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TREATED FIBROUS MATERIAL

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This invention relates to treated fibrous material and, particularly, to an article of manufacture comprising incombustible fibers and a binder of special type adhering them together into a water-repellent, fire-resistant, self-sustaining felt.

There have been made heretofore many attempts to provide a felt of rock wool or the like of satisfactorily low density and high thermal insulating efficiency, adequate resistance of the felt to being torn apart during handling or to collapsing while in use, and water-repellent properties. There have been proposed, for example, felts including rock wool and various binders, such as water-permeable or water-soluble casein, glue, or sodium silicate or viscous liquids such as asphalt or pitch. Products thus made have been unsatisfactory for various uses. Thus, for example, the proportion of binder required to give an adequate degree of waterproofing or sufficient strength and durability to the felt has been so high as to affect unfavorably the density and/or combustibility of the resulting product.

I have now discovered a product that combines to a satisfactory degree lightness, toughness, resistance to being wetted by water, and fireproofness.

Briefly stated, a preferred embodiment of the invention comprises the method of and the product resulting from the intimate association with rock wool fibers or the like of a solid binder composition of outstanding effectiveness, used in limited proportion, preferably coalesced over the fibers, and adhering the fibers together into a coherent, self-sustaining felt. The composition that is used as a binder includes a toughening agent, preferably a water-insoluble, adhesive, solid, resinous material, natural or synthetic, such as rosin, dammar resin, or the like and also a plasticizing and waterproofing agent, as, for example, a petroleum product that is substantially non-volatile at ordinary temperatures and is adapted to blend with the resinous material, to decrease the brittleness thereof and to increase the waterproofing action and the adherence of the binder to the fibers, particularly when the latter are flexed slightly. Such an agent is montan wax, beeswax, paraffin wax, or other petroleum hydrocarbon that is non-brittle and substantially non-volatile.

While various fibers may be used, the fibers that are preferred are incombustible and of the type known as mineral wool, including slag wool, rock wool and glass wool.

In the preferred method of practicing my in-

vention, there is first made a suspension, in a gaseous atmosphere, of the incombustible fibers. A binder composition of type stated is intimately associated with the fibers and the solid material of the binder composition is caused to melt, whereupon it coalesces over the fibers. The fibers are then allowed to settle, as by gravity, into a pad or felt and the molten binder composition therein is allowed to solidify. The resulting product may then be shaped, as by moderate compression, with preservation of the binding of the fibers to each other.

The invention is illustrated in more detail by the following example, in which the fibers used are rock wool and the binder composition is one comprising rosin and petroleum products.

Rock wool is made by melting suitable, naturally occurring material, say an argillaceous limestone, allowing the molten material in the form of a small stream to strike a jet of steam adapted to shred the molten material and form fibers therefrom. A binder composition is blown against the resulting fibers, while the fibers are still suspended in a gaseous atmosphere and at a position so near to the point of formation of the fibers that the temperature thereof is well above the melting point of the solid ingredient or ingredients present in the binder composition.

The ingredients that are to constitute the solid binder in the finished product are dissolved in a suitable, volatile solvent. A satisfactory binder for spraying against the newly blown and suspended rock wool fibers is made by dissolving 325 pounds of commercial rosin of a hard grade and 50 pounds of crude paraffin wax in a volatile solvent therefor, as, for example, gasoline, the gasoline being preferably one that is substantially free from materials boiling below 120° F. Five gallons of petroleum lubricating oil may also be added to supplement the action of the paraffin wax. This solution is made conveniently by warming the mixed ingredients to a temperature sufficiently high to cause complete solution, as, for instance, to a temperature above 115° F. During the atomization of the solution upon the blown fibers, the solution is maintained at a temperature sufficiently high to keep all the ingredients dissolved.

The apparatus used and the general method of operation, save for the exceptions noted herein, may be that described in U. S. Patent 1,899,056, issued to me on February 28, 1933. The solution of the binder composition may be supplied through a pipe adjacent to the position of blowing of the molten rock, as indicated, for example,

in the said patent, through the pipe 212, and then atomized upon the fibers. The atomization may occur at a position removed a foot or two from the position of blowing of the fibers.

5 Volatile material in the binder composition, as sprayed upon the rock wool, is quickly evaporated by the heat of the recently blown fibers.

After the fibers have been thus treated, they are allowed to settle through the gaseous atmosphere in which they are initially suspended, to form a felted sheet or layer. The felt is then allowed to cool, as by being moved from the settling chamber on an endless conveyor belt, until the binder composition has solidified or frozen.

15 After the binder composition has solidified, the resulting felt may be cut to width and length desired. Also, it may be shaped somewhat, as by the application of moderate compression adapted to avoid fracturing the binder and to preserve the adherence of the fibers by means of the binder to each other.

