Sept. 20, 1966 A. R. LACASSE 3,273,812

METHOD FOR FORMING AND WINDING GLASS STRANDS

Filed Nov. 13, 1962

FIG. 1

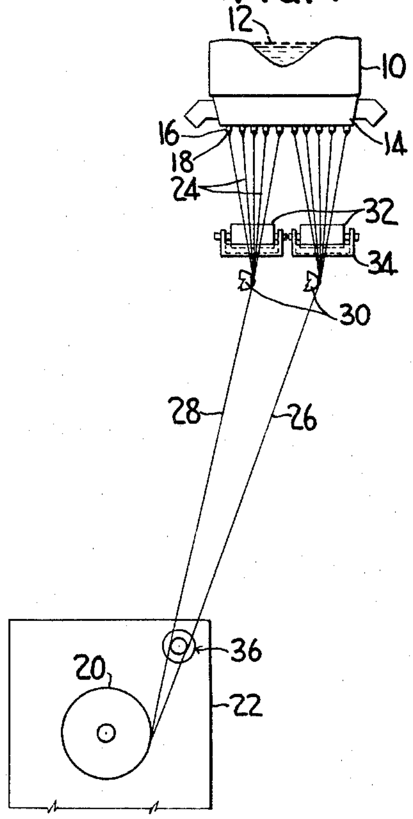
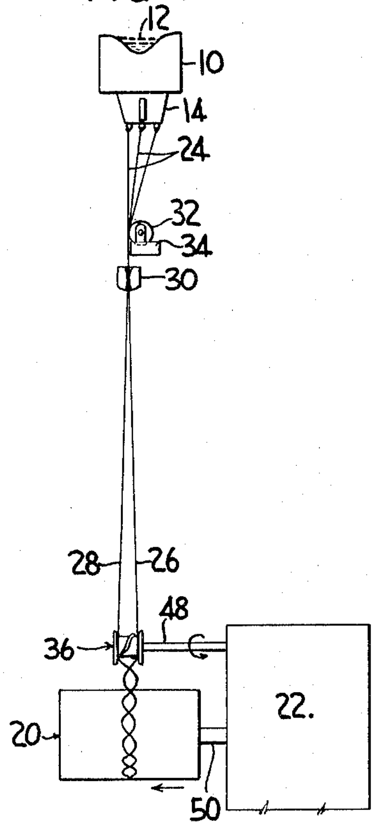


FIG 2



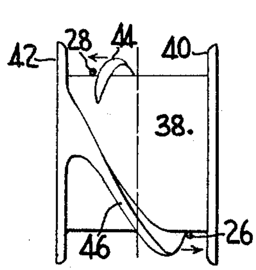


FIG.4

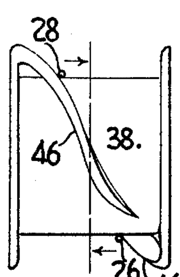


FIG.5

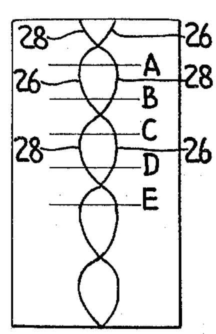


FIG.3

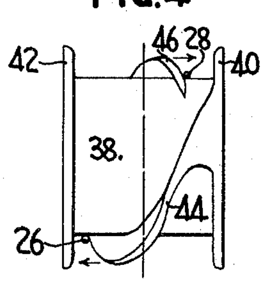


FIG.6

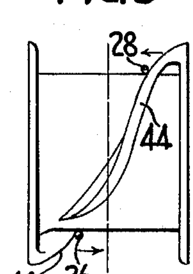


FIG.7

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METHOD FOR FORMING AND WINDING GLASS STRANDS

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1 Claim. (Cl. 242—42)

This invention relates to a method for forming and winding strands and it has particular relation to a method for forming a plurality of glass fiber strands and winding them on a single forming tube. The invention will hereinafter be described with respect to the formation of glass fiber strands, but it is to be understood that it is applicable to the winding of strands of other types of materials.

