

United States Patent

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[54] **SOUND-RETARDING WALL
ELEMENTS**

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[58] Field of Search.....181/33 R, 33 G, 33 GA

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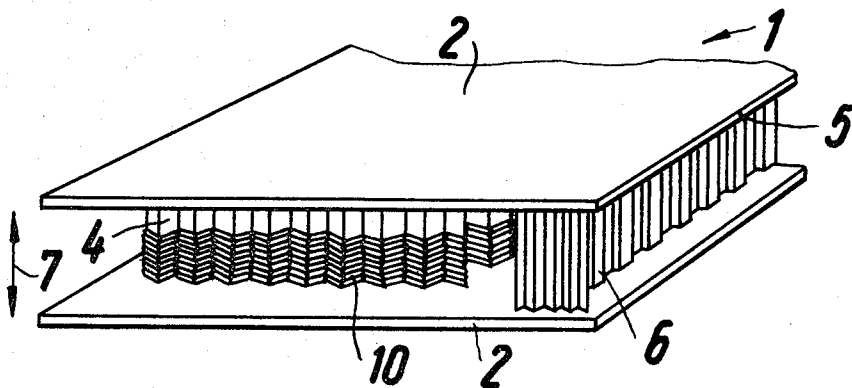
Primary Examiner—Robert S. Ward, Jr.

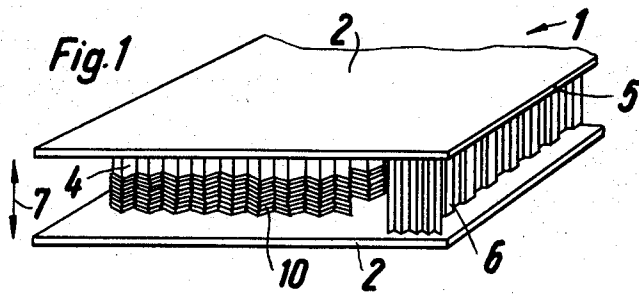
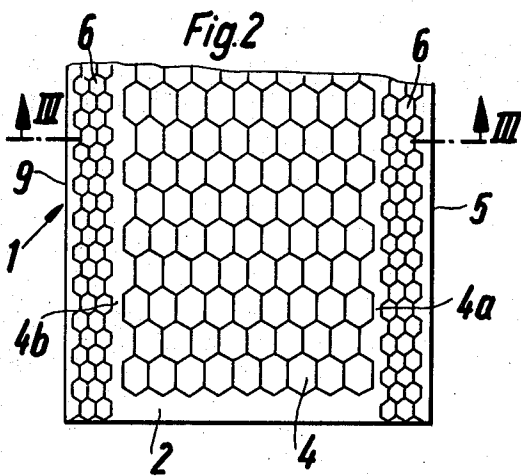
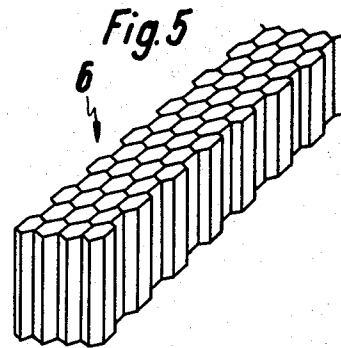
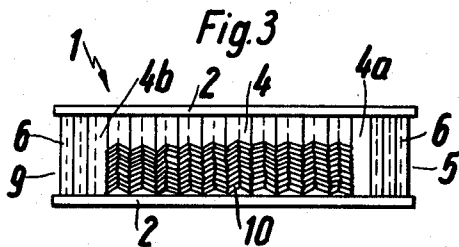
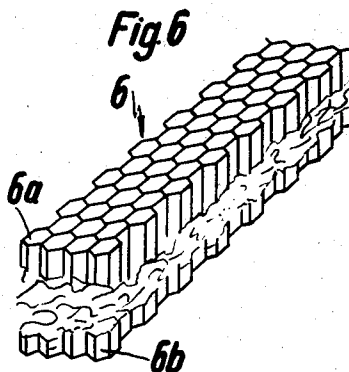
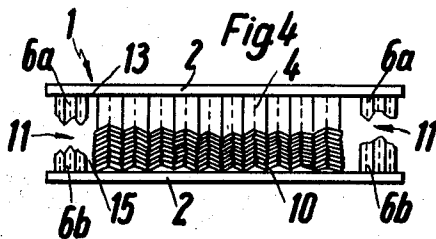
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[57] **ABSTRACT**

