Jan. 25, 1955 B. A. GRAYBEAL 2,700,176

MULTIPLE ROTOR FIBERIZING DEVICE

Filed Jan. 24, 1951

Fig. 1.

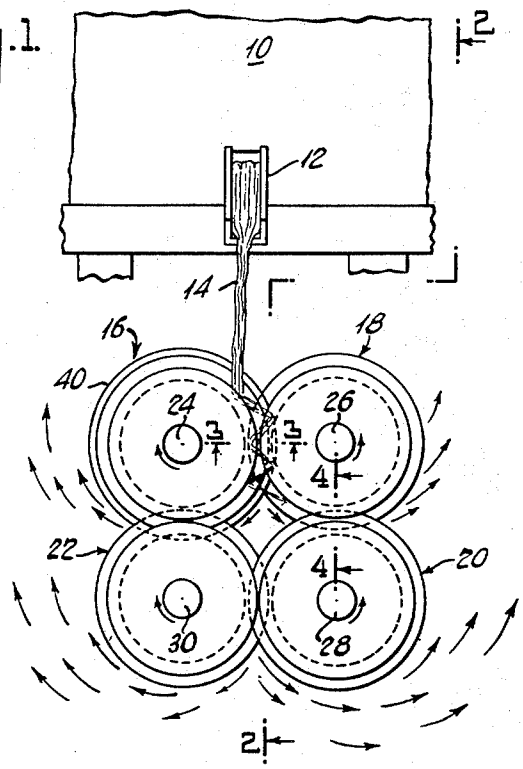


Fig. 2.

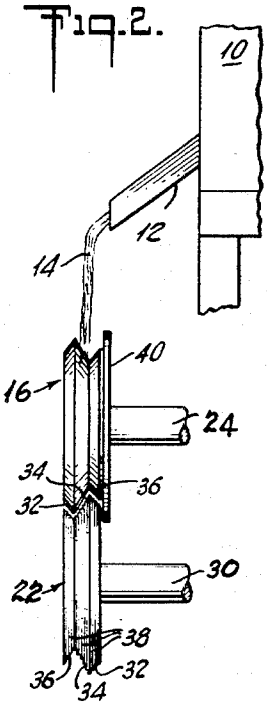


Fig. 3.

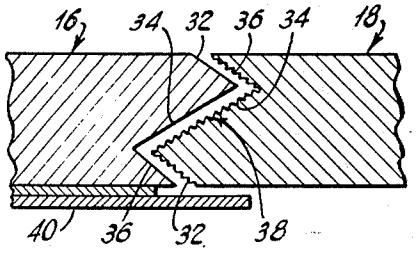
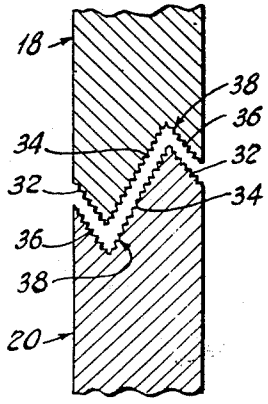


Fig. 4.



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MULTIPLE ROTOR FIBERIZING DEVICE

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13 Claims. (Cl. 18—2.6)

The present invention relates to the manufacture of mineral wool and more particularly to an improved apparatus and method for converting a molten mineral wool forming material into fibers.

It has recently been proposed to fiberize molten materials, such as rock, slag, glass, mixtures thereof, and like raw material, by the use of a plurality of cooperating rotors. The molten material is delivered to an initial or primary rotor which serves to accelerate the movement of the material and to discharge it onto the peripheral surfaces of other rotors to which it becomes bonded in the form of incandescent rings. High speed rotation of the rotors causes the fibers to be drawn from the rings of incandescent molten material by centrifugal force. Apparatus and methods of this type are disclosed and claimed in patent of E. R. Powell, #2,428,810, issued October 14, 1947, and in the copending applications of E. R. Powell, S. N. 555,359, filed September 22, 1944 and S. N. 51,750, filed December 29, 1948, now Patents No. 2,520,168 and No. 2,520,169, respectively.

The instant invention has for its principal object the provision of an improved apparatus and method of fiberizing molten materials involving a plurality of cooperating rotors. More specifically an object of the invention is the provision of an improved multiple rotor fiberizing device which reduces spatter of the molten material and promotes a wider spreading of the molten material on the surfaces of the rotors, these features contributing to more efficient operation and higher production.

Another object of the invention is the provision of such apparatus in which the open area between the rotors is reduced to a minimum to overcome objectionable cooling of the molten material prior to fiberization. A further object of the invention is the provision of a fiberizing device involving a plurality of rotors in which the peripheral surfaces of the rotors lie closely together while, at the same time, adequate space is provided for passage between the rotors of solid particles such as chunks of coke, slag, or the like.

