

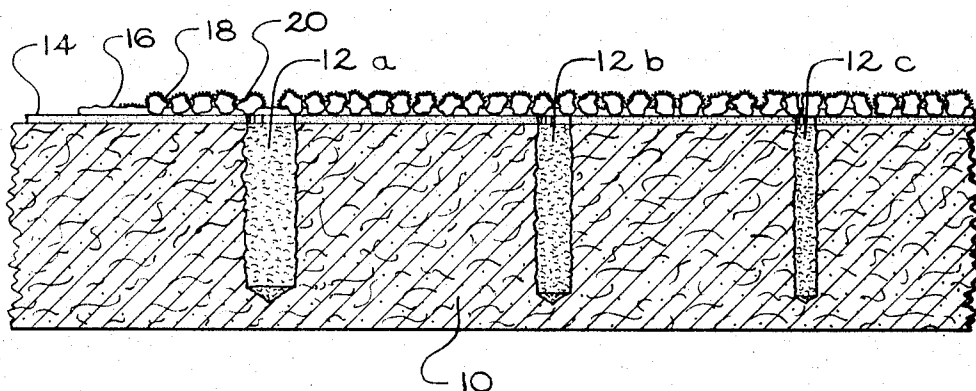
Dec. 12, 1967

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3,357,516

ACOUSTICAL PANELS

Filed April 20, 1964



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3,357,516

ACOUSTICAL PANELS

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Filed Apr. 20, 1964, Ser. No. 361,097

4 Claims. (Cl. 181-33)

The present invention relates generally to acoustical panels and more specifically to fibrous acoustical panels having acoustical openings punched or drilled into the porous interior from one face of the panel.

More specifically, this invention relates to the use of a layer of macroscopic particulate material over the punched or drilled face of acoustical panels to achieve certain unexpected benefits.

Still more specifically, this invention relates to the use of a layer of granular particulate material over the face of punched or drilled acoustical panels in order to achieve better aesthetics while at the same time improving certain acoustical properties, retaining other acoustical properties, and improving still other properties of the product.

A still further objective of this invention is to greatly upgrade what would otherwise be cull material to create a commercial product with enhanced functional properties.

Other and ancillary objects and advantages of the invention will become apparent from the following description and explanation of the invention as given herein-after with reference to the accompanying drawing in which:

The single figure shows an enlarged cross-section, somewhat schematically, of an acoustical panel of the invention.

Heretofore, one of the problems inherent in acoustical panels, particularly in fibrous acoustical panels, has been the relatively poor aesthetics of such panels due to the need for openings either drilled or punched into the face of the panel for acoustical purposes. The earlier acoustical panels had relatively large holes drilled into the face—generally of about 1/4 inch in diameter. Subsequently, it was found that by increasing the number of openings the hole sizes could be reduced to 1/8 inch or less, even as small as 3/64 or 1/32 inch with relatively little loss of acoustical properties. With the use of a multitude of these scattered small holes, considerable improvement in the aesthetics was obtained with little or no loss in acoustical properties. Nevertheless, it was still not possible to present a monolithic appearance on a large ceiling area because of the need to retain relatively large numbers of these small holes for acoustical purposes. In normal wood fiber or mineral fiber acoustical panels of this type the small holes are punched or drilled in a density of about 1500-1600 holes per square foot. This large number of holes, while preferable to a smaller number of large holes, still detracts from the potentially expansive look of the ceiling.

The panels have other disadvantages including problems of dimensional stability. In the larger sizes, such as 2 feet by 4 feet, these panels have a tendency to sag in the center under continued humid conditions. Generally, these products, particularly those of wood or mineral fiber are bound together with a hydrophilic binder. Examples of such binders are the usual wood fiber "paper-maker's bond" and added binders such as starch. When the binder is somewhat softened by high humid conditions, the weight of the panel will cause it to droop or sag out of shape. It has been found, quite surprisingly, that by the addition of granular particulate material in solid stable form, such as silica sand, to the face of the panel

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according to the present invention that this tendency to sag is not increased but is even slightly improved despite the fact that the weight of the panel is increased.