In proceeding as described and using a binder composition comprising rosin and paraffin wax, for example, it is possible to obtain adequate toughening or strengthening of the felt and adequate waterproofness and fireproofness with the use of a proportion of binder that is very low. Thus, the finished felt may contain from 0.8 to 8 per cent by weight of the binder composition, suitably 1 to 5 per cent. The proportion of the binder used and the ratio of the amounts of toughening and waterproofing agents to each other are somewhat variable and are to be determined exactly in view of the properties desired in the finished product. Increasing the proportion of paraffin increases the density and water resistance of the felt and decreases the tendency to dusting. The lubricating oil increases the density and decreases the tendency to dusting. 40 Particularly satisfactory results have been obtained when paraffin was used in proportion of 15 to 100 per cent of the weight of the rosin. An increased rosin proportion, within limits, strengthens and toughens the felt, minimizes the tendency to collapse, and decreases the density of a felt formed as described and allowed to cool before being pressed.

A felt made as described possesses a number of interesting features in addition to those that have been mentioned. The product is resistant to water to a large degree, that is, it is water-repellent or waterproof to such an extent that when thrown, in the form of small tufts, upon water, the tufts will float for a considerable period of time. The product does not burn, the incombustibility of the original fibers being preserved by the use of a binder that, although combustible, is so effective that only a limited proportion thereof, less than the amount that would impart combustibility, is required. Furthermore, the low proportion of binder and its effectiveness in spacing the fibers and preserving voids there-between contribute to the low density of the felt; in typical preparations, the felt averages 7 to 9 pounds to the cubic foot and has a thermal conductance of 0.23 to 0.25 British thermal units per square foot, per hour, per degree F., per inch of thickness. The felt is self-sustaining and coherent to the extent that a 4 to 6-foot length of the felt may be supported at one end without the felt tearing quickly under the influence of its own weight. The felt is an effective absorbent of incident sound. The 75 fibers are preserved by the binder against the

deteriorating effects of atmospheric humidity. The color of the felt is substantially unaffected by the binder. Finally, the felt is particularly well adapted to being wrapped around a piece of cardboard or the like, of width approximately equal to the felt, to form a reenforced bat, say, of dimensions 18 x 15 x 3 inches and suitable for use in insulating the wall of a building. Also, the treated fibers may be formed into modules or granules, by conventional means and methods, to give units that do not crush under their own weight to the same extent as corresponding units of untreated fibers.

While it is not necessary to the invention to explain the cause of the unusual effectiveness of the small proportions of the binder, the following possible explanation is offered. The binder being very intimately associated with the fibers and then frozen, skeletonizes the structure. On the other hand, binder compositions of the type described are somewhat resilient and adapted not to fracture under slight stress. Finally, rock wool fibers consist largely of the silicate of an alkaline earth metal and contain appreciable alkalinity. On the other hand, the acids in acidic resinous materials, such as rosin or dammar, form resinates by chemical reaction with an available alkaline compound, of an alkaline earth metal, for example. As a result of the physical and/or chemical properties of the materials, there is obtained intimate association of the acidic ingredients of the binder with the fibers, the alkalinity thereof, or with an intermediate film of material resulting from chemical reaction between ingredients of the fibers and binder.

The details that have been given are for the purpose of illustration, not restriction, and variations may be made therefrom within the scope of the appended claims.

What I claim is:

1. An article of manufacture comprising felted mineral wool fibers and a water-insoluble organic binder adhering the fibers into a lightweight unit, the binder including an adhesive solid disposed over the fibers, constituting 0.8 to 8 per cent of the weight of the unit, and serving to maintain resiliently the spacing of the fibers in the unit and to make the unit self-sustaining and coherent, while preserving the incombustibility thereof.

2. An article of manufacture comprising felted inorganic fibers containing appreciable alkalinity and binder adhering the fibers into a self-sustaining, lightweight, water-repellent felt, the binder including a substantial proportion of the reaction product of a water-insoluble, acidic, solid substance with an alkaline constituent of the said fibers.

3. An article of manufacture comprising felted mineral wool fibers and binder coalesced over the fibers and adhering the fibers into a self-sustaining, lightweight, water-repellent, incombustible felt, the binder including a substantial proportion of rosin and a plasticizing and waterproofing agent.

4. An article of manufacture comprising felted inorganic fibers containing appreciable alkalinity and an acidic resinous binder adhering the fibers into a self-sustaining, lightweight, water-repellent, incombustible felt, the binder including a substantial proportion of a water-insoluble, reaction product of the acidic resinous substance with the alkalinity of the said fibers and including also a non-brittle, substantially non-volatile,

petroleum product, as a plasticising and waterproofing agent.

5 An article of manufacture comprising felted mineral wool fibers and an organic binder coalesced over the fibers and adhering the fibers into a self-sustaining, lightweight, water-repellent, incombustible felt, the binder including a substantial proportion of a water-insoluble, acidic, solid, adhesive substance, the proportion
10 of the binder material being approximately one to five per cent of the weight of the finished unit.

6. An article of manufacture comprising felted fibers of mineral wool and a binder, including a solid toughening agent and a waterproofing

agent, adhering the fibers together while preserving the voids therebetween, the said waterproofing agent being a plasticizer for the solid toughening agent.

7. An article of manufacture comprising felted fibers of mineral wool and a binder, including a toughening agent and a waterproofing agent, adhering the fibers together while preserving the voids therebetween, the binder including a chemical reaction product of an ingredient of the
5 toughening agent as used and an alkaline component of the mineral wool.
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