Feb. 20, 1962 W. G. KEMP 3,021,916

REINFORCED ACOUSTICAL UNIT

Filed April 6, 1959

FIG.1.

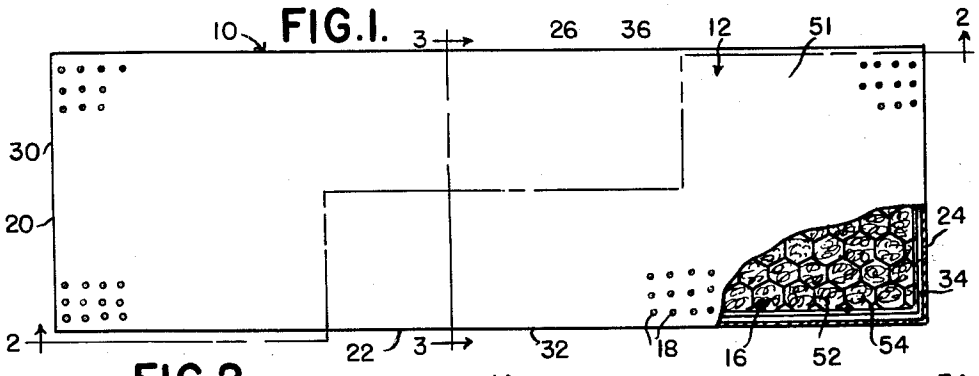
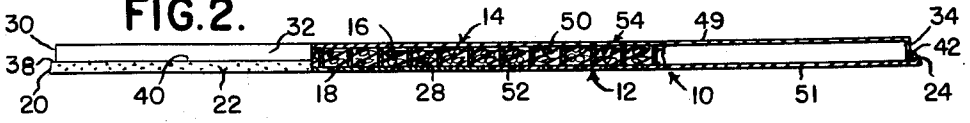


FIG.2.



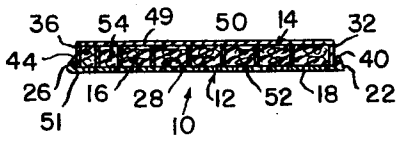
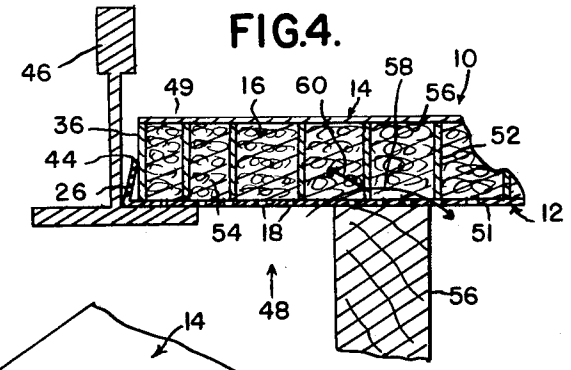


FIG.3.

FIG.4.



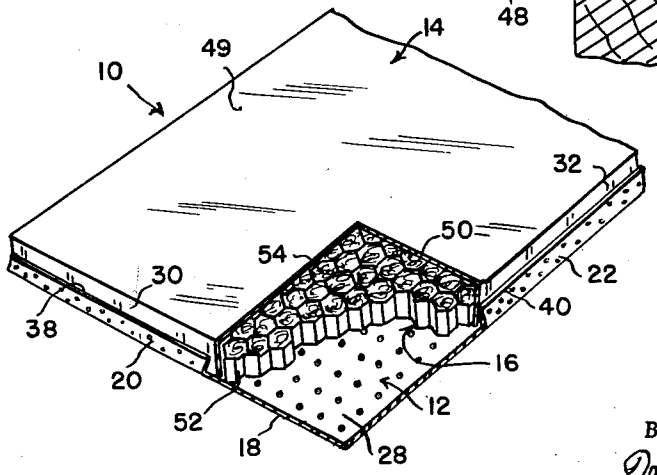


FIG.5.

