is preferred, however, to have the operator stop the fiber forming run rather than have it automatically stop for several reasons. If the operation is stopped automatically, glass which is extruding slowly from the bushing orifice may fall on to the finished package and ruin it. The molten glass may also fall on to the winding equipment and cause some damage to it. Also, automatically stopping the operation at a given time eliminates the formation of good strand on the forming tube during the short interval of time that is required for the operator to see the light and stop the run, thereby reducing production by a certain small percentage.

The above description of the apparatus and the details of its operation are intended to be exemplary and not limiting upon the scope of the invention except as set forth in the accompanying claims.

Claims:

1. A method of forming a glass fiber strand which comprises drawing a plurality of individual glass filaments from a source of glass, applying a size to the glass filaments, passing them through a stationary guide to group them into a strand, wrapping the strand in substantially parallel relation around one end of a cylinder while the cylinder is located in a first position, commencing rotation of the cylinder, increasing the rotation of the cylinder to a desired speed, thereafter moving the cylinder axially to a second position so that the strand is wound around the other end of the cylinder, engaging the strand at one location intermediate the guide and the cylinder after the axial movement of the cylinder, in a traverse position being intermediate the first and second positions, means for imparting a slight traversing movement to the strand as it is wound on the rotating cylinder, reversing the axial movement of the cylinder to cause the cylinder to move axially to a third position intermediate the first and second positions, axially reciprocating the rotating cylinder between the second and third positions while imparting a slight traversing movement to the strand being wound upon the cylinder so as to provide a supply of the strand on the cylinder, returning the cylinder to the first position, discontinuing the traversing movement of the strand and discontinuing the rotation of the cylinder.

2. Apparatus for forming a glass fiber strand which comprises a bushing, a guide for grouping the filaments drawn from the bushing into a strand, means for applying a size to the filaments and means for drawing the strand over the guide, said drawing means comprising a base, a carriage mounted on the base for longitudinal movement thereon between first, second and third positions, the third position being intermediate the first and second positions, a cylinder mounted on the carriage for movement therewith in an axial direction, a traverse mounted adjacent the cylinder so as to be in line with the bushing, and one end of the cylinder when it is in the first position, means for rotating the cylinder, means for moving the carriage to cause the carriage to move from the first position toward the second position, means for rotating the traverse, means for actuating the traverse rotating means, said traverse rotating actuating means being responsive after a delay to the means for actuating movement of the carriage from the first position toward the second position, and means for returning the carriage to the first position and stopping the rotation of the cylinder and traverse.

3. Apparatus for forming a glass fiber strand which comprises a bushing, a guide for grouping the filaments drawn from the bushing into a strand, means for applying a size to the filaments and means for drawing the strand over the guide, said drawing means comprising a base, a carriage mounted on the base for longitudinal movement thereon between first, second and third positions, a cylinder mounted on the carriage for movement therewith in an axial direction, a traverse mounted adjacent the cylinder so as to be in line with the bushing, and one end of the cylinder when it is in the first position, means for rotating the cylinder, means for actuating the carriage moving means to cause the carriage to move from the first position toward the second position, means for rotating the traverse, means for actuating the traverse rotating means, said traverse rotating actuating means being responsive after a delay to the means for actuating movement of the carriage from the first position toward the second position, and means for returning the carriage to the first position and stopping the rotation of the cylinder and traverse.

4. Apparatus for forming a glass fiber strand which comprises a bushing, a guide for grouping the filaments drawn from the bushing into a strand, means for applying a size to the filaments and means for drawing the strand over the guide, said drawing means comprising a base, a cylinder mounted on the base, an electric motor for rotating the cylinder, a normally engaged brake for stopping rotation of the cylinder, means for actuating the motor, means responsive to the motor actuating means for disengaging the brake, stop means for deactuating the motor actuating means, means for plugging the motor, means responsive to the stop means for actuating the motor plugging means, means responsive to the motor plugging actuating means for maintaining the brake disengaged, and means for deactuating the motor plugging actuating means after a period of time to stop the motor plugging and permit the brake to stop rotation of the cylinder.