A sound-retarding wall element having outer sheets and a honeycomb core which is compressed to an irregularly folded shape to improve the sound insulating qualities of the element. Honeycomb spacers formed of easily broken material are inserted between the sheets along opposite side edges of the element to prevent collapse of the cone when the elements are attacked for transport or storage. A process for producing such sound-retarding wall elements.

6 Claims, 6 Drawing Figures





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SOUND-RETARDING WALL ELEMENTS

This invention relates to sound-retarding wall elements and in particular, to a sound-retarding wall element with at least one sound-retarding (proofing) core between essentially parallel sheets.

In a handbook by C. M. Harris, entitled "Noise Control", published by McGraw-Hill Book Company, New York, 1957, pages 20-4, FIG. 20.2, there are shown a number of examples of sound-retarding wall elements. However, these well known wall elements are all expensive to produce and, due to their construction, not sufficiently sound retarding. Furthermore, it is difficult to stack such sound-retarding wall elements horizontally one upon the other, as each wall element exerts a not inconsiderable pressure upon the wall element immediately below, increasing with the height of the stack and causing the wall elements to be compressed in such manner as to adversely affect their sound-retarding capacity.

An object of this invention is, therefore, the creation of sound-retarding wall elements, capable of being produced from relatively inexpensive materials in a simple process and having good sound-retarding quality and further, in spite of the thickness required for sound-retarding the elements have resistance against torsion and may be transported and stacked without adversely affecting their sound-retarding quality.

In connection with sound-retarding wall elements, as described in the preamble, the problem is solved in the following manner: the core is to be composed of hexagonal shapes (e.g. in the manner of honeycombs), the axes of the honeycombs are to be vertical to the outside sheets; the honeycomb core is to be irregularly folded by pressure exerted vertically upon the outer sheets and, finally, spacers are to be inserted between the outer sheets, possibly also of honeycomb shape, and are to be glued to the sheets, the spacers consisting of absorptive material, impregnated with synthetic resin, hardened and in a brittle state.

The sheets with which the honeycomb core and spacers are connected, may be made in the usual manner of wood, press board, cardboard, gyproc, plastics, metals, etc. Material to be used for honeycomb core and spacer is generally known and is widely used for door cores, heat insulations, etc.

This invention is based on the new and surprising discovery that sound insulation by means of a honeycomb core may be vastly improved if by pressure exerted vertically to the outer sheets, the walls forming the honeycomb core are so compressed that they are irregularly folded or deformed respectively. In this manner, a totally unexpected degree of sound retarding is effected, e.g. by approximately 40 to 50 decibels. This feature may perhaps be explained by the fact that the semi-elastic folded (deformed) walls of the core convert sound energy particularly well into kinetic energy or heat energy and thus avoid resonance.

It is essential that the walls of the cells forming the core, in the original, uncompressed state, are approximately vertical to the outer sheets.

In the case of the sound-retarding elements, to which this invention relates and which may be utilized for walls, ceilings, etc., the problem of storage and transport to the building site is solved in a simple manner by honeycomb spacers, glued to the sheets, so that compression may be avoided, leading to a reduction in flex-

ibility and thereby of the sound-retarding quality of the deformed honeycomb core. The spacers must be so arranged so to be easily and quickly removable before utilization of the wall elements at the building site and without damage to the wall elements.

