Aug. 21, 1962 C. J. STALEGO 3,049,751

METHOD AND APPARATUS FOR FORMING FIBERS

Filed Dec. 2, 1952 3 Sheets-Sheet 1

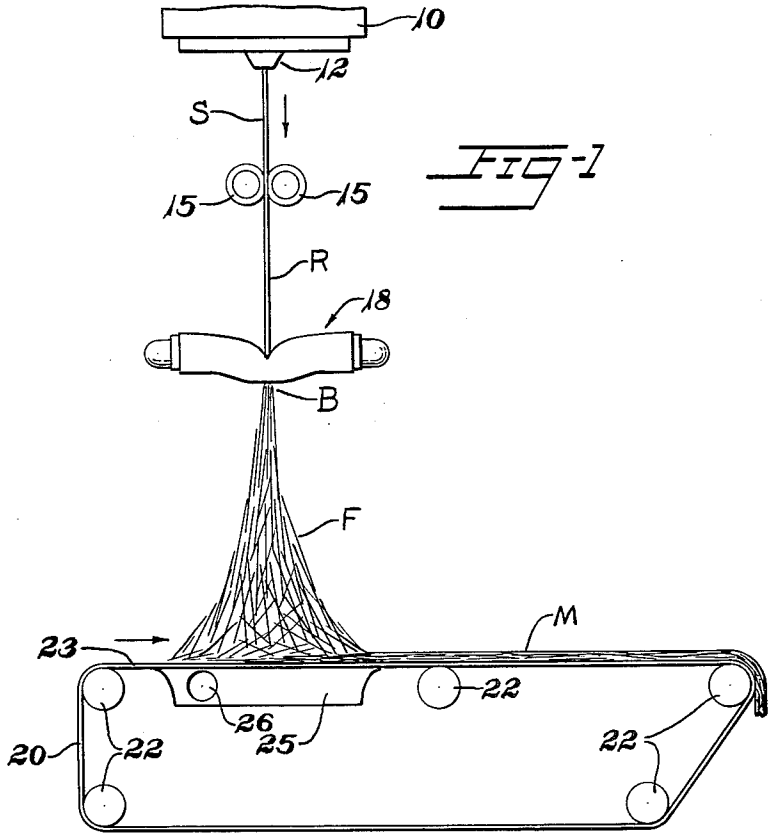


Fig-1

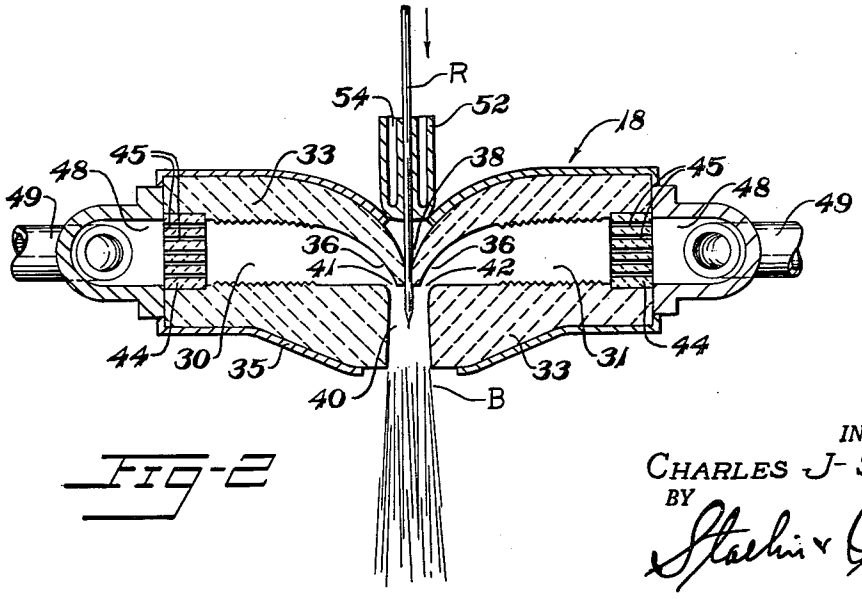


Fig-2

INVENTOR.
CHARLES J. STALEGO
BY
Stachin & Overman
ATTYS.