5. Apparatus for forming a glass fiber strand which comprises a bushing, a guide for grouping the filaments drawn from the bushing to a strand, means for applying a size to the filaments and means for drawing the strand over the guide, said drawing means comprising a base, a carriage mounted on the base for longitudinal movement thereon between first, second and third positions, the third position being intermediate the first and second positions, a cylinder mounted on the carriage for movement therewith in an axial direction, an electric motor for rotating the cylinder, a normally engaged brake for stopping rotation of the cylinder, means for actuating the motor, means responsive to the motor actuating means for disengaging the brake, means for moving the carriage, means responsive to the motor actuating means for actuating movement of the carriage after a delay from the first position toward the second position, a traverse mounted adjacent the cylinder so as to be in line with the bushing, and one end of the cylinder when it is in the first position, means for rotating the traverse, means for actuating the traverse, said traverse ro-
tation actuating means being responsive after a delay to the means for actuating movement of the carriage from the first position toward the second position, means for controlling oscillating movement of the carriage between the second and third positions, stop means for returning the carriage to the first position and deactuating the motor and return means for rotating the traverse, means for lining the cylinder motor, means responsive to the stop means for actuating the plugging means, means responsive to the motor plugging actuating means for maintaining the brake disengaged, and means for deactuating the motor plugging actuating means after a period of time to stop the motor plugging and permit the brake to stop rotation of the cylinder.

6. An apparatus for forming glass fibers which comprises a bushing, a guide for grouping filaments drawn from the bushing into a strand, means for applying a size to the filaments and means for drawing the strand over the guide, said drawing means comprising a base, a carriage mounted on the base for longitudinal movement thereon between first, second and third positions, the third position being intermediate the first and second positions, a cylinder mounted on the carriage for movement thereon in an axial direction, means for rotating the cylinder, a first control means for actuating the cylinder rotating means, driving means for moving the carriage longitudinally on the base, a second control means for causing the carriage driving means to move toward the first position, a third control means for holding the carriage in the first position, a fourth control means responsive to the first control means for actuating after a delay the third control means and for actuating after the delay the carriage driving means to cause the carriage to move from the first position toward the second position, a traverse mounted adjacent the cylinder for operation at a single station intermediate the cylinder and in line with the bushing, guide and one end of the cylinder when it is in the first position, means for operating the traverse, a fifth control means responsive to the fourth control means for actuating the means for operating the traverse after the actuation of the carriage driving means, a sixth control means operating in combination with the second and fourth control means to permit reciprocative movement of the carriage between the second and third positions by the carriage driving means, a seventh control means for actuating the third control means and deactuating the first, fourth and fifth control means to cause the carriage to return to the first position, deactuating the means for rotating the cylinder and deactuating the means for operating the traverse, means for stopping rotation of the cylinder, and means responsive to the seventh control means for actuating the means for stopping rotation of the cylinder.