Still another difficulty inherent in panels of this type is the problem of sound attenuation. This relates to the passage of sound through the panel from one face to the other of the panel. Increasingly, as these panels are used in commercial construction, it is important that sound be kept from passing from the room of origin through the panel and into the space behind the panel and from thence downward through other panels into adjoining or nearby rooms. Various methods of improving the sound attenuation of these panels have been devised including coatings on the back of such panels and the lamination of films or metal foils to the back of such panels. Such techniques for improving sound attenuation, however, are sometimes detrimental to sound absorption. Frequently, for best sound absorption, some sound should pass entirely through the panel but with these back coatings or sheet laminations the passage of the sound through the panel is reduced. It has been found that by use of granular particulate material on the front face of the panel, according to this invention, the sound attenuation factor may be improved while at the same time not seriously deteriorating the acoustical absorption property of the panels.

It has also been found that by use of certain particulate materials as disclosed herein, particularly sand, the fire resistant properties of acoustical panels may be significantly enhanced.

With reference to the drawing, wherein a preferred embodiment is shown, the numeral 10 indicates a fibrous board or acoustical panel having inter-fiber void space and openings such as openings 12a, 12b and 12c punched or drilled therein. A prime coating 14 is applied to the top face of the board and dried and over this dry prime coat the first top pigmented coating 16 is applied. While the top coating 16 is still wet a layer of the selected macroscopic particulate material, such as the granular particulate material 18 shown in the drawing, is applied to the board in a layer substantially one particle thick. This application of the particulate material is accomplished by distributing an excess amount of such material evenly onto the wet top coating 16 and then removing the excess by application of vacuum over the surface of the board preferably before drying the coat 16. This procedure in using sand produces panels having from 0.210 to 0.220 pound of sand per square foot of panel. Thereafter, a final top pigmented coating shown in the drawing by the stippling 20, is applied over the retained granular material and the two top coatings 16 and 20 of the board are then dried. In this way the top coatings 16 and 20 secure the granular particulate material 18 to the prime-coated board and the top coat 20 imparts a uniform color to the face. It should be pointed out that the top coating 20 is applied lightly and, as such, does not flood the spaces between granules, though there may be some bridging of the coating between granules when two or more of them touch or come very close together. In this way, the top coating does not seal off the panel from the entrance of sound waves. Of course, the coats 14 and 16 are also applied such as to avoid sealing the openings 12 either by forming the openings after application of the coats or by applying the coats in a manner to avoid bridging the openings. In some instances, as where it is desired to reclaim panels that have scratches or other surface defects, there may already be one or more coats, usually dried, on the panel before the granule adhering coats 16 and 20 are applied. In any event, however, the openings are not blocked by the coats and thus remain open acoustically.

If the size distribution of the granules of the granular particulate material 18 is properly selected none of the

holes, or only the very smallest of the holes such as hole 12c, will be blocked. However, portions of grains of the granular material will extend over a portion of even the larger openings in some instances as shown at 12b. When properly selected the holes are nearly or totally obliterated from view; however, acoustical tests have shown that the holes remain largely acoustically open and function adequately to absorb sound. It has been found, for example, that the sound absorption is reduced only about 10%–20% despite the fact that practically all of the smaller openings and all but a few of the larger openings are hidden from view when the panels are viewed straight on and all of the openings are hidden from view when the panels are viewed at even a slight angle as is usual when the panels are in place in a ceiling.

When the particulate material has an acceptable color, either natural or by an applied coating on the particles, the second coating composition may be omitted, thus yielding a visual appearance which may be a mixture of the colors of the macroscopic particles and of the coat 16 which anchors them to the board. However, a final pigmented coat is preferred.

Any one of a number of macroscopic particulate materials may be used such as metal shavings or granular materials such as sand, walnut shell grit, perlite, glass beads, vermiculite, or the like. For various reasons, which are largely aesthetic, it is preferred to use a light colored round or partially round grain silica sand. While others of the above-mentioned materials may work satisfactorily, to achieve certain aesthetic properties, there may be some difficulties. For example, walnut shell grit being quite dark requires more coating material to achieve the same degree of light reflectance as a panel with sand on the face with a lesser amount of coating. For this and other similar reasons, naturally occurring round-grain sand is generally preferable.

The particular size of granules best suited for this use is somewhat difficult to pinpoint since it may be varied depending upon the hole size or sizes in the board and the aesthetics desired. As illustrative of the invention, however, the samples of sand listed in the following table were distributed by the procedure described above on perforated mineral fiber acoustical panels having 1596 openings per square foot distributed among four sizes, there being 199 openings of $\frac{3}{32}$ inch in diameter, 317 openings of $\frac{5}{64}$ inch in diameter, 460 openings of $\frac{1}{16}$ inch in diameter and 620 openings of $\frac{3}{64}$ inch in diameter. It will be seen from the following table that the granular size of the particulate material is best selected according to the hole sizes in the panel.

