United States Patent

Brossard

[15] **3,650,716**

[45] **Mar. 21, 1972**

[54] METHOD OF AND APPARATUS FOR THE PRODUCTION OF FIBERS FROM THERMOPLASTIC MATERIALS, PARTICULARLY GLASS FIBERS

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[22] Filed: **Sept. 2, 1969**

[21] Appl. No.: **854,369**

[30] **Foreign Application Priority Data**

Sept. 6, 1968 France 165317

[52] **U.S. Cl.** ..... **65/6,** 18/2.5 RR, 18/2.6, 18/85 R, 65/14

[51] **Int. Cl.** **C03b 37/04**

[58] **Field of Search** ..... 18/2.5 RR, 2.6, 8 SR; 264/8, 264/176; 65/6, 8, 14, 15, 7

[56] **References Cited**

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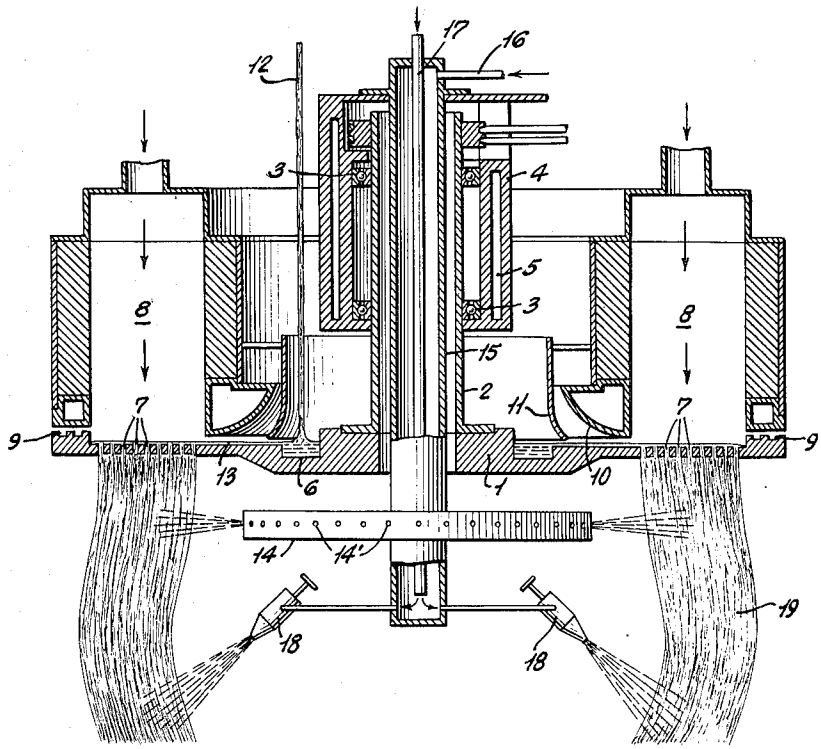
[57] **ABSTRACT**

The production of fibers from viscous thermoplastic material by collecting a reserve supply of the material at the central portion of a centrifuge plate, in the form of a disc or the bottom of an enclosure, which plate rotates on a vertical axis, where from the material is thrown in sheet form toward the periphery of the plate. A plurality of openings are provided in the outer portion of the plate through which the material of the sheet is forced, either by centrifugal force alone or with the aid of a gaseous blast acting on the top of the sheet, which serves to subdivide the material into a plurality of primary filaments to be drawn out into fine fibers. Additional attenuating blasts for drawing out the fibers, and blowers for directing the fibers may be used for effecting their withdrawal.

