

March 5, 1940.

E. SCHENK

2,192,653

ACOUSTIC CONSTRUCTION

Filed Nov. 13, 1937

2 Sheets-Sheet 1

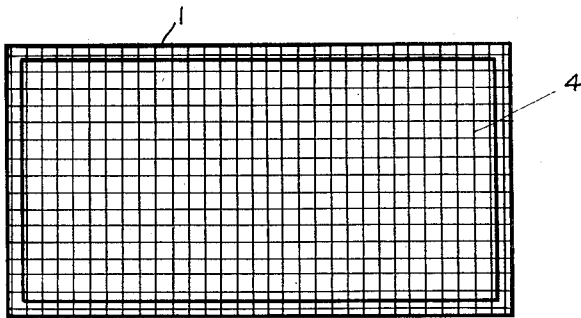


Fig. I.

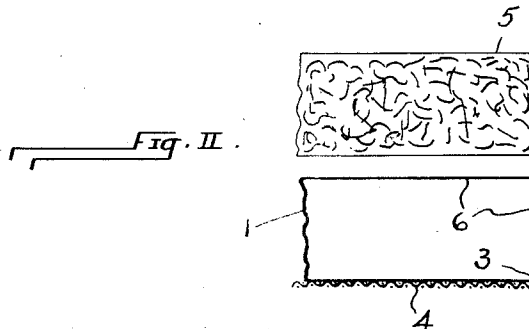


Fig. II.

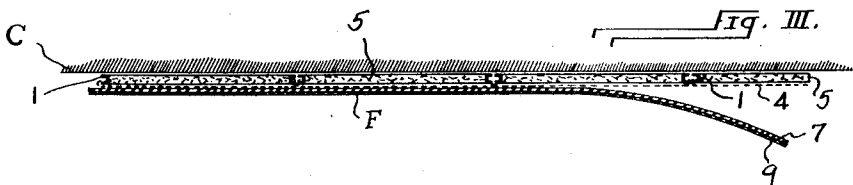


Fig. III.

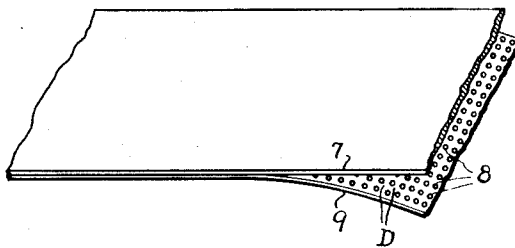


Fig. IV.

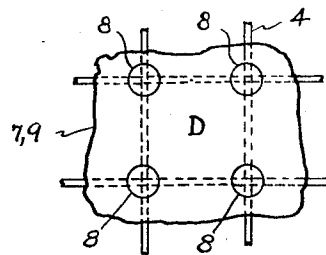


Fig. V.

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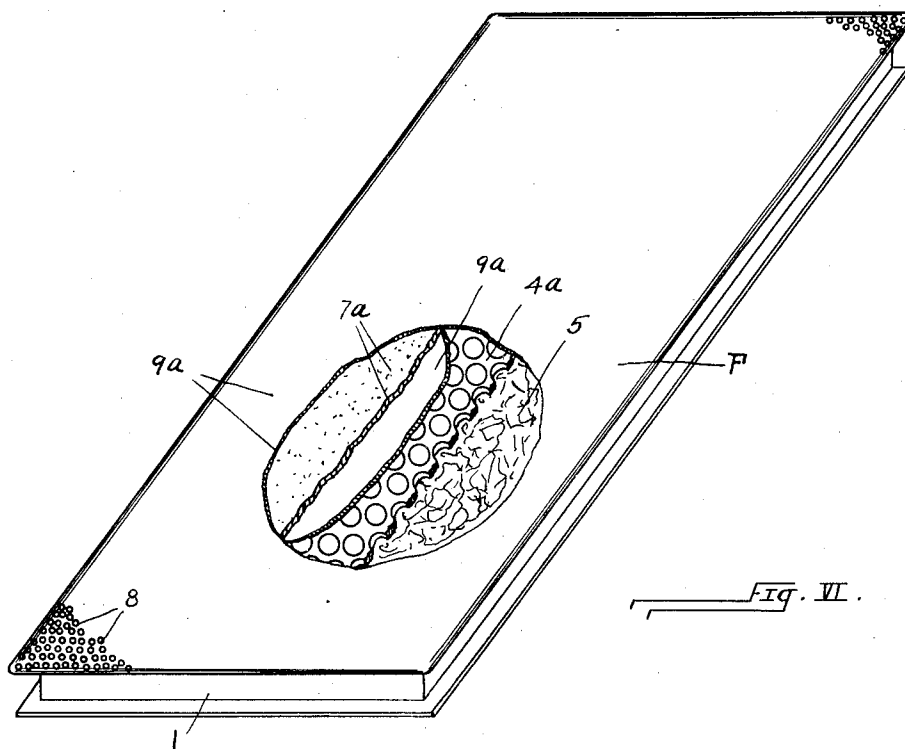
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ACOUSTIC CONSTRUCTION

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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ACOUSTIC CONSTRUCTION

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Application November 13, 1937, Serial No. 174,339

9 Claims. (Cl. 154-44)

My invention relates to wall structures, and consists in an improved acoustic construction.

