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Aug. 29, 1950 E. R. POWELL 2,520,168

METHOD AND APPARATUS FOR FIBERIZING MOLTEN MATERIAL

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Fig. 1.

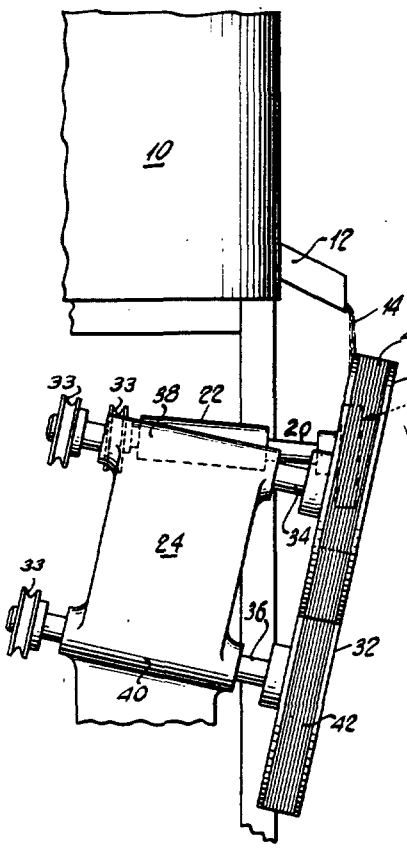


Fig. 3.

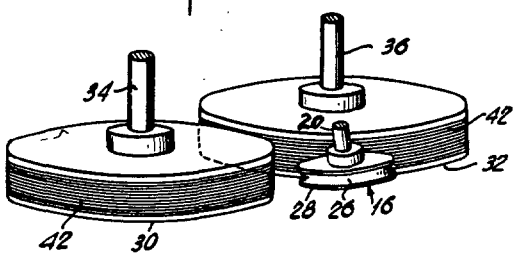


Fig. 2.

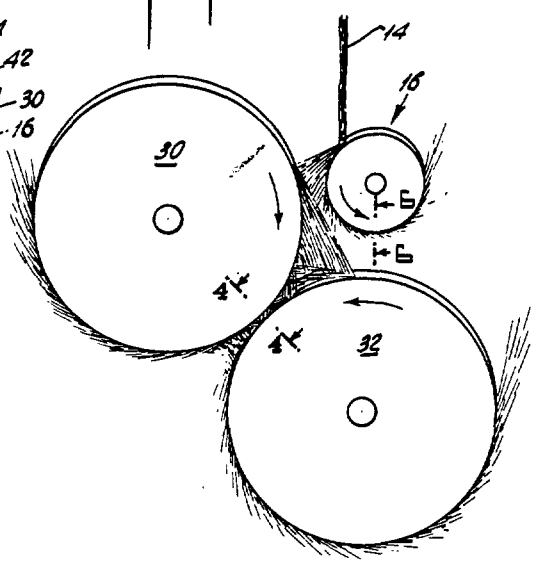


Fig. 4.

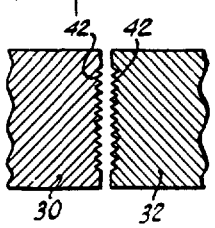


Fig. 5.

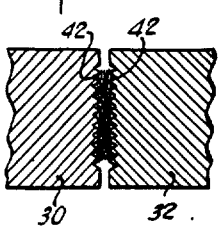
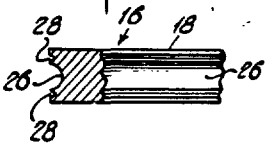


Fig. 6.



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METHOD AND APPARATUS FOR FIBERIZING MOLTEN MATERIAL

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Application September 22, 1944, Serial No. 555,359

11 Claims. (Cl. 18—2.6)

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The present invention relates to the manufacture of mineral wool and, more particularly, to improved apparatus for converting a molten raw material into fibers. The instant application is a continuation in part, as to all common subject matter, of my copending application, S. N. 485,009, filed April 29, 1943, now Patent No. 2,428,810. The term "mineral wool" is employed herein in a generic sense to include wool or fibers formed from rock, slag, glass, mixtures thereof and like raw materials.

Heretofore, molten raw materials of the type referred to above have been converted into fibrous form in a number of ways including the conventional method of disintegrating a molten stream of the material into fibrous form by the action of a high pressure steam jet. It has also been proposed to fiberize the material by the use of one or more spinners or rotors rotated at high speed upon which the material impinges and by which it is broken up into drops or masses which are thrown from the spinner by centrifugal force to be drawn out into fiber or thread form. The instant invention has for its principal object the provision of an improved apparatus and method of the latter type.