A still further object of the invention is the provision of a fiberizing apparatus in which the several rotors, with the exception of the initial rotor, may be identical, permitting interchange of the rotors with increased life of the apparatus as a whole.

Briefly stated, the invention is embodied in a fiberizing apparatus generally of the character disclosed in the said Patent No. 2,520,169, and similarly employing four rotors. In accordance with the instant invention, the rotors are preferably made of the same diameter and are preferably driven at the same speed. The peripheral surfaces of the rotors are shaped to define relatively deep V-shaped tongues and grooves, and the rotors are supported in the form of a ring of rotors with the tongues and grooves of adjacent rotors in spaced, but closely adjacent, intermeshing relationship at the bights between the rotors. This arrangement serves to substantially enclose the molten material to reduce spatter and, at the same time to spread the molten material over a greater fiberizing area. In the preferred embodiment, the primary rotor which receives the original stream of molten material is provided with a baffle extending beyond the peripheral edge to prevent loss of the molten material on its initial contact with the rotors.

My invention will be more fully understood and further objects and advantages will become apparent when reference is made to the following detailed description

of the invention and to the accompanying drawings in which:

Fig. 1 is a diagrammatic, front elevational view of an apparatus embodying the invention;

Fig. 2 is a sectional view, on an enlarged scale, taken on the line 2—2 of Fig. 1; and,

Fig. 3 is a sectional view, on an enlarged scale, taken on the line 3—3 of Fig. 1; and,

Fig. 4 is a sectional view, on an enlarged scale, taken on the line 4—4 of Fig. 1.

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

In accordance with the instant invention the fiberizing apparatus consists of a plurality of rotors arranged in ring formation, the rotors being indicated by the reference characters **16**, **18**, **20** and **22**. These rotors are fixed to shafts **24**, **26**, **28** and **30**, respectively, for rotation therewith. Any suitable means (not shown), such as individual motors or a common drive, may be employed to drive the rotors in the directions indicated by the arrows in Fig. 1.

The rotors are of heat-resistant steel or other alloy of a character to chill and bond a portion of the molten material and thus resist excessive erosion or wear when subjected to the molten slag or other raw material which may be at temperatures as high as 2900° F.

The rotors are all preferably of the same diameter and have peripheral surfaces with similar profiles as best illustrated in Figs. 2 and 3. Thus the peripheral surface of each of the rotors consists of annular faces or surfaces **32**, **34** and **36** which are frusto-conical in shape and define a relatively deep V-shaped groove and a complementary tongue. In profile or in cross-section, the peripheral surface of each rotor is Z-shaped, and, as illustrated in Fig. 3, the diagonal leg **34** of the Z is substantially greater in length than either of the other legs **32** or **36**. Each leg of the Z extends at an acute angle to the rotor axis. The area of surface **34** is substantially greater than the area of either of surfaces **32** or **36**, and because of its location at a greater distance from the axis of rotation of the rotor (see Fig. 2), the area of surface **32** is substantially greater than the area of surface **36**. It will also be appreciated that the length of the axis of generation of surface **34** is greater than length of the axis of generation of either of surfaces **32** or **36**. As used herein, "axis of generation" of surface **34**, for example, is that portion of the rotor axis between parallel lines extending perpendicularly to the rotor axis from opposite ends of leg **34** in Fig. 3. As will be observed, the edge profile of each rotor of a pair of adjacent rotors is reversed with respect to the opposite rotor of the pair so that the tongues and grooves are in intermeshing relationship and the opposed faces lie in parallel relationship. The rotors are supported on their respective shafts with the end faces of the rotors lying in substantially the same plane and with the peripheral surfaces of adjacent rotors of the ring in spaced, but relatively adjacent, relationship at the bight between them. The exact spacing between the rotors is not critical within reasonable limits. For example, the rotors may be spaced, say, ¼" to ¾" apart at the bights.

The series of rotors is located so that the molten material stream **14** strikes the initial or primary rotor **16** substantially centrally widthwise of its peripheral surface and at a point on a downturning segment thereof adjacent the bight between it and rotor **18**.

The surfaces of rotors **18**, **20** and **22** are preferably provided with a series of relatively fine grooves **38** running, say, 6 to 10 per inch of width, these grooves being of either V or U-shape, to insure bonding of the molten material to the faces **32**, **34** and **36**. However, bonding of the molten material is not necessarily dependent on

the presence of such grooves. It has been found that, even if these faces are plane surfaced, the molten material will tend to bond after the rotors are in use for a period of time. However, the more positive means for this purpose, such as the grooves 38, is preferred. Such bonding grooves are preferably omitted from the initial rotor 16 for reasons later more fully explained.