26 Claims, 12 Drawing Figures



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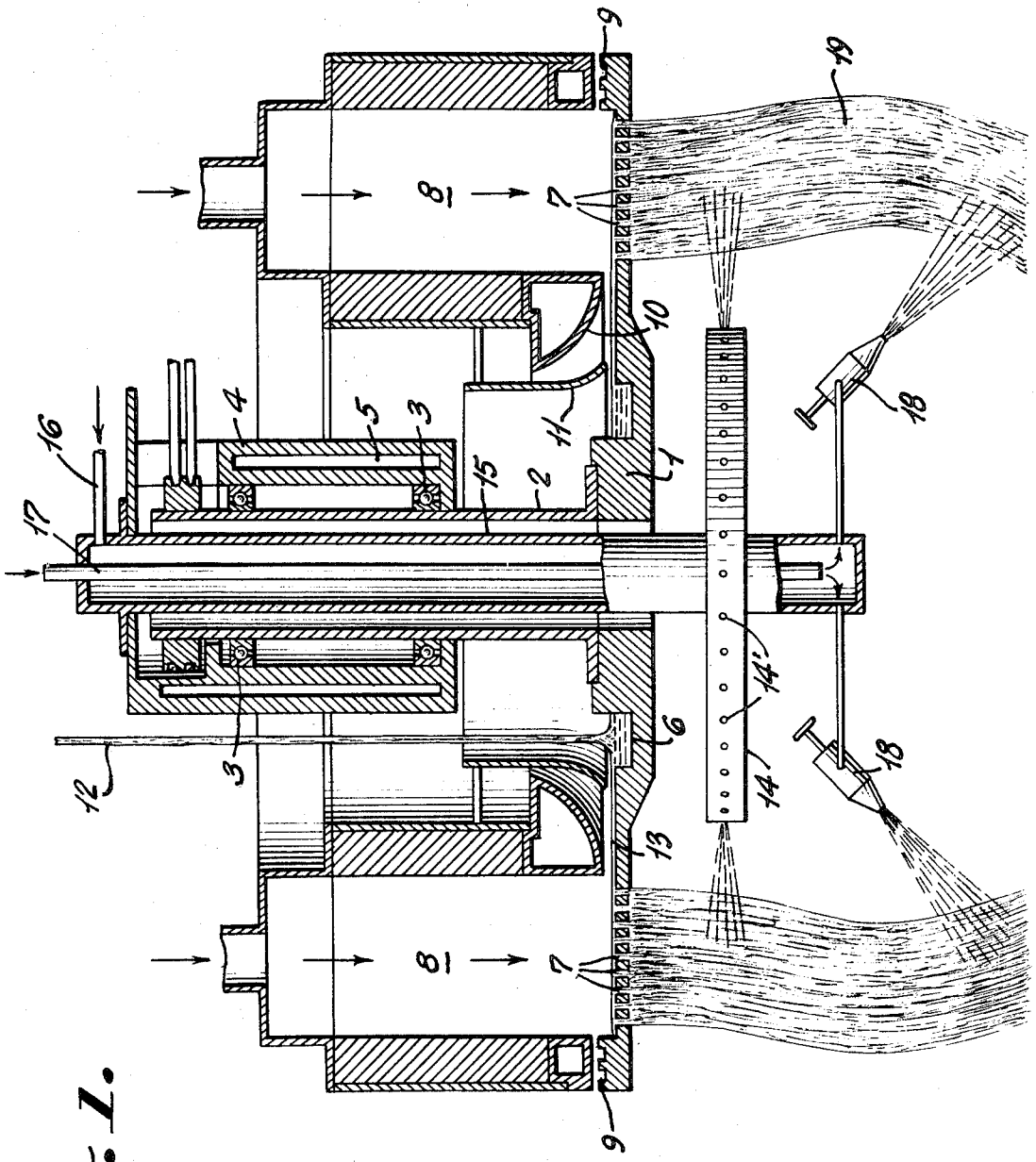

Fig. 1.

