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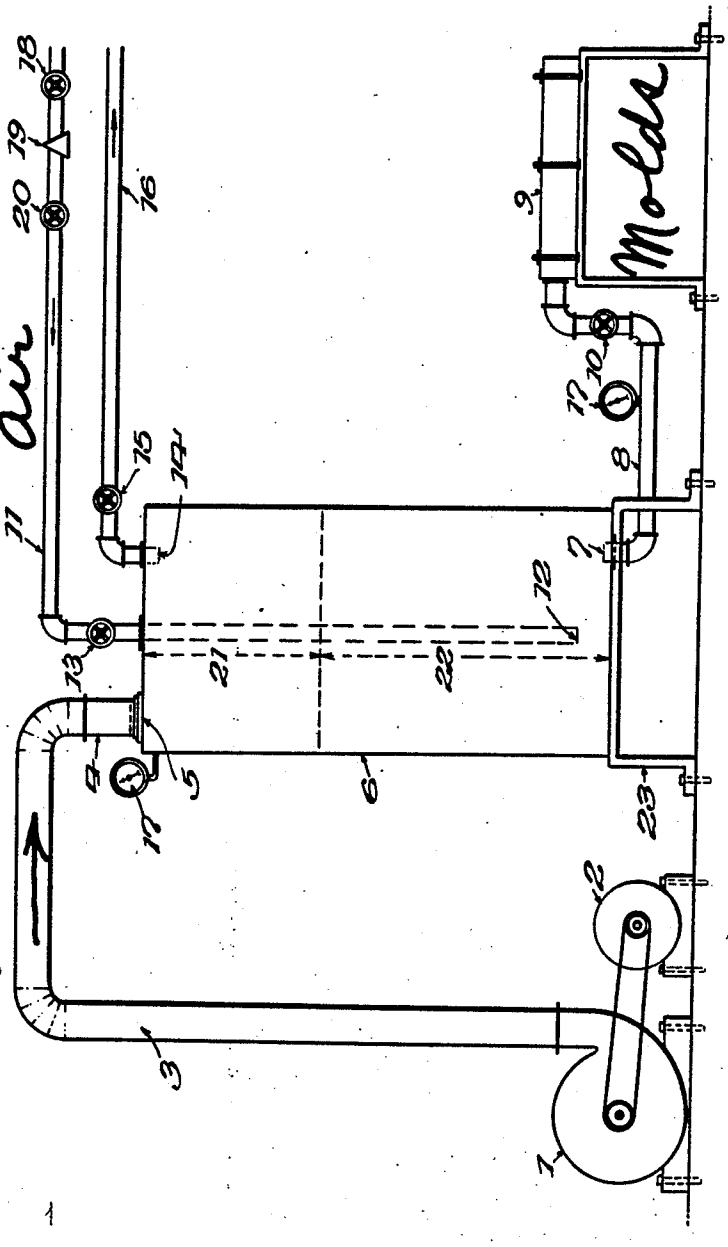
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Sept. 13, 1938. J. C. KERSHAW 2,130,091

MANUFACTURE OF INSULATION MATERIAL

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exfoliated vermiculite
asbestos
magnesium oxysulfate bond

2,130,091

UNITED STATES PATENT OFFICE

2,130,091

MANUFACTURE OF INSULATION MATERIAL

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11 Claims. (Cl. 25—155)

The invention relates to a new and improved heat insulating material and method of producing same that readily withstands high temperatures without disintegration. The invention comprises the addition of materials to a mix in definite proportions and under given operating conditions whereby a product of the desired quality can be produced in an efficient and economical operation.

It is an object of the invention to provide a method for producing a heat insulating material having low density and low thermal conductivity at high temperature ranges.

Another object of the invention is the provision of a method for producing a thermal insulating material which can be molded into blocks and shapes with a density varying from 16 to 20 pounds per cubic foot.

Another object of the invention is the production of an insulating material which can be molded into blocks and shapes of low density and high insulating efficiency as compared with similar articles manufactured and sold at the present time.

A further object of the invention is the provision of a continuous step by step method of producing heat insulating material which can be molded into blocks and shapes of low density and having low thermal conductivity at high temperature ranges.

Further objects are to provide a method of maximum simplicity, efficiency, economy, ease of operation and assembly and such further objects, advantages and capabilities as will later more fully appear, and are inherently possessed thereby.

The invention further resides in the combination of steps, construction and arrangement illustrated in the accompanying drawing, and where I have shown a preferred embodiment it is to be understood that the same is susceptible of modification and change, and comprehends other details, arrangement of parts, methods, features and constructions without departing from the spirit of my invention.

