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F. A. MENNERICH

3,206,924

METHOD OF FORMING FIBROUS GLASS YARN

Filed Sept. 27, 1961

3 Sheets-Sheet 1

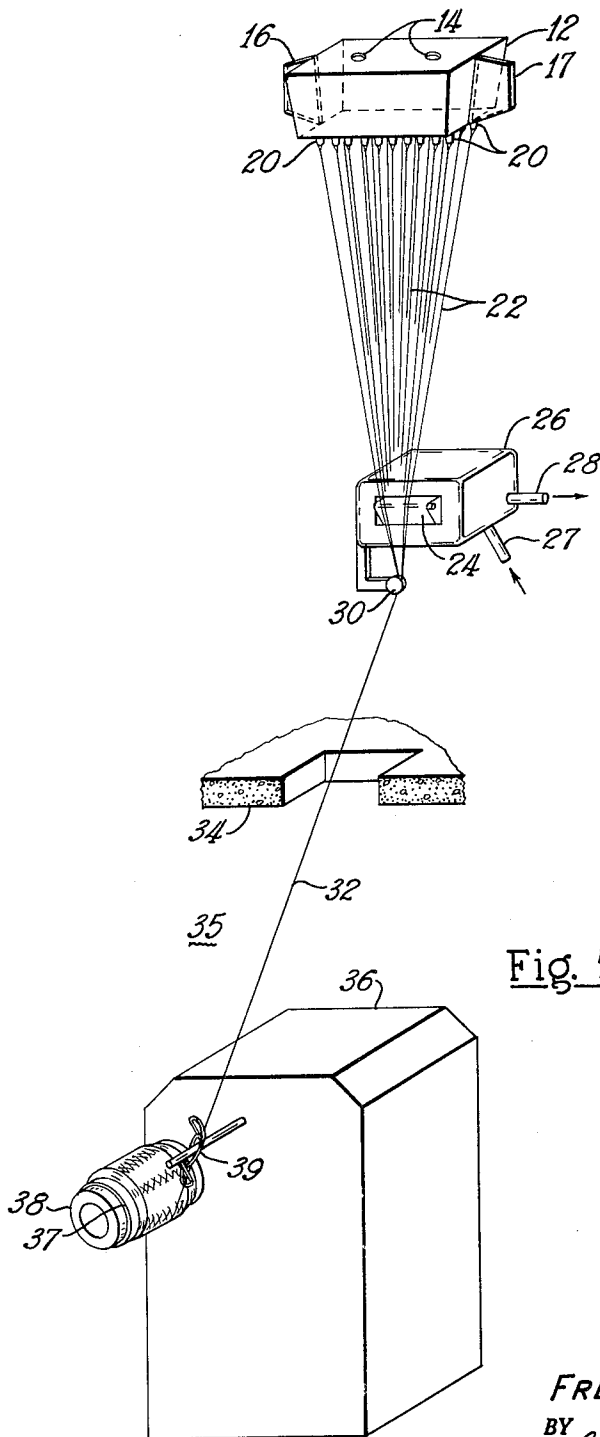


Fig. 1

INVENTOR.  
FRED A. MENNERICH  
BY  
*Stachin & Overman*  
ATTORNEYS

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F. A. MENNERICH

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3 Sheets-Sheet 2

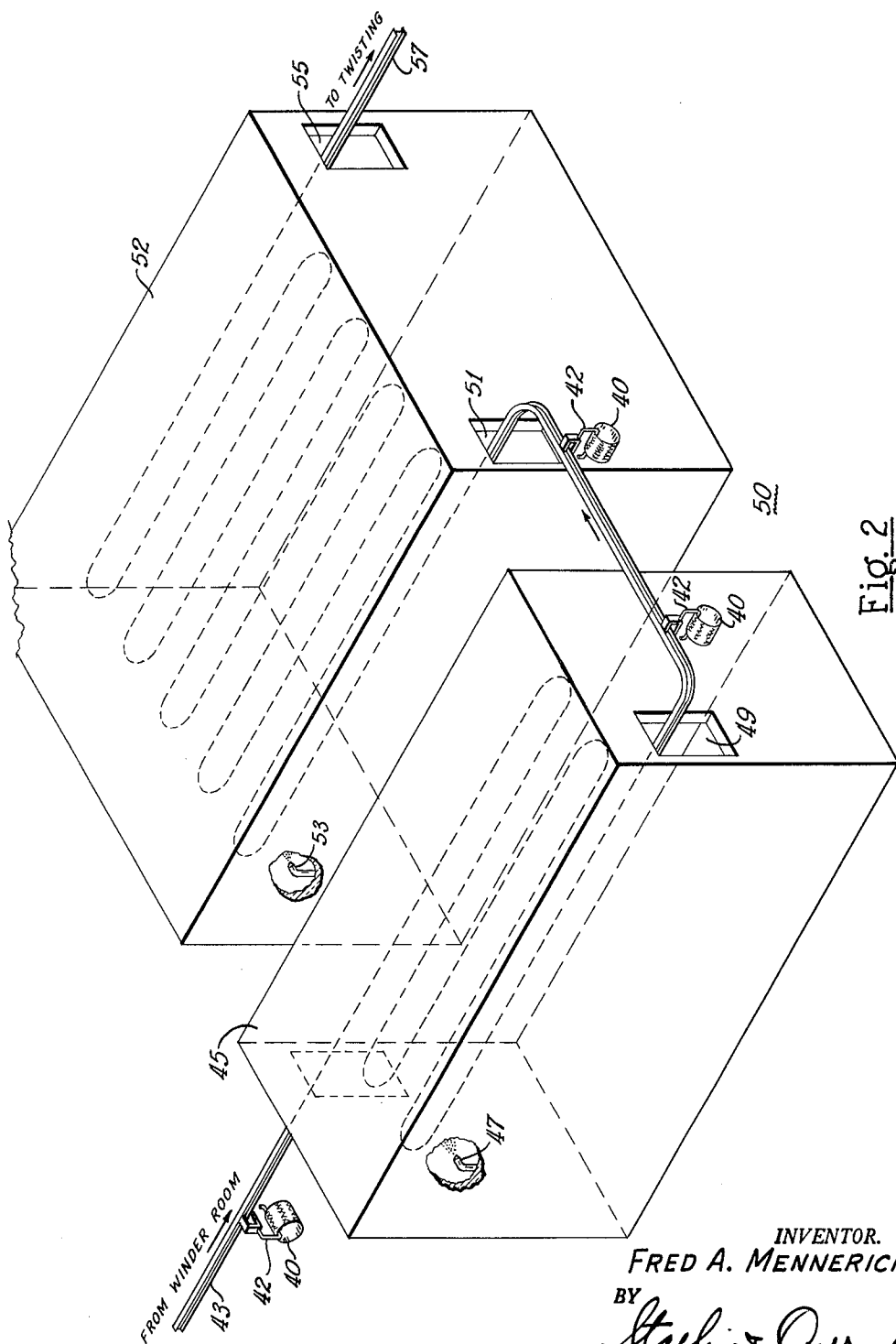


Fig. 2

INVENTOR.  
FRED A. MENNERICH

BY

*Stackin & Overman*  
ATTORNEYS

