PRODUCTION OF MINERAL FIBERS

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FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5
The present invention relates to a method of producing fibers from mineral materials, such as slag, stone or glass, and an apparatus for carrying out the method. More particularly, the invention relates to a method, in which molten material is introduced into a stream of gaseous medium under such conditions as to cause fiber formation to take place.

Mineral fibers are usually produced by introducing a melt of the mineral material into a rapid stream of a gaseous medium under such conditions as to cause fiber formation to take place. In this connection, either a jet of the molten material can be brought to flow towards the gas stream, or the melt can be contacted with the gas stream by mechanical means, such as a rotatable disc, as disclosed in the U.S. Patents Nos. 2,587,710 and 2,646,593.

Whatever purpose the fiber material is intended for, it is desirable that it should be as free from pearls and other non-fibrous particles (hereinafter referred to as scraps) as possible. This is particularly true of fiber material which is to be shaped into flat articles such as boards and slabs, for building purposes.

Such products are usually produced from suspensions of the fibers in an aqueous liquid such as water. To obtain such suspensions it has heretofore been normal practice to start from so-called loose wool from conventional mineral wool plants. The latter is mixed with aqueous liquid such as water, and the mixture is disintegrated to form the suspensions of fibers. As a result of its manner of manufacture the suspension contains all the scraps which were initially present in the loose wool. A drawback of the boards and slabs produced from such suspensions is that they cannot be worked with usual carpenter's tools but require special hard metal tools. Due to the content of scraps the flat articles also have reduced heat and sound insulating properties.

In the manufacture of mineral fibers using the known process the fibers are admixed with pearls of droplets which have solidified during the fiberizing process. Moreover, a portion of the molten material can pass without undergoing defibration due to too low a temperature or an unsuitable composition of the melt. All scraps formed in the defibration process will thus be retained in the mineral wool, and consequently also in the suspension of fibers made from this wool. The scraps are enclosed in the fiber balls of which the mineral wool consists. The difficulty of freeing the fiber suspension from these scraps is ascribed to the fact that the scrap particles are enclosed in these fiber balls.

It has now been found that it is possible to substantially decrease the formation of fiber balls and/or prevent the fiber from twisting together. For this purpose the fibers, on their formation, suspended in the stream of the gaseous medium used to effect the defibration, are contacted directly with an aqueous liquid such as water in such an amount that a suspension of fibers in the liquid is instantly formed or the fibers are wetted to such a degree that their tendency towards twisting together to a great extent decreases.

According to the present invention a method is contemplated for the manufacture of fibers from a mineral material which comprises introducing a stream of molten mineral material into a stream of gaseous medium and contacting the suspension of fibers so obtained in the stream of gaseous medium with an aqueous liquid whereby the fibers are prevented from twisting together and/or forming fiber balls.

To attain this result there are usually required water quantities of at least 15 percent by weight preferably at least 50 percent by weight of the fibers. By preventing the fibers from twisting together it is possible to obtain the scraps in such a form that they can be readily removed. It is preferable to add sufficient water to form a diluted suspension of fibers. The latter may have a concentration of less than 0.5 percent by weight. However, the concentration is usually from 0.5 to 2 percent by weight. The whole of the water may be supplied in one stage, or in such a manner that water is first supplied in a sufficient amount to prevent the fibers from twisting together, whereupon more water is added in one or more stages, separately, from the fiberizing process. Of course, wool twisted together can also be converted to a fiber suspension by grinding it and agitating the ground mass obtained with water, but to remove the scraps completely the fibers have to be ground so far that they do not give wet sheets of a satisfactory strength.

Further while the fiber suspension can be freed from scraps more readily and completely, the invention also makes possible the manufacture of a suspension capable of being pumped.

As mineral materials for the fiberizing process may be used stone, slag, glass, etc., either alone or in a mixture with each other. The materials have about the same structure which means that they are built up of a three-dimensional network which, in contrast to a crystal lattice, has no periodicity. The network consists of large negative ions, mainly oxide ions. The most important one is the silicate acid group, in which there is a silicon atom arranged centrally in a tetrahedron with oxygen atoms at the corners thereof. A similar network can be built up with boron and phosphorus as central atoms. The network is limited or interrupted by ions of different kinds, deriving from basic oxides, rendering the material more readily fusible. This is particularly true of the monovalent alkali metals, but also of such divalent ions as those of calcium barium and magnesium which produce a certain network limiting effect, while they are also capable of rendering the material more water-insoluble.

The trivalent ions of aluminum, zinc, lead, iron, chromium and cobalt are capable of both forming a network and changing it. According to the composition of the material, the melt thereof will obtain varying properties. As it is difficult to characterize a material composed of so many components as in the present case, it is practice to relate them to different groups and only such components which are present as major ingredients are to be considered.

In respect of the raw material for the fiberizing process, this means that in order to characterize this material the sum of moles of the basic oxides Na₂O, K₂O, CaO and MgO has to be put in relation to the sum of moles
of acid oxides SiO₂, P₂O₅ and, possibly, Fe₂O₃. It is a known fact that the more basic is a material the more low-viscous will be the melt for a given temperature, while, of course, a correspondingly more viscous melt will be obtained, if the acid ingredients dominate in relation to the basic. It is also a known fact that for higher temperatures, a melt will be less viscous. In melting the material in a cupola furnace, an increased temperature will be obtained, for example by preheating the air blast to about 500° C, or by increasing the content of coke and/or changing the quality of the coke. The factors determining the fiberizing work as the quantity (quantity per time unit) of the fiberizing stream of gaseous medium and the speed (length per time unit) thereof.