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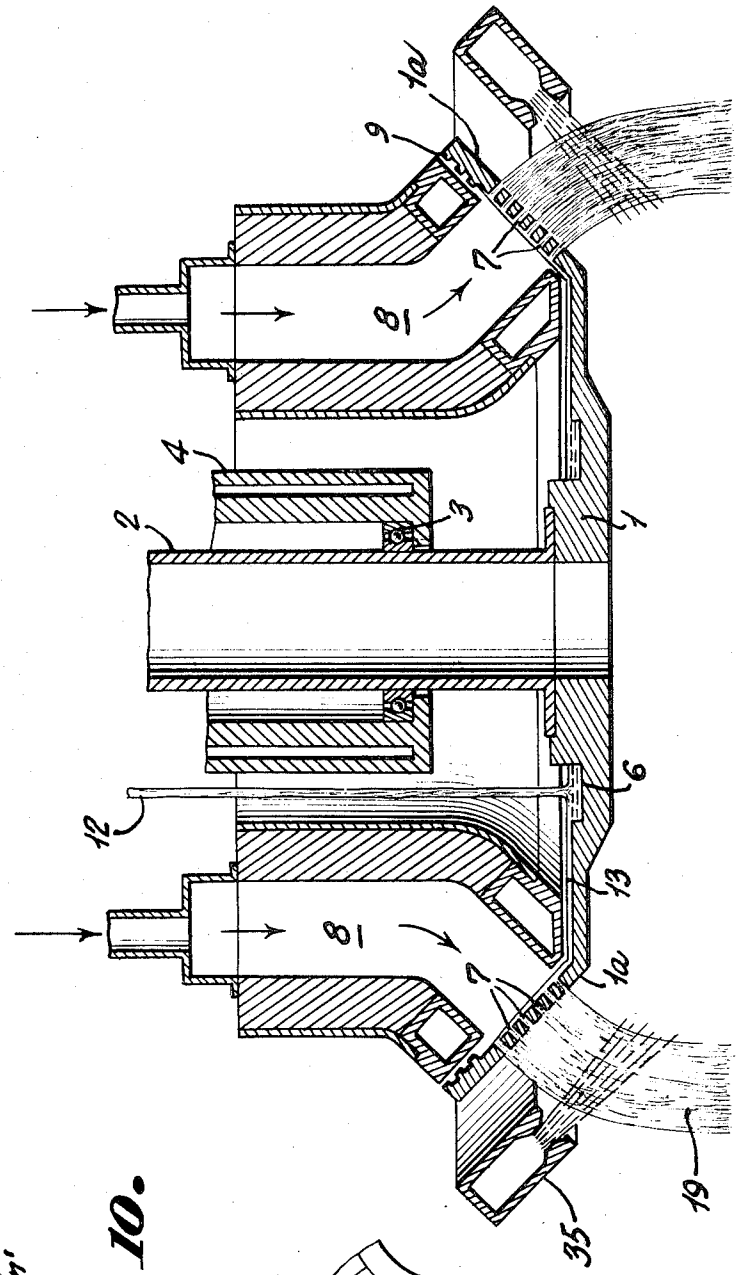
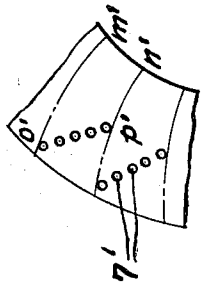


Fig. 2.

Fig. 9.



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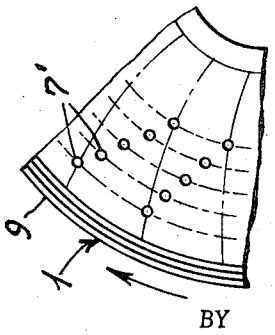

