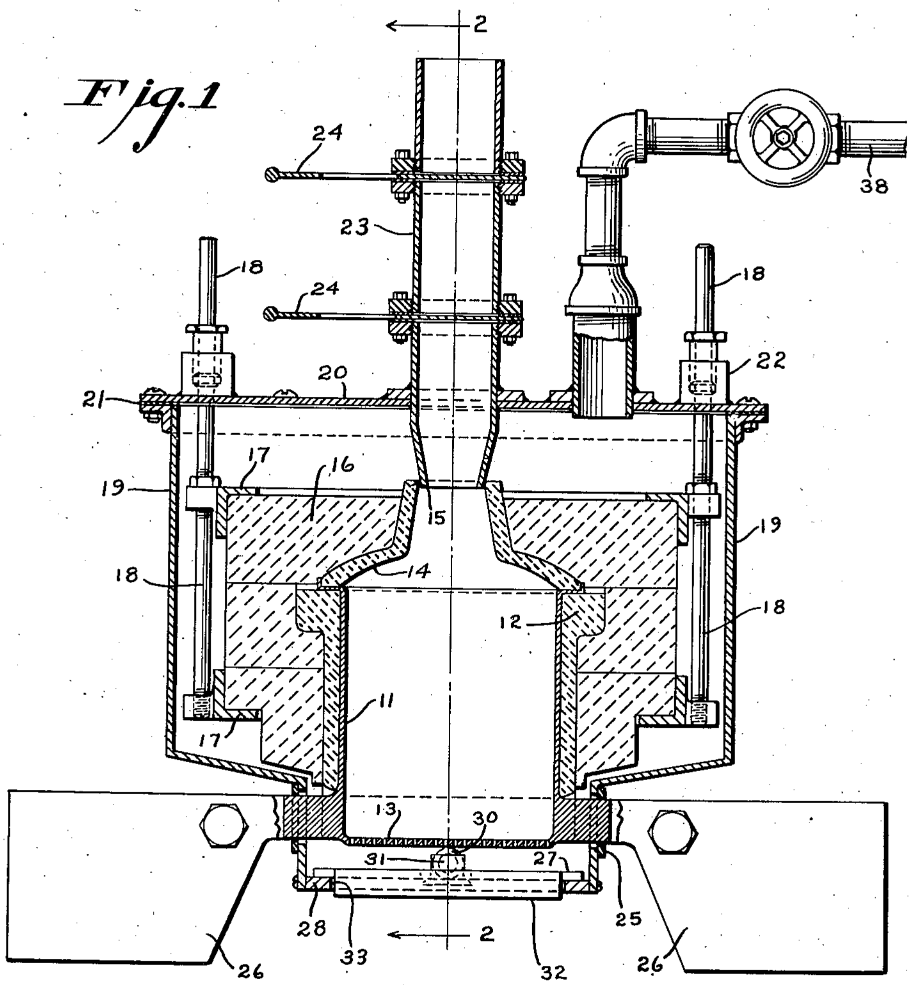
June 16, 1942. S. M. DOCKERTY 2,286,903

FIBER PRODUCING MECHANISM

Filed May 24, 1938 2 Sheets-Sheet 1

Fig. 1



INVENTOR.
STUART M. DOCKERTY

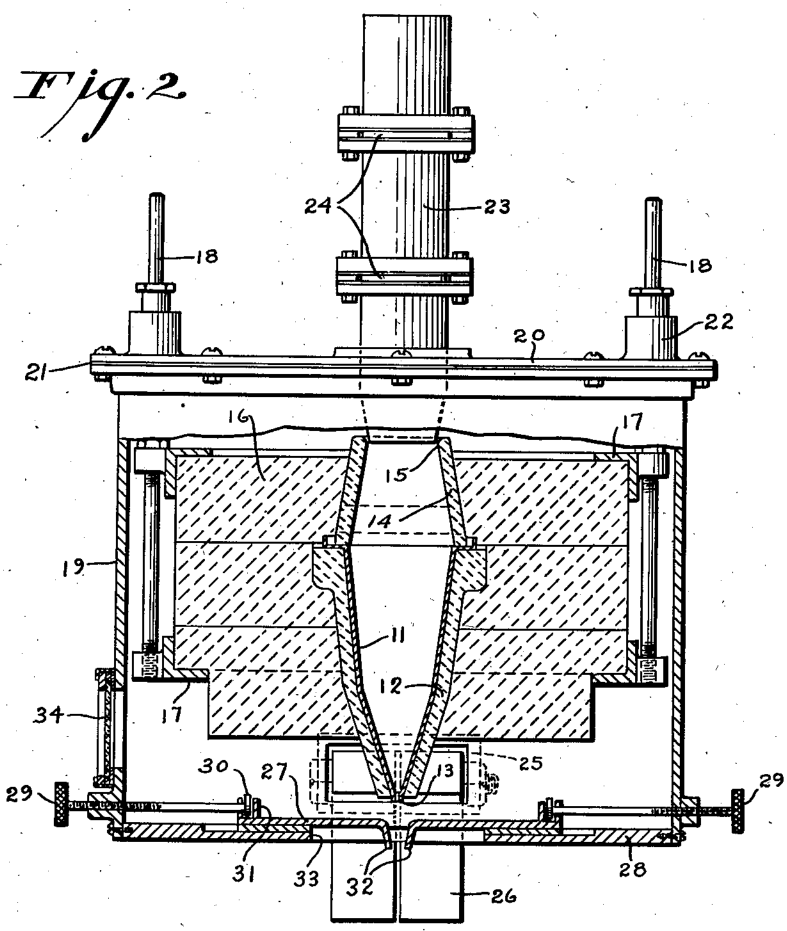
BY Dorsey, Cole + Garner
ATTORNEYS.

June 16, 1942. S. M. DOCKERTY 2,286,903

FIBER PRODUCING MECHANISM

Filed May 24, 1938 2 Sheets-Sheet 2

Fig. 2.



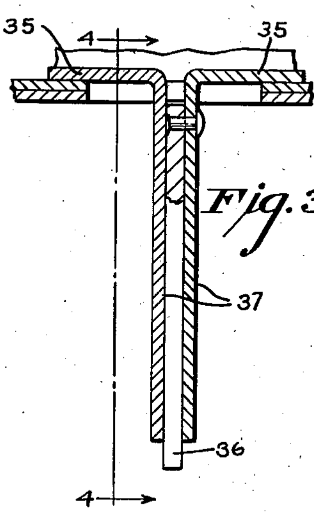


Fig. 3

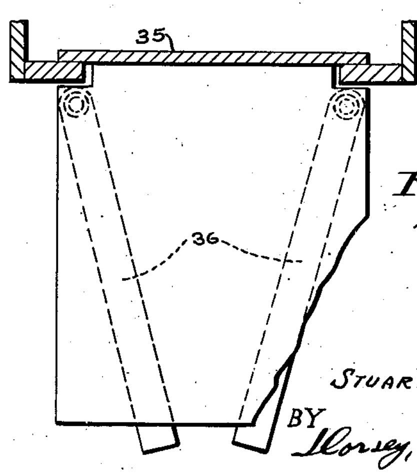


Fig. 4

INVENTOR.
STUART M. DOCKERTY
BY Dorsey, Cole & Garner,
ATTORNEYS.

Patented June 16, 1942

2,286,903

UNITED STATES PATENT OFFICE

2,286,903

FIBER PRODUCING MECHANISM

Stuart M. Dockerty, Corning, N. Y., assignor, by mesne assignments, to Owens-Corning Fiberglas Corporation, a corporation of Delaware

Application May 24, 1938, Serial No. 209,822

8 Claims. (Cl. 49—17)

This invention relates to the production of fine fibers of thermoplastic material and more particularly to the production of artificial silicate fibers for textile purposes.