Figure 1 is a diagrammatical illustration showing apparatus constructed in accordance with the invention. With reference to the disclosures in the drawing the invention briefly comprises a conventional digester into which materials to be treated are introduced in the presence of a fixed volume of air and a fixed volume of water and thoroughly agitated for a fixed period of time, when the discharge outlet is opened and the digested material and liquid are removed through a conduit by pressure sufficient to force both material and liquid into a mold, where it is formed into blocks and shapes and further treated to cure and dry the finished product. Figure 1 is a blow fan of conventional design the blades of which can be used to disperse certain of the materials to be digested and with an opening through which materials can be fed into the revolving blades. It is driven by a motor 2 likewise of conventional design conveniently situated in a position to afford free access to the fan. 3 is a conduit running from blow fan 1 and connected by means of the duct 4 with inlet 5 and digester 6. The duct 4 is formed of materials such as canvas or rubber which can be securely connected with both conduit 3 and inlet 5 to form a continuation of conduit 3 and removed at will to form ready access with the interior of digester 6. Inlet 5 is of a size that will permit ready access of materials into digester 6 by pouring or shovelling and so constructed that it can be readily sealed with an air-tight covering such as a conventional type boiler manhole cover to prevent the passage of air into or from digester 6. 7 is a discharge outlet by means of which material from the digester 6 is passed through conduit 8 into the molds 9, while 10 is an outlet valve which can be opened or closed at will and controls the flow of materials through conduit 8 into the molds 9 of any desired size and shape. Air from a compression tank (not shown) is fed by means of the line 11 into digester 6 through inlet 12. The inlet 12 is located in spaced relationship to the bottom of the digester 6 so that air entering under pressure will act on materials at the lowest point and keep the entire contents in a state of suspension, while maintaining static pressure in the static pressure area 21 when desired. 13 is an intake valve which can be opened and closed at will and serves to admit the air supply flowing through the line 11 and out the inlet 12. 14 is an outlet designed to permit the escape of pressure through the control valve 15 and conduit 16 into the open air. Pressure gauges 17 attached to conduit 8 and digester 6 are of conventional design. 18 is a recording air flow meter for indicating the volume of air passing through inlet 12 and thence through the mixture. 19 is a controlled valve for controlling the static pressure above the mixture and is operated by a pressure controller 20. 21 is the static pressure area in digester 6 and 22 is the mixture area. 23 is a stationary support or foundation for digester 6.

The invention consists principally in preparing

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what I call the raw material by introducing the different ingredients into digester 6 in regulated quantities in the presence of air and a fixed volume of liquid and agitating same by means of compressed air until the mass is thoroughly digested. In practice I fill digester 6 with a fixed volume of liquid and inject air under pressure through inlet 12 sufficient to produce violent agitation. Asbestos fiber is next passed into blow fan 1 where it is divided into fine shreds to reduce the density by coming in contact with the revolving blades while leaving fibers long enough to give the desired tensile strength. It is then passed by means of pressure from the fan, through conduit 3 and duct 4 to digester 6 while the liquid is in a state of violent agitation. The fibers should be passed through the fan and into the digester at an even and constant rate to prevent bunching and formation of tufts which otherwise tends to lower the tensile strength. Magnesium oxide is then introduced by pouring through inlet 5, care being exercised to make certain that it is evenly distributed and thoroughly broken up by agitation. There is then added magnesium sulphate by the same method and the whole thoroughly agitated until such time as a preliminary formation of what I call magnesium oxysulphate crystals is in progress. At this stage I introduce exfoliated vermiculite of desired size and density and continue agitation of the whole mass for a length of time necessary to reach maximum distribution of the ingredients. By this means my raw material is efficiently and economically formed, being of a nature which can be readily molded into blocks and shapes that upon further treatment will give the desired density and tensile strength.

The invention further consists in forcing the raw material so prepared from the digester into a mold of desired shape and size where part of the water originally present in the mix is forced out and the molded shape removed from the form to be kept at a constant temperature for a period of time sufficient to permit the growth of formed oxysulphate crystals at controlled temperatures. At the end of this period the blocks and shapes are placed in an oven where the remaining water is expelled and the material is then ready for machining to the desired finished dimensions.

Without desiring to restrict myself to the proportions named I will give an example of the method for carrying out my process which will possess the advantages described. It will be understood the amounts given are approximate only and that the relative proportions of material may be varied to a reasonable extent without impairing the results.

Into digester 6 containing 465 gallons of water air is injected through inlet 12 at the rate of about 200 cubic feet per minute sufficient to provide violent agitation of the water and the ingredients to be added . In the example given the air has a pressure of 80 pounds per square inch. Asbestos fiber with a screen analysis of 2–8–4–2 is then passed to the blow fan 1 where it is dispersed by the blades to reduce the density from approximately 11.25 lbs. to 7.75 lbs. per cubic foot at atmospheric pressure, leaving fibers long enough to give the desired tensile strength. The fibers thus prepared are passed by means of pressure from the blow fan through conduit 3, duct 4, and inlet 5 into digester 6 in an amount equal to 35 pounds by weight, it being necessary to add the fibers at an even rate to prevent bunching and the formation of tufts which tends to lower the tensile strength of the finished product.