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F. A. MENNERICH

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3 Sheets-Sheet 3

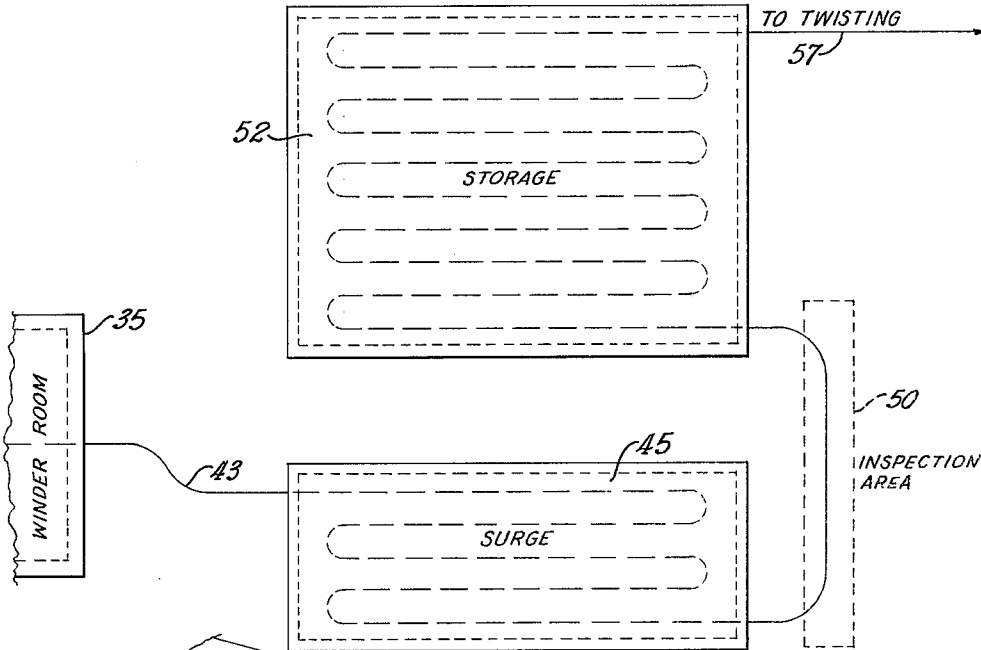


Fig. 3

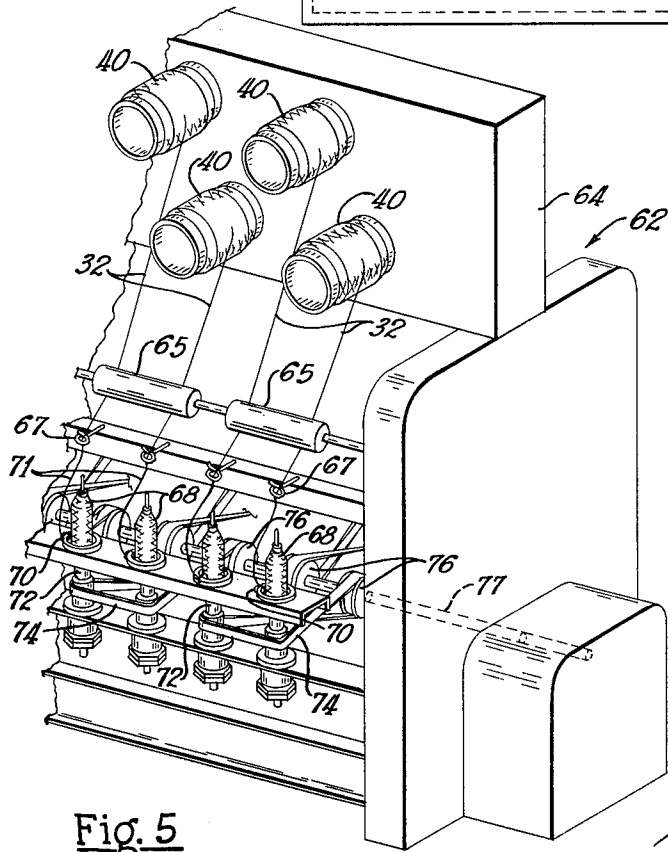


Fig. 5

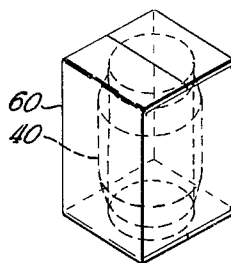


Fig. 4

INVENTOR.  
FRED A. MENNERICH  
BY  
*Stachin & Overman*  
ATTORNEYS

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3,206,924

METHOD OF FORMING FIBROUS GLASS YARN  
Fred A. Mennerich, Cumberland Hill, R.I., assignor to  
Owens-Corning Fiberglas Corporation, a corporation of  
Delaware

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18 Claims. (Cl. 57—164)

This invention relates to the forming and sizing of fibrous glass strands and the converting of such strands into yarns by twisting and plying.

In the conventional practice of drawing molten glass into continuous filaments one hundred or more of the filaments from closely positioned forming orifices in a ceramic bushing in the bottom of a glass furnace are gathered together into a strand which is then wound on a collecting tube.

