Nov. 19, 1935. D. N. HALSTEAD 2,021,359

PREFORMED SOUND ABSORBING UNIT AND METHOD OF MAKING THE SAME

Filed Oct. 19, 1932

Fig. 1.

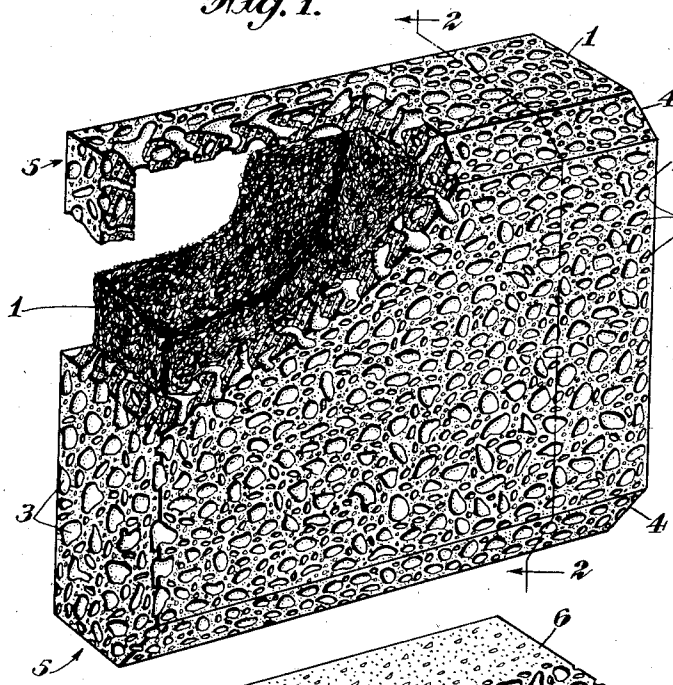
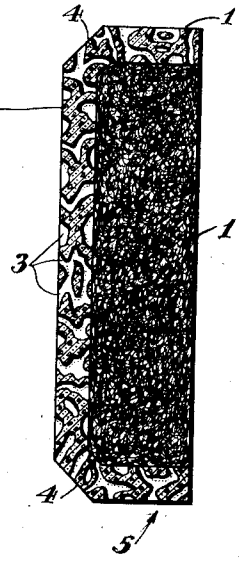


Fig. 2.



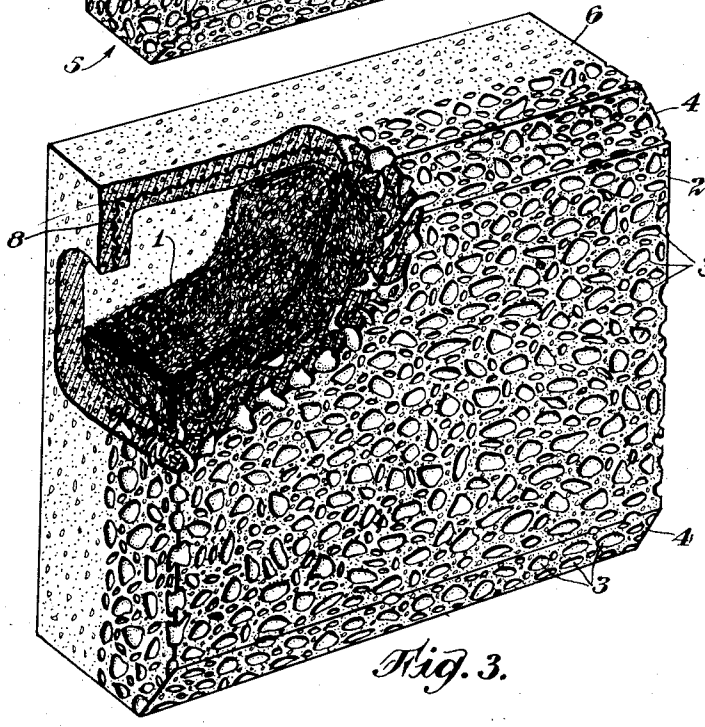


Fig. 3.

