

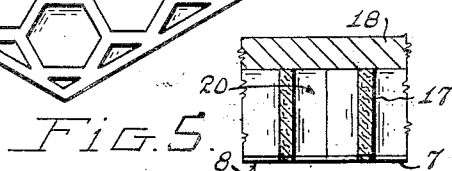
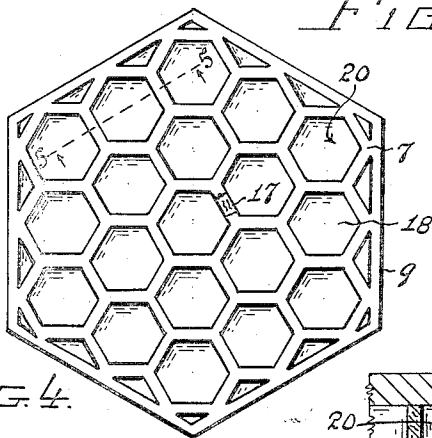
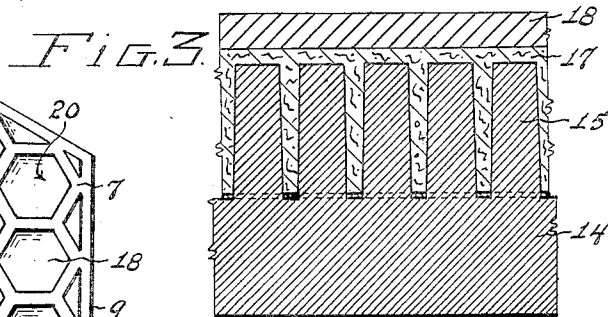
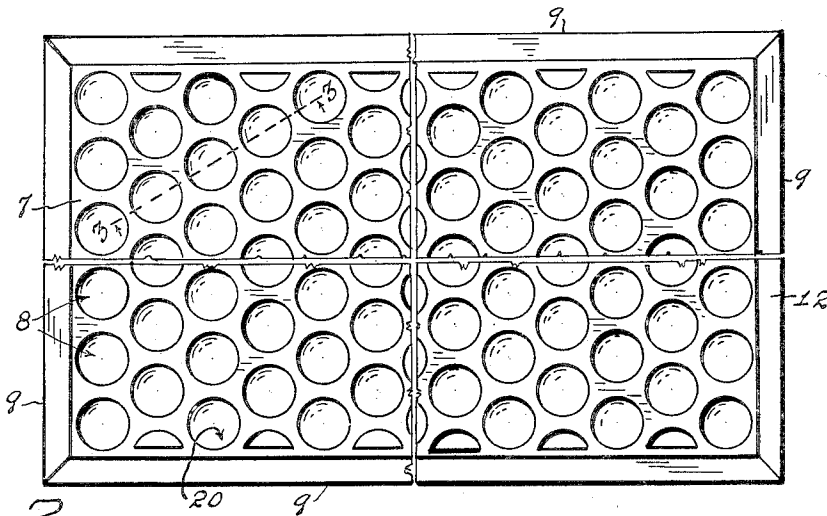
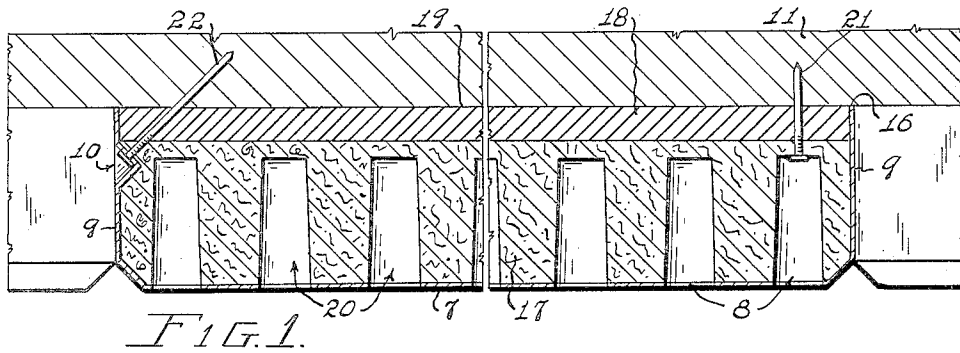
Sept. 17, 1935.

