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SPINNING GLASS FILAMENTS

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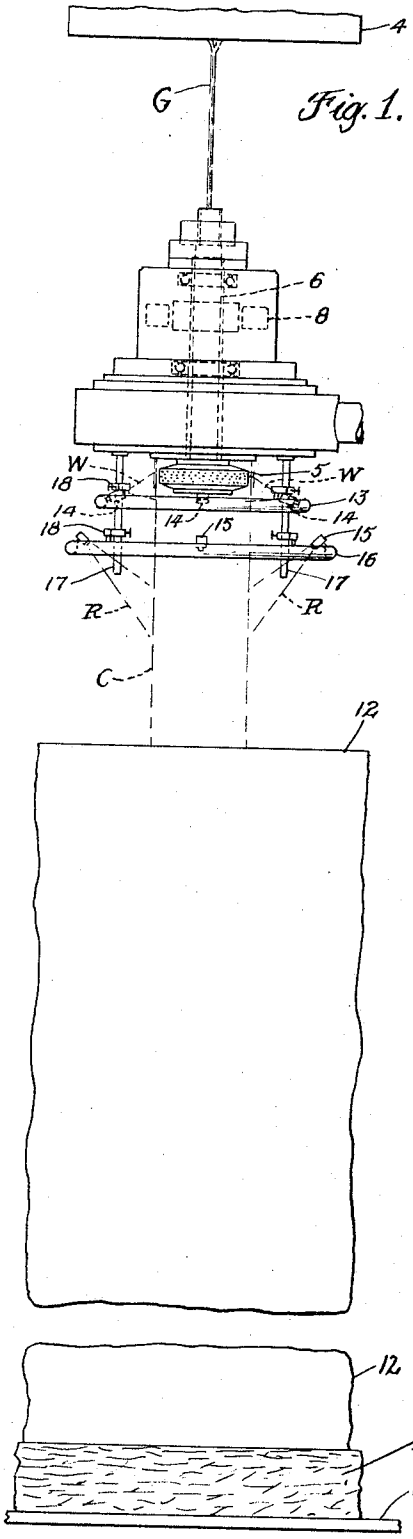


Fig. 1.

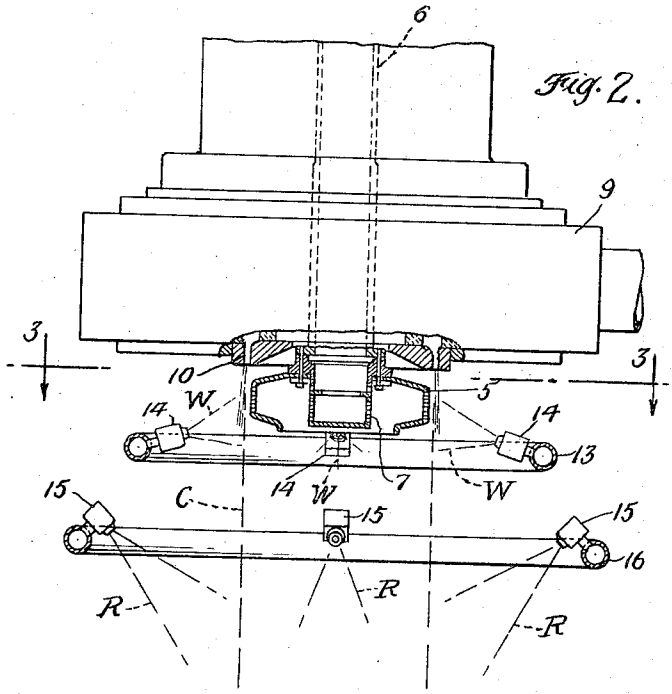


Fig. 2.

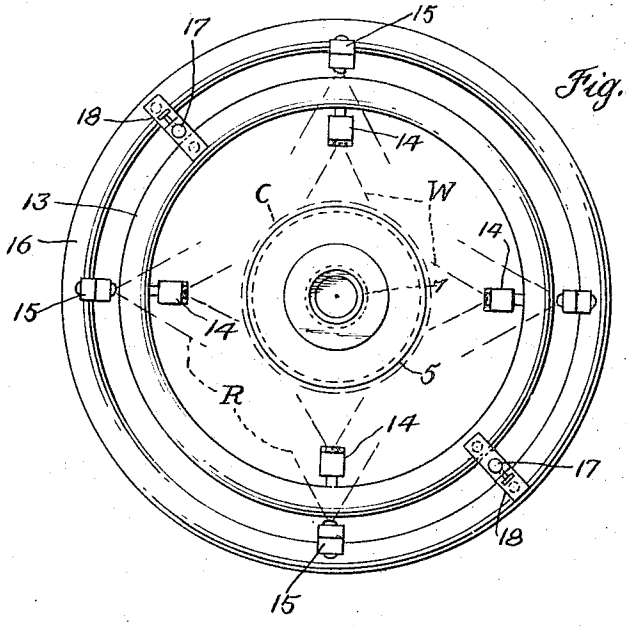


Fig. 3.

