Jan. 19, 1943. H. ECKARDT 2,308,869

ACOUSTIC WALL PANEL

Filed May 11, 1940

FIG. 1

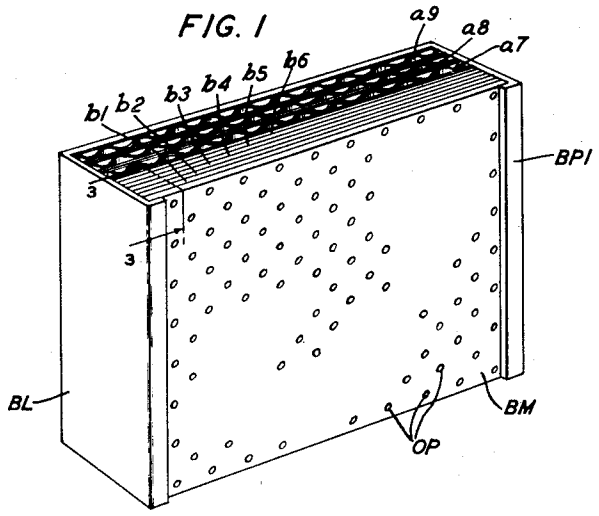


FIG. 2

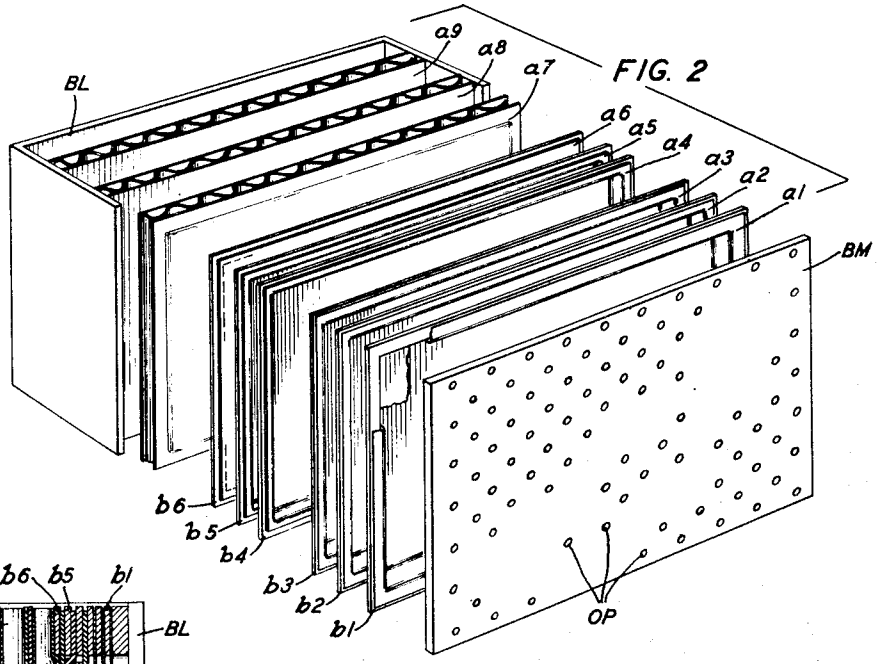
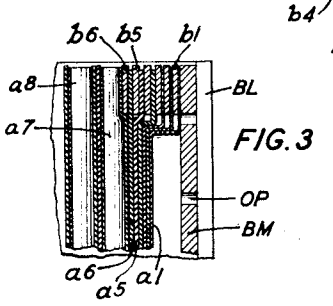


FIG. 3



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ACOUSTIC WALL PANEL

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7 Claims. (Cl. 181—0.5)

This invention relates to sound-absorbing wall constructions and has particular reference to sound-absorbing wall constructions adapted for use, for example, in telephone booths, auditoriums and the like.

The object of the invention is to simplify and improve such wall construction.

In the operation of telephone transmitter diaphragms, for example, as is well known, sound is absorbed when it is converted into other forms of energy such as heat due to the successive bending of the material. While comparatively little sound energy is thus dissipated in the use of a single diaphragm, due to the sound waves being reflected by the resiliency or tension of such a diaphragm, applicant has discovered that any degree of sound-absorbing effect may be obtained by the use of a multiplicty of diaphragms and that maximum sound-absorbing effect was obtained when such diaphragms were lightly stacked together in contacting relation so as to increase the dissipation of energy through the frictional resistance introduced between such diaphragms and by making the diaphragms of different thickness, placing them in a progressive order relative to the sound waves impinged thereon with the lighter diaphragm at the front of the pile-up.