A water emulsion size is applied to the filaments as they are brought together. Various applicators may be used including felts kept soaked with the size or belts or rollers carrying a surface film of size from a supply reservoir. The size may contain from eighty to ninety parts by weight of water and three to five parts of each of several solid constituents such as an emulsifying agent, animal or vegetable oil, and gelatin.

The size has two main functions, a first that of lubrication to curb abrasive action between the glass filaments, and secondly to serve as a binder after the evaporation of at least the major portion of the water content.

Other size formulations may contain starches, waxes and various other ingredients, but they have been, generally, similar to that described, in being dilute water emulsions with water amounting to at least seventy-five percent of the whole composition.

Control of the amount of size applied is secured by regulating the speed of the roller or belt applicators and by selecting the point of application. There also appears to be some removal of excess size through the centrifugal action of the rotating collecting tube.

These sizes have served their purpose well from a lubricating standpoint in the forming and initial packaging of the multi-filament strands. There have, however, been partial failures in the functioning of the sizes in subsequent twisting and plying operations.

The size component is generally between nine and twelve percent by weight of the packaged strand with water accounting for seven and a half to ten and a half percent of the total weight of the package.

The lubricating capability of the size is desirable in subsequent processing of the strand by twisting or plying as well as in the forming and collecting. Also, setting of the size prior to such fabricating is very objectionable as the binding effect of the size is not then carried over to the yarn product.

The premature setting of the size provides a temporary binding only of the strand as the rubbing and bending of the strands through guides and the traveler in the twisting process breaks the bond between the filaments of the strand. Having once dried, the size has lost any further binding power. Accordingly, the twist of the yarn is not set and a wild yarn results. The poor strand integrity also causes fuzzing. Another consequence is that the dry, soft yarn is likely to slough off the yarn package.

Another difficulty associated with partial setting of the size that has been widely experienced and concluded to be quite unavoidable is the migration of the solid components of the size to the outer layer of the forming package. The resulting concentration causes streaks in fabrics, tension variations in creeling, quilling and weaving, and wet-out variations in fabric reinforced plastics.

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The premature setting of the size and size migration makes the outer portion of the strand package quite unusable. As a consequence it has been the practice to remove as much as two thousand yards from the package before further processing of the strand.

For good stiff or hard yarn the size should set at the finish of the twisting or other primary processing of the strand. In the feeding and guiding of the strand from the package in such processing the strand is linearly exposed to the air and with the attendant whipping movement loses the major portion of the water in a properly formulated size. If there is an excess of moisture, it is retained in the product yarn and objectionably delays setting of the size and integration of the yarn.

It is then an object of this invention to provide a system of applying size to a strand and a method of handling the strand package thereafter that eliminates serious migration of the size.

Another object of the invention is a method to prevent premature setting of the size.

A further object is the preservation of a full package of strand in good condition for further processing.

A still further object of the invention is to deliver a package of strand to a twisting operation or to any other processing step with enough moisture in the size of the strand to restrain setting of the size until the completion of the processing step.

These and other objects and advantages of the invention are attained principally by controlling the amount and nature of the size applied to the strand and curtailing drying of the size until yarn is produced therefrom.

The invention will be described at greater length, hereafter, in connection with the accompanying drawings in which:

FIGURE 1 is a rather schematic, perspective view of conventional apparatus for forming continuous filaments of glass, applying size thereto, gathering them into a strand, and packaging the strand by winding it on a collection tube;

FIGURE 2 is a perspective view of two humidified chambers to which the tubes are conveyed from the winder room;

FIGURE 3 is a diagrammatic plan view, on a reduced scale, of the chambers of FIGURE 2;

FIGURE 4 is a perspective view of a container for storage and transport of individual tube packages of strand; and

FIGURE 5 is a perspective view of conventional apparatus for twisting the strand into yarn.

Referring to the drawings with more particularity, the filament forming and strand collection apparatus of FIGURE 1 includes an electrically heated, glass melting bushing 12 with openings 14 in the top for receiving the glass batch in the form of marbles. Flanges 16 and 17 constitute electrical terminals for the heating current. The molten glass is drawn down through orifices in nipples 20 in the bottom of the bushing 12 and attenuated into continuous fibers or filaments 22, usually two hundred and four in number.