Hitherto, in order to keep fixed dimensions in bodies of flexible height or thickness, small blocks or moldings, suitably dimensioned, and of a solid substance, such as wood, metal, ceramic, plastics, etc., were utilized, preferably at the edges and between the respective sheets. In such instance, the spacer must be fastened, either by gluing, screwing or nailing so that removal of the spacer before utilization of the sound-retarding wall element is very difficult. Where spacers are glued and removed after storage or transport, damage may be caused to the core or outer sheets, in particularly if the former consist of pressboard, cardboard, gyproc or plastics, by the tearing of the sheet at the spot where the spacers are pulled away. The removal of screws or nails, on the other hand, requires an unduly long period of time.

Pursuant to the present invention, these disadvantages are avoided by the use of honeycomb shaped brittle spacers.

On the other hand, the spacers are resistant against pressure in the direction of the cell walls, so that the sound-retarding wall elements may be stacked to virtually any height. On the other hand, the spacers, by reason of their honeycomb shape, may be easily removed by lateral pressure, exerted by an instrument shaped like a stick and can be destroyed so that their distance spacing effect is terminated.

The remnants of the brittle spacers glued to the sheets need not be removed but, after elimination of the central portion of the spacers, may be left within the now flexible interior of the wall element, as they are not visible from the outside. The honeycomb structure of the spacer is of importance insofar as sufficient space must be available between the individual walls in order that laterally exerted pressure by a suitable tool may split and break it away. The hexagonal structure, such as honeycomb, may be fabricated for both core and spacers in a well tested manner.

If the sound-retarding wall element, object of this invention, is to be fabricated directly where it is to be utilized, the honeycomb shaped, brittle spacers need naturally not be employed.

The walls of the sound-retarding core are only partly folded in a special manner provided for in this invention. By the degree of folding, a compromise may be reached between the required mechanical solidity and stiffness on the one hand, and the desired sound-retarding effect on the other. In this way, the non-folded part of the honeycomb shaped walls provides solidity and stiffness, while the irregularly folded part of the honeycomb shaped core provides the sound-retarding effect.

In the production of the sound-retarding cone, the walls may be most advantageously and economically made from paper, pressboard or cardboard as such materials may be easily worked and are light in weight.

The walls of the honeycomb structure of the spacers may best be made from paper, pressboard, cardboard or thin wood, etc., as such materials may readily absorb synthetic resin, with which the spacers are to be im-

pregnated, hardened and rendered brittle. Weakly glued absorptive paper proved to be excellent material for the spacers.

Moreover, the aforesaid materials for the spacers have little specific weight so that the total weight of sound-retarding wall elements hereunder in storage or transport is only inconsiderably increased.

For the impregnation of the walls of the spacers, cut to the required height and width, synthetic resin soluble almost completely in water, may be advantageously utilized. In this connection phenol resin, carbamid resin or duroplast, readily available in water soluble form, are most suitable. The sound-retarding effect of the wall elements hereunder may be further increased by partly or wholly filling the honeycomb cell structures with sound insulating material.

The sound-retarding wall elements hereunder may be constructed in the following manner: to begin with, the walls of the honeycomb structure of the sound-retarding core are so compressed that they are wholly or partly folded; subsequently the core is tied to the sheets and, for the purpose of transport or storage, brittle spacers are fitted along the edges of the sheets, whereby at least one end of the spacer is connected to the respective sheet.

However, the sound-retarding wall elements hereunder may also be constructed in the manner hereinafter: to begin with, the honeycomb shaped walls of the sound-retarding core are attached to the sheets non-folded; subsequently, spacers are placed at the edges of the sheets, glued or attached in whatever manner to at least one sheet; finally, and in a vertical direction to the level of the sheets, the non-folded wall element is compressed to the height of the spacers so as to partly or wholly fold the walls of the sound-retarding core and pressure is maintained until the loose ends of the spacers, suitably prepared, make contact with and are tied to the adjoining sheet.

