

Feb. 10, 1970

J. H. SEARS

3,494,753

APPARATUS FOR FORMING, COATING AND COLLECTING FILAMENTS

Original Filed Jan. 14, 1965

3 Sheets-Sheet 1

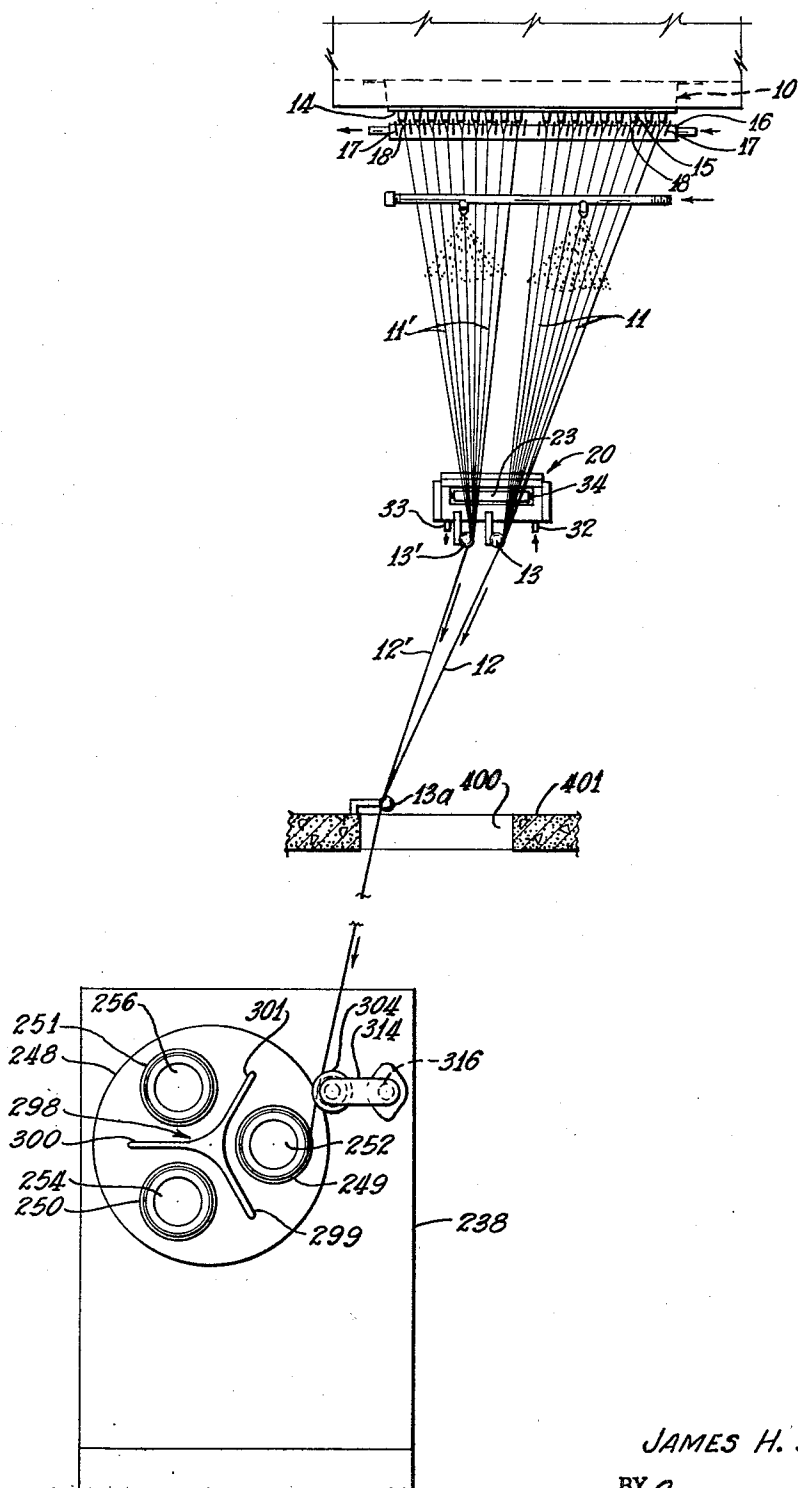


Fig. 1

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3 Sheets-Sheet 2

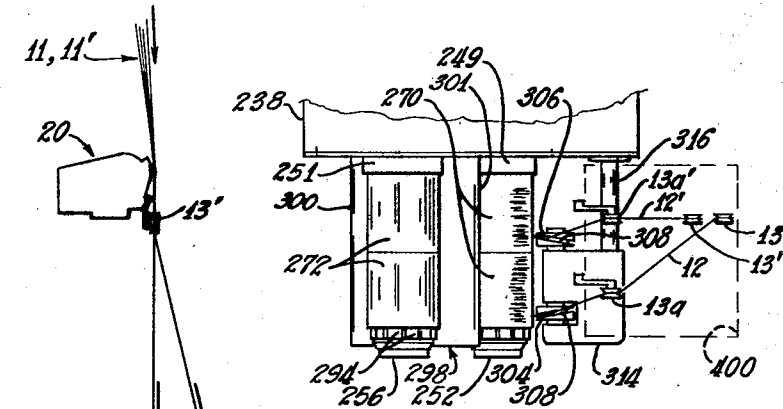


Fig. 3

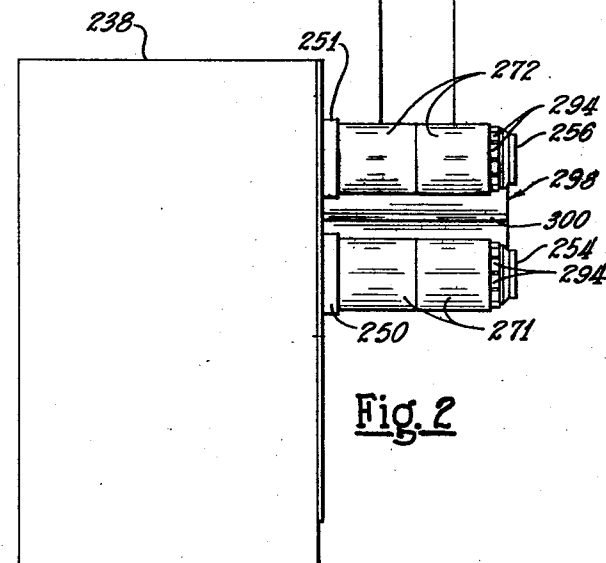


Fig. 2

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3 Sheets-Sheet 3

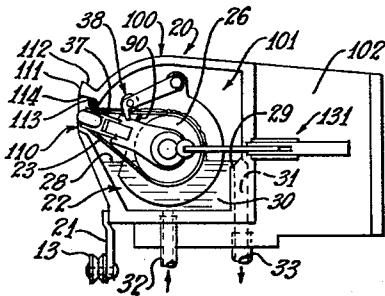


Fig. 4

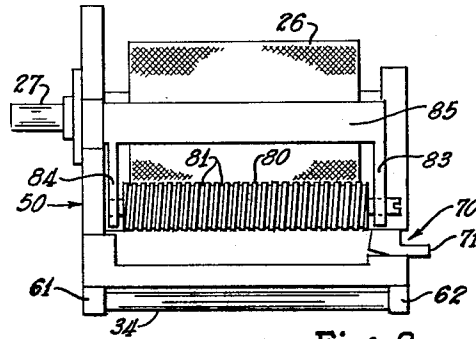


Fig. 8

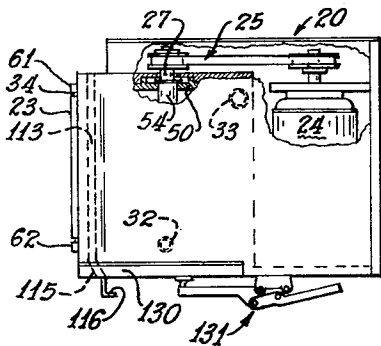


Fig. 5

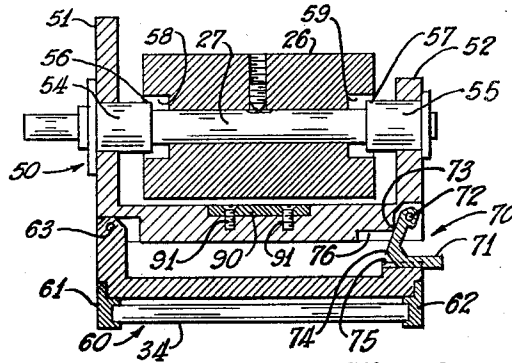


Fig. 9

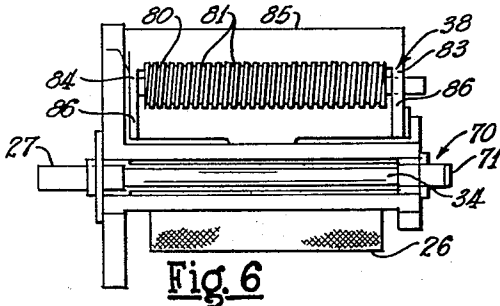


Fig. 6

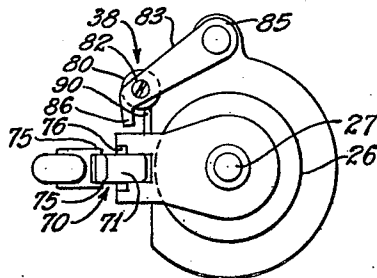


Fig. 7

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3,494,753

APPARATUS FOR FORMING, COATING AND COLLECTING FILAMENTS

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Continuation of application Ser. No. 681,294, Nov. 7, 1967, which is a continuation of application Ser. No. 425,459, Jan. 14, 1965. This application Mar. 28, 1969, Ser. No. 812,964

Int. Cl. C03b 37/08, 37/00

U.S. Cl. 65—11

4 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for producing a plurality of uniform packages from a plurality of groups of strands from a single filament forming station which includes a single applicator station for applying a coating to said filaments, means for gathering each group of filaments into a strand and guiding each group past the applicator station, rotating means for collecting each group into a package having a single means for driving the rotating collectors at a uniform speed, means for distributing each strand on its package, and guide means located intermediate the gathering means and distributing means for centering the strand with respect to the distributing means.

