

April 6, 1965

S. LIGHTER
ACOUSTIC PANELS

3,176,789

Filed Jan. 26, 1962

4 Sheets-Sheet 1

FIG. 1

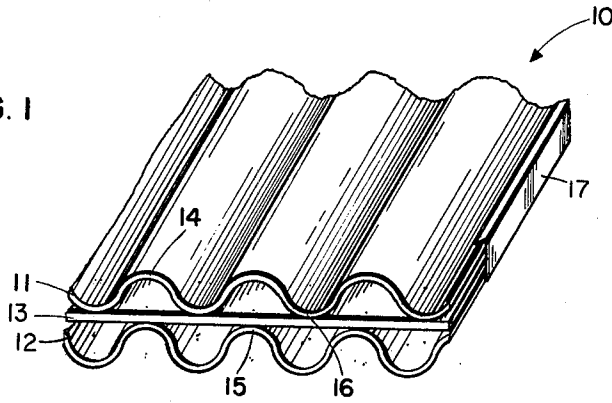


FIG. 2

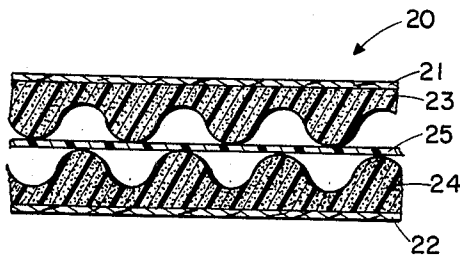
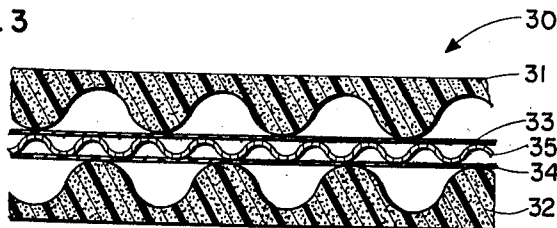


FIG. 3



INVENTOR.
STEPHEN LIGHTER
BY *John E. Diehl*
ATTORNEY

April 6, 1965

S. LIGHTER
ACOUSTIC PANELS

3,176,789

Filed Jan. 26, 1962

4 Sheets-Sheet 2

FIG. 4

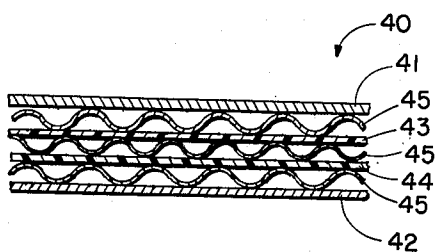
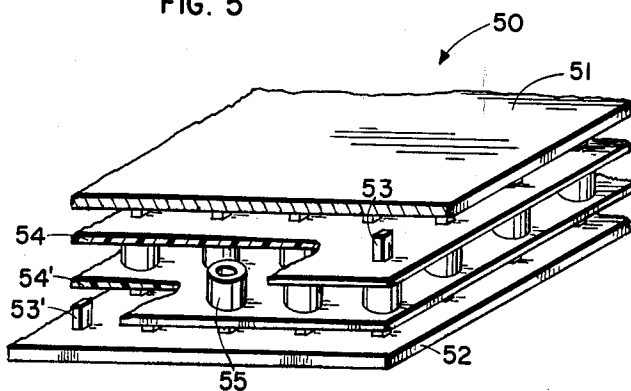


