May 22, 1962 C. G. LEMON 3,035,657

ACOUSTIC PANEL

Filed Dec. 22, 1959 2 Sheets-Sheet 1

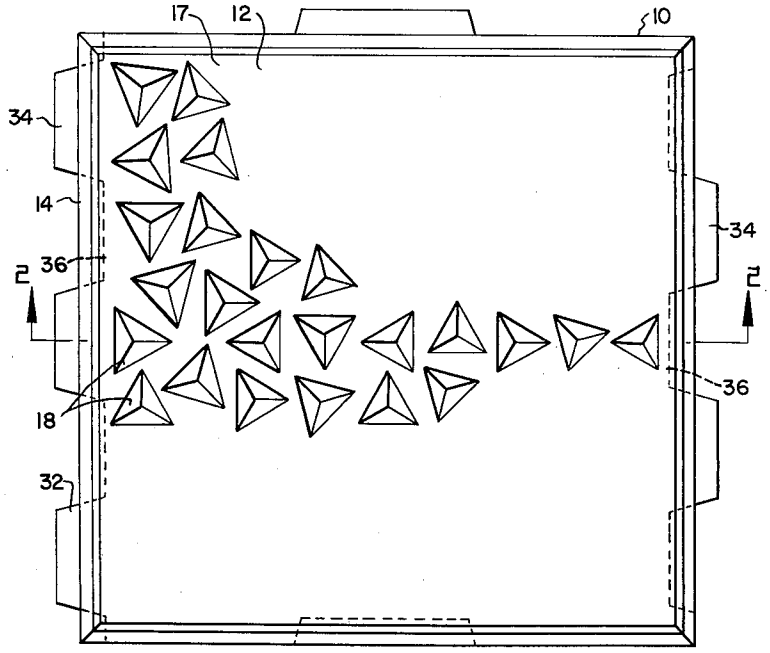


Fig. 1.

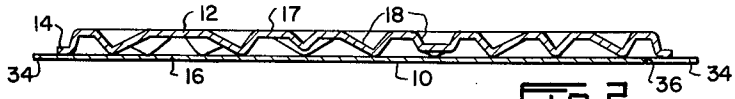


Fig. 2.

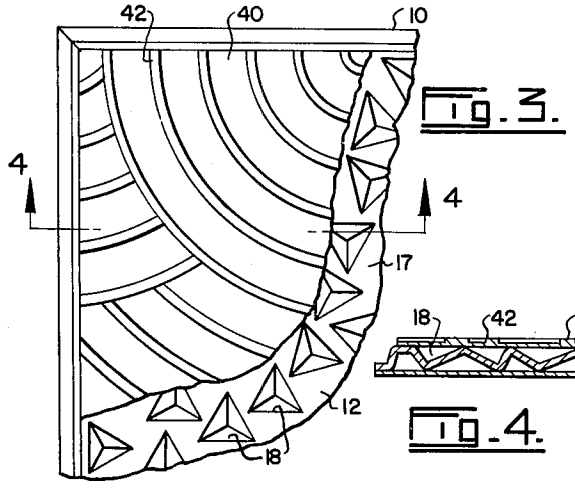


Fig. 3.

Fig. 4.

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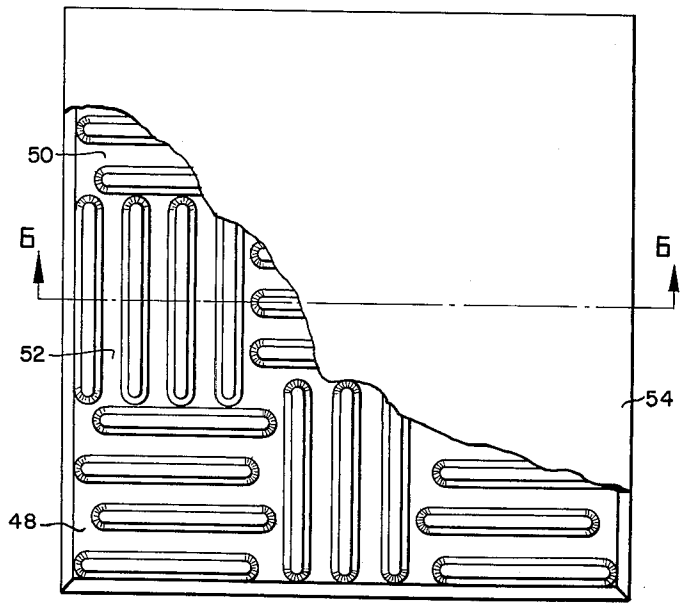


Fig. 5.