Aug. 21, 1962 C. J. STALEGO 3,049,751

METHOD AND APPARATUS FOR FORMING FIBERS

Filed Dec. 2, 1952 3 Sheets-Sheet 2

Fig-3

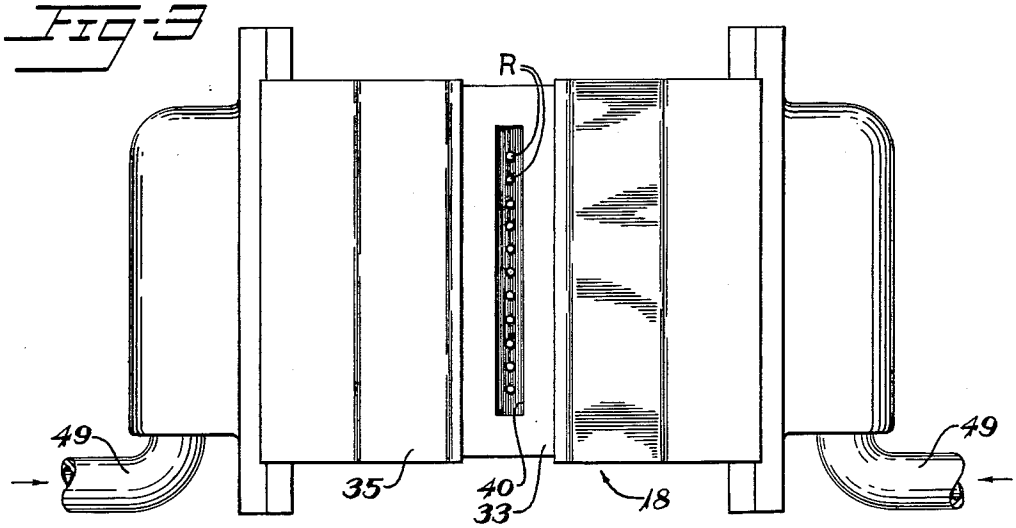


Fig-4

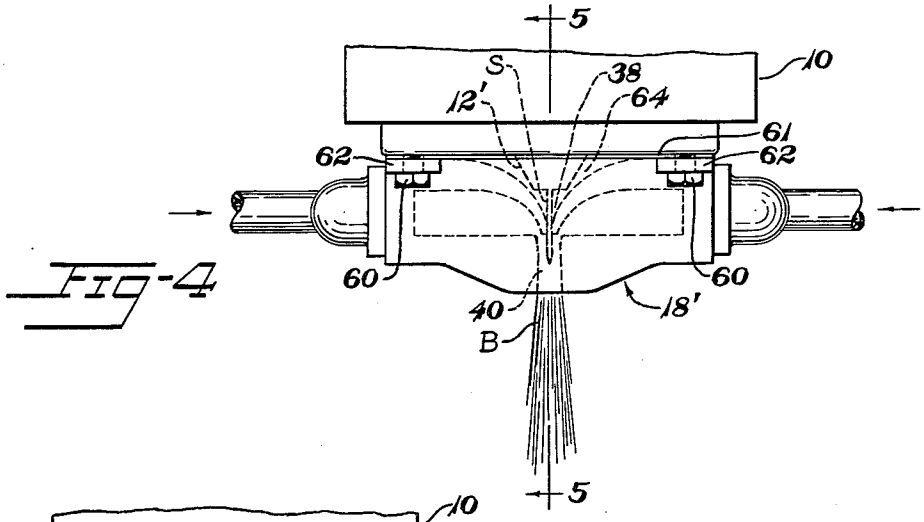
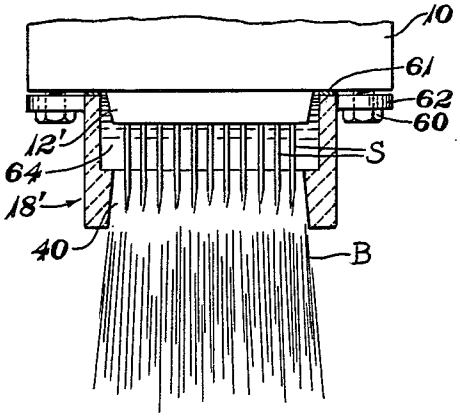


Fig-5



INVENTOR.
CHARLES J-STALEGO
BY
Stalkin & Quermen
ATTYS.