The initial rotor 16 preferably carries a baffle 40 consisting of an annular plate welded or otherwise secured to the rear end face of the rotor. The baffle extends across the gap between the rotors and a substantial distance, say, an inch or more therebeyond, as illustrated in Fig. 2. The plate is spaced outwardly from the end face of rotor 16 sufficiently to insure against contact between the baffle and rotor 18.

In the operation of the apparatus described above and in carrying out the method of the invention, the fiberizing device is positioned to have the molten material stream issuing from the cupola impinge upon rotor 16 at a point to the right of a vertical line through the axis of the rotor, as viewed in Fig. 1, that is, on a downturning segment of the peripheral surface of the rotor adjacent the bight between it and rotor 18, as previously explained.

The molten material issuing from the cupola and forming the stream 14 is in a highly fluid, incandescent condition and, for economy, the stream is of considerable size, say ½" in diameter. The condition of fluidity employed for the molten material in mineral wool fiberization by the conventional steam jet process is an example of the fluidity suitable for the instant operation, although somewhat more fluid streams may be used if desired. The rotors are driven at preferably the same speeds and in the directions indicated by the arrows. The molten material deposited on rotor 16 is mostly discharged substantially tangentially from, and in directions normal to the faces of, rotor 16 and onto the faces of rotor 18, although some may be carried around and discharged onto rotor 22. The material received on rotor 18 is partially retained thereon in the form of one or more molten, incandescent rings, bonding of the material to the rotor being promoted by the grooves 38. Excess material is thrown off rotor 18 and onto rotor 20 where a similar bonding action takes place, and incandescent rings of molten material are formed. Again, excess material is discharged from rotor 20 onto rotor 22. The latter rotor may also receive material directly from rotor 16, as previously mentioned, and also from rotor 18, although the general path of the material is as described.

The continued rotation of the rotors at high speed causes portions of the material of the incandescent rings on rotors 18, 20 and 22 to be thrown or drawn from the rotors by the centrifugal forces created, these portions being drawn out into long, fine fibers. Rotor 16 may fiberize to a minor extent, but the material will not as readily bond thereto due to the omission of the material retaining grooves and to the fact that the rotor is running at high speed while stream 14 is moving at the relatively low speed imparted to it by gravity. The failure of the initial rotor to fiberize to any substantial extent is beneficial as there is a tendency for fibers formed by this rotor to be carried back into the path of the slag stream. Also, the elimination of the bonding grooves from this rotor is beneficial as grooves would tend to increase the windage effect of the rotor and, hence, increase the difficulty of controlling stream 14.

The particular dimensions of the rotors are not critical within reasonable limits and may be selected on the basis of the capacity desired, that is, the quantity per hour of molten material to be delivered by the melting furnace. Also, the peripheral speed at which the rotors are driven will depend upon the operating conditions, such as the fluidity of the molten material, and the like, but for purposes of example it may be stated that in employing a substantially conventional mineral wool melt, successful operation was obtained by employing rotors having mean diameters of approximately 10" and driving them at high peripheral speeds in the ranges of 8,000 to 18,000 feet per minute. It will be understood that the molten material must be at a sufficiently high temperature, the specific temperature range depending upon the character of the material, to maintain the molten material on the surfaces of 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 the original fiber collection, the particular apparatus for these purposes forming no part of the instant invention.

The above described apparatus and method attain the several objects previously set forth. The tongue and groove profile of the rotors in effect encloses the molten material to reduce splattering and loss of the material. This permits the rotors to be driven at the same speeds, as the molten material is, in effect, confined within the fiberizing area. The baffle on the initial or primary rotor is an additional safeguard and, in combination with tongue and groove profile, insures that even though the initial rotor is driven at full speed, no substantial distribution of the molten material beyond the confines of the rotors can take place. The tongue and groove profile of the rotors also promotes wider distribution of the material on the surfaces of the rotors as the material is discharged normal to the surface of the rotors. The open space between the rotors is greatly reduced whereby objectionable cooling of the material is reduced to a minimum. All of the rotors except the initial rotor may be interchanged.

Having thus described my invention in rather full detail, it will be understood that these details need not be strictly adhered to and 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 into fibers having means for delivering the molten material, pairs of rotors each adapted for high-speed rotation, the peripheral surface of each of the rotors having annular faces lying at angles to one another, said rotors being positioned with the peripheral surfaces of each pair in spaced but adjacent relationship with opposed annular faces lying in parallel planes and with the peripheral surface of one of the rotors lying in the path of the delivered material.

2. In an apparatus for converting a molten raw material into fibers having means for delivering the molten material, pairs of rotors each adapted for high-speed rotation, the peripheral surface of each of the rotors having annular faces lying at angles to one another, the faces of at least some of the rotors being of a character to retain molten material thereon, said rotors being positioned with the peripheral surfaces of each pair in spaced but adjacent relationship with opposed annular faces lying in parallel planes and with the peripheral surface of one of the rotors lying in the path of the delivered material.