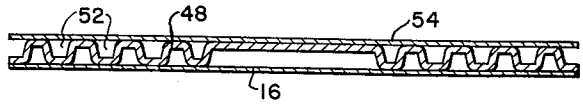


Fig. 6.

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ACOUSTIC PANEL

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This invention relates to acoustic panels and in particular to acoustic panels suitable for application to the inner walls and ceilings of buildings.

In the design of buildings, an important consideration is that of controlling the distribution of sound in the individual rooms thereof and of controlling the transmission of sound from one room to another. Many methods have been proposed hereto for modifying the sound distribution pattern within buildings and these usually involve the use of suitable sound absorbent and reflecting materials. One of the most commonly employed techniques is to cover some or all of the wall and ceiling surfaces with sound absorbent panels or acoustic tiles. These panels are generally formed from a suitable porous material such as fiberboard or similar porous materials and plaster compositions and are often provided with a perforated surface in order to maintain the absorption of the panels upon subsequent painting of the panels which would otherwise seriously affect their performance. The perforated acoustic panel, however, is not an entirely satisfactory solution to this problem and is objectionable on hygienic grounds since it acts as a trap for dust and is difficult to clean. It is also often objectionable on aesthetic grounds since it is frequently undesirable to have a perforated surface finish.

It is an object of the present invention to provide an acoustic panel which overcomes these disadvantages and provides a high degree of sound absorption together with high attenuation of any sound reflected from the panel.

It is another object of the invention to provide an acoustic panel which is of light weight and inexpensive construction and which can easily be rendered fire resistant.

Another object of the invention is to provide an acoustic tile which can be applied to a wall or ceiling in the same way as ordinary panelling and which can be provided with a variety of decorative surface finishes.

A still further object of the invention is to provide an acoustic panel which may be easily interlocked thereby facilitating the application of a plurality of the panels to a wall or ceiling.

In accordance with these objects, the present invention contemplates the provision of a panel comprising a backing member and a sheet of cellular material formed on one face thereof with a plurality of randomly disposed cavities, each of said cavities projecting downwardly into abutment with the backing member, said sheet bonded to said backing member adjacent the peripheral edge thereof and at the lowermost extremities of said cavities to provide an air chamber between said sheet and said backing member, said air chamber divided by said cavities into a plurality of irregular interconnected air cells effective to attenuate sound energy entering therein through said sheet.

Preferably the backing member is provided with alternating edge projections and recesses adapted to interengage with complemental edge portions of the backing members of adjoining panels thereby to facilitate the assembly of a number of said panels to form a wall or ceiling surface. Also, if desired, a plain or decorative cover sheet substantially co-extensive in area with the interrupted surface of the cellular sheet may be bonded thereto, thereby to seal off the open tops of the cavities to form a plurality of individual sealed air cells between

the cover sheet and the cellular sheet which further increase the sound absorption characteristics of the panel.

Other features of the invention will be described hereinafter and referred to in the appended claims.

The invention is illustrated in the accompanying drawings which show exemplary embodiments of the invention and in which,

FIGURE 1 is a top plan view of one embodiment of the invention,

FIGURE 2 is a sectional view taken on the line 2—2 of FIGURE 1,

FIGURE 3 is a top plan view, partly in section, of another embodiment of the invention,

FIGURE 4 is a sectional view taken on the line 4—4 of FIGURE 3,

FIGURE 5 is a top plan view, partly in section, of a further embodiment of the invention, and

FIGURE 6 is a sectional view taken on the line 6—6 of FIGURE 5.