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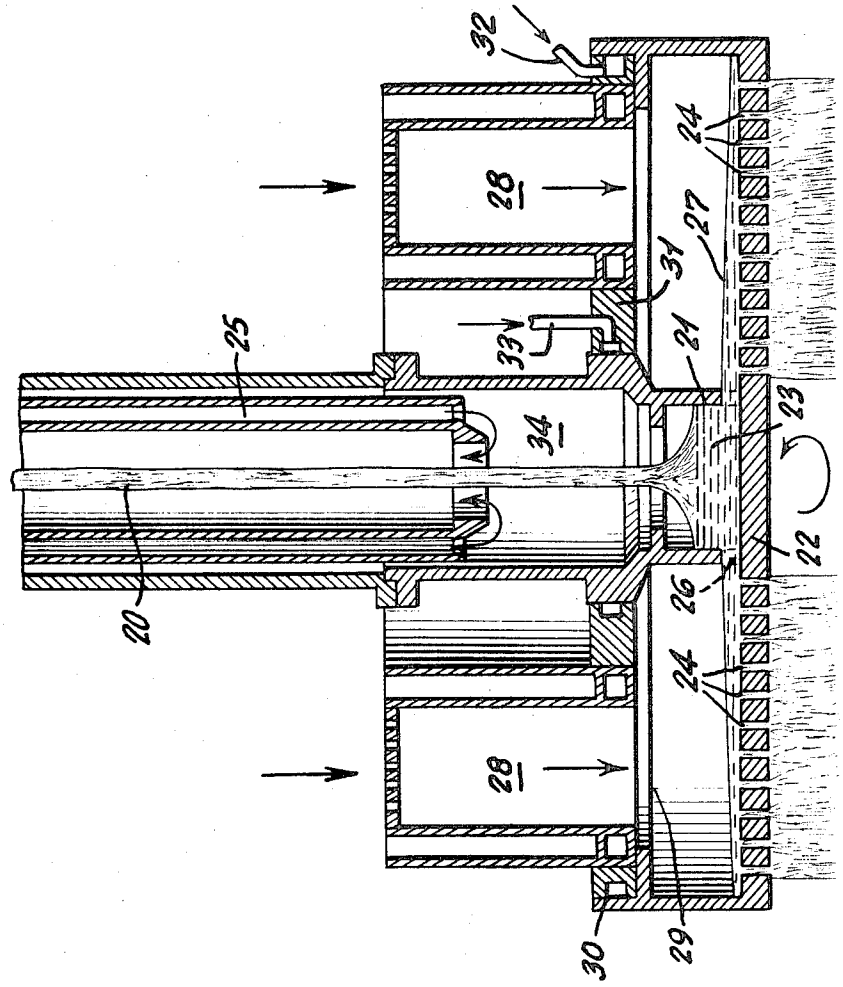
Fig. 3.



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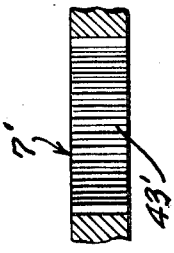

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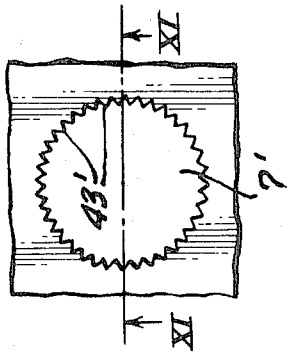

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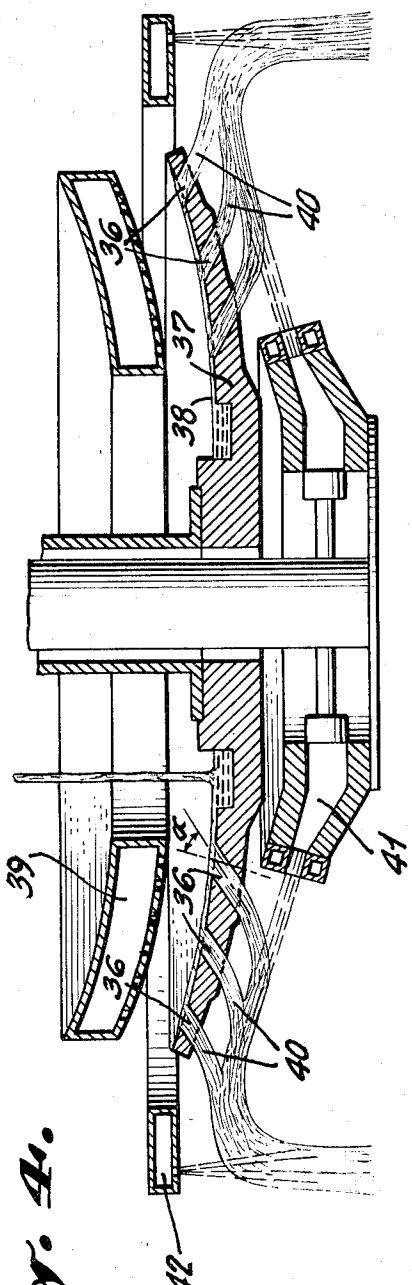

