Aug. 14, 1956 E. R. OVERMAN 2,758,335

FIBER DRAWING MACHINE AND METHOD

Filed Dec. 9, 1950

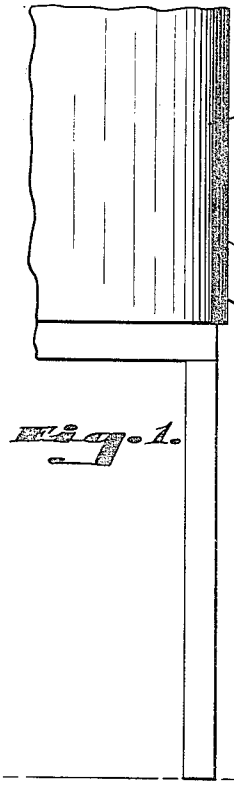


Fig. 1.

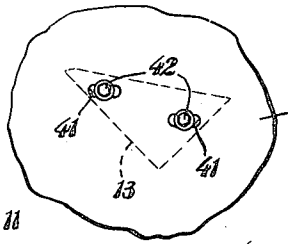


Fig. 4.

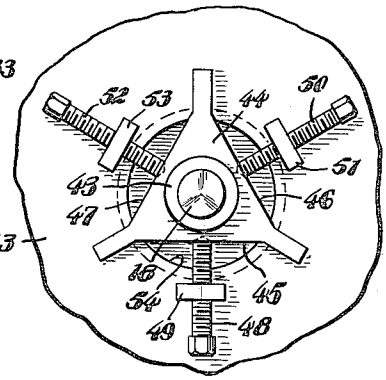


Fig. 5.

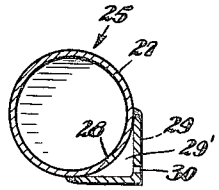


Fig. 3.

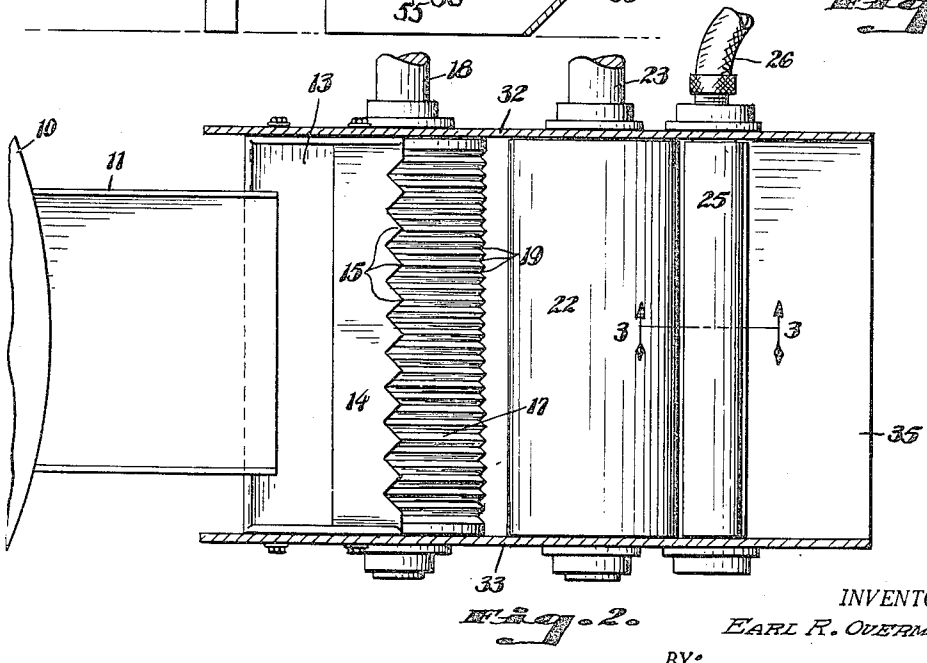


Fig. 2.

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United States Patent Office 2,758,335 Patented Aug. 14, 1956

2,758,335

FIBER DRAWING MACHINE AND METHOD

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Application December 9, 1950, Serial No. 199,976

9 Claims. (Cl. 18—2.5)

The present invention relates to a fiber drawing machine, and is particularly concerned with a machine capable of converting molten material such as rock, slag, glass, or mixtures thereof and like raw materials into the fibrous product known as "mineral wool"; and to a novel method of so converting such materials. More particularly, the invention relates to a method of, and a machine for, producing an improved grade of mineral wool, the fibers of which shall be quite uniformly long and attenuated, and which will be discharged from the machine substantially in individualistic form, without any substantial clotting, matting, or lumping of the fibers produced.