The filaments 22 are drawn together in fan form and near the apex of the fan, where the fan width is between one-half inch and two inches, are brought in contact with a size applicator. As illustrated in FIGURE 1 the applicator is an endless belt or apron 24 passing through a bath of size in the reservoir 26. The belt speed is between twenty and forty feet per minute, and preferably coats the strand with a size the water component of which amounts to about nine and a half percent of the total strand weight and the solid component about two percent thereof.

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The strand 32 of 204 of the filaments 22 is brought together by the graphite gathering wheel 30 and passes through an opening in the flooring 34 into the winder room 35.

A winder 36 by which the drawing tension is applied back through the strand 32 to the filament forming zone collects the strand on a tube 37 mounted on the rotating collet 38. A conventional spiral wire transversing mechanism 39 guides the strand back and forth across the tube 37.

After the desired amount of strand, which may, for instance, be twenty-two thousand yards, is wound on the tube 37, the resulting package of strand is removed. As shown in the embodiment of the invention of FIGURE 2 the strand package 40 is carried from the winder room by being placed on a hanger 42 of a conveyor 43.

The amount of the size carried by the belt 24 is controlled by the speed of the belt, the level of the size in reservoir 26 and by the size composition. The quality of the size and its level in the reservoir are maintained by providing a constant flow through inlet 27 and overflow through outlet 28.

The amount of the size picked up by the filaments 22 may further be controlled by selection of the portion of the fan of filaments contacted by the applicator belt 24. The nearer the applicator is to the apex of the fan, the less size is applied. Generally the applicator belt 24 is about seven inches above the gathering wheel 30.

In order that an attendant may supervise the forming operation and readily remedy any faulty action, a flooring such as indicated at 34 is provided for his support.

According to the precepts of this invention the strand 32 of the package 40, as it is delivered from the winder room 35, carries a size in a proportion of about eleven and one-half percent by weight of the strand in the package and the size composition includes about eighty-three percent by weight of water. This proportion of size is secured by the control of the size composition and belt applicator as previously explained and by restricting evaporation of water, through humidification, from the size in the winder room.

Another factor, affecting the water content of the size, are water cooling sprays frequently utilized in the region of the forming bushing 12 and the spiral wire mechanism 39. The amount of water thus added is determined and correlated with other factors to establish the desired final size composition.

As shown in FIGURE 2, the packages 40 are first carried into a surge chamber 45. By governed operation of water nozzles 47 and temperature control equipment either directly associated with chamber 45 or with the area surrounding it, the humidity and temperature of the chamber are maintained at certain desirable levels designed to restrain evaporation of water from the size while the packages are held within the chamber. The temperature is desirably held near 70° F. and the relative humidity at 85 percent or above. Full moisture retention in the packages is, of course, only accomplished with one hundred percent humidity, but a minor loss of moisture at a lower relative humidity is not too harmful.

The surge chamber 45 is more a receiving station than for storage, and is designed to accommodate an irregular delivery of packages 40 from the winder room and then discharge them on a schedule suitable for inspection and steady movement through a subsequent storage area.

After spacing in surge chamber 45 the packages are carried therefrom on conveyor 43 through the outlet opening 49. The packages on the conveyor then pass the inspection area 50 where packages of improper weight or with other imperfections may be removed.

The main number of the packages then proceed through the entry opening 51 of a storage chamber 52. The humidity of this chamber is controlled through regulated

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operation of water sprays 53 and maintenance of a definite temperature. These should provide substantially the same environment as exists in the surge chamber. The progress of the packages through chamber 52 is set to bring them to the exit 55 for immediate delivery and utilization in textile apparatus such as a twister, to which they may be carried by conveyor 57.

The scheduling and storage functions of the surge chamber 45 and the storage chamber 52 may be combined in a single unit.

If any delay is involved between chamber 52 and the subsequent twisting or plying operation (or any other processing) this invention prescribes the utility of containers such as that illustrated in FIGURE 4 and given the designation 60. Such a container may be a separate unit or one of numerous compartments in a truck and may have room for one or more packages.