FIG. 5



INVENTOR.
STEPHEN LIGHTER
BY *John E. Pich*
ATTORNEY

April 6, 1965

S. LIGHTER
ACOUSTIC PANELS

3,176,789

Filed Jan. 26, 1962

4 Sheets-Sheet 3

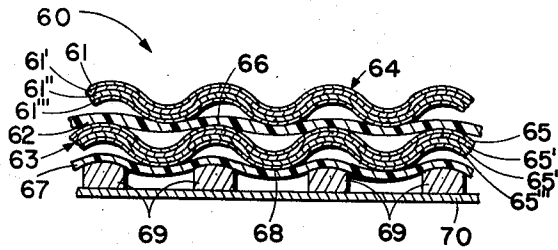


FIG. 6

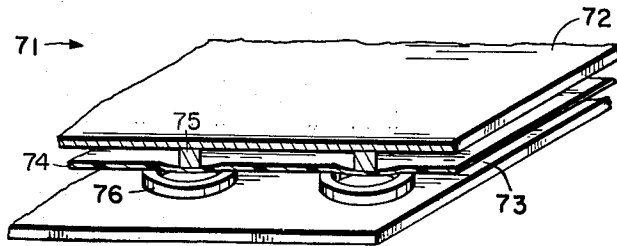


FIG. 7

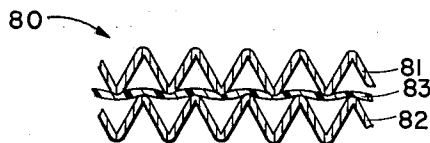


FIG. 8

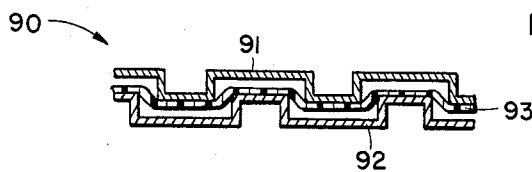


FIG. 9

INVENTOR.
STEPHEN LIGHTER
BY *John E. Diehl*
ATTORNEY

April 6, 1965

S. LIGHTER
ACOUSTIC PANELS

3,176,789

Filed Jan. 26, 1962

4 Sheets-Sheet 4

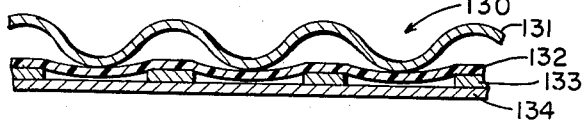


FIG. 13

FIG. 10

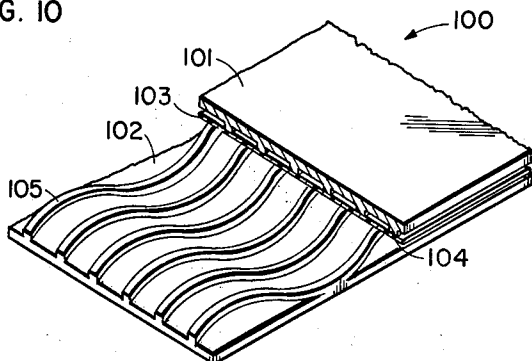


FIG. 11

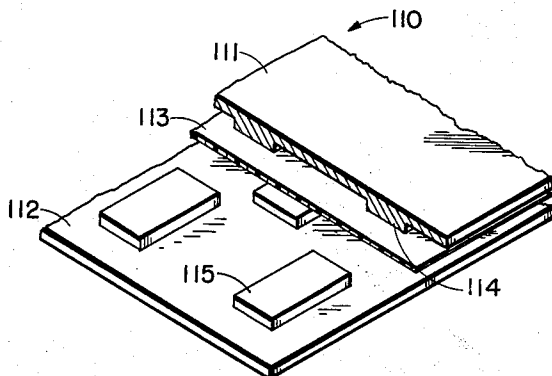
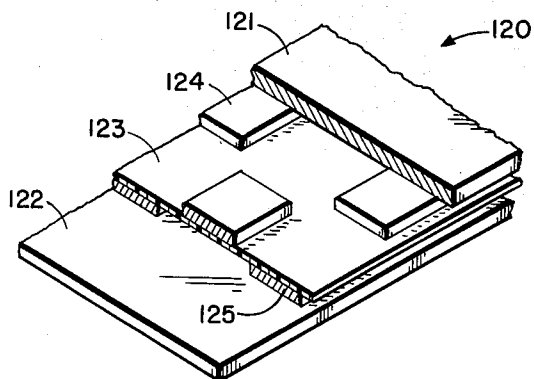


FIG. 12



INVENTOR
STEPHEN LIGHTER
BY *John E. Divil*
ATTORNEY

1

3,176,789

ACOUSTIC PANELS

Stephen Lighter, 3522 Lake Mendota Drive, Madison, Wis.