This application is a continuation of Ser. No. 681,294 which is a continuation of Ser. No. 425,459 filed Nov. 7, 1967 and Jan. 14, 1965 respectively, both abandoned.

This invention relates to a method of and apparatus for forming continuous filaments from attenuable materials and more particularly to a method of and apparatus for continuously attenuating groups of filaments from heat-softened glass or heat-softenable materials or fiber-forming resins, and collecting strands formed from groups of filaments by winding the strands upon a collector rotating at high speed. The invention is particularly directed toward a cooperation of components to control strand tension effects to attain the best package build-up and the highest yield with the fewest interruptions or breakouts, and the steps and apparatus connected therewith.

The more groups of filaments that may be formed at a single forming station the more economical the formation becomes in terms of return on the investment. There has, heretofore, been utilized apparatus for forming at least two groups of filaments at a station, i.e. producing two packages instead of one, as illustrated in U.S. Patent No. 3,109,602, issued Nov. 5, 1963. In that patent as well as all other utilizations of the production of a plurality of groups of filaments, a like plurality of applicator stations or means for applying a liquid coating to the filamentary material have been required. While this has improved the production for an individual fiber-forming station some difficulties have arisen in connection with the air and mechanical friction affecting strand tension and with the uniform application of liquid coatings to the filaments. Strand tension affects package build-up. If strand tension is too much a traversing means cannot properly distribute the strand on a package and may result in breakouts. If the strand tension is too light the package build-up is adversely affected, and may also produce breakouts because of whiplash effects.

It is, accordingly, an object of this invention to provide an improved method and apparatus for forming and collecting filaments as hereinafter described.

Another object of the invention is the provision of a method and apparatus for forming and collecting filaments wherein only a single applicator station is required.

A still further object of this invention is the provision

of method and apparatus for forming and collecting filaments in which a single applicator station is combined with means for guiding the plurality of strands to reduce whiplash effects of the strands between the applicator station and the collecting means.

The present invention provides a method of forming and collecting linear bodies of filamentary materials in packages including the steps of forming a plurality of groups of filaments, passing said filaments over a single applicator station, applying a liquid coating to said filaments at said applicator station, gathering each group of filaments into a strand, and collecting said strands in a plurality of packages. The method may include winding the plurality of strands into a like plurality of packages and guiding each of the strands into wrapping alignment with its respective package. The strands may be traversed to enable an even package build-up and the guide means may be located a predetermined distance from the traversing to confine whiplash effects in said strands.

Apparatus embodying the teachings of this invention may include means for forming a plurality of groups of filaments, means for gathering each group of filaments into a strand, a single applicator station adapted to apply a liquid coating to said filaments immediately prior and/or above said strand gathering means, and means for collecting said plurality of strands into package form. The applicator station advantageously includes a supply of liquid to be applied and rotating means positioned in contact with said liquid supply and further positioned in substantially tangential contact with the filaments. The applicator station further advantageously includes a housing substantially enclosing the rotating means, the housing having an elongated, horizontally extending aperture formed therein to enable contact of the rotating means and the filaments. The forming station may have means for maintaining a moist region ambient the filaments. The housing advantageously has a configuration formed to effect drainage of the moisture shaken from the filaments and to direct air flow moving with the filaments around the housing to assist in the drainage and to hold air turbulence to a minimum. The collecting means may include means for winding the plurality of strands onto a like plurality of rotating collectors in axially aligned adjacent relation and means for distributing each strand lengthwise of its collector. Means are provided for centering each strand with respect to its associated distributing means. The guide means may be located a predetermined distance from the distributing means to confine whiplash effects.

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 combinations of parts, elements per se and to economies of manufacture, and numerous other features will be apparent from a consideration of the specifications and drawings of a form of the invention, which may be preferred, in which:

FIGURE 1 is an elevational view illustrating a form of automatic winding apparatus suitable for the invention employed in carrying out the method of forming a plurality of groups of filaments;

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

FIGURE 3 is a plan view of a portion of the apparatus shown in FIGURE 1;

FIGURE 4 is an enlarged view of the applicator station of FIGURE 1;

FIGURE 5 is a plan view of the applicator station illustrated in FIGURE 4;

FIGURE 6 is a front elevational view of the belt supporting and metering portion of the apparatus of FIGURE 5;

FIGURE 7 is a view in elevation of the apparatus of FIGURE 6 taken from the right;

FIGURE 8 is a plan view of the apparatus of FIGURE 6; and

FIGURE 9 is a sectional view of the apparatus of FIGURE 7 taken at lines A—A.

Referring to the drawings in detail and initially to FIGURES 1 through 3, there is illustrated a feeder containing heat-softened, fiber-forming material such as molten glass. The feeder may be supplied with molten glass from a forehearth connected with a melting furnace (not shown) or otherwise provided with a supply. The floor 14 of the feeder is provided with a comparatively large number of tips or projections 15 and each of the projections is formed with an orifice or outlet through which the glass or other fiber-forming material in the feeder is discharged in fine streams 18.

