UNITED STATES PATENT OFFICE.

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HEAT-INSULATING MATERIAL AND METHOD FOR MANUFACTURING SAME.

1,045,933. Specification of Letters Patent. Patented Dec. 3, 1912.

No Drawing. Application filed April 29, 1908. Serial No. 429,860.

To all whom it may concern:

Be it known that I, CHARLES H. BELKNAP, a citizen of the United States, and a resident of the borough of Brooklyn, in the city and State of New York, whose post-office address is 42 Franklin street, New York city, New York, have invented certain new and useful Improvements in Heat-Insulating Materials and Methods for Manufacturing the Same, of which the following is a specification.

My present invention relates to heat-insulating coverings for boilers, steam-pipes and the like, and is applicable to the manufacture of such products for whatever purpose they may be designed. Commonly when applied to machinery they are denominated laggings, but when I use that term in this specification I use it generically to cover all devices having for their object the retention of heat, whether they are strictly laggings or not; such, for example, as the linings of refrigerators, walls, partitions, etc., as well as boiler and pipe coverings.

It is well known that air when properly confined is one of the best, if not the very best, of heat insulators, but it is essential that there should be no circulation; for a slight circulation, even through a contracted duct, results in considerable loss of efficiency. It is therefore desirable to subdivide the space occupied by the lagging into as many air-cells having no communication as is reasonably possible. For this reason many forms of cellular covering have been devised, which answer a certain restricted utility. One of the best forms of the more solid coverings is magnesia, made in shapes to fit the surfaces from which heat would radiate; this has relatively low conductive power and also includes a large amount of air space subdivided into exceedingly minute cells. It is, however, costly and somewhat heavy. One of the best kinds of material for these purposes is kieselguhr, called by many names in the art, such as fossil meal, fossil flour, diatomaceous earth, silicious earth, diatomite, etc. This substance consists of the exceedingly minute mineral skeletons of infinitesimally small organisms called diatoms. Under the microscope these little cellular skeletons are seen to be composed of immense numbers of still more minute air-cells, each separated from its neighbor by a thin earthy wall. In a mass of this material circulation of air is therefore practically impossible, and its heat efficiency (that is, its non-conductivity) is very high. Although innumerable attempts involving large expense have been made to employ it, it has heretofore been found impossible to solidify this material successfully, on account of the fact that all of the binding materials with which it has heretofore been attempted to compound the kieselguhr fill up the spaces in the cells and expel a large part of the air, thus lowering its efficiency; and a second and equally important objection has been that they render the finished product very heavy, greatly increasing the freight charges and the gross weight of the machinery to which these articles have been applied; the low price of the various heat insulating materials renders it of importance that they should not be subjected to large freight charges.

I have by experiment discovered a process which enables me to combine the kieselguhr with other materials into a lagging which is of very superior quality, of low cost, and small weight. The new product or composition of matter consists of kieselguhr combined with or bound by lime, and also by preference mixed with some porous or fibrous material, such as asbestos fiber; and this new composition of matter, by whatever process it may be produced, I believe to be of my invention and aim to protect by my claims. I have also devised what I believe to be an efficient and novel process for the production of the product described, and certain of my claims are addressed to this improvement in the art.

To prepare the new composition of matter, or new manufacture, I take diatomaceous earth in proportion of about seventy-five per cent.; of fine ground lime, such as lime hydrate, about twelve and a half per cent.; of asbestos fiber, about twelve and a half per cent.; these are thoroughly mixed, and either while mixing or afterward I add to the mixture sufficient water to make a paste which will flow readily, say of about the consistency of moderately thin plaster of Paris. While in this condition I pour the composition into molds such as are in common use in the art and which do not need description; the composition should run easily into these molds, in which it is al-

lowed to remain until it is fully set. This setting is greatly facilitated by the application of a moderate and regular heat, such as that from live steam of about 125 lbs. pressure. I therefore preferably arrange the molds upon suitable supports or otherwise in a closed chamber to which the steam may be admitted and in which it may be maintained under the desired pressure for so long as may be desired; no illustration of such chambers is necessary, since they are common and well-known. In general in about eight hours, depending on the size and thickness of the articles, and the pressure used, the material will be found to have set sufficiently to be removed from the molds, and at the end of that time it is so removed and placed in any suitable drying apparatus. It may of course be used while still damp, if desired, but it is weak and its efficiency in this condition is low; until it is dried out, it is not in its best form.

The new article of manufacture may be handled in the same way as the well-known magnesia laggings. It is readily cut, is sufficiently strong to withstand transportation easily, has a high efficiency and is lighter than any other lagging with which I am acquainted.

