March 31, 1953 C. J. KOEHLER 2,632,919

METHOD AND APPARATUS FOR PRODUCING MINERAL WOOL

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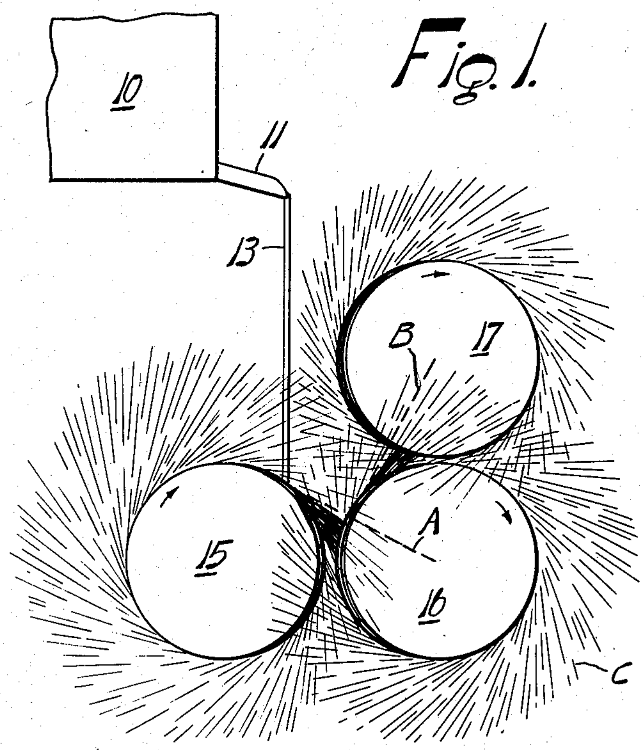

Fig. 1.

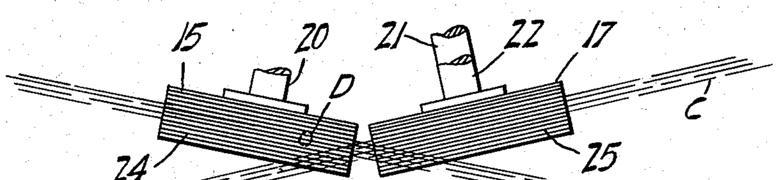

Fig. 2.

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METHOD AND APPARATUS FOR PRODUCING MINERAL WOOL

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7 Claims. (Cl. 18—2.6)

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This invention relates to the manufacture of mineral wool from molten slag and particularly to improved apparatus for producing such mineral wool by the spinning process. The use of the term "mineral wool" in this application is in a generic sense and is intended to include wool or fibers produced from molten rock, slag, glass, mixtures thereof, and similar raw materials.

At the present time most mineral wool, especially that produced from molten slag, is converted into fibers by subjecting a molten stream of the slag to a disintegrating blast of high pressure steam. Mineral wool produced in this general manner is known in the art as "blown wool."

An alternative means of converting molten mineral material into wool or fibers is by directing the molten material against the surfaces of high speed rotors from which the material is thrown or spun by centrifugal force, this force being such that the material is drawn out into fiber, thread or strand form.

Certain advantages of fineness, uniformity and relative freedom from objectionable pellets known as "shot" are attainable in this latter process which is called "spinning" and produces what the art terms "spun wool." However, the attainment of these benefits by spinning the wool instead of blowing is not without its technical difficulties, due in part to the nicety of control and the practical necessity of converting economical percentages of the molten slag into fibers.

The present invention relates to a method and apparatus for spinning mineral wool in an improved manner which employs a simpler apparatus, and produces a higher yield of spun fiber of good quality and fineness. The apparatus of the present invention is such that plural cooperating rotors contribute to the production of fiber from a single slag stream with relative freedom from interference between the slag stream and the fibers being formed and with maximum fiber production.

In spinning mineral wool fibers by throwing the material from rapidly rotating rotors under centrifugal force a system of two or more rotating bodies or wheels is most commonly employed. A stream of molten slag falls onto the surface of one wheel or rotor whereupon a certain part of the slag adheres to the surface of that wheel and the remainder or excess is thrown onto the next wheel in the system, the several wheels being properly positioned to receive the thus-deflected stream of excess molten slag. This process is repeated on each successive wheel surface until there is no remainder or excess of slag.

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The part of the slag that adheres to the wheel in each case forms an incandescent ring of molten slag around the wheel from which numerous globules of melt are thrown by centrifugal force to produce fibers from the still viscous molten slag. This centrifugal production of fibers takes place around the full circumference of the wheel.

In prior art attempts to produce spun wool whenever more than one revolving body or rotor has been used, the direction of rotation of each successive rotor has been opposite to that of the preceding rotor in the system. I have found that highly novel and superior results are obtained when all of the rotors are caused to revolve in the same direction, that is, all clockwise or all counterclockwise.

In prior art proposals this possibility has not been exploited. This failure may be attributed in part to two factors; first, the belief that a multiple rotor system must, in throwing slag from one rotor, accelerate it in the direction of movement of the periphery of the other rotor; and, second, the difficulty of arranging multiple rotors in such a way that they can be effectively rotated in the same direction and still properly receive the slag streams and spin wool.