The invention embraces the discovery that diaphragms composed of two sheets of electro-conductive material, extending in closely spaced relation with an air space or sheet of dielectric material between, may be arranged in an electric field to dampen and absorb sound with exceedingly high efficiency. The diaphragms, so constituted, comprise electric condensers whose vibrations under the influence of sound waves are dampened by the lines of electric or magnetic flux of said field, with the consequence and effect that the energy of the sound waves is dissipated and the transmission of sound inhibited.

In the accompanying drawings Fig. I is a view in bottom plan of a wall panel in which an exemplary embodiment of my invention is illustrated; Fig. II is a fragmentary sectional view, showing to larger scale the panel in course of construction; Fig. III is a diagrammatic sectional view, illustrating the application of the invention to a ceiling; Fig. IV is a view in perspective and to relatively large scale of a composite sheet used in the construction of my sound-absorbing wall; Fig. V is a fragmentary view to still larger scale of the sheet in assembly with the face of the panel; and Fig. VI is a view in perspective of the panel, illustrating certain modifications, to larger scale than Fig. I, but on smaller scale than Fig. V.

In constructing or treating a ceiling (or a wall, floor, or other structure) in accordance with my invention, I cover the expanse of the ceiling with a plurality of diaphragms, which in this case extend in common plane. The diaphragms comprise electric condensers or elements of electric condensers that are adapted to vibrate in the earth's magnetic field, as presently will be more fully described. Advantageously, if not essentially, a blanket of sound-absorbing material, such as felt, rock-wool, cork, or other material of suitable sound-absorbing characteristics, is provided within the expanse of diaphragms. For convenience in installation or erection, the structure is provided in the form of panel-like units.

Turning to the drawings, it will be understood that each of such panels or units may consist in a rectangular frame 1 formed of channel-iron 6, typically standard one-inch channel-iron. In this case the frame is three feet in length and a foot and one-half in width. Over one face of the frame, a rectangular sheet 4 of iron wire screen is tautly stretched and secured, say by folding and clinching the margins of the screen upon the lower flange 3 of the channel-iron frame, as shown at 2 in Fig. II. Into the shallow box or pan thus formed is inserted a bat or slab 5 of rock-wool, or a body of other suitable sound-deadening material.

By means of suitable fastening devices (not shown, but known to the art) the panels are as-

sembled in or secured upon the wall being constructed or treated. In exemplary way in Fig. III, I show a preformed ceiling C which is to be rendered soundproof. The panels 1, 4, 5 are secured edge-to-edge upon the face of the ceiling. The entire exposed face of the ceiling is covered with the panels, in such manner that the slabs 5 of rock-wool form in effect a continuous blanket of sound-absorbing material, confined between the surface of the ceiling C above and the screen 4 below. The exposed surface formed by the screens 4 of the several panels 1, 4, 5 is covered with a facing F which, as shown in Fig. IV, consists in a sheet 7 of flexible dielectric material (such as paper), to which is pasted a facing of aluminum foil 9, or other non-resonant, electro-conductive material. The composite sheet material 7, 9 may be put up in rolls, the same as ordinary wall paper, and conveniently such sheet material is pasted or glued to the screen surface of the assembled panels 1, 4, 5, in the same general way that wall paper is applied to plaster walls. In the completed installation, the metal foil 9 of the applied sheet material 7, 9 is presented downward or outward, and the paper 7 is secured immediately to the wire screen (4), forming a dielectric membrane between the outer facing of foil 9 and the inner expanse of wire screen.

While I have mentioned paper as the preferred material of which to form the dielectric between the electro-conductive sheets 4 and 9, it will be understood that many other materials may be used. For example, a sheet of thin, flexible rubber, or a sheet of flexible Cellophane, or the like, may be used as the dielectric. Again, the sheet may consist in a film of dielectric material applied to the inner surface of the foil, such film being formed, for example, of glue, varnish, rubber, cellulosic material, asphalt, or the like, which may be applied in liquid state.

It will be understood that in the area defined by the frame 1 of each panel the applied facing F forms with the wire screen 4 to which it is applied a large diaphragm. This diaphragm, including a dielectric (7) between two sheets (4 and 9) of electro-conductive material, forms a flexible electric condenser that in response to the impingement of sound waves upon it vibrates in the earth's magnetic field. When the diaphragm so vibrates in the natural magnetic field infinitesimal electric currents are generated, and these currents are dissipated, or grounded through the screen 4 and frame 1. The kinetic energy of the sound waves, being otherwise productive of the undesired transmission of sound, is spent in the generation of electric energy that is quickly dissipated.