The primary object of the invention, of course, is to produce a machine and method which will produce such fibrous material in the above-defined condition. A second object of the invention is to provide a method whereby, and a machine in which, substantially continuous, relatively coarse streamers of heat-plastic material of the character above described, will be produced by disintegration of a flowing stream of the molten material, and then will be elongated and attenuated, or "drawn" by the action of a gaseous blast or jet. A further object of the invention is to provide means whereby an accelerating gaseous blast may be caused to impinge upon such heat-plastic streamers while such streamers are velocity-suspended, to produce upon such streamers a "drawing" action, whereby such streamers will be converted into hair-like fibers.

Further objects of the invention will appear as the description proceeds.

To the accomplishment of the above and related objects, my invention may be embodied in the form illustrated in the accompanying drawings and the steps herein disclosed, attention being called to the fact, however, that the drawings are illustrative only, and that change may be made in the specific construction illustrated and described, or the steps defined herein, so long as the scope of the appended claims is not violated.

Fig. 1 is a more or less diagrammatic, broken illustration of a source of molten material discharging such material to a machine constructed in accordance with the present invention;

Fig. 2 is a broken plan view thereof, parts being shown in horizontal section;

Fig. 3 is a section taken substantially on the line 3—3 of Fig. 2, and drawn to an enlarged scale;

Fig. 4 is an enlarged, fragmental elevation showing the manner in which the delivery trough is adjustably mounted in the machine; and

Fig. 5 is an enlarged, fragmental elevation showing one means whereby the rotors of the machine may be adjustably mounted.

Referring more particularly to the drawings, I have indicated more or less diagrammatically a furnace or reservoir 10 in which is contained a supply of molten material of the character from which "mineral wool" or similar material may conventionally be produced. The furnace 10 is provided with a discharge spout 11, flow through

which may be controlled by conventional means (not shown). A (usually continuous) stream 12 of molten material flows from the spout 11 to a distributing or supply trough 13 formed to provide a dam 14 whose upper edge is preferably serrated, as at 15, to effect a first spreading, disintegration or division of the molten material. Such material thus overflows from the trough in a plurality of separate streams 16 spaced axially of a rotor 17 mounted to receive upon its peripheral surface the material so discharged from the trough 13. The rotor 17 is carried upon a shaft 18 driven, at high velocity in the direction indicated by the arrow in Fig. 1, by any suitable means (not shown). Preferably, but not necessarily, the peripheral surface of the roll 17 will be formed to provide an axially-spaced series of generally peripherally-extending shallow channels 19. The rotor 17, of course, will be so constructed as to withstand the temperature of the molten material to be discharged thereonto; and the construction of said rotor will be such that the molten material will not be accumulated upon its surface, but will be disintegrated into a great number of much narrower streamers spaced axially of the rotor, and such streamers will be promptly thrown centrifugally from said surface. Thus, the molten material will be discharged from the rotor 17 largely in the form of heat-plastic, relatively coarse streamers. If necessary to prevent adherence of the material to the rotor surface, the rotor may be cooled by any suitable means; but I prefer to mount a steam blower 55 beneath the rotor 17 to direct a material-stripping jet 56 tangentially against the advancing surface of the rotor, as shown.

A second rotor 20 is mounted upon a shaft 21 and a third rotor 22 is mounted upon a shaft 23, said shafts being supported upon parallel axes in a common plane parallel with the axis of the shaft 18, and so positioned that the adjacent peripheral regions of the two rotors 20 and 22, which are preferably of equal diameters, will be equally and oppositely spaced from a plane tangent to the periphery of the rotor 17 substantially at the point from which streamers of molten material will be discharged from said rotor 17. Suitable means (not shown) will be provided for driving the shafts 21 and 23, the shaft 21 being driven in the direction of rotation of the shaft 18 and the shaft 23 being driven in the opposite direction. Preferably, the peripheral speed of the rotors 20 and 22 will be substantially equal to the peripheral speed of the rotor 17. However, since the rotors 20 and 22 act merely as shields or guards to prevent dissipation of streamers projected from the rotor 17, their speeds are not critical.

Two jet headers 24 and 25 are mounted, just beyond the rotors 20 and 22, in equal and opposite spaced relation to said tangent plane. Each such header has a length substantially equal to the axial length of the rotors 20 and 22, and each is formed to provide an axially spaced series of jet ports opening generally away from the plane common to the axes of the shafts 21 and 23, but inclining slightly toward said tangent plane. I presently believe that any suitable construction may be adopted for the headers 24 and 25; but I have shown in Fig. 3 one satisfactory form of construction. As there shown, each such header comprises a tube 27 formed with an axially-spaced series of radially-opening ports 28. A shield 29, which may take the form of an angle bar, is welded or otherwise suitably secured to the external surface of the tube 27 with its legs straddling the perforations 28 to define a pressure-equalizing chamber 29' from which will open a series of perforations 30 accurately aimed in the desired direction of movement of the blast to emanate from the header.