Aug. 21, 1962 C. J. STALEGO 3,049,751

METHOD AND APPARATUS FOR FORMING FIBERS

Filed Dec. 2, 1952 3 Sheets-Sheet 3

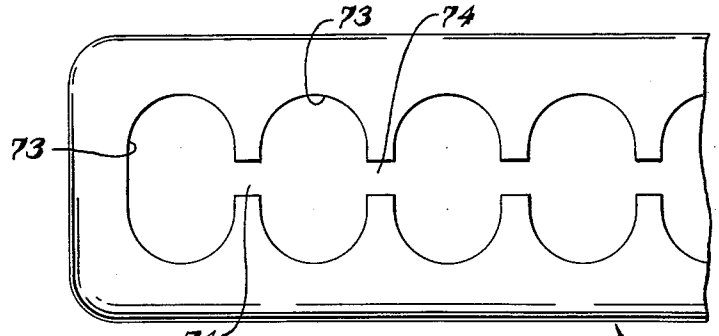


Fig-6

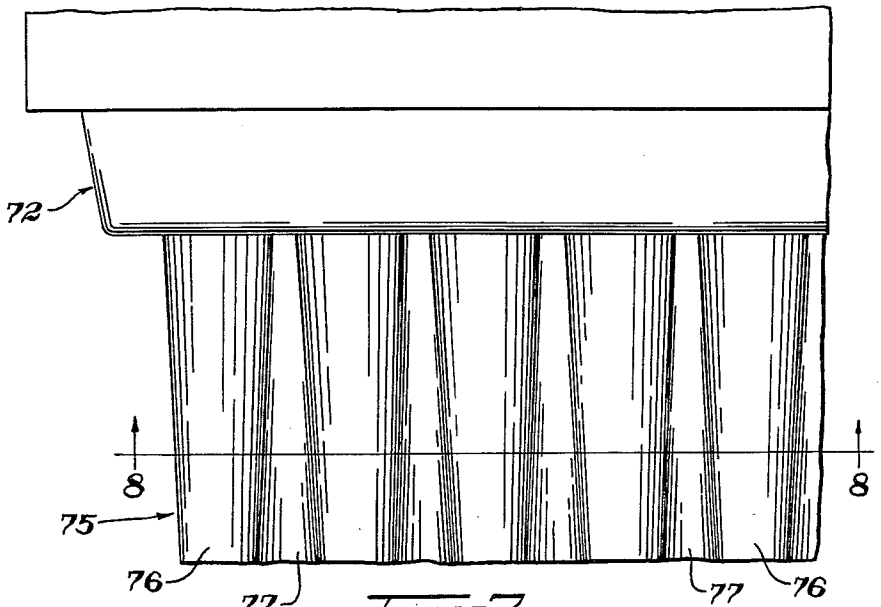


Fig-7

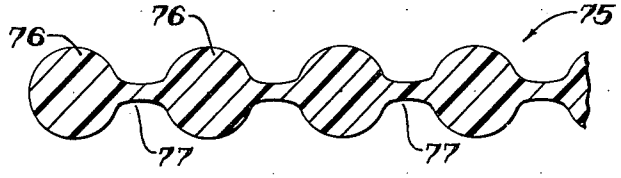


Fig-8

INVENTOR.
CHARLES J-STALEGO
BY
Strauch & Overman
ATTYS.

United States Patent Office 3,049,751 Patented Aug. 21, 1962

3,049,751
METHOD AND APPARATUS FOR FORMING FIBERS

Charles J. Stalego, Newark, Ohio, assignor to Owens-Corning Fiberglas Corporation, a corporation of Delaware

Filed Dec. 2, 1952, Ser. No. 323,561
18 Claims. (Cl. 18—2.5)

This invention relates to method and apparatus for forming fibers from heat-softenable materials and more especially to forming fibers from mineral materials through the utilization of high velocity gaseous blasts.

It has been conventional practice to feed primary filaments or rods of heat-softenable mineral material such as glass into a blast of intensely hot gases of combustion projected through a restricted orifice from an internal combustion burner in a direction normal to the blast, the ends of the filaments being softened and drawn into fibers by the heat and velocity of the blast. Such a method is disclosed in my prior Patent No. 2,607,075. While satisfactory for forming fine fibers, this method has certain limitations. As the primary filaments or rods are projected into the blast substantially at right angles to the direction of movement of the blast, the correct rate of feed of the primary filaments must be established and maintained in order to secure efficient attenuation. If the feed is too fast, the primary filaments may be projected through the blast without being attenuated. If the feed is too slow, the softened extremities of the primary filaments do not reach the interior or core of the blast and may be carried along the boundary layer of the blast by the induced air currents resulting in interruption of attenuation. Introduction of primary filaments into the blast in directions normal to the movement of the blast tends to affect the stability of the blast due to turbulence at the zone of entry of the filaments into the blast. Hence, this method involves accurate control of various critical factors in order to attain satisfactory commercial production of mineral fibers.

It has also been conventional practice to feed primary filaments or rods of heat-softenable material into a composite blast of gases projected from two spaced, angularly disposed burners in an unconfined region at the zone of convergence, the rods being softened and attenuated to fibers under the heat and velocity of the composite blast. A method of this character is disclosed in Slayter and Fletcher Patent No. 2,489,242.

Manufacturers have endeavored to increase the commercial production of fibers as the quantity of fibers produced by the utilization of the above-mentioned methods is necessarily limited. Furthermore, in the use of blasts produced from spaced burners as in the Slayter and Fletcher patent, there is a gradual expansion of the gases as they flow away from the burner orifices. As the glass or other mineral material is introduced into the zone of convergence of the two gas streams at a region spaced from the burners, substantial heat and velocity losses are encountered, reducing the efficiency of attenuation. It has been found difficult to successfully introduce a stream or streams of heat-softenable material into a blast because of the tendency for the molten material to ride upon the layer of induced air moving with the blast, and in endeavoring to deliver a molten stream into a dual blast, the turbulence at the zone of convergence or confluence of the gases forming the blasts tends to resist entry of the stream.

The present invention embraces a method and apparatus avoiding the difficulties mentioned above and involves the formation of a blast of high velocity and of substantial size or volume by burning combustible mixtures in a plurality of chambers or confined zones, discharging the

gases of combustion through a common passageway and feeding heat-softenable fiber-forming material into the passageway whereby the heat and velocity of the blast attenuate the material to fiber form.

An object of the invention is the provision of a method adaptable for converting heat-softenable material to fibers wherein the fiber-forming material may be delivered to an attenuating means in rod or filament form or in the form of one or more molten streams.

Another object of the invention is the provision of a method of attenuating heat-softenable fiber-forming material to fibers through the employment of an intensely hot, high velocity blast of gases wherein the heat and velocity of the gases of the blast are utilized to a high degree of efficiency, making possible the conversion of a large volume of fiber-forming material to fine fibers with a minimum expenditure of energy.