The winding apparatus is constructed and arranged to simultaneously attenuate two groups of streams into two groups of continuous filaments 11 and 11' which are formed into dual strands 12 and 12' and the strands concomitantly wound upon rotating collector means to form packages of strand. The groups of streams are preferably delivered from a single feeder and each strand may contain upwards of 400 or more filaments. The feeder 10 is preferably formed of an alloy of platinum and rhodium or other material capable of withstanding the intense heat required to maintain the glass or other material in the feeder in a flowable condition.

The feeder may be connected with a source of electrical energy of comparatively high amperage and low voltage for heating the glass or other material within the feeder and the electrical energy controlled to maintain the material in the feeder at a proper viscosity so that the streams 18 of glass flowing through the orifices in the tips 15 are substantially uniform.

A manifold 16, provided with fins 17 extending between rows of the streams, is arranged to accommodate a circulating cooling fluid, such as water for cooling the streams to raise the viscosity of glass for improved attenuation.

In the illustrated embodiment of the invention, two groups of streams of glass or other material are drawn into continuous filaments and the filaments of each group are converged to form two strands 12 and 12' as shown in FIGURE 1. The groups of filaments 11 and 11' are converged as illustrated in FIGURE 1 by strand gathering members 13 and 13', so that both groups of filaments receive a liquid coating from a single applicator station 20. It is to be understood that while only two groups of filaments are shown that the discussion herein is illustrative of a fiber-forming station which may have a plurality of groups of filaments formed and converged to receive a liquid coating from a single applicator station.

A means is provided for delivering a sizing lubricant or other coating material onto the newly formed filaments by the applicator station 20. Applicator station 20 contains filament coating material and is provided with an inlet 32 and an outlet 33 through which material may be circulated in the station or receptacle by means of a pump or other circulator (not shown) connected with a supply of coating material.

Journalled within the station 20 is a roller which is adapted to be partially immersed in the filament-coating material in the receptacle. A second roller 34 is supported by the receptacle and an endless belt 23 of flexible material carries coating material over the rollers. One of the rollers is preferably rotated at a comparatively low speed by a motor. The filaments of each group are adapted to engage the belt at the region of the second roller 34 with a substantially tangential contact area, and coating material adhering to the belt during its movement through the material in the receptacle, transfers to the groups of filaments by wiping the contacts of the filaments with the belt. It is desirable to prevent breakouts which may be

caused by foreign particles adhering to the filaments by maintaining a moist region ambient the filaments and fine sprays of water may be delivered by a conduit and nozzle system into the attenuating region to purge the atmosphere of foreign particles.

The two strands of filaments 11 and 11' are simultaneously wound onto rotatable collectors into two individual packages, thereby securing a high production yield for the single forming station. As shown in FIGURES 1 through 3 the automatic winding and package-forming apparatus is inclusive of a housing 238 mounted on the floor of the room and beneath the feeder 14, the housing enclosing the electrical, mechanical and hydraulic means for controlling and actuating components of apparatus for attenuating filaments and automatically packaging the strands or linear material. This apparatus is described in greater detail in the above-noted Patent No. 3,109,602.

Secured to the frontal region of a turret is a circular turret plate 248 fashioned with three hollow boss portions 249, 250 and 251. Each of the hollow boss portions accommodates a winding collet and drive mechanism, the winding units being identical. The units are respectively inclusive of driving collets 252, 254 and 256, provided with individually operable electrically energizable motors. The three collets 252, 254 and 256 are spaced circumferentially equal distances apart and their individual axes of rotation are disclosed at equal radial distances from the axis of rotation of the indexible head or turret. The turret is adapted to be moved at each indexing cycle through one-third of a revolution by means of an indexing motor. The purpose of indexing the collets is to successively move completed strand packages away from winding position and to move empty or strand free sleeves or tubes into winding or strand collecting position. Each of the collets or mandrels 252, 254 and 256 is adapted to accommodate strand-collection means and in the embodiment illustrated each collet is equipped with two collectors, the three groups of collectors being designated 270, 271 and 272, respectively. Each winding unit or collet assembly is inclusive of a motor driving the collet. Each of the motors for rotating the winding collets is of the type in which the speed may be varied by varying the frequency of the current supplied to the motors for the purpose of reducing the speed of rotation of a collet as a strand package increases in diameter during the winding operation.

The peripheral region of each of the collets is formed with longitudinally extending recesses in which are disposed bars or friction shoes 294 which are biased radially outwardly of the collets by means of springs or flexible plates. The resiliently biased bars 294 engage interior surfaces of the winding tubes or collectors and frictionally grip the tubes for rotation with the collet.

Baffle means 298 comprising radially extending plates 299, 300 and 301 is supported by the turret frontal plate 248, the members extending between adjacent collets to confine water sprayed onto strand oscillators in the region of the strand package being formed.