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SPINNING GLASS FILAMENTS

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This invention relates to the production or spinning of glass filaments or fibers, and the invention is particularly concerned with an improved method and improved equipment for producing filaments of relatively small diameter which at the same time manifest relatively high strength.

Although not limited thereto, the invention is of especial applicability to the general type of technique for producing glass filaments in which a centrifuge or spinner is employed to radially discharge fine streams of molten glass in a generally horizontal direction and in which a downwardly directed annular hot gaseous blast impinges downwardly upon the streams of glass leaving the rotor and effects attenuation of those streams to develop a downwardly moving cylindrical curtain of fibers or filaments. In equipment of this type the filaments are laid upon a horizontally moving conveyor arranged below the spinning equipment and a blanket of filaments is thus laid down upon the conveyor, the conveyor serving to transport the filaments away to a point of further treatment or use.

We have found that by spraying water on the hot gaseous blast and on filaments as they are being formed or attenuated by the hot gaseous blast, the filaments produced are of greater strength in relation to their diameter. Moreover, because the water spray acts to cool the gas blast it is possible to increase the rate of the gas producing combustion and thereby increase the velocity of the gas blast. This in turn enables greater attenuation of the fibers without overheating them and thus makes possible production of finer fibers. These factors are of great advantage because of the advantages and desirability of filaments of small diameter and high strength in various of the products for which such filaments are employed, notably insulating materials, in which both strength of the insulation and also a maximum of air spaces present within the insulation is important.

In addition to the foregoing the cooling of the gas blast in the region of the spinner aids in avoiding overheating of the spinner.

In the preferred practice of the invention as applied to the technique for producing filaments in which a hot gaseous blast downwardly attenuates the filaments from the periphery of a spinner or centrifuge, the water is sprayed upon the filaments generally in the horizontal plane of the spinner, the spray preferably being positioned to substantially blanket the region of the periphery of the spinner. This technique has certain advantages in addition to the above described effect on the filaments themselves. One such further advantage may be explained if it is first kept in mind that in the production of filaments it is frequently desirable to spray upon the filaments a resinous binder in liquid form, the binder being subsequently cured or set in order to bind together the insulation being made from the filaments, for instance mat type insulation commonly employed in the walls of houses. In a production line where such a resin is being applied, the application of the water spray at an elevation close to the spinner enables the spraying of the liquid binder onto the filaments at a higher elevation than is practical where the water spray is not used. The reason

for this is that the water spray accelerates the cooling of the filaments and the resin may therefore be applied to the filaments at an earlier point in the attenuation path without danger of prematurely setting or curing the resin. In turn the application of the resin at this earlier point increases the uniformity of distribution of the resin over the filaments. The reason for this is that the curtain of filaments tends to become disrupted and portions thereof follow iregular paths at points more remote from the spinner, the filaments being substantially uniformly distributed in the curtain in the zone in which the invention contemplates application of the binder.

How the foregoing and other objects and advantages are attained will appear more fully from the following description referring to the accompanying drawings illustrating a preferred embodiment of the equipment according to the invention and in which:

FIGURE 1 is an outline elevational view of suitable equipment including a spinner or centrifuge adapted to rotate on a vertical axis, and the associated parts including water and binder spray means in their relationship to the spinner;

FIGURE 2 is an enlarged view of certain parts shown in FIGURE 1, with some of the parts being shown in vertical section; and

FIGURE 3 is a plan section taken as indicated by the section line 3—3 on FIGURE 2.

The glass to be spun into filaments is prepared in a glass furnace and a stream of the molten glass indicated by the letter G in FIGURE 1 is adapted to be discharged from a forehearth **4** associated with the furnace, into the equipment for producing the fibers or filaments.