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2,014,749

ACOUSTIC TILE

Filed Feb. 1, 1933



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UNITED STATES PATENT OFFICE

2,014,749

ACOUSTIC TILE

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Application February 1, 1933, Serial No. 654,676

12 Claims. (Cl. 72—18)

The present invention relates to sound absorbing material and more particularly that type of product known as acoustic tile and which is adapted to complete manufacture prior to being applied to wall or ceiling.

An object of the invention is the provision of a highly efficient sound-absorbing tile provided with a durable exterior surface which may be painted or otherwise decorated without altering the efficiency of the tile as a whole.

One type of acoustic tile employed in present practice is a perforated pan or box filled with sound absorbing material which lies directly over the openings. The exposed area of material is of course limited to the extent of the total area of the perforations. This requires scientific spacing of the apertures with respect to their diameters and best results are had only when the diameter of the apertures is less than the spaces between them; this resulting in considerably less than one-half of the total area of the tile presenting sound absorbing material directly to sound waves.

My invention provides a tile having an exposed metal surface which is perforated but there is, practically speaking, no limit to the total area which the perforations may occupy and in fact the invention permits of having the diameter of each aperture greater than the distance between two adjacent apertures. The invention is further distinct in that it provides for exposing to the sound waves a total sound absorbing surface greater than the total area of all perforations combined and in fact greater than the total area of the tile.

Another type of tile presenting increased surface is composed of fibrous material worked into a composition board of relatively great density as compared with other well known sound absorbing media, and the outer surface of this board is perforated with drill holes running into the interior structure.

It is an object of the present invention to provide a tile presenting a perforated metal face; the perforations of which communicate with deep holes extending inwardly through a very resilient and porous sound absorbing material contained behind the metal face. Another object of the invention is to dispense with the cost and disadvantage of drilling the holes since drilling operations are expensive; the walls of a drilled hole are usually less porous than the structure in which the hole is drilled; chips may remain which later filter out and become generally troublesome; and, it is another object of

the invention to employ material that is so resilient and porous and so highly efficient acoustically as not to even permit of being drilled.

In fact the invention provides, and it is an object of the invention to provide, an acoustic tile which while distinct from previous types possesses in addition to unique advantages of its own the advantages ascribed to the aforesaid types without the use of the structural features of either.

Finished appearance and properly concealed anchorage, at minimum expense, is another object of the invention. Composition board, unless the edges are carefully finished does not provide the finished appearance that I desire to obtain by this invention whereas the metal box type of tile with its loosely articulated contents does not permit of being attached to a ceiling except by the use of complicated and costly attaching means; usually in the form of tracks in which boxes or pans are suspended.

In this connection it is another object of my invention to not only provide a tile of finished appearance and properly abutting edges, but to provide a tile which while containing a loosely articulated sound absorbing material is of great structural strength and which may be nailed or glued in place at minimum expense, and in such manner that all anchorage is concealed.

Other objects of the invention include; fire proof qualities; inorganic material; durability to permit of stacking, packing and shipping; mass production methods for manufacture and low cost throughout.

In many applications of my tile toe-nailing may be employed to anchor same altho the invention provides that the tile may be secured by nails driven directly through the tile from the outer surface without the nail being exposed to view.

As a rule, the more efficient a sound absorbing material, the greater its first cost. An object of this invention is to provide for maximum sound absorbing surface with the minimum of material and with the use of the higher grades of material. Through my invention there can be no loss of material by reason of waste material from drilled holes, while the total volume or bulk of material used is less, with respect to the total exposed surface area than in the present types of acoustic tile.

In this connection I have discovered that whereas in sound absorbing material laid parallel to a wall surface a given depth is required to meet the usual requirements and specifications;

it is possible to obtain results with a lesser bulk of material by having surfaces of the material disposed at right angle to the wall or ceiling. In a tile measuring 12 inches by 14 inches and having a total bulk of 168 cubic inches it is possible to have as much as 500 square inches of exposed sound absorbing surface or three times as much as the surface area; which is equivalent to obtaining all the benefits of one inch thickness of material with the use of only enough material to spread over the ceiling or wall surface to a depth of one-third of an inch in thickness.