There is shown in FIGURES 1 and 3 primary strand traverse means for distributing the strands lengthwise of the packages and secondary traverse means or high-frequency oscillators for guiding the strands in angular directions as the strand is deposited or wound on the collectors in a manner to build a flat or level wound package. The traverse arrangement illustrated includes rotatable strand guiding oscillators or members which are reciprocated by an adjustable reducing stroke builder motion or primary traverse of low-frequency and high-amplitude which, combined with the low-amplitude and high-frequency oscillation, imparts to the packages a generally uniform thickness with tapered ends to prevent sloughing of the strand at the end of the packages. This arrangement is shown and described in detail in the above-mentioned Patent No. 3,109,602. Other traverse arrangements such as known to those skilled in the art may be suitable for use in this invention.

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In the traverse arrangement, the means for establishing the primary builder motion and the second high-frequency oscillation of the strand are powered by hydraulic means. In the embodiment illustrated, a rotatable strand-guiding oscillator is provided for each of the dual strands, the oscillators being 304 and 306. The high-frequency strand oscillators 304 and 306 are arranged to be driven at very high speeds and perfect balance of the oscillators is essential for successful high-speed operation. Each of the traverse oscillators has its peripheral region formed with an angular or cam slot, recess or groove 308 to impart oscillation to the strand, the base of the slot and each oscillator being defined by a cylindrical hub-like portion generated about an axis normal to the plane of the slot 308.

The strands 11 and 11' engage in the respective grooves or cam slots 308 of the traverse members 304 and 306 whereby each strand is guided by an individual traverse oscillator onto a sleeve or collector. Each of the grooves is preferably of the harmonic motion type of configuration to effect during rotation of the traverse members, a winding of the strands on each collector and overlapping wraps or convolutions in crossing, non-parallel relation.

By forming the wraps in crossing relation the tendency of the wraps or convolutions of the strands to wedge or adhere together is reduced to the minimum so that the liability of strand breakage, when the strand is unwound from the package in subsequent processing operations is greatly reduced. A supporting means or traverse carrier 314 is provided for the traverse oscillators, the carrier 314 being reciprocable lengthwise of the strand collectors through a substantial distance at a comparatively slow rate of reciprocation to distribute the strand, controlled by the oscillators 304 and 306, lengthwise on the package being formed.

The traverse oscillator carrier 314 is mounted upon a cylindrically shaped supporting shaft or member 316. The member 316 is supported by a supplemental frame and is reciprocably or slidably mounted in suitable bearings carried by the supplemental frame. The cylindrically shaped member 316 is controlled to reciprocate through progressively reduced distances providing the builder motion for distributing the strands lengthwise of the collector sleeves and concomitantly form the tapered end regions of strand in the packages.

In the formation of a plurality of strands from a plurality of groups of filaments over a single applicator station as described above, it is necessary to converge the groups of filaments into strands by strand-gathering means 13 and 13' at narrowly spaced positions. It is then advantageous to provide further guide means 13a and 13a' to center the strands with respect to its associated distributing means for best operation. The guide means 13a and 13a' preferably are utilized to center the strands 12 and 12' and further may be advantageously used in particular applications to reduce the whiplash effects of the strands 12 and 12' by confining the free distance of the strands between the gathering means 13 and 13' and the distributing means including the oscillators 304 and 306. The guide means 13a and 13a' are spaced a predetermined distance from the distributor means to properly confine the "whiplash" effects of the strands 12 and 12'. In this particular embodiment the fiber-forming and applicator means are located in a room above the room housing the means for collecting the material into packages below, with the strands 12 and 12' passing through an opening 400 formed in the floor 401. The guides 13a and 13a' are shown secured to the floor at the predetermined distance to best confine the whiplash effects. The whiplash effects may cause breakout or other interruptions in the proper collection and distribution of the strand onto the collectors 270, 271 and 272. It is to be noted that in the embodiment illustrated that at least one of the strands (e.g. strand 12') may be centered with respect to the distributing means of its collector without requiring a guide means

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13a' for such centering (see FIGURE 2). However, the centering discussed with this invention includes said centering of one strand without benefit of the particular guide means by properly locating the guide means 13a'. The guide means 13a' may still be advantageously used to confine the whiplash effects discussed above and/or to pass the strand 12' over a corner of the opening 400 in the floor 401 as illustrated in FIGURE 3.

Referring now to FIGURES 4 and 5 there is described in greater detail the applicator station indicated generally by the reference number 20. The applicator station 20 includes the gathering means 13 and 13', a coating material supply tank 22, a coating transfer belt generally indicated at 23 and the necessary apparatus for driving a transfer belt 23 including a motor 24 and power connection as generally indicated at 25 which may include belt and pulley means.

The transfer belt is mounted upon a crown drum or roller 26 which is, in turn, supported by a shaft 27 driven from the power connecting means 25 and extending horizontally over the liquid material supply tank 22, at such a level that the peripheral surface of the drum or roller 26 dips beneath the level of a supply of coating material, generally indicated at the tank 28, in the tank 22. The level of the coating material 28 is maintained by a weir 29 extending transversely across the tank 22 and separating the tank 22 into a supply compartment 30 and an overflow compartment 31. A coating material input line 32 leads to the bottom of the supply compartment 30 and a return line 33 leads from the overflow compartment 31 to a pump and supply for the coating material (not shown).

