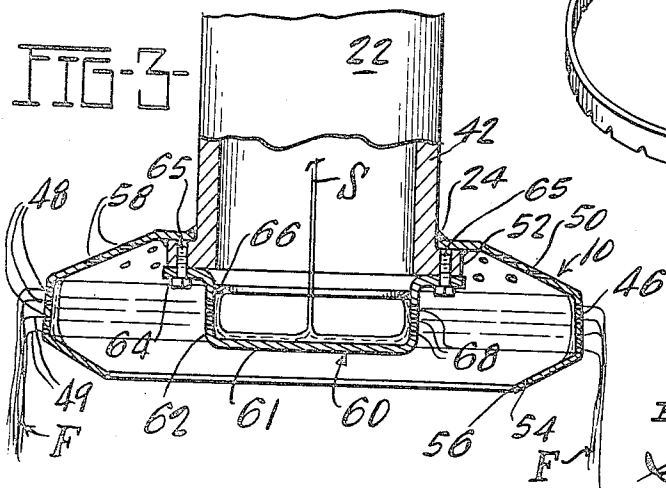
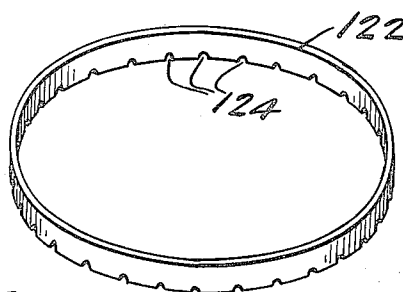
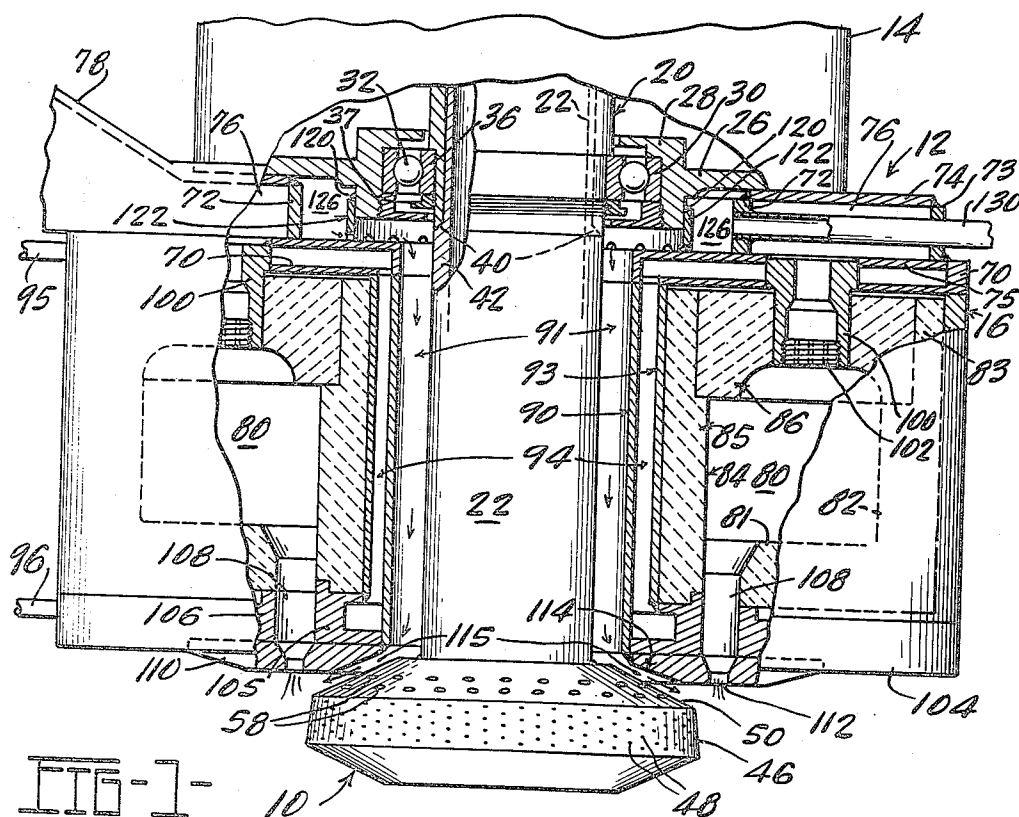


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APPARATUS FOR FORMING FIBERS

Filed Dec. 6, 1956



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2,949,631

APPARATUS FOR FORMING FIBERS

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Filed Dec. 6, 1956, Ser. No. 626,631

2 Claims. (Cl. 18—2.5)

This invention relates to method and apparatus for forming heat-softenable materials into discrete bodies, and more especially to a structural arrangement for subjecting heat-softened material to centrifugal forces to form or subdivide the material into linear formations or bodies and attenuating the formations or bodies to fine fibers.

