Oct. 25, 1938. H. J. WOODALL ET AL 2,134,495

LAMINATED STRUCTURE

Filed May 25, 1931

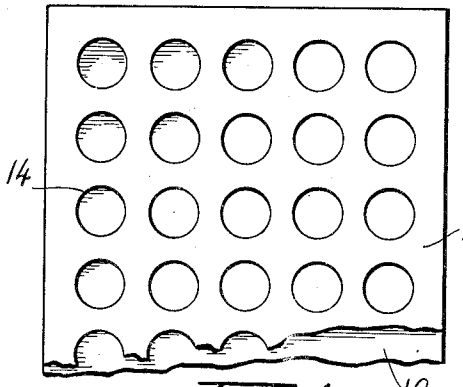


Fig. 1

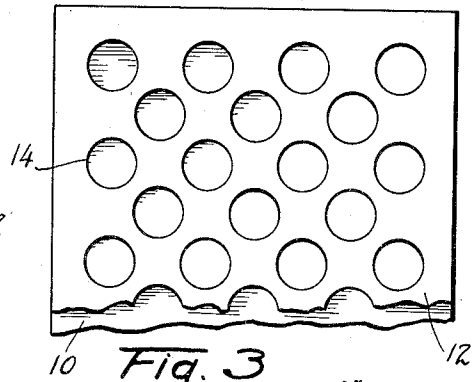


Fig. 3

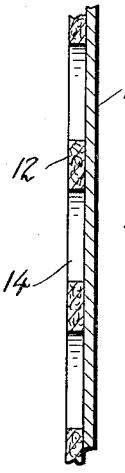


Fig. 2

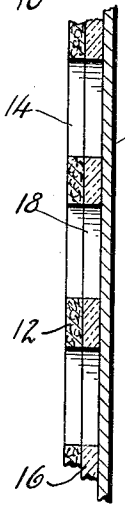


Fig. 4

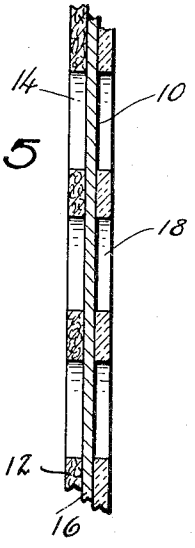


Fig. 5

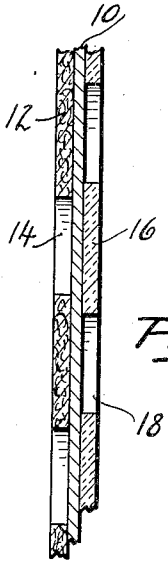


Fig. 6

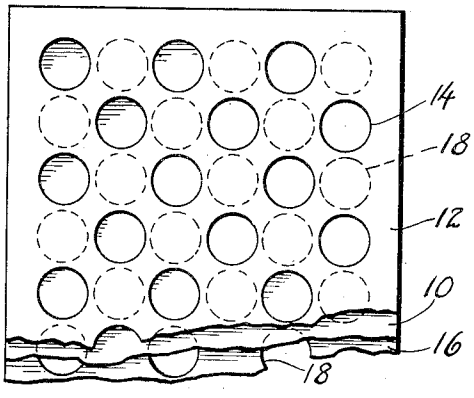


Fig. 7

Herbert J. Woodall and Meredith S. Randall INVENTORS

BY Parker & Burton

ATTORNEYS

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LAMINATED STRUCTURE

Herbert J. Woodall and Meredith S. Randall, Detroit, Mich., assignors to Woodall Industries Incorporated, Detroit, Mich., a corporation of Michigan

Application May 25, 1931, Serial No. 539,762

12 Claims. (Cl. 154—44)

Our invention relates to laminated structures composed of a plurality of plies or veneers.

Where panels are used to provide built up structures of one type or another difficulty frequently arises because of the noise created by such panels as the result of vibrations set up therein in response to vibrations set up from one cause or another in the surrounding atmosphere. Panels formed in part of metal are particularly objectionable for this reason and our invention relates particularly to a panel so constructed. Panels utilized in housing in or partitioning off operating mechanism are commonly relatively thin and these function when set in vibratory motion somewhat in the manner of a diaphragm to send forth sound vibrations.