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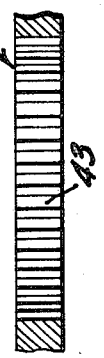

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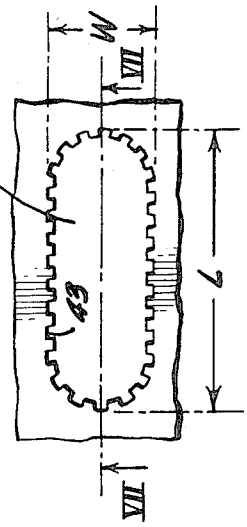

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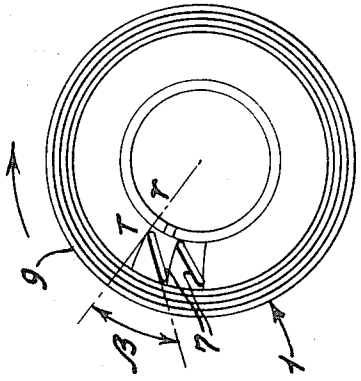

Fig. 5.

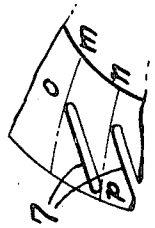

Fig. 6.

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METHOD OF AND APPARATUS FOR THE PRODUCTION OF FIBERS FROM THERMOPLASTIC MATERIALS, PARTICULARLY GLASS FIBERS

The present invention relates to the production of fibers from mineral or organic materials in the viscous state, and in particular, glass fibers.

It is the object of the invention to provide a process which comprises causing a sheet of the viscous material to flow in continuous fashion onto a surface having orifices or slots therein and to subject this sheet to the action of a gaseous current, which drives the material through these orifices or slots while effecting its attenuation or drawing out in the form of fibers.

The invention is characterized by the fact that the viscous material is brought onto the upper surface of a plane or concavely-shaped disc body rotating about a vertical axis, in proximity to the center of the rotary body. The latter is provided with orifices or slots in a zone between its central portion and its periphery, and the viscous material dropping thereon adjacent to its central portion is carried therefrom by the action of centrifugal force towards these orifices or slots in the outer peripheral zone, whereat it is divided into filaments while crossing these orifices or slots, and which filaments are then subjected to the action of gaseous currents in order to draw them out into fibers.

It is another characteristic of the invention to cause the gaseous attenuating currents to pass through the orifices or slots provided in the rotating body.

It is also within the purview of the invention to cause the gaseous attenuating currents to act on the material when it leaves the orifices or slots of the rotating body.

The invention also contemplates devices for executing the methods in accordance with the invention, illustrative embodiments of which are described below in conjunction with the accompanying drawings wherein;

FIG. 1 is a vertical sectional view, with some parts in elevation, of one embodiment of the invention;

FIG. 2 is a partial vertical sectional view of a variant embodiment;

FIG. 3 is a vertical sectional view of another embodiment of the invention;

FIG. 4 is a partial vertical sectional view of still another embodiment;

FIGS. 5 and 6 are plan views of the rotating body illustrating the orifices therein having the shape of slots;

FIG. 7 is an enlarged vertical sectional view of a slot in the rotating body along line VII—VII of FIG. 8;

FIG. 8 is a plan view of the slot shown in FIG. 7;

FIGS. 9 and 10 are plan views of the rotating body illustrating the orifices therein of circular outline;

FIG. 11 is an enlarged vertical sectional view of one of the orifices shown in FIGS. 9 and 10 along line XI—XI of FIG. 12; and

FIG. 12 is a plan view of the orifice shown in FIG. 11.