The belt 23 is also engaged over a nose or guide or roller bar 34 mounted in the framework generally indicated at 50 and extending parallel to the axis of the drum or roller 26 above or in front of this supply tank 22. As can be best observed in FIGURE 4 when the belt 23 is in position on the roller 26 and nose bar or roller 34, the front edge of the belt is vertically positioned directly above the apices of the V-shaped slot in the gathering means 13 and 13'.

In operation, the drum or roller 26 is rotated at constant speeds so that the belt 23 is moved through the pool of coating material 28 and picks up a layer of the coating substance on its outer surface. The layer of coating material generally indicated at 37 is leveled and metered by a metering bar means 38 and is carried forward across a span of the belt 23 and around the nose bar or roller means 34 moving in the same direction around the nose bar as the group of filaments 11 and 11'. The groups of filaments 11 and 11' wipe through the layer of coating material 37 with a controlled quantity of the material adhering to each of the filaments as each filament is submerged in and pulled out of the coating 37. The quantity of material adhering to each of the filaments is referred to as "controlled" because by proper coordination and relationship of the viscosity, temperature and other characteristics for the coating material, the metering of the material, and the lineal speeds of the belt 23 and the groups of filaments 11 and 11', a uniform thin coating of material is continually transferred to or picked up by the groups of filaments 11 and 11'. It is thus possible to attain a more uniform percentage of size or other liquid coating applied to each filament since a plurality of groups of filaments are passed over a single applicator station in which the quantity of material adhering to each of the filaments is "controlled" as described above. Thus, package to package uniformity is attained at a single station that has not been heretofore possible.

The unique supporting arrangement structure for the belt means also aids in the uniformity of size or coating applications. Other applicator means have utilized cantilevered nose bar guide means and pickup roller means in which there has been difficulty in maintaining the parallel relationship desired, maintaining the belt in the

proper tracking relationship, and problems arising with the entanglement of loose filaments with any rotating components that are exposed. These problems are of course multiplied when a plurality of groups of filaments are passed over a single applicator station. The problems are overcome by the provision of the following means. Referring to FIGURES 6 through 9 a framework generally indicated at 50 has a first yoke means with arms 51 and 52 for supporting the roller means 26. Bushing means 54 and 55 are set in arms 51, 52 and journal support shaft 27 upon which roller 26 is mounted. Enclosing flanges 56 and 57 surround the shaft 27 and extend into the cavities 58, 59 formed in the ends of the roller means 26 around the shaft 27. The extending flanges 56, 57 are advantageously a portion of the bushings 54, 55 and provide internal bearing surfaces. However, the flanges 56, 57 may be other suitable protective assemblies. In order to assemble the roller 26 into its operative position the roller 26 may be placed in a position shown in bushings 54, 55 and press fitted into place. Shaft 27 is then inserted into bushings 54, 55 and may be retained in place by suitable means such as a washer and snap ring configuration that fits into a key groove on the shaft 27. The roller 26 may be retained in a stationary position with respect to the shaft by the use of a set screw cooperating with a flattened portion of the shaft 27. By using this arrangement it will be noted that no rotating components other than the roller itself are exposed so that filaments may not become wrapped around or entangled with the rotating shaft 27.

The framework 50 also includes a second yoke means generally indicated at 60 having a first and second arms 61 and 62. The nose bar means 34 is preferably journaled in arms 61 and 62 in parallel relationship with respect to roller means 26. However, the nose bar means 34 may be held in a stationary position if desired and be formed with a smooth, curved outer surface so that the transfer belt 23 may be slidably driven over the nose bar 34 by means of the roller 26. While this arrangement avoids having to clean nose bar bearings, the belt will wear more quickly. Side 61 of the yoke 60 is pivotable at pin 63 mounted on framework 50 so that the side or arm 62 may collapse toward the roller 26 by the use of the collapsible locking means generally indicated at 70. A trigger 71 is pivotally mounted on a pin 72 attached to framework 50. When in the locked position, the trigger 71 abuts against a shoulder 73 formed on the framework 50. A cam surface 74 is formed on the trigger 71 to aid in urging the nose bar means to a parallel relationship desired. A pair of flanges 75 extend from the arm 62 to form a slot to receive the cam surface 74 of the trigger 71. A slot 76 is formed in the framework 50 to receive the flanges 75 when the nose bar is in the collapsed position so that the slot formed by the flanges 75 will be in the proper position to receive the trigger 71 when it is urged in the locking position. The assembly just described affords the advantage of collapsing the nose bar toward the roller means so that the belt 23 may be quickly and easily placed on or removed from its desired position without stressing or tearing the belt. Because there is a crown formed on the roller 26 the belt may be installed while the roller 26 is operating and the crown portion will be operative to generally center the belt 23.

The metering bar means generally indicated at 38 comprises a cylindrical roller 80 advantageously having helical grooves 81 formed therein to properly meter the liquid supply. The cylinder 80 is rotatably mounted at 82 in support arms 83, 84 which form a portion of the cantilevered pivoting meter bar framework 85. The framework 85 is positioned to be rotated out of the way during installation of the belt 23. A pair of guide arms 26 depend below the cylindrical roller 80 and are adapted to guide the belt 23 in its proper tracking position over nose bar means 34 and roller means 26.