Another object of the invention is the provision of improved means for fiberizing molten material which will provide a greater fiber yield and which will produce finer, more uniform fibers than prior practice.

A further object of the invention is the provision of a rotor type fiberizing apparatus employing a plurality of fiberizing rotors with means for distributing the molten material on the rotors, the distributing means and the rotors cooperating in the fiberizing operation.

My invention will be more fully understood and further objects and advantages thereof will become apparent when reference is made to the more detailed description thereof which is to follow and to the accompanying drawings in which:

Fig. 1 is a diagrammatic, elevational view illustrating the arrangement of the material melting and fiberizing means;

Fig. 2 is a front elevational view of the fiberizing apparatus of Fig. 1;

Fig. 3 is a top plan view of the apparatus of Fig 2;

Fig. 4 is a sectional view on an enlarged scale taken on the line 4—4 of Fig. 2 illustrating the condition of the rotors before operation;

Fig. 5 is a view corresponding to Fig. 4 diagrammatically illustrating the condition of the rotor surfaces during operation; and

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Fig. 6 is a sectional view on an enlarged scale taken on the line 6—6 of Fig. 2.

Referring now to the drawings, there is shown an apparatus comprising a melting furnace 10 which may be of any suitable type such as the cupola illustrated. In lieu of a cupola, a tank furnace or the like may be used. The furnace includes a discharge trough 12 from which a stream of molten material 14 is drawn from the furnace and discharged into position for fiberization. The raw material melted in the furnace and converted into the molten stream 14 may comprise rock, slag, glass or mixtures thereof or other materials suitable for conversion into mineral wool, glass wool and like fibrous materials.

Below the end of trough 12 and positioned to receive stream 14 is a distributing means or roll 16. Distributor 16 is supported for rotation by shaft 20 which in turn is carried in suitable bearings 22 from a frame structure 24. The distributor is adapted to be rotated in the direction indicated by the arrow (see Fig. 2) by any suitable drive means, not shown. The peripheral surface of the distributor, as shown particularly in Fig. 6, is preferably contoured to include a central, relatively large depression or groove 26 and marginal, relatively fine V-grooves 28 to receive and in part retain the molten material striking the distributor.

The fiberizing means comprises a pair of rotors 30 and 32 supported for rotation on shafts 34 and 36, respectively, which in turn are carried by bearings 38 and 40 on frame structure 24. Rotor 32 is driven in the same direction as the distributor and rotor 30 is driven in the opposite direction by suitable drive means (not shown). Thus in the showing of Fig. 2, distributor 16 and rotor 32 turn in a counter-clockwise direction and rotor 30 turns in a clockwise direction. Rotors 30 and 32 are of substantially greater diameter and are considerably wider than distributor 16. For purposes of example and without limiting the invention thereto it may be stated that the rotors may be approximately twice to three times the diameter and twice the width across their peripheral surfaces as compared to the distributor roll 16. The peripheral surfaces of rotors 30 and 32 are suitably provided with a succession of annular material retaining grooves 42. These grooves are preferably V-shaped in cross-section and of relatively small uniform size. It has been found, for example, that the grooves should run about 20–40 to the inch.

As illustrated, particularly in Figs. 1 and 3, the shafts supporting the several rotors are at an

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angle to the horizontal, preferably at an angle of about 12°. The shaft supporting distributor 16 may be at a smaller angle to the horizontal, as shown in Fig. 1. Shaft 20 also preferably extends at a slight angle, say at an angle of about 6° to the vertical planes of shafts 34 and 36. The mounting of the several shafts is of any conventional or suitable type to permit adjustment of the angularity of the rotors and distributor roll in both vertical and horizontal directions, and also to permit adjustment of the position and angularity of the roll with respect to the rotors.

Distributor 16 and rotors 30 and 32, or at least the peripheral portions thereof, are composed of steel or like heat resistant material. The drive for the several rotors is not shown, but it will be understood that it may be of any suitable type comprising, say, separate motors for each shaft or a single motor with suitable belting connecting them through pulleys 33 for rotation at relative speeds within the required ranges.

