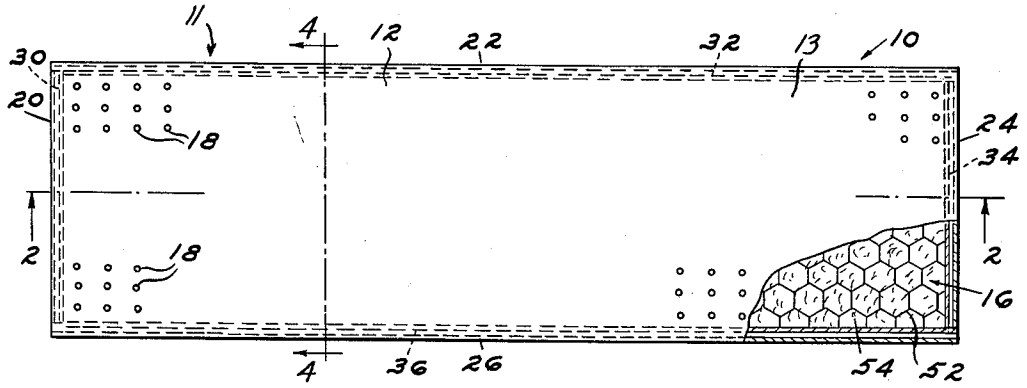
July 2, 1963 W. G. KEMP 3,095,943

ACOUSTICAL STRUCTURE

Filed May 29, 1961

FIG. 1



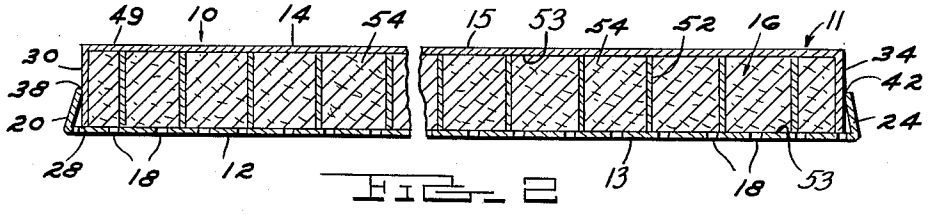


FIG. 2

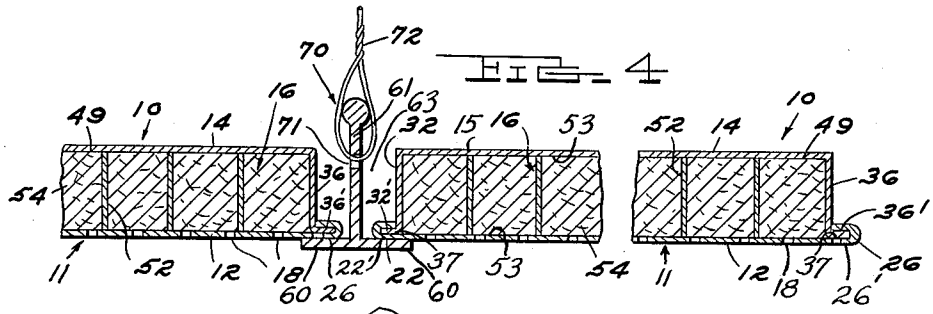


FIG. 4

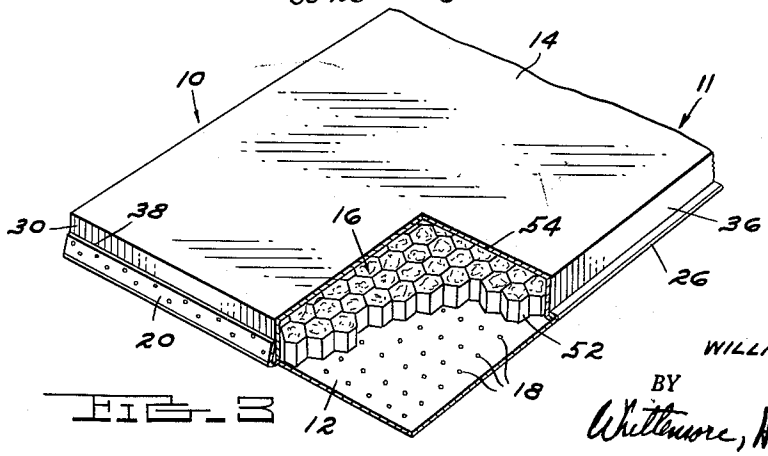


FIG. 3

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United States Patent Office 3,095,943 Patented July 2, 1963

3,095,943

ACOUSTICAL STRUCTURE

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Filed May 29, 1961, Ser. No. 113,451
Claims priority, application Canada Sept. 19, 1960
6 Claims. (Cl. 181—33)

This invention relates generally to acoustical structure and refers more particularly to a strong, lightweight acoustical panel designed to present a pleasing appearance.