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REINFORCED ACOUSTICAL UNIT

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This invention relates generally to reinforced acoustical units and refers more particularly to an acoustical panel including a light weight semi-rigid core comprising a honeycomb structure for strength and sound absorbing material between the cells of the honeycomb structure to deaden sound, and also including a reflecting pan bonded to the core on one side to reflect sound into the sound absorbing material and a perforated member bonded to the other side of the core and constructed to facilitate the installation and removal of the panel.

It is therefore one of the objects of this invention to provide a light weight acoustical panel having improved strength and rigidity.

Another object is to provide an acoustical panel for a ceiling structure including means to prevent sound from escaping from around the edges of individual panels into the area above the ceiling above a first room and back into an adjacent room when the rooms are separated by a common partition extending only ceiling high.

Another object is to provide an acoustical panel including means to prevent undesirable engagement of the panel with the supporting members therefor.

More specifically it is an object to provide an acoustical panel including a light weight semi-rigid core secured between a perforated bottom pan and an upper sound reflecting pan.

Still more specifically it is an object to provide an acoustical panel adapted to be supported on T-bars and including a lower perforated pan having edges upturned to form an angle of less than ninety degrees with the inner surface of the pan and extending less than the full height of the pan to prevent said edges from interfering with the removal of the panel from the T-bar supports therefor.

Still more specifically it is an object to provide an acoustical panel including an upper sound reflecting pan having the edges thereof turned down and extending to the inside of the lower surface of the perforated pan of the panel as installed.

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 in connection with the accompanying drawings, wherein:

FIGURE 1 is a plan view of the acoustical panel of the invention looking at the normally exposed surface thereof with the normally exposed surface partly broken away.

FIGURE 2 is a section through the acoustical panel of FIGURE 1 on the line 2—2 in FIGURE 1.

FIGURE 3 is a section through the acoustical panel of FIGURE 1 on the line 3—3 in FIGURE 1.

FIGURE 4 is an enlargement of the right end of FIGURE 3 showing the acoustical panel supported on a T-bar above a ceiling height partition between adjacent rooms.

FIGURE 5 is a partly broken away perspective view of a corner portion of the acoustical panel of FIGURE 1.

One embodiment of the acoustical panel of the invention generally indicated **10** is shown in the figures. The panel **10** as shown includes a perforated pan **12** for exposure to sound which it is desired to deaden, a reflecting pan **14** positioned behind the perforated pan **12** with respect to sound which it is desired to deaden for reflecting sound which passes through the perforated pan and

strikes the reflecting pan back toward the perforated pan, and a light weight 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** is a substantially flat rectangular member 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 outer pan surface capable of being cleaned with ease since the outer pan surface will be exposed to view in a finished acoustical installation.

As shown the perforated pan **12** has edges upturned to form sides **20, 22, 24,** and **26** at an angle of less than ninety degrees with respect to the general flat interior surface **28** of pan **12**. Sides **20, 22, 24** and **26** as shown extend for only a part of the depth of the completed panel **10**. In a complete panel as best shown in FIGURES 2 and 3 of the drawings the sides **20, 22, 24** and **26** of the perforated pan abut sides **30, 32, 34** and **36** of the reflecting pan. The free edges **38, 40, 42** and **44** of the sides **20, 22, 24** and **26** do not therefore form corners of the complete panel **10**. The edges **38, 40, 42** and **44** are also not extending outwardly from the complete panel **10**. Therefore, as shown best in FIGURE 4 in the installation of a panel **10** or removal thereof from an installation wherein the panel **10** is supported on T-bars such as **46** or similar structure the edges **38, 40, 42** and **44** will not catch on the supporting structure making removal or installation thereof difficult.