According to one embodiment of the present invention the fiber formation is controlled to obtain a fiber material, the major part of which has a fiber length of less than 15 cm., preferably less than 5 cm., more preferably less than 2 cm.

The aqueous liquid used to suspend the fibers may have additives dissolved and/or emulsified and/or suspended therein. Examples of such additives are fillers such as asbestos fibers, binders such as starch in ungelatinized or gelatinized form, resin acids, resin pitch, collophonym resin, tall oil, product from linseed oil, soya oil, blood albumins, phenolic urea or melamin resins, hydrophobing agents such as zink or copper stearate, pH-controlling agents such as acedy reacting substances, for example alum, sulfite acid, phosphoric acid or the ammonium salts thereof, which also are capable of rendering the final product more hydrophobic.

The content of starch may be in the range of from 0.5 to 10 percent, based on the weight of fibers. Contents in the range of from 2 to 8 percent are preferred. The content of filler may amount to about 15 percent, although contents between 3 and 8 percent are usually preferred. The hydrophobing agent is usually added in an amount of less than 1 percent. It is possible to mix backwater from a wet machine or a press of a wallboard-plant with the aqueous liquid used to prevent the formation of fiber balls.

According to another feature of the present invention an apparatus for carrying out the aforesaid method comprises a water-cooled rotor to throw out the molten mineral material in the form of small streams, which are fiberized by a gaseous medium, the rotor being provided with means to divide an aqueous liquid such as water in the form of a shield or curtain in the way of the gas suspended fibers. For the throwing-out of the liquid there may be used a centrally arranged tubular portion communicating with the cooling system of the disc. From the edge of the disc at least a portion of the cooling water is thrown out under the influence of the centrifugal force in the intended manner.

The invention will now be further described by way of example with reference to the accompanying drawing in which:

FIG. 1 is a side elevational view, partly in section, of a first embodiment of the invention,
FIG. 2 is an end view of the embodiment of FIG. 1,
FIG. 3 is a section through a second embodiment of the invention,
FIG. 4 is an axial section through a third embodiment of the invention,
FIG. 5 is an end view of the embodiment shown in FIG. 4.

As evident from FIG. 1 the apparatus for carrying out the process according to the invention primarily comprises a hollow rotor 1, which is arranged on a hollow shaft 2. This shaft supported by two bearings 3 and 4 is driven by an electric motor (not shown) which is coupled to the shaft by a belt and pulley (not shown). The hollow shaft 2 communicates with a space 5 defined by the rotor for the purpose of permitting the passage of a suitable coolant, viz. an aqueous liquid such as water to the rotor 1.

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The wall 6 of the rotor remote from joint of the hollow shaft is apertured and provided with a pipe socket 7. In the rotor 1 the mouth of the hollow shaft 2 is covered with a guiding sheet 8 arranged at a variable distance from it to direct the aqueous stream discharged from the hollow shaft 2 to kids the cylindrical surface of the rotor. Between the rotor 1 and the bearing 4 there is arranged an annular nozzle 9, to which is connected a duct 10 to supply a gaseous medium through a number of openings 11 regularly spaced therearound. This apparatus also includes an inclined chute 12 for supplying molten mineral material 13 to the internal side of a rim portion 14 of the rotor, where the molten material forms a rapidly rotating ring 15 and is thrown out from the edge 16 of the rotor tangentially and at right angles to the stream of gaseous medium from the nozzle 9 whereby to form a suspension of fibers in the gaseous medium. This suspension is then directly introduced into a curtain of water formed under the influence of centrifugal force when the water discharged from the pipe socket 7 reaches the edge 17 of the rotor. The aqueous suspension of fiber formed is then collected in a manner not described.

In the embodiment shown in FIG. 3 the pipe socket 7 is replaced by a sleeve 18 closed at one end and screwed into a smaller pipe socket 19 attached to the side of the rotor. The sleeve 18 has its end remote from the fixing point provided with a number of openings to disperse the water, which has passed through and cooled the rotor.

In the embodiment shown in FIGS. 4, 5 and 6 the rotor is provided with a tubular projection 20 from the side 6 extending in the axial direction therefrom. To this projection are connected 6 nozzles 21 arranged at right angles to the axial direction forming angles of 60° with each other, through which the cooling water is thrown out in the same number of jets which are then dispersed and combined into a curtain of water.

While certain embodiments of the invention have been disclosed, it is to be understood that the inventive idea may be carried out in a number of ways. The application is therefore not to be limited to the precise details described, but is intended to cover all variations and modifications thereof falling within the spirit of the invention or the scope of the appended claim.

What I claim is:

A method for manufacturing mineral fiber products which comprises:

(a) forming a molten slag of mineral fiber forming material,
(b) centrifugally ejecting said molten slag outwardly in an annular pattern and in a substantially vertical plane,
(c) intercepting said centrifugally discharged molten slag with a plurality of jet streams of gaseous material arrayed in a circle,
(d) said plurality of jets of gaseous material impinging upon said molten material at substantially right angles so as to abruptly alter the direction of travel of the ejected molten material from a substantially vertical to an approximately horizontal path thus drawing the molten material into a multitude of mineral wool fibers and forming an approximately conical pattern of fibers suspended in said gas stream,
(e) introducing an aqueous liquid consisting of at least 50% water into the interior of said conical pattern,
(f) flaming said aqueous liquid radically outwardly under the influence of centrifugal force so as to form an outwardly moving radial curtain of aqueous liquid that will intercept said horizontally moving conical pattern and thereby immediately wet the mineral fibers suspended in said gas stream so as to prevent the fibers from twisting together and forming fiber balls,
(g) the amount of said aqueous liquid being sufficient to form a liquid suspension of mineral fibers which
has a fiber concentration of less than 2.0 percent by weight.

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