June 1, 1937. L. S. PERRY 2,081,953

SOUND DAMPING STRUCTURE

Filed Sept. 8, 1932

Fig. 1.

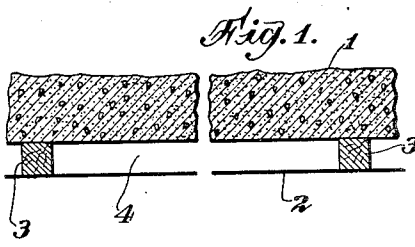


Fig. 2.

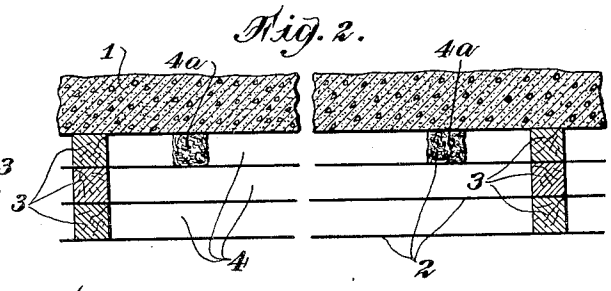


Fig. 3.

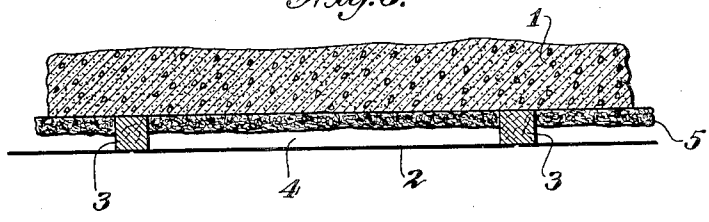
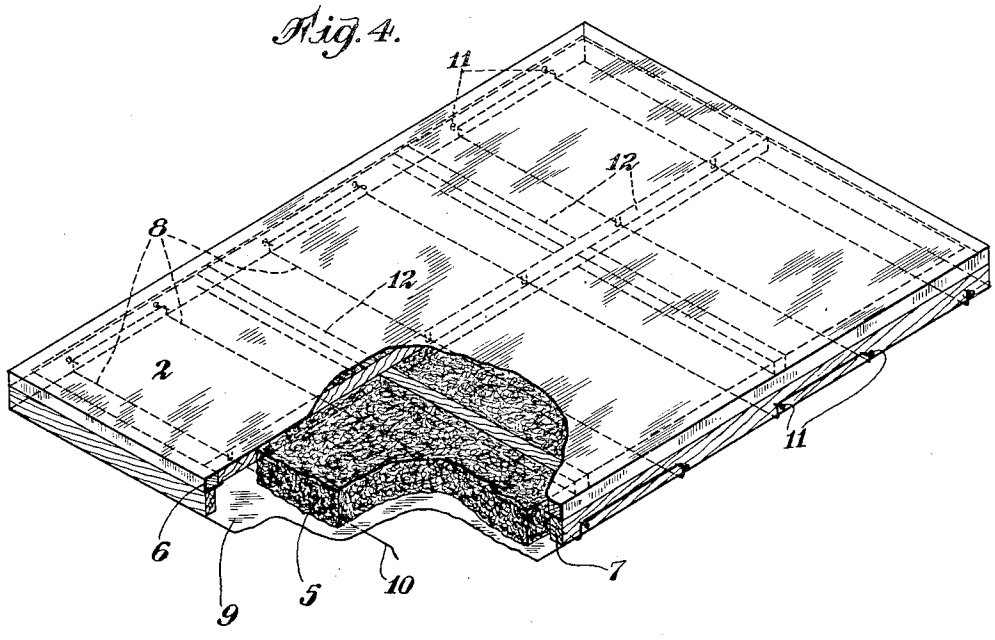


Fig. 4.



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SOUND DAMPING STRUCTURE

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7 Claims. (Cl. 154—44)

This invention relates to a sound dissipating or damping structure, particularly to one adapted to dissipate sound energy in a vibratile sheet.

The sound dissipating or damping structure includes an air-impermeable, unstretched sheet member, exposed to incident sound and adapted to be vibrated readily thereby. Suitably it includes also a rearwardly disposed sound damping or absorbing member, as, for example, a member similar to the first mentioned vibratile sheet or a porous sound absorbing pad.