Another object of the invention resides in a method and apparatus for introducing heat-softenable fiber-forming material into a gaseous blast in a confined region so that the pattern or shape of the blast is not impaired or disturbed by the introduction of the fiber-forming material into the blast.

Another object of the invention is the provision of a method of forming fibers wherein a stream of fiber-forming material may be delivered directly from a feeder into a gaseous blast in a confined region whereby heat loss from the stream of material is substantially eliminated.

Another object of the invention is the provision of a burner arrangement adapted to produce a blast of intensely hot gases moving at high velocity, the burner being formed with means for accommodating the delivery of fiber-forming material axially into the blast in a manner substantially eliminating flow of induced air at the zone of delivery of the fiber-forming material into the blast.

A further object of the invention resides in a burner construction of the internal-combustion type adapted to produce a blast of intensely hot gases moving at high velocity wherein the burner may be disposed in contact with a feeder whereby molten fiber-forming material is substantially isolated from circulating air and is delivered directly from the feeder into the blast.

Another object of the invention resides in a feeder arrangement for heat-softenable fiber-forming material adapted for cooperation with means for producing a gaseous blast wherein the feeder is shaped or configurated to flow the fiber-forming material in a manner forming a sheet-like body delivered directly into the gaseous blast for attenuation by the blast to fibers.

Another object of the invention is the provision of a means for feeding heat-softened material such as glass from a supply whereby the material is discharged from the feeder to provide laterally contacting streams and in such formation is delivered into a gaseous attenuating blast thus increasing the volume of material attenuated to fibers.

Still another object of the invention is the provision of blast-producing means including a pair of chambers in which combustible mixtures are burned and the products of combustion delivered to a passageway in the form of a high velocity blast, the means being shaped to accommodate the delivery of fiber-forming material into the blast while the blast is confined.

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 a diagrammatic elevational view of a

form of apparatus for carrying out the method of the invention;

FIGURE 2 is a transverse sectional view through a gaseous blast producing means of the invention;

FIGURE 3 is a bottom plan view of the apparatus illustrated in FIGURE 2;

FIGURE 4 is an elevational view showing a blast-producing means associated with a feeder for attenuating heat-softened material to fibers;

FIGURE 5 is a vertical sectional view taken substantially on the line 5—5 of FIGURE 4;

FIGURE 6 is a plan view of a feeder showing one form of orifice construction for delivering heat-softened material;

FIGURE 7 is an elevational view of the feeder construction of FIGURE 6 illustrating the shape of the body of heat-softened material delivered from the feeder, and

FIGURE 8 is a detail sectional view taken substantially on the line 8—8 of FIGURE 7 showing the cross-sectional configuration of the heat-softened material delivered by the feeder shown in FIGURES 6 and 7.

The method and apparatus of the present invention have particular utility in forming streams of molten or flowable glass into fibers, but it is to be understood that the method and apparatus of the invention may be utilized in forming fibers from other heat-softenable materials such as fusible minerals, slag, rock, thermoplastic resins and the like. The arrangement of the invention is particularly adaptable for forming fibers from heat-softenable fiber-forming materials wherein one or more streams of material may be first formed into primary filaments or rods which are delivered in such form into the attenuating blast. The invention also involves a method of delivering one or more streams of fiber-forming material in a molten or flowable state directly to an attenuating blast in a manner whereby the fluid material is delivered into a high velocity blast of gases without being affected by aspirated or induced air.

Referring to FIGURE 1 of the drawings, there is illustrated one arrangement of apparatus for carrying out the method of the invention wherein a stream or streams of heat-softenable material are drawn into primary filaments or rods which, in a substantially rigid state, are delivered to a restricted passage or confined zone of an attenuating blast which is formed by projecting burned gases from combustion chambers through restricted orifices. A supply of the fiber-forming material, such as glass, is contained in a forehearth or forebay **10** of a melting furnace. The forehearth is equipped with a feeder **12** provided with one or more orifices through which streams S of fiber-forming material may flow from the feeder. In the embodiment illustrated a plurality of streams is delivered through a like number of orifices in the feeder. As the streams S move away from the feeder, they are subjected to a much lower atmospheric temperature and, in a comparatively short distance, are congealed into rods or primary filaments. In order to form the rods or primary filaments of a substantially uniform size it is preferable to provide a pair of pull rolls **15** disposed below the feeder at a sufficient distance to allow the rods or filaments to congeal, the pull or feed rolls being rotated at a speed to draw the streams into rod or filament formation.

Disposed beneath the rolls **15** is a blast-producing means **18** shown in detail in FIGURES 2 and 3 and hereinafter described in detail. The blast-producing means **18** is shaped to direct streams of hot gases of combustion in a downward direction forming a blast B, the rods or filaments being delivered into the blast axially thereof through a suitable passage or entrance in an upper wall of the burner construction. The extremities of the rods or filaments are softened and drawn out or attenuated into fine fibers by the heat and velocity of the blast.

The fibers may be collected in any suitable manner depending upon their ultimate use or further processing. One method of collection is illustrated in FIGURE 1 and includes an endless conveyor **20** of the foraminous type which is supported upon rollers **22** and arranged whereby the substantially horizontal upper flight **23** thereof forms a collecting surface or zone to receive the fibers attenuated by the blast. The fibers F may thus be collected in the form of a mat or web M which is continuously conveyed away from the fiber-collecting zone by the conveyor. The conveyor may be operated by a suitable motor or other driving means (not shown).