Filed Jan. 26, 1962, Ser. No. 168,901

15 Claims. (Cl. 181—33)

This invention relates to acoustic panels for use in the interior of buildings such as for use as office walls and the like, and more particularly relates to a sandwich panel comprising two relatively rigid facing panels having non-planar facing surfaces in contact with a non-rigid film interlayer. The rigid facing panels are in all cases resiliently separated by the film interlayer which provides a flexible resilient barrier to acoustic vibrations transmitted through the panels.

The acoustic panel of this invention may be transparent, translucent, or opaque, and may be textured, fluted or planar, as desired.

It is an object of this invention to provide an acoustic panel.

It is another object of this invention to provide an acoustic panel which provides an attractive structural component for interior walls, floors or ceilings.

It is another object of this invention to provide an acoustic panel which is thinner than a panel of rigid foamed thermoplastic resin of similar acoustic insulating properties.

Other objects will become apparent from the drawings and from the following detailed description in which it is intended to illustrate the applicability of the invention without thereby limiting its scope to less than that of all equivalents which will be apparent to one skilled in the art. In the drawings like reference numerals refer to like parts and;

FIGURE 1 is a fragmentary perspective partially cut-away view of one embodiment of this invention;

FIGURE 2 is a cross-sectional elevation of a portion of another embodiment of this invention;

FIGURE 3 is a cross-sectional elevation of a portion of another embodiment of this invention;

FIGURE 4 is a cross-sectional elevation of a portion of another embodiment of this invention;

FIGURE 5 is a partially cutaway sectional perspective view of a portion of another embodiment of this invention;

FIGURE 6 is a cross-sectional elevation of a portion of another embodiment of this invention;

FIGURE 7 is a partially cutaway partially cross-sectioned perspective view of a portion of another embodiment of this invention;

FIGURE 8 is a cross-sectional elevation of a portion of another embodiment of this invention;

FIGURE 9 is a cross-sectional elevation of a portion of another embodiment of this invention;

FIGURE 10 is a cut away perspective view of a portion of another embodiment of this invention;

FIGURE 11 is a cut away perspective view of a portion of another embodiment of this invention;

FIGURE 12 is a cut away cross-sectional elevation of a portion of another embodiment of this invention;

FIGURE 13 is a cross-sectional elevation of a portion of another embodiment of this invention.

In FIGURE 1 article 10 comprises upper panel 11 and lower panel 12 of relatively rigid material, such as phenolic resin impregnated kraft paper, glass fiber reinforced polyester resin or the like with pliable sheet or resin film 13 such as polyethylene film interposed therebetween. Panels 11 and 12 are disposed with crests 14 of panel 11 directly opposite crests 15 of panel 12. Crests 15 of panel 12 are disposed in contact with film 13 and the film is substantially untensioned to prevent audible

2

reverberation of acoustic frequencies transmitted in the panel. Troughs 16 of panel 11 are disposed in contact with film 13 intermediate adjacent crests 14 of panel 11. Article 10 may be fabricated by applying binding tape 17 along the edges of the panel as shown in FIGURE 1 or be unitarily fixed by adhesive disposed between film 13 and panels 11 and 12 at the contacting points therebetween. Alternatively, fusing of resin film 13 to upper and lower panels 11 and 12 may be utilized. Film or sheet material other than polyethylene such as vinyl polymers and co-polymers, cellulosic materials such as cellophane or paper, rubber hydrochloride film, metal foil such as aluminum foil or the like or other material may be provided as film 13. In a preferred embodiment an aluminum coated resin film such as aluminum coated polyethylene or polyethylene terephthalate may be employed with a film thickness of from 3 to 20 mils. Panels 11 and 12 may comprise operable material such as resin impregnated paper, fiber reinforced polyester molding resin, or asbestos or carbon block filled synthetic resin or cement, wood veneer or laminated wood such as plywood, or other materials as may be desired. It is requisite that fluted panels 11 and 12 comprise relatively rigid material while interlayer 13 comprises a relatively tough non-rigid non-taut material which is preferably somewhat resilient.