3. In an apparatus for converting a molten raw material into fibers having means for delivering the molten material, a series of rotors defining a ring of rotors each adapted for high-speed rotation, the peripheral surface of each of the rotors having annular faces lying at angles to one another, said rotors being positioned with the annular faces of adjacent rotors in opposed, parallel relationship and with the peripheral surface of one of the rotors in the path of the delivered material.

4. In an apparatus for converting a molten raw material into fibers having means for delivering the molten material, a series of rotors defining a ring of rotors each adapted for high-speed rotation, the peripheral surfaces of the rotors having tongue and groove profiles, said rotors being positioned with the peripheral surface of each rotor in spaced but adjacent, intermeshing relationship with the peripheral surfaces of adjacent rotors of the ring and with the peripheral surface of an initial one of the rotors in the path of the delivered material.

5. In an apparatus for converting a molten raw material into fibers having means for delivering the molten material, a series of rotors defining a ring of rotors, each adapted for high-speed rotation, the peripheral surfaces of the rotors having tongue and groove profiles, said rotors being positioned with the peripheral surface of each rotor in spaced but adjacent, intermeshing relationship, and with the peripheral surface of an initial one of the rotors in the path of the delivered material, the surfaces of at least the rotors other than the initial rotor being of a character to retain the molten material thereon.

6. In an apparatus for converting a molten raw material into fibers having means for delivering the molten material, a series of rotors defining a ring of rotors each adapted for high-speed rotation, the peripheral surfaces

of the rotors having tongue and groove profiles, said rotors being positioned with the peripheral surface of each rotor in spaced but adjacent, intermeshing relationship with the peripheral surfaces of adjacent rotors of the ring, and with the peripheral surface of an initial one of the rotors in the path of the delivered material, the surfaces of the rotors other than the initial rotor having means for retaining molten material thereon.

7. In an apparatus for converting a molten raw material into fibers, two pairs of rotors grouped to form a ring of rotors, each rotor of each pair being adapted for high-speed rotation in a direction opposite to that of the other rotor of said pair, the surfaces of the rotors having tongue and groove profiles, said rotors being positioned with the peripheral surface of each rotor in spaced but adjacent, intermeshing relationship with the peripheral surfaces of adjacent rotors of the ring, an initial rotor of the ring being positioned to receive the delivered material on a downturning segment of its peripheral surface.

8. In an apparatus for converting a molten raw material into fibers having means for delivering the molten material, a series of rotors defining a ring of rotors, the peripheral surfaces of the rotors including annular faces defining V-shaped tongues and grooves, said rotors being positioned with their peripheral surfaces in spaced but adjacent relationship with the tongue of a rotor received in the groove of an adjacent rotor and with the surface of an initial one of the rotors in the path of the delivered material, and a baffle carried by the initial one of said rotors, said baffle projecting beyond the periphery thereof.

9. A rotor for cooperation with other rotors in the fiberization of mineral wool, said rotor comprising a cylindrical body having a peripheral surface including annular faces defining relatively deep V-shaped tongues and grooves, and a baffle carried by said cylindrical body at one end thereof and projecting annularly beyond the periphery thereof.

10. In an apparatus for converting a molten raw material into fiber, a ring of rotors all of substantially the same size and shape and each having a peripheral surface comprising an annular surface positioned in generally parallel, spaced but adjacent relationship with the annular surfaces of two adjacent rotors, means for rotating all of said rotors at substantially the same high speed, and means for delivering said molten raw material to said surfaces.

11. The apparatus of claim 10 wherein said ring of rotors comprises two pairs of rotors, the rotors of each pair being arranged for rotation in opposite directions.

12. The apparatus of claim 10 wherein said annular surfaces are frusto-conical.

13. A rotor for cooperation with other rotors in the fiberization of mineral wool, said rotor comprising a cylindrical body having a peripheral surface including a relatively deep groove, and a baffle carried by said cylindrical body at one end thereof and projecting annularly beyond the periphery thereof.

References Cited in the file of this patent

UNITED STATES PATENTS

361,822	Hohre et al.	Apr. 26, 1887
443,651	Galindo	Dec. 30, 1890
452,204	Weies et al.	May 12, 1891
1,459,947	Cronemeyer	June 26, 1923
2,182,720	Cannard	Dec. 5, 1939
2,398,707	Hawthorne et al.	Apr. 16, 1946
2,399,383	Powell	Apr. 30, 1946
2,428,810	Powell	Oct. 14, 1947
2,520,168	Powell	Aug. 29, 1950
2,520,169	Powell	Aug. 29, 1950