Disposed beneath the fiber-collecting zone of the conveyor is a chamber **25** which may be connected by means of a pipe **26** with a blower or source of reduced pressure or vacuum to establish an air stream flowing through the upper flight **23** of the conveyor to aid in the collection of the fibers upon the conveyor as well as to carry away the spent gases of the blast from the fiber-collecting zone. It is to be understood that any suitable method or apparatus may be employed for collecting the fibers or conveying them away from the gases of the blast. For example, they may be collected upon a suitable trough-like surface in the form of a thin web and the web drawn into a sliver or strand of staple fibers.

The blast-producing means in the embodiment illustrated in FIGURES 2 and 3 is configurated to provide opposed chambers **30** and **31**, the interior walls of which are formed of refractory material **33**, the refractory material being sheathed or enclosed within a metal shell **35**. The upper walls of the chambers **30** and **31** are curved downwardly as at **36** providing an entrance or passageway **38** through which the rods or primary filaments R may be conveyed into a passage **40**. The passage **40** is connected with chambers **30** and **31** by restricted orifices or throats **41** and **42**.

Disposed at the outer ends of each of the chambers **30** and **31** is a wall **44**, each wall being formed with a plurality of minute passages or openings **45** to admit a combustible mixture to the chambers from supply manifolds **48**. The manifolds **48** may be connected by means of conduits or pipes **49** with a supply of combustible gas and air or other oxidant. It has been found that gas, such as propane, methane or the like, may be used to advantage as a combustible and mixed with the proper amount of air may be introduced into the burner chambers at comparatively low pressures, for example, two to five pounds per square inch. The amount of combustible mixture admitted to the chambers may be regulated by suitable valve means (not shown).

In the use of the burner construction or blast-producing means **18**, the combustible mixture is continuously supplied from the manifolds **48** to the combustion chambers or confined zones **30** and **31** wherein the gases are completely burned and undergo great expansion, developing a temperature within the burners of upwards of 3000° F. or more. The intensely hot burned gases or products of combustion are projected through the throats or restricted orifices **41** and **42** into the passage **40**, the gas streams from the chambers combining or converging in the passage **40** to form a single, intensely hot, high velocity blast B which moves through the passage **40** and away from the burner. The rods or filaments R are fed into the passageway **40** through the entrance **38** of the burner construction.

As the filaments move into the pasageway **40**, they are preheated by the heated wall portions of the burner at the entrance **38** and are readily softened by the intensely hot gases as the filaments travel into the passage **40**. The softened extremities of the filaments or rods are drawn out or attenuated by the velocity of the blast B into fine fibers which are collected upon the collecting surface of the conveyor **20** hereinbefore described. It should be noted that the walls of the passage **40** in which the gases from the chambers **30** and **31** converge are preferably tapered slightly outwardly and downwardly so as to accommodate the streams of gas forming the blast B and the fiber-forming material delivered into the blast. If

desired, the walls of the passageway 40 may be disposed in substantial parallelism without materially affecting or reducing the velocity of the blast providing the cross-sectional area of the passageway is sufficient to accommodate the gas streams from the chambers 30 and 31 without setting up appreciable back pressure.

A suitable guide means 52 may be provided adjacent the entrance 38 for directing the rods or filaments into the burner. The guide 52 is formed with suitable channels or passages to accommodate the filaments or rods, the guide also serving to prevent surrounding air from entering the burner through the entrance 38 which might otherwise chill the gases of the blast and impair the efficient operation of the blast. The guide means 52 may be cooled by circulating water or other cooling fluid through a chamber 54 formed in the guide.

It should be noted that the interior walls of the chambers 30 and 31 are preferably shaped to corrugated configuration, such contour facilitating the combustion of gases within the chambers, a feature which tends to increase the temperature of the burning gases within the chambers. The higher the temperature of the gases within the confined zones or chambers the greater the velocity of the gases discharged through the restricted throats 41 and 42 forming the gaseous blast B. Through this arrangement the fiber-forming material may be delivered into the gaseous blast in the direction of flow of the gases of the blast without impairment of the characteristics thereof in a manner virtually eliminating back pressure or "sting out."

Due to the particular positioning of the entrance 38 and the passage 40, the rods or primary filaments of glass or other fiber-forming material are heated by the blast and drawn into fibers in an efficient manner without involving the presence of induced air streams at the zone of delivery of the fiber-forming material into the blast, with a consequent increase in efficiency of attenuation. Furthermore, the walls of the entrance 38 and the intensely hot gases in the passage 40 provide a preheating area for the rods or filaments so that the same may be quickly softened and attenuated into fibers, facilitating increased linear speeds of feed of the rods to the blast. Through this arrangement, an economical and commercially usable apparatus is provided for forming fine fibers. Primary filaments or rods of different sizes may be delivered into the blast without modifying or changing the characteristics of the burner or the orifice dimensions whereby the burner is readily adaptable without alteration for producing or forming fibers of a desired size.