A stripper bar means 90 is mounted by suitable attach-

ing means 91 to the framework 50 and is positioned to be on the inside of the loop formed by the belt 23 to strip from the inside of the loop any excess of the liquid supply material. The stripper bar 90 will contact the belt 23 at a position just prior to the metering contact of the cylinder 80 and is advantageously operative to raise the belt 23 to insure both a better stripping of the material from the inside of the belt as well as insure better contact of the metering bar 80 with the exterior surface of the loop of the belt 23.

The housing is generally indicated at 100 and has an applicator compartment 101 and a motor compartment 102. The liquid supply tank is advantageously formed within the applicator compartment 101 and has been described. The housing substantially encloses the applicator equipment and is advantageously formed from glass fiber reinforced plastic which, in combination with a substantial enclosure of the apparatus in the liquid supply tank, is operative to maintain the liquid supply at a desired temperature and insulated from the ambient atmosphere. An elongated horizontally extending aperture generally indicated at 110 is formed in the housing. The nose bar means 34 is positioned to extend through the aperture to provide an exposed contact area on the belt 23 for the filamentary material.

The housing may be formed so that one entire side is closed by a door means 130 which enables the molding of the housing in one piece and facilitates entrance to the housing for maintenance and for belt removal and installation. The door means is preferably of a transparent material such as an acrylic plastic so that the operation of the applicator equipment and the level of the sizing material may be ascertained without opening the door. A door closing and opening means is generally indicated at 131 and may comprise a locking toggle clamp that is well known in the art.

When glass fibers or other continuous filaments are formed, extraneous water or other liquids may collect on the filaments between the time of formation and arrival at an applicator. Because of the speed of passage of the filaments a negative pressure area exists in the aperture above the belt producing a tendency to pull or blow the liquid toward the belt and the inside of the housing of the applicator station. In using a single applicator station in the present invention a configuration may be advantageously formed in the upper side of the aperture 110 to effect drainage of the extraneous liquid or moisture shaken from the filament and, in combination with the remainder of the housing, may direct the air flow moving in the direction of the filaments around the housing and substantially reduce the total air friction for a plurality of groups of filaments being formed into a like plurality of strands. The configuration comprises a lip 111 extending toward the filaments which also forms a trough 112 with the housing to drain part of the water or extraneous liquid away. The lip 111 is spaced far enough from the filaments to avoid contact by vibration of the filaments but spaced close enough to prevent water from being blown onto the belt 23. The lip 111 and trough 112 also divert the air flow normal to the applicator station to help drain the water through the trough 112 and, in combination with the curved upper portion of the housing 100, to create the least turbulence possible and to reduce the air friction even further.

Experiments have indicated that this spacing of the lip from the filaments is advantageously between $\frac{3}{32}$ and $\frac{5}{32}$ of an inch. The configuration further includes a second trough 113 formed in the housing 100 beneath and communicating with the underside 114 of the lip to drain water or extraneous liquid collected on the front and underside of the lip 111. If the entire housing is not formed of the glass fiber reinforced plastic material described above, the lip advantageously is formed of or coated with a material on which an even wetting action will occur so that the water will flow evenly into the

second trough 113 and not form drops which will fall on belt 23. The trough 113 may include a portion 115 which is angled away from the filaments so that the passage of the filaments will not pull the water draining from the trough portion 115 towards the strands. Rather than inclining the portion 115 away from the filamentary material, or in conjunction with the inclining of the portion 115 of the trough 113 away from the filamentary material a shield 116 may be installed at the trough outlet. To prevent the water being drawn back onto the filamentary material the trough may be sloped toward its drainage point.

The underside 114 of the lip 111 is advantageously inclined at least 15 degrees from the horizontal but not more than 30 degrees to insure a proper flow of the water collected on the underside 114 of the lip 111 into the second trough 113. If the inclination is too small the water will not run into trough 113 but will form droplets which will fall on belt 23. If the inclination is too large the velocity of the water running into trough 113 will be too high and it will spill over the front of the trough and onto belt 23.

The bottom of trough 113 is spaced close enough to the belt 23 to prevent water being blown back into the housing 100, but is spaced far enough from the belt 23 to avoid contact with the liquid supply 37 being carried on the belt 23. Experiments have indicated that this spacing is advantageously approximately $\frac{3}{16}$ of an inch. The trough 113 must also be spaced far enough from the forwardmost portion of the lip 111 to prevent water being sucked out of the trough by passage of the filaments, but not spaced too far in order to avoid the water dripping from the underside 114 of the lip 111 instead of running into the trough 113. Experiments have indicated that most advantageous spacing of the trough is approximately $\frac{3}{8}$ of an inch from the center line of the trough to the filaments. The spacing discussed may vary with the speed of passage of the filaments, the type of extraneous liquid, the number of plurality of groups of filaments being passed over the applicator station, etc. The above-described air-diverting and moisture-draining means becomes particularly important when a plurality of groups of filaments are being passed over a single applicator station at high speeds, since there is an increase of moisture resulting from an increased number of filaments. Further, the air flow with the groups of filaments is changed from that when only a single group is passed over the applicator station. The housing is advantageously formed to combine aerodynamic effects with an economy of material, as well as suitable compartments for the components discussed hereinbefore, to best enhance the uniformity of application of a liquid coating to the filaments as well as least affecting the strand tension required to most advantageously wind the strands onto a plurality of packages with the least interruptions from breakouts, whiplash effects, etc.