Mineral fibers and more particularly glass fibers or filaments have been produced wherein centrifugal forces are utilized to deliver elongated bodies of mineral material in softened or molten condition into an annularly shaped gaseous blast whereby the blast attenuates the linear bodies to fine fibers of varying lengths. This method of forming fibers by centrifugal forces has been carried out by apparatus embodying a spinner or hollow rotor having a peripheral perforated wall through the perforations of which the material is extruded or projected by centrifugal forces arising through rapid rotation of the spinner or rotor, the extruded or projected bodies of the material moving into an annular blast and attenuated by the blast to fibers.

The softened or molten material such as glass may be of a temperature of 2000° F. or more and the intense heat under certain operating conditions causes overheating of the shaft or rotor or both which may tend to distort the shaft or rotor. Such difficulties necessitate prolonged interruption of operations to effect replacement or repair resulting in decreased production and increase in the cost of the processed material or fibers.

The present invention embraces a method of and means for delivering a cooling medium into the region of the rotor and its support for maintaining these components at safe operating temperatures.

Another object pertains to a method of and means for directing or establishing flow of air or other gas adjacent the rotor support and at the inner boundary region of an attenuating blast for cooling the rotor, rotor support and to assist in stabilizing the blast.

Another object of the invention resides in the provision of a cooling or temperature controlling arrangement associated with the rotor and shaft construction which accommodates a circulating heat absorbing medium or fluid for maintaining a control of the temperature adjacent the shaft and rotor. The invention described and claimed herein embraces an apparatus or structural arrangement for metering and delivering a heat absorbing medium such as air or other fluid into contact with surfaces of a rotor and a rotor support which are subjected to high temperatures for maintaining the rotor and support at safe operating temperatures and assist in stabilizing an attenuating blast adjacent the rotor.

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

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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 of the rotor and burner construction of a fiber-forming apparatus illustrating a cooling arrangement for the rotor and rotor support, certain parts being shown in section;

Figure 2 is an isometric view of an element of the construction shown in Figure 1, and

Figure 3 is a vertical sectional view through the rotor.

The apparatus illustrated embodying a form of the invention is particularly adaptable for forming elongated discrete bodies or filaments from heat-softenable material such as glass, and attenuating the bodies to fibers, but it is to be understood that we contemplate the use of the invention wherever it may be found to have utility.

Referring to the drawings in detail, there is illustrated an apparatus for forming elongated discrete bodies of heat-softenable mineral materials, such as glass, and attenuating the discrete bodies to fine fibers through the utilization of a high velocity gaseous blast.

The material processing or fiber-forming apparatus shown in Figure 1 embraces a rotor construction 10 adapted to receive heat-softened or molten fiber-forming material S from a feeder (not shown) attached to a forehearth containing a supply of the molten material, the material being extruded by centrifugal forces through openings in a wall of the rotor to form discrete bodies or primaries. The bodies or primaries of glass or heat-softened material so formed are engaged by an annular gaseous blast, the gases of which are directed at high velocities into engagement with the bodies or primaries for attenuating or forming them into fine fibers.

The fiber-forming unit 12 is supported by suitable means (not shown) and is inclusive of a housing 14 beneath which is positioned a casing or housing 16 containing an internal combustion burner adapted to burn a combustible mixture, the burned gases providing the hot, high velocity attenuating blast.

The rotor construction 10 is supported upon and is adapted to be driven by a shaft or spindle 20 within which is telescoped a quill or thin walled hollow shaft or sleeve 22, the rotor being secured to the lower end of the sleeve 22 as by welding 24 or other suitable means. An inwardly extending wall 26 of the housing 14 is formed with a central boss portion or zone 28 which is recessed to receive an outer race 30 of an anti-friction or ball bearing 32, the race being held in place by a threaded plate 34.