One object of the invention is to provide a lightweight acoustical panel having improved strength and rigidity.

Another object is to provide an improved acoustical panel constructed to facilitate the installation thereof, or removal from an installation, without interference with the supporting members.

Another object is to provide an acoustical panel composed of a lightweight semi-rigid core secured between a perforated bottom pan and an upper sound reflecting pan.

Another object is to provide an edge construction for the acoustical panel which will prevent delamination of the various parts of the panel.

These and other objects, advantages and novel details of construction of this invention will be made more apparent as this description proceeds, especially when considered with the accompanying drawing, wherein:

FIGURE 1 is a plan view of an acoustical panel embodying the invention, looking at the normally exposed surface thereof, with parts broken away and in section.

FIGURE 2 is an enlarged sectional view taken on the line 2—2 of FIGURE 1.

FIGURE 3 is a perspective view of a corner portion of the acoustical panel shown in FIGURE 1, with parts broken away and in section.

FIGURE 4 is an enlarged fragmentary view of a ceiling installation composed of panels of the type shown in FIGURES 1–3, the section being taken across the panels substantially along the line 4—4 in FIGURE 1.

Referring now more particularly to the drawing, the acoustical panel shown in FIGURE 1 is generally indicated at **10**. The panel **10** includes a casing **11** having a perforated cover member or pan **12** for exposure to sound to be deadened, and a reflecting cover member or pan **14** positioned behind the perforated pan **12** for reflecting sound back toward the perforated pan. The panel also includes a lightweight, semi-rigid core **16**, comprising a honeycomb structure **52** having sound deadening material **54** between the cells thereof, positioned between the perforated pan **12** and the reflecting pan **14** and secured to both for deadening the sound passing therethrough and for adding strength and rigidity to the complete acoustical panel.

The perforated pan **12** comprises a substantially flat rectangular sheet **13** having a plurality of orifices **18** therein. The orifices **18** may be in either a regular or irregular pattern and are provided to allow sound to pass into the interior of the panel **10** where it is deadened by the sound deadening material **54** of the core **16**. The pan **12** may be molded, stamped or otherwise produced from metal, plastic or other suitable material. The material should present a smooth relatively rigid hard surface capable of being cleaned with ease since the outer surface of the sheet **13** of pan **12** will be exposed to view in a finished acoustical installation.

The perforated pan **12** has at the ends of the flat sheet **13** ends **20** and **24** which are integral with sheet **13** and extend upwardly therefrom at an angle of less than 90° to the flat interior surface of sheet **13**. Ends **20** and **24** extend for only a part of the depth of the completed panel **10**. In a complete panel, and as best shown in FIGURES 2 and 3, the ends **20** and **24** of the perforated pan **12** abut ends **30** and **34** of the reflecting pan. Since the free edges **38** and **42** of the ends **20** and **24** terminate short of the plane of the flat sheet **15** of reflecting pan **14**, and since these free edges are disposed laterally inwardly of the end of sheet **13**, the panels can be arranged end to end in an installation (not shown) and the actual installation and removal of the panels can be made without the edges **38** and **42** catching on the adjacent end surfaces of the abutting panel.

The reflecting pan **14** as shown comprises a substantially flat rectangular sheet **15**. Reflecting pan **14** may also be molded, stamped or otherwise formed of metal, plastic or other suitable material. The pan **14** should have a relatively smooth hard dense inner surface in order to efficiently carry out its sound reflecting function. As best shown in FIGURE 4 wherein it may be assumed that the sound which it is desired to deaden is travelling upwardly, the reflecting pan **14** is positioned behind the perforated pan **12** with respect to the direction of travel of the sound so that the sound passing through the perforated pan and striking the reflecting pan **14** will be reflected back toward the perforated pan through the sound deadening material **54** of core **16**.

It will also be noted that the reflecting pan **14** is provided at the ends of sheet **15** with ends **30** and **34** and sides **32** and **36**. These ends and sides are integral with and extend downwardly from sheet **15** at a 90° angle. The sides and ends **30**, **32**, **34** and **36** extend from the upper surface **49** of the reflecting pan **14** to the inner surface of sheet **13** of perforated pan **12**. The free edges of the sides and ends **30**, **32**, **34** and **36** actually contact the inner surface of sheet **13** in a continuous line so that sound is prevented from escaping around the edges of the panel. This construction also allows the complete pan **12** including its ends and its hereinafter described sides to be perforated without affecting the acoustical properties of the panel.