In FIGURE 2 is shown another embodiment of the invention. Article 20 comprises plywood facing panels 21 and 22 with foamed polystyrene core blocks 23 and 24 interposed therebetween. The inner surfaces of blocks 23 and 24 are of fluted configuration with film interlayer 25 disposed therebetween. The interlayer material may be paper, polymeric resin film, wood veneer or the like. Article 20 is preferably approximately 2½ inches thick and comprises ¼ inch thick plywood, hardboard, or plasterboard panels 21 and 22, and foamed polystyrene blocks 23 and 24 approximately 1 inch thick adhered to the interior surface of panels 21 and 22 respectively. Interlayers 25 comprises resinous film or paper sheet of operable thickness preferably of approximately 6-10 mils thickness. The articles shown in FIGURES 1 and 2, wherein polyethylene film of as little as 3 or 4 mils thickness or polyethylene terephthalate film of as little as ½ mil thickness is provided between panels having flutings spaced approximately on two inch centers will support the weight of a man standing on a 1 square foot panel. It is preferred in the embodiment shown in FIGURE 2 when polyethylene is used for interlayer 25 to heat seal the polyethylene to blocks 23 and 24. When paper or other non-fusible material is used, it is possible to coat the materials with adhesive. Blocks 23 and 24 may be affixed to plywood panels 21 and 22 by means of phenolic or epoxy resin or other operable materials such as are commonly used in the manufacture of plywood. Facing panels 21 and 22 may comprise any operable material such as rigid paper or resin sheet, or may comprise a coating material such as paint or plastisol or the like, or may be eliminated if desired without materially affecting the invention. The article of FIGURE 2 will provide acoustic insulation substantially greater than will a two-fold thickness of solid foamed polystyrene. If desired interlayer 25 and blocks 23 and 24 may be secured together at the edges of the panel by use of binding tape or other operable means disposed along the edge extremities of panel 20. The tape may be gummed tape or pressure sensitive tape or the like. In place of foamed polystyrene blocks 23 and 24 other operable material may be used such as foamed polyurethane resin, a material obtained from the reaction of a polyol, water and a diisocyanate. Other material may be used such as foamed vinyl resin, foamed cellulosic

material, foamed glass, or foamed or unfoamed gypsum or cement.

In FIGURE 3 is shown another embodiment of the invention comprising glass panels 31 and 32 configured with smooth outer surfaces and fluted inner surfaces. Between glass panels 31 and 32 are disposed flexible foldable films 33 and 34 and corrugated interlayer 35. Interlayer 35 preferably comprises a clear plastic material such as cellulose acetate, cellulose acetate butyrate, polymethyl methacrylate, ethylacrylate, or other clear polymer, or may comprise glass. Film materials 33 and 34 preferably comprise a clear film material such as acrylic polymer films, clear cellulosic films such as cellophane or the like, glass film, polyethylene film, nylon film, fluorinated polyethylene film, or polyester films such as polyethylene terephthalate, the latter material being a preferred material because of its superior properties of strength, heat resistance, and clarity. Article 30 is composed of transparent materials, and is configured to diffuse transmitted light so that the panel may be used as either exterior or interior glazing. If desired, materials other than transparent materials may be provided for panels 31 and 32 such as fiber reinforced polyester resin or surface roughened resin film. Alternatively, some elements of the article 30 may be translucent or pigmented to provide decorative color to the article. Article 30 may be provided in thicknesses as small as $\frac{3}{4}$ inch or less without greatly restricting the acoustic insulating properties of the panel.