FIGURES 4 and 5 illustrate an arrangement of burner construction and fiber-forming material feeding means wherein one or more streams of molten glass or other heat-softenable fiber-forming material may be directly attenuated to fibers by the gaseous blast as the stream or streams are delivered from the feeding means. To accomplish this result, a burner of the construction substantially identical with that disclosed in FIGURES 2 and 3 is secured directly to a stream feeder. As shown in FIGURE 4, the burner construction 18' is secured to the glass stream feeder or bushing 12' by means of bolts 60 passing through lugs or projections 62 carried by the shell or housing construction of the burner. The upper exterior wall of the burner casing is shaped to fit snugly against the feeder. A gasket 61 of refractory material or high temperature-resistant alloy may be disposed between the burner and feeder to effectively isolate the streams from the atmosphere. In this method of operation, the burner may thus be advantageously sealed or secured to the feeder in a manner preventing atmospheric air circulating in the zone 64 existent between the feeder 12' and the upper exterior wall portions of the burner.

As shown in FIGURES 4 and 5, molten streams S of glass or other fiber-forming material are delivered directly through the entrance 38 into the passageway 40 and into the gases of the blast B.

Through the medium of this apparatus and the method of operation, there is substantially no loss of heat from the fiber-forming material as it flows directly into the burner and, being isolated from the atmosphere, there is no chilling of the fiber-forming material during its travel from the feeder into the blast. This method of attenuation is highly efficient in that little or no transfer of heat from the hot gasses to the fiber-forming material is needed as the latter is in molten condition at an elevated temperature. Hence, substantially all of the energy of the gases of the blast may be effectively utilized for drawing or attenuating the streams to fibers.

By reason of the absence of an induced air stream at the zone of delivery of the stream or streams of heat-softened material into the blast, the material readily flows into the blast axially thereof as there is no zone of turbulence tending to resist the entry of the material ino the blast.

FIGURES 6 through 8 illustrate an arrangement of openings or orifices in a feeder which are of a configuration to effect a discharge of a substantial amount of heat-softened fiber-forming material into the blast. The orifices or outlet of the feeder is shaped to provide a unitary stream of fiber-forming material having alternately thick and thin zones in cross-section. As shown in FIGURE 6, a feeder 72 may be formed with a row of orifices 73, each preferably of oval configuration and which are connected by narrow zones 74, the orifices defining the cross-sectional configuration of the stream or body 75 of fiber-forming material as it flows through the orifices. However, as the stream moves away from its zone of discharge from the feeder, the oval zones tend to assume substantially circular cross-sectional shape. Due to this characteristic of the oval zones to assume circular shapes, the stream in cross-section is formed with alternately thick and thin portions as illustrated in FIGURE 8, the thick portions or ridges 76 being circular, being joined by the web-like portions 77. The unit body of glass of the above-described shape moves into the entrance 38 of the burner and into the blast. Thus the glass or other heat-softened fiber-forming material may be delivered into the blast in the form of a ribbon-like body of laterally connected, substantially cylindrical portions. As there is no induced air at the zone of introduction of the sheet-like unit 75 of glass as it enters the entrance 38 in the burner, the glass is in a flowable state and substantially all of the energy in the gases of the blast may be utilized for attenuating the material to fibers. This mehod facilitates the delivery of a greater amount of glass into the burner and hence production of fibers is greatly increased through this arrangement.

If the burner construction is spaced from the feeder a distance sufficient to permit the stream of glass from the feeder 72 to solidify by contact with the atmosphere, the rigid body of the shape shown in FIGURE 8 may be continuously delivered through a guide similar to the guide 52 and through the entrance 38 into the blast in the passageway 40 where the advancing extremity of the body is softened and attenuated to fibers. While the ridges or thick portions 76 of the ribbon or sheet-like body 75 of fiber-forming material are illustrated as generally cylindrical in cross-section, they may be of other shapes if desired.

The method and apparatus hereinbefore described have distinct advantages in that primary filaments, rods, or streams of fiber-forming material of various sizes or dimensions may be delivered through the entrance into the blast of the burner without modifying the characteristics of the burner. By this means within certain limits the size of attenuated fibers may be controlled through the feeding of filaments or streams of particular dimensions into the blast. Furthermore, the burner construction of the present invention may be utilized for

softening and attenuating substantially solid rods or primary filaments to fibers or for attenuating molten streams of material to fibers without substantial modification of the burner construction. Through the delivery of the fiber-forming material into the gaseous blast in the direction of flow of the gases while the gases are confined in the passageway 40, turbulence in the blast is avoided and attenuation of fibers is carried on efficiently and economically.

While the apparatus of the invention has been illustrated as employing an attenuating blast formed by discharging burned gases from confined zones through restricted orifices, it is to be noted that other gases may be used to produce the blast. When molten streams or bodies of the fiber-forming material are delivered into the blast, the blast may be produced by streams of gas such as compressed air or steam delivered into the passageway at high velocity into engagement with the molten material. The method and apparatus are especially adapted for utilizing glass as a fiber-forming material but other materials such as slag, fusible rock and heat-softenable fiber-forming resins may be processed to fibers through the use of the method and apparatus of the invention.

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.