A centrifuge is indicated at **5**, this centrifuge having a pheripheral wall provided with a multiplicity of apertures adapted to discharge streams of molten glass in a generally horizontal direction under the influence of the centrifugal force of rotation of the spinner and glass therein.

The spinner is mounted at the lower end of a quill or hollow drive shaft **6** which receives the molten glass G and which is provided with a perforated distributor **7** at its lower end centrally arranged within the spinner **5** and serving to distribute the molten glass to the inner periphery of the spinner from which the glass passes through the orifices in the peripheral wall in a generally horizontal direction under the influence of centrifugal force. Any suitable means may be provided for journalling and driving the quill **6**, a driving motor being diagrammatically indicated at **8** in FIGURE 1.

Surrounding the quill **6** in a plane just above the spinner **5**, a combustion chamber **9** is provided into which air and fuel, such as gas, may be introduced, to provide the hot gaseous blast employed for attenuating the streams of glass leaving the spinner **5** and thus form the filaments or fibers. Chamber **9** is provided with an annular discharge orifice indicated at **10** and directed downwardly just outside of the peripheral wall of the spinner **5** so as to downwardly impinge upon the streams of glass leaving the spinner and thus effect downward attenuation of the fibers. This action produces a cylindrical curtain of fibers, diagrammatically indicated at C. The fibers of the curtain are ultimately delivered to the surface of a conveyor diagrammatically indicated at **11** at the bottom of FIGURE 1. An open topped forming hood **12** is arranged just above the conveyor and receives the curtain of fibers, thereby assisting in laydown of the fibers on the conveyor **11** and avoiding undesirable lateral spread of the fibers, the fibers being laid down in the form of a blanket B, the thickness of which will vary, depending upon rate of production of the fibers and also upon the rate of travel of the conveyor **11**. The conveyor **11** serves to transport the blanket of fibers to a point for additional treatment or use of the fibers. In use of the fibers to form insulation the

blanket of fibers is preferably carried into equipment for compressing the blanket to form a mat of the desired thickness and while under compression the mat is also heated to set or cure the binder and thereby bind the fibers of the mat together.

In accordance with the invention, spray means are provided for delivering water spray to the curtain of fibers, preferably generally in the plane of the spinner **5**. For this purpose an annular water supply pipe **13** is arranged concentrically of the spinner **5**, the annulus having a diameter substantially greater than that of the spinner and being provided with spray nozzles **14** at the inner edge presented inwardly so as to deliver water sprays diagrammatically indicated at W against the filaments of the curtain C. The spray nozzles **14** need not necessarily be directed exactly at the angle indicated in FIGURE 2, but may be directed somewhat upwardly or downwardly from the horizotal although it is preferred that the nozzles be constructed, positioned and directed so as to deliver water toward the periphery of the spinner and thus to the fibers in a direction transverse to the direction of attenuation of the fibers. In the embodiment as illustrated wherein the attenuation is in a generally downward direction, the water spray is directed in a generally horizontal direction against the attenuated fibers. The spray nozzles **14** may also be raised or lowered somewhat as compared with the location illustrated, but it is preferred that these nozzles be so positioned as to bring water to the fibers at the commencement of, or shortly after the commencement of, the attenuation thereof in the downward direction from the spinner.

With regard to the water sprays it should further be noted that it is preferred that these sprays are not of such strength or velocity as to extensively interfere with the downward attenuation path as established by the annular blast of hot gases leaving the combustion chamber **9** by way of the annular discharge orifice **10**.

The quantity of water sprayed upon the fibers is not critical but is advantageously kept within a range of from .025 to .4 gallon per pound of fibers produced, preferably from .05 to .1 gallon per pound of fibers.

The glass fibers, being quite hot at the time of impingement of the water sprays thereon, result in volatilization of the sprayed water and thereby rather rapid cooling of the filaments in the region of the sprays and just below. It is believed that the chilling effect results in development of a partially solidified skin on the filaments during the attenuation, the interior of the filaments hardening later, thus causing compression forces in the outer skin. In addition the water sprays act to cool the gaseous attenuating blast, without however diminishing the blast velocity. Although the mechanism or reasons for improvement in fiber strength are not fully understood, the action which takes place produces a striking improvement in fiber strength with fibers of given diameter. Moreover, with the attenuating blast cooled the rate of combustion producing the blast may be increased, thereby increasing the blast velocity and this enables production with given equipment of fibers of smaller diameter than is possible in the absence of the water spray.