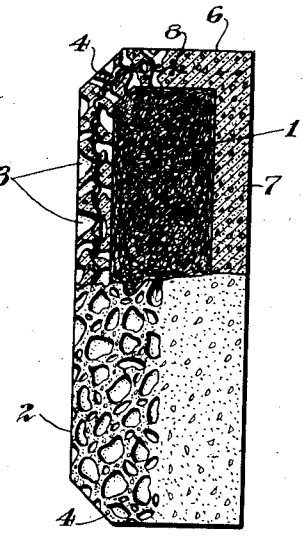


Fig. 4.

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PREFORMED SOUND-ABSORBING UNIT AND METHOD OF MAKING THE SAME

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Application October 19, 1932, Serial No. 638,502

8 Claims. (Cl. 18—59)

This invention relates to a preformed sound-absorbing unit and to the method of making the same.

Pads of felted fibers, suitably strengthened and made semi-rigid by means of a binder, such as a small proportion of starch, are very effective in sound absorption. Because of the inherent weakness of such pads, the tendency to dusting, and undesired architectural effects, it is usual in acoustical construction to provide the pads with a facing element. A facing that is very commonly used is one of sheet metal provided with circular openings regularly spaced at close intervals, to admit incident sound.

For many purposes it is desired to provide a facing of the type of plaster and to provide sound-transmitting openings of irregular shape and size, to resemble figurations in a natural product, such as some varieties of stone. Further, the openings for the transmission of sound through the face should have such irregular spacing as to mutilate effectively sound waves incident upon the face. In using a facing that is somewhat fragile, as in the case of plaster, it is desirable also that the plaster should be supported by integral union, over a large part of its back surface, with the sound-absorbing backing element and also that the facing should be strengthened and reenforced by screen wire or the like.

It is an object of the invention to provide an acoustical unit having the desirable properties above mentioned. Other objects and advantages will appear as the description of the invention progresses.

In the embodiment that is preferred at this time, the invention comprises a sound-absorbing pad, including rock wool or the like and a binder, and a facing element integrally united thereto. The facing comprises a hardened hydraulic cementitious composition provided with irregularly shaped and spaced holes communicating with the outer surface of the facing element and also with the pores within the sound-absorbing backing pad.

The invention is illustrated by the drawing in which

Fig. 1 shows a perspective view of a preformed acoustical unit, with parts broken away for clearness of illustration;

Fig. 2 shows a cross sectional view on line 2—2 of Fig. 1;

Fig. 3 shows a perspective view of a modified form of acoustical unit, with parts broken away for clearness of illustration; and

Fig. 4 is an edge view, partly in section, of the structure illustrated in Fig. 3.

In the various figures like reference characters denote like parts.

There is illustrated a preformed sound-absorbing element 1 in the form of a pad that is porous, fibrous, and suitably semi-rigid. A sound-absorbing element that has been used to advantage is one containing felted rock wool fibers adhered together into a shaped, semi-rigid slab, by a small proportion of starch binder. Such an element may be made by a method which includes forming a mixture of rock wool fibers with a dispersion of starch in hot water, suitably in the proportion of approximately 1 pound of starch to 20 pounds of water, shaping the mixture in a mold with a screen bottom, allowing the excess of starch dispersion to drain from the shaped mixture, removing the drained unit from the mold, and drying and trimming the product to size desired.

Other felted fibrous materials may be used, as, for example, asbestos fibers. Also, other binders such as chlorinated diphenyl or bituminous material in limited quantity may be used. In any case, the felted fibrous product should be porous and be adapted to absorb sound incident upon a face thereof.

The sound-absorbing element is integrally united to a facing element 2 of generally plane surface that may comprise a binder of the type of a hydraulic, cementitious material and is provided with irregularly shaped, sized, and spaced openings or pores 3 that communicate with the outer surface of the facing element and with the pores within the sound-absorbing element. The hydraulic cementitious material may be Portland cement, plaster, or the like. Plaster has been used to advantage, as it sets quickly and is a material that is widely accepted as constituting a desirable interior finish.

The unit may have beveled edges 4 and also side sealing and strengthening portions 5 of a composition like the face and integrally united to the edges of the sound-absorbing element.

In the modification illustrated in Figs. 3 and 4, the edges of the unit may comprise a non-porous, hydraulic cementitious portion 6 integrally united to the edges of the sound-absorbing pad and also a similar backing portion 7.

The method of making the improved products of the present invention consists essentially in molding a hydraulic cementitious composition, provided with density-reducing and pore-forming material, onto the face and, if desired, onto the

side edges and/or back of the sound-absorbing element. The said composition is applied in castable form and is then allowed to harden. The finished, composited article may be dried and trimmed or otherwise sized to the exact dimensions desired.