7. An apparatus for forming glass fibers which comprises a bushing, a guide for grouping filaments drawn from the bushing into a strand, means for applying a size to the filaments and means for drawing the strand over the guide, said drawing means comprising a base, a carriage mounted on the base for longitudinal movement thereon between first, second and third positions, the third position being intermediate the first and second positions, a cylinder mounted on the carriage for movement thereon in an axial direction, an electric motor for rotating the cylinder, a normally engaged brake for stopping rotation of the cylinder, a first control means for actuating the motor, means responsive to the motor actuating means for disengaging the brake, driving means for moving the carriage longitudinally on the base, a second control means for causing the carriage driving means to move toward the first position, a third control means to hold the carriage in the first position, a fourth control means for actuating after a delay the third control means and for actuating after the delay the carriage driving means to cause the carriage to move from the first position toward the second position, said fourth control means being responsive to said first control means, a traverse mounted adjacent the cylinder for operation at a single station intermediate the guide and cylinder and in line with the bushing, guide and one end of the cylinder when it is in the first position, means for operating the traverse, a fifth control means responsive to the fourth control means for actuating the means for operating the traverse, means for spinning the traverse operating means after the actuation of the carriage driving means, means for actuating the means for controlling reciprocative movement of the carriage between the second and third positions, a seventh control means for deactuating the first and fifth control means to stop the power to the motor and stop the traverse, said seventh control means also deactuating the fourth control means and actuating the third control means so as to return the carriage to the first position, means for plugging the motor, means responsive to the seventh control means for actuating the motor plugging means, means responsive to the motor plugging actuating means for maintaining the brake disengaged and means for deactuating the motor plugging actuating means after a period of time to stop the motor plugging and permit the brake to stop the rotation of the cylinder.

8. Apparatus for winding fibers which comprises a base, a carriage mounted on the base for reciprocal longitudinal movement thereon between first, second and third positions, the third position being intermediate the first and second positions, a cylinder mounted on the carriage for movement thereon in an axial direction, a traverse mounted adjacent the cylinder so as to be in line with one end of the cylinder when it is in the first position, means for rotating the cylinder, means for moving the carriage, means for actuating the carriage moving means to cause the carriage to move from the first position toward the second position, means for rotating the traverse, means and guide and in line with the motor for rotating the cylinder, a normally engaged brake for stopping rotation of the cylinder, means for actuating the motor, means responsive to the motor actuating means for disengaging the brake, means for moving the carriage, means responsive to the motor actuating means for actuating movement of the carriage from the first position toward the second position, means for controlling oscillating movement of the carriage between the second and third positions, means for returning the carriage to the first position and for reactuating the motor actuating means, means for plugging the motor for a timed interval after the motor actuating means has been deactuated, means for actuating the motor plugging means, means responsive to the motor plugging actuating means for maintaining the brake disengaged, and means for engaging the brake when the motor is running and is not being plugged.

9. Apparatus for winding fibers which comprises a base, a carriage mounted on the base for movement between a first position, a second position and a third position intermediate the first and second positions, a carriage mounted on the carriage for movement thereon in an axial direction, an electric motor for rotating the cylinder, a normally engaged brake for stopping rotation of the cylinder, means for actuating the motor, means responsive to the motor actuating means for disengaging the brake, driving means for moving the carriage longitudinally on the base, a second control means for causing the carriage driving means to move toward the first position, a third control means to hold the carriage in the first position, a fourth control means for actuating after a delay the third control means and for actuating after the delay the carriage driving means to cause the carriage to move from the first position toward the second position, said fourth control means being responsive to said first control means, a traverse mounted adjacent the cylinder for operation at a single station intermediate the guide and cylinder and in line with the bushing, guide and one end of the cylinder when it is in the first position, means for operating the traverse, a fifth control means responsive to the fourth control means for actuating the means for operating the traverse, means for spinning the traverse operating means after the actuation of the carriage driving means, means for actuating the means for controlling reciprocative movement of the carriage between the second and third positions, a seventh control means for deactuating the first and fifth control means to stop the power to the motor and stop the traverse, said seventh control means also deactuating the fourth control means and actuating the third control means so as to return the carriage to the first position, means for plugging the motor, means responsive to the seventh control means for actuating the motor plugging means, means responsive to the motor plugging actuating means for maintaining the brake disengaged and means for deactuating the motor plugging actuating means after a period of time to stop the motor plugging and permit the brake to stop the rotation of the cylinder.
plugging means, means responsive to the motor plugging actuating means for maintaining the brake disengaged, and means for deactuating the motor plugging actuating means after a period of time to stop the motor plugging and permit the brake to stop rotation of the cylinder.

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