The exterior surface zone of the lower end of shaft 20 is formed with a recess to accommodate the inner race 36 of the bearing held in place by a ring 37 threaded on the shaft. Additional bearing means (not shown) are provided in the housing 14 surrounding the shaft 20, which with the bearing 32 journally supports the shaft and rotor construction.

The lower extremity of the hollow shaft 20 is formed with a chamfered or beveled edge 40 which, in assembly, engages a reciprocally shaped abutment or surface formed upon the portion 42 of the quill. Through the cooperation of the engaging chamfered surface 40 with the quill portion 42, the quill and rotor are properly centered with respect to the shaft 20. A suitable drive connection (not shown) is established between the shaft and quill whereby the rotor, shaft and quill are driven by an electrically energized motor contained in the housing 14 or by other suitable source of power.

The rotor structure 10 illustrated in Figures 1 and 3 is fashioned with comparatively thin wall sections in order to reduce the weight of the rotor to a minimum. The rotor may be made of metals or alloys capable of with-

standing the intense heat from the molten glass such as stainless steel, and by fashioning the rotor with thin walls, it may be made of rare metals having long wearing characteristics such as platinum rhodium or the like. The rotor is formed with a perforated peripheral wall portion or band 46 concentrically arranged with respect to the axis of the quill or hollow shaft 22 and is preferably tapered slightly outwardly and downwardly as illustrated.

It is to be understood that the peripheral wall or band 46 may be cylindrical about the central axis of the rotor or the same may be inclined or of frusto-conical shape of substantial angularity depending upon the character of the attenuating blast engaging the bodies projected from the rotor. The wall 46 of the rotor is provided with a comparatively large number of orifices or apertures 48 through which the molten material is projected under the influence of centrifugal forces of rotation to form the material into discrete bodies or primary filaments 49.

The upper portion of the wall 46 is joined or integrally formed with an angularly arranged connecting portion or wall 50 terminating in the ledge portion 51 of the rotor structure which is secured to a flange 52 formed at the lower end of the hollow shaft or sleeve 22. The lower zone of wall 46 is joined or integrally formed with an angularly disposed wall portion 54 extending in a direction opposite to the angularity of the portion 50. The angularity of the wall portions 50 and 54 is substantially symmetrical about a plane through the central zone of the wall portion of the rotor normal to the axis of rotation.

The walls 50 and 54 are of substantially the same shape and thickness whereby they will expand and contract substantially uniformly irrespective of wide temperature variations so that no distortion of the rotor occurs. The lower wall 54 of the rotor terminates at a zone 56 defining a circular opening through which gases in the rotor may escape. The upper angular wall 50 of the rotor may also be provided with circumferentially spaced ports or openings 58 to facilitate passage of hot gases from the rotor and onto the bodies or primaries 49.

Disposed within the rotor 10 is a means for distributing the molten glass or other molten fiber-forming material to a zone or region at the inner surface of the wall portion 46 so as to provide a uniform supply of material adjacent the orifices 48 in order that elongated bodies or primaries 49 of uniform character may be formed. As shown in Figure 3, there is illustrated a cup-like member or basket 60 having an imperforate bottom wall 61, a circular cylindrical side wall 62 terminating at its upper zone in an outwardly extending circumferentially spaced flange or ear portions 64.

The flange portion 52 of the quill or sleeve 22 is formed with threaded bores which are aligned with openings in the circumferentially spaced flange portions or projections 64 to receive securing bolts 65 for connecting the material distributing means or cup 60 with the hollow shaft 22.

Disposed within and at the upper portion of the cup member is an annular element or ring 66 welded or secured to the circular wall 62 which serves to reinforce the cup and prevent or avoid distortion thereof. The circular cylindrical wall 62 of the cup construction is formed with a plurality of orifices or outlets 68 which are sufficient in number and size to accommodate transfer or delivery of an adequate supply of molten glass or fiber-forming material to the inner zone of the wall 46.

The stream of glass or other material is delivered through the hollow interior of the shaft 22 and engages the bottom wall 61 of the cup 60. Centrifugal force of the rotating cup propels or projects the molten material through the openings 68 in the cup wall 62, the material being delivered on the interior surface of the wall 46 forming a film or supply of material adjacent the orifices 48. Centrifugal forces propel or project the material

through the orifices 48 in the rotor wall to form discrete bodies or primaries 49.