I claim:

1. The method of forming fibers from heat-softenable mineral materials including advancing a body of fiber-forming material from a supply, burning combustible gases in spaced confined zones, discharging the products of combustion from said zones at high velocity through restricted orifices into a passageway, delivering the body of fiber-forming material into the passageway, and attenuating the material delivered into the passageway into fibers by the heat and velocity of the blast.

2. The method of forming fibers from heat-softenable mineral materials including flowing a plurality of streams of the material from a supply, drawing the streams into primary filaments, burning combustible gases in spaced zones, projecting the products of combustion from the zones through restricted orifices into a passageway to provide an intensely hot, high velocity gaseous blast, delivering the primary filaments into the passageway in a direction axially of the movement of the blast, and softening and attenuating the filaments to fibers by the heat and velocity of the blast.

3. The method of forming fibers from heat-softenable mineral materials including flowing a body of the material from a supply, burning combustible gases in spaced chambers, projecting the products of combustion from the chambers through restricted orifices into an elongated confined zone to provide an intensely hot, high velocity gaseous blast, continuously advancing the body of fiber-forming material into the confined zone in a direction axially of the movement of the gases of the blast, and attenuating the material to fibers by the heat and velocity of the blast.

4. The method of forming fibers from heat-softenable mineral materials including flowing a stream of the material from a supply, congealing the stream to a rigid body by contact with the atmosphere, burning combustible gases in spaced chambers, projecting the products of combustion from the chambers through restricted orifices into an elongated confined zone to provide an intensely hot, high velocity gaseous blast, delivering the body of fiber-forming material into the confined zone in a direction axially of the movement of the blast, softening the extremity of the body by the heat of the blast, and attenuating the softened material to fibers by the velocity of the blast.

5. The method of forming fibers from heat-softenable fiber-forming material including forming a stream of heat-softened fiber-forming material into a sheet-like body having spaced parallel ridges, burning combustible mixtures in horizontally elongated opposed chambers, discharging the gases of combustion from the chambers through restricted orifices into a passageway to form an intensely hot, high velocity blast, delivering the body into the blast in the passageway in the direction of flow of the gases, and attenuating the body to fibers under the heat and velocity of the blast.

6. The method of forming fibers from heat-softenable fiber-forming material including flowing a sheet-like body of heat-softened fiber-forming material from a supply, burning combustible mixtures in horizontally elongated spaced chambers, discharging the products of combustion from the chambers through restricted orifices into a confined zone to form an intensely hot, high velocity blast, delivering the sheet-like body into the blast in the confined zone in a manner avoiding the introduction of air into the blast with the sheet-like body, and attenuating the body to fibers under the heat and velocity of the blast.

7. In an apparatus for forming fibers from heat-softenable fiber-forming material including a pair of horizontally opposed combustion chambers, each of said chambers adapted to burn a combustible mixture of gases, the outer end of each of said chambers having an inlet port through which the combustible mixtures of gases are introduced into the chambers, a passageway, each of said chambers having an orifice in communication with the passageway through which the products of combustion are discharged into the passageway to form a high temperature, high velocity blast, and means for delivering fiber-forming material into the passageway and into the blast whereby the fiber-forming material is attenuated by the blast to fibers.

8. In an apparatus for forming fibers from heat-softenable material including a housing formed with a pair of horizontally opposed elongated combustion chambers, each of said chambers being shaped to burn a combustible mixture of gases, means for conveying a combustible mixture into the outer end of each of the chambers, a vertical passageway formed in the central region of said housing, each of said chambers having a restricted orifice in communication with the passageway through which the gases of combustion are discharged into the passageway in the form of a high temperature, high velocity blast, said housing being formed with an entrance through which heat-softenable material may be delivered into the passageway and into the blast whereby the material is attenuated by the blast to fibers.

9. In an apparatus for forming fibers from heat-softenable material including a pair of opposed horizontally elongated combustion chambers, each of said chambers being shaped to burn a combustible mixture of gases, each of said chambers having an inlet port at its outer end through which a combustible mixture of gases is introduced into the chamber, a passageway centrally disposed adjacent the inner ends of the chambers, each of said chambers having an orifice in communication with the passageway through which the gases of combustion are discharged into the passageway to form a high temperature, high velocity blast, said housing being formed with an entrance through which the heat-softenable material may be delivered into the passageway and into the blast whereby the material is attenuated to fibers by the heat and velocity of the blast.

10. In an apparatus for forming fibers from heat-softenable fiber forming material including, in combination, a member formed with a pair of oppositely disposed burners and having a passageway formed therein, means for delivering gases moving at high velocities from the burners into said passageway to form a high velocity gaseous blast, said member having an entrance formed therein in communication with the passageway through which one or more bodies of fiber-forming material may

be delivered into the blast in said passageway in the direction of flow of the gases of the blast.

11. In an apparatus for forming fibers from heat-softenable fiber-forming material including, in combination, a member having a passageway formed therein, a chamber disposed at each side of the passageway and shaped to burn a combustible mixture delivered into each chamber, each of said chambers having a restricted orifice in communication with said passageway whereby the products of combustion from said chambers are discharged at high velocities through said orifices and into the passageway providing a high velocity, high temperature blast, said member having an opening aligned with the passageway through which a body of fiber-forming material may be projected into the blast in said passageway in the general direction of flow of the gases of the blast.