In the production of continuous filament glass fiber strand, a number of individual glass filaments are drawn from an electrically heated, platinum alloy bushing containing a molten supply of the glass. The glass passes through tips which define orifices in the bottom of the bushing and form inverted cones of glass suspended from the ends of the tips. The individual filaments are drawn from the cones of glass at a high rate of speed, i.e. 5,000 to 20,000 feet per minute, and are grouped into a strand as they pass over a suitable guide. The strand is thereafter wound on a rapidly rotating forming tube. The forming tube is rotated at approximately 2,000 to 15,000 r.p.m. depending upon the size of the fiber to be produced.

There is no twist in the strand as it is formed, and a size composed of a binder and a lubricant, such as starch and a vegetable oil, is applied to the individual filaments prior to the time they are grouped into the strand and wound on the tube in order to bond the filaments together and maintain the integrity of the strand. The size also reduces abrasion of the multiple filaments being attenuated. The single strand is usually wound on the tube with a slight traverse so that succeeding turns cross each other at an angle rather than parallel to each other. This facilitates the removal of the strands from the tube. The traverse is imparted to the strand after the filaments have been grouped into a strand and before the strand is wound on the forming tube by means of a suitable traversing mechanism.

The production of glass fiber strands by the above process is limited in that the rate of strand formation is dependent upon the rate at which the single strand is wound on the forming tube. It is apparent that a substantial increase in production could be attained if a plurality of strands could be wound on the same forming tube and readily unwound therefrom simultaneously as separate strands.

It has been proposed in the past to produce a plurality of strands at a single forming station and wind all the strands on a single forming tube. U.S. Patent No. 2,386,158 discloses a process where the filaments are separated into two groups and the filaments of each group are combined to form two separate strands. The strands are then simultaneously wound on a forming tube and traversed in one direction by a pinwheel type of traversing mechanism. The strands are wound on the forming tube in substantially parallel relation and in close proximity to each other. In the prior art process of U.S. Patent No. 2,386,158, especially at the end of each traverse, the strands frequently overlap and are in intimate contact with each other over a substantial portion of their length.

The winding of the strands on the forming tube is at a relatively high speed so that the size applied to the individual filaments is still moist as the strands are wound on the forming tube. The separate strands, when brought into intimate contact throughout a substantial portion of

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their length, adhere to each other much in the same manner as the individual filaments in each strand. U.S. Patent No. 3,056,711 discloses a process where separate strands may be permanently joined by bringing portions of their length into intimate contact and winding the strands onto a forming tube.

It has been further discovered that the tension of the separate strands as they are wound on the forming tube has a substantial effect on the unwinding of the separate strands from the forming tube. If the tensions on the strands are different from each other at corresponding points along their length, the strands tend to unwind unevenly from the forming tube. It is believed that uneven tension of the strands causes groups of turns to be removed at one time from the forming tube instead of a single turn at a time.

Both the bonding of the strands to each other and the uneven tension of the strands as they are wound on the forming tube cause the strands to break and interrupt the unwinding operation. It is, therefore, desired to lay the strands down on the forming tube in a manner that the strands have minimum contact with each other so that the strands have little opportunity to adhere to each other. It is further desired to lay the strands down on the forming tube with substantially the same tension on each strand so that the strands may be quickly and readily removed from the forming tube without pulling off many turns of the strands at one time.

In accordance with the present invention it has been found that the winding of a plurality of strands on a single forming tube by positioning the strands in overlying relation with each other, separately traversing the strands in predetermined time relation, and thereafter winding the strands on a forming tube provides a package of wound strands that may be readily unwound from the package as separate strands. The winding of a plurality of strands in the above manner may be accomplished by means of a suitable traversing mechanism. The strands are so positioned relative to the traversing mechanism that they are traversed in opposite directions. The traversing mechanism and the forming tube are rotated at predetermined speeds relative to each other so that the strands are wound on the forming tube with substantially the same tension on each strand and the strands cross each other at a substantial angle so that a minimum length of each strand is in touching relation with any other strand.

It is, therefore, a principal object of this invention to form a plurality of glass fiber strands and wind them on a single forming tube while separately traversing each strand.

It is a further object of this invention to produce a package of a plurality of glass fiber strands wound on a single forming tube in a manner that the strands can be separately unwound from the forming tube.