Referring to the drawings, the panel indicated generally at 10 consists of a sheet 12 formed with a peripheral flange 14 and secured to a backing member 16 which may be of cardboard or other suitable material. The sheet 12 is preferably fabricated by slush or vacuum moulding of waste paper pulp to the desired shape and it is provided on its upper surface 17 with a plurality of randomly disposed cavities 18. The cavities 18 may be of any suitable form but in the embodiment shown in FIGURES 1 to 4 they are of inverted pyramidal form, the sides of the cavities sloping downwardly and inwardly from their upper ends towards the centre of the cavity and the depth of the cavities being such that the lower surfaces of the cavities are co-planar with the lower edge of flange 14. By forming the cavities in this manner, the surface of the moulded sheet 12 is broken up into a multiplicity of randomly disposed planes whereby sound is absorbed and light incident on the surface of the panel is broken up and more uniformly diffused. In assembling the panel, the moulded sheet 12 is placed over the backing member 16 so that the undersurface of flange 14 contacts the backing member 16 and the base of each of the cavities 18 abuts against the backing member. The moulded sheet 12 is secured to the backing member 16 by coating the contacting surfaces of either the moulded sheet 12 or the backing member 16 or both with a suitable heat curing adhesive and clamping the two components together whilst applying heat thereto for a time sufficient to bond the moulded sheet 12 to the backing member 16 thereby to form a rigid panel. With the panel assembled in this manner, an air chamber is formed between the moulded sheet 12 and the backing member 16, this air chamber being divided by the cavities 18 intto a series of irregular interconnected air cells. The air trapped in these air cells is an excellent sound insulator and effectively attenuates any sound energy entering the panel thereby minimizing the sound transmission through the panel whilst the little sound energy not absorbed by the panel is uniformly diffused by the interrupted surface thereof. The interrupted surface of moulded sheet 12 which is broken up into a multiplicity of randomly disposed planes by the cavities 18 is effective to prevent regularly spaced reflections and focussing of any sound not absorbed by the panel and ensures that light incident on the panel and any sound reflected from the panel is evenly diffused through the enclosure of which the panel forms a part.

Preferably a pair of opposite edges, or all four edges, if desired, of the backing member 16 are castellated as at 32 to form a series of tabs 34 protruding beyond the edge of the moulded sheet 12 and alternating with a series of complemental incuts or recesses 36. The tabs and recesses on opposite edges of backing member 16 are stag-

gered relative to each other. With this arrangement, the fabrication of a wall or ceiling from these panels is facilitated since the panels may be interlocked by engaging the tabs 34 and recesses 36 of one panel with the complemental recesses and tabs respectively of the adjoining panels.

In many applications, it may be desirable to provide the panel with a decorative or with a plain surface finish. In such cases, see FIGURES 3 and 4, a cover layer 40 which may have a suitable design 42 embossed or otherwise applied thereto and substantially co-extensive in area with the moulded sheet 12 is bonded as by a suitable adhesive to the upper interrupted surface of the moulded sheet. This cover layer is effective to seal off the cavities 18 in the moulded sheet 12, thereby providing a group of individual sealed air cells between it and the moulded sheet. These air cells co-operate with the group of irregular interconnected air cells between the moulded sheet 12 and the backing member 16, further to increase the sound absorption characteristics of the panel.

In an alternative form of the invention, shown in FIGURE 5 and 6, the upper surface of the moulded sheet 48 is formed with a network of groups of mutually parallel grooves 50, the base 52 of each groove making line contact with the backing member 16 and being bonded thereto by means of a suitable adhesive. In this manner, therefore, the upper surface of the moulded sheet 48 is broken up in a similar manner to that of the first described embodiment and the air chamber between the moulded sheet 48 and the backing member 16 is divided into a series of irregular interconnected air cells. If desired, the backing member may be provided with alternating edge projections and recesses adapted to interengage with the complemental edge portions of the backing members of adjoining panels thereby facilitating the assembly of a plurality of the panels to form a wall or ceiling facing. A suitable plain or decorative surface finish may be given to the panel by bonding a cover layer 54 to the upper interrupted surface of the panel.