Irregular folding of the honeycomb structure walls is best obtained by exerting even pressure, by means of a press, upon the whole of the honeycomb core or upon the outer sheets honeycomb structure with water dissolved synthetic resin and, in the case of phenolic resin, (soluble in water up to the ratio of 1 to 3 by Volume) heat treatment of about 150° C, is applied for about 15-20 minutes in order to harden the plastic resin. Temperature and duration of heat treatment depend on the type of synthetic resin employed. By means of this treatment, the honeycomb shaped walls become stiff and brittle and, in consequence, are capable of supporting considerable even pressure exerted upon their edges, vertically to the axes of the cells, without breaking. However, pressure exerted upon the walls of the honeycomb structure, i.e. with a tool shaped like a stick, will cause the spacers to burst individually and one after the other, due to their lack of elasticity. This quality of the spacers makes them highly suitable for the sound-retarding wall elements hereunder, i.e. high stability in case of vertical pressure and inferior stability and brittleness in case of lateral pressure.

A sample product pursuant to this invention is explained hereunder with the aid of the attached drawing in which:

FIG. 1 is a perspective view of a portion of a sound-retarding wall element with brittle spacers inserted along edges of the element;

FIG. 2 is a plan of the wall element shown in FIG. 1, with a sheet removed, and showing spacers inserted along edges of the element;

FIG. 3 is a section taken on the 3-3 of FIG. 2;

FIG. 4 is a section similar to FIG. 3 and showing the spacers broken away in the middle by a suitable tool;

FIG. 5 is a perspective view of a honeycomb spacer; and

FIG. 6 is a perspective view of the spacer shown in FIG. 5 with the middle broken away, as in FIG. 4.

The wall element indicated generally by the numeral 1 in the drawing comprises two outer sheets 2, which may be of wood, pressboard, cardboard, gyproc, plastic, metal or the like. Between the outer sheets 2 there is placed a honeycomb shaped core 4 as sound insulation, preferably partly folded or deformed. The walls 10 of the honeycomb shaped core 4, which are essentially vertical to the outer sheets 2, may consist of paper, cardboard, plastics, or other material and, at their edges, said walls are glued or welded or otherwise tied or secured to said outer sheets. The walls 10 of the honeycomb shaped core 4 are partly folded. The width of the core 4 and extent of folding (deformation) of the walls 10 depends, on the one hand, on the degree of sound insulation to be achieved and, on the other, upon the resistance to bending of the wall element to be obtained. The extent of folding of the walls 10 depends on the material utilized and pressure exerted. In case of the wall element 1 partly shown in FIG. 1, a spacer 6, consisting of honeycomb shaped walls of absorptive material, impregnated with artificial resin, hardened and rendered brittle, is inserted along edge 5. The width of the honeycomb is ordinarily between 1 and 1.5 cm, in order that the spacer 6 may be easily broken away immediately before utilizing wall element 1.

In order to avoid shifting of the spacer 6 during transport of horizontally stacked wall elements 1, said spacer is glued, welded or otherwise tied at opposite ends to the sheets 2.

Insertion of the spacer 6 along at least two edges of the wall element 1 prevents free elasticity (flexibility), shown in FIG. 1 by double arrow 7, which later assures sound-retarding quality, so that during storage and transport of the wall element, the sound-retarding quality thereof is not impaired.

FIG. 2 shows a view from above of wall elements 1, as in FIG. 1, a sheet 2 having been removed in order to indicate the honeycomb shape of the sound-retarding core 4, as well as that of the spacer 6 inserted along the edge 5 with a similar spacer 6 being installed edge 9. Optional spaces 4a and 4b are allowed between spacers 6 and the sound-retarding core 4. The dimensions of the honeycombs and width, length and height of core 4 and spacers 6 are not drawn to scale. The width of the honeycombs of spacers 6 may be larger or smaller than that of the honeycombs of the sound-retarding core 4.