The discrete bodies or filaments 49 may be further processed into fine fibers by attenuation. Figure 1 illustrates an arrangement wherein a gaseous blast of intensely hot gases is projected as an annular blast into engagement with the bodies or primaries. Disposed adjacent and beneath the motor housing 14 is a burner unit including a substantially circular cylindrical casing or housing 16 which is provided at its upper portion with a circular member 70 secured to the casing by suitable means (not shown).

Disposed above the member 70 is a construction comprising inner and outer circular walls 72 and 73 and an upper wall 74 which with the upper surface of a plate 75 define a manifold chamber 76. The walls are welded to members 74 and 75 so as to form a closed chamber 76 as well as to provide means for supporting the burner construction. The housing 14 is secured to the member 74 by suitable means (not shown). The circular manifold chamber 76 is formed with a mixture inlet portion 78 which is connected with a supply of combustible mixture, as for example, fuel gas and air, which is to be delivered to the burner construction.

The burner construction in the embodiment shown in Figure 2 includes an annular combustion chamber or confined zone 80 and is defined by horizontal and vertical surfaces 81 and 82 of an annular member 83, a surface 84 of an annular sleeve-like member 85, and an annular member 86 disposed above the chamber 80. The members 83, 85 and 86 are formed of high temperature resistant refractory.

The burner arrangement is inclusive of a circular vertical metal wall 90 which surrounds the lower zone of the quill or hollow shaft 22 forming an annular space 91 to retard transfer of heat between the burner and quill. Spaced from the annular wall 90 is an annular wall 93, the space 94 between the walls forming a chamber or passage to accommodate the circulation of a cooling fluid through inlet and outlet pipes 95 and 96.

By continuously circulating temperature controlling or cooling fluid through the chambers the metal parts or components of the burner construction may be maintained within safe operating temperatures. Liquids such as water or oil may be utilized as temperature controlling or cooling mediums, but it is to be understood that any suitable fluid having satisfactory heat adsorbing characteristics may be utilized for the purpose.

Means are provided for admitting combustible mixture from the manifold 76 into the combustion chamber or confined zone 80. A plurality of tubular fittings 100 are circumferentially spaced establishing communication between the manifold 76 and the combustion chamber 80, two of the fittings being illustrated in Figure 1. The fittings 100 extend through openings formed in the member 70 and plate 75 and are welded thereto forming fluid tight joints.

The fittings 100 are shaped to accommodate members 102, each of which is formed with a plurality of small channels or passages forming a fire screen for preventing ignition of combustible mixture in the manifold 76. A sufficient number of mixture conveying fittings 100 is provided in order to obtain satisfactory distribution of the combustible mixture in the combustion chamber 80.

The lower portion of the burner structure is formed with upwardly extending concentric annular members 105 and 106 which are spaced to form an annular passage 108 which is in direct communication with the combustion chamber 80. Secured to the members 105 and 106 is an annularly shaped orifice means or plate 110 which is held in place by suitable means.

The means 110 may be formed of two concentric sections providing an unobstructed annularly shaped orifice 112 which is restricted so that the burned gases from the chamber are discharged through the annular orifice

112 as an intensely hot, high velocity annular blast projected adjacent the periphery of the rotor 10 and in concentric relation therewith. The orifice means 110 may be formed as one member with spaced narrow portions extending across the orifice 112 providing a substantially unobstructed annular blast.

Means is provided for directing cooling fluid such as a stream of air or other gas under pressure in the region or passage 91 adjacent the hollow shaft 22 and upper portion of the rotor 10.

Welded as at 120 or otherwise secured to a wall of the boss portion 28 is a circular plate or member 122 illustrated in detail in Figure 2. The plate or member 122 is provided with notches, slots or openings 124 for establishing restricted communication between the annular chamber or passage 126 and the annular chamber or passage 91 existent between the exterior peripheral surface of the quill 22 and the circular casing wall 90 of the burner construction.

Means is provided for flowing or delivering a cooling fluid such as air under pressure into the annular chamber 126 and through the slots or openings 124 in the plate thence downwardly through the passage 91 and through the passage 115. The fluid or air flow is desirable under certain operating conditions in order to control or reduce the temperature adjacent the quill 22 to avoid overheating the same and the elements associated therewith and to stabilize the gaseous blast emanating from the orifice 112.