Other novel features and advantages of the invention will appear from the following description and by the claims appended thereto, reference being had to the accompanying drawing in which:

Fig. 1 is an elevation view of a sound-absorbing wall constructed according to the invention shown in perspective;

Fig. 2 is an exploded view; and

Fig. 3 is a partial view of Fig. 1 shown in section taken on 3—3 of Fig. 1.

According to the invention a plurality of diaphragms or membranes as a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8, and a_9 made of paper of different thickness and therefore of different stiffness and weight are placed in parallel relation to each other in a pile-up arrangement as shown in Fig. 1 and in a progressive order of stiffness relative to the direction of the sound waves impinged thereon. These diaphragms are mounted in a sheet metal container BL and retained in adjusted position thereon by a metallic plate BM serving as a guard for the diaphragms a_1, a_2, a_3, etc., the plate BM having perforations as OP permitting the sound waves to pass therethrough for impinging on the diaphragm a_1 etc., adjacent the plate.

The diaphragms a_1, a_2, a_3, a_4, a_5, and a_6 are supported by the frames b_1, b_2, b_3, b_4, b_5, and b_6 to which they are adhesively attached and while good results have been obtained by the use of paper diaphragms, material such as aluminum foil, and metallic magnesium may equally be used for the construction of such diaphragms especially in places where a fire-proof sound-absorbing wall is necessary. The container BL together with the diaphragms and the guard plate BM may be made of any desired shape and dimension depending upon the size of the wall to be sound-proofed, and each wall or panel unit may include any number of diaphragms depending upon the degree of sound absorption desired.

According to the invention the container BL, while being preferably made of a single sheet of metallic material of sufficient rigidity, may also be made of metallic foils assembled in the manner of the corrugated cardboard diaphragms a_7, a_8, and a_9, shown in Figs. 1 and 2. Similarly the perforated plate BM which is used solely for the protection of the diaphragms d_1, d_2, d_3, etc., is made of metal whenever used to form the inner walls of telephone booths, but may be entirely omitted in conditions where protection of the diaphragms is not necessary or this plate, if used, may be constructed to represent any decorative wall surface desired, but in no case has such a plate been found to affect the sound-absorbing effect of wall units constructed according to the present invention. However, it has been found that the total area of the perforations as OP should not be less than at least 20 per cent of the total surface area of the plate.

The present invention makes possible the construction of preformed wall panels of any square surface area and of any geometrical figure desired readily applicable to any wall and ceiling which it is desired to sound-proof. Wall panels so constructed have been found in actual tests to be substantially free of sound reverberations.

The sound absorption efficiency obtained by the acoustic wall panel of this invention is due to the frictional resistance between the series of normally contacting diaphragms a_1, a_2, a_3, etc. and to the adjusted different natural periods of vibration of the diaphragms obtained by forming the latter of different thicknesses and therefore weights, with the result that interference in the individual operation of the diaphragms is produced, and owing to the frictional resistance created between the lighter diaphragm and the next diaphragm in thickness, the energy of the sound

waves is completely absorbed or dissipated prior to their reaching the stiffest or last diaphragm of the series or pile-up which is made non-responsive to sound waves in the range of audible frequencies, the friction between the diaphragms, as is well known, being due to the contraction of the molecules of similarly disposed sides of the diaphragms with a corresponding elongation of the molecules on the other sides of these diaphragms with the added non-similar fractional effect on the diaphragms due to their graded thickness and stiffness.

What is claimed is:

1. A sound-proofing panel comprising a plurality of membranes of different thickness disposed for coacting frictional movement with each other.

2. A sound-proofing panel comprising a plurality of membranes, disposed in sets, the membranes of one of said sets being made of metallic material and the others of fibrous material disposed for coacting frictional movement with each other.

3. A sound-proofing panel comprising a plurality of membranes of different stiffness disposed in parallel relation in a progressive order relative to the direction of the sound waves impinged thereon and frictionally engaging each other.

4. A sound-proofing panel unit comprising a plurality of sets of membranes of fibrous and metallic material of different thickness disposed in frictional relation to each other to dissipate the energy of sound waves impinged on said panel.

5. A sound-proofing panel comprising a plurality of diaphragms of fibrous and metallic material of different stiffness disposed in coacting frictional relation with each other in a progressive order relative to the direction of the sound waves impinged thereon, a container, and a perforated metallic plate cooperating with means formed with said container for securing the diaphragms in said relation in said container.

6. A sound-proofing panel comprising a plurality of sets of diaphragms disposed for relative frictional movement with each other, the diaphragms in each set having different thickness disposed in a progressive order and a perforated plate at the front of the set of diaphragms of the least thickness, said plate serving as a guard for said diaphragms.

7. A sound-proofing wall panel comprising a plurality of diaphragms of different pliability, individual supporting means for each of said diaphragms, and means for collectively holding said diaphragms in coacting frictional relation to each other.

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