I next add 110 pounds of magnesium oxide by weight to digester 6 by pouring same at an even rate through inlet 5 and continue agitation until it is thoroughly broken up, after which I add 50 pounds of magnesium sulphate in the same manner and thereafter continue agitation of the entire mass for approximately one hour and forty-five minutes during which time a chemical reaction is started that results in the formation of what I call magnesium oxysulphate crystals. By this step in the operation I provide a chemical bond which forms the cementing action for my product. I next introduce in the same manner 305 pounds of exfoliated vermiculite with a screen size before exfoliation of minus 10 plus 28 and continue agitation for approximately 15 minutes to provide maximum distribution. The resulting product comprises my raw material and is a semi-fluid mix comprising water, asbestos fibers, magnesium oxysulphate crystals and exfoliated vermiculite in which the weight of the water equals approximately eight times the weight of the solids.

To carry out the molding operation the digester is sealed and a static pressure of 15 to 20 pounds per square inch provided. The discharge outlet 7 is then opened by turning control valve 10 permitting the raw material in the digester to be forced under static pressure through conduit 8 into molds 9, where approximately 5 parts by weight of the water originally present in the mix along with a certain proportion of the formed oxysulphate crystals are squeezed out. The molded form is removed from the molds and maintained at a temperature of approximately 70 degrees Fahrenheit for 48 hours when it is placed in an oven for drying at a temperature not to exceed 300 degrees Fahrenheit. Upon completion of this latter operation my heat insulating material in the form of molded shapes and blocks is ready for machining by conventional methods to finished dimensions.

It may be said that agitation is continued from the first introduction of dispersed fibers into the digester until completion of the molding operation. During the latter period agitation is necessary as otherwise the pressure tends to filter out the liquids through the solids, causing the latter to settle in the bottom of the tank by reason of the varying densities of the different ingredients that comprise the raw material. In particular it should be pointed out that my process depends upon simultaneously maintaining a controlled agitation and a controlled static pressure during the molding operation, and this I successfully accomplish by the use of inlet valve 13, the outlet valve 15, the air flow meter 18, the control valve 19, and the pressure controller 20.

To illustrate one method by which I maintain this continuously controlled agitation and static pressure during the molding period, the tank is first sealed and the static pressure controller 20 is set for a pressure of approximately 20 pounds, which, when the intake valve 13 is completely opened, operates the control valve 19, permitting a pressure of 20 pounds to build up in the static pressure area 21. This volume of air is measured by the air flow meter 18 and passes through the intake 12 and thence through the mixture 22. By manipulation of outlet valve 15 and observation of the air flow meter 18, a given volume of air passes thus through the mixture, the control valve 19 permitting this passage when sufficient air has been discharged from the static pressure

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area 21 to reduce this static pressure below that for which the pressure controller 20 has been set. The volume of air necessary to maintain proper agitation in this illustration is approximately 100 cubic feet per minute. Regardless of the initial air pressure, this flow is constantly maintained by this method.

While I have described the use of a blow fan to shred and feed asbestos fibers and other ingredients into digester 6, it is to be understood the same is by no means necessary to the successful carrying out of the operation, as other methods equally effective may be used, as for instance by pouring or feeding the ingredients in by hand or from an overhead hopper.

It is a characteristic of my material that it can be forced under pressure into the molds and there formed into blocks and shapes without substantial setting of the ingredients in the semi-fluid mix by chemical reaction. The cementing action of the magnesium oxysulphate crystals progresses slowly and evenly throughout the entire molded shape for the 48 hour waiting period while it attains the high tensile strength desired. Likewise in the drying operation care must be exercised that the oven temperature does not exceed 300 degrees Fahrenheit over a sustained period, as otherwise the cementing action of the oxysulphate crystals is destroyed.

By the foregoing operation I am enabled to prepare an insulating material with a density varying from 16 to 20 pounds per cubic foot and with low thermal conductivity, capable of withstanding high temperatures without disintegration. My finished product contains approximately the following ingredients:

	Per cent
Asbestos fibers	7
Magnesium oxysulphate crystals	32
Exfoliated vermiculite	61

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The herein described process of producing a binder for the manufacture of heat insulation which comprises adding finely divided asbestos fibers to a fixed volume of water and agitating same, adding magnesium oxide and continuing agitation until thoroughly dispersed, adding magnesium sulphate and continuing agitation of the entire mass for approximately one hour and forty-five minutes to produce a preliminary formation of magnesium oxysulphate crystals by chemical reaction.