Attention is now called to the provision of binder spray means comprising the nozzles **15**, which are mounted on and supplied from the supply pipe **16** located slightly below the water supply ring **13**. These nozzles are adapted to deliver sprays of liquid binder material indicated diagrammatically at R, for instance a thermosetting resin binder in a solvent, such materials not being discussed in detail herein as they are well known in this art. The nozzles **15** it will be noted are positioned so as to direct the sprays R somewhat downwardly, although the angle of impingement of the binder material on the curtain C may be at various different angles. Since the water sprays W cool the gas blast and also the fibers being formed it becomes practical to apply the resin sprays R at an elevation relatively high in the downward path of the curtain C because the fibers and the gas stream are not so hot as to prematurely cure the binder. Moreover at the region of impingement of the binder, the curtain is of substantially uniform configuration, as compared with a zone considerably farther down, for instance within the hood **12**, in which the curtain has a tendency to become disrupted or broken up. Because of this, the application of the resin shortly below the application of the water sprays results in more uniform distribution of the binder on the fibers, than is practicable by directing the binder sprays against the fibers in the lower region where the curtain becomes broken up.

The water and binder supply rings **13** and **16** are advantageously adjustable as to height and spacing, for instance by means of supporting posts **17** (see FIGURES 1 and 3) depending from the lower side of the combustion chamber **9**, the water and binder rings **13** and **16** being provided with apertured mounting brackets **18** adapted to be adjustably fixed on the posts **17**.

In an operation of the kind herein described and in equipment of the kind as illustrated in FIGURES 1 to 3, the glass may be delivered from the forehearth **4** at a temperature in the neighborhood of about 2000° F. The temperature of the water used in the sprays is not critical and may be water at ordinary supply temperature.

Although water is the preferred liquid to employ for the purposes herein described, certain other volatile organic liquids may also be used, provided they have certain physical characteristics similar to those of water and provided they will not adversely affect the glass fibers. Thus any liquid employed should be nonflammable and inert to the glass at the glass temperatures at which the liquid is applied and preferably should also be volatile at the temperature of the glass so as not to leave any residue on the filaments and further so as to accentuate the cooling effect of the sprayed liquid.

Although the invention has been specifically described and illustrated in the drawings as applied to a technique of filament production in which a spinner or centrifuge is employed rotating about a generally vertical axis, it will be understood that the principles of the invention are also applicable to glass fiber forming techniques generally. While water may be sprayed into the formed filaments from various directions and positions, an arrangement of the kind illustrated in the drawings has been found particularly effective.

We claim:

1. A process for preparing glass filaments which comprises projecting small streams of molten glass generally horizontally, directing a gaseous blast against the glass streams in a generally downward direction to downwardly attenuate the glass streams and thereby form filaments, spraying water against the attenuating filaments in a direction transverse the direction of attenuation, and spraying liquid binder resin against the filaments in a zone below the water spray, the water spray serving to cool the gaseous blast and the fibers above the binder spray, to thereby minimize precuring of the binder in the zone in which it is sprayed against the attenuating filaments.

2. A process for preparing glass filaments which comprises projecting small streams of molten glass generally horizontally, directing a gaseous blast against the glass streams in a generally downward direction to downwardly attenuate the glass streams and thereby form filaments, separately spraying water and liquid binder resin against the filaments in a direction transverse the direction of attenuation, the water spray being directed to the filaments in a zone close to the horizontal plane of projection of the streams of molten glass, and the binder spray being directed to the filaments in a zone closely below the water spray, the water spray serving to cool the gaseous blast and the fibers above the binder spray, to thereby minimize precuring of the binder in the zone in which it is sprayed against the attenuating filaments.

3. A process according to claim **2** in which the water

is sprayed generally horizontally and in which the binder resin is sprayed at a downwardly inclined angle.

4. A process for making glass fiber insulating mat comprising projecting small streams of molten glass generally horizontally from a rotating spinner, directing an annular hot gaseous blast downwardly against the glass streams to attenuate the streams and form a cylindrical curtain of filaments, spraying water against the curtain of attenuating filaments in a direction transverse the direction of attenuation, spraying a liquid thermosettable binder on the curtain of filaments below the water spray, the water spray serving to cool the gaseous blast and the fibers above the binder spray, to thereby minimize precuring of the binder in the zone in which it is sprayed against the attenuating filaments, laying down the curtain of coated filaments in the form of a blanket, compressing the blanket to form a mat, and setting the binder coating on the filaments while the blanket is maintained under said compression.

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