TABLE.—APPROXIMATE SCREEN ANALYSIS IN PERCENT BY WEIGHT

Screen, mesh/inch	Samples and Percent Retained on Screens				
	A	B	C	D	E
16		3.3	5	6.6	10
20	25	43.3	52.5	61.5	80
30	72	51.3	41	30.6	10
40	3	2	1.5	1.0	

In the table Samples A and E are commercially available sands having the screen analyses shown. Samples B, C and D are mixtures in various proportions, as indicated hereinafter, of Samples A and E. Sample B is $\frac{2}{3}$ by weight of Sample A and $\frac{1}{3}$ by weight of Sample E. Sample C is $\frac{1}{2}$ by weight of Sample A and $\frac{1}{2}$ by weight of Sample E. Sample D is $\frac{1}{3}$ by weight of Sample A and $\frac{2}{3}$ by weight of Sample E. The approximate screen analyses for Samples B, C and D were determined mathematically from the screen analyses of Samples A and E and from the amounts of each mixed to provide the other Samples B, C and D. For this reason, the total amounts in B

and D do not quite total 100—there being a small fraction lost in the mathematical computation. As used on the panels as above indicated, it was found that Sample A gave a panel that was somewhat less than aesthetically pleasing. The panel with Sample B sand applied was found to be marginally acceptable aesthetically. Samples C, D and E gave panels which were found to be quite satisfactory both aesthetically and acoustically. It will be seen from the table that Sample B had a screen analysis such that more 95% of the sand granules were retained on a No. 30 screen and more than 45% were retained on a No. 20 screen. While Sample B is not preferred, it being considered to be marginal to inadequate aesthetically, for certain applications the aesthetics may be thought by some to be pleasing and the acoustics are entirely adequate. In other words, the sand granule distribution in the sand used for application in the instant invention should be approximately as coarse as, and preferably coarser than, Sample B—particularly when used on the panels described above. Because of the relative scarcity of the coarser types of sand such as Sample E, it has been found that a 50–50 mixture of Sample A and Sample E giving the approximate screen distribution shown for Sample C is a completely adequate and satisfactory grain distribution for commercial use for panels having holes of approximately the size and distribution indicated above. It should be borne in mind that sand grain distribution, as mentioned above, has reference to the type of sand as applied and not as finally retained on the panels. It is believed, however, that the sand grain distribution of the sand retained is roughly comparable to the distribution of the sand applied.

As indicated previously, a variation in hole sizes may affect the coarseness of the sand which will be satisfactory. In addition, other macroscopic particulate materials which may be used, such as metal shavings, granular walnut shell grit or sand of less roundness, have different shapes and thus different hole-hiding properties for any selected size. Accordingly, the particle size distribution above disclosed for commercially available sands must be thought of as merely exemplary and not as limiting. Nor is it necessary that the particles be of a size distribution as indicated, but they could be all of a uniform size; however, a variation in size of the particles used is generally desirable aesthetically. The characteristics and quantity of particles used will to some degree depend upon the particular properties and a balancing of the properties desired such as the degrees of texture, hole obliteration, color, fire resistance and acoustics (both sound absorption and sound attenuation) preferred.

While the sand granules 18 are shown as being aligned in a straight row with the coating 20 shown as extending substantially in a line over the tops of the granules, it should be understood that this showing is only for the convenience of the draftsman. In actuality, of course, the sand granules are not in alignment but are distributed in a layer substantially one granule thick over the panel with the granules nestled together laterally without any appreciable open space between granules as a result of the method of application described above. Also, because of the method of application, for example by spraying, the coat 20 forms caps over the tops of the granules not just a line as shown.

We claim:

1. An acoustical panel comprising a rigid fibrous body having a multiplicity of inter-fiber voids for the absorption of sound, openings formed in one face of said body and extending therinto to communicate with said inter-fiber voids, said openings terminating short of the opposite face of said body, a layer of granular material substantially covering said one face of said panel, a paint-like coating on said panel serving to adhere said granular material to said one face, said granular material being of such a size and so arranged with respect to said openings as to hide substantially all of said openings when the panel is

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viewed obliquely without seriously obstructing the access of sound to said openings.

2. The product of claim 1 in which said body includes a hydrophilic binder to bind the fibers thereof into said rigid body.

3. The product of claim 2 in which the granules used to make said product are of such size that at least 95% thereof are retained on a No. 30 screen.

4. The product of claim 3 in which said granules are of such size that at least 45% thereof are retained on a No. 20 screen.

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