2. The herein described process of producing raw material for the manufacture of heat insulation which comprises adding finely divided asbestos fibers to a fixed volume of water and agitating same, adding magnesium oxide and continuing agitation until thoroughly dispersed, adding magnesium sulphate and continuing agitation of the entire mass for approximately one hour and forty-five minutes to produce a preliminary formation of magnesium oxysulphate crystals by chemical reaction, introducing exfoliated vermiculite and continuing agitation of the entire mass for approximately 15 minutes.

3. The herein described process of preserving the cementing action of formed magnesium oxysulphate crystals which comprises forming the oxysulphate crystals in a preliminary state of formation, incorporating the same into a formed object and permitting the object to stand at a constant temperature of approximately 70 degrees Fahrenheit for 48 hours to permit the growth of formed oxysulphate crystals, and completing the process by drying at a temperature not to exceed 300 degrees Fahrenheit.

4. The improvement in the process of manufacturing heat insulating material which comprises forming asbestos fibers, magnesium oxide, magnesium sulphate and exfoliated vermiculite into a semi-fluid mass containing oxysulphate crystals in a preliminary state of formation, forcing the same into molds under pressure, removing the formed shape from the mold and maintaining same at a constant temperature to permit the growth of oxysulphate crystals and a substantial setting of the ingredients by chemical reaction, and completing the operation by drying at a temperature which will preserve the cementing action of the formed oxysulphate crystals.

5. The improvement in the process of manufacturing heat insulating material which comprises forming asbestos fibers, magnesium oxide, magnesium sulphate, and exfoliated vermiculite into a semi-fluid mass containing oxysulphate crystals in a preliminary state of formation, forcing the same into molds under static pressure of 15 to 20 pounds per square inch, removing the formed shape from the mold and maintaining at a constant temperature of approximately 70 degrees Fahrenheit for 48 hours to permit the growth of formed oxysulphate crystals, and completing the process by drying at a temperature not to exceed 300 degrees Fahrenheit.

6. The improvement in the process of manufacturing heat insulating material which comprises forming magnesium oxysulphate crystals in the presence of asbestos fibers and water maintained in a constant state of agitation, adding exfoliated vermiculite and digesting until the mass is semi-fluid, forcing the same into molds under static pressure, removing the formed shape from the molds and maintaining same at a constant temperature of approximately 70 degrees Fahrenheit for 48 hours to permit the growth of the oxysulphate crystals to maximum size and strength, and drying the molded shape at a temperature not to exceed 300 degrees Fahrenheit.

7. The step by step process of manufacturing heat insulating material comprising the steps of introducing a fixed volume of liquid into a digester and agitating same by means of compressed air, adding finely divided asbestos fibers, adding magnesium oxide and digesting, adding magnesium sulphate and digesting, and continuing agitation of the entire mass for approximately one hour and forty-five minutes, introducing exfoliated vermiculite and continuing agitation for approximately 15 minutes.

8. The step by step process of manufacturing heat insulating material comprising the steps of introducing a fixed volume of liquid into a digester and agitating same by means of compressed air, adding finely divided asbestos fibers, adding magnesium oxide and digesting, adding magnesium sulphate and digesting, and continuing agitation of the entire mass for approximately one hour and forty-five minutes, introducing exfoliated vermiculite and continuing agitation for approximately 15 minutes, forcing the raw material thus formed under static pressure from the digester into molds, removing the molded form from the mold and maintaining same at a temperature of approximately 70 degrees Fahrenheit for 48 hours and placing the same in an oven for drying at a temperature not to exceed 300 degrees Fahrenheit.

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9. The step by step process of manufacturing heat insulating material comprising the steps of introducing 465 gallons of water into a digester and agitating same by means of compressed air with a pressure of 80 pounds per square inch, and while agitation is continued adding asbestos fibers with a density of approximately 7.75 lbs. at atmospheric pressure, adding 110 pounds of magnesium oxide and digesting, adding 50 pounds of magnesium sulphate and digesting and continuing agitation of the entire mass for approximately one hour and forty-five minutes, introducing 305 pounds of exfoliated vermiculite and continuing agitation for approximately 15 minutes, forcing the raw material from the digester under static pressure into molds, removing the molded form from the mold and maintaining same at a temperature of approximately 70 degrees Fahrenheit for 48 hours and placing the same in an oven for drying at a temperature not to exceed 300 degrees Fahrenheit.

10. In the manufacture of heat insulating material the step which comprises introducing magnesium oxide in the presence of a fixed volume of water and asbestos fibers agitated by compressed air and agitating the mass until magnesium oxide is thoroughly dispersed and adding magnesium sulphate and continuing agitation of the entire mass for approximately one hour and forty-five minutes to produce a preliminary formation of magnesium oxysulphate crystals.

11. Heat insulating material with a density of 16 to 20 pounds per cubic foot and low thermal conductivity comprising asbestos fibers 7%, magnesium oxysulphate crystals 32%, and exfoliated vermiculite 61%.

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