Another process, or more strictly a variation of the same process, is to mix the kieselguhr and asbestos with milk of lime which has been previously prepared, and is of such strength as to make with the admixture the rather thin mortar which is best for the filling of the molds with the least labor. So far as I am now advised, the substances when thus united or mixed form a chemical combination, consisting of a mixture of calcium carbonate and calcium hydrosilicate, which is much more strongly cohesive than persons skilled in the art would suppose. Whether the asbestos combines to any extent with the other materials or whether it is merely embedded therein I am at this time unable to say, nor is it material for the purposes of my invention. Whatever the theoretical explanation of the combination may be is for my purposes wholly unimportant; and whether the chemical reactions are such as I have indicated or vary therefrom I neither know nor care.

By the words "alkaline earth" in my claims, I intend to cover either the earths themselves, such as calcium or magnesium or other oxids of salts. The alkaline earth used in the mixture may be in any of these forms. For the asbestos, I may upon occasion substitute mineral or organic materials of a sufficiently fibrous or pulverulent nature to serve the purposes of the invention, such as spun glass or mineral wool, etc. I believe, however, that the asbestos, the heat resistivity of which is well known, is the best for the purposes of the invention. By the addition of the relatively large amount of water necessary to insure the pouring of the mortar into the mold, the lagging is rendered somewhat porous, since after the material has set its shape and size do not substantially change in the process of drying, and the minute cellular spaces occupied by the water are left vacant as it is dried out. I consider this an especially valuable feature of the particular process which I have devised for the manufacture of my improved product. While the amount of water employed may be varied considerably in both directions, I find the best results are obtained by the use of about 3½ pounds of water to each pound of dry material. This amount of water provides for the water which is taken up in the indurating process, and leaves a surplus sufficient to produce the cellular spaces above referred to, due to the formation of a portion of the water into steam.

Having thus described my invention, what I claim and wish to protect by Letters-Patent of the United States is:

1. As a new article of manufacture, heat-insulating material formed from a mixture composed mainly of diatomite, an alkaline earth and water, a portion at least of the alkaline earth being combined with the diatomite in the form of a silicate, the material having, in addition to the cellular structure of its diatomite, a large number of air cells formed by evaporation of water contained in the mixture, substantially as described.

2. As a new article of manufacture, a porous heat-insulating material composed of diatomite, lime and a fibrous binding material, a portion at least of the lime being combined with the diatomite in the form of a silicate, the material being uncompressed and containing a large number of artificial air cells in addition to the natural pores of the materials used, substantially as described.

3. As a new article of manufacture, a porous heat-insulating material composed of diatomite, lime and asbestos, a portion at least of the lime being combined with the diatomite in the form of a silicate, the material being uncompressed and containing a large number of artificial air cells in addition to the natural pores of the materials used, and the fibers of asbestos acting to bind or felt the materials together, substantially as described.

4. The herein described method of making heat-insulating material, which consists in mixing diatomite with not over thirty per cent. of alkaline earth and with sufficient water to form a mixture which can be readily poured, and shaping and indurating the mixture without any substantial com-

pression thereof, some of the excess water in the mixture being driven off during the indurating, to thereby form a large number of air cells within the mass, substantially as described.

5. The herein described method of making heat-insulating material, which consists in mixing diatomite and a fibrous binding material with not over thirty per cent. of alkaline earth and with sufficient water to form a mixture which can be readily poured, and shaping and indurating the mixture without any substantial compression thereof, some of the excess water in the mixture being driven off during the induration, to thereby form a large number of air cells within the mass, substantially as described.

6. The herein described method of making heat-insulating material, which consists in mixing diatomite, lime and a fibrous binding material with sufficient water to make a relatively thin pourable mixture, shaping and setting said mixture without substantial compression or shrinkage, and converting some of the free water in the shaped article into steam and driving the same off to thereby form a plurality of air cells throughout the mass, substantially as described.

7. The herein described method of making heat-insulating material, which consists in mixing diatomite, lime and a fibrous binding material with sufficient water to make a relatively thin pourable mixture, shaping and setting said mixture in an uncompressed condition, and converting some of the water in the shaped article into steam and driving the same off to thereby form a plurality of air cells throughout the mass, substantially as described.

8. The method of making heat-insulating material, consisting in mixing diatomite with not over thirty per cent. of an alkaline earth and with fibrous material and water, molding the same, and indurating the wet mixture in natural uncompressed condition in the mold to form a silicate combination between the diatomite and the alkaline earth while forming a large number of small air cells due to converting the contained water into steam during induration, substantially as described.

In witness whereof, I have hereunto set my name in the presence of two witnesses.

CHARLES H. BELKNAP.

Witnesses:

T. J. JOHNSTON,

IRVING M. OBRIEGHT.