In the embodiment shown in FIG. 1, the apparatus comprises a disc 1 which is rotated around a vertical axis by means of a hollow rotary shaft 2 mounted in bearings 3 in a column 4 having a chamber 5 through which is circulated a cooling fluid. A circular or annular trough or gutter 6 is provided in the upper surface of the disc 1, adjacent to its central portion and arranged concentrically with the axis thereof. In addition, the disc is provided with openings, slots or orifices 7, at the outer portion thereof towards its periphery, the constitution and spacing of which on the disc are described below in detail.

The apparatus also comprises an annular burner 8 having a gas exhaust which strikes the zone of the disc containing orifices 7. The periphery of the disc is provided with zigzag baffles 9, which are designed to assure tightness to arrest the escape of combustion gases. The contour of the inner edge 10 of the gas exhaust of the burner is so shaped as to impart to the gases escaping toward the interior of the disc, a speed sufficiently slow so that they will not disturb the flow of the glass in its viscous state towards orifices 7. A screen 11 is also provided around the lower part of the inner lateral wall of the burner.

The thread or filament 12 of glass or other thermoplastic material falls into annular trough 6, where it constitutes a reserve supply of viscous material. From there, the glass spreads in a sheet 13 over the upper part of the disc and reaches its peripheral zone under the action of centrifugal force. In this zone, the glass is subjected to an elevated temperature and considerable pressure by the action of gas currents produced by pressure chamber or burner 8. Under the effect of this pressure, the viscous material passes through orifices 7 at the same time as the gases issuing from the burner, thus undergoing an abrupt change of direction. The sheet of viscous material is transformed into a large number of primary filaments, by virtue of the subdivision of the material which is attained by its passage through orifices 7. These primary filaments are accelerated and drawn out into fibers by the gaseous jet emitted by burner 8.

A blower device 14, having openings 14' in its peripheral wall, is mounted on a conduit 15 on the interior of shaft 2. This conduit is fixed to frame 4 and is supplied with air or steam by small tube 16. This device facilitates the evacuation or removal of the fibers.

In addition, a tube 17 in the interior of conduit 15, feeds a binding agent to the atomizers or sprayers 18 disposed below the blower device 14, which spraying devices project the binder onto the annular curtain 19 formed by the falling curtain of fibers.

FIG. 2 illustrates an apparatus which is a variation of that shown in FIG. 1. In this variant, disc 1 has a raised edge 1*a* in which are provided the subdividing orifices 7. The burner 8 itself has a discharge opening which is inclined corresponding to the inclined edge of the disc. The primary filaments which are accelerated and drawn out by the gas jet from burner 8 are again acted on by a second burner or steam blower 35.

In the embodiment shown in FIG. 3, the thread or filament 20 of viscous vitreous or other material to be fiberized, drops into a central reservoir 21 constituting part of the centrifuge body 22, whereat collects a reserve supply 23. This centrifuge body may assume the form of a flat disc at its bottom which is provided with orifices or slots 24, as in the preceding embodiments. An internal burner 25, arranged coaxially with the centrifuge body and adjustable in height, makes possible the maintenance of a constant temperature of the molten glass or other material in reservoir 21. The latter is provided with orifices 26 of large diameter through which the glass spreads into a sheet 27 over the upper surface at the bottom of centrifuge body 22. An annular pressure chamber or burner 28 is disposed coaxially with centrifuge body 22, and the gases therefrom, as in the preceding embodiments, exert a pressure on the glass sheet, which is transformed into a large number of primary filaments by passage through orifices 24. These primary filaments are accelerated and drawn out by the high-speed jet emitted by burner 28.

A constant pressure prevails in chamber 29 of the centrifuge body, and sealing joints 30 and 31, supplied with cooling fluid by small tubes 32,33, assure the tightness of this chamber. Instead of this arrangement, a large number of zigzag baffles may be used in order to reduce the escape of gas to a maximum degree. The pressure of the material to be fiberized at 26 by centrifugal force, assures tightness with the inner chamber 34.

