Feb. 19, 1963 H. J. SNOW ET AL 3,077,751

METHOD AND APPARATUS FOR FORMING AND PROCESSING FIBERS

Filed Sept. 14, 1955 3 Sheets-Sheet 1

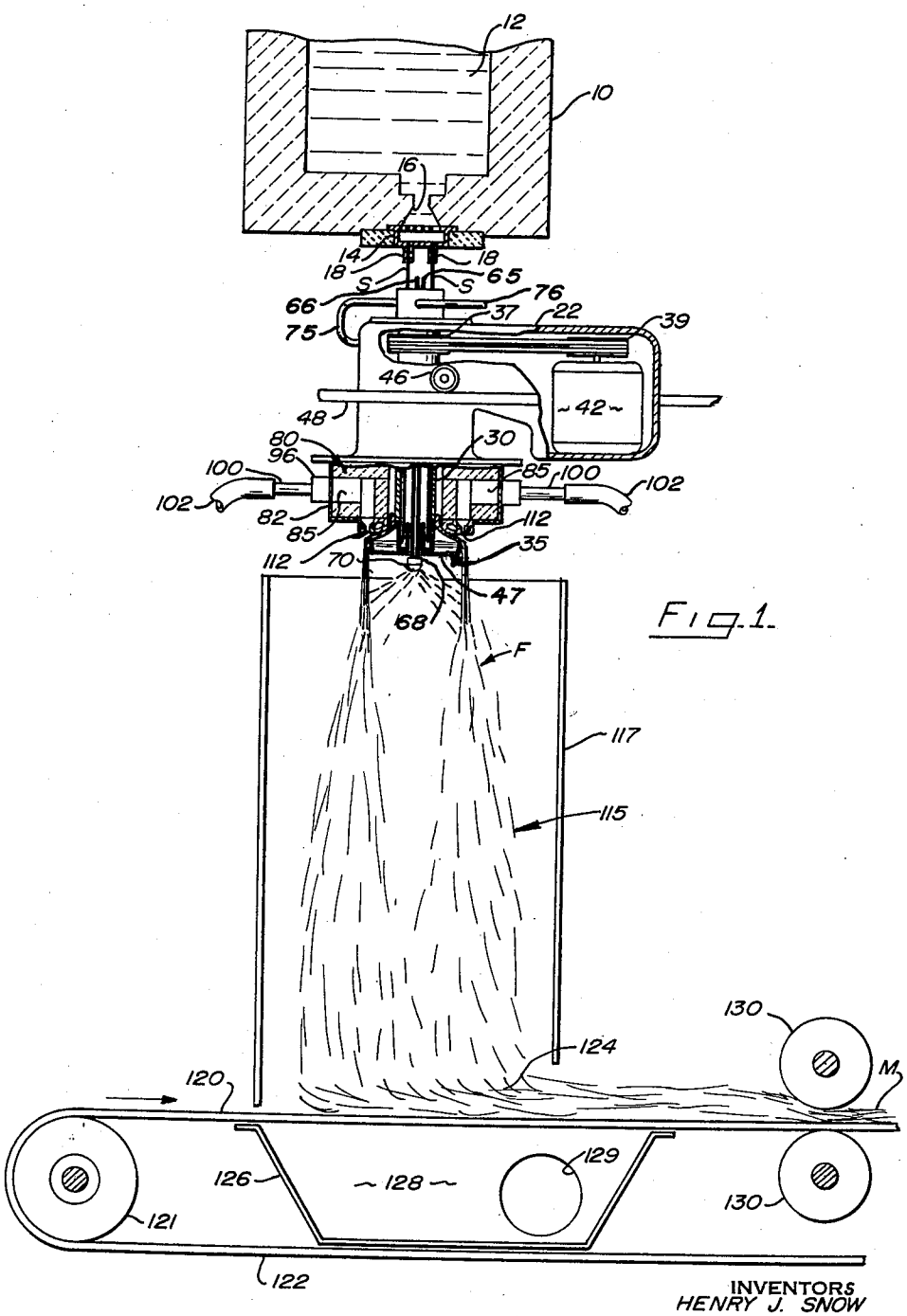

Fig. 1.