Thin panel sheets when set in vibratory motion serve as diaphragmatic elements in producing sound. Whether this vibration is objectionable, because of noise created, depends upon the frequency of the sound waves set up by the vibration, the sound being inaudible below a certain vibration frequency and above an upper limit. This sound is emphasized in panels used in automobile body construction and in this instance the sound is particularly objectionable. It frequently develops into an annoying drumming or rumble.

An object of this invention is to eliminate the sound set up by the vibration of such panels and this invention contemplates breaking up the diaphragmatic structure of the panel sheet to such an extent that whatever vibrations may arise will be of such frequency as to produce substantially inaudible sound waves. In accomplishing this result we create an entirely new type of panel structure so formed that it does not constitute a diaphragm capable of being set in vibration with a frequency which will result in audible sound waves. The panel structure as a whole is divided into a multiplicity of small diaphragmatic sections which respond to the outside vibrations at a frequency different from that of the entire panel and at a frequency which will not produce an objectionable noise.

Various other objects and meritorious features of our invention will be apparent from the following description taken in conjunction with the drawing wherein like numerals refer to like parts throughout the several figures and wherein:

Fig. 1 is a plan view, partly broken away, of our improved panel.

Fig. 2 is a section therethrough.

Fig. 3 illustrates a somewhat modified arrangement of Figs. 1 and 2.

Figs. 4, 5, and 6 illustrate somewhat modified forms of panel assembly.

Fig. 7 is a plan, partly broken away, of the assembly illustrated in Fig. 6.

Referring to the drawing, numeral 10 represents a metal sheet constituting the basic ply of the laminated structure. A sheet, or secondary ply, 12 having a plurality of openings therethrough is superposed upon the metal panel 10 and firmly secured thereto over the entire expanse of adjacent surfaces in any suitable manner. Various types of animal glue or cement are available for this purpose, but it is important that the two veneers or plies adhere to each other firmly throughout their adjacent surfaces for the purpose of forming an integral unit. These spaced apart apertures 14 may be arranged in any of a number of ways, a plurality of aligned openings being illustrated in Fig. 1 and successive rows in staggered relation being shown in Fig. 3. The effectiveness and relative merit of the two arrangements of openings in the superposed ply 12 depend somewhat on the surface dimension of the panel as well as upon the inherent characteristics of the basic ply 10.

While the secondary ply 12 may be of various compositions, it is suggested that some fibrous material be utilized because of its inherent sound insulation properties which may substantially assist in the complete elimination of sound resulting from vibration. A material which has been found suitable is known as "KB" board and includes a substantial asphaltum content which possesses the physical characteristics aforesaid. It will be seen that, while the metal panel 10 alone constitutes what may be regarded as a single diaphragm which might be readily set into vibration at a frequency productive of audible waves, the structure illustrated in Figs. 1, 2, and 3 comprises an integral unit which includes a relatively large number of small diaphragmatic sections, the vibration frequency of which would normally result in inaudible waves.

Under certain circumstances it may be desirable to insulate the panel against the deleterious effects of heat. In Fig. 4 we have illustrated a panel structure somewhat similar to that of Fig. 2 but including as a third ply 16 formed of some material which will function as a heat insulator. It is of importance that each ply be firmly secured to the ply upon which it is superposed over its entire contacting area, as hitherto explained in relation to the metal panel 10 and secondary ply 12. When the additional ply 16 has been secured in this manner the resulting assembly will likewise be an integral structure providing a single unit. While any suitable heat insulating material may be utilized to form the ply 16 we have found that fiber board possessing heat insulating qualities functions very satisfactorily and such a material is available in the form of what is known as "Masonite".

In Fig. 4 we have illustrated the openings in the third ply or heat insulating ply as being alined with those in the secondary ply 12, both

plies being positioned on the same side of the metal panel 10. This particular relationship is not essential, however, and, as illustrated in Fig. 5, the laminations 12 and 16 may be arranged on opposite sides of the metal panel lamination 10.

Under some circumstances, depending to a large extent on the surface dimensions of the basic panel 10, it may prove desirable to superpose the two secondary panels 12 and 16 upon opposite sides of the panel 10 and arrange the openings 14 and 18 thereof in staggered relation as illustrated in Figs. 6 and 7.

