Patented Oct. 9, 1928. 1,687,285

UNITED STATES PATENT OFFICE.

WARREN M. EMERSON, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO CERTAIN-TEED PRODUCTS CORPORATION, A CORPORATION OF MARYLAND.

INSULATING MATERIAL.

No Drawing. Application filed February 9, 1925. Serial No. 8,059.

This invention relates to insulating material and more particularly to a mineral cellular composition that is adapted to be used as a non-conductor of heat and sound, and is also fire resisting and vermin proof.

One of the objects of the invention is the provision of a cellular mineral structure that is a non-conductor of heat and sound, is fire-resisting and vermin proof, is adapted to be used as insulation in refrigerators, cold storage plants, furnaces, around pipes, hot water tanks, under floors, roofs, in walls and the like, that may be produced at a small cost, and is comparatively light in weight, efficient in use, rigid and durable.

Another object of the invention is the provision of a dry mixture of which gypsum plaster is the principal ingredient, which upon the addition of a liquid may be poured in position and will set to form a new and improved cellular insulating material.

A further object of the invention is the provision of a dry mixture that upon the addition of water will immediately expand to its maximum extent and will be sufficiently delayed in setting to permit the necessary pouring and leveling of the material.

Other and further objects and advantages of the invention will appear as the description proceeds.

In compositions that have heretofore been employed as non-conductors of heat and sound, and which are adapted to be poured in position in a plastic state, either the reaction of the elements forming the gas for expanding the gypsum has been prolonged to such an extent that the setting of the gypsum will under certain conditions begin before the expansion is completed, thereby not only partially rupturing the cellular walls and injuring to a certain extent its insulating properties, but making it almost impossible to obtain a uniform thickness of the different pourings without leveling it a number of times until it has fully expanded and the setting almost completed; or while in other compositions the reaction has been sufficiently rapid, adequate provision is not made for retarding the setting of the material and the same sets before it can be placed in position and properly leveled. If the reaction of the elements is delayed, the mass will continue to rise after it is placed in position, thus necessitating leveling the material a number of times, which not only adds to the cost of the operation, but subsequent levelings of the material after it begins to set result in a roughened surface which is highly objectionable in certain classes of work, as where building paper is laid over the material, over which the workmen must walk. In walking over the paper the roughened surfaces of the material will cut holes in the paper, thus injuring the same.

The present invention eliminates these objectionable features by providing a new and improved composition in which the reaction is exceedingly rapid and the setting of the gypsum is considerably delayed, whereby the expansion of the gypsum is accomplished before it begins to set, and the setting of the same is sufficiently delayed to give ample time for placing the material in position. As a result, the material is fully expanded by the time it is poured in position, and there is ample time for leveling the same before the setting process begins. The expansion of the material being completed before it is leveled, a smooth surface is insured with one stroke of the level and uniformity in the thickness of the different or successive batches is obtained with little or no difficulty.

The principal ingredient of this material is calcined gypsum (partially dehydrated calcium sulphate) preferably in a finely divided state, which for convenience of description will be referred to as gypsum or gypsum plaster, and to this material is added substances which upon the application of a liquid, as water, will cause a rapid evolution of gas which becoming imprisoned in the mass of the gypsum will form cells, thereby causing the gypsum material to rapidly expand. The composition also preferably includes a substance for controlling the size of the cells as well as distributing them uniformly throughout the material, and another substance for retarding the setting of the gypsum plaster. For convenience in transportation and handling, the substances are

preferably reduced to a finely divided granular or pulverized form and mixed in a dry state with gypsum plaster. When it is desired to form the cellular material water is added to the mixture.

Any suitable substances for producing the gas within the material may be employed, provided the reaction is prompt and of short duration. A solid soluble carbonate, such as sodium bicarbonate and a substance that will chemically react on the carbonate in the presence of water, such as alum or aluminum sulphate and the like, may be employed to liberate carbon dioxide gas. Aluminum sulphate is preferable because of its cheapness, and because it reacts on the carbonate to form an insoluble hydroxide which does not in turn react on the liberated carbon dioxide gas.