INVENTORS
HENRY J. SNOW
ROBERT W. KENDRICK
BY
ATTORNEYS

Feb. 19, 1963 H. J. SNOW ET AL 3,077,751

METHOD AND APPARATUS FOR FORMING AND PROCESSING FIBERS

Filed Sept. 14, 1955 3 Sheets-Sheet 2

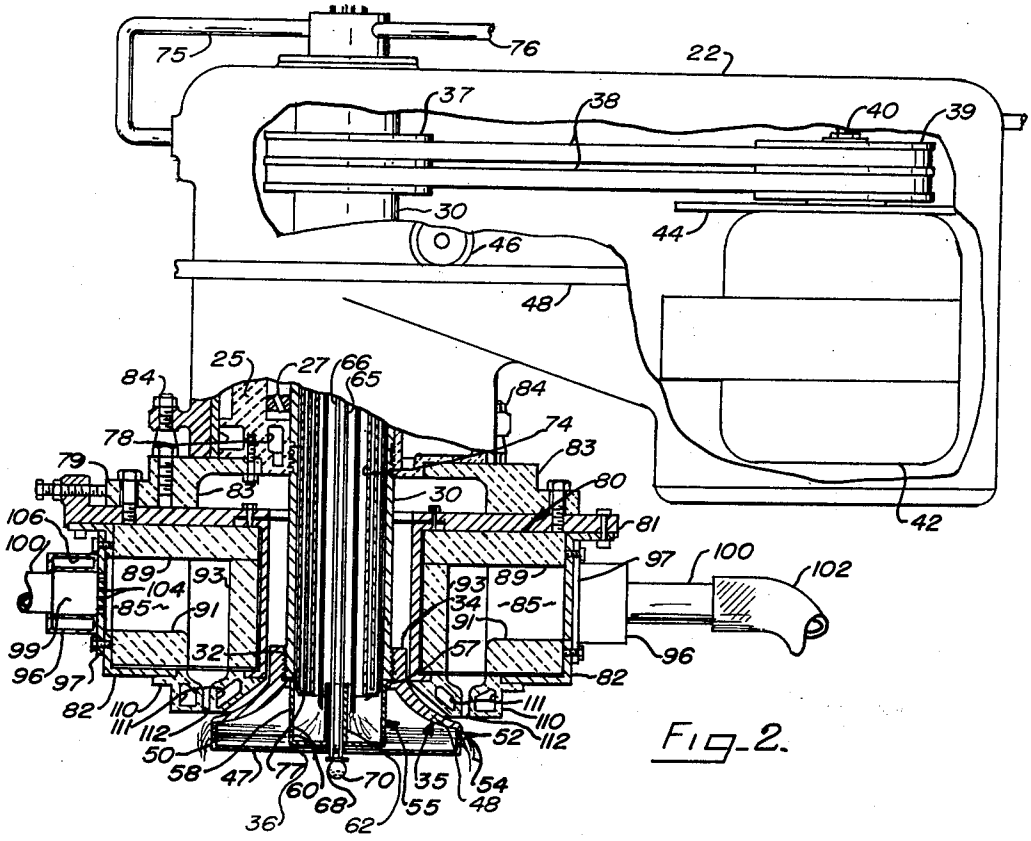

FIG. 2.

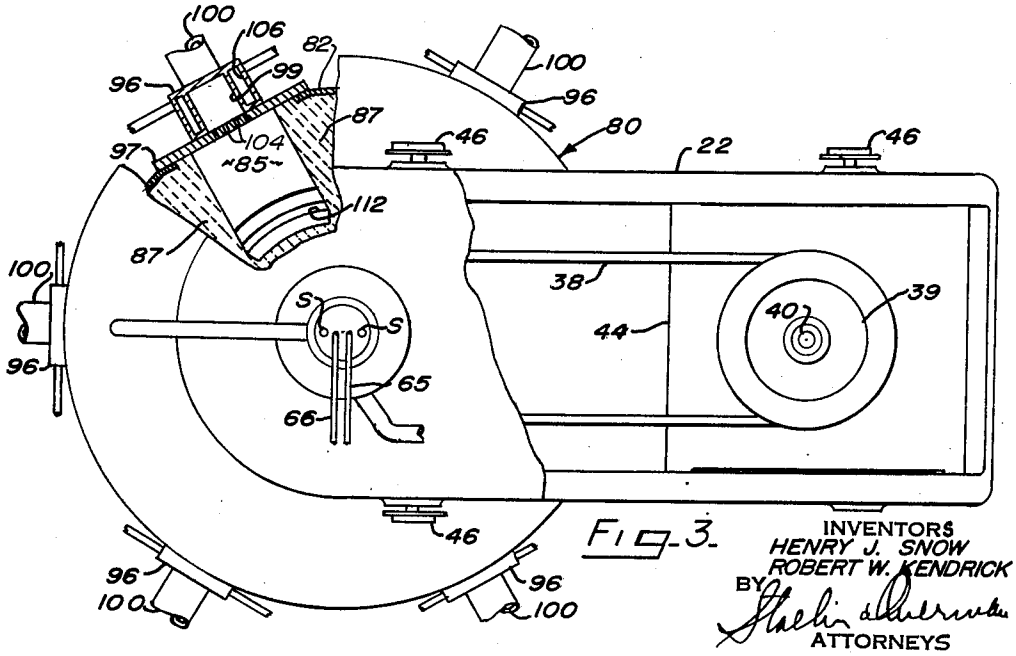

FIG. 3.

