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HIGH TEMPERATURE INSULATION
AND METHOD OF MANUFACTURE
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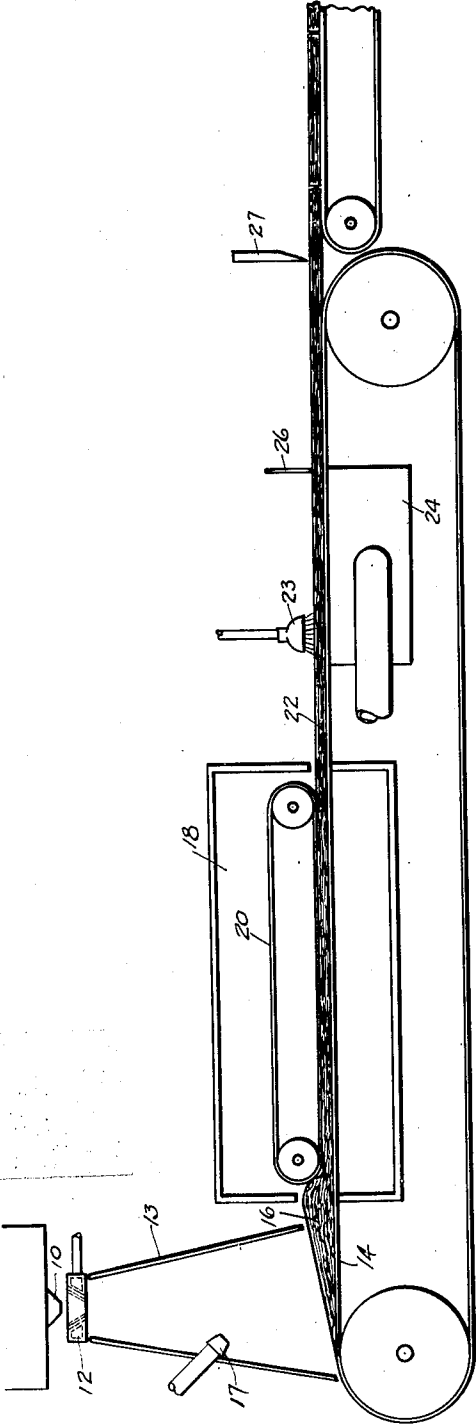


FIG. 1

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HIGH-TEMPERATURE INSULATION AND
METHOD OF MANUFACTUREHarry C. Courtright, Newark, Ohio, assignor to
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This invention relates to insulating materials capable of withstanding high temperature, and, to an improved method of producing insulating materials of this type.

One of the principal objects of this invention is to provide an unusually strong, light-weight, inexpensive, self-sustaining insulating block having fixed dimensions and high insulating properties in the presence of high temperatures.

High temperature insulation has previously been made of such materials as asbestos, magnesite and asbestos, diatomaceous earth, rock wool, and the like bonded into blocks or boards with suitable binders. Most of these materials must be of relatively high density, say from about 15 to 25 pounds per cubic foot, to provide the required insulating characteristics and they are also of such a nature that insulation in the form of boards and blocks made therefrom have relatively little strength. The strength is oftentimes so low that even ordinary handling causes breakage of the insulation especially at the edges or corners. This results in great waste because the broken boards or blocks must usually be discarded.

Much higher strengths are obtained by making such insulating boards and blocks from long fine mineral fibers such as fibrous glass. Fibrous glass as presently manufactured is in the form of a loose fluffy mass having original densities of approximately one to two pounds per cubic foot. The individual fibers are of great length and high strength so that products made from these fibers have increased strength. Previously, however, the process of manufacture of the insulation from fibrous material was beset with serious difficulties. In the manufacture of the insulation it was required to impregnate the loose fluffy fibrous material with a high temperature binder such, for example, as bentonite and the impregnated material must then be compressed or compacted to increase the density to from six to twelve pounds per cubic foot. While being held to this compacted form, it must be heated to elevated temperatures for long periods of time to dry or set the binder. Since large amounts of water are required as a vehicle for most binding materials, the drying time may be in the order of days.

This process for making high temperature insulation is open to the objection that means such as manually applied compacting frames or the like must be used to hold the impregnated fibrous material compressed to the required relatively high density during the prolonged heat

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treating period. This necessitates a very large amount of equipment to produce even a small amount of insulation, and the process involves a great deal of hand labor which makes the product prohibitively costly.

It is the object of the present invention to provide a simple process for the manufacture of high temperature insulation at low cost.