The parts of the fiber drawing machine thus far described will preferably be mounted in a frame or hood

indicated generally by the reference numeral 31 and comprising parallel upright sheets 32 and 33 upon which the trough 13 and the headers 24 and 25 will be supported, and in which bearings for the shafts 18, 21 and 23 will be mounted. Preferably, but not necessarily, baffle plates 34 and 35 will be supported from the sheets 32 and 33 to define a discharge orifice 36 suitably registering with said tangent plane.

In operation, the shafts 18, 21 and 23 will be driven, in any suitable manner, at high speed, in the indicated directions; and a suitable medium will be supplied, under high pressure, to the headers 24 and 25 (and, if desired, to the blower 55), as through pipe or hose lines indicated at 26 in Fig. 2. I presently believe that steam is the optimum blast or jet material; but air or other vaporous or gaseous media may be substituted for steam with some possible loss of efficiency. The term "gaseous jet" as used in the appended claims is intended to include steam and such other media.

The divided stream of molten material 16, when it strikes the rapidly moving surface of the rotor 17, will be further divided into a mass composed largely of relatively coarse streamers which will be centrifugally thrown, as a discrete mass, in the direction and generally in the manner indicated at 37 in Fig. 1, such mass moving substantially in the above-mentioned tangential plane. The whirling rotors 20 and 22 will act as moving shields or guards to concentrate the velocity-suspended mass.

The individual jets emitted through the ports 30 of the headers 24 and 25 cooperate to define high velocity curtains 38 and 39 moving generally in the direction of movement of the above-described discrete mass, but converging slightly toward the said tangential plane. The movement of those high velocity curtains produces an injector effect, sucking air past the rotors 20 and 22 and accelerating that air in the direction of movement of the discrete mass of streamers. The velocity of the curtains 38 and 39 will substantially exceed the velocity of the stream of discrete material, so that the gaseous jets, as well as the mass of the entrained air, will impinge upon the streamers composing the velocity-suspended mass to exert thereon an accelerating effect and, because of the inertia of the individual streamers, a "drawing" effect, whereby the heat-plastic streamers will be elongated and attenuated. The action of the jets and of the entrained air upon those streamers will convert the same from relatively coarse streamers to hair-like fibers of much greater length.

It will be seen that, in the operation of the machine, the moving mass of individual coarse streamers of heat-plastic material is velocity-suspended as it enters the region of influence of the jets or curtains 38 and 39. The character of the streamers in the region 37 may be modified, to some extent, by varying the position of the trough 13 with respect to the rotor 17; and for that reason I prefer to mount the trough for adjustment toward and away from the vertical plane of the axis of shaft 18. One means for so mounting the trough is indicated in Fig. 4, in which I have shown elongated slots 41 in the sheet 33, screws or bolts 42 passing through said slots, and engaging the adjacent end of the trough 13. Similar mounting means, of course, will be provided in the sheet 32 for the opposite end of the trough.

For optimum performance, at given rotor velocities, adjustments in the relative positions of the rotors 17, 20 and 22 may be desirable; and I prefer to mount said rotors for limited universal adjustment. One means for accomplishing such adjustment is indicated in Fig. 5, in which I have shown a bearing 43 for one end of the shaft 18, carried in a block 44 formed to provide surfaces 45, 46 and 47 arranged to define an equilateral triangle. A screw 48 mounted in an ear 49 fixed to the sheet 33 has supporting engagement with the surface 45; and similar screws 50 and 52, threadedly mounted in ears 51 and 53, similarly engage the surfaces 46 and 47, respectively.

The sheet 33 is formed with an enlarged opening 54 to accommodate the shaft 18 in its adjustments under the influence of the screws 48, 50 and 52; and if desired, a shield (not shown) may be carried to move with the shaft 18 to keep the opening 54 covered regardless of the position of the shaft 18 in said opening. Of course, similar mountings will be provided for the opposite end of shaft 18 and/or for the ends of shafts 21 and 23.

The character of the end product of the method and machine may be varied by changing the velocity of the rotor 17 or the velocity or the density of the curtains 38 and 39, or both. The higher the velocity and/or density of the curtains 38 and 39 with relation to the velocity of the rotor 17, the greater will be the degree of attenuation of the streamers making up the discrete mass, as they emerge from the machine. That ratio may, within limits, be modified either by varying the pressure or character of the jet medium or by varying the peripheral velocity of the rotor 17, or by oppositely varying the two factors.

