

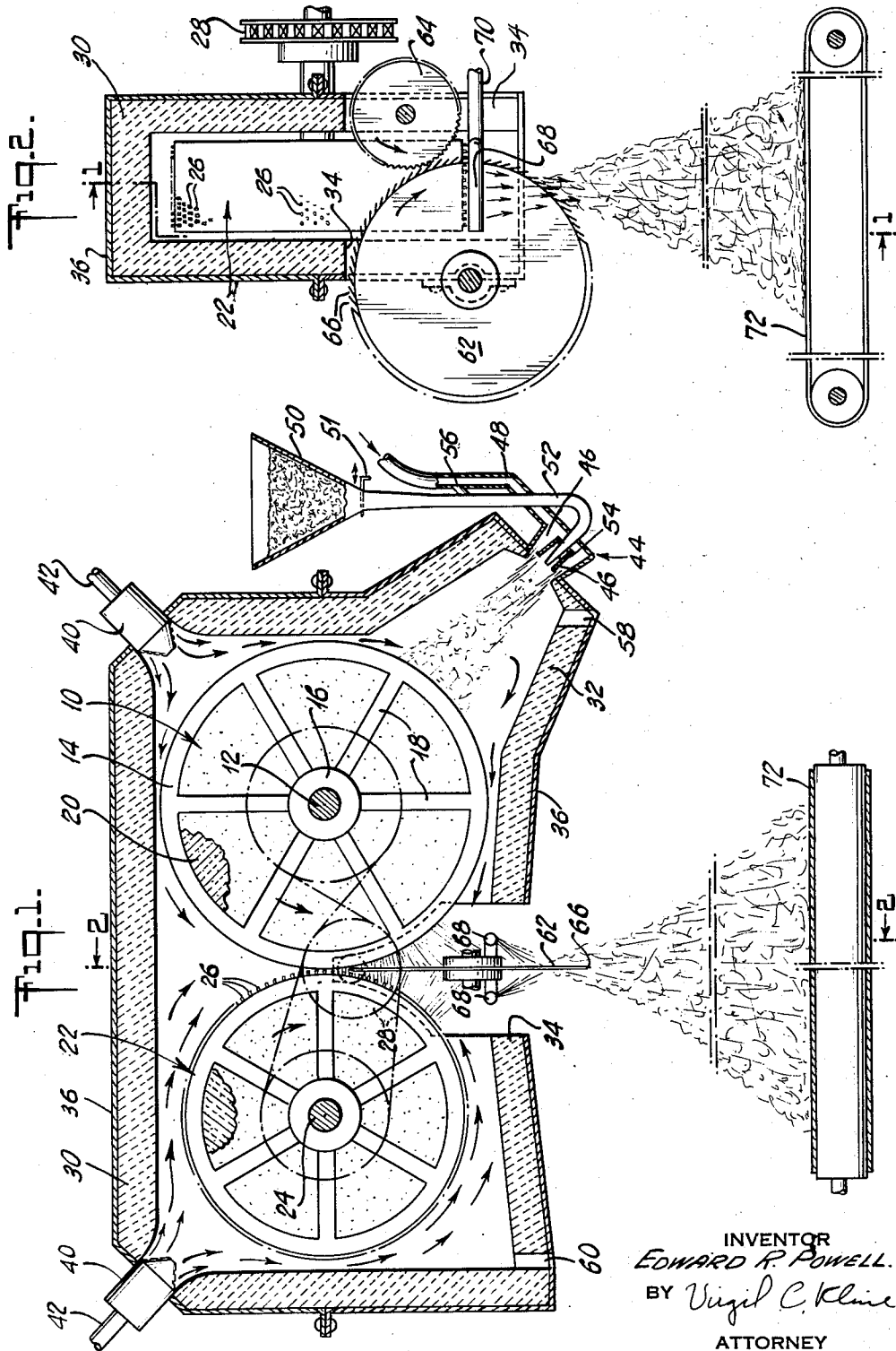
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METHOD AND APPARATUS FOR FORMING FINE FIBERS

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METHOD AND APPARATUS FOR FORMING FINE FIBERS

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The instant invention relates to a method of and apparatus for producing fine fibers of glass and similar thermoplastic or meltable materials and is an improvement upon my former application, S. N. 118,815, filed September 30, 1949, of which it constitutes a continuation in part as to all common subject matter. It will be appreciated that in this application, as in my said prior application, the term "glass" is used in a generic sense to include glass compositions, synthetic low alkali glasses, natural glasses, mineral wool compositions, and other meltable materials.