Expressed in still other terms, I have discovered that where a mass of sound absorbing material provides opposed surfaces extending normally of the wall surface, and both surfaces of the material are exposed to sound waves, a given sound absorbing result can be obtained with less bulk of material, or less depth between the two surfaces than would be the depth of material required between one sound absorbing surface and a solid wall surface.

My invention while broad in its scope and not limited to the structure about to be described, is more readily understood from an explanation of one practical embodiment thereof; said embodiment being shown in the accompanying drawing in which:

Figure 1 is a vertical sectional view showing a plurality of one embodiment of tile applied to a ceiling.

Figure 2 is a face view of the tile.

Figure 3 is a vertical fragmentary section of the tile in the act of being manufactured; the view showing certain moulding appliances used in connection therewith.

Figure 4 is a fragmentary face view of a modified form of tile and Figure 5 is a cross section on line 5—5 of Figure 4.

More specifically, Figure 1 indicates a metal box or pan having a bottom wall, 7, provided with closely spaced and relatively large apertures, 8; the latter preferably so arranged that the maximum distance from two adjacent margins of spaced openings is not greater than the diameter of the openings itself and so that the total area of openings is equal to at least the area of the remaining metal. The box is further provided with encompassing vertical side walls, 9, 9, etc.; the latter being imperforate except for a nail hole such as 10 in each side wall.

The box is formed with beveled edges to give the proper appearance to the finished tile and either before or after application to a ceiling such as 11, the outer surface 12 of the box may be suitably decorated. It is understood that the arrangement of apertures 8; their spacing and size, is such that a great multiplicity of them appearing in an otherwise co-extensive surface does not prevent carrying out any decoration scheme and the individual apertures do not appreciably detract from the appearance of a co-extensive surface. It is also provided that the material visible slightly through the apertures may be of the same color as that of the surface 12 of the box.

In the manufacture of the tile, I provide a matrix consisting of a base plate, 14, provided with a multiplicity of vertical core pegs, 15; one for each of the many apertures in each tile. The box is placed with surface, 12, in contact with the base plate, 14, so that each aperture, 8, is closed by a corresponding peg which extends into the interior of the box a suitable depth. The pegs are preferably slightly tapered and termi-

nate slightly below the upper edges, 16, of the box.

With the box in such position it is filled to a point just above the pegs with the sound absorbing material, 17. This may be any mixture of suitably porous material and a binder, such as pellets of pumice with a binder, mica composition or ex-foliated vermiculite; asbestos fibre with a binder, or mineral wool in any of the usual commercial forms with a binder comprising just enough silicate of soda to hold the material in place without detracting from its high sound absorbing values. As will appear hereinafter the structural strength of the tile as a whole is not in any way dependent upon the material, 17.

It will be apparent now that the total volume of space between pegs is considerably less than the total volume of the box and that less material is employed than if the box were without the pegs. Also less expensive material may be employed as for instance in the case of mineral wool short fibres in the form of shredded or balled wool may be used in place of the usually more expensive pads or quilts.

When the box has been practically filled with the material, 17, a more dense molding material, or the like, is placed in the upper part of the box overlying the material, 17, as at 18. The material should be of such strength as to form a top wall and a top surface, 19, for the box. This may be done by using a greater amount of binder in the material, 17, at the top of the box or by pouring or moulding therein another denser substance such as asphalt, cement or the like. Preferably, the material should present the surface, 19, of such nature that it may be glued or cemented to another surface and it should not be dense enough to detract from sound absorbing qualities. The wall, 18, of the box now becomes a part thereof; becoming joined or bonded to the side metal walls, 9, 9, etc.

The tile, immediately after the material, 17, and the material, 18, are in place, may be removed from the matrix and set aside to dry until cured. The nature of the binder used depends upon the time required for drying and also determines how quickly the tile may, or should be, removed from the matrix.

When the tile is finished by drying the space taken up by each peg during molding leaves the corresponding deep cavity, 20, aligned with the corresponding aperture and having a total surface, 21, of far greater total area than that of the aperture, 8.