In such a restricted and confined space, a slight amount of evaporation quickly saturates the air thereof and prevents any further evaporation. Only one-quarter of a gram of water may thus be lost. This quantity is too minor to impair the size function. Such containers or compartmented trucks may, of course, be utilized without the humidified chambers 45 and 52 for directly transferring the strand packages from the winder room to the following textile operation.

The strand is usually next submitted to a twisting or plying operation as performed by the twisting frame depicted in FIGURE 5. The tube packages are mounted on a vertical support member 64 and the strands are led therefrom around tension rollers 65 and through guides 67 to be wound on twister tubes 68. Travelers 70 riding around the tubes 68 contribute to the twisting of the strand. The tubes 68 are mounted on spindles 72 rotated by belts 74 running over pulleys 76 on the drive shaft 77.

In accord with the recommended practice of this invention the strand package 40, as it is mounted on the twisting frame 62, has a moisture content of about nine percent. To prevent rapid drying in the twisting room the latter has a relative humidity of fifty to sixty percent and a controlled temperature. These conditions correlated, as far as possible, with the twisting speeds and the size of the package are designed to cause all of the water except about one percent to be evaporated from the strand before it is confined in a yarn package on a twisting tube 68.

Some of the water evaporates from the strand as it moves downwardly past the tension rollers 65 and the guides 67. However, it is believed that a major portion is lost as the strand balloons at points 71 and swings around the twisting tube 68 in following the traveler 70.

The remaining one percent or less of water is sufficient to promote proper and timely setting of the size and the resulting formation of a well integrated, hard twisted strand or yarn having a solid size component of about two percent. The yarn also hangs firmly on the twist package and the restricted evaporation of the water from the winder room to the twister frame curtails size migration which causes streaks in fabrics woven with the yarn.

Other means for following the basic concept of this invention includes wrapping or enveloping the strand packages with foil, paper, plastic film, non-evaporating liquid coatings, or other sealable material as the packages leave the highly humidified winder room and only removing such wrappings as the packages are placed on a twisting frame. Such air tight envelopes maintain the moisture content in somewhat the same manner as the individual containers and truck compartments previously discussed. The liquid coatings may include well known peelable materials or thin films of slow evaporating glycols.

Another modification in the process involves spraying a limited amount of water over the surface of the strand

package after any period of exposure which might intervene between the protective measures provided by this invention. By this action evaporated water may be replaced and the size brought back to its normal condition.

Other changes and modifications in the preferred manner of practicing this invention, but still encompassed by the spirit of the invention and the scope of the appended claims, will occur to those skilled in the art.

I claim:

1. A method of forming a fibrous glass yarn involving the gathering together into a strand of freshly drawn, continuous, glass filaments, applying to the filaments, while they are being gathered together into a strand, a lubricating and binding size having water as a major component, said size setting as a binder upon evaporation of the water, winding the strand on a packaging tube, subsequently removing the strand from the tube, converting the strand into a yarn, and forming a package of the yarn, said method characterized by the providing of a surrounding atmosphere of high humidity while the size is applied to the glass filaments, the filaments are gathered together into a strand and the strand is wound on a packaging tube; the restricting of evaporation of the water component of the size until the strand is removed from the packaging tube; and finally facilitating evaporation of the water component while the strand is converted into a yarn by exposing the strand to an under-saturated atmosphere, whereby the size then sets to bind the filaments together as they are arranged in the yarn.

2. A method according to claim 1 in which the restricting of evaporation of the water component of the size is effected by enclosing the packaging tube of strand in a highly humidified space.

3. A method according to claim 2 in which the space includes a chamber through which the packaging tube is transported on a conveyor.

4. A method according to claim 2 in which the space includes a small, sealed, transportable compartment in which a high humidity is quickly established by a slight evaporation of water of the size.