This apparatus may be complemented, as in the preceding example, by a blower device acting on the produced fibers, and by spraying devices for coating the fibers with binder material.

In the embodiment shown in FIG. 4, the transformation of the sheet of viscous material to be fiberized, such as glass, into primary filaments, by the subdividing orifices, is obtained solely by the action of centrifugal force. In this case, angle α which the axis of each orifice 36 makes with the normal to the surface of centrifuge body 37, must be sufficiently large, and for practical purposes, may be comprised between approximately

50° and 80°. The adherence between the glass sheet **38** and the surface of the centrifuge body, is enhanced by imparting a slight concave curvature to the upper surface of the centrifuge.

A heating device **39**, which may be a radiant burner or an infra-red ray radiator, makes possible the maintenance of the glass sheet **38** at a suitable temperature. Primary filaments **40** issuing from the subdividing orifices **36** are again acted upon and attenuated by a high-speed gas jet produced by a pressure chamber or burner **41** or a steam blower. An annular blower device **42** supplied with air or steam, makes possible the evacuation or removal of the fibers.

FIGS. **5** to **12** show, by way of example, the forms of orifices which may be provided in the rotating body.

In FIGS. **5** and **6**, the *o-p such as 7, have an oblong shape and are arranged in such a way that their leading edge o-p* intercepts and subdivides a portion *m-n* of the glass sheet issuing from the reserve glass supply, such as formed at **6** in FIG. **1**. The number of primary filaments will be greater as the ratio (*m-n/o-p*) becomes smaller, or, in other words, as the angle β between the leading edge *o-p* with radius *r*, tangent at point T of the forward end of the orifice, becomes smaller. In practice, angle β should be small and less than 30°. All the orifices are arranged at intervals sufficiently small for the entire glass sheet to be intercepted by the gas blast.

FIGS. **7** and **8** show in detail the shape of the orifices described above. In order to permit the passage of the viscous material and the flames or burner gases, these orifices have a width W at least equal to 3 mm. Preferably, the ratio of the length L to width W should range between 1 and 10. In order to increase the surface of the material acted upon by the burner gases, and to encourage the stability of fiberizing operation, channels **43** are provided in the walls of the orifices. These channels may be of square or triangular section, of about 2 mm. on the side.

FIGS. **9** to **12** illustrate orifices such as **7'**, of circular shape. The rows of these orifices are arranged so that the sheet of material to be fiberized arriving at arc *m'-n'* is intercepted at *o'-n'*. As described above, it is advantageous for the ratio (*m'-n'/0'-p'*) to be small. Also, as can be seen in FIGS. **11** and **12**, channels **43'** of triangular section, are provided on the walls of these orifices. The diameter of these orifices is at least 3 mm.

I claim:

1. The method of producing fibers from a hardenable mineral thermoplastic material in a viscous state, which comprises

a. feeding a stream of the viscous material onto the inner portion of a supporting surface of a rotary disclike body, to form a reservoir of said material at said portion,
b. rotating said body rapidly around a vertical axis to throw said viscous material outwardly in sheet form by centrifugal force from said inner portion to the outer portion of said supporting surface which is provided with a plurality of openings extending therethrough,
c. segregating said sheet of viscous material into individual filaments by downwardly projecting the viscous material through said openings, and
d. attenuating said filaments into fibers by subjecting them to gaseous blasts.

2. The method set forth in claim **1**, wherein the mineral thermoplastic material is a molten vitreous composition for producing glass fibers therefrom.

3. The method set forth in claim **1**, wherein the segregation of said material into filaments is executed by a downwardly directed hot blast of gas under pressure acting on the upper surface of the flowing sheet of material, which passes through said openings together with the material.

4. The method set forth in claim **1**, wherein the step of segregating the sheet of viscous material into filaments through said openings is executed solely by centrifugal force.

5. The method set forth in claim **1**, wherein the segregation of said material into filaments is executed by a downwardly directed hot blast of gas under pressure acting on the upper surface of the flowing sheet of material, which passes through said openings together with the material, and which is augmented by the effects of centrifugal force.