The material between the cavities is of lesser thickness than the tile as measured normally to the surface, 8, and the total area of surfaces of the cavities may be many times that of the total area of tile surface and apertures combined, while the total volume of the cavities is about one-half the total cubic contents of the tile.

By reason of the tapered pegs the material between cavities is of slightly increasing thickness upwardly while the surfaces of the cavities are slightly declined from the vertical.

Sound waves rising directly normal to the surface of the tile will enter the cavities and strike either the declined side walls thereof or strike the very innermost end of the cavities while those reaching and entering the apertures at angles are reflected further inwardly.

Those skilled in the art will realize at a glance that the total area and relative disposition of the surfaces surrounding the cavities is conducive to high sound-absorbing efficiency while those

skilled in the manufacturing arts to which this appertains will realize that low manufacturing cost and high-speed production is possible by reason of this invention.

5 The modification shown in Figures 4 and 5 shows the apertures of hexagonal shape and since the cavities are produced by moulding there is no limit to the shapes that may be employed. By using the hexagonal shapes and the spacing
10 shown, the remaining metal surface of the box is composed only of interconnected strips of material and the material, 17, forms itself into a crossing arrangement of relatively thin depending curtains which by reason of the structure of the
15 tile as a whole are held substantially while having all the advantageous properties for which they are intended.

Thus it will be seen that by using relatively large openings and close spacing and great cavity
20 depth, the total area of apertures may be as great or greater than the area of the unperforated surface of the tile while the total internal surface area of the cavities may be many times that of the total area occupied by the tile.

25 While the top wall of the tile permits of same being cemented or glued directly to a surface, and while the tile may be caused to adhere even to a ceiling surface by setting it in place while the composition of the top wall is still tacky enough
30 to hold, and so that the tile may cure while in place, it is also possible to keep the tile in stock and later secure them in place by nails such as 21 or 22.

The nail, 21, is driven into an aperture, and then
35 by the use of a suitably long center punch (not shown) may be driven home until it is out of sight and until its head abuts the more dense material, 18. Or again, the tile may be secured as by toenailing with the nail, 22, passing obliquely through
40 the aperture therefor provided as at 10 in the side wall, so that the nail passes through the structure and into the ceiling or wall to which the tile is applied.

Considering the finished product structurally,
45 the perforated bottom wall, the imperforated side walls which are an integral part of the box, and the moulded top wall which becomes substantially an integral part of the box, form a complete six sided hollow box of light weight, low
50 cost and great strength. The remaining interior volume is occupied by a relatively resilient structure of the material, 16, which is held gently but immovably between the top and bottom walls and this structure is cellular both by reason of the
55 cellular material of which it is composed and by reason of the great multiplicity of outwardly opening cavities alining with the apertures in the bottom or outer wall.

The tile may be handled and nailed as freely as
60 if it were one solid piece and in fact more so since while equally as strong it is not given to splitting, warping or other deformation to which solid moulded products are inclined.

The invention is not limited to the specific structures and materials mentioned herein and is of a
65 broad nature; the scope of the invention being set forth by the appended claims.

I claim:

1. In an acoustic tile, a hollow metal box comprising integral side walls, an integral perforated
70 bottom wall and a substantially integral top wall, the walls enclosing a cellular sound-absorbing material normally unsuited to direct exposure contained in the interior of said box, the cellular material being provided with a plurality of molded
75

cavities corresponding in number and spacing to the perforations in said bottom wall, each cavity in communication with a corresponding perforation and presenting an internal wall surface of greater area than said perforation.

2. In an acoustic tile, a hollow box comprising rigid bottom, top and interconnecting side walls respectively providing a hollow interior, the bottom wall being provided with a plurality of closely spaced perforations communicating with said interior, and a cellular sound-absorbing structure normally unsuited to direct exposure contained in said interior, said structure provided with a plurality of deep cavities moulded in said material, the cavities corresponding in number and spacing to the perforations with each cavity in direct communication with the corresponding perforation, the cavities providing a total internal wall surface area greater than the total area of said bottom wall.