5. A method according to claim 2 in which the space is defined by an envelope of film.

6. A method according to claim 2 in which the space is defined by a wrapping of film about the packaging tube.

7. A method of forming a fibrous glass yarn involving the gathering together into a strand of freshly drawn, continuous, glass filaments, applying to the filaments, while they are being gathered together into a strand, a lubricating and binding size having water as a component amounting by weight to at least seventy-five percent of the size, said size setting as a binder upon evaporation of the water, winding the strand on a packaging tube, subsequently removing the strand from the tube, converting the strand into a yarn, and forming a package of the yarn, said method characterized by the providing of a surrounding atmosphere of high humidity while the size is applied to the glass filaments, the filaments are gathered together into a strand and the strand is wound on a packaging tube; the restricting of evaporation of the water component of the size by maintaining the packaging tube of strand in a highly humidified atmosphere until the strand is removed from the packaging tube; and finally facilitating evaporation of the water component while the strand is converted into a yarn by exposing the strand to an under-saturated atmosphere, whereby the size then sets to bind the filaments together as they are arranged in the yarn.

8. A method of forming a fibrous glass yarn involving the gathering together into a strand of freshly drawn, continuous, glass filaments, applying to the filaments, while they are being gathered together into a strand, a lubricating and binding size having water as a component amounting by weight to at least seventy-five percent of the size, said size setting as a binder upon evaporation

of the water, winding the strand on a packaging tube, subsequently removing the strand from the tube, converting the strand into a yarn, and forming a package of the yarn, said method characterized by the providing of a surrounding atmosphere of high humidity while the size is applied to the glass filaments, the filaments are gathered together into a strand and the strand is wound on a packaging tube; the restricting of evaporation of the water component of the size by covering the packaging tube with a sealing agent until the strand is removed from the packaging tube; and finally facilitating evaporation of the water component while the strand is converted into a yarn by exposing the strand to an under-saturated atmosphere, whereby the size then sets to bind the filaments together as they are arranged in the yarn.

9. A method according to claim 8 in which the sealing agent is a film of plastic.

10. A method according to claim 8 in which the sealing agent is applied in liquid form.

11. A method of forming a fibrous glass yarn involving the gathering together into a strand of freshly drawn, continuous, glass filaments, applying to the filaments, while they are being gathered together into a strand, a lubricating and binding size having water as a major component, said size setting as a binder upon evaporation of the water, winding the strand on a packaging tube, subsequently removing the strand from the tube, converting the strand into a yarn, and forming a package of the yarn, said method characterized by the providing of a surrounding atmosphere of high humidity while the size is applied to the glass filaments, the filaments are gathered together into a strand and the strand is wound on a packaging tube, storing the packaging tube of strand under controlled humidity and temperature until the strand is to be removed from the packaging tube; and finally facilitating evaporation of the water component while the strand is converted into a yarn by exposing the strand to an under-saturated atmosphere, whereby the size then sets to bind the filaments together as they are arranged in the yarn.

12. A method according to claim 11 in which the relative humidity of the chamber is held above eighty-five percent.

13. A method of forming a fibrous glass yarn involving the gathering together into a strand of freshly drawn, continuous, glass filaments, applying to the filaments, while they are being gathered together into a strand, a lubricating and binding size having water as a major component, said size setting as a binder upon evaporation of the water, winding the strand on a packaging tube, subsequently removing the strand from the tube, converting the strand into a yarn, and forming a package of the yarn, said method characterized by the providing of a surrounding atmosphere of high humidity while the size is applied to the glass filaments, the filaments are gathered together into a strand and the strand is wound on a packaging tube, controlling the humidity and temperature to which the packaging tube is submitted until the strand is to be removed from the packaging tube whereby the water component of the size has not been reduced beyond a predetermined amount by the time the strand is removed from the packaging tube, and finally facilitating evaporation of the water component while the strand is converted into a yarn by exposing the strand to an under-saturated atmosphere, whereby the size then sets to bind the filaments together as they are arranged in the yarn.

14. A method of forming a fibrous glass yarn involving the gathering together into a strand of freshly drawn, continuous, glass filaments, applying to the filaments, while they are being gathered together into a strand, a lubricating and binding size having water as a major component, said size setting as a binder upon evaporation of the water, winding the strand on a packaging tube, subsequently removing the strand from the tube, converting

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the strand into a yarn, and forming a package of the yarn, said method characterized by the providing of a surrounding atmosphere of high humidity while the size is applied to the glass filaments, the filaments are gathered together into a strand and the strand is wound on a packaging tube, storing the packaging tube of strand under controlled humidity and temperature until the strand is to be removed from the packaging tube; and finally facilitating evaporation of the water component while the strand is converted into a yarn by exposing the strand to an under-saturated atmosphere, whereby the water content of the yarn is brought down to no more than about one percent by weight of the yarn, and the size is thus conditioned to properly set and bind the filaments together as they are arranged in the yarn.