The present invention provides a rotor arrangement which permits the use of three successive rotors operating in the same direction and I have found that, with this arrangement and with the slag streams directed against successive rotors in a novel manner, the rate of fiber production of a system of three wheels, all rotating in the same direction, is about equivalent to the rate of fiber production of systems in which it is necessary to employ four successive alternately rotating wheels or rotors to consume the deposited slag.

Previous prior art proposals have been based upon an assumed theory that the acceleration of the mineral melt from one wheel to the next and an accumulation or buildup of such acceleration is beneficial to the efficiency of the spinning process. I have found that the acceleration, per se, is not the important element but that the forceful application of the mineral melt to and against the rotating surface is very important. The effect of increasing the force of impingement is achieved, in one instance, by causing the melt to strike the wheels at an angle greater than 90 degrees to the tangent, or in such a manner that the direction of movement of the melt upon impingement is to some extent reversed. It is believed that the conception of this principle is responsible in an important part for the superior results obtained by the present apparatus and method.

In the accompanying drawing and the following specification one form of apparatus and one method of procedure according to the present invention is set forth by way of example. It is to be understood, however, that this method and apparatus is merely illustrative and the principles of the present invention are subject to many variations without departing from the spirit of the invention as defined in the appended claims.

In the drawing:

Fig. 1 is a general schematic front elevational view of one form of the rotor arrangement of the present invention viewed from the side toward which the spun wool is ultimately blown; and

Fig. 2 is a top plan view of the apparatus of Fig. 1.

Like characters of reference denote like parts and, referring particularly to Fig. 1, the numeral **10** designates a melting furnace for supplying molten slag and any suitable type of cupola may be employed. The numeral **11** designates a discharge trough or spout through which a molten stream **13** of rock, slag, glass or mixtures thereof or other materials in a fluid state and suitable for conversion into mineral wool, glass wool, and like fibrous material by spinning, is conducted.

The rotors for fiber spinning are disposed beneath the trough **11** in position to intercept the falling stream **13** of molten material. The rotors receive and act upon the slag in a more or less successive manner and the rotors are, in their successive order of operation, designated **15**, **16**, and **17**.

It will be noted from Fig. 1 that the stream of molten slag **13** falls to the periphery of rotor **15** in such manner that it is moving partially in the direction of movement of the periphery of the rotor. However, in the case of the impingement of slag against rotors **16** and **17**, successively, the angle of impingement of the slag against their peripheries is somewhat the reverse from that in the case of rotor **15**. A line A extends from the axis of rotor **16** tangent to the periphery of rotor **15**, and it will be noted that the somewhat fan-shaped stream of excess slag thrown from rotor **15** to rotor **16** strikes the latter behind this line A so that the direction of movement of the slag stream is, to some extent, reversed upon impingement of the periphery of rotor **16**.

The construction line B extending from the center of rotor **17** and tangent to the periphery of rotor **16** shows substantially the same condition with respect to excess molten slag thrown from rotor **16** to rotor **17**.

The rotors **15**, **16**, and **17** have mounting and rotating shafts **20**, **21**, and **22**, respectively, and the bearing and support means for the shafts and their driving means are conventional and need not be illustrated herein. The rotors may be belt connected in the manner heretofore practiced in this art, the only requirement being that all three rotors rotate in the same direction.

It will be noted that the shafts **21** and **22** of rotors **16** and **17** are parallel and in alignment but extend at a slight angle to the shaft **20** of rotor **15** as viewed in plan. Accordingly a vertical plane through rotors **16** and **17** at right angles to their axes, as indicated at C in Fig. 2, does not intersect the slag stream **13** which falls to the first rotor **15** at substantially the point marked D in Fig. 2. Thus the slag stream and the streams of spun wool extending from the peripheries of rotors **16** and **17** do not interfere with each other in any way.

It is to be understood that a certain amount of the slag falling to rotor **15** clings to its periphery temporarily while the remainder is immediately deflected and flung to or thrown against the periphery of rotor **16**. The slag which thus temporarily clings to rotor **15** appears thereon as an incandescent ring extending about its periphery with spun fibers emanating therefrom at all points about the periphery of the rotor quite uniformly. The same division of or a similar division of the slag occurs at rotor **16**, whereas the slag thrown from rotor **16** to rotor **17** has attenuated in volume at a point where substantially all of the remaining slag clings temporarily to rotor **17** and is converted into fibers.

The rotors are preferably provided with peripheral grooves as at **24** and **25** in Fig. 2. While subject to considerable variation, V-grooves $\frac{1}{16}$ inch wide and $\frac{1}{16}$ inch deep have operated in a satisfactory manner.