Prior to this invention it has been common practice to form artificial silicate fibers by flowing fine streams of molten glass or rock and blowing them to fibrous form by the action of jets of high pressure steam. The most refined form of such apparatus is illustrated in the British patent to Triggs, No. 428,720. By suitable regulation of the temperature of the melting furnace and the pressure of the steam applied to the blower, fibers of almost any desired length and fineness may be produced with such apparatus. However, only a small amount of the available energy in the steam fed to the blower is utilized in producing fiber and as a result the amount of steam consumed is enormous, amounting to as much as one hundred fifty pounds of steam for each pound of textile fiber produced.

It is applicant's belief that this large amount of steam is required because each individual fiber is surrounded with a film of air drawn into the top of the blower slot by the injector action of the steam issuing from the blower. The steam can attenuate the fiber only by increasing the velocity of the adjacent air. Only that portion of the steam actually in contact with the air can have any effect thereon and this is limited due to the fully elastic characteristics of the two fluid media involved.

It is the object of the present invention to reduce the amount of energy required for the production of artificial silicate textile fibers. More specifically the object of this invention is a method by which a fluid tractive effort may be directly applied to fine streams of molten material and an apparatus for the practicing of this method.

This invention includes among its features a melting furnace and pressure means associated therewith by which a fluid medium is caused to flow past and away from the feedings openings in the melting furnace carrying with it and attenuating to fibrous form the molten material issuing from the furnace. The invention further features the control of the direction and velocity of fluid medium with respect to the furnace openings and its path and velocity during the attenuation of the fibers. These and other features will be readily apparent from the detailed description of the structure and operation of the apparatus disclosed in the accompanying drawings in which:

Fig. 1 is a vertical section of a melting furnace and associated pressure chamber;

Fig. 2 is a vertical section taken on line 2—2 of Fig. 1;

Fig. 3 is a detailed elevation in section of a modification of the adjustable bottom plates shown in Figs. 1 and 2; and

Fig. 4 is a detailed elevation partially in section taken along line 4—4 of Fig. 3.

Referring in more detail to the embodiment of the invention disclosed in Figs. 1 and 2, it will be seen that a melting furnace is provided consisting of electrically heated, V-shaped bushing 11 composed of platinum or a similar high melting point alloy. This bushing is supported in a refractory shell 12 composed of sillimanite or similar material in such manner that the feeder tips 13 extend slightly therefrom. A refractory cover 14 having a feeding opening 15 is positioned above the open end of the bushing. Both the bushing and cover are enclosed in insulating material 16 which is held in a suitable frame 17. Support rods 18 suspend the entire furnace from a support, not shown.

The entire furnace structure may desirably be enclosed in an air tight pressure chamber which may be supplied with air or other fluid medium under pressure and provided with an orifice slot adjacent the feeder tips of the bushing. In the illustrated structure a metal shell 19 surrounds the furnace and is provided with a removable top 20 sealed against loss of fluid by gasket material 21. Support rods 18 pass thru stuffing boxes 22 welded to the top and a feeding tube 23 which passes therethru in alignment with opening 15 is provided with closely fitting gates 24 so that charges of cullet or other material to be melted may be introduced from time to time without loss of pressure. Gaskets 25 are provided at the points where the bushing electrodes 26 pass thru the chamber walls so that the only place for any material amount of the pressure fluid to escape is thru the slot in the bottom of the chamber in alignment with the bushing tips 13. This slot is preferably adjustable as to width and as shown in Figs. 1 and 2 may consist of two plates 27 slidably attached to the bottom plate of the chamber 28 and adjustable with respect to the bushing tips and to one another by means of thumb screws 29 passing thru the walls of the chamber 19 and terminating in flanges 30 engaging with a vertical slot in the plates 31. The adjacent edges of these plates are formed into smoothly contoured depending flanges 32 which cooperate to form an elongate nozzle extending downwardly thru an opening 33 in the bottom plate 28. Adjustment of these plates may be observed thru a window 34 sealed in the wall of the chamber at a point opposite thereto.