The panels fabricated in accordance with this invention may easily be rendered fireproof by treating the completed panel with a fire-resistant solution or by painting it with a suitable fire-resistant paint or alternatively suitable fire resistant materials may be incorporated in the materials from which the panel is fabricated.

What I claim as my invention is:

1. An acoustic panel comprising a backing member and a sheet of cellular material, said sheet sealed adjacent the periphery of one face thereof to the backing member and spaced therefrom over a substantial part of its area thereby to form an air chamber between the sheet and the backing member, said sheet formed on its other face with a plurality of cavities each of said cavities projecting downwardly from said other face, the lowermost portions of the sheet which define said cavities abutting said backing member and being bonded thereto, thereby to divide said air chamber into a plurality of interconnected air cells effective to attenuate sound energy entering said panel, the walls of said cavities disposed in a multiplicity of planes irregularly inclined relative to the plane of said sheet and adapted uniformly to diffuse sound and light incident thereon not absorbed by said panel.

2. An acoustic panel comprising a sheet of moulded pulp material, said moulded sheet provided with a peripheral flange depending therefrom and plurality of randomly disposed cavities in one face thereof, the depth of said cavities being such that the lowermost portion of the sheet which define said cavities are co-planar with the lower edge of said flange and the walls of said cavities sloping downwardly and inwardly from said face to form a multiplicity of randomly disposed surfaces effective uniformly to absorb sound and diffuse light energy incident thereon; and a backing member secured to said moulded sheet adjacent the lower edge of said flange and the lowermost parts of the sheet portions defining said cavities thereby to form an air chamber between said moulded sheet and said backing member, said air chamber divided by said cavities into a plurality of irregular interconnected air spaces effective to attenuate sound energy entering said panel through said moulded sheet.

3. An acoustic panel comprising a backing member; a sheet of moulded cellular material, said moulded sheet sealed adjacent the periphery of one face thereof to the backing member and spaced therefrom over a substantial part of its area thereby to form an air chamber between the moulded sheet and the backing member, said moulded sheet formed on its other face with a plurality of irregularly placed cavities, each of said cavities projecting downwardly from said other face and the lowermost parts of the sheet portions defining said cavities abutting said backing member and bonded thereto, thereby to divide said air chamber into a plurality of interconnected air cells effective to attenuate sound energy entering said panel; and a cover sheet substantially co-extensive in area with said other face of the moulded sheet and bonded thereto, thereby to seal off the open tops of said cavities to form a group of individual sealed air cells between said cover sheet and said moulded sheet adapted further to attenuate sound energy entering said panel.

4. An acoustic panel comprising a backing member and a sheet of moulded cellular material, said moulded sheet sealed adjacent the periphery of one face thereof to said backing member, and spaced therefrom over a substantial part of its area thereby to form an air chamber between the moulded sheet and the backing member, said moulded sheet formed on its other face with a plurality of randomly disposed cup-like cavities, each of an inverted pyramidal shape, the sides of said cavities sloping downwardly and inwardly from their upper base ends towards the centre of the cavity and the lowermost parts of the sheet portions defining said cavities abutting said backing member and bonded thereto, thereby to divide said air chamber into a plurality of irregular interconnected air cells effective to attenuate sound energy entering said panel, the walls of said cavities disposed in a multiplicity of randomly disposed planes inclined relative to the plane of said sheet and adapted uniformly to absorb sound and diffuse light incident thereon not absorbed by said panel.

5. An acoustic panel comprising a backing member and a moulded sheet of cellular material, said moulded sheet sealed adjacent the periphery of one face thereof to said backing member and spaced therefrom over a substantial part of its area, thereby to form a closed air chamber between the moulded sheet and the backing member, said moulded sheet formed on its other face with a plurality of grooves, said grooves formed in mutually perpendicular interconnected groups each of said grooves projecting downwardly from said other face and the lowermost parts of the sheet portions defining said grooves abutting said backing member and being bonded thereto, said grooves effective to divide said air chamber into a plurality of irregular interconnected air cells adapted to attenuate sound energy incident on said panel.