12. An apparatus for forming fibers from heat-softenable fiber-forming materials including, in combination, a feeder having an orifice for flowing a body of fiber-forming material from a supply, a member having a passageway formed therein shaped to receive the body of fiber-forming material from the feeder, said member being formed with orifices communicating with the restricted passageway, and means for discharging high velocity gas streams through said orifices into the passageway, said gases forming a high velocity blast in the passageway engageable with the body of fiber-forming material to attenuate the body of material to fibers.

13. An apparatus for forming fibers including, in combination, a member formed with horizontally disposed combustion chambers adapted to burn combustible mixtures in confined zones, a passageway formed in said member, restricted orifices, associated with said chambers through which products of combustion from said chambers are discharged into the passageway to form a high velocity blast, an entrance formed in a wall of said member in communication with said passageway through which a body of fiber-forming material is delivered into the passageway, guide means disposed adjacent the entrance in said member for directing the fiber-forming material into the entrance, and means for cooling said guide means.

14. Apparatus for forming heat-softenable material to fibers including a feeder, said feeder being formed with a material discharge configuration for flowing fiber-forming material in a sheet-like body of nonuniform thickness from a supply, a member disposed adjacent the feeder and having chambers shaped to burn combustible mixtures under confined conditions, said member having a passageway, a wall of each of said chambers being formed with a restricted orifice in communication with said passageway for the discharge of products of combustion from the chambers into the passageway to form an intensely hot, high velocity blast, said member having an entrance in communication with said passageway adapated to convey the sheet-like body of fiber-forming material into the blast in said passageway whereby the material is attenuated to fibers by the heat and velocity of the blast.

15. In an apparatus for forming fibers from heat-softenable mineral materials including a feeder having a discharge orifice adapted to flow a body of mineral material from a supply, a member disposed beneath the feeder and formed with a pair of chambers, said chambers having inlet openings for the introduction of combustible gaseous mixtures into the chambers, a passageway in said member, said chambers being shaped to burn the gaseous mixtures under confined conditions, each of said chambers being formed with a restricted orifice through which intensely hot gases of combustion are discharged into the central passageway to form a high velocity gaseous blast, an opening in a wall of said member in alignment with the passageway through which the body of material is delivered into the gaseous blast in the passageway, the body of material moving through said passageway in the direction of flow of the gases of the blast, and means for securing the member in sealing relation with the feeder to avoid delivery of air with the material as it enters the blast, said blast having a velocity sufficient to attenuate the body to fibers.

16. An apparatus for forming fibers from heat-softenable material, in combination, a receptacle containing a supply of softened material, a feeder having discharge orifice means configurated to flow a corrugated-like sheet of fiber-forming material from the supply, means including a chamber adapted to burn combustible mixture in a confined zone, said chamber being formed with a restricted orifice through which intensely hot burned gases from the chamber are discharged as a high velocity gaseous blast, and guide means for directing the corrugated-like sheet of fiber-forming material into the blast whereby the heat of the gases of the blast softens the sheet of fiber-forming material and the velocity of the blast attenuates the softened material to fibers.

17. An apparatus for forming fibers from heat-softenable material, in combination, a receptacle containing a supply of softened material, a feeder having discharge orifice means configurated to deliver fiber-forming material from the supply in a sheet-like body of nonuniform thickness, a burner disposed adjacent the feeder and having a chamber in which a combustible mixture is burned, a wall of the chamber having a restricted orifice through which intensely hot products of combustion from the burner are discharged as a high velocity gaseous blast, and guide means for delivering the sheet-like body of fiber-forming material into engagement with the blast whereby the heat and velocity of the gases of the blast soften and attenuate the body of material to fibers.

18. An apparatus for forming fibers from heat-softenable material, in combination, a receptacle containing a supply of softened material, a feeder having discharge orifice means shaped to deliver from the supply a body of the material having spaced thickened zones, a chamber disposed beneath the feeder for burning a combustible mixture, said chamber having an orifice through which the products of combustion from the chamber are discharged as an intensely hot high velocity blast and means for directing the body of material into engagement with the blast whereby the heat and velocity of the gases of the blast soften and attenuate the material to fibers.

References Cited in the file of this patent

UNITED STATES PATENTS

1,773,969	Dreyfus et al.	Aug. 26, 1930
2,002,153	Mendel	May 21, 1935
2,121,802	Kleist et al.	June 28, 1938
2,175,224	Slayter	Oct. 10, 1939
2,175,225	Slayter	Oct. 10, 1939
2,224,466	Baker et al.	Dec. 10, 1940
2,286,903	Dockerty	June 16, 1942
2,489,242	Slayter et al.	Nov. 22, 1949
2,509,845	Slayter	May 30, 1950
2,518,744	Barnard	Aug. 15, 1950
2,569,699	Stalego	Oct. 2, 1951
2,585,496	Powell	Feb. 12, 1952
2,626,484	Stalego	Jan. 27, 1953
2,635,285	Toulmin	Apr. 21, 1953

FOREIGN PATENTS

610,845	Great Britain	Oct. 21, 1948
1,091,906	France	Apr. 15, 1955
766,315	Germany	Aug. 9, 1951