The core **16** is provided between pans **12** and **14** to increase the strength and rigidity of the assembled panel **10** and to deaden the sound passing therethrough. The core **16** comprises a honeycomb structure **52** of plastic, asbestos, paper, or other suitable core material, bonded to both the sheet **15** of reflecting pan **14** and the sheet **13** of perforated pan **12**, the individual cells of which are filled with loose sound deadening material **54** such as plastic fiber, glass fiber, wool or the like. The bond is provided by films of adhesive **53**. The core **16** may alternatively be foamed plastic, expanded metal or other lightweight semi-rigid material in combination with separate sound deadening material **54**.

The perforated pan **12** has along the sides of the flat sheet **13** channel-shaped edge portions **22** and **26** which are of the same construction. As shown in FIG. 4, one side **22'** or **26'** of each channel-shaped edge portion extends laterally outwardly and in the plane of the sheet to form an extension thereof. These channel-shaped edge portions are laterally outwardly of and coextensive with sides **32** and **36** of the reflecting pan **14** and define laterally inwardly opening channels **37**. The sides **32** and **36** of pan **14** have flanges **32'** and **36'** which extend laterally outwardly from the free edges thereof. These flanges are received within the channels **37** and tightly clamped by the channel-shaped edge portions to positively prevent separation of the pan at the edges so that delamination cannot begin. Since delamination is prevented at the edges, the opposed surfaces of the pans will not be stripped away from the surfaces of the core to which they are adhered. The flanges **32'** and **36'** are pressed tightly

against the sheet 13 of the perforated pan so that sound is prevented from escaping around the edges of the panel 10 and is reflected back into the sound deadening material.

The semi-rigid lightweight core 16 positioned between and bonded to the pans 12 and 14 provides a structure which is extremely resistant to deformation under both bending and twisting stresses. Such structure besides having excellent acoustical properties may be cut around openings in an acoustically treated surface or at the edge of the surface without providing special framing to prevent sagging or warping of the panels. Therefore panels constructed as herein described have the advantages of not only being simply constructed in themselves but are also simple and economical to install. Further economy in construction exists due to the high strength ratio of the panels 10 constructed with core 16 which permits larger panels to be used to cover an area to be acoustically treated thereby requiring less supporting structure and installation time.

The panels are arranged in rows end to end and supported along their adjacent sides by inverted T-bars 70. Referring to FIGURE 4, the adjacent return-bent edges of the lower pan are supported on the oppositely extending flanges 60 of the T-bar, and the web 61 of the T-bar extends upwardly therefrom between the panels and is formed with an aperture 71 through which a wire suspension member 72 extends. The wire forms a loop through the aperture and about the web of the T-bar and is twisted upon itself to support the T-bar.

The provision of the channel shaped edges of the lower pans providing supporting lips for the panels in effect produces a recess 63 above the lips so that the sides of the panels above the lips are spaced laterally from the web of the T-bar. With this construction, the sides and upper corners of the panels provide clearance and hence do not interfere with the wire suspension member, either during or after assembly. Obviously, if the recessed construction were not provided, and the upper and lower corners of the panels adjacent the web of the T-bar formed simple 90° angles, it would be necessary to form wider T-bar flanges to support the panels in sufficiently spaced relation to the web of the T-bar that no interference would result.

The supporting lips defined by the return-bent channel-shaped edge portions 22 and 26, together with the flanges 32' and 36' provide a triple layer of material which has a rigidifying and strengthening effect on the entire panel structure. Hence these supporting lips tend to prevent any irregularity from developing in the exposed surface of the lower pan.

The panels 10 have a multiplicity of sound isolation cells bounded by the walls of the honeycomb and by the inner surfaces of the sheets 13 and 15 of perforated pan 12 and reflecting pan 14. Sound entering a cell through the perforations is effectively isolated, since it cannot escape to the other cells through the walls of the honeycomb, nor through the unperforated sheet 15, nor can any appreciable amount of sound pass from the cell through the perforations. The isolated sound is effectively attenuated by the deadening material 54 within each and every cell.

Any suitable adhesive 53 may be employed to secure the edges of core 16 to the pans 12 and 14. The pans are pressed tight against opposite surfaces of the core and contact the edges of the core defining each cell. The adhesive layer 53 extends between all contacting surfaces to provide a rigid unitary structure. The pans, while of light gage, will not sag because of the adhesive connection with the core. The distance across each cell is so small that obviously no sagging of the pan material between cells will occur. It is of course absolutely necessary that the lower pan 12 present a perfectly flat appearance because it provides the exposed surface and any irregularity or unevenness would be readily apparent.