A suitable emulsifier or colloidal substance, such as starch, flour, glue, gum and the like, is mixed with the gypsum plaster and the gas forming substances for preventing the escape of the gas bubbles and for controlling the size of the cells. In practice a suitable commercial form of colloidal substance known to the trade as a "retarder" is employed. This colloidal substance entangles the gas bubbles formed in the mass of the material and prevents their escape. It also insures uniformity in the cellular structure throughout the mass of the material. The size of the cells is controlled within certain limits by the amount of the colloid used. Additional amounts of the colloidal substance will result in a product having finer cells. Colloidal substances will delay the setting of the material to a certain extent, but amounts necessary to effect sufficient retardation of the setting, especially in hot weather, would result in a material in which the cells would be objectionably small for certain uses.

An additional substance which does not affect the size of the cells, but which will materially retard the setting of the gypsum, especially in warm weather, is employed. A solid soluble acid retarder, such as citric, tartaric or oxalic acid, is employed for this purpose. Oxalic acid is preferable, because of its cheapness and because it forms an insoluble compound with calcium hydrate when the same is present in the material. This substance is not required in sub-freezing weather, because low temperatures sufficiently retard the setting of the gypsum to enable the material to be placed in position and leveled off before the setting has sufficiently progressed to interfere with the proper laying of the material. At summer temperatures, however, the setting is so rapid that unless some substance be employed to delay the setting of the gypsum plaster the quality of the material is greatly affected by the subsequent spreading or laying and leveling of the same. In practice it is used in the preparation of all the mixtures because the mixture is placed in bags and sold to the trade and may be used in summer as well as in winter. The presence of oxalic acid enables the material to be used under all temperature conditions.

For simplicity and convenience in working the material, and to render the same "fool-proof", it is desirable that the proportion of water by volume to be added shall remain constant. Commercial gypsum plasters vary in weight as to given volumes, so that the same volume of water added to different mixtures would result in the lighter mixtures being so thin that unless something be employed to strengthen the cellular walls objectionable impressions would be made in the surface of the material by the workmen in walking over the same, especially in walking over it while it is still wet. It has been found that the addition of a small quantity of lime, preferably calcium hydrate, will materially strengthen the structure of the wet material. It may be used with the different grades or classes of gypsum plaster with beneficial results. More lime is added in the thinner mixtures. By the use of hydrated lime the mixtures are standardized, so that the same amount of water by volume may be added in all cases. A good working proportion is three parts of the dry mixture to two of water, by volume. The use of calcium hydrate in the mixture is considered an important feature of the invention because it not only permits the workmen to proceed without delay with their subsequent operations of laying the building paper, floor, roof or the like over the material, but enables the producer to standardize the proportionate amount of water to be added regardless of the class or fineness of the gypsum plaster employed.

In actual practice, in producing material that will weigh 24 lbs. to the cubic foot, the following proportionate amounts of the substances has been found to give excellent results:—

Gypsum plaster	400#
Aluminum sulphate	10#
Sodium bicarbonate	4#13oz.
Hydrated lime	1#12oz.
Oxalic acid	1# 5oz.
Commercial retarder	6oz.

To the above proportionate amounts of material is added one part by volume of water to one and one half parts of the mixture, and after mixing the mass it is poured in position and leveled off, if required.

The proportions indicated above may obviously be varied. If lighter material is desired more gas producing substances are used, and vice versa. If it is desired to form smaller cells in the material, more of the commercial retarder is employed. The setting of the material especially in warm weather may be delayed as much as desired by the acid retarders.

Any soluble salt that reacts, with a soluble carbonate, to release carbon dioxide gas and does not form a carbonate, or forms an unstable carbonate, or in which, in forming a carbonate, all the gas released is not reacted on, may be employed for liberating or evolving the carbon dioxide gas.

When calcium hydrate is employed without the acid retarder, additional aluminum sulphate is necessary to compensate for the amount required to react on the lime.

It is desirable that the chemicals be so balanced as in the formula given that accidental addition of an excess of water will not result in a different class of material. It will do no harm except it will take longer for the excess water to evaporate.

It is desirable that an excess of aluminum sulphate necessary to react on the soluble carbonate be employed in order that the reaction shall always be carried to completion.

