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APPARATUS FOR FIBERIZING MOLTEN MATERIAL

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Fig. 1.

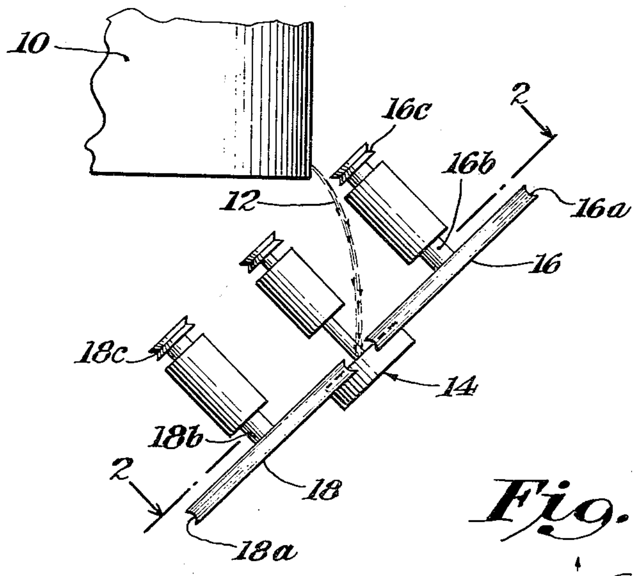


Fig. 3.

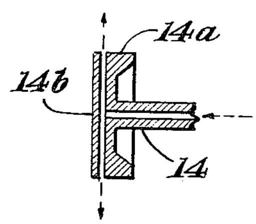


Fig. 2.

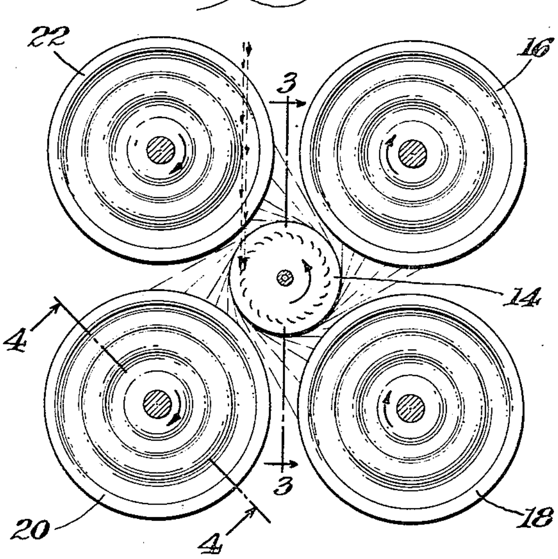
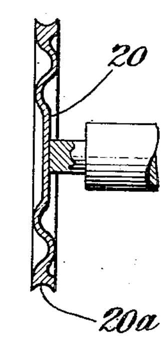


Fig. 4.



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APPARATUS FOR FIBERIZING MOLTEN MATERIAL

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3 Claims. (Cl. 18—2.6)

This invention relates to improvements in apparatus for the manufacture of mineral wool, which, in a generic sense, includes wool or fibers formed from rock, slag, fused clay or mixtures thereof, and other heat liquefiable raw materials capable of being converted into fibers.

In accordance with some presently known practices, such materials are fiberized by a spinning process in which a stream of the molten material is discharged from point to point onto one or more adjacent spinners or rotors rotated at high speed whereby the centrifugal forces set up cause portions of the material on the rotors to be thrown out as fibers.

While the practice as disclosed above has several significant advantages over the prior practice of steam blowing, I have found by further experimenting that even greater advantages are possible in rotor fiberization.

An important feature of my invention is the provision of a unique slag distributor and fiber forming rotor nest consisting of at least three very high speed rotors so arranged that each fiber forming rotor not only receives the molten slag over a very wide arc of its periphery, but also so that each fiber forming rotor takes substantially the same load. With such a construction, increased yields are obtained and maintenance greatly reduced.

Another principal feature of my invention is an improved construction of the slag distributing rotor and fiber forming rotors, the latter of which are formed of a heat and erosion resistant alloy in a light-weight manner which permits very high speed operation and air cooling, and thus avoids the prior practice of water cooling and all its attendant mechanical problems.