These and other objects will become apparent from the description of the drawing, in which:

FIGURE 1 is a view in elevation of a glass forming process utilizing the present invention;

FIGURE 2 is a side view of FIGURE 1;

FIGURE 3 is a developed surface of the forming tube illustrating the manner in which a pair of strands are wound thereon by means of the present invention.

FIGURE 4 is a top plan view of the traversing mechanism illustrating the relative position of the strands and their direction of traverse.

FIGURES 5, 6 and 7 are views similar to FIGURE 4 illustrating the relative position and direction of movement of the strands to each other as the traversing mechanism rotates through 90° increments.

In FIGURES 1 and 2 there is shown a glass melting furnace **10** containing a supply of molten glass **12** and having an electrically heated, platinum alloy bushing **14** attached to the bottom of the furnace 10. The bushing is provided with a plurality of orifices in the form of tips 16 through which molten glass flows and forms in small inverted cones 18 suspended from the bottom of tips 16. The tips are usually formed in a number of rows, for example, four to twenty, or more, rows, having a substantial number of tips in each row that the total number of tips is about two hundred to four hundred, or more, in number. The bushing is thus rectangular in shape with the longest dimension facing the operator and being at right angles to the axis of a forming tube 20, mounted on a winder support 22.

Glass filaments 24 are pulled from the cones 18 at a very high rate of speed, that is, 2,000 to 30,000 feet per minute, and wound on the rapidly rotating forming tube 20. The glass filaments are grouped into two separate strands 26 and 28 as they pass over two separate gathering shoes or guides 30.

Throughout the specification the invention will be described with apparatus for forming two strands. It should be understood, however, that a greater number of strands can be formed and wound on a single forming tube without departing from the scope of this invention.

The guides 30 are positioned below the bushing 14 and are aligned in the same vertical plane as illustrated in FIGURE 2. The guides 30 are in substantially the same horizontal plane which is parallel to the long dimension of the bushing. A size containing a liquid binder and a lubricant, such as a combination of starch and vegatable oil, is applied to the individual filaments prior to the time they are grouped in the strands. The size is applied to the filaments by passing the filaments 24 over rotating rolls 32 which are mounted for rotation in reservoirs 34 containing the size.

The strands 26 and 28 are drawn over the guides 30 in substantially the same vertical plane (FIGURE 2) and pass over a traverse mechanism generally designated by the numeral 36 as they are wound on the forming tube 20. The traverse mechanism 36 has a cylindrical body portion 38 with a pair of flanged end walls 40 and 42. There are a pair of spirally shaped complementary cam members 44 and 46 formed on the body portion 38. The cam portions 44 and 46 extend through slightly more than 180° of a convolution. The end of one cam terminates inside of the other end of the complementary cam member so that the cams 44 and 46 are overlapped at their end portions. The traversing mechanism 36 can be made of any material capable of resisting the wear action of the strands. The traversing mechanism 36 is positioned on a shaft 48 for rotation therewith. The shaft 48 is mounted parallel to the shaft 50 which carries the forming tube 20. The winder support 22 carries both shafts 48 and 50 and includes suitable mechanism to rotate the shafts 48 and 50 at preselected speeds and to move either shaft 50 or shaft 48 or both shafts 48 and 50 axially to suitably distribute the strands 26 and 28 as they are wound on the forming tube 20. For example, the shaft 50 and forming tube 20 could be reciprocated in the manner disclosed in U.S. Patent No. 3,041,662.

The traversing mechanism 36 is so positioned relative to the guides 30 and the forming tube 20 that both strands 26 and 28 ride on the traversing mechanism body portion 38 and are traversed laterally by the cam portions 44 and 46. For convenience, the strands 26 and 28 will be designated the top and bottom strands respectively since strand 26 is wound on the forming tube 20 in overlying relation with strand 28. The strands 26 and 28 are traversed or moved laterally relative to each other by means of the complementary cam surfaces 44 and 46 on traversing mechanism 36. The manner in which the strands 26 and 28 are laid down on the forming tube 20 is illustrated in both FIGURES 2 and 3. In FIGURE 3 the vertical lines A, B, C, D and E indicate the same position of strands 26 and 28 as is illustrated in FIGURES 4–7. The cam portions 44 and 46 extend through 180° and are complementary to each other so that with a complete revolution of the traversing mechanism 36 the strands 26 and 28 will cross each other twice and form a figure eight when viewed in plan.