In the modification shown in Figs. 3 and 4 the adjustable plates 35 are provided with flanges 37 of much greater length which cooperate to form a narrow slot the thickness of which is determined by spacers 36. These spacers determine two opposite walls of the slot and, since they are pivotally attached to one of the flanges, may be used to reduce the cross sectional area of the slot to any desired amount between its inner and outer ends. The position of these spacers may be maintained by clamps, not shown, which engage the outer walls of the flanges 37.

In operation air, steam or any other suitable gas may be admitted under pressure to the interior of chamber 19 thru the valved supply line 38 from a suitable compressor, boiler or other source, not shown. Any desired pressure may be maintained within the chamber depending on the rate at which molten material is produced by the furnace 11 and the diameter of fiber it is desired to produce. In the actual production of glass fibers it has been found that compressed air at from three to ten pounds gauge pressure will attenuate the glass to fiber of the usual commercial diameter, from .00025 to .0005 inch, as rapidly as it can be melted by the furnace. This is customarily about four to five pounds per hour.

As pressure builds up within the chamber the air or other fluid passes around the furnace and issues as a high velocity jet from the slot in the bottom of the chamber. Since both the feeding opening 15 of the furnace and the bushing tips 13 are located within the chamber the same static pressure exists both above and below the molten material in the furnace and it is forced thru the tips 13 merely by the action of gravity. The bottom plate 28 of the chamber is so positioned and the plates 27 are of such thickness that only a narrow space exists between the tips 13 and the inner end of the slot. Since the terminal lugs 26 clamped to the bushing 11, refractory shell 12, and insulation 16 all tend to obstruct the passage of the air around the ends of the bushing the bulk of the air issuing thru the slot passes thru the narrow space aforementioned and exerts a wiping action, drawing the molten material away as it issues from the tips. This air tends to cool the molten material, but since its velocity accelerates as it passes down thru and issues from the slot, the plastic material is drawn out to a very fine diameter before it solidifies. Since all of the air in contact with and surrounding the fibers in the slot is moving at substantially the same velocity the efficiency of the apparatus as a means for attenuating the fibers is limited only by such slippage as occurs between the surface of the fiber and the adjacent moving air which is relatively small. In fact from the weight of fiber produced and the average diameter it has been determined that the rate of draw of each fibre is approximately 80% of the velocity of the adjacent air.

Since the volume of air or weight of steam issuing at a given velocity is directly proportional to the area of the orifice from which it issues it has been found that the efficiency of the equipment can be further increased by reducing the area of slot in the pressure chamber to a minimum. Two means have been disclosed by which this can be accomplished. The first and most important is the provision of adjustable bottom plates 27 forming the slot. As the apparatus goes into operation these plates must be spaced sufficiently apart to permit passage of the relatively large globules or slugs of molten material that collect on the bushing tips and are pulled therefrom as the viscosity of the molten material is lowered. However, after these slugs have been cleared from the tips and the issuing material is being continuously attenuated the plates 27 may be moved closer together thus reducing the area of the slot and the amount of air or other pressure fluid consumed. If the pressure within the chamber is maintained constant the rate of draw will likewise remain constant altho the area of the slot is reduced. Should slugs form in the subsequent operation of the equipment they can readily be cleared by temporarily increasing the width of the slot.

Another way of further reducing the area of the slot is illustrated in Figs. 3 and 4. Since the length of the slot at the top must be substantially coextensive with the length of the bushing it can only be reduced to a certain extent by moving the plates toward one another. However, if the flanges of these plates are lengthened adjustable spacers 36 may be used in conjunction therewith to form an elongated slot of gradually reducing cross section having an area at its exit end only a fraction of the area of the inner end adjacent the bushing tips. Thus the area of the slot may be further reduced while maintaining the same maximum velocity of the issuing fluid medium. Since such an apparatus as this produces substantially continuous fibers, often operating for several hours without a break, the velocity of the fluid as it passes the tips need be only enough to insure clearing of the material when a slug forms and the maximum tractive effort attenuating the fiber may as well be applied several inches below the tips as at a point more closely adjacent thereto. Various operating characteristics of the apparatus will determine the extent to which the area of the slot may be reduced in this way, but it may be from one-fourth to one-half that of the inner end.