While I have disclosed one specific formula for practicing the invention it is understood that the proportion of the substances may be varied and that while it is preferable that the substances other than water be solid and that they be mixed before adding the necessary amount of water, it is understood that this is not necessary for the formation of the cellular product and that certain of the elements may be in liquid form or dissolved in water before they are added to the mixture containing the gypsum plaster.

I claim as my invention:

1. A dry mixture, comprising calcined gypsum as the major ingredient, a carbonate, aluminum sulphate, a colloid, and an acid retarder.

2. A process of making insulating material which consists in mixing in a dry state gypsum plaster, sodium bicarbonate, aluminum sulphate, a colloidal substance, oxalic acid in such quantities as to act as a retarder, and then adding water to the mixture.

3. A process of making insulating material which consists in mixing in a dry state gypsum plaster, sodium bicarbonate, aluminum sulphate, a colloidal substance, oxalic acid in such quantities as to act as a retarder, calcium hydrate and then adding water to the mixture.

4. A composition of matter formed by mixing a calcined gypsum, as the principal ingredient, a soluble carbonate, aluminum sulphate, a colloid, oxalic acid in such quantities as to act as a retarder, and water.

5. A dry mixture which, upon the addition of water will form a cellular substance, said mixture comprising gypsum as the principal ingredient, substances for evolving a gas, a colloid and oxalic acid in such quantities as to act as a retarder.

6. A dry mixture comprising a substance that will set, as the major ingredient, a substance that will react with a soluble carbonate to evolve a gas, a colloid, and a non-colloidal substance in such quantities as to delay the setting of the mixture without affecting the size of the cells.

7. A new cellular composition formed by mixing gypsum plaster as the principal ingredient, a soluble carbonate, a substance that will react on the carbonate to liberate a gas, a colloidal substance, an acid retarder and water.

8. A dry mixture comprising gypsum plaster as the major ingredient, a plurality of substances which upon the addition of water will evolve a gas, a colloidal substance, oxalic acid in sufficient quantities to act as a retarder, and a small quantity of calcium hydroxide for stiffening the wet composition formed by the addition of water to said mixture.

9. A dry mixture comprising calcined gypsum, as the principal ingredient, substances which, upon the addition of water, will evolve a gas, a substance for controlling the size of the cells in the ultimate product, and an acid retarder.

10. A dry mixture comprising gypsum as the major ingredient, a plurality of substances which upon the addition of water will liberate a gas, a substance for holding said gas in suspension, a quantity of hydrated lime, aluminum sulphate in sufficient quantities to completely convert the hydrated lime into calcium sulphate, and an acid retarder.

11. A dry mixture comprising calcined gypsum as the major ingredient, soluble carbonate, aluminum sulphate in sufficient quantities to liberate the gas from said carbonate upon the addition of water, a substance for holding said gas in suspension, hydrated lime, sufficient additional aluminum sulphate to convert all of the hydrated lime not converted into calcium oxylate into calcium sulphate, and oxalic acid which acts as a retarder.

12. The method of making a cellular structure of the character described which comprises introducing sodium bicarbonate and aluminum sulphate into a calcined gypsum in quantities to react when in solution to yield a gas in said calcined gypsum when the latter is in plastic condition; controlling the time of set of the calcined gypsum without affecting the size of the cells therein, by adding oxalic acid,—whereby upon the addition of water the plastic cementitious material is immediately given a cellular structure by an abrupt and complete release of gas.

13. The method of making a cellular structure of the character described which comprises introducing sodium bicarbonate and aluminum sulphate into a calcined gypsum in quantities to react when in solution to yield a gas in said calcined gypsum when the latter is in plastic condition, controlling the time of set of the calcined gypsum without affecting the size of the cells therein by adding a non-colloidal retarder whereby upon the addi-

tion of water the plastic cementitious material is immediately given a cellular structure by an abrupt and complete release of gas.

14. The method of making a cellular structure of the character described which comprises introducing sodium bicarbonate and aluminum sulphate into a calcined gypsum in quantities to react when in solution to yield a gas in said calcined gypsum when the latter is in plastic condition, controlling the time of set of the calcined gypsum without affecting the size of the cells therein by adding an acid retarder whereby upon the addition of water the plastic cementitious material is immediately given a cellular structure by an abrupt and complete release of gas.

In testimony whereof I affix my signature.

WARREN M. EMERSON.