In my prior application I have disclosed an apparatus and method of drawing fine fibers from thermoplastic materials of the type mentioned, the operations involving the formation of a glass layer on the surface of a rotating body, and the contact with the layer by a plurality of protuberances or points, preferably supported on an adjacent rotating body, whereby fibers are drawn from the surface of the layer by the protuberances upon continued rotation of the bodies. The fibers thus initiated are drawn out into longer fibers by the application of forces applied transversely of the lengths of the fibers while they are still attached to the layer of material and to the protuberances. The instant invention has for its principal object the provision of an improved method and apparatus for obtaining a layer of molten glass of the desired properties from which the fibers are drawn.

Another object of the invention is the provision of a method and apparatus for supplying the molten material to the layer carrying body in the form of molten particles, whereby the distribution of material in a layer of predetermined thickness and at the specific temperatures desired may be obtained.

Another object of the invention is the provision of such method and apparatus involving the feeding of the raw material in particulate or powdered form, and the melting and depositing of the particulate raw material on the surface of the body by the action of a melting blast. A further object of the invention is the provision of such apparatus and method in which the blast projects the material onto the surface of the body at a point remote from the fiber drawing operation to permit conditioning of the glass layer before fiber drawing.

A still further object of the invention is the provision of an apparatus providing an enclosed structure for the rotating bodies, the enclosing structure housing the melting burner and having drain openings for excess molten material.

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My invention will be more fully understood and further objects and advantages thereof will become apparent when reference is made to the more detailed description of the invention which is to follow and to the accompanying drawings in which:

Fig. 1 is a longitudinal sectional view of an apparatus embodying the invention, the view being taken on the line 1—1 of Fig. 2; and

Fig. 2 is a transverse sectional view of the apparatus of Fig. 1, taken on the line 2—2 of Fig. 1.

Referring now to the drawings, the apparatus includes a rotor or body 10 mounted on a shaft 12 for rotation in the direction indicated by the arrow. Rotor 10 is of a construction to permit heating from room temperature to 1800° F. without strain or eccentricity and to be mechanically stable and run true at elevated temperatures. Suitably for this purpose it includes a tire 14 made of a heat-resistant metal, connected to a hub 16 by spokes 18, the intervals between the spokes being filled with a high temperature insulating material 20. If desired, the tire can also be made of a suitable ceramic material.

A second rotor 22 is mounted on a shaft 24 lying in parallelism with shaft 12. Rotors 10 and 22 are in alignment and portions of their peripheral surfaces lie in adjacent, parallel but non-contacting relationship. The peripheral surface of rotor 10 is preferably smooth, while that of rotor 22 is provided with a multiplicity of protuberances, specifically pins or projections 26, suitably equally spaced at relatively close intervals over the peripheral surface of the rotor. For example, the protuberances may be placed from 64 to 400 to the square inch. Rotor 22, except for the protuberances, is of similar construction to, but suitably of somewhat smaller diameter than, rotor 10 and is mounted for rotation in the direction indicated by the arrow, that is, in a direction opposite to rotor 10. The rotors are driven by any suitable means at the same peripheral speeds, the drive being diagrammatically illustrated at 28.

Rotors 10 and 22 are enclosed, or substantially enclosed, by a housing 30 having an extension 32 in the lower corner adjacent rotor 10. The housing is cut away at the bottom and part way up the side walls, as indicated at 34, to provide room for the fiber drawing and removal apparatus later to be described. The housing may consist of a steel shell 36 lined with refractory material of a character to resist excessive erosion under the temperatures involved. The housing is of a

width to closely embrace the rotors, as illustrated particularly in Fig. 2, and is of such length and height that the refractory lining is relatively close to the peripheries of the rotors, except at the corners and particularly at extension 32. Suitably the housing and refractory lining are made in sectional form to permit their mounting about the rotors.