Certain types of sheets have been used heretofore in acoustical structures for resounding, for counteracting reverberations and reflecting sound, and for making resonant walls. In addition, closely perforated or foraminous sheets have been used as sound-permeable facing members, to admit incident sound to a rearwardly disposed sound absorbing material.

The invention is illustrated in the drawing in which,

Fig. 1 shows a sectional view of an embodiment of the invention.

Figs. 2 and 3 show sectional views of modifications of the invention.

Fig. 4 shows a perspective view of a preformed, sound damping unit, with parts broken away for clearness of illustration.

In the various figures, like reference characters denote like parts.

Thus, 1 denotes a boundary surface of an enclosure, say, a concrete wall, over which there is placed an imperforate readily vibratile sheet **2**, maintained in spaced relationship to the wall surface by supporting means, such as furring strips **3** that may be constructed of wood, metal or other usual material, and may contact with all edges of the sheet. The furring strips may be held to the wall and also to the edges of the vibratile sheet member by means of adhesive or conventional fastening elements that are not shown in the figures. The furring strips, wall and vibratile sheet may enclose a practically dead air space **4**.

The vibratile sheet **2** is suitably imperforate, that is, impermeable to air over a large part of its area and unstretched, that is, not normally under tension. Perforations or openings, if any, are localized in limited areas that do not interfere with the desired vibration of the sheet. The sheet should be resonant, very thin and adapted to be set in vibration readily by incident sound, in distinction from layers or sheets of plaster, insulating lumber, ceramic tile, or heavy metal sheets. The vibratile sheet may consist of sheet steel, say, 0.001 to 0.006 inch thick, brass or other metal, and is suitably elastic in the sense that steel is elastic, that is, of marked tendency to return approximately to either original form or volume after a distorting force applied to the sheet is removed. For best results in damping sound of selected pitch, the sheet should have a natural vibration period or frequency that is not the same as that of the predominant frequency of the sound that is to be damped. Under such conditions, the sheet, when vibrated by the sound, will damp or dissipate a substantial amount of the energy of the sound. It is not necessary to have the sheet under tension.

In order to increase the effectiveness of the sound damping, there may be used a plurality of spaced, approximately parallel, readily vibratile sheets **2**, as illustrated in Fig. 2. Such sheets and the supporting means, including the wall **1** and the furring strips **3**, or other supporting means, may define enclosed or dead air spaces between the several sheets. When incident sound falls upon the outer sheet of such a structure, and causes the sheet to vibrate, the sheet will dissipate some of the energy of the sound and will emit sound of lower intensity than that of the incident sound. The emitted sound will impinge upon an adjacent sheet, in which an additional amount of energy will be dissipated. The said adjacent sheet will, in turn, emit sound which, in the structure illustrated, will be damped in part by the third or innermost vibratile sheets. For certain desired sound controlling purposes, the assembly of the plurality of vibratile sheets may have a thinner, more readily vibratile sheet as the outer member and a thicker, less readily vibratile sheet disposed to the rear of the said outer member. Also, damping members **4***a*, such as strips or points that are suitably felt-covered, may be maintained in selected positions in contact with the rearwardly disposed vibratile sheet or sheets, to give natural vibration frequencies different from those of the adjacent sheet or sheets.

For some purposes, particularly when an efficient thermal insulating as well as sound damping structure is desired, the rearwardly disposed sound damping member may consist of a conventional, porous sound absorbing pad or layer **5**. Thus, the layer may be approximately an inch thick and may consist of felted asbestos, mineral wool, or other fibers or of other sound-permeable, sound absorbing material. The sound absorbing layer **5** may be maintained in spaced relationship

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to the outer imperforate, readily vibratile sheet 2, by any suitable means, as illustrated in Fig. 4.