As a further means of eliminating any appearance of irregularity or unevenness in the surface of the lower pan 12, is is preferably covered with a coating (not shown) of a flat or non-glossy paint.

What I claim as my invention is:

1. An acoustical panel comprising a casing and sound deadening means within said casing, said casing including first and second cover members, said first cover member comprising a substantially flat perforated sheet adapted to be exposed to sound, said second cover member comprising a substantially flat sound reflecting sheet in spaced parallel relation to said perforated sheet, said reflecting sheet being substantially coextensive with said perforated sheet and adapted to reflect sound passing through said perforated sheet back toward the latter, said second cover member having laterally spaced sides integrally joined to opposite margins of said reflecting sheet and extending from said reflecting sheet toward said perforated sheet, said first cover member having channel-shaped edge portions integral with and extending along opposite margins of said perforated sheet, said channel-shaped edge portions being laterally outwardly of and substantially coextensive with said sides of said second cover member and defining channels opening laterally inwardly toward said sides of said second cover member, said sound deadening means including a relatively rigid honeycomb core forming a layer between and substantially coextensive with said sheets, the opposite surfaces of said honeycomb core being adhered directly to the opposed surfaces of said sheets to prevent said sheets from sagging or separating from said honeycomb core, sound deadening material in the cells of said honeycomb core, and flanges integral with and extending laterally outwardly from the free edges of said sides of said second cover member, said flanges being received within said channels and tightly gripped by said channel-shaped edge portions to prevent separation of said cover members and to prevent delamination of said sheets and said core.

2. The acoustical panel defined in claim 1, wherein said sheets are rectangular, one side of each of said channel-shaped edge portions extends laterally outwardly from and in the plane of said perforated sheet as an integral member are disposed at right angles to said sheets.

3. The structure defined in claim 2, including an inverted T-bar supporting a channel-shaped edge portion on a flange of said T-bar, the web of said T-bar being disposed to one side of said supported channel-shaped edge portion and in laterally spaced generally parallel relation to the side of said second cover member adjacent the associated channel-shaped edge portion, and a suspension member engaging the web of said T-bar for supporting the same, the space between the web of the T-bar and the last-mentioned side of the second cover member providing clearance to avoid interference with the suspension member both during and after installation of the panel.

4. An acoustical panel comprising a casing and sound deadening means within said casing, said casing including first and second cover members, said first cover member comprising a substantially flat first sheet, said second cover member comprising a substantially flat second sheet in spaced parallel relation to and coextensive with the first sheet, said second cover member having laterally spaced sides extending from opposite margins of said second sheet toward said first sheet, said first cover member having channel-shaped edge portions extending along opposite margins of said first sheet, said channel-shaped edge portions being laterally outwardly of and substantially coextensive with said sides of said second cover member and defining channels opening laterally inwardly toward said sides of said second cover member, said sound deadening means including a relatively rigid honeycomb core forming a layer between and substantially coextensive with said sheets, the opposite surfaces of said honeycomb core being adhered directly to the opposed surfaces of said sheets to prevent said sheets from sagging or separating from said honeycomb core, sound deadening material in

the cells of said honeycomb core, and flanges integral with and extending laterally outwardly from the free edges of said sides of said second cover member, said flanges being received within said channels and tightly gripped by said channel-shaped edge portions to prevent separation of said cover members and to prevent delamination of said sheets and said core.

5. An acoustical panel comprising a casing and sound deadening means within said casing, said casing including first and second cover members, said first cover member comprising a substantially flat first sheet, said second cover member comprising a substantially flat second sheet in spaced parallel relation to and coextensive with the first sheet, said sound deadening means including a relatively rigid honeycomb core forming a layer between and substantially coextensive with said sheets, the opposite surfaces of said honeycomb core being adhered directly to the opposed surfaces of said sheets to prevent said sheets from sagging or separating from said honeycomb core, sound deadening material in the cells of said honeycomb core, said second cover member having extensions projecting laterally outwardly beyond opposite sides of said second sheet, said first cover member having extensions projecting laterally outwardly beyond opposite sides of said first sheet alongside the extensions of said second cover member, the extensions of said cover members being rigidly secured together to prevent separation of said members and to prevent delamination of said members and said core.

6. The acoustical panel defined in claim 5, wherein the extensions of one of said members are channel-shaped portions defining laterally inwardly opening channels receiving and tightly gripping the extensions of the other of said members to prevent the aforesaid separation of the members and delamination of the members and the core.

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