It will also be understood that the diaphragmatic-condenser described provides a multiplicity of minute diaphragm units that are

individually effective, while the diaphragm as a whole vibrates under the influence of sound waves. Specifically, the facing F provides an individual diaphragm unit D (Fig. V) for each opening or mesh in the screen to which it is applied, and these diaphragm units are responsive to sound waves independently of the vibrations of the diaphragm as a whole. These minute diaphragm units, individually and in groups, are set in vibration by waves of sounds of relatively high pitch and medium pitch, while the diaphragm as a whole responds to sound waves of relatively low pitch. And the above-mentioned theory of operation of the diaphragm as a whole applies to each of the minute diaphragm units.

In the drawings, reference numeral 8 indicates minute perforations which may be, and advantageously are, provided in the facing F. (The perforations 8 may extend through both the sheet 7 and the sheet 9.)

In some cases I may augment the effect of the earth's field by providing additional and stronger lines of magnetic or electric force in the vicinity of the condensers. More specifically, I may magnetize or otherwise electrically charge the iron screen 4, and provide a stronger and more effective magnetic or electric field in which the multiplicity of minute condenser elements is organized.

The various ways in which the wire screen may be magnetized or electrically charged will be understood by the engineer, and a more detailed consideration of the physical and electromagnetic principles involved in the operation of my structure is deemed unnecessary to an understanding of the invention. In the appended claims the words "electrically charged screen" are intended to cover a screen which in service radiates either magnetic or electric lines of force.

In Fig. VI, I show in way of modification that the facing F may be applied to the panels individually, before they are applied to or incorporated in the ceiling or wall structure. The facing F may itself form the diaphragmatic condenser without the use of the wire screen 4. That is, the facing F may consist in two or more reaches of electro-conductive material with a dielectric interposed between, and as so constituted may be assembled upon the frame 1 or other support with or without the wire screen 4, or with a supporting member that is not necessarily formed of electro-conductive material. In Fig. VI, I show a screen 4a of perforate sheet metal as the support for the applied facing F, and I show the facing formed of a sheet 7a of paper, with a skin 9a of aluminum foil applied to both its inner and outer surfaces. It goes without saying that other modifications and refinements of the structure herein illustrated may be made without departing from the essence of the invention defined in the appended claims.

I claim as my invention:

1. A wall structure including a blanket of sound-absorbing material, a thin body of electrically charged metal covering said blanket, and a thin sheet of electro-conductive metal secured in assembly adjacent to said charged body, with a dielectric interposed between said body and said sheet.

2. A wall structure including a blanket of sound-absorbing material, a perforate screen of

electrically charged metal covering said blanket, a thin flexible sheet of electro-conductive metal secured in assembly adjacent to said screen and means for electrically isolating said sheet from said screen.

3. A wall structure including an electrically charged screen of metal, and a flexible sheet of electro-conductive metal secured in assembly adjacent to said screen with a dielectric interposed between.

4. An acoustic wall structure including an electric condenser in the form of a diaphragm, said diaphragm including two reaches of electro-conductive metal assembled to extend in close juxtaposition with an interposed dielectric, the body of at least one of said reaches including a multiplicity of perforations, whereby the assembly provides a multiplicity of relatively small diaphragms within the expanse of the first-mentioned diaphragm.

5. An acoustic wall structure including an expanse of open-work screen formed of electro-conductive metal carrying a facing composed of a sheet of dielectric material secured face to face with a sheet of electro-conductive foil; said facing being flexible, including a plurality of minute perforations, and being arranged with the dielectric material between said open-work screen and said foil.

6. A wall structure including an electrically charged screen of metal, and a flexible sheet of electro-conductive metal secured in assembly adjacent to said screen with a dielectric interposed between, said dielectric comprising a sheet of electrically non-conductive material carrying said flexible electro-conductive sheet on its surface.

7. A wall structure including an electrically charged perforate screen of metal, and a flexible sheet of electro-conductive metal secured in assembly adjacent to said screen with a dielectric interposed between, said dielectric comprising a sheet of electrically non-conductive material forming with said flexible sheet of electro-conductive metal, as applied to said perforate screen, a multiplicity of small diaphragms.

8. An acoustic wall structure including a diaphragm that comprises a perforate sheet of metal faced with a sheet of dielectric material carrying on its outer face a thin coating of electro-conductive metal.

9. An acoustic wall structure including a blanket of sound-absorbing material applied to and extending in the plane of the wall structure and covered with a perforate screen of electro-conductive metal, and an outer facing consisting in a thin, flexible, sheet applied to such screen over the expanse of the wall area, after the manner that wall-paper is applied to the surface of a plaster wall, said sheet comprising a thin perforate web of dielectric material carrying a facing of perforate electro-conductive metal foil, and such sheet being applied to the screen with the dielectric web extending between the screen and the foil, the body of the applied sheet, within the areas of the perforations in said screen and within the areas defined by and between the perforations of the applied sheet itself, providing a multiplicity of diaphragms that are adapted to vibrate individually and in groups under the influence of impinging sound waves.

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