Extending through openings formed on the interior and exterior walls 72 and 73 is a tube or conduit 130. The exterior zones of the tube adjacent the walls 72 and 73 are welded thereto to prevent leakage of combustible mixture from the chamber 76. The tube 130 extends exteriorly of the wall 73 and is arranged to be connected with a supply of compressed air or other gas under pressure for establishing continuous flow of air or gas into the annular chamber 126.

While one air supply tube 130 is illustrated in Figure 1, it is to be understood that a plurality of tubes may be utilized, circumferentially spaced and extending across the mixture manifold 76. The stream of compressed air or other gas flowing through the passage 115 in the zone adjacent the rotor and the inner boundary layers of gases of the blast tends to more nearly equalize the pressures interiorly and exteriorly of the annular gaseous blast projected through the annular orifice 112 and avoids direct "licking" or contact of the hot gases of the blast with the wall 46 of the rotor.

The amount of air admitted to the chamber or passageway 91 adjacent the quill is restricted by the openings or slots 124 in the annular plate 122 and the amount of air may be varied by changing or modifying the number or size of the openings 124. By establishing flow of air or other gases through the passage 91 and adjacent the exterior wall of the rotor, such air flow provides, in effect, an induced air stream interiorly of the annular blast of hot gases projected through the orifice 112 comparable to the natural stream of blast-induced air adjacent the exterior boundary of the gaseous blast.

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 for processing heat-softenable mineral material including, in combination, a support, a hollow rotor, a tubular shaft supporting the rotor, journal means carried by the support for rotatably supporting the tubular shaft and rotor, said tubular shaft being arranged to ac-

commodate delivery of heat-softened mineral material into the rotor, means for rotating the shaft and rotor, said rotor having a peripheral wall formed with orifices through which the mineral material in the rotor is projected by centrifugal forces to form discrete bodies of the material, an annularly-shaped burner surrounding said shaft and having a combustion zone adapted to burn a combustible mixture, an annularly-shaped manifold adapted to supply combustible mixture to the combustion zone, said burner being formed with an annularly-shaped orifice substantially concentric with the peripheral wall of the rotor and through which hot gases of combustion from the combustion zone are discharged as a blast into engagement with the discrete bodies for attenuating the bodies to fibers, said tubular shaft being spaced from the burner to provide an elongated passage of annular cross-section, an annular chamber concentric with the annularly shaped manifold, a circular wall of the chamber arranged concentric with the tubular shaft being formed with circumferentially spaced restricted openings establishing communication between the annular chamber and the elongated passage, and means connected with said annular chamber for admitting a gas under pressure into said annular chamber for distribution through the openings in the circular wall of the chamber into the elongated passage and generally downwardly along the gases discharged from the annularly shaped orifice.

2. Apparatus for processing heat-softenable mineral material including, in combination, a support, a hollow rotor, a tubular shaft supporting the rotor, journal means carried by the support for rotatably supporting the tubular shaft and rotor, said tubular shaft being arranged to accommodate delivery of heat-softened mineral material into the rotor, means for rotating the shaft and rotor, said rotor having a peripheral wall formed with orifices through which the mineral material in the rotor is projected by centrifugal forces to form discrete bodies of the material, an annularly-shaped burner surrounding said shaft and having a combustion zone adapted to burn a combustible mixture, an annularly-shaped manifold adapted to supply combustible mixture to the combustion zone, said burner being formed with an annularly-shaped orifice substantially concentric with the peripheral wall of the rotor and through which hot gases of combustion from the combustion zone are discharged as a blast into engagement with the discrete bodies for attenuating the bodies to fibers, said tubular shaft being spaced from the burner to provide an elongated passage of annular cross-section, an annular chamber arranged adjacent and concentric with the annularly-shaped manifold, a circular wall of the chamber being formed with circumferentially spaced restricted openings for establishing communication between the annular chamber and the elongated passage, tubular means extending through the manifold to admit air under pressure to said annular chamber, said restricted openings in the circular wall metering the air flow from the annular chamber into the elongated passage, said rotor being formed with a frusto-conically shaped upper wall provided with circumferentially spaced openings for the escape of gases from the rotor, said frusto-conically shaped surface being spaced from the burner whereby air under pressure from the elongated passage flows along the frusto-conically shaped surface of the rotor and downwardly along the gases of the blast for stabilizing the blast.

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