The reflecting pan **14** as shown is a substantially flat rectangular member. 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 shown best in FIGURE 4, wherein the direction in which sound which it is desired to deaden is traveling is indicated by arrow **48**, the reflecting pan **14** is positioned behind the perforated panel **12** with respect to the direction of travel of the noise so that sound passing through perforated pan **12** and striking the reflecting pan **14** will be reflected back toward the perforated pan **14** through the sound deadening material **54** of core **16** as later considered in more detail.

It will also be noted that the reflecting pan **14** is provided with edges turned down to form sides **30, 32, 34** and **36** previously referred to and that the outer surface **49** of pan **14** is shorter in length and width than the outer surface **51** of pan **12**. With this construction, in a completely assembled panel **10** the sides of the reflecting pan **14** and perforated pan **12** form complete panel sides presenting no outstanding edges to engage supports such as T-bar **46** and thereby interfere with installation or removal of the panel **10**. Further it will be noted that in the completed panel **10** the sides **30, 32, 34** and **36** extend from the upper surface **49** of the reflecting pan **14** to the inner surface **28** of perforated pan **12**. Through such construction sound is prevented from escaping from around the edges of the panel **10** by being reflected back into the sound deadening material. Such construction also allows the complete pan **12** including sides **20, 22, 24** and **26** to be perforated without harm to the acoustical properties of the panel **10**.

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 reflecting pan **14** and the perforated pan **12**, the individual cells of which are filled with loose sound deadening material **54** such as plastic fibre, glass fibre, wool or the like. The core **16** may alternatively be foamed plastic, expanded metal or other light weight semi-rigid material in combination with separate sound deadening material **54**.

The semi-rigid light weight core **16** is 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 as is evident from inspection thereof, but are also simple and economical to install. Further economy in construction exists due to the high strength weight 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.

In use the panel **10** constructed as shown is suspended on T-bars such as **46** or otherwise positioned with its perforated surface exposed to sound to be deadened. As above indicated the sound passes through the perforated pan **12**, through the sound deadening core **16** to the reflecting pan **14** where the sound which has not been deadened by passage through the core material is reflected back into the core material to be further deadened thereby. The sides **30, 32, 34** and **36** of reflecting pan **14** extending the full depth of the panel **10** as shown prevent sound from escaping from the panel around the edges thereof by also reflecting sound coming in contact therewith back into the sound deadening core. Thus efficient use is made of the sound deandening core by causing sound to pass therethrough a plurality of times and preventing escape of sound from the panels **10** once it has entered the panels.

It will also be noted in referring to FIGURE 4 that in use the edges of assembled panel **10** constructed as disclosed present no outstanding projections which are likely to interfere with support members such as **46** on installation or removal from an installation of an acoustical panel **10**. This is possible due to the less than ninety degree angle made by the sides of pan **12** with the interior surface **28** thereof and the fact that surface **49** of pan **14** is shorter in length and width than surface **51** of pan **12** as best shown in FIGURES 2, 3 and 4 wherein sides **30, 32, 34** and **36** of pan **14** are illustrated as nesting within the shorter sides **20, 22, 24** and **26** of pan **12**.

With further reference to FIGURE 4 it can be seen that the honeycomb structure **52** serves also to prevent sound from entering the panel **10** on one side of a ceiling height partition **56** and passing directly through the panel **10** to the other side of the partition **56** as indicated by arrow **58**. With the honeycomb part of the core **16** dimensioned so that the individual cells are less in width than the partition **56** as shown, any sound passing into the panel **10** on one side thereof will impinge on at least one cell wall of the honeycomb structure **52** and will be at least partly reflected back into the sound absorbing material **54** as indicated by arrow **60**. The sound will thereby be prevented from passing unhindered from one side of partition **56** to the other.

The panel will be seen to have a multiplicity of sound isolation cells bonded by the walls of the honeycomb and by the surfaces **28** and **49** of the perforated pan **12** and

the 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 imperforate wall **49**, 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.

What I claim as my invention is:

1. An acoustical panel, comprising a substantially flat perforated pan adapted to be exposed to sound which it is desired to deaden and having opposed sides inclined at an angle of less than ninety degrees to the inner surface of said pan to facilitate the removal of said panel from an installation thereof, and sound deadening means attached to and behind said pan with respect to the sound which it is desired to deaden.