In the operation of the apparatus described above, and in carrying out the method of the instant invention, the position of distributor 16 is adjusted so that the molten material stream 14 impinges against its peripheral surface primarily within groove 26 and somewhat to the left of a vertical line through the axis of the distributor, as viewed in Fig. 2. The molten material is in a highly fluid condition such as that attained in conventional mineral wool fiberization operations. Rotors 30 and 32 are adjusted relatively to distributor 16 so that molten material discharged tangentially by the distributor over a relatively wide arcuate area thereof is distributed on portions of the peripheral surfaces of both rotors. The rotors are also positioned relatively to one another to define a bight or space therebetween of approximately the combined thickness of the molten material built up thereon, say $\frac{1}{8}$'' to $\frac{3}{32}$''. The rotors are driven at pre-determined peripheral speeds which will depend upon the particular operating conditions, such as the fluidity of the molten material and the like. For purposes of example, it may be stated that in employing a conventional mineral wool melt, successful operation was obtained by driving rotors 30 and 32, 12 inches in diameter, at approximately 4400 and 4250 R. P. M. respectively. Distributor 16 approximately 6 inches in diameter was driven at a somewhat slower speed, say 3500 R. P. M.

The molten material impinging on the distributor roll 16 is initially partially bonded to the roll in grooves 26 and 28 to form a relatively permanent annular ring of the bonded material revolving with the distributor and carrying a superposed, unbonded, incandescent layer. The main portion of the stream is projected at a greatly accelerated speed, as compared to the original gravity flow of the stream, tangentially from the distributor roll through a substantial arc of its rotation, the projected material impinging principally on the peripheral surface of rotor 30 and to some extent on the peripheral surface of rotor 32 as illustrated in Fig. 2, rotors 30 and 32 forming in effect a substantially unbroken surface to receive the molten material. The molten material striking rotor 30 partially bonds to the grooved surface thereof to form an annular ring of material and the unbonded, molten, incandescent material is, in part, discharged from roll 30 onto the grooved peripheral surface of roll 32 where again a relatively temporary bonded ring of the molten material is formed. Roll 32 may project a portion of unbonded material back against roll 30 and the rebounding of the molten material may continue until the bight is reached. During the high speed rotation of the rotors the molten material is thrown off from the rings by centrifugal force and drawn out into fibrous form. Distributor roll 16, in addition to its material distributing function, acts itself as a fiberizing medium to some extent. Fiberization also takes place in the bight between rotors 30 and 32. That is, when any unbonded material on the rotors reaches the bight, (see Fig. 6) it is leveled off and admixed instantaneously with the material on the opposite rotor. As the rotor surfaces separate, fiberization takes place by the pulling of the material from the surfaces of the opposite rotors, the fibers being momentarily attached to both.

The peripheral speeds of the rotors, the fluidity of the melt and the grooving of the rotors may be varied to meet given conditions. It will be understood, however, that the molten material must be at a sufficiently high temperature to maintain the bonded rings in a highly fluid or incandescent state to permit fiberization to take place.

The fiber formed as described above may be collected in any suitable manner and a binder may be introduced if desired, either before or after initial fiber collection. The particular construction and operation of means to perform these functions forms no part of the instant invention.

The construction as described above has been found to deliver a greatly increased fiber yield over other rotor type fiberizing apparatus previously employed. This is due in great part to the ability of the device to handle a larger and more fluid stream. Such large fluid streams, when run directly on the flat surfaces of the fiberizing rotors as previously proposed, have spattered excessively. In the present construction the special grooved shape of the distributor roll and its lower speed reduces spattering to a minimum. As stated above, the distributor roll may be one-third to one-half the diameter of the larger fiberizing rotors. For the more fluid melts the small diameter distributor is used. Very fine uniform fibers are obtained adapting the product for many special uses.

Having thus described my invention in rather full detail it will be understood that these details need not be strictly adhered to but that various changes and modifications may suggest themselves to one skilled in the art, all falling within the scope of the invention as defined by the subjoined claims.

What I claim is:

1. In an apparatus for converting a molten, raw material to fibrous form having means for discharging a concentrated stream of the material, a distributor roll including a peripheral surface, means for rotating said roll in a given direction, said roll being located with the down turning segment of its peripheral surface in the path of the stream whereby the roll breaks up the concentrated stream and projects the molten material generally outwardly and downwardly in distributed formation, rotors having heat-resistant, peripheral surfaces, means locating said rotors to have their peripheral surfaces intercepting the path of the material discharged by said distributor roll, means for rotating said rotors, and means on the surfaces of said rotors for retaining annular rings of the molten material thereon.

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2. In an apparatus for converting a molten, raw material to fibrous form having means for discharging a concentrated, fluid stream of the raw material, a distributor roll including a peripheral surface, means for rotating said roll in a given direction, said roll being located with the down turning segment of its peripheral surface in the path of the stream whereby the concentrated stream is broken up and the molten material projected generally outwardly and downwardly, a pair of rotors having heat-resistant, peripheral surfaces located to have their peripheral surfaces intercept substantially the entire path of the material discharged by said distributor roll, means for rotating said rotors in opposite directions, and means on the peripheral surfaces of said rotors for maintaining annular rings of the molten material thereon.