It is another object to manufacture high temperature insulation of high density from fibrous glass and similar fibrous mineral material that is originally of very low density without the need for large amounts of equipment.

The present invention overcomes the difficulties previously experienced by binding the fibers into a compact insulating board having the required dimensions and density by means of a binder that has high strength to hold the fibers compacted and that may be set in a very short period so that compacting pressures need be maintained on the fibrous mass for only a short time. This binder is also one that is unaffected by the temperature required to dry the usual high temperature binders such as bentonite but that may be removed readily from the fibrous material after its purpose has been served.

This board is then converted into a high temperature insulation by impregnating the bonded board with a high temperature binder such, for example, as bentonite in the form of a slurry, and thereafter heat treating the board to dry the latter binder. After this the original binder is removed without affecting the high temperature binder. Thus heat treatment of the binder may be accomplished without the difficulty previously referred to, namely, providing equipment for holding the fibrous mass compacted to the proper density during the heat treating period.

Other advantages of the invention will be apparent as this description proceeds, especially when considered in connection with the accompanying drawing, illustrating diagrammatically one type of apparatus capable of being used to carry out the method of manufacture forming the subject matter of this invention.

Although the present invention is applicable in practically all cases where the insulating blocks or boards are formed of mineral wool, such as slag wool, rock wool or the like, it is particularly valuable in the production of insulating bats formed of fibrous glass.

The fibrous glass or other mineral wool may be produced by any suitable process, one such process being illustrated diagrammatically in the drawing. Here molten material, such as molten

glass, is flowed from a feeder 10 in a plurality of small streams which are engaged by the blast from a blower 12 to be attenuated into fibers. The fibers are conveyed by the blast through a chamber 13 and onto a conveyor 14 where they build up into a mat 16. As the fibers are collected a suitable binding material is sprayed onto the fibers by means of a spray gun 17.

This binder is preferably one that can be applied in a liquid or sub-divided form and that can be converted by treatment for a relatively short time into a rigid material capable of securing the fibers together in a compacted relation. For this purpose I have found that an incompletely reacted thermosetting resin, preferably an aldehyde condensation product such as phenol or urea formaldehyde, or furfuryl aldehyde, are particularly suitable. The binder may also be a carbohydrate such as sugar syrup, corn syrup, or the like, which may be converted by heating into a rigid carbonaceous binding material. These materials, in addition to being convertible to rigid binders by means of heating for a short time, are also capable of being removed from the fibrous material by heating for a short period to a temperature somewhat above the curing or setting temperature. For example, most of the thermosetting resins may be thermally set at temperatures ranging from about 200 to 350° F. and may be burned out of the fibrous material at temperatures of about 450 to 600° F. The carbohydrates such as sugar and corn syrup are likewise first converted to a rigid binding material and subsequently removed by heating respectively to temperatures from about 250 to 300° F. and from about 500 to 600° F.

The heating of the binding material distributed throughout the fibrous mat 16 may be accomplished in any suitable manner, for instance, by passing the mat through an oven 18. An endless chain 20 is located within the oven and is arranged to compress the mat on the conveyor 14 to the desired density and to hold the mat compacted until the binding material has been set or cured. With the binders mentioned the mat need remain in the oven for only five to twenty minutes depending upon the thickness of the mat and the temperature of the oven. When the heat-treated mat leaves the oven 18 the binder is completely set or cured and the mat is in the form of a semi-rigid or rigid board 22 of permanent dimensions of from 6 to 12 pounds per cubic foot density.

In accordance with this invention the board bonded to desired density in this or other suitable manner is converted into a high temperature insulating material by distributing a high temperature-resisting binder such as an inorganic material throughout the bonded board while the latter is held in a highly compacted condition by the previously applied and set organic binder. This operation is illustrated in the drawing as being performed by means of a spray head 23 located above and extending across the continuously advancing board 22. A plurality of outlet openings in the spray head direct a solution or suspension of selected binding material onto the board.

Preferably the solution or suspension is applied at such a rate that a puddle forms on the top surface of the board to be drawn into the board by a vacuum chamber 24 beneath the board. Any excess binder solution drawn completely through the board is collected in the chamber from which it may be returned by a

suitable pump and piping (not shown) to the spray head 23. A doctor bar 26 is arranged transversely of the board in contact with the top surface of the board and adjacent the forward end of the vacuum chamber to prevent the puddle of binder solution from spreading beyond the region above the vacuum chamber.