INVENTORS
HENRY J. SNOW
ROBERT W. KENDRICK
BY
ATTORNEYS

Feb. 19, 1963 H. J. SNOW ET AL 3,077,751

METHOD AND APPARATUS FOR FORMING AND PROCESSING FIBERS

Filed Sept. 14, 1955 3 Sheets-Sheet 3

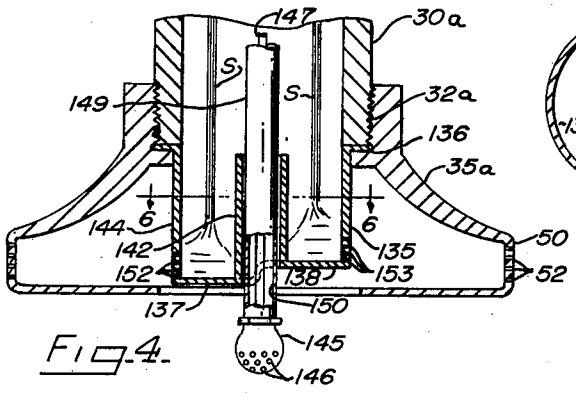

Fig. 4

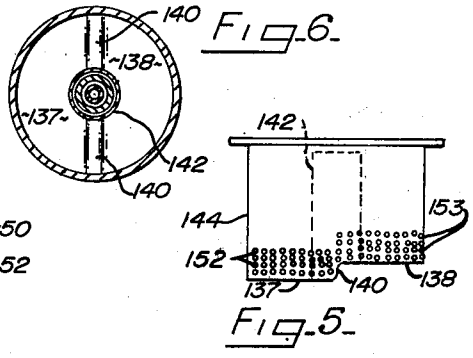

Fig. 6

Fig. 5

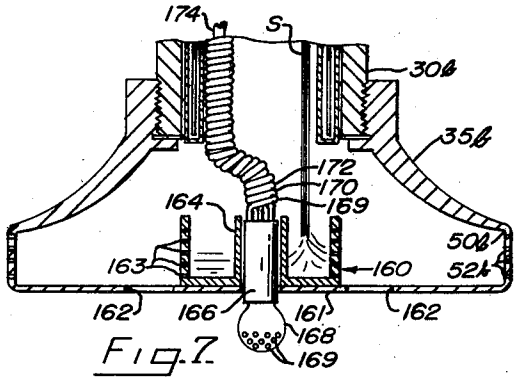

Fig. 7

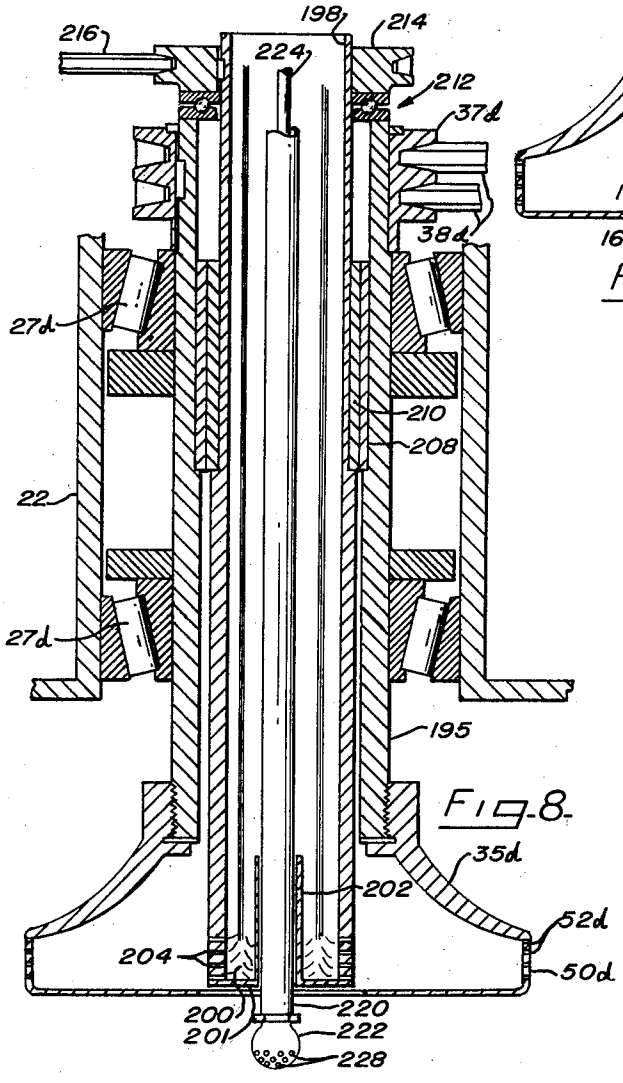

Fig. 8

INVENTORS
HENRY J. SNOW
ROBERT W. KENDRICK
BY
ATTORNEYS

United States Patent Office

3,077,751

Patented Feb. 19, 1963

3,077,751

METHOD AND APPARATUS FOR FORMING AND PROCESSING FIBERS

Henry J. Snow and Robert W. Kendrick, Newark, Ohio, assignors to Owens-Corning Fiberglas Corporation, a corporation of Delaware

Filed Sept. 14, 1955, Ser. No. 534,370
10 Claims. (Cl. 65—3)

This invention relates to method and apparatus for forming, treating and processing fibers from heat-softenable materials and more especially to the formation of fibers from mineral materials such as glass, slag or fusible rock.

It has been commercial practice to form fibers from glass or similar mineral material by directing high velocity blasts of steam in the general direction of flow of glass streams and into engagement with streams whereby the velocity of the blasts draws or attenuates the streams of molten material to fibers. The fibers formed by this method are usually comparatively coarse and of non-uniform character.

Another method of producing very fine fibers involves the steps of burning a combustible mixture in a closed chamber and projecting the intensely hot gases of combustion from a restricted orifice into engagement with solidified filaments or rods of glass advanced endwise into the blast whereby the heat of the gases softens the filaments or rods and the velocity of the gases attenuates the softened material into fine fibers.

This method requires the expenditure of subsatntial heat energy in reheating the solidified filaments or rods to attenuation temperature by the hot gases of the blast.

Developments have been carried on wherein a stream of glass is delivered into engagement with a spinner having a perforated wall, the spinner revolving at a speed to extrude the material of the stream outwarddly through the perforations or openings in the spinner wall by centrifugal forces of rotation forming the material into elongated bodies or streams which are projected into a gaseous blast and attenuated thereby to fibers.

The present invention embraces a method involving the introduction of one or more streams of molten fiber forming material into a material receiving zone within a spinner or rotor and delivering or distributing the molten material from the receiving zone into contact with a perforated surface of the spinner in a manner attaining more uniform distribution or dispersion of the molten material over the perforated surface of the spinner.

An object of the invention embraces a method of forming primary filaments or elongated bodies of heat-softened fiber-forming material, the method including the steps of delivering one or more streams of the fiber forming material into contact with a surface disposed within a spinner and rotating the surface in a manner to distribute material from the surface under the influence of centrifugal forces over a desired area or region of the spinner from which the material is extruded in linear bodies or filaments which are delivered into an attenuating blast.

Another object of the invention resides in the provision of a method wherein one or more streams of material are delivered into contact with a surface disposed within a rotatable spinner, the material receiving surface being arranged for rotation independently of the spinner so as to secure improved and efficient distribution of the molten material in an interior region or surface zone of the spinner from which the material is delivered into an attenuating blast by centrifugal forces of rotation.

Another object of the invention resides in a method and apparatus for conveying a fiber treating or bonding material through a spinner whereby the treating or bonding material may be delivered or sprayed onto the newly formed fibers without disturbing the orientation of the fibers at the region of application of the treating or bonding material.

Another object of the invention is the provision of an apparatus utilizing a rotating spinner into which fiber forming material is delivered and distributed outwardly by centrifugal forces through openings in the spinner to form primary filaments arranged to be attenuated by a blast into fibers and wherein a fiber coating or bonding material and a vehicle therefor are conveyed through the spinner and delivered onto the newly formed fibers from a region beneath the spinner without disturbing or impairing the pattern of the fibers entrained in the gaseous attenuating blast.

Another object in the invention is the provision of an apparatus including a spinner and a fiber-forming material receiving and distributing member disposed within the spinner and configurated or shaped to distribute molten fiber forming material over a substantially large peripheral area or region of the spinner whereby the distribution of fiber forming material at the peripheral region of the spinner is rendered more uniform resulting in the fomation of primary filaments or fine streams extruded from openings in peripheral region of the spinner of more uniform character and size.