2. An acoustical panel, comprising a substantially flat perforated pan adapted to be exposed to sound which it is desired to deaden and having sides inclined at an angle of less than ninety degrees to the inner surface of said perforated pan to facilitate the removal of said panel from an installation thereof, a substantially flat sound reflecting pan positioned behind said perforated pan with respect to said sound to reflect sound passing through said perforated pan and striking said reflecting pan back toward said perforated pan, said reflecting pan having sides forming an angle of substantially ninety degrees with the inner surface thereof, said sides contacting the inner surface of said perforated pan around substantially the entire periphery of said panel to prevent the escape of sound from the edges of said panel, and a light weight semi-rigid core between said perforated pan and reflecting pan and secured to both said pans for deadening said sound and adding strength and rigidity to said panel.

3. An acoustical panel, comprising a substantially flat perforated pan adapted to be exposed to sound which it is desired to deaden and having sides inclined at an angle of less than ninety degrees to the inner surface of said perforated pan to facilitate the removal of said panel from an installation thereof, a substantially flat metal sound reflecting pan positioned behind said perforated pan with respect to said sound to reflect sound passing through said perforated pan and striking said reflecting pan back toward said perforated pan, said reflecting pan having sides forming an angle of substantially ninety degrees with the inner surface thereof, said sides contacting the inner surface of said perforated pan around substantially the entire periphery of said panel to prevent the escape of sound from the edges of said panel, and a light weight semi-rigid core of honeycomb structure with sound deadening material within the individual cells thereof positioned between said perforated pan and reflecting pan and secured to both said pans for deadening said sound and adding strength and rigidity to said panel.

4. An acoustical panel, comprising a substantially flat perforated member adapted to be exposed to sound which it is desired to deaden, a sound reflecting member positioned behind said perforated member with respect to said sound to reflect sound passing through said perforated member and striking said reflecting member back toward said perforated member, and a light weight semi-rigid core of honeycomb structure with sound deadening material within the individual cells thereof positioned between said perforated member and reflecting member for deadening said sound and adding strength and rigidity to said panel, a partition abutting said panel, said honeycomb structure having individual cells of a dimension transverse the abutting partition less than the width of the abutting partition whereby the walls of the individual cells prevent sound from passing directly through said acoustical panel from one side of a partition to the other side thereof without contacting said honeycomb structure.

5. An acoustical panel, comprising a substantially flat perforated pan adapted to be exposed to sound which it is desired to deaden and having opposed sides inclined

at an angle of less than ninety degrees to the inner surface of said perforated pan to facilitate the removal of said panel from an installation thereof, a substantially flat metal sound reflecting pan positioned behind said perforated pan with respect to said sound to reflect sound passing through said perforated pan and striking said reflecting pan back toward said perforated pan, and a light weight semi-rigid core of honeycomb structure positioned between said perforated pan and reflecting pan and secured to both said pans for adding strength and rigidity to said panel.

6. An acoustical panel, comprising a substantially flat perforated pan adapted to be exposed to sound which it is desired to deaden and having sides inclined at an angle of less than ninety degrees to the inner surface of said perforated pan to facilitate the removal of said panel from an installation thereof, a substantially flat sound reflecting pan positioned behind said perforated pan with respect to said sound to reflect sound passing through said perforated pan and striking said reflecting pan back toward said perforated pan, said reflecting pan having sides forming an angle of substantially ninety degrees with the inner surface thereof, said sides contacting the inner surface of said perforated pan around substantially the entire periphery of said panel to prevent the escape of sound from the edges of said panel, and a light weight semi-rigid core of honeycomb structure between said perforated pan and reflecting pan and secured to both said pans for deadening said sound and adding strength and rigidity to said panel.