FIG. 3 shows a section of wall element 1, along the line 3-3, as shown in FIG. 2. In this drawing not only the partly folded honeycomb core 4 is shown but also the spacer 6 inserted along the edges 5 and 9 of the wall element 1 for the purpose of storage or transport. In this connection, it is pointed out that the degree of irregular folding of the walls 10 effected by deformation, need not be smaller than the distance between the honeycomb walls. The folds may also touch each other laterally.

While the section in FIG. 3 shows the wall element 1 during storage or transport, and includes spacers 6, FIG. 4 shows the wall element immediately before utilization and the spacers broken in the middle as indicated at 11, ensuring free flexibility and restoring the sound-retarding quality. On interior sides 13 and 15, only remnants 6a and 6b remain of the severed spacers 6, without, however, impeding the flexibility or any other quality of wall element 1. If spacer 6 is tied to a sheet 2 at one end only of the spacer, remnants would be found on that side only. In this state, the wall element may be used in construction as the remaining remnants 6a and 6b are not visible from the outside.

In FIG. 5 and 6, spacer 6 is shown on a larger scale for the sake of clarity, before and after separation with a tool.

Spacers 6 may, of course, be utilized not only in wall element 1 as described but in all cases of essentially flat or sheet-like objects with a flexible height (thickness) whose flexibility is to be prevented during storage or transport and restored prior to relevant use of said objects. Employment of spacers 6 is clearly independent of the material of the flexible core 4 and outer sheets 2. Preferably, the same material should be used for both sound-retarding core 4 and spacers 6, so that said spacers may be fabricated from waste material derived from the production of the flexible core.

The widths of the walls of the sound-retarding core 4 and spacers 6 is not critical. The width of walls 10 should be calculated in relation to the required degree of sound-retarding and the corresponding resistance to bending of the wall element. The width of the spacer walls should be calculated in accordance with the load weighing upon them vertically and the lateral pressure required to destroy them, due to their brittleness.

This invention is not limited to the examples shown herein, in particular not to wall elements with only two outer sheets and one core, but may also be applied, for example, to wall elements with more than one sound-retarding core, separated by interior sheets. Also, other than honeycomb structured cells may be employed.

I claim:

1. Sound-retarding wall elements comprising two substantially parallel, spaced sheets, a core interposed

between said sheets, said core comprising elastic honeycomb cells having an axis substantially perpendicular to each of said sheets, said honeycomb cells being folded over a portion of their axial length, and substantially rigid, brittle spacers interposed between said sheets and fixed to at least one of the sheets along at least one edge of the sheets, said spacers being formed of honeycomb cells of an absorptive material impregnated with a synthetic resin and having an axis substantially perpendicular to said sheets whereby the spacers provide structural strength to the elements and are adapted to be fractured to provide wall elements having elasticity to retard sound.

2. Sound-retarding wall elements as defined in claim 1 wherein the walls of the core are formed of paper.

3. Sound-retarding wall elements as defined in claim 1 wherein the synthetic resin is a phenolic resin.

4. Process for the production of sound-retarding wall elements comprising the steps of forming a core of honeycomb cells, compressing the core to at least partially fold the honeycomb cells over their axial length to render the cells elastic, fixing the core to two parallel, spaced sheets whereby the axis of the cells is substantially perpendicular to the sheets, inserting brittle spacers formed of honeycomb cells of an absorptive material impregnated with a synthetic resin along at least one edge of the sheets and fixing the spacers to at least one of the sheets.

5. Process for the production of sound-retarding wall elements comprising the steps of forming a honeycomb core, fixing the honeycomb core between two substantially parallel spaced sheets whereby the axes of the cells are substantially perpendicular to the sheets, inserting spacers formed of rigid honeycombed cells having an adhesive on at least one end thereof, apply pressure to compress the honeycomb core to the height of the spacers whereby the honeycomb cells are at least partially compressed to form folds over their axial length and maintaining the pressure until a bond between the sheets and the spacers is established.

6. Process as defined in claim 5 wherein the pressure is exerted to compress the honeycomb core in a direction parallel to the axis of the honeycomb cells.

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