A preformed sound damping unit adapted to be applied to the surface of a wall or ceiling, is shown in perspective in Fig. 4. In this figure there is illustrated a vibratile sheet 2, of the type described above, that, at its edges, may be turned over spacing and retaining members 6, say wooden bars approximately 1 x ½ inch in cross section or iron angles. The bars may be secured to each other, as by nailing at the corners (not shown). This partial assembly may be secured, as by nails or otherwise, to additional spacing and supporting members 7, suitably also wooden bars that are nailed to each other at the four corners. Disposed behind the vibratile sheet and within the box-like structure formed by the members 6 and 7, is a layer of sound absorbing material 5, say in the form of several pads of substantially lesser area each than the area of the vibratile sheet. This material may be maintained in spaced relationship to the sheet 2, by means of spacing means 8, suitably strong, stiff wires, which extend from an inner face of a member 6 to the inner face of an opposite member 6 and are secured to the said members by any suitable means such as staples or nails. Over the back of the unit there may be provided means 9 to enclose the space within the box-like structure and thus confine the air to a substantial degree. As strengthening and/or spacing members within the box, there may be provided cross-bars 12, suitably of wood or metal. The means 9 may consist of a sheet of wrapping paper or other material adhered or otherwise secured to the edges of the members 7. Or, the closing means 9 may be held in position by the heavy wires 10 which are passed and secured from rear edge to rear edge of the members 7 by fasteners, suitably by nails 11.

Regardless of the particular type of structure used, the acoustical properties of the product are interesting.

Particularly interesting is the smallness of the difference in results in damping sounds of different pitch, when there is used a readily vibratile facing member of the type described. This feature adapts the structure for use in sound damping and correcting, with preservation, to a large extent, of the original quality of the sound.

Acoustical structures made in accordance with the present invention may be painted, or otherwise decorated, continuously over the outer side that is exposed to incident sound. Also, such structures are free from the dusting which is sometimes experienced in assemblies in which a fibrous material is maintained behind a perforated facing element. Also, there is eliminated the possibility of dust collecting in a porous backing layer and partly closing the surface pores, inasmuch as dust cannot pass through the imperforate sheet facing element of preferred type of the present invention.

Unlike many other structures such as those having a fabric facing element, the facing elements of the present invention are fire-proof and mildew-proof, and are not susceptible to the influence of moisture, that is, they are not caused to expand or contract with varying conditions of atmospheric humidity.

The details that have been given are for the purpose of illustration and not restriction, and many variations therefrom may be made without departing from the spirit and scope of the invention.

What I claim is:

1. A sound damping structure, comprising an elastic, resonant, vibratile, air-impermeable sheet member, in unstretched condition, adapted to be set in vibration readily by incident sound and sound absorbing means disposed behind and in spaced relationship to the said sheet member.

2. A sound damping structure comprising a plurality of approximately parallel, spaced, vibratile elastic, resonant sheets adapted to be set in vibration readily by incident sound, a supporting substructure, and means for maintaining the said sheets in spaced relationship to each other, whereby sound emitted by one of the said sheets may be damped, in part, in causing vibration of an adjacent sheet.

3. A sound damping structure for sound of selected frequency comprising a vibratile sheet member adapted to be set in vibration readily by incident sound and possessed of a natural vibration frequency substantially different from the predominant frequency of the sound to be damped.

4. In a sound damping structure comprising a plurality of spaced air-impermeable sheets adapted to be vibrated by incident sound, the improvement comprising adjacent sheets of different natural vibration frequencies.

5. In a sound damping structure comprising a plurality of spaced air-impermeable sheets adapted to be vibrated by incident sound, the improvement comprising damping means applied in selected position to one sheet, to cause it to have a different natural vibration frequency from that of an adjacent sheet.

6. A structure, adapted to absorb sound of a substantial range of frequencies, comprising in combination a plurality of vibratile membranes of various masses per unit of area, spaced from but adjacent to each other, and extending in direction substantially transverse to the direction of incidence of the sound to be absorbed, the membranes being arranged in order, according to mass, so that the sound to be absorbed strikes first the membrane of least mass.

7. A structure, adapted to absorb sound of a substantial range of frequencies, comprising in combination a plurality of superposed, flexible, air-impermeable, vibratile membranes spaced from each other and being of different masses, the membrane of lightest mass being exposed on its forward surface to the sound to be absorbed, and a sound-absorbing element of the type of a felt pad being disposed behind and adjacent to at least one of the said membranes.

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