15. A method of combining a fibrous glass strand with other strands involving the gathering together into a strand of freshly drawn, continuous, glass filaments, applying to the filaments, while they are being gathered together into a strand, a lubricating and binding size in a volatile liquid vehicle, said size becoming effective as a binder upon evaporation of a definite portion of the liquid vehicle, collecting the strand in a package, subsequently removing the strand from the package, combining the strand with other strands, and forming a package of the combined strands; said method characterized by retaining said portion of the liquid vehicle while the size is applied to the glass filaments, the filaments are gathered together into a strand, the strand is collected in a package and until the strand is to be removed from the package; and finally removing said portion of the liquid vehicle by facilitating evaporation while the strand is combined with other strands, whereby the size then becomes effective to bind the filaments of the strand together as they are arranged in the combination of strands and the combined strands are formed in a package.

16. A method of combining a fibrous glass strand with other strands involving the gathering together into a strand of freshly drawn, continuous, glass filaments, applying to the filaments, while they are being gathered together into a strand, a lubricating and binding size in a liquid vehicle, said size becoming effective as a binder upon evaporation of a definite portion of the liquid vehicle, collecting the strand in a package, subsequently removing the strand from the package, combining the strand with other strands, and forming a package of the combined strands; said method characterized by providing surrounding atmospheres of sufficient humidity to prevent evaporation of said portion of the liquid vehicle while the size is applied to the glass filaments, the filaments are gathered together into a strand and the strand is collected in a package; controlling the humidity and temperature to which the strand package is submitted until the strand is to be removed from the package whereby the said portion of liquid vehicle of the size has not been removed by evaporation by the time the strand is removed from the package; and finally facilitating evaporation of the said portion of the liquid vehicle while the strand is combined with other strands by exposing the strand to an under-saturated atmosphere, whereby the size then becomes effective to bind the filaments of the strand together as they are disposed in the combination of strands and the combined strands are formed into a package.

17. A method of combining a fibrous glass strand with

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other strands involving the gathering together into a strand of freshly drawn, continuous, glass filaments, applying to the filaments, while they are being gathered together into a strand, a lubricating and binding size with water as a liquid vehicle, said size becoming effective as a binder upon evaporation of a definite portion of the water, collecting the strand in a package, subsequently removing the strand from the package, combining the strand with other strands, and forming a package of the combined strands; said method characterized by providing surrounding atmospheres of sufficient humidity to prevent evaporation of said portion of the water while the size is applied to the glass filaments, the filaments are gathered together into a strand, the strand is collected in a package, and until the strand is to be removed from the package; and finally facilitating evaporation of the said portion of the water while the strand is being removed from the package and is combined with other strands by exposing the strand to an under-saturated atmosphere, whereby the size then becomes effective to bind the filaments of the strand together as they are disposed in the combination of strands.

18. A method of forming a fibrous glass yarn involving the gathering together into a strand of freshly drawn, continuous, glass filaments, applying to the filaments, while they are being gathered together into a strand, a lubricating and binding size with water as a liquid vehicle, said size becoming effective as a binder upon evaporation of a definite portion of the water, collecting the strand in a package, subsequently removing the strand from the package, converting the strand into a yarn, and forming a package of the yarn; said method characterized by providing surrounding atmospheres of sufficient humidity to prevent evaporation of said portion of water while the size is applied to the glass filaments, the filaments are gathered together into a strand and the strand is collected in a package; controlling the humidity and temperature to which the strand package is submitted until the strand is to be removed from the package whereby the said portion of the water of the size has not been removed by evaporation by the time the strand is removed from the package; and finally removing said portion of the water while the strand is converted into a yarn, whereby the size then becomes effective to bind the filaments together as they are arranged in the yarn and the yarn is formed into a package.

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MERVIN STEIN, *Primary Examiner.*

RUSSELL C. MADER, *Examiner.*