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 as will be apparent from a consideration of the specification and drawing of a form of the invention, which may be preferred, in which:

FIGURE 1 is an elevational view with certain elements shown in section illustrating a form of novel apparatus for practicing the method of the invention;

FIGURE 2 is an enlarged elevational view of a portion of the apparatus shown in FIGURE 1, certain parts being illustrated in section;

FIGURE 3 is a top plan view of the construction shown in FIGURE 2, certain parts being shown in section;

FIGURE 4 is a vertical sectional view through a spinner illustrating a modified form of material distributing means disposed within the spinner;

FIGURE 5 is an elevational view of the fiber forming material distributing means shown in FIGURE 4;

FIGURE 6 is a transverse sectional view taken substantially on the line 6—6 of FIGURE 4;

FIGURE 7 is a vertical sectional view similar to FIGURE 4 illustrating another form of material distributing means and arrangement for treating fibers with coating or bonding material;

FIGURE 8 is a vertical sectional view through a spinner and supporting means illustrating another form of material distributing means within the spinner.

The method and apparatus of the invention are particularly usable for forming fibers from heat-softenable materials such as glass, wherein primary filaments, fine streams or elongated bodies of the material are attenuated to fibers by a high velocity gaseous blast and for treating or coating the newly formed fibers adjacent the region of attenuation. It is to be understood that we contemplate the utilization of the method and apparatus for forming and treating fibers attenuated from other heat-softenable materials such as slag or fusible rock or wherever the invention may be found to have utility.

Referring to the drawings in detail, and first with respect to the form of apparatus shown in FIGURES 1 through 3, there is illustrated a forehearth 10 which is connected with a melting furnace or receptacle (not shown) in which glass batch or other fiber-forming

mineral material is reduced to a flowable state or condition by the application of heat, providing a supply of the molten material 12 in the forehearth.

Disposed beneath and secured to the bottom wall or floor of the forehearth 10 is a feeder or bushing 14 adapted to receive molten material 12 through a passage 16 in the forehearth floor.

In the arrangement illustrated in FIGURE 1, the feeder 14 is provided with projections or tips 18 each having an orifice or outlet through which is delivered a stream S of the fiber forming material. While two streams are illustrated in FIGURE 1, it is to be understood that the feeder 14 may be formed with a single orifice or with more than two orifices to deliver one or a number of streams to the fiber forming apparatus.

Disposed beneath the forehearth 10 is a frame or frame construction 22 which as shown in FIGURES 1 and 2 is shaped to provide a housing construction for enclosing and supporting components of the fiber forming apparatus. Disposed within the housing 22 is a generally cylindrically shaped member 25 which is equipped with anti-friction bearings 27 shown in FIGURE 2 upon which is journally supported a hollow spindle or shaft 30. The lower exterior surface of the shaft 30 is threaded as at 32 and upon which is threaded a hub portion 34 of a rotatable member, rotor or spinner 35. The shaft 30 is equipped with pulleys or sheaves 37 driven by belts 38 from sheaves 39 fixedly secured to a shaft 40 driven by an electric motor 42 or other suitable means. The motor is mounted upon a plate or support 44 which is arranged for longitudinal adjustment by means (not shown) for regulating the tension of the driving belts 38.

As shown in FIGURES 1 and 3 the housing may be provided with wheels 46 adapted for traverse on rails 48 of a track or other suitable supporting means.

Through the arrangement of mounting the housing 22 upon a frame or track through the medium of wheels 46, the fiber forming unit or apparatus may be readily moved away from operative position for purposes of repair or replacement.

The rotor or spinner 35 is formed with a bottom wall 47 and a tapered or cone-shaped upper wall 48 integrally joined with the hub portion 34. A central circular opening 36 is formed in the bottom wall 47 to provide for the escape of gases from the spinner. A circular or peripheral wall 50 joins the walls 47 and 48 as particularly shown in FIGURES 1 and 2. The peripheral or circular wall 50 of the spinner 35 is provided with a large number of small openings or orifices 52 through which fiber forming material is projected or extruded by centrifugal forces forming fine streams, elongated bodies or primary filaments 54 of the fiber-forming material.

The region of the perforated wall 50 of the spinner provides a circular zone from which the streams, primaries or elongated bodies are formed. Means is provided interiorly of the spinner or rotor 35 adapted to receive the stream or streams S of fiber forming material from the feeder 14 and distribute or disperse the molten material of the streams outwardly into contact with the circular zone provided by the wall 50 of the spinner.

As shown in FIGURE 2, the molten material or glass distributing means includes a cup-like member, basket or slinger 55 having an upper flange 57, the latter being clamped between a flange portion of the spinner wall 48 and the extremity of the shaft 30. When the hub portion 34 is drawn up on the shaft 30, the flange 57 is securely held in position whereby the member 55 rotates with the spinner 35. The member 55 is formed with spaced cylindrical walls or sleeve portions 58 and 62 defining an annular chamber to receive the stream or streams of molten fiber-forming material. The exterior wall 58 of the cup member 55 is formed with a plurality of orifices or outlets 60 through which fiber forming material in the annular chamber is extruded or projected outwardly by centrifugal forces into engagement with the wall 50 of the spinner.

The sleeve 62 defines an axial passage through which extends a means for conveying and delivering fiber coating, binder or other material onto the fibers which are formed in a manner to be hereinafter described. As shown in FIGURES 1 and 2, a pair of tubes 65 and 66 extend downwardly through the shaft 30 and through the passage provided by the sleeve 62. Secured to the extremities of the tubes 65 and 66 is an applicator or spray head 68.

One of the tubes conveys a bonding or fiber coating material into the applicator 68 and the other tube conveys vehicle such as compressed air for dispersing or distributing the binder or coating material, or if an aqueous binder is used, the second tube may convey water under pressure into the applicator 68. The applicator or sprayhead 68 is of a character wherein the binder or coating material is entrained by the compressed air and delivered in atomized condition through orifices 70 in the spray head or unit 68 onto the newly formed fibers.

Depending into the interior of the shaft 30 is a cooling means in the form of a multi-walled, cylinderically shaped jacket construction 74 which is connected with an inlet pipe 75 and an outlet pipe 76. The jacket 74 is constructed with two annular chambers so that water, air or other cooling medium is circulated from the inlet through one chamber to the lower end of the jacket thence through openings 77 in the intermediate wall of the jacket and upward through the second chamber and through the outlet pipe 76.