I claim as my invention:

1. In a machine of the character described, means for producing a high-velocity, gaseous curtain, and means for delivering into such curtain a flowing mass of heat-plastic material which is solid under atmospheric temperatures, such material being delivered into such curtain in the form of individual, relatively coarse streamers under a velocity somewhat less than the velocity of the curtain and generally in the direction of movement of the curtain, said delivering means including a primary rotor receiving on its peripheral surface a stream of molten material and throwing such material substantially unidirectionally therefrom, and a pair of secondary rotors interposed between said primary rotor and said curtain, to confine such flowing mass in a direction transverse to the direction of flow thereof, said secondary rotors being driven respectively in opposite directions and being spaced apart on parallel axes with their adjacent surfaces respectively substantially tangent to the line of flow of material thrown from said primary rotor.

2. In a machine of the character described, means for producing a high-velocity, gaseous curtain, means for providing a second, similar curtain, said curtain-providing means being separated from each other and said curtains converging in the direction of movement thereof, and means for delivering between said curtains a flowing mass of heat-plastic discrete material which is solid under atmospheric temperatures, said stream being delivered substantially in a plane bisecting the angle included between such curtains at a velocity somewhat less than that of said curtains, said delivering means including a primary rotor, and a pair of secondary rotors interposed between said primary rotor and said curtain-providing means and spaced apart in the direction of separation of said curtain-providing means, said secondary rotors being driven respectively in opposite directions with their adjacent surfaces respectively substantially tangent to the line of flow of material thrown from said primary rotor.

3. In a machine of the character described, a first rotor, a pair of rotors mounted adjacent said first rotor upon axes disposed in a common plane parallel with the axis of said first rotor, the adjacent peripheral regions of said pair of rotors being oppositely spaced from a plane tangent to the periphery of said first rotor, a pair of jet devices oppositely spaced from said tangent plane, said pair of rotors being located between said first rotor and said jet devices, means for delivering a stream of molten material to the periphery of said first rotor, means for rotating said first rotor at high speed to disintegrate such material and discharge the same substantially in said tangent plane, means for rotating said pair of rotors in opposite directions at high speed to move said adjacent peripheral regions thereof generally in the direction of flow of such disintegrated material, and means for discharging through said jet devices gaseous streams converging in the direction of flow

of such disintegrated material and at a velocity exceeding that of such disintegrated material.

4. The machine of claim 3 in which said means for delivering molten material to said first rotor is formed to divide such stream axially of said rotor.

5. The machine of claim 3 including means for adjusting the relative positions of the axes of said rotors.

6. The method of fiberizing molten material which comprises the steps of establishing a free-falling stream of such material, causing such stream to impinge upon a rapidly-rotating, substantially cylindrically-convex surface located upon a substantially horizontal axis to disintegrate such stream into a velocity-suspended substantially horizontal, substantially unidirectionally flowing mass of separated streamers of such material, and impinging thereagainst a jet of gas originating in a region spaced from said surface in the direction of flow of said mass and moving substantially in the direction of flow of said mass but at a higher velocity.

7. The method of fiberizing molten material which comprises the steps of establishing a free-falling stream of such material, causing such stream to impinge upon a rapidly-rotating, substantially-cylindrically-convex surface located upon a substantially horizontal axis to disintegrate such stream into a velocity-suspended substantially horizontal, substantially unidirectionally flowing mass of separated streamers of such material, and directing thereagainst a curtain of gaseous material moving, at a higher velocity, in the same general direction but at an acute angle to the direction of flow of said mass, said curtain originating in a region spaced from said surface in the direction of flow of said mass.

8. The method of fiberizing molten material which comprises the steps of establishing two converging gaseous, high-velocity curtains flowing substantially in a common direction, establishing a free-falling stream of heat-plastic material which is solid under atmospheric temperatures,

causing such stream to impinge upon a rapidly-rotating, substantially cylindrically-convex surface located upon a substantially horizontal axis to disintegrate such stream into a velocity-suspended flowing mass of separated streamers of such material, and thereafter causing such flowing mass to move past the region of origin of said curtains and into the region between said curtains, at a velocity lower than that of said curtains, in the general direction of curtain movement.

9. The method of fiberizing molten material which includes the steps of disintegrating a flowing body of such material into a discrete mass largely composed of relatively coarse streamers, discharging such mass as a substantially unidirectional, velocity-suspended stream, and applying an accelerating force to individual streamers of such mass, while so suspended, through the medium of a fluid jet, originating in a region beyond the point of such discharge, to elongate and attenuate such streamers.

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