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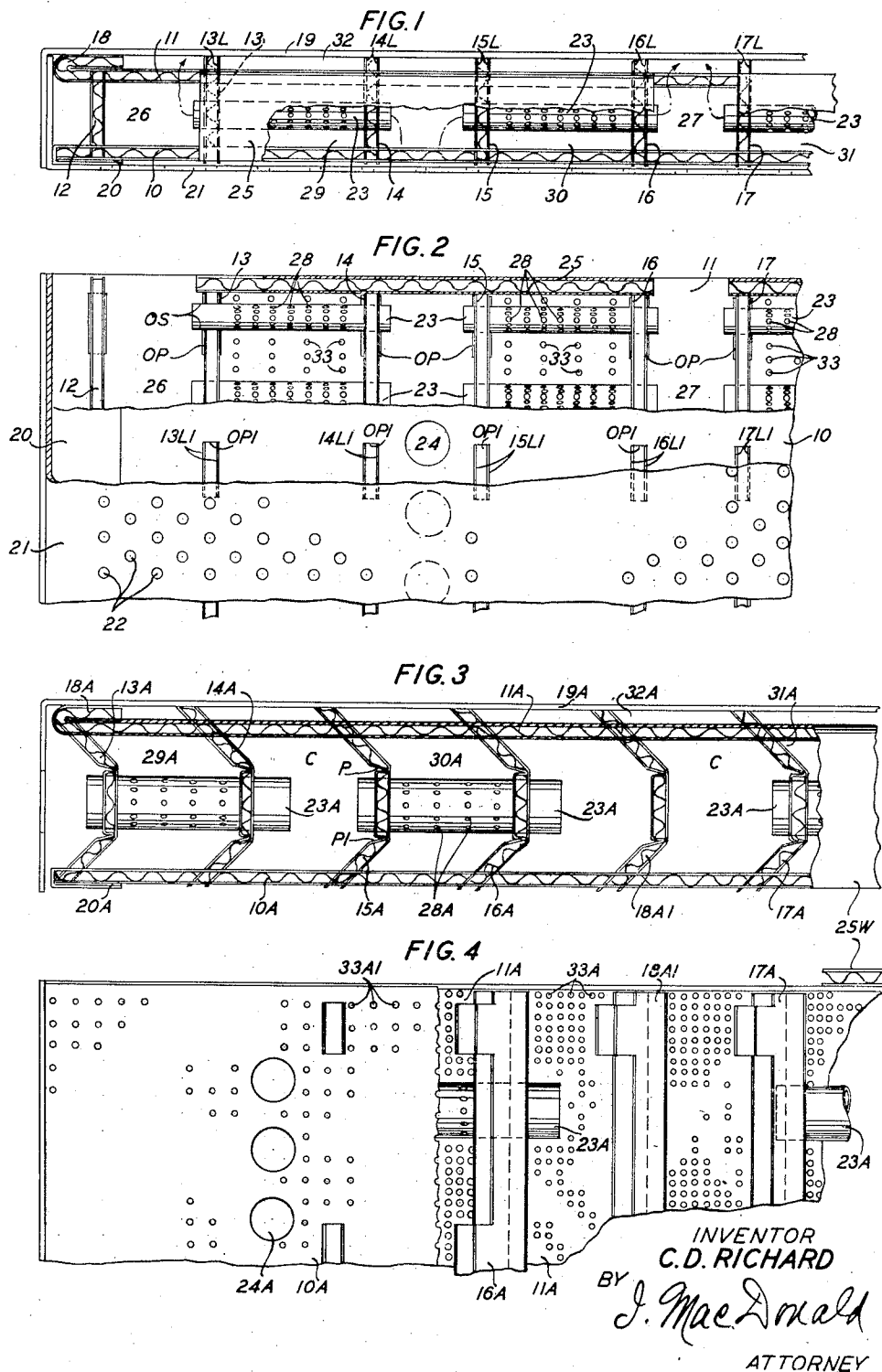
C. D. RICHARD