It is apparent that, within the scope of this 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. Apparatus of the character disclosed for producing a plurality of uniform packages wherein each package contains a strand substantially identical to the strands on the other packages, in combination, means for forming a plurality of groups of filaments at a single filament forming station, a single applicator means for applying a coating to said filaments including means for controlling the amount of coating material applied to each filament thereby providing uniformity of coating for each filament and thus package to package coating uniformity, a like plurality of means for gathering each of said plurality of groups of filaments into a like plurality of strands, said plurality of gathering means being located at spaced

and aligned positions with respect to each other to guide the filaments in each of the groups past the single applicator station in spaced-apart paths thereby reducing air friction and breakouts and maintaining the fiber fans of each group in alignment with each other to insure application of attenuation forces to each fiber fan which are uniform with respect to the other fiber fans, means for collecting each strand into a separate package, said collecting means including means for winding said plurality of strands onto a like plurality of rotating collectors and a single driving means for said collectors to provide a uniform tension on all of said strands and to pull said filaments past said applicator station at a uniform linear speed to ensure the application of a uniform coating to each filament to obtain substantially identical strands, means for distributing each strand back and forth along its collector, and guide means for each strand located between said gathering means and said distributing means for centering each strand with respect to its associated distributing means to provide more effective distribution and to reduce whiplash effects produced by the back and forth movement of said distributing means which cause strand breakouts and non-uniformities in strand tension which permits non-uniform coatings to be applied to said filaments at said applicator station.

2. Apparatus for producing a plurality of packages of glass fiber strands, wherein the strand on each package is substantially equal to the strand on any of the other of the plurality of packages comprising, a feeder means for containing a body of molten glass and having a plurality of orifices formed in a floor thereof for discharging streams of molten glass, winder means located below said feeder means for attenuating said streams into continuous glass filaments, a single applicator station intermediate said winder and feeder means for applying a coating to each of said filaments, a plurality of gathering members for dividing the filaments into a like plurality of groups and forming a like plurality of strands, said gathering members being disposed below said applicator station in an alignment to converge said groups of filaments into fiber fans having substantially the same angular approach to said applicator station and to cause individual filaments to have wiping contact with the coating material provided by said applicator station, said winder means including a single means for driving a rotating collector for each strand to provide a uniform attenuating tension on all of said strands and to pull each filament past said applicator station at a uniform linear speed to insure the application of a uniform amount of coating to each filament, means for traversing each strand along the length of its collector, and guide means for each strand located intermediate the gathering member and the traverse means for the strand for centering each strand with respect to its traverse means and to reduce the oscillatory movement of the strand produced by the traverse means, all of said guide means being spaced apart in a direction substantially normal to the alignment of the gathering members to more readily confine the whiplash effect of the oscillation of the strands.

3. Apparatus as defined in claim 2 in which each of said strand gathering members has a filament group receiving and strand forming groove formed in a surface thereof and opening in a first direction, and in which each of said strand guide means has a strand receiving groove formed in a surface thereof which faces in a direction substantially opposite to that of the gathering member grooves, the strand guide members being positioned past a line defined by its associated gathering member and traverse means so that a strand is pulled over said guide means under tension to more effectively confine oscillatory movement imparted thereto by said traverse means.

4. Apparatus for producing a plurality of packages of glass fiber strands, wherein the strand on each package is substantially equal to the strand on any of the other of the plurality of packages comprising, a feeder means

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for containing a body of molten glass and having a plurality of orifices formed in the floor thereof and arranged in a row for discharging streams of molten glass, winder means located below said feeder means for attenuating said streams into continuous glass filaments, a single applicator station including a roller for applying a coating to each of said filaments, said roller being rotatable about an axis parallel with said row of orifices, a plurality of gathering members for dividing the filaments into a like plurality of groups and forming a like plurality of strands, said gathering members being disposed below said applicator station in alignment in a plane substantially parallel with the axis of the roller to converge said groups of filaments into fiber fans having substantially the same angular approach to said applicator station and so located as to bend the filaments over the roller so as to cause them to have wiping contact with the roller, said winder means including a plurality of rotating collectors in axial alignment, there being one rotating collector for each strand, means for traversing each strand along the length of its collector, and guide means for each strand located

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intermediate the gathering member and the traverse means for the strand for centering each strand with respect to the stroke of its traverse means and to minimize the extent of the oscillatory movement of the strand produced by the traverse means, said guide means being spaced apart in a direction substantially normal to the plane in which the gathering members are located to more readily confine the whiplash effects of the oscillation of the strands.

References Cited

UNITED STATES PATENTS

3,056,711	10/1962	Frickert.
3,254,978	6/1966	Hayes.
3,281,224	10/1966	Lowe.

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