The jacket construction 74 is stationary and adequate running clearance is provided between the inner surface of the shaft 30 and the exterior surface of the jacket 74. The housing or frame construction 22 is also formed with cooling chambers and passages 78 through which water, air or other cooling medium is circulated for conveying heat away from the housing construction. Through the circulation of cooling fluid or medium through the cooling jacket 74 and the chambers in the housing construction 22, the apparatus is maintained at safe operating temperatures.

The fiber-forming apparatus is inclusive of means for establishing and directing a high velocity gaseous blast into engagement with the primary filaments or bodies 54 which are extruded from the orifices 52 in the wall of the spinner 35 for attenuating the filaments or bodies to fine fibers. Disposed adjacent and surrounding the shaft 30 and a portion of the spinner 35 is a blast establishing means such as a burner 80 of the internal combustion type for producing a gaseous blast of generally annular configuration or shape.

The burner construction illustrated in FIGURES 1 through 3 is of a compartmental character wherein a plurality of combustion chambers or confined zones are arranged in an annular pattern and from which gaseous blasts are projected in a substantially annular path adjacent the peripheral wall 50 of the spinner 35. The burner 80 is inclusive of a metal shell or casing formed by an upper plate 81 and a polygonally contoured member or plate 82 of substantially Z-shaped cross section as shown in FIGURE 2. The plate 81 is suspended from a bracket or plate 83 secured to the housing 22 by means of stud bolts 84.

In the embodiment illustrated, the burner 80 is formed with a plurality of radially arranged burner units including combustion chambers or confined zones 85 which are symmetrically disposed about the axis of the shaft 30. Each of the chambers 85 is defined by vertically arranged partitions 87, an upper wall 89, a lower wall 91 and a front end wall 93. The wall constructions 87, 89, 91 and 93 are formed of high temperature refractory.

Secured to the outer region of each of the burner or combustion units is a manifold 96 adapted to receive a combustible mixture from a supply for delivery into the

adjacent combustion chamber 85. Each manifold is inclusive of a substantially rectangular casing mounted upon a plate 97 which is secured to the burning casing member 82. Each manifold member 96 is formed with a chamber 99 which is connected by means of a pipe 100 and a flexible tube 102 with a supply (not shown) of combustible mixture.

The fuel constituent of the mixture may be fuel gas such as ethane, methane, propane or the like, and air or other oxidant may be employed to support combustion. Valve means (not shown) is associated with each of the tubes 102 for controlling the flow of combustible mixture into each of the manifold chambers 99. The plate or wall 97 between each manifold chamber 99 and the adjacent combustion chamber 85 is formed with a plurality of small passages or channels 104 to conduct mixture from the manifold into the combustion chamber 85.

The perforated or channelled plate 97 forms a fire screen to avoid preignition of the mixture in the manifold and the supply pipe. The combustible mixture is introduced into the combustion chamber under comparatively low pressure of from three to ten pounds per square inch. Each of the manifold chambers 99 may be surrounded by a jacket or chamber 106 through which water or other fluid may be circulated to cool the manifolds.

The burner units are provided with orifice means for discharging the burned gases or products of combustion from the combustion chamber 85 as an intensely hot, high velocity blast of a temperature above the attenuating temperature of the glass or other fiber-forming material, the burning gases in the chambers 85 attain temperatures of 3000° F. or more which is well above the attenuating temperature of the fiber-forming material.

Secured to the lower walls of the burner units is an orifice construction or member 110 provided with restricted orifices or outlets 112 through which the burning gases are discharged as a high velocity blast.

The orifice construction 110 may be provided with chambers 111 through which water or other temperature controlling or reducing medium may be circulated in order to maintain the orifice construction at safe operating temperatures. While the orifice construction 112 is illustrated as formed of metal, it is to be understood that same may be fabricated of refractory or other suitable high temperature resistant material.

The orifices 112 associated with the chambers 85 are arranged in a substantially annular pattern or relation to provide a substantially annularly shaped blast projected downwardly and in substantially concentric relation with and adjacent to the peripheral wall 50 of the spinner or rotor 35. The primaries, elongated bodies or fine streams 54 of glass or other fiber-forming material projected from the orifices 52 in the spinner 35' are delivered or enter the annular blast in endwise relation thereto, and the velocity of the gases of the blast or blasts draws or attenuates the streams, filaments or bodies 54 into fine fibers F which move downwardly in a hollow column or beam-like pattern 115.

It is to be understood that the burner arrangement may be constructed to provide a substantially annular combustion chamber or confined zone functioning in conjunction with an annularly shaped restricted orifice through which the burned gases or products of combustion may be discharged as an uninterrupted annular blast.

The rotor or spinner is revolved at a speed sufficient to establish centrifugal forces adequate to extrude the material through the orifices in the spinner so that the fine streams, primaries or bodies remain in substantially horizontal positions as they enter the attenuating blast. It has been found that a spinner of from seven to nine inches in diameter should be rotated at 3000 revolutions per minute or more in order to properly extrude the molten material through the orifices. The number and size of the openings in the wall of the material distributor or cup member 55 should be adequate to discharge sufficient molten material to maintain a layer of the material over the entire region of the openings 52 in the wall 50 of the spinner to assure extrusion of uniform streams, filaments or bodies from the spinner.

The binder or bonding agent conveyed through the tube 65 to the applicator 68 may be of any suitable type, and either thermo-plastic or thermo-setting binders may be used. A thermo-setting binder such as phenol formaldehyde or urea formaldehyde has been found to be satisfactory to impart mass integrity of the fibrous mat. When a thermo-curable binder is applied, the binder-impregnated mat is conveyed through a suitable heating zone or oven (not shown) for curing or setting the binder.

In some instances, it may be desirable to deliver a coating material or a lubricant onto the newly formed fibers by means of the applicator 68. Coating material or lubricant may be conveyed through the tube 65 and sprayed onto the fibers from the orifices 70 of the applicator through the medium of compressed air or other fluid vehicle conveyed to the applicator through the tube 66.