After the inorganic material is thoroughly distributed throughout the mat, the mat is cut into desired lengths to form insulating boards, as by a cutter 27. The boards are then dried in any suitable manner to remove water therefrom. A unique feature of the present invention is that the inorganic binder may even be air-dried since the only requirement is for storage space, no means being necessary to hold the fibrous material in compacted relation. Usually, however, speed and efficiency are better served if the binder-impregnated boards are heated to slightly elevated temperature, as about 250 to 300° F., for several hours.

After being dried the insulating boards are placed in an oven or heated in other convenient manner to a temperature exceeding the ignition temperature of the original organic binding agent to burn this binder out of the insulation and convert the board to a high temperature insulation. The drying of the second binder and ignition of the original binder may be performed in a single heat treating cycle by heating the board for the required period at moderate temperatures to dry the board and then increasing the temperature for a short period to burn out the original binder. Since the bentonite is converted into a binder at a temperature below that at which the organic binder is burned out, the fibrous material is held in its compacted state throughout the entire process. Temperatures in the range of 400 to 600° F. are usually sufficient to burn out the original binder but this temperature will be higher or lower depending upon the particular organic binder employed.

In installations where the temporary presence of products of combustion of the original binder are not objectionable, it is entirely possible to use the heat generated or produced by the equipment on which the insulation is installed to burn out the original binder. In either case a high temperature insulation board is produced wherein the fibers are effectively bonded together to form a self-supporting bat by an inorganic, high temperature bonding agent that replaced the original bonding agent without disturbing or permitting disarrangement of the fibers in the mat, and form and dimensions of the bat or board of insulation are not altered during the process of converting the board from what is in effect a low temperature insulation to a high temperature insulation.

This feature of the invention permits the manufacture of low temperature insulation with the ability to readily convert the production equipment to the manufacture of high temperature insulation merely by adding the steps of applying a second binder, drying the second binder and, if desired, then removing the first binder. Thus one machine or line of equipment may be used to manufacture two different products by making slight changes in the equipment, which increases greatly the flexibility of the apparatus.

Although particular materials have been mentioned as the original and the second binder, others may be chosen within the limits that the original binder should be hardened by treatment for a short time and should be removable by a second short time treatment, and the second

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binder should be hardened by a heat-treatment at temperatures intermediate the hardening and ignition temperatures of the original binder. The second binder is preferably a colloidal clay such as bentonite and the original binder is preferably an aldehyde condensation product.

It may be desirable in some instances to water-proof the bentonite to some degree, and this may be accomplished readily by mixing a small quantity of alkali soap in the bentonite slurry and by increasing the temperature of the last part of the heat treating cycle of the process to approximately 800 to 1000° F. for a short period of time. At temperatures in this range the alkali from the soap apparently combines with the bentonite to make it water repellant and the other constituents of the soap burn out.

I claim:

1. As a product of manufacture, a porous mass of resilient mineral wool bonded into an integral form-retaining body with a substantially completely reacted aldehyde condensation product distributed throughout the mass and surrounding the fibers at their junctures to adhere the fibers together throughout the body, and bentonite deposited from an aqueous slurry and dried and superposed on and coating the aldehyde condensation product as a discrete layer and surrounding the fibers at their junctures to bond the fibers together, said aldehyde condensation product and said bentonite each being present in sufficient amount to act independently of the other to hold the fibers together in fixed relation in a form-retaining body but both being in insufficient amount to fill all the pores of said body.

2. The method of making high temperature

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insulating board in which a fluffy resilient mass of loose glass fibers is compacted under pressure to higher than its original density and bonded in compacted relation, which comprises applying to the fibers of the mass about their junctures a thermosetting phenol formaldehyde resin to bind the fibers together, compressing the fibrous mass to compacted relation while heating the said resin on the fibers for a time sufficient to cure the resin and thereby bond the fibrous mass in said compacted relation, after the completion of said heating operation impregnating the fibrous material with an aqueous suspension of bentonite and distributing the bentonite as a discrete layer over the said resin on the fibers and around the junctures of the fibers in said mass to bind the fibers together, the bentonite being present in sufficient amount to hold the fibers together independently of the said resin, and subjecting the bentonite on the fibers to temperatures at which said resin burns out to dry the bentonite and thereby convert it to a binder for the fibers.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,076,078	French	Apr. 6, 1937
2,184,316	Plummer	Dec. 26, 1939
2,225,009	Hyde	Dec. 17, 1940
2,249,275	Hanley	July 15, 1941
2,306,347	Slayter	Dec. 22, 1942