3. In an acoustic tile, a metal box having a bottom wall provided with closely spaced apertures, vertical side walls to said box, a cellular sound absorbing material in said box overlying said bottom wall, and a denser material molded in said box over said cellular material and forming a top wall to said box joined to said side walls, the cellular sound absorbing material being moulded with a plurality of deep cavities corresponding in number and spacing to said apertures and each cavity in direct communication with the corresponding aperture, the total of all cavities providing a combined internal wall surface area greater than the area of said bottom wall.

4. In an acoustic tile a metal bottom wall provided with closely spaced apertures, encompassing side walls rising from said bottom wall, angular indentations in said side walls providing for nailing the tile to a ceiling, and a mass of cellular material in the space enclosed by said walls, said material being of lesser structural strength than the material of said walls.

5. In an acoustic tile a metal bottom wall provided with closely spaced apertures, encompassing side walls rising from said bottom wall, angular indentations in said side walls providing for nailing the tile to a ceiling, and a mass of cellular material in the space enclosed by said walls, said material being of lesser structural strength than the material of said walls and said material moulded with a plurality of deep cavities, one for and alined with each of the corresponding apertures in said bottom wall.

6. In combination with a ceiling, a moulded mass of sound absorbing moulded material paralleling said ceiling and provided with a plurality of originally moulded inwardly extending deep cavities dividing said material into a plurality of interconnected depending curtains of said material providing vertical sound absorbing surfaces of a total area greater than the area of the ceiling occupied by said material and means for retaining said material comprising a sheet of metal perforated so that the remaining metal is distributed coextensively of the bottom edges of said curtains and means for securing said perforated sheet relative to said ceiling and in supporting contact with said material.

7. In combination with a ceiling, a metal box comprising a perforated bottom wall and integral side walls, a porous sound-absorbing material moulded in said box and provided with a plurality of cavities extending each from a corresponding perforation of said bottom wall in-

wardly of the box, a more dense material moulded in the top of said box forming a substantially integral top wall to said box, and means holding said top wall of said box in contiguity with said ceiling.

8. In combination with a ceiling, a metal box comprising a perforated bottom wall and integral side walls, a porous sound-absorbing material moulded in said box and provided with a plurality of cavities extending each from a corresponding perforation of said bottom wall inwardly of the box, a more dense material moulded in the top of said box forming a substantially integral top wall to said box, and means holding said top wall of said box in contiguity with said ceiling, comprising a nail driven through one of said apertures and the corresponding cavity through said porous material and said top wall until the nail shall have become obscured.

9. In an acoustic tile, a polygonal box comprising a bottom wall and vertical side walls, a plurality of perforations in said box each of the same shape as said box and arranged so that the remaining material in the bottom wall of said box is divided into a plurality of interconnecting strips of uniform width, the total area of said strips being less than the total area of the perforated areas of said bottom wall, and a sound absorbing material moulded in said box with deep cavities, one for and communicating with each perforation whereby the said material is divided into a plurality of depending interconnected curtains of greater depth than thickness.

10. In a sound absorbing body, the combina-

tion of a perforated thin and relatively rigid sheet of surface material, a porous sound absorbing cellular structure normally unsuited to direct exposure supported thereby in contiguity therewith, said structure having deep cavities moulded therein; one for and aligned with each perforation, and means for retaining said structure in position with respect to said perforated sheet.

11. In a sound absorbing body, the combination of a perforated thin and relatively rigid sheet of surface material, a porous sound absorbing cellular structure normally unsuited to direct exposure supported thereby and in contiguity therewith, said structure having deep cavities moulded therein; one for and aligned with each perforation and of the same diameter as the corresponding perforation at the plane of the sheet, and means for retaining said structure with respect to said sheet.

12. In a sound absorbing body, the combination of a perforated thin and relatively rigid sheet of surface material, a porous sound absorbing cellular structure normally unsuited to direct exposure supported thereby and in contiguity therewith, said structure having deep cavities moulded therein; one for and aligned with each perforation and of the same diameter as the corresponding perforation at the plane of the sheet, and means for retaining said structure with respect to said sheet; the said structure being of limited structural strength and normally unsuited for direct exposure.

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