FIGURES 4–7 illustrate the relative position of the strands 26 and 28 and their direction of lateral movement as the traversing mechansim 36 makes a complete revolution. In FIGURE 4 strands 26 and 28 are moving laterally away from each other. Cam portion 44 is urging strand 28 toward the flanged side wall 42 and cam portion 46 is urging strand 26 toward flange side wall 40. The relative position of strands 26 and 28 is indicated at A in FIGURE 3. As the traversing mechanism 36 rotates through 90°, the strands 26 and 28 have reversed their lateral direction of movement relative to each other and are now moving toward each other under the influence of the cam portions 44 and 46. The relative position of strands 26 and 28 as indicated in FIGURE 5 is illustrated at B in FIGURE 3. As the traversing mechanism 36 rotates another 90°, the strand 26 crosses over strand 28 and, as illustrated in FIGURE 6, the strands 26 and 28 are again moving away from each other. The relative position of strands 26 and 28 as illustrated in FIGURE 6 is indicated at C in FIGURE 3. In FIGURE 7 the strands have again reversed their direction so that they are again moving toward each other, as indicated at D in FIGURE 3. Thus, between the position indicated at C and at D the strands have reached the maximum lateral distance from each other and are again moving toward each other. In FIGURE 3 line E indicates the same position of the strands 26 and 28 as that of A. In this position the traversing mechanism has rotated to the position illustrated in FIGURE 4. It will be apparent from the foregoing description that the strand 26 crosses over the strand 28 twice during a complete revolution of the traversing mechanism 36.

The relative speeds of the forming tube and the traversing mechanism 36 are controlled so that the strand 26 crosses over a strand 28 at a substantial angle and there is a minimum amount of contact between the strands 26 and 28 at their point of intersection. The strands 26 and 28 do not tend to adhere to each other at the crossover since the length of the strands in contact with each is slightly greater than the diameter of a strand.

During the winding of the strands on the forming tube, either the forming tube or the traversing mechanism is reciprocated axially to distribute the strands 26 and 28 throughout the length of the forming tube 20. The distribution of the pair of strands axially in a conventional manner on the forming tube 20 does not hamper the unwinding of the strands from the forming tube. It is the relative position of the strands to each other and the manner in which the strands are laid down in a crossover relation that provides for their easy removal.

By positioning the strands 26 and 28 on opposite sides of the traversing mechanism 36, the tension on both strands is substantially the same. For example, when the strands 26 and 28 are at the maximum lateral distance from each other, substantially the same tension is exerted on both strands. Similarly, when strand 26 crosses over strand 28 both strands have substantially the same tension exerted thereon. As previously discussed, the strands unwind more evenly from the forming tube when both strands are under substantially the same tension.

Although the invention has been described utilizing the particular traversing mechanism illustrated in FIGURES 4–7, it should be understood that other suitable traversing mechanisms can be employed. One of the main features of this invention is to position the strands 26 and 28 on opposite sides of a traversing mechanism so that the strands will traverse in opposite directions and periodically the top strand crosses over the bottom strand at a substantial angle, as has been illustrated and described.

The present invention has described the winding of two strands on a single forming tube. It should be understood it is within the scope of this invention to utilize the features herein described to wind more than two strands on a single forming tube and unwind the strands separately and simultaneously from the single forming tube.

Although the present invention has been described with respect to specific details of certain embodiments thereof, it is not intended that such details serve as limitations upon the scope of the invention except as set forth in the following claim.

I claim:

A method of forming a plurality of untwisted strands and winding said strands on a single tube so that said strands can be unwound from said tube as separate strands which comprises,

drawing a multiplicity of individual filaments from a molten glass body,

grouping said filaments together to form a pair of spaced strands,

advancing said strands in overlying spaced relation to each other and in converging planes to a traversing station, which planes intersect at a point of take-up on a winding tube,

separately traversing said strands at said traversing station in opposite directions and in parallel planes as said strands are wound on said tube,

said strands being separately traversed at said traversing station so that said strands are deposited on said tube in continuously varying lateral spaced relation to each other with one strand alternately overlapping and crossing over the other of said strands at a substantial angle and alternately being spaced from the other strand,

and maintaining substantially the same tension on both strands as they are wound on said tube.

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