6. An acoustic panel consisting of a backing member and a sheet of moulded cellular material, said moulded sheet having a peripheral flange depending therefrom and provided with a plurality of randomly disposed cavities on one face thereof, each of said cavities projecting downwardly from said one face thereof and the lowermost parts of the portions of said sheet which define said cavities abutting said backing member, said moulded sheet bonded to said backing member adjacent the lower edge of said peripheral flange and at the lowermost parts of the sheet portions defining said cavities to provide an air chamber between said moulded sheet and said backing member, said air chamber divided by said cavities into a plurality of irregularly shaped interconnected air cells effective to

attenuate sound energy entering therein through said moulded sheet.

7. An acoustic panel as claimed in claim 6 including a cover sheet substantially co-extensive in area with said one face of the moulded sheet and bonded thereto to seal off said cavities, thereby to form a plurality of individual air cells between said cover sheet and said moulded sheet.

8. An acoustic panel as claimed in claim 6 wherein said backing member is provided with alternating edge projections and recesses adapted to interengage with complemental edge portions of the backing members of adjoining panels.

9. An acoustic panel comprising a backing member, a sheet of moulded cellular material, said moulded sheet sealed adjacent the periphery of one face thereof to the backing member and spaced therefrom over a substantial part of its area thereby to form an air chamber between the moulded sheet and the backing member, said moulded sheet formed on its other face with a plurality of irregularly placed cavities, each of said cavities being of inverted pyramidal shape, the sides of said cavities sloping downwardly and inwardly from their upper base ends and the lowermost portions of the sheet which define said cavities abutting said backing member and being bonded thereto, thereby to divide said air chamber into a plurality of interconnected air cells; and a cover sheet substantially co-extensive in area with said other face of the moulded sheet and bonded thereto, thereby to seal off the open tops of said cavities to form a group of individual sealed air cells between said cover sheet and said moulded sheet, said air cells effective to attenuate sound energy entering said panel.

10. A sound absorbent panel comprising a backing member and a sheet of cellular material bonded along its peripheral edge to said backing member to form an air chamber between the cellular sheet and the backing member, said cellular sheet formed on one face with a plurality of randomly disposed cavities projecting downwardly from said one face, the lowermost parts of the portions of said sheet which define said cavities abutting said backing member and being bonded thereto, said air chamber being divided by said cavities into a plurality of irregularly shaped interconnected air cells.

11. A panel as claimed in claim 10 including a cover sheet substantially co-extensive in area with the interrupted surface of said cellular sheet and bonded thereto,

thereby to seal off the open tops of said cavities to form a group of individual sealed air cells between said cover sheet and said cellular sheet.

12. A panel as claimed in claim 10 wherein said backing member is provided with alternating edge projections and recesses adapted to interengage with complemental edge portions of the backing members of adjoining panels.

13. A sound absorbent panel comprising a backing member and a sheet of cellular material bonded along its peripheral edge to said backing member to form an air chamber between the cellular sheet and the backing member, said cellular sheet formed on one face with a plurality of randomly disposed cup-like cavities, each of an inverted pyramidal shape, the sides of said cavities sloping downwardly and inwardly from their upper base ends towards the centre of the cavity the lowermost parts of the portions of said sheet which define said cavities abutting said backing member and being bonded thereto, thereby to divide said air chamber into a plurality of irregularly shaped interconnected air cells.

14. A panel as claimed in claim 13 including a cover sheet substantially co-extensive in area with the interrupted surface of said cellular sheet and bonded thereto, thereby to seal off the open tops of said cavities to form a group of individual sealed air cells between said cover sheet and said cellular sheet, and wherein said backing member is provided with alternating edge projections and recesses adapted to interengage with complemental edge portions of the backing members of adjoining panels.

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