By conveying the fiber bonding or coating material through the rotor and applying the material to the beam of fibers from a central zone, the orientation of the fibers in the beam is not impaired or disturbed.

The beam of fibers 115 moves downwardly through a hood, enclosure or confining means 117 which directs or guides the fibers onto the upper flight 120 of an endless belt conveyor 122 of the foraminous type, the conveyor being supported upon rollers 121, one of which is shown on FIGURE 1. The fibers collect upon the upper flight of the conveyor in a fibrous mass 124. The conveyor moves in the direction of the arrow viz: in a right-hand direction as viewed in FIGURE 1 whereby the mass of collected fibers is continuously removed from the attenuating zone for further processing.

A box-like member 126 is disposed beneath the upper flight of the conveyor in registration with the path of the descending fibers and provides a suction chamber 128 connected by a pipe or tube 129 with a suction blower or other means for impressing suction or sub-atmospheric pressure in the chamber 128. The suction in the chamber 128 performs the dual function of assisting in the collection of the fibers upon the conveyor and carrying away the spent gases of the attenuating blast. The mass 124 of fibers may be advanced by the conveyor through sizing or pressure rolls 130 which compress the fibrous mass to a desired thickness forming a mat M. If thermo-curable binder is used, the mat M is conveyed through a heating zone to set the binder.

FIGURES 4 through 6 illustrate a modified form of construction for distributing or dispersing glass or other molten fiber-forming material within a rotor or spinner and conveying a fiber-coating or bonding material to an applicator. The spinner 35*a* shown in FIGURE 4 is of the same construction as the spinner 35 shown in FIGURE 1, and is mounted upon a threaded portion of the hollow shaft 30*a* which is arranged to rotate the spinner 35*a* in the manner described in connection with the form of construction shown in FIGURE 1.

Disposed within the spinner 35*a* is a member 135 adapted and arranged to distribute molten material from the streams S to a circular region adjacent the peripheral wall 50*a*. The member 135 is of generally cup-like configuration, the upper portion of which is formed with a flange 136 which engages a ledge on the spinner 35*a* and the end of the shaft 30*a* for securing the member 135 in a fixed position within the spinner 35*a*.

The material distributing member 135 has its lower or bottom wall formed of two portions or sections 137 and 138 arranged at different levels. Each section of the lower wall extends substantially through an angle of 180°, the floor sections being connected by an intermediate portion or section 140. The member 135 is formed with

a sleeve 142 which defines a central or axial passage through the cup-like member 135 and through which extends a means for conveying a fiber coating or bonding material to an applicator 145.

The spaced walls or sleeves 142 and 144 and bottom portions 137 and 138 form an annular chamber to receive the streams S of molten glass or other fiber-forming material.

As particularly shown in FIGURE 4, a tube 147 is disposed within a second tube 149 of larger diameter providing an annular chamber or passage 150 between the outer wall of the tube 147 and the inner wall of the tube 149. The tube or hollow member 147 may be connected with a supply of fiber coating or bonding material and is arranged to convey the material to a mixing zone (not shown) in the spray-head or applicator 145. Compressed air or other fluid vehicle for dispersing the fiber coating or bonding material onto the fibers is conveyed to the mixing zone of the spray-head 145 through the chamber 150.

The sleeve 142 of member 135 is spaced from the exterior surface of the tube 149 to provide adequate running clearance between the tube 149 and the sleeve. The compressed air is engaged with the fiber coating or bonding material in the applicator or spray-head 145 in a manner whereby the bonding material is sprayed or projected onto the newly formed fibers through orifices 146 formed in the applicator.

The outer walls of the cup member 135 are formed with two groups of orifices 152 and 153, the orifices 152 of one group being at a lower zone of the cup wall adjacent the floor section 137. The orifices 153 of the other group are arranged in the cylindrically shaped wall of member 135 adjacent the uppermost floor section 138.

Rotation of the cup member 135, having two different levels supporting the fiber-forming material establishes centrifugal forces causing outward movement of the glass or other fiber-forming material through the openings or orifices 152 and 153, thus distributing the glass through a greater vertical area and obtaining a more efficient distribution of the glass adjacent the orifices 52*a* in the rotor. The fine streams, primaries or bodies of glass extruded from the rotor orifices are attenuated to fibers by an annular blast of the character hereinbefore described.

FIGURE 7 illustrates a modified form of the apparatus of the invention. The spinner 35*b* having a peripheral wall 60*b* provided with orifice 52*b* is secured to the hollow shaft 30*b*. Disposed within the spinner 35*b* is a cup-like material distributing member 160 supported by a bottom wall 161 of the rotor 35*b* having an outer wall formed with orifice 163. The bottom wall 161 is formed with a plurality of spaced openings 162 through which gases may escape.

The member 160 is formed with a vertical cylindrical sleeve 164 defining a passage through which extends a tubular fitting 166 having an applicator or spray head 168 secured thereto in a region beneath the spinner 35*b*. In this form means are provided for conveying compressed air and fiber coating or bonding material to the applicator 168 through individual tubes 169 and 170. The tubes 169 and 170 together with a third tube 172 which conveys water or other cooling fluid downwardly are wound in a spiral configuration about a water return tube 174, the arrangement being shown in FIGURE 7.

A binder may be conveyed to the applicator through the tube 169, compressed air conveyed to the applicator through the tube 170 and a cooling fluid circulated downwardly through the spiral tube 172 and returned through the central tube 174. The arrangement shown in FIGURE 7, wherein a cooling medium is provided for the binder conveying means, is especially advantageous where thermo-setting binders are used which are liable to be affected or partially cured by the heat within the shaft 30*b* and the spinner 35*b*. Thus by circulating water or a cooling fluid through the tubes 172 and 174, the binder may be maintained below a temperature at which it will be precured.

While a single stream S of glass is shown flowing into the cup-like member 160, it is to be understood that additional streams of glass or other fiber-forming material may be delivered into the cup if desired. The sleeve portion 164 of the cup 160 is spaced from the member 166 to provide running clearance for the cup member which, as shown, is rotatable with the spinner 35*b*.