In each of the modifications herein disclosed the invention includes forming an integral panel structure of a plurality of plies wherein at least one of the plies is apertured at spaced intervals. Experiment has shown that a panel so constructed eliminates the audible sound usually created by vibration of an ordinary panel. The reason for its success in so doing may be explained in various ways. It is believed that the resulting composite panel forms a plurality of small diaphragms each of which reacts to a vibration frequency which produces inaudible sound waves. The vibration of the panel as a whole is not necessarily wholly eliminated but it is substantially damped, and the secondary vibrations set up by the smaller diaphragmatic sections may interfere with those set up in the panel assembly per se to substantially eliminate waves of a frequency to produce audible sound.

In this connection it is of considerable importance that the surfaces of the superposed plies be firmly secured throughout. Otherwise an integral composite panel would not result.

While we have illustrated certain preferred forms of our invention various modifications will be obvious to those skilled in the art and for that reason we wish to limit ourselves only within the scope of the appended claims.

What we claim is:

1. A laminated structure comprising a sheet of vibratile non-sound insulating material, and a second sheet of porous fibrous sound insulating material secured thereover forming an integral structure therewith, said second sheet provided with a plurality of substantial apertures exposing the porous interior structure thereof.

2. A sound deadening panel comprising a plurality of laminations secured together, one lamination being vibratile metal, and a lamination of fibrous material having a plurality of small apertures therethrough juxtaposing and secured to said metal lamination forming an integral panel structure therewith.

3. A sound deadening panel comprising a plurality of laminations secured together forming an integral panel, one lamination being metal and having a fibrous lamination on each side, one of which fibrous laminations has a plurality of small apertures therethrough throughout substantially its entire area.

4. A sound deadening panel comprising a plurality of laminations secured together forming an integral whole, one lamination being vibratile and provided with a juxtaposed lamination consisting of thermoplastic material provided with a plurality of small apertures therethrough throughout substantially its entire area.

5. A sound deadening panel comprising a sheet metal lamination and a thermoplastic fibrous lamination, said fibrous lamination juxtaposing to the metal lamination and forming an integral structure therewith and provided with a multiplicity of openings therethrough exposing the metal lamination.

6. A sound deadening panel comprising a permanently deformable vibratile lamination, an insulating lamination provided with a plurality of small apertures and incapable of alone permanently retaining a deformed shape secured to the deformable lamination to be held in deformed shape thereby and forming an integral structure therewith.

7. A sound deadening panel comprising a layer of vibratile material, a layer of fibrous insulating material provided with a plurality of apertures juxtaposing one side of said layer of metal, a second layer of fibrous material provided with a plurality of apertures juxtaposing the opposite side of said layer of metal with the apertures of each layer arranged opposite portions of the metal supported on the opposite side by unbroken fibrous material of the opposite layer, said three layers being united to form an integral structure.

8. A sound deadening panel comprising a layer of sheet metal, a layer of loosely integrated insulating fibrous material provided with a plurality of apertures juxtaposing one side of said layer of metal, and a layer of more closely compacted thermoplastic sheet material juxtaposing the opposite side of said layer of metal, said three layers being united in an integral structure.

9. A sound deadening panel including three laminations of material, namely, a vibratile lamination of metal, a lamination of loosely integrated insulating material secured to one side of the lamination of metal and provided with a plurality of apertures, and a lamination of closely compacted fibrous thermoplastic material secured to one of the first two laminations to dampen the vibration of the metal lamination, said three laminations being so secured together as to form an integral structure.

10. A laminated structure comprising a sheet of nonsound insulating vibratile material and a sheet of fibrous cellular sound insulating material juxtaposed over one surface and provided with a plurality of apertures formed therein, each aperture extending through a multiplicity of the cells of the structure thereof, said two sheets being secured together to form an integral structure.

11. A laminated panel comprising a vibratile lamination of metal, a lamination of loosely integrated cellular fibrous insulation material juxtaposed over the metal lamination and a lamination of asphalt impregnated fibrous material overlying said insulation lamination, said insulation lamination having a plurality of apertures formed therein, said three laminations being secured together to form an integral structure.

12. A laminated structure comprising a vibratile lamination of relatively dense impervious diaphragmatic material, a lamination of loosely integrated cellulose fibrous insulation material overlying the same, and a lamination of asphalt impregnated fibrous material overlying the insulation material, said insulation lamination and asphalt impregnated lamination having a plurality of communicating apertures formed therein, said three laminations being secured together to form an integral structure.

HERBERT J. WOODALL.
MEREDITH S. RANDALL.