Burners 40 are mounted in apertures in the upper corners at the opposite ends of the casing. Each of the burners is positioned to direct its flame along the refractory walls of the housing whereby the rotors and the air spaces between the walls and the rotors are principally heated by radiation from the refractory walls. The burners, which may be of conventional type, are connected by lines 42 to a suitable supply (not shown) of a fuel, such as a mixture of gas and air. The burners serve as means to condition a layer of raw material carried by rotor 10 for the fiber drawing operation, and also to maintain the wheels at their optimum temperatures.

Mounted in extension 32 is a raw material melting and projecting device, indicated generally at 44. This device consists of a plurality of, suitably two, burners 46 positioned to direct converging flames against the adjacent peripheral surface of rotor 10. Burners 46 are connected by a supply line 48 to any suitable source of fuel, such as a mixture of gas and air under such pressure that a high velocity blast is set up. The raw fiber forming material in particulate form is delivered to the flaming blast issuing from burners 46. To this end a supply means for the particulate matter, such as hopper 50 having a valve 51 for adjusting the rate of flow from the hopper, is mounted adjacent casing 30, the hopper being connected by feed conduit 52 to a nozzle 54 having its outlet located between burners 46. Preferably a portion of the gaseous fuel from supply line 48 is by-passed to the feed line 52 to issue from nozzle 54 with the particulate material. For this purpose a connecting tube 56 may be provided between the fuel supply line 48 and the feed line 52.

Extension 32 extends downwardly and rearwardly, as illustrated, from the main portion of the housing 30. One or more drain openings 58 are provided at the low point of the extension to permit any excess molten material to flow from the housing. One or more similar drain openings 60 may also be provided at the other end of the housing adjacent rotor 22 to permit the removal of any molten material which may be carried around by the points 26 and deposited in the housing.

In the operation of the apparatus described above and in carrying out the method of the instant invention, glass of a suitable composition, which may be any of those available for fiber drawing, is supplied in ground or particulate form to hopper 50. The raw material is relatively finely ground to have a particle size of 60 mesh to dust or 100-200 mesh. The material is fed to nozzle 54 and discharged therefrom, the feeding and discharge of the particulate matter being caused partially by gravity, and partially by the suction action of the blasts issuing from burners 46, as well as by the pressurized gases entering the feed line 52 through connecting tube 56. The fuel issuing from nozzles 46 is ignited to set up a high temperature combined blast directed toward rotor 10. The particles of raw material issuing from nozzle 54 are, hence, projected into this blast, the gaseous fuel entering with the particles being ignited and increasing the melting capacity

of the device. The particles are substantially immediately melted by the flame and projected as molten particles in relatively individualized, discrete relationship onto the surface of rotor 10 to form a layer. This layer is conditioned by burners 40 which direct their flames along the wall of the casing, as explained above, to heat the refractory surfaces of the walls whereby the latter radiate heat to the glass layer. The conditioning is carried out at a temperature which will vary depending upon the particular glass or other material used, to maintain the glass at a molten but viscous state as it reaches the fiber drawing operation. For example, commercial plate glass should be at a temperature of 1750° F. to 1850° F. at this stage. The layer is carried by the rotor 10 to the right between it and rotor 22 at which point the protuberances or points 26 contact or dip into the glass layer on rotor 10. As the surfaces of the rotors move apart on continued rotation, each of the protuberances 26 which has dipped into or been contacted by the glass layer draws a fiber from the layer whereby a multiplicity of parallel fibers extend between the protuberances and the layer, the fibers being elongated as the surfaces of the rotors continue to separate.

The temperatures maintained within the casing are such that the protuberances are above the melting point of the glass and, hence, they do not tend to accumulate glass on successive rotation of the rotors, an equilibrium point being reached at which the amount of glass on the protuberances is substantially constant. Also, it has been determined that the temperature of the rotor carrying the protuberances should be kept above, say, 20-30° above that of the other rotor.