In FIGURE 4 is shown article 40 comprising facing panels 41 and 42 of a hardboard or other rigid material such as one comprising wood particles and resin binder, gypsum board, plywood or other conventional materials. Thin film interlayers 43 and 44 such as resinous film or paper are provided as shown between corrugated paper separators 45. The materials used in article 40 of FIGURE 4 may be other of the operable materials as heretofore mentioned.

Any number of separators 45 may be provided, the requisite condition being that the corrugations of adjacent separators 45 are resiliently supported by film interlayers 43.

In FIGURE 5, is shown another embodiment of the invention wherein article 50 comprises facing panels 51 and 52 with projections 53 and 53' affixed thereto extending inwardly therefrom into contact with sheets 54 and 54' respectively. Sheets 54 and 54' are separated by hollow cardboard cylindrical spacers 55. Panels 51 and 52 comprise plywood in a preferred embodiment with projections 53 and 53' comprising wooden blocks glued to panels 51 and 52 respectively. Sheets 54 and 54' are flexible films of paper, resin, foil or cardboard, and are adhesively secured to spacers 55. Sheets 54 and 54' may be of paper, resinous film, light weight cardboard, wood veneer or other operable material. It is necessary, however, that the material which is used be relatively stronger than the materials used in FIGURES 1-4 because the area of loading of sheets 54 and 54' in FIGURE 5 is relatively less than that of FIGURES 1-4. Relatively thick polyethylene film such as film of from 8 mils to 30 mils thickness is preferred for sheets 54 and 54', or kraft paper or other relatively strong non-rigid material may also be used. As will be apparent, facing panels 51 and 52 are not rigidly separated and damping of acoustic energy transmitted therethrough is achieved by the resilience of the interlayer.

If desired, separators 55 may be fixedly secured to one of facing panels 51 or 52 and one of films 54, 54' be eliminated together with one layer of projections 53, 53'; however, such an embodiment is not preferred.

In FIGURE 6 is shown article 60 comprising rigid outer laminate 64 of phenolic impregnated paper layers 61, 61', 61'', 61'''. Disposed in contact with the interior surface thereof is film 62 comprising polyethylene or similar non-rigid resin or paper material. Elasto-

meric or plastomeric material may be used, an example of the former being rubber hydrochloride film, and an example of the latter being regenerated cellulose film. In all embodiments of this invention, if the acoustic panel is to be used as an exterior wall for a building it is preferred to provide a heat reflective coating such as aluminum or white pigment or other material on at least one film interlayer such as interlayer 62 of FIGURE 6. Such coating on the film markedly improves the thermal insulation coefficient and reduces vapor transmission in the article. Panel 63 is similar to panel 64 and comprises resin impregnated paper layers 65, 65', 65'' and 65'''. Film interlayer 62 is disposed in contact with ribs 66 of panel 63 while film interlayer 67 is disposed in contact with oppositely disposed ribs 68 of panel 63. Disposed intermediate the points of contact of the ribs with film interlayer 67 and on the opposite side of the film are projections 69. Projections 69 are adhered to facing panel 70 and preferably comprise wooden blocks or the like. Facing panel 70 may be cardboard, plasterboard, plywood or the like. Panel 60 of FIGURE 6 may be painted or treated with other surface coating materials and may comprise material other than paper laminate, for example, the outermost surface of panel 64 may comprise sheet aluminum which may be surface finished by being anodized or otherwise treated to provide an attractive and lasting appearance. Other conventional material and finishings may be provided as desired.