In general I am enabled by my apparatus to produce greater yields of higher purity product than is otherwise possible and this is accomplished with simpler apparatus and with longer operating life.

Further objects and advantages of my invention will appear from the following description of a preferred form of embodiment thereof, taken in conjunction with the attached drawing illustrative thereof and in which:

Fig. 1 is a side elevation of a cupola or melting furnace and adjacent mineral wool distributing and fiberizing rotors.

Fig. 2 is a front elevation of the rotors shown in Fig. 1 with a diagrammatic showing of the fiber path.

Fig. 3 is a central vertical cross-section through the hollow distributor rotor.

Fig. 4 is a central vertical cross section through a fiberizing rotor.

As hereinafter described, my mineral wool fiberizing machine is adapted to produce high quality mineral wool fiber from molten silicious raw materials commonly used in the mineral wool industry. This is generally slag which is produced in a blast furnace type cupola and it may be remelted in a suitable furnace **10**. This is usually a cupola similar to a blast furnace cupola but may be an oil or gas fired or arc type furnace and it produces a continuous stream **12** which is drawn off from the customary tap, not shown.

Below this tap, and in position to meet the falling slag

stream **12** is the primary or slag distributing rotor **14**. As shown in cross-section in Fig. 2, this rotor is cup shaped to receive the slag which is then rapidly ejected tangentially from the inside across the sharp edge over the 360° periphery to produce the desired skirt of dispersed molten slag.

I prefer to make the rotor **14** with a hollow central shaft **14a** and diametrically opposed openings **146** through which I can pass the bonding solution as well as sufficient water for cooling purposes. This gives a high dispersion of the binder at the best area. The rotor **14** will be driven at a suitable speed through a belt and pulley or by an individual drive as may be found preferable.

Concentrically mounted with respect to the slag distributing rotor **14** and suitably spaced therefrom, and with an overlap of edges are the fiberizing rotors **16**, **18**, **20** and **22**. At least three of these rotors are found essential but for best operations, I have had especially satisfactory results with four as shown. More than four can be used.

Each of these rotors is also driven by suitable means such as the pulleys **16c** and **18c**, but it will be apparent that individual drives such as high speed motors (not shown) may be used.

A preferred form of fiberizing rotor is shown in detail in Fig. 4. It consists of a relatively thin alloy corrugated disc surmounted by a grooved and transversely curved channel rim **20a** which is of a heat and abrasion resistant alloy. With such a thin and concentrically expansible disc construction, I have the advantage of a light weight unit which may be rotated at the super high speeds I find necessary. The rotor is adequately cooled by air, however, and the complications of water cooling can be completely eliminated. Such expansion or contraction as does occur is readily taken up by the corrugated disc construction without deformation.

As will appear from Fig. 1, the faces of the various rotors are all preferably in a common plane at an angle of about 45° with the horizontal to assure free flow of slag to the inside of the distributor rotor **14**. The slag is then discharged at moderate velocity onto the rims of the fiberizing rotors **16**, **18**, **20**, and **22** which are operated at a much higher surface speed. A small angularity of the central rotor throws a wider band of slag on the fiberizing rotor.

In my operation I find that the slag adheres to the concave peripheral surface of the fiberizing rotors and forms an incandescent band around the rotor. This molten slag is discharged tangentially from the fiberizing rotors and travels in a straight path until it cools to the optimum temperature for fiberization, the resistance of air against the moving molten particles causes very fine fibrous tails to be attenuated from the molten particles. The core of the particle usually remains as an unfiberized "shot" particle.

According to my practice, this "shot" is kept to a minimum. Laboratory tests have shown that there is a direct correlation between average fiber diameter and percent of "shot" on a given mesh screen. Finely dispersed molten slag trajected at high velocity through air is the prerequisite for fine fibers with a minimum of unfiberized slag.

As the four fiberizing rotors **16**, **18**, **20** and **22** are each arranged symmetrically about the distributing rotor **14** and preferably have the same peripheral speed, each rotor takes its proportionate share of the load and overloading is avoided. Contact is over approximately a 90° arc when four rotors are used (or 120° when three rotors are used) and acceleration is greatly facilitated as compared to a point to point discharge. There is no double contact of the slag on any single fiberizing rotor.