3. In an apparatus for converting a molten raw material into fibrous form having means for supplying a stream of the material, rotary distributor means in the path of the stream, means for rotating said distributor means to project the main portion of the molten material as a distributed stream moving at a greatly accelerated speed, and rotor means including an unobstructed, molten-material retaining, annular surface, means supporting said rotor means in position to have said annular surface intercept material of said distributed stream, and means for rotating said rotor means to move said annular surface at a speed substantially higher than the speed of the distributed stream.

4. In an apparatus for converting a molten raw material to fibrous form having means for supplying a stream of the material, a distributor roll including a peripheral surface, means for rotating said roll in a given direction and at a peripheral speed several times greater than the rate of movement of the stream, means supporting said roll to have a down-turning segment of its peripheral surface in position to intercept said stream and project the main portion of the molten material generally outwardly and downwardly as a distributed stream moving at a greatly accelerated speed, a plurality of rotors having unobstructed, molten-material retaining annular surfaces, means supporting said rotors in position to have their annular surfaces intercept said projected material, and means for rotating said rotors at peripheral speeds substantially higher than the speed of the distributed stream.

5. In an apparatus for converting a molten raw material to fibrous form having means for supplying a stream of the material, distributor means in the path of the stream for intercepting the stream and projecting the main portion of the molten material as a distributed stream moving at a greatly accelerated speed, a plurality of rotors having unobstructed, molten-material retaining, annular surfaces, means supporting one of said rotors in position to have its annular surface intercept material of said distributed stream, means for supporting another of said rotors in position to have its annular surface intercept molten material discharged by said first rotor, and means for rotating said rotors at speeds substantially higher than the speed of the distributed stream.

6. In an apparatus for converting a molten raw material to fibrous form having means for supplying a stream of the material, rotary distributor means in the path of the stream, means for rotating said distributor means to project the main portion of the molten material generally outwardly and downwardly as a distributed stream moving at a greatly accelerated speed, a plurality of rotors having unobstructed, molten-material retaining, annular surfaces, means supporting one of said rotors in position to have its annular surface intercept material of said distributed stream, and means supporting a second of said rotors in position to have its annular surface intercept molten material discharged by said first rotor, and means for rotating said rotors at peripheral speeds substantially higher than the speed of the distributed stream.

7. The method of forming fibers from molten material comprising, discharging a stream of molten material, intercepting said stream and projecting the main portion of the material as a distributed stream moving at an accelerated speed, intercepting material of said distributed stream by an unobstructed, molten-material retaining, annular surface to form an incandescent ring of molten material thereon, and to discharge molten material therefrom, intercepting material discharged from said first-mentioned annular surface on a second unobstructed, molten-material retaining, annular surface and forming an incandescent ring of molten material thereon, and rotating said annular surfaces at speeds substantially higher than that of the distributed stream to form fibers from material of said incandescent rings.

8. In an apparatus for converting a molten raw material to fibers having means for discharging a stream of the molten material, the improvement comprising rotary means in the path of the discharged material for accelerating the material, a rotor having a grooved peripheral surface, means mounting said rotor for rotation with said peripheral surface in the path of the material whereby a portion of the material is bonded in the grooves on said surface to form an incandescent ring and another portion is thrown off, a second rotor having a grooved peripheral surface, means mounting said second rotor for rotation with its peripheral surface in the path of material thrown off by said first rotor, and means for rotating said rotors at high speeds to convert the material into fibrous form.

9. A method of making mineral wool from a molten mineral material comprising discharging a stream of the molten material, spreading and accelerating the stream, discharging the spread and accelerated stream at a relatively high velocity onto the peripheral surface of a rotor to form an incandescent ring thereon from a portion of the material, discharging another portion of the material from the first rotor onto the peripheral surface of a second rotor to form an incandescent ring thereon, and rotating said rotors at higher peripheral speeds than the velocity of the spread stream to form fibers from said incandescent rings.

10. In an apparatus for converting a molten raw material into fibrous form having means for discharging a stream of the material, the improvement comprising rotary means in the path of discharged material to receive material and discharge material therefrom, rotors having unobstructed, molten material retaining annular surfaces positioned to receive material discharged by said rotary means, and means for rotating said rotary means and rotors.

11. The method comprising discharging a stream of molten mineral wool forming material and converting the same into fibers by intercepting the discharged material by a rotating annular surface and projecting material therefrom, inter-

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cepting material projected by said surface on an unobstructed, molten material retaining annular surface rotating at a higher speed than that of the first surface, and projecting molten material therefrom onto another unobstructed, molten material retaining annular surface rotating at high speed.

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