The parallel fibers formed between the rotors 10 and 22 are carried into a position where they are picked up by means which apply force transversely of the fiber lengths. This means or apparatus for picking up and drawing out and lengthening the fibers may take different forms. For example, as illustrated, it may be substantially that shown and described in my said prior application, S. N. 118,815, filed September 30, 1949. This apparatus consists of a disc 62 mounted for rotation in the direction indicated by the arrow, the disc being positioned to have a downturning arc of its peripheral surface intercept the fibers formed between the rotors. The periphery of disc 62 carries a continuous series of pins or other projections 66 adapted to hook the fibers and carry them downwardly on rotation of the disc. Opposite the stretching disc is a pusher wheel 64 mounted for rotation in a direction opposite to that of the stretching disc, as indicated by the arrow, and at preferably the same, or slightly lower peripheral speed. The pusher wheel intercepts the fibers which are beyond the path of movement of the stretching disc and carries them into position to be picked up by pins 66. The shafts of the disc and pusher wheel may be driven by any suitable mechanism (not shown).

Gaseous jets 68, directed downwardly adjacent the periphery of the disc and substantially at the point where the projections 66 point approximately downwardly, remove the fibers from the projections and further draw them out. These nozzles are connected by a line 70 to a supply of any suitable gas under pressure, such as compressed air or superheated steam. It will be appreciated that, in lieu of this device for elongating and removing the fibers drawn between rotors 10 and 22, other suitable apparatus may be employed,

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the invention of the instant application being directed to the apparatus and method for forming and conditioning the layer of fiber forming material on the rotor 10, and for initially drawing the fibers between the rotors 10 and 22.

The drawn fibers may be collected in any suitable way, for example, on a conveyor 72 located below the fiber forming equipment.

The instant apparatus and method, described above, provide for uniform distribution of the material on the rotor 10 in the form of a layer of the required thickness and at the desired temperature. As will be readily recognized, the thickness of the layer may be predetermined by proper feed of the particulate matter and by adjustment of the speed of rotation of the rotors. Inasmuch as no scraping or leveling operation need be performed on the deposited glass, the glass need not be at the undesirably high temperatures necessary to fluidify it for such scraping or leveling operations. The application of the material to the rotor at a point remote from the drawing operation permits the conditioning of the glass to the specific range of viscosity for most efficient operation. Any molten material which may tend to gather in the housing, either as a result of splattering of the material in the blast or otherwise, is drained from the area of operation through the drain opening 58 and similarly, molten material which may be carried from the zone of fiber formation by protuberances 26 and the drip therefrom, may escape through drain opening 60.

Having thus described my invention in rather full detail, it will be appreciated that these details need not be strictly adhered to and that various changes and modifications may suggest themselves to one skilled in the art, all falling within the scope of the invention as defined by the subjoined claims.

What I claim is:

1. A method of making fibers comprising discharging molten particles of fiber forming material onto the surface of a body to form a layer, contacting said layer with an element, and moving said element relatively away from said layer to draw a fiber therefrom.

2. A method of making fibers comprising depositing molten particles of fiber forming material onto the surface of a body to form a layer, carrying said layer on said body and conditioning the layer, contacting the layer with an element, and moving said element relatively away from the layer to draw a fiber therefrom.

3. A method of making fibers comprising melting particles of raw material, discharging the molten particles onto the surface of a body to form a substantially uniform layer, contacting said layer with an element, and moving said element away from said layer to draw a fiber therefrom.

4. A method of making fibers comprising melting particles of raw fiber forming material in a flame, discharging the molten particles in relatively discrete relationship onto the surface of a body to form a layer, contacting said layer with an element, and moving said element relatively to said layer to draw a fiber therefrom.

5. A method of making fibers comprising melting particles of raw fiber forming material in a flame, discharging the molten particles in relatively discrete relationship onto the surface of a body to form a layer, contacting said layer with an element, maintaining said element at a temperature above said body, and moving said

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element relatively to said layer to draw a fiber therefrom.

6. A method of making fibers comprising conveying particles of raw fiber forming material together with a gaseous fuel to a flame, melting the particles in the flame, discharging the molten particles in relatively discrete relationship onto the surface of a body to form a layer, conveying said layer on said body while conditioning the layer, contacting said layer with a plurality of elements, and moving said elements relatively to said layer to draw fibers therefrom.

7. A method of making fibers comprising melting particles of raw fiber forming material, projecting the molten particles onto the surface of a moving body to form a substantially uniform layer thereon, contacting said layer with a plurality of elements, moving said elements relatively away from said layer to draw fibers therefrom, and applying force to the fibers, said force moving transversely of the fibers while the fibers are attached to the layer and elements.