7. An acoustical panel, comprising a substantially flat perforated pan adapted to be exposed to sound which it is desired to deaden and having sides inclined at an angle of less than ninety degrees to the inner surface of said perforated pan to facilitate the removal of said panel from an installation thereof, a substantially flat sound reflecting pan positioned behind said perforated pan with respect to said sound to reflect sound passing through said perforated pan and striking said reflecting pan back toward said perforated pan, said reflecting pan having sides forming an angle of substantially ninety degrees with the inner surface thereof, said sides contacting the inner surface of said perforated pan around substantially the entire periphery of said panel to prevent the escape of sound from the edges of said panel, and a light weight semi-rigid core between said perforated pan and reflecting pan for deadening said sound.

8. An acoustical panel, comprising a substantially flat perforated pan adapted to be exposed to sound which it is desired to deaden and having sides inclined at an angle of less than ninety degrees to the inner surface of said perforated pan to facilitate the removal of said panel from an installation thereof, a substantially flat metal sound reflecting pan positioned behind said perforated pan with respect to said sound to reflect sound passing through said perforated pan and striking said reflecting pan back toward said perforated pan, said reflecting pan having sides forming an angle of substantially ninety degrees with the inner surface thereof, said sides contacting the inner surface of said perforated pan around substantially the entire periphery of said panel to prevent the escape of sound from the edges of said panel, and a light weight semi-rigid core of honeycomb structure with sound deadening materal within the individual cells thereof positioned between said perforated pan and reflecting pan for deadening said sound.

9. An acoustical panel, comprising a substantially flat perforated pan adapted to be exposed to sound which it is desired to deaden, a substantially flat sound reflecting pan positioned behind said perforated pan with respect to said sound to reflect sound passing through said perforated pan and striking said reflecting pan back towards said perforated pan, said reflecting pan having sides extending toward said perforated pan, said perforated pan having inclined sides extending toward said reflecting pan at an angle less than ninety degrees to the inner surface of said perforated pan and laterally outwardly of certain of the sides of said reflecting pan with the free marginal edges of said inclined sides contacting outer surfaces of the latter sides of said reflecting pan, a light weight semi-rigid honeycomb core between said perforated pan and reflecting pan and secured to both said pans for adding strength and rigidity to the panel, and sound-deadening material within the individual cells of the honeycomb core.

10. The acoustical panel defined in claim 9 wherein the free marginal edges of the inclined sides of said perforated pan terminate short of the plane of the substantially flat reflecting pan.

11. The acoustical panel defined in claim 9 wherein the free edges of the sides of said reflecting pan are in substantially continuous uninterrupted contact with the inner surface of said perforated pan around the entire periphery of the panel.

12. The structure defined in claim 4 wherein said partition abuts said panel in surface-to-surface engagement with said perforated member.

13. An acoustical panel comprising a substantially flat perforated metal pan adapted to be exposed to sound, a substantially flat metal sound reflecting pan positioned behind said perforated pan with respect to the sound to which said perforated pan is exposed, said reflecting pan being adapted to reflect sound passing through said perforated pan back toward said perforated pan, the sides of said sound reflecting pan being turned toward said perforated pan, the peripheral edges of said sides of said reflecting pan constituting substantially a continuous margin contacting the inner surface of said perforated pan around substantially the entire periphery of the panel to prevent the escape of sound, the sides of said perforated pan overlapping and contacting the sides of said reflecting pan around substantially the entire periphery of said panel to further prevent the escape of sound, a light weight core of honeycomb structure positioned between said pans and having individual cells, said cells forming sound isolation compartments in conjunction with the opposed surfaces of the pans so that sound entering an isolation compartment through the perforations in the perforated pan is effectively isolated and entrapped so that it cannot escape the panel and cannot pass to another compartment, and sound deadening material filling the compartments, the isolated sound being effectively attenuated by the sound deadening material in each and every cell, said core being semi-rigid and secured in surface-to-surface relation to both pans to add strength and rigidity to the panel.

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