While certain specific embodiments of this invention have been described in detail by way of illustration it is appreciated that various alterations may be made in the apparatus and its manner of operation while still employing the principles of the invention. Accordingly, the limits of the invention are to be defined solely by the scope of the appended claims.

I claim:

1. The method of producing fibrous material which comprises flowing molten material in a fine stream, contacting and completely surrounding said stream while still molten with a fluid medium confined under pressure, flowing said compressed fluid medium while in contact therewith to exert a tractive effort on the fine stream over an appreciable length thereof and rapidly accelerating the velocity of said stream and fluid medium by expanding said fluid medium thru an orifice while maintaining it in contact with said stream to attenuate said molten material to fibrous form.

2. The method of forming fibrous material which comprises flowing a fine stream of molten material into a gaseous atmosphere confined above atmospheric pressure, moving said atmosphere in the direction of flow of said stream while in contact therewith to exert a tractive effort thereon over an appreciable portion of its length and rapidly increasing the tractive effort on said

stream to attenuate it to fibrous form by passing said molten stream and surrounding atmosphere thru a restricted orifice into a region of lower pressure while maintaining the enveloping relation of said atmosphere with said stream.

3. The method of forming fine filaments of thermoplastic material which comprises melting said material, flowing a fine stream of said material directly into a gaseous atmosphere confined at superatmospheric pressure, progressively cooling and attenuating said stream by moving said atmosphere in the direction of flow of and in contact with said stream for an appreciable distance, and progressively increasing the tractive effort applied to the surface of said stream as it is attenuated until it has set in fibrous form.

4. The method of producing fibrous material which comprises flowing fine streams of molten material at a plurality of spaced points directly into a confined body of gas under superatmospheric pressure, flowing said compressed gas in the direction of flow of said streams and in contact therewith to attenuate the same and progressively increasing the velocity of said gas by releasing it to a region of lower pressure thru a restricted opening of progressively diminishing cross sectional area.

5. In an apparatus for producing fibrous material in combination a receptacle adapted to contain molten glass, a feeder opening in the bottom of said receptacle, means including a housing for establishing a superatmospheric fluid pressure surrounding the exterior of the said opening, means for communicating said pressure with the interior of said receptacle above the glass level therein and a restricted opening formed in said housing in alignment with said feeder opening for the escape of said compressed fluid to atmosphere.

6. In an apparatus for producing fibrous material in combination a melting furnace having a plurality of feeder openings arranged in a straight line in the bottom thereof, a pressure chamber associated with said furnace and adapted to maintain a superatmospheric pressure about said feeder openings, means for supplying fluid under pressure to said chamber and spaced plates in the bottom of said chamber forming a slot therein coextensive with the line of said feeder openings, said plates being adjustable to vary the width of said slot.

7. In an apparatus for producing fibrous material in combination a melting furnace having a plurality of feeder openings arranged in a straight line in the bottom thereof, a pressure chamber associated with said furnace and enclosing said feeder openings, means for supplying fluid under pressure to said chamber and spaced plates in the bottom of said chamber forming a slot therein coextensive with the line of said feeder openings, said plates being adjustable to vary the width of said slot and having depending flanges along their adjacent edges to determine the contours of said slot.

8. In an apparatus for producing fibrous material in combination a melting furnace having a plurality of feeder openings arranged in a straight line in the bottom thereof, a pressure chamber associated with said furnace and enclosing said feeder openings, means for supplying fluid under pressure to said chamber and spaced elements on the bottom of said chamber forming a slot therein coextensive with the line of said feeder openings, said elements being adjustable to vary the width of said slot and having depending flanges along their adjacent edges to determine the contours of said slot and further means carried by said flanges and effective to reduce the cross sectional area of said slot between the top and bottom of said flanges.

STUART M. DOCKERTY.