In the formation of certain types of mats of fibers, it may be desirable to utilize an aqueous binder solution on the fibers. When such a binder solution is to be delivered onto the fibers, the tube 174 may be eliminated and the tube 172 employed to deliver water into the member or fitting 166 wherein it may be mixed with the binder and the aqueous mixture discharged by compressed air through the orifices 169 onto the fibers.

FIGURE 8 is illustrative of another form of novel apparatus for carrying out the method of the invention. In this form, the molten material distributing means disposed within the spinner is arranged to be driven or rotated in either direction of rotation and at a desired speed independently of the spinner. The spinner 35*d* is secured to a hollow shaft 195, the latter being journaled in bearings 27*d* associated with the frame or housing 22 of the character shown in FIGURE 1.

The hollow shaft 195 is equipped with a sheave construction 37*d* which is connected by means of driving belts 38*d* with a sheave carried by a motor in the manner shown in FIGURE 1. The hollow shaft 195 and the spinner 35*d* are rotated at a speed sufficient to extrude molten fiber-forming material by centrifugal forces from the interior of the spinner through orifices 52*d* in the wall 50*d* to form primaries or elongated bodies which are projected into an attenuating blast in the same manner as illustrated in FIGURE 1.

Extending through the shaft 195 is a tubular shaft or sleeve 198 which is formed at its lower end with an annular material receiving zone or chamber 200 formed by a bottom wall 201 and an upwardly extending cylindrical sleeve portion 202. The lower zone of the tubular shaft or sleeve 198 is formed with orifices, passages or channels 204 through which molten material may be projected outwardly toward and into contact with the interior surface of the spinner wall 50*d*.

The shaft 195 and the sleeve 198 are provided respectively with bearing members 208 and 210 whereby the sleeve 198 is journalled for rotation within the shaft 195 and is held in concentric relation therewith by the bearing members. An anti-friction bearing 212 is arranged at the upper end of the shaft 195 and supports the sleeve 198 and a sheave 214. The sheave 214 is connected by means of a belt 216 with a motor (not shown) or other driving means which is operable independently of the means or motor for driving the hollow shaft 195.

The sheave 214 may be driven from a sheave on the shaft of the motor utilized to drive the spinner 35*d*. By employing sheaves of different diameters, the speed of the sleeve and glass distributing means may be varied as desired for most efficient operation.

Through this arrangement the material distributing means formed at the lower end region of the sleeve 198 may be driven at any speed in either direction of rotation independently of the spinner 35*d*. If it is desired to increase the centrifugal forces operative to extrude or project the fiber-forming material through the orifices or channels 204, the speed of the sleeve 198 may be increased to attain the desired forces.

Extending through the interior of the sleeve member 198 and coincident with the axis thereof is a tube or tubular member 220 which extends through the interior sleeve portion 202 of member 198 and is provided at its lower extremity with an applicator 222. Disposed within the tube 220 is a second tube 224 of a smaller size providing an annular passage defined by the interior wall of tube

220 and the exterior wall of tube 224. The tube 224 is also connected with the applicator 222 and is adapted to convey a fiber coating material or binder to the applicator.

The annular passage between the walls or tubes 220 and 224 may be connected with a source of compressed air for conveying the same to the applicator 222. The applicator is provided with orifices or outlets 228 through which the coating material or binder is projected by the compressed air onto the newly formed fibers produced by blast attenuation of bodies or primaries of molten material extruded through the outlets 52*d* in the spinner wall.

The passages or outlets 204 in the material distributing means within the spinner are arranged to effect a uniform distribution of the material of the fiber-forming material over the interior surface or zone of the spinner wall 50*d*. It is to be understood that the constructions shown in FIGURES 4 through 8 are adapted to be used with the blast producing means shown in FIGURES 1 through 3 and the fibers collected in any suitable manner such as the fiber collecting arrangement illustrated in FIGURE 1.

The arrangement of the invention as illustrated in the drawings utilizes an intensely hot blast of gases of a temperature well above the attenuating temperature of the fiber-forming material for attenuating the extruded primaries or elongated bodies into fibers. While the hot blast method is preferred as it results in the production of very fine fibers, it is to be understood that a high velocity attenuating blast of lower temperature may be utilized for fiber attenuation such as blasts of steam, compressed air or other gaseous medium under pressure.

It is apparent that, within the scope of the invention, modifications and different arrangements may be made other than is herein disclosed, and the present disclosure is illustrative merely, the invention comprehending all variations thereof.

We claim:

1. Apparatus of the character disclosed, in combination, a support, a hollow rotor journaled on the support, a member disposed in the rotor adapted to receive molten fiber-forming material, means for rotating the member and rotor, said member being formed to deliver the material outwardly by centrifugal forces into contact with said rotor, means for establishing an annularly shaped gaseous blast, said rotor being formed whereby the material is projected therefrom by centrifugal forces of rotation in the form of elongated bodies delivered into the gaseous blast and attenuated by the blast to fibers entrained in the blast in the form of a hollow column, relatively stationary tubular means extending through the member and rotor adapted to convey a fiber coating material, and nozzle means associated with the tubular means for delivering the coating material in divergent directions onto the fibers from the interior of the hollow column of fibers.

2. Apparatus of the character disclosed, in combination, a support, a hollow rotor journaled on the support, a member disposed in the rotor and having an annular chamber adapted to receive molten fiber-forming material, means for rotating the member and rotor, said member being formed to deliver the molten material outwardly by centrifugal forces of rotation, said rotor having a perforated peripheral wall engaged by the material delivered outwardly by the member, means for establishing an annularly shaped gaseous blast, the material adjacent the perforated wall of the rotor being projected therefrom in the form of a plurality of bodies into the gaseous blast and attenuated by the blast to fibers, tubular means extending through the member and rotor arranged to convey a fiber coating material through the rotor, and nozzle means connected with the tubular means adapted to deliver the coating material in divergent directions onto the fibers.