8. In an apparatus for producing fibers, a body for carrying a layer of fiber forming material, means movable relatively away from said body for contacting said layer and drawing a fiber therefrom, and means for discharging molten particles of fiber forming material onto said body to form said layer thereon.

9. In an apparatus for producing fibers, a body for carrying a layer of fiber forming material, means movable relatively away from said body for contacting said layer and drawing fibers therefrom, means for discharging particles of fiber forming raw material, means for melting the particles, and means for projecting the molten particles onto the body to form the layer.

10. In an apparatus for producing fibers, a body for carrying a layer of fiber forming material, means movable relatively away from said body for contacting said layer and drawing fibers therefrom, means for supplying particles of fiber forming raw material, a melting blast directed toward said body, and means for feeding the particles to the blast whereby the particles are melted and projected onto said body to form the layer thereon by said blast.

11. In an apparatus for producing fibers, a rotatable body for carrying a layer of fiber forming material, means movable relatively away from said body for contacting said layer and drawing fibers therefrom, means for supplying particles of fiber forming raw material, a melting blast directed toward said body at a point remote from the fiber drawing operation, means for feeding the particles to the blast whereby the particles are melted therein and projected onto said body to form the layer thereon, and means for conditioning said layer on the body before it reaches the fiber drawing operation.

12. In an apparatus for producing fibers, a body for carrying a layer of fiber forming material, means movable relatively away from said body for contacting said layer and forming a fiber therefrom, a hopper for particles of raw fiber forming material, means for setting up a particle melting blast directed toward said body, and a feed pipe leading from the hopper to the blast.

13. In an apparatus for producing fibers, a body for carrying a layer of fiber forming material, means movable relatively away from said body for contacting said layer and forming fibers therefrom, a hopper for particles of raw fiber forming material, means for setting up a

particle melting blast directed toward said body, a feed pipe leading from the hopper to the blast, and means for supplying fuel to said feed pipe for intermixture with said particles.

14. In an apparatus for producing fibers, a rotor having a peripheral surface for receiving a layer of molten material, a second rotor, elements projecting from said second rotor to contact said layer on said first rotor at a bight therebetween, means mounting said rotors for rotation with said elements moving into and out of contact with said layer of draw fibers therefrom, a housing partially enclosing the rotors, means for setting up a flaming blast in said housing directed toward said first rotor at a point remote from the bight between the rotors, means for feeding particles of fiber forming raw material to said blast whereby said first rotor receives a layer of molten material, and heating means for conditioning the layer as it is carried by the first rotor to said bight.

15. In an apparatus for producing fibers, a rotor having a peripheral surface for receiving a layer of molten material, a second rotor, elements projecting from said second rotor to contact said layer on said first rotor at a bight therebetween, means mounting said rotors for rotation with said elements moving into and out of contact with said layer to draw fibers therefrom, a casing partially enclosing the rotors, said casing having an extension at a corner thereof adjacent the first rotor, a burner mounted within said extension for directing a flaming blast toward said first rotor at a point removed from the bight between the rotors, and means for feeding particulate fiber forming raw material to said blast.

16. In an apparatus for producing fibers, a rotor having a peripheral surface for receiving a layer of molten material, a second rotor, ele-

ments projecting from said second rotor to contact said layer on said first rotor at a bight therebetween, means mounting said rotors for rotation with said elements moving into and out of contact with said layer to draw fibers therefrom, a housing partially enclosing the rotors, said housing having an extension at a corner thereof adjacent the first rotor, a burner mounted within said extension for directing a flaming blast toward said first rotor at a point removed from the bight between the rotors, means for feeding particulate fiber forming raw material to said blast, and a drain opening in said extension to permit excess molten material to drain from the housing.

17. In an apparatus for producing fibers, a rotor having a peripheral surface for receiving a layer of molten material, a second rotor, elements projecting from said second rotor to contact said layer at a bight between the rotors, a housing partially enclosing the rotors and having lower corners defining the low spots of the housing, a burner mounted within the housing adjacent one of said corners to direct a particle melting blast toward said first rotor, means for supplying raw material to said blast, and drain openings in said housing at said corners to permit excess molten material to drain from the housing.

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