This method of manufacture is illustrated by the following specific examples.

There is first made a mixture of calcined gypsum (plaster) with a density-lowering, pore-forming material, such as a small proportion of materials adapted to generate gas when wet with water. Ground calcium carbide may be used. But I prefer a mixture consisting essentially of a carbonate, such as carbonate of sodium or calcium, and an acidic substance, such as an alum or hydrochloric acid diluted with a large volume of water. In any case, the mixture of plaster with the materials adapted to generate a gas, such as carbon dioxide, is quickly wetted with sufficient water to give a consistency suitable for casting or molding. Gas-entangling agents may also be present in the composition. Thus there may be used saponin, glucose, or other foam-stabilizing agent, to decrease the tendency of the bubbles of gas, when generated, to escape from the composition. The castable hydraulic cementitious composition, made as described, is poured into a mold of conventional type, suitably with a greased interior and with removable side and end walls, to give a thickness of casting approximately equal to the thickness of face desired in the finished unit. Upon this casting there is then placed and pressed slightly a preformed pad of felted rock wool fibers made semi-rigid with starch binder. The length and breadth of the rock wool pad are suitably somewhat less than the corresponding inside dimensions of the mold, so that a space is left around the edges of the pad. Into this space there may be poured a hydraulic cementitious composition, like that first used, to form sides 5 of the block of the type illustrated in Figs. 1 and 2. Or the composition cast around the pad may be a conventional mixture of plaster and water that is free from density-reducing and pore-forming materials, to give a side edge 6 and, if desired, also a backing portion 7 of the relatively impervious composition, as illustrated in Figs. 3 and 4. The backing portion may be smoothed by means of a flat mold lid applied over the top of the casting.

In the example described, the plaster applied to the outer surfaces of the fibrous pad may penetrate within the pad to a depth sufficient to decrease the porosity of the surface of the pad. In order to minimize this tendency and to insure that the pores will be opened and adapted to receive incident sound over a satisfactory proportion of the total surface of the pad, the following modification of the general method of manufacture may be used. Void-containing aggregations of felted fibers, suitably of rock wool, are waterproofed. To the waterproofed aggregations there is then applied a mixture of water and a hydraulic cementitious material. The cementitious material is allowed to harden, whereby the voids within the said aggregations are preserved. Thus, before the fibrous pad is placed in position on the casting, a portion of the surface of the pad is treated with a grease, oil, or a solution of aluminum stearate, say, in kerosene or other volatile solvent, to provide water-resistant patches of small area each, averaging, say, a few square inches, distributed over the surface of the pad. The pad is then placed with the treated surface in contact with the freshly cast plaster composition and pressed thereagainst. Under such circumstances the plaster will penetrate the limited areas to which waterproofing has not been applied and will not close the pores at the surface in the other, localized areas to which the waterproofing has been applied. The remainder of the operations of making and finishing the block may be performed as described above.

Units made by the latter method combine the advantages of a facing portion which is keyed or integrally united to the sound-absorbing element, by penetration of the plastic composition within pores at the surface of the said element, followed by its hardening in situ, and which is adapted to admit sound readily to the other said localized areas. Sound incident upon the entire face of the unit and admitted only through the areas of open surface pores, diffuses throughout the element and is absorbed practically as effectively as though it were admitted over the entire surface of the sound-absorbing element.

The waterproofing treatment applied to the localized areas, while minimizing penetration of the aqueous composition therein during the casting operation, does not prevent the ready admission of sound into the finished unit. If the waterproofing composition used contains volatile materials, subsequent evaporation thereof favors openness of the pore structure of the surface. If the waterproofing composition does not contain volatile materials but consists essentially, for example, of a non-volatile, soft grease or wax of low melting point, this non-volatile material is suitably caused to distribute itself, finally, over a relatively large area and thus to migrate in part from the place of first application, by maintaining the finished block for some time at a moderately elevated temperature above the melting point of said material and below the temperature of dehydration or weakening of the cementitious substance in the face portion of the block.