In FIGURE 7 is shown another embodiment of this invention wherein acoustic panel 71 comprises rigid upper panel 72 and rigid lower panel 73. Disposed intermediate panels 72 and 73 is flexible film interlayer 74. The film interlayer material may be similar to that heretofore described. Disposed on the interior surface of upper rigid panel 72 is projection 75 which is in contact with film interlayer 74. Immediately adjacent projection 75 and disposed on the opposite surface of film interlayer 74 is ring projection 76 which may be molded into lower rigid panel 73 or otherwise affixed thereto. Projection 75 on upper rigid panel 72 is disposed at approximately the center of ring projection 76 on lower panel 73 and the two projecting elements are separated by film interlayer 74. Projections 75 and 76 are regularly spaced about panels 72 and 73 and provide an operable means for damping acoustic vibrations which are transmitted through article 71. As will be evident a greater number of film interlayers may be provided by repetitions of the structures shown in FIGURE 7.

In FIGURE 8, is shown another embodiment of this invention comprising article 80. Article 80 is constructed from crimped sheet metal facing panels 81 and 82. In the manner similar to that heretofore described, panels 81 and 82 are disposed with crests and with troughs directly opposed on opposite sides of film interlayer 83. Interlayer 83 may comprise resin film, metal foil, or other operable and flexible material which is suitable for damping acoustic vibrations. Panel 80 may be unitarily adhered by binding the edges with tape or the like. Interlayer 83 provides a vapor barrier in the article while panels 81 and 82 of crimped construction provide for non-destructive thermal expansion and contraction of the panel. In a preferred embodiment, panels 81 and 82 comprise aluminum sheet stock and interlayer 83 comprises resin film. Rather than being of metal, members 81 and 82 may be of laminated paper or other such materials as hereinbefore described.

In FIGURE 9 is shown acoustic partition 90 similar to article 80 of FIGURE 8, but configured with crenellated facing panels 91 and 92. The crenellations of one of panels 91 and 92 are disposed opposite crenellated portions of the other of the panels with film interlayer 93 disposed therebetween separating the panels. Article 90 provides acoustic damping at audio frequencies in the

5

manner similar to that heretofore described in relation to other embodiments of the invention.

In FIGURE 10 is shown another embodiment of this invention comprising acoustic panel 100. Panel 100 comprises upper and lower rigid facing sheets 101 and 102 respectively, with flexible film interlayer 103 disposed therebetween and adhered or otherwise attached thereto.

Serpentine projections 104 and 105 on the interior surfaces of panels 101 and 102 respectively are disposed in staggered relation with the projections of one of the panels being offset with relation to adjacent projections of the other of the panels and with the interlayer 103 separating the two panels. In a preferred embodiment of this invention, panels 101 and 102 are integrally molded with serpentine projections 104 and 105 respectively, and interlayer 103 comprises resinous film, paper or other similar material.

In FIGURE 11 is shown another embodiment of this invention comprising article 110. Article 110 comprises upper rigid sheet 111 and lower rigid sheet 112 with flexible film interlayer 113 disposed therebetween. Block projections 114 and 115 are disposed on the interior surfaces of panels of 111 and 112 respectively. Projections 114 and 115 are staggered in arrangement so that any of blocks 114 are offset relative to blocks 115 with film interlayer 113 being disposed between blocks 114 and 115. The structure, when unitarily secured, provides a construction which may be suitably used for soundproof interior or exterior partitions.

In FIGURE 12 is shown article 120 comprising rigid facing panels 121 and 122 of plywood or the like with film interlayer 123 disposed therebetween. Spacing elements 124 are adhered to interlayer 123 and comprise foam resin such as flexible or rigid foamed polyurethane or other similar material. Spacing elements 124 are staggered in arrangement on opposite sides of interlayer 123 so that facing panels 121 and 122 are resiliently separated. Spacing elements may be adhesively affixed to facing panels 121 and 122 or may be selectively secured or may free therefrom with film interlayer 123 being supported by edge binding (not shown) on article 120.

In FIGURE 13 is shown article 130 comprising relatively rigid fluted facing panel 131 of glass fiber reinforced resin or similar material and planar facing panel 134 of plywood, plasterboard, glass or other material. Film interlayer 132 of pliable sheet, foil or film material is disposed between the facing panels. A preferred material is vinyl resin sheet loaded with lead particles. Such material provides excellent acoustic insulation. Lead foil, thin pliable lead sheet, or leaded fabric may also be used with excellent results. Spacing elements 133 are adhered to interlayer 132 and to facing panel 134. The spacing elements preferably comprise foamed organosiloxanes. Such materials have heat stability ranging to 500° F. and thereby provide excellent fire resistant properties to article 130.