6. The method set forth in claim **4**, including the step of heating the sheet of material above said openings to facilitate the passage of the filaments therethrough in subdivided form.

7. The method set forth in claim **1**, wherein the last-mentioned step of attenuating the filaments into fibers is executed by blowing a transverse radial blast of gas across the curtain of filaments projected through said openings in an outward direction from the center of the annular curtain of falling filaments.

8. The method set forth in claim **1**, wherein the last-mentioned step of attenuating the filaments into fibers is executed by blowing a transverse radial blast of gas across the curtain of filaments projected through said openings in an inward direction from the outside towards the center of the annular curtain of falling filaments.

9. An apparatus for producing fibers from a hardenable mineral thermoplastic material in a viscous state, comprising

a. a disclike body provided with a supporting surface for said viscous thermoplastic material and mounted on a vertical axis with means to rapidly rotate the body,
b. said supporting surface having an inner central reservoir portion and an outer portion provided with a plurality of openings therein,
c. means for supplying the viscous material to said supporting surface at the inner reservoir portion thereof wherefrom it spreads in sheet form by centrifugal force over said outer portion, and
d. means including a pressure chamber for hot gases to project the viscous material through said openings in filamentary form and to attenuate the resulting filaments into fibers.

10. An apparatus as set forth in claim **9**, wherein the supporting surface of said disclike body is substantially horizontal at the inner central reservoir portion and is shaped concavely in an upward direction at said outer portion.

11. An apparatus as set forth in claim **10**, which includes a heating device above said outer portion to facilitate the projection of the viscous material through said openings solely by the effects of centrifugal force, and said pressure chamber is disposed below said outer portion for directing hot gaseous blasts against the filaments projected from said openings to effect their attenuation into fibers.

12. An apparatus as set forth in claim **11**, wherein the angles between the axes of the openings in said outer portion and the lines normal to the planes of said supporting surface at said outer portion, are large, and range between approximately 50° to 80°.

13. An apparatus as set forth in claim **11**, including an annular blower beyond said supporting surface, heating device and pressure chamber, for directing a blast of gas downwardly to effect the withdrawal of the attenuated fibers.

14. An apparatus as set forth in claim **9**, wherein said pressure chamber comprises an annular burner overlying said outer portion of said disclike body and closely adjacent thereto.

15. An apparatus as set forth in claim **14**, comprising an annular heater above said central reservoir portion in surrounding relation to the first-mentioned means for supplying the viscous material to the supporting surface.

16. An apparatus as set forth in claim **14**, including sealing joins between said annular burner and said disclike body to prevent the escape of the hot gases from said annular burner at said joints.

17. An apparatus as set forth in claim **14**, wherein said outer portion of said disclike body is inclined upwardly adjacent to its periphery.

18. An apparatus as set forth in claim **17**, wherein said last-mentioned means comprises an annular blower below said inclined peripheral portion of said supporting surface to direct a jet of gas or steam inwardly against the fibers discharged from said openings.

19. An apparatus as set forth in claim 9, wherein said last-mentioned means comprises a blowing device below said disclike body for discharging radial blasts of gas against the interior of the falling curtain of fibers to effect the attenuation and withdrawal thereof.

20. An apparatus as set forth in claim 9, wherein said openings are arranged in short lengths in directions which are oblique to the direction of outward radial travel of said sheet of viscous material.

21. An apparatus as set forth in claim 20, wherein said openings are of oblong outline.

22. An apparatus as set forth in claim 21, wherein the width of said oblong openings is at leas 3mm.

23. An apparatus as set forth in claim 21 wherein the length of the openings is one to ten times the width thereof.

24. An apparatus as set forth in claim 20, wherein said openings are in groups of circular outline.

25. An apparatus as set forth in claim 24, wherein the diameter of the circular openings is at least 3mm.

26. An apparatus as set forth in claim 20, wherein the walls of said perforations are channeled or serrated in a vertical direction.

* * * * *