2,308,827

ACOUSTIC WAVE FILTER PANEL

Filed April 16, 1941

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

FIG. 7

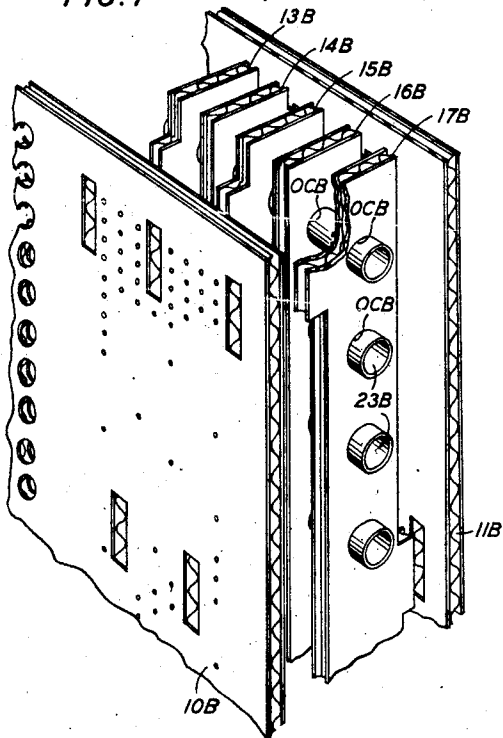


FIG. 8

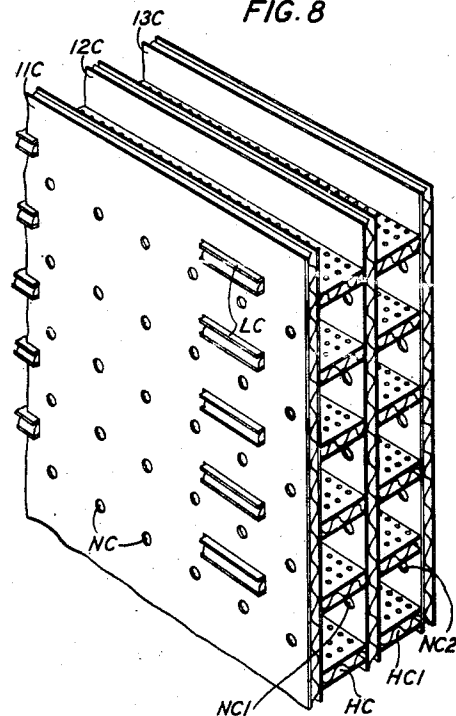


FIG. 5

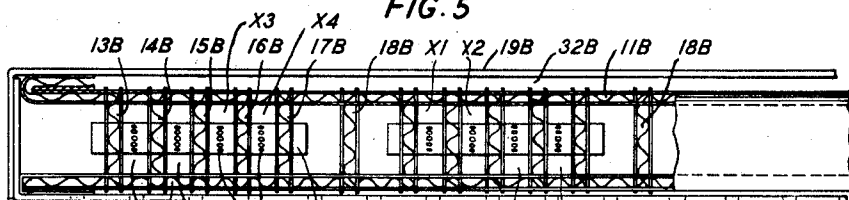
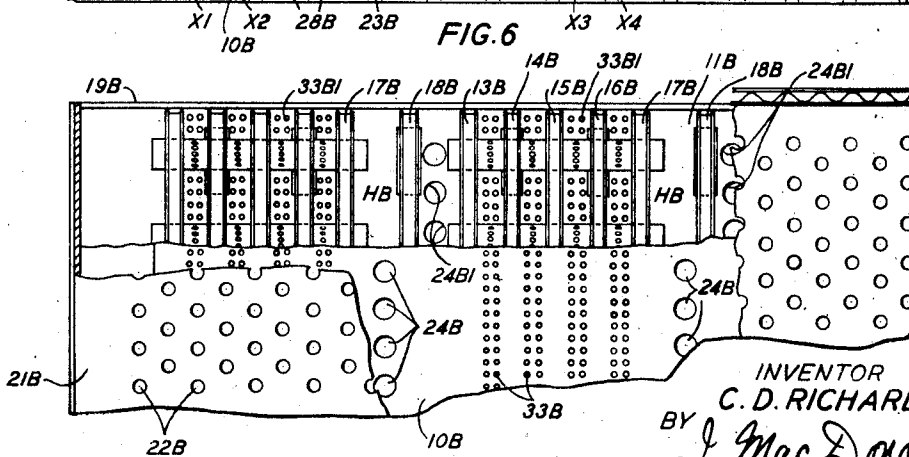


FIG. 6



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ACOUSTIC WAVE FILTER PANEL

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9 Claims. (Cl. 181—33)

This invention relates to acoustic devices.

The object of the invention is the provision of a self-supporting acoustic wave filter panel which will be cheap to manufacture, easily installed and efficient in operation.

In auditoriums, telephone booths, airplane cabins and automobile bodies, for example, noises of definite ranges of frequencies are encountered which have been found to markedly interfere with the transmission and reception of speech and while numerous attempts have been made to prevent extraneous sounds reaching the interior of a room or preventing the reverberation of sound waves in such a room, only partial results have been obtained not withstanding the high cost entailed in the manufacture and installation of the sound-proofing material heretofore used.

I have utilized the acoustic wave filter theory disclosed in Patent 1,692,317 to G. W. Stewart, granted November 20, 1928, in the production of the wave acoustic filter panels forming the subject of this invention.

In the drawings,

Fig. 1 is an end view of a portion of an acoustic wave filter panel constructed according to the invention;

Fig. 2 is a front view thereof shown with a number of operating parts with portions cut away;

Fig. 3 is an end view of a modification of Fig. 1;

Fig. 4 is a front view of the modification of Fig. 3 shown with a number of parts with portions cut away;

Fig. 5 is an end view of another modification of Fig. 1;

Fig. 6 is a front view of Fig. 5 shown with a number of parts with portions cut away;

Fig. 7 is an exploded view of the modification of the acoustic panel of the invention shown in Figs. 5 and 6;

Fig. 8 is an assembly view of another modification shown in perspective;

Fig. 9 is an exploded view of Fig. 8;

Fig. 10 is a view of a piece of perforated cardboard of the type used in the construction of the acoustic panel of the invention;

Fig. 11 is a view of a piece of perforated paper tape or strip used in the construction of tubing elements shown in Figs. 1 and 2; and,

Fig. 12 is a view of a piece of perforated paper tape used in the construction of the tubing elements embodied in the modification shown in Figs. 3 and 4.

The self-supporting wave filter panel of the invention as shown in the present embodiment

in Figs. 1 and 2 consists of two corrugated cardboard plates or elements 10 and 11, cardboard partitions such as 12, 13, 14, 15, 16 and 17 extending from edge to edge of the plates 10 and 11. The plates or elements 10 and 11 and the partitions 12, 13, 14, etc., which may be of any suitable surface area, are held in assembled relation by lugs 13L, 14L, 15L, 16L, 17L and 13Ll, 14Ll, 15Ll, 16Ll and 17Ll formed at the opposite edges of the partitions and engaging rectangularly shaