

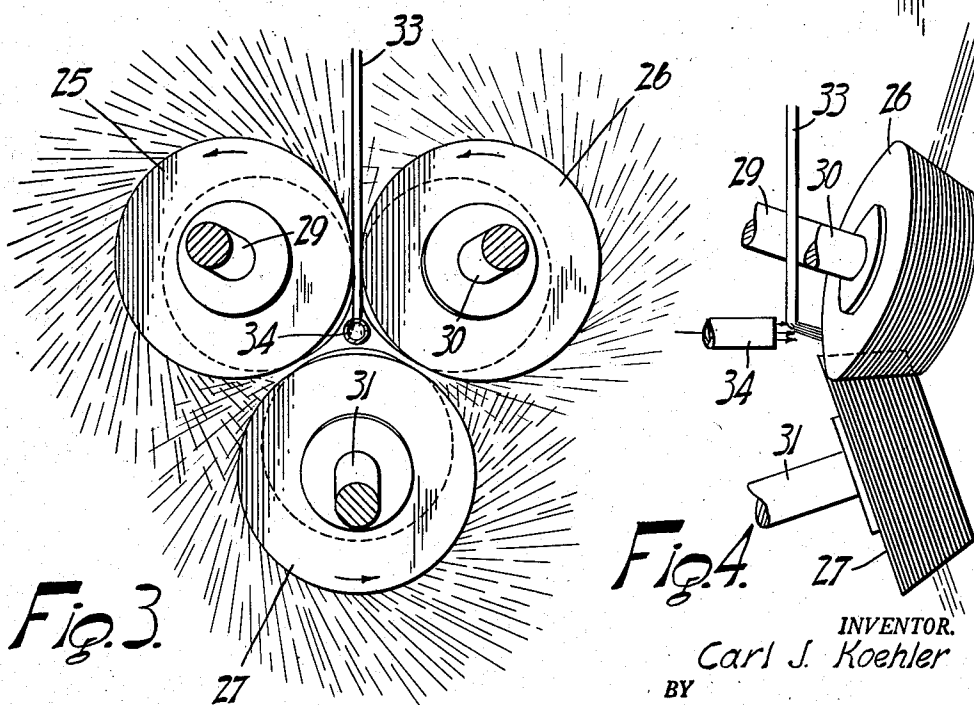
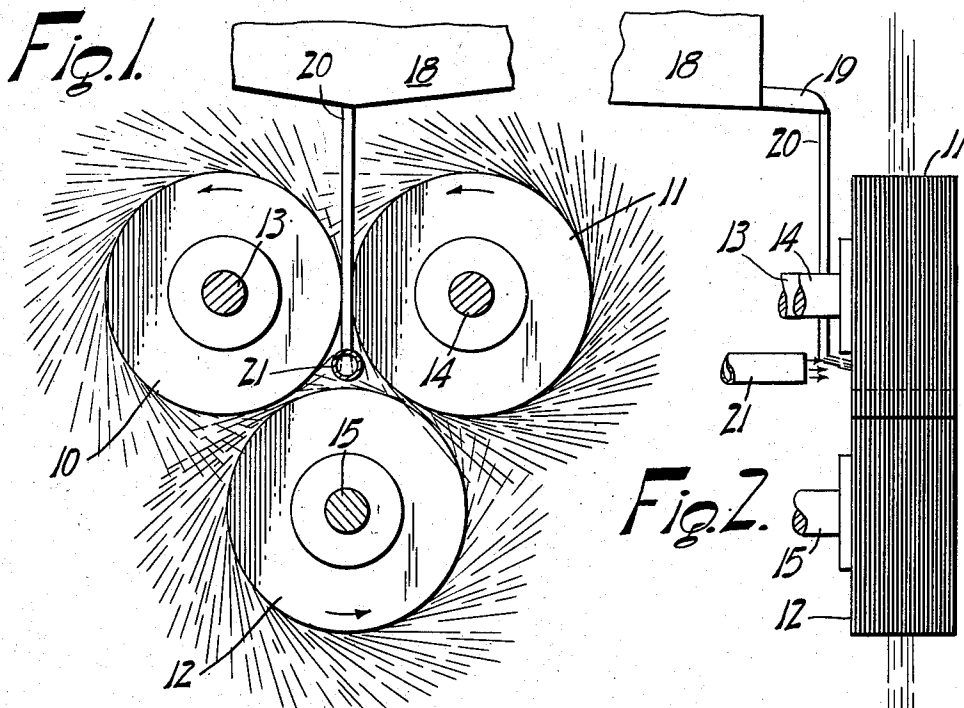
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METHOD AND APPARATUS FOR PRODUCING MINERAL WOOL

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METHOD AND APPARATUS FOR PRODUCING
MINERAL WOOL

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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 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.

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. 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.

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The foregoing general method of spinning wool by using a series of rotors and dropping the slag upon the surface of the initial rotor has had a necessarily attendant disadvantage since the initial rotor must have a vertically unobstructed upper surface portion to receive the falling stream of slag and the entire multi-rotor arrangement must necessarily be devised to allow for and accommodate this fundamental necessity.

The present invention relates to a method and apparatus of 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.

Further, the rotor arrangement is such that fiber production throughout the general area of the rotors is more uniform than heretofore and the problem of subsequently collecting the fibers, generally but not necessarily in the form of a continuous blanket, is ameliorated. Furthermore, the spinning method and apparatus of the present invention is such that the several rotors produce spun wool in substantially equal quantities so that maximum of efficiency is thus attained.

Basically, there are three distinctly different processes for the manufacture of mineral fibers in common use today. In one, the molten mineral material is passed through small orifices to form relatively coarse fibers, and these are immediately attenuated while the fibers are hot and plastic. In another, the molten mineral composition is disintegrated by a blast of steam or air and fibers are formed from the molten stream as the result of such disintegration and the rapid movement of particles of the molten material through the air. In still another process, the molten mineral composition is caused to flow onto the surface or surfaces of rapidly rotating bodies and fibers are formed as the result of the high speed propulsion of small globules of the molten material from such rotating bodies by centrifugal force.

The efficiency of any individual wheel or rotor as a spinning member depends largely upon the force with which a given amount of molten slag impinges against its surface. If the slag merely falls from the cupola onto the wheel sur-

face, as is general at the initial rotor in prior art spinning arrangements, the rate of fiber production is small and the excess slag that is thrown from the surface unfiberized is relatively great. If the slag is more forcefully applied to the wheel as by means of an air blast, or as a consequence of striking the wheel in such a manner as to have its direction suddenly reversed upon contact with the rotating surface of the wheel, or as a consequence of being thrown forcibly against the wheel surface from a previous wheel, the rate of fiber production at that particular wheel is increased.

It is quite obvious, therefore, that in the conventional multiple rotor spinning apparatus the first wheel yields little fiber, the second considerably more, the third even more and so on. In an actual test of one four wheel system of this general type the first wheel produced fiber at a rate of only 170 pounds per hour; the second, 570 pounds per hour; the third 1260 pounds per hour; and the fourth, 660 pounds per hour. In this case the first three wheels illustrate the action described. The production rate of the fourth wheel in this test was lower merely because of the fact that most of the slag had already been fiberized and with the molten slag supply thus depleted there was less molten slag thrown onto the surface of the last wheel.

The obvious disadvantage of the conventional apparatus is the inefficient and unequal use of the several wheel surfaces. A second disadvantage lies in that more of the fibers are made on one side of the apparatus which increases the problem of collecting them in a chamber to form a uniform blanket. Thirdly, the quality of the wool spun and the relative quantity of objectionable shot will vary under widely varying spinning conditions in different stages of a multiple roller apparatus.

Apparatus consisting of three wheels all turning in the same direction and so arranged as to cause some reversal in the direction of the moving slag at the points of impingement with the wheel surfaces, has been tested and found to be more efficient than the conventional system mentioned above. The disadvantage residing in the fact that most of the wool was thrown off on one side, however, was still observed.

My present invention is a multi-wheel or multi-rotor apparatus with all wheels turning in the same direction and so arranged that each wheel is substantially as efficient a wool spinning element as the other wheels of the system, and fibers are produced substantially symmetrically about the apparatus. In one form of the apparatus of the present invention, the molten slag is blown laterally into the more or less enclosed space between three or more peripherally adjacent wheels by means of a light current of air. In other arrangements such as when the axes of the wheels are substantially inclined to the horizontal the slag or other molten material may merely be dropped into this enclosed space of interstice by gravity.

Important advantages of this new apparatus include greater efficiency of the spinning surfaces and uniform or symmetrical production of fibers throughout the rotor system. This greater efficiency enables the efficient conversion of a given volume of slag to spun wool with fewer rotors and, accordingly, with a simpler and more economical apparatus and one which is easier to maintain. The uniform quantitative production of wool throughout the rotor system greatly

facilitates the gathering of a blanket of uniform thickness.

In the accompanying drawing and the following specification several forms of apparatus and methods of procedure according to the present invention are set forth by way of example. It is to be understood, however, that these methods and apparatus are 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 drawings:

Fig. 1 is a rear elevational view of one form of the fiber forming apparatus of the present invention, viewed from the end away from which the wool is blown after it is spun from the rotors;

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

Fig. 3 is a view similar to Fig. 1 but showing another form of the apparatus of the present invention; and

Fig. 4 is a side elevational view of the apparatus of Fig. 3.

In the several figures of the drawing like characters of reference denote like parts and, referring first to the embodiment set forth by way of example in Figs. 1 and 2, the numerals 10, 11, and 12 designate a series of cylindrical rotors mounted on shafts 13, 14, and 15, respectively. The manner in which the shafts 13, 14, and 15 are mounted and rotatably driven is conventional and need not be illustrated. The shafts may be connected for joint rotation by belts and pulleys or otherwise, suffice to say that in both of the illustrated embodiments the rotors all turn in a counterclockwise direction. This direction is immaterial, however, just so that all of the rotors of a system turn in the same direction. In the illustrated embodiments all of the rotors of a set are of equal size and shape and rotate at substantially the same speed.

In the embodiment of Fig. 1 the shafts 13, 14, and 15 are mounted for rotation on parallel, equally spaced axes so that these axes form an equilateral triangle. In the present instance rotors 10 and 11 are at substantially the same elevation and rotor 12 is disposed beneath them in such manner that all of the rotors are coplanar. The peripheries of the rotors 10, 11, and 12 are in relatively close adjacency, their closest approach to tangency being of the general order of one-fourth inch.

In Figs. 1 and 2 the numeral 18 designates schematically a melting furnace having a discharge spout, chute, or trough 19. Any suitable form of cupola may be employed. The stream of molten material, in this embodiment, is designated 20 and falls from trough 19 to a point where it is relatively close to the rotors and intersects a horizontal line through the center of the generally triangular space between the three rotors.

At substantially this point of intersection the slag stream 20 is deflected laterally into such triangular space, in the present instance by a current of air issuing from a conduit 21. The air, steam, or other gaseous current is of only moderate intensity and is adjusted to a point where it will deflect the slag stream into the space between the rotors without blowing it beyond that space.

The precise phenomena within the space are not fully understood and are a matter of guess or speculation. The turbulence within this space appears to be such that the slag addresses itself

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or attaches itself uniformly to the three rotors. In any event the incandescent rings which the melt forms on the three rotors are assumed to be uniform in size and character since the wool produced at and about the several rotors is substantially the same in quantity, an aim which has thus far not been achieved or approached in conventional spinning methods and arrangements.

Figs. 3 and 4 show another embodiment of the present invention which differs only in the fact that tapered or frustoconical rotors are employed and so arranged that the entrance side of the aforesaid triangular space between the rotors is larger than the opposite side and in effect the space or recess tapers from one side to the other of the rotors.

In Figs. 3 and 4 the numerals 25, 26, and 27 designate three frusto-conical rotors mounted on shafts 29, 30, and 31. In this embodiment the axes of the rotors converge in the direction in which the spun wool is removed to such a degree that, where each pair of rotors is closest to tangency, their peripheral surfaces are substantially parallel. Here again the space between such generally parallel portions, in each instance, is of the general order of one-fourth inch.

The manner in which the falling molten stream, designated 33 in Figs. 1 and 2, is deflected into the tapering space between the rotors by a gaseous current from a conduit 34, is the same as in the embodiment of Figs. 1 and 2.

The rotors in both the cylindrical and tapered forms are found to better retain the incandescent rings of molten material for ultimate spinning when they are provided with peripheral grooves. While subject to considerable variations, V-grooves one-sixteenth inch wide and one-sixteenth inch deep have operated in a satisfactory manner.

What is claimed is:

1. Apparatus for spinning fibers from molten material comprising a set of at least three rotors grouped uniformly about a common center with their peripheries facing each other and in relatively close adjacency, whereby said adjacent peripheries define a partially enclosed space, means for discharging molten material at a point laterally adjacent to said rotors and in line with said space, and fluid current means for applying a fluid force against the discharged material to deflect it laterally into said space.

2. Apparatus for spinning fibers from molten material comprising a set of at least three rotors grouped uniformly about a common center with their peripheries facing each other and in relatively close adjacency, whereby said adjacent peripheries define a partially enclosed space, and means for introducing a continuous stream of molten material into said space substantially centrally thereof.

3. Apparatus for spinning fibers from molten material comprising three rotors grouped uniformly and equidistantly about a common center with their peripheries facing each other and in relatively close adjacency, whereby said adjacent peripheries define a partially enclosed generally triangular space, means for discharging molten material at a point laterally adjacent to said rotors and in line with said space, and fluid current means for applying a fluid force against the discharged material to deflect it laterally into said space.

4. Apparatus for spinning fibers from molten material comprising three rotors grouped uni-

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formly and equidistantly about a common center with their peripheries facing each other and in relatively close adjacency, whereby said adjacent peripheries define a partially enclosed generally triangular space, and means for introducing a continuous stream of molten material into said space substantially centrally thereof.

5. Apparatus for spinning fibers from molten material comprising a set of at least three generally cylindrical rotors grouped uniformly about a common center with their peripheries facing each other and in relatively close adjacency, the axes of said rotors being substantially parallel and equidistant from said common center, means for discharging molten material at a point laterally adjacent to said rotors and in line with said common center, and fluid current means for applying a fluid force against the discharged material to deflect it laterally into the central space between said rotors.

6. Apparatus for spinning fibers from molten material comprising a set of at least three generally cylindrical rotors grouped uniformly about a common center with their peripheries facing each other and in relatively close adjacency, the axes of said rotors being substantially parallel and equidistant from said common center, and means for introducing a continuous stream of molten material into the central space between said rotors.

7. Apparatus for spinning fibers from molten material comprising a set of at least three rotors having frusto-conical peripheral portions, said rotors being grouped uniformly about a common center with their tapering peripheral portions facing each other and in relatively close adjacency, the axes of rotation of said rotors being uniformly inclined toward said common center extended whereby the adjacent peripheral portions of adjacent rotors are substantially parallel, means for discharging molten material at a point laterally adjacent to the central space between said rotors, and fluid current means for applying a fluid force against the discharged material to deflect it laterally into said central space.

8. Apparatus for spinning fibers from molten material comprising a set of at least three rotors having frusto-conical peripheral portions, said rotors being grouped uniformly about a common center with their tapering peripheral portions facing each other and in relatively close adjacency, the axes of rotation of said rotors being uniformly inclined toward said common center extended whereby the adjacent peripheral portions of adjacent rotors are substantially parallel, and means for introducing a continuous stream of molten material into the central space between said rotors substantially centrally thereof.

9. A method of fiberizing molten material by means of a set of at least three rotors grouped uniformly about a common center with their peripheries facing each other to define a partially enclosed space therebetween, said method comprising discharging molten material adjacent to said rotors and in line with said space, applying a fluid current against the molten material to deflect the same into said space, and continuously rotating the several rotors rapidly and all in the same direction.

10. A method of fiberizing molten material by means of a set of at least three rotors grouped uniformly about a common center with their peripheries facing each other to define a partially enclosed space, said method comprising discharging molten material substantially con-

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tinuously and substantially centrally within said space and simultaneously continuously rotating the several rotors rapidly and in the same direction.

11. A method of fiberizing molten material by means of a set of three rotors grouped uniformly about a common center with their peripheries facing each other to define a partially enclosed generally triangular space therebetween, said method comprising discharging molten material adjacent to said rotors and in line with said space, applying a fluid current against the molten material to deflect the same into said space, and continuously rotating the several rotors rapidly and all in the same direction.

12. A method of fiberizing molten material by means of a set of three rotors grouped uniformly about a common center with their peripheries facing each other to define a partially enclosed

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generally triangular space, said method comprising discharging molten material substantially continuously and substantially centrally within said space and simultaneously continuously rotating the several rotors rapidly and in the same direction.

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