3. Apparatus of the character disclosed, in combination, a support, a hollow shaft journaled on the support, a hollow rotor carried by the shaft, means for rotating the shaft and rotor, a member disposed in the rotor arranged to receive molten mineral fiber-forming material delivered into the hollow shaft, said rotor having a peripheral wall provided with openings, means extending through the shaft arranged to rotate the member independently of the rotor whereby the material is distributed outwardly into engagement with the peripheral wall of the rotor, the molten material being extruded through the openings in the wall of the rotor by centrifugal forces of rotation to form elongated bodies of the material, means for directing a gaseous blast into engagement with the elongated bodies for attenuating the bodies to fibers, and means extending axially through the hollow shaft, member and rotor arranged to deliver a bonding material onto the fibers.

4. Apparatus of the character disclosed, in combination, a support, a hollow rotor journaled upon said support, means for rotating the rotor, a member disposed within the rotor, said member being formed with spaced walls defining an annular chamber and a central opening, means for feeding a stream of molten fiber-forming material into the annular chamber, a wall of said member and a wall of the rotor having openings through which the molten material is extruded by centrifugal forces of rotation from the member and rotor, means for establishing a high velocity annular gaseous blast and directing the blast into engagement with the material extruded from the rotor whereby the material is attenuated to fibers by the blast, and tubular means extending through the central opening in the member for conveying a coating material through the rotor, and nozzle means connected with the tubular means arranged to deliver the coating material in divergent directions onto the fibers.

5. Apparatus of the character disclosed, in combination, a support, a hollow rotor journaled upon the support and having a perforated peripheral wall, means for rotating the rotor, means for feeding a stream of molten fiber-forming material into the rotor, a member disposed in said rotor formed with wall portions defining an annular chamber into which the molten material is delivered, said member having passages formed in one of said wall portions and being rotatable whereby molten material is projected by centrifugal forces from the annular chamber into engagement with the perforated wall of the rotor, the material adjacent the peripheral wall of the rotor being extruded through the perforations by centrifugal forces of rotation of the rotor, means for directing a high velocity gaseous blast into engagement with the material extruded from the rotor for attenuating the material to fibers, said member having an axial opening defined by one of said wall portions, and tubular means extending through the axial opening through which a coating is delivered onto the fibers.

6. Apparatus for forming fibers from heat-softenable material including in combination a support, a hollow rotor journaled on said support and having openings formed in a peripheral wall thereof, a member disposed in the rotor formed with a central opening and having inner and outer annular walls forming an annular chamber, the outer annular wall of said member being formed with a plurality of openings, means for feeding heat-softened material into said annular chamber, means for rotating the rotor and the member whereby the material is extruded from the openings in said outer annular wall of said member and in said peripheral wall of said rotor, means for directing a high velocity gaseous blast into engagement with the material extruded from the openings in the wall of said rotor to attenuate the extruded material to fibers, the annular chamber in said member being formed with material supporting surfaces at different levels, means extending through the central

opening in said member for conveying fiber coating material, and an applicator connected with the coating material conveying means for distributing the coating material onto the fibers.

7. Apparatus of the character disclosed, in combination, a support, a hollow shaft journaled on the support, a hollow rotor secured to said shaft and having a perforated peripheral wall, a member disposed in the rotor formed with an annular chamber, means for rotating the member and rotor, said annular chamber adapted to contain material in a fluid condition, a wall of the chamber being formed with passages through which material in the chamber is discharged into engagement with the peripheral wall of the rotor and through the perforations of the rotor wall by centrifugal forces of rotation.

8. A material distributing means for use in a material distributing rotor including a rotatable member adapted to be disposed within a rotor, said member being formed with a circular vertical wall defining a chamber and a bottom wall, said bottom wall of the chamber having portions arranged at different levels, said vertical wall being formed with a group of openings adjacent each bottom wall portion of the chamber whereby material in the chamber is distributed through the groups of openings by centrifugal forces of rotation of the rotor and projected therefrom onto said material distributing rotor at different heights as determined by the different levels of said portions of said bottom wall.

9. A method of forming fibers from heat-softenable mineral material including the steps of flowing a stream of the material from a supply, distributing the material in the stream outwardly into a first annular zone surrounding the stream and the point of distribution, projecting the material in the first said annular zone outwardly therefrom by centrifugal force in the form of elongated streams of material engaging the streams with an annular gaseous blast in a second annular zone surrounding and concentric with the first said annular zone for attenuating the bodies to fibers entrained in the blast in the form of a hollow column, conveying a fiber coating material along a path extending axially through both of said zones and into the interior of said hollow column of fibers, and delivering the fiber coating material outwardly in diverging directions onto the newly formed fibers in said hollow column of fibers.

10. In apparatus of the character disclosed having a support, in combination, a hollow shaft journaled on said support, a hollow rotor mounted by said shaft, means for rotating said shaft and said rotor, said rotor having a peripheral wall provided with openings through which molten mineral material is adapted to be extruded by centrifugal forces of rotation in the form of elongated bodies, means for feeding a stream of molten material through said shaft into said rotor, a member supported interiorly of said rotor and having an annular bottom extending across and normal to the path of movement of the stream of molten material, an inner annular wall and an outer annular wall, said walls forming with said bottom an annular chamber open for the reception of said stream of material therein and the outer annular wall of said member having a plurality of orifices therein for separating such material and delivering such material therefrom in the form of discrete, continuous flowing streams outwardly into engagement with the peripheral wall of said rotor, means for establishing an annular gaseous blast and directing the gases of said blast into engagement with the bodies of the material moving outwardly from said rotor for attenuating the elongated bodies to fibers entrained in said blast and forming a hollow moving column of fibers, tubular means extending through the said shaft and said rotor for conveying a fiber coating material and an applicator associated with said tubular means and arranged to deliver such fiber coating material in divergent directions onto the fibers from a zone interior of the hollow column of fibers.

References Cited in the file of this patent

UNITED STATES PATENTS

2,192,944	Thomas	Mar. 12, 1940
2,238,204	Woods	Apr. 15, 1941
2,431,205	Slayter	Nov. 18, 1947
2,577,204	McElroy	Dec. 4, 1951
2,609,566	Slayter et al.	Sept. 9, 1953
2,624,912	Heymes et al.	Jan. 13, 1953
2,707,847	Anliker	May 10, 1955
2,816,826	Brennan	Dec. 17, 1957
2,839,782	Tillotson	June 24, 1958