Merely by way of example and to set forth a single full embodiment of the method and apparatus of the present invention, the rotors **15**, **16**, and **17** have operated within a fully satisfactory manner when their diameters were each about 9½ inches, their face widths each about 4 inches, and their speeds of rotation each about 5000 R. P. M. or greater. Increases in peripheral speeds of the rotors are generally beneficial to the spinning process, both from the qualitative and quantitative standpoint, the limiting factor being the mechanical and physical abilities of the rotors and the supporting and driving means to stand up under these higher speeds.

It is generally inherent in the rotor arrangement of the present invention, with three rotors rotating in the same direction whether that direction be all clockwise or all counterclockwise, that the excess slag from the second rotor will be thrown generally upwardly to the third rotor, the latter being disposed with its axis somewhat higher than the axes of the first two rotors.

What is claimed is:

1. Apparatus for spinning fibers from molten material comprising three successively acting generally cylindrical rotors having facing peripheral portions, means for rotating said rotors at relatively high speed in a common direction of rotation, means for dropping molten material on the upper portion of the periphery of one of said rotors, the second rotor being disposed laterally of said one rotor in the direction of rotation of the upper part of said one rotor to receive excess molten material from the first rotor, and the third of said rotors being disposed generally above said second rotor to receive the excess molten material therefrom.

2. Apparatus for spinning fibers from molten material comprising three successively acting generally cylindrical rotors having facing peripheral portions, means for rotating said rotors at relatively high speed in a common direction of rotation, means for dropping molten material on the upper portion of the periphery of one of said rotors, the second rotor being disposed laterally of said one rotor in the direction of rotation of the upper part of said one rotor to receive excess molten material from the first rotor, and the third of said rotors being disposed generally above said second rotor to receive the excess molten material therefrom, said second and

third rotors being substantially coplanar and at an angle to the plane of the first rotor whereby the fiber spun by said second and third rotors is not in interference with molten material dropping to the first rotor.

3. Apparatus for spinning fibers from molten material comprising three successively acting rotors having facing peripheral portions, means for rotating said rotors at relatively high speed in a common direction of rotation, means for dropping molten material on the upper portion of the periphery of one of said rotors, the second rotor being disposed laterally of said one rotor in the direction of rotation of the upper part of said one rotor to receive excess molten material from the first rotor, and the third of said rotors being disposed generally above said second rotor to receive the excess molten material therefrom.

4. Apparatus for spinning fibers from molten material comprising three successively acting generally cylindrical rotors having facing peripheral portions, means for rotating said rotors at relatively high speed in a common direction of rotation, means for dropping molten material on the upper portion of the periphery of one of said rotors, the second rotor being disposed laterally of said one rotor in the direction of rotation of the upper part of said one rotor with its axis approximately intersecting a line tangent to the first rotor at the point where the molten material is dropped thereon to receive excess molten material from the first rotor, and the third of said rotors being disposed generally above said second rotor with its axis approximately intersecting a line substantially at right angles to said tangent to receive the excess molten material therefrom.

5. Apparatus for spinning fibers from molten material comprising three successively acting rotors having facing peripheral portions, means for rotating said rotors at relatively high speed in a common direction of rotation, means for dropping molten material on the upper portion of the periphery of one of said rotors, the second rotor being disposed laterally of said one rotor in the direction of rotation of the upper part of said one rotor with its axis approximately intersecting a line tangent to the first rotor at the point where the molten material is dropped thereon to receive excess molten material from the first rotor, and the third of said rotors being disposed generally above said second rotor with its axis approximately intersecting a line substantially at right angles to said tangent to receive the excess molten material therefrom.

6. A method of making mineral wool from a molten mineral material comprising discharging a falling stream of the molten material against

the upper peripheral portion of a generally cylindrical rotor while rotating the same at a relatively high velocity to form an incandescent ring of molten material thereon from a portion of said material, discharging the remainder of said material from the first rotor against the peripheral surface of a second rotor in a direction generally perpendicular to the receiving peripheral surface while rotating said second rotor at a relatively high velocity in the same direction as the first rotor to form an incandescent ring on the second rotor from a portion of the material so discharged, and discharging the remainder of the material from the second rotor against the peripheral surface of a third rotor in a direction generally perpendicular to the receiving peripheral surface while rotating said third rotor at a relatively high velocity in the same direction as the second rotor to form an incandescent ring on said third rotor from substantially the remainder of said molten material.

7. A method of making mineral wool from a molten mineral material comprising discharging a falling stream of the molten material against the upper peripheral portion of a generally cylindrical rotor while rotating the same at a relatively high velocity to form an incandescent ring of molten material thereon from a portion of said material, discharging the remainder of said material from the first rotor against the peripheral surface of a second rotor in a direction somewhat opposed to the direction of movement of the receiving peripheral surface while rotating said second rotor at a relatively high velocity in the same direction as the first rotor to form an incandescent ring on the second rotor from a portion of the material so discharged, and discharging the remainder of the material from the second rotor against the peripheral surface of a third rotor in a direction somewhat opposed to the direction of movement of the receiving peripheral surface while rotating said third rotor at a relatively high velocity in the same direction as the second rotor to form an incandescent ring on said third rotor from substantially the remainder of said molten material.

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