The materials disclosed for use in various embodiments of the invention may be interchanged to provide a construction which is optimum for a particular application, or other known materials may be substituted to achieve a desired appearance or property.

While certain modifications and embodiments of the invention have been described, it is of course to be understood that there are a great number of variations which will suggest themselves to anyone familiar with the subject matter thereof and it is to be distinctly understood that this invention should not be limited except by such limitations as are clearly imposed in the appended claims.

I claim:

1. An acoustic panel comprising in combination two relatively rigid facing panels, at least one laminar interlayer comprising relatively pliable sheet material, said sheet material being of substantially planar configuration,

6

rigid projecting members extending inwardly from each of said facing panels into contact with said interlayer at points of contacting adjacency, with points of contacting adjacency therebetween with respect to one of said facing panels being staggered in arrangement with respect to points of contacting adjacency with the other of said facing panels, said interlayer providing a resilient support to said facing panels, said inner layer and said facing panels defining air filled spaces.

2. The article of claim 1 wherein said sheet material comprises at least one resin film layer.

3. The article of claim 1 wherein said members adjacent said facing panels comprise spacing elements interposed between said facing panels and said interlayer.

4. The article of claim 1 wherein said members adjacent said facing panels comprise an adherent bond between said sheet material and said facing panels.

5. The article of claim 1 wherein at least the interior surfaces of said facing panels are of corrugated configuration.

6. The article of claim 1 wherein said facing panels have a protuberant interior surface.

7. An acoustic insulating panel comprising in combination two rigid facing panels, pliable laminae means disposed between said facing panels, said pliable laminae comprising at least one flexible foldable film, spacing means separating said facing panels and said laminae, said spacing means comprising spaced apart blocks of material fixedly attached to at least one said facing panel and laminae, said spacing means being disposed in staggered array on opposite sides of said laminae.

8. The article of claim 7 wherein said laminae means comprises synthetic resin film.

9. The article of claim 7 wherein said facing panels and said laminae are affixedly secured by binding tape along the edges of said acoustic panel.

10. An acoustic panel comprising in combination two facing panels of rigid construction, the interior surface of said facing panels being of protuberant configuration, a pliable interlayer disposed between said two facing panels, said interlayer being disposed in contact with inwardly projecting portions of said protuberant surfaces, said inwardly projecting portions of said protuberant surfaces being disposed in staggered arrangement on opposite sides of said interlayer, said acoustic panel providing sound damping of acoustic vibrations transmitted therein.

11. The article of claim 10 wherein said interlayer comprises a multiple layer.

12. The article of claim 10 wherein at least one of said facing panels comprises a planar exterior surface.

13. The article of claim 10 wherein at least one of said facing panels is of corrugated configuration.

14. The article of claim 10 wherein said interlayer comprises lead.

15. The article of claim 11 wherein said interlayer comprises a corrugated layer.

References Cited in the file of this patent

UNITED STATES PATENTS

2,042,721	Loewy	June 2, 1936
2,045,733	Spafford	June 30, 1936
2,077,155	Prudden	Apr. 13, 1937
2,215,241	Eichelberger et al.	Sept. 17, 1940
2,221,309	Gazelle	Nov. 12, 1940
2,350,513	Leadbetter	June 6, 1944
2,922,483	Harris	Jan. 26, 1960
3,051,260	Eckel	Aug. 28, 1962
3,077,947	Peebles et al.	Feb. 19, 1963
3,087,574	Watters	Apr. 30, 1963
3,110,369	Ruzicka	Nov. 12, 1963

FOREIGN PATENTS

564,424	Italy	June 17, 1957
---------	-------	---------------