Each of the fiberizing rotors **16**, **18**, **20** and **22** may be rotated in the same direction or in any desired direction, as, for example, an adjacent pair may be run countercurrent to each other to produce a double tongue of material. A rotor may be reversed to circumvent a collection problem or to influence blanket formation. It is found that direction of rotation does not materially affect the quality of fiber and other considerations, such as convenience of fiber collection may be paramount.

It is also not critical that the fiberizing rotors be in exactly the same plane as the slag distributing rotor and some angularity may be helpful to permit fiber to throw free.

As an example of best operating conditions, I find that a central rotor of about 6″ in diameter is most effective at about 1000 R. P. M. which is sufficient for slag ejection as no fiber is produced. On the other rotors, however, I find that a peripheral speed of about 35,000 feet per minute is preferable, not only to produce the best fiber, but also to produce the least waste. I have driven 14″ diameter rotors at 10,000 R. P. M. for sustained periods without water cooling and with very little erosion. This is about the maximum rate available with present drives and bearings.

The successful results of my operations appear to be due in part to the higher speed and somewhat higher temperature of operation. With the higher temperature, a better "wetting" of the rim is accomplished, and as a consequence there is less slipping in giving the slag the necessary acceleration.

Another main benefit comes from the nearly uniform loading of each of the fiberizing rotors. This materially departs from prior practice wherein as much as 15% of the feed was unfiberized. This was particularly objectionable not only in cutting down capacity, but the material not fiberized had to be separated from the product. I have opearted continuously with less than 5% waste.

Another advantage is, of course, the uniform radial flow of the slag to the fiberizing rotors. The slag may be dispersed in a narrow band and I find that rotors **16**, **18**, **29** and **22** of only one inch in thickness are comparable in capacity with former constructions which were as much as three inches thick. This lighter construction is of the utmost importance since it permits the use of smaller shaft sizes and higher speeds with less power consumption.

It is also found that water cooling of the rotors is unnecessary, and, in fact, is to be avoided. Better binding with less crust formation results with hotter surfaces. It will be apparent that with equal division of the feed, the amount of molten slag striking each of the rotors is only the amount that is actually fiberized. The elimina-

tion of water cooling reduces the amount of crusty solid matter found in the fiber and a separation step is thus avoided.

The resulting symmetrical pattern of fiber formation is conducive to more uniform felting which is otherwise a porblem when spinning wool for mineral wool batt manufacture. Uniform distribution of the binding material among the fibers is also facilitated by using the centrally located spreading rotor to disperse the binding material. This is accomplished as follows:

A water soluble phenolic binder in water solution is introduced through the hollow shaft of the central rotor **14**. Due to the transverse channels **14*b***, this solution issues from the periphery of the spreading rotor which thus coincides with the symmetrical pattern of fiber formation. The fog of binder misses the fiberizing rotors as it moves outward in all directions and intermingles with the fiber. A substantially superior binder distribution results.

My improved operation thus provides a much higher fiberizing efficiency which is the result not only of higher quality, but greater quantity of fiber produced.

I claim:

1. A fiberizing rotor assembly consisting of a central cup shaped rotor having a hollow liquid conduit therein, at least three symmetrically mounted, symmetrically shaped fiberizing rotors adjacent to and equally spaced from said central rotor, means to drive said cup shaped rotor, means to drive each of the fiberizing rotors, said fiberizing rotors having a corrugated disc body and a curved channel rim and means to introduce a liquid through said cup shaped rotor.

2. A fiberizing rotor assembly consisting of a central rotor, at least three symmetrically mounted, symmetrically shaped fiberizing rotors adjacent to and equally spaced from said central rotor, means to drive said central rotor, and means to drive each of the fiberizing rotors, each of said fiberizing rotors having a corrugated disc body.

3. A fiberizing rotor assembly consisting of a central rotor, at least three symmetrically mounted, symmetrically shaped fiberizing rotors adjacent to and equally spaced from said central rotor, means to drive said central rotor, means to drive each of the fiberizing rotors, each of said fiberizing rotors having a disc body of concentrically corrugated, expansible construction extending from the center portion thereof and being formed with a concave peripheral surface.

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