The waterproofing that is preferred is grease buttered onto the surface of the pad in the selected localized areas, suitably spread on with a knife, as a continuous film of water-repellent material. Grease so applied and also the grease or oil on the interior of the mold in which the plaster is cast have the desired effect of causing bubbles of gas in contact with the greased surface to remain open and provide pores opening on the surface of the finished article.

To provide a maximum of strength in the facing and/or edge elements of cementitious composition, sound-permeable reenforcing means may be disposed within the said composition. Thus there may be used a foraminous material, such as a woven fabric, say, a wire gauze 8. The reenforcement should be provided with openings large enough and so closely spaced as to provide permeability to sound. In making a reenforced unit, the reenforcing means may be placed over the surfaces of the sound-absorbing element that are to be provided with a molded-on plaster layer and suitably spaced therefrom at a distance equal approximately to one-half of the thickness of the said plaster layer that is to be applied. The sound-absorbing element and spaced reenforcing means are then pressed against and united to freshly cast plaster.

The fact that such metal reenforcing means

could not be used to advantage in a face that is to be perforated mechanically, subsequent to its being cast, provides an advantage of the present structure in which the openings are formed in a manner that avoids interference by the screen wire.

The product made in accordance with the present invention has features of advantage in addition to those that have been indicated previously. The facing has areas that individually are dense and strong and plaster-like in appearance. The over-all density of the facing, on the other hand, is lighter than that of ordinary plaster. The irregularities in the spacing, size and shape of the openings provide not only a decorative and attractive appearance but also effective means of mutilating sound waves and facilitating their subsequent absorption in the sound-absorbing element, the pores of which are in communication with the openings through the said facing. The facing may be decorated, as by painting or lacquering, without closing the sound-transmitting openings therethrough. Furthermore, the sound-absorbing pad, being integrally united to the facing, provides a source of strength to the relatively fragile facing and minimizes the tendency of the face to crack. The whole is fire-resistant.

The term "waterproofing" is used to include rendering a material water-resistant although not completely impervious to water.

The details that have been given are for the purpose of illustration and not restriction and many variations therefrom may be made without departing from the spirit and scope of the invention.

What I claim is:

1. A preformed structural unit comprising a sound-absorbing element of felted fibers, waterproofing material associated with a portion of the surface of said element, and a rigid facing of generally plane surface molded thereon and integrally united thereto and provided with irregularly spaced, irregularly shaped openings adapted to admit incident sound to the sound-absorbing element.

2. In making an article comprising aggregations of felted fibers defining voids in the said aggregations and an aqueous hydraulic cementitious composition, the method which comprises waterproofing the aggregations of felted fibers in localized areas, applying the cementitious composition to the said aggregations, and allowing the cementitious composition to harden, whereby penetration of the cementitious material within the localized areas is minimized.

3. The method of making an acoustical unit which comprises forming a sound-absorbing pad of felted fibers, applying a film of waterproofing material to a face of the sound-absorbing pad, applying to the thus treated face a castable composition including water, a hydraulic cementitious material, and density-reducing, pore-forming material, and then allowing the said composition to harden.

4. The method of making an acoustical unit which comprises forming a sound-absorbing pad of felted fibers, applying a film of waterproofing material to a face of the sound-absorbing pad, applying to the thus treated face a castable composition including water, a hydraulic cementitious material, and bubbles of gas, and then allowing the said composition to harden.

5. The method of making an acoustical unit which comprises forming a sound-absorbing pad of felted fibers, applying a film of waterproofing material to a face of the sound-absorbing pad, applying to the thus treated face a castable composition including water, a hydraulic cementitious material, and a gas-generating material, and then allowing the said composition to harden.

6. The method of making an acoustical unit which comprises forming a sound-absorbing pad of felted fibers, forming a continuous film of water-repellent material over localized areas of the face of the pad, applying to the said face a castable composition including water, a hydraulic cementitious material, and a gas generating material, and then allowing the said composition to harden.

7. A structural unit comprising a porous sound-absorbing element, localized areas on the surface of the said element provided with open pores, and a rigid facing member united to the sound-absorbing element at positions intermediate the said limited areas and provided with irregularly spaced, irregularly shaped, sound-transmitting openings extending through the facing member and communicating with the said open pores.

8. In making a porous article containing a binder and aggregations of felted fibers defining voids in the said aggregations, the method which comprises waterproofing the said aggregations, applying thereto an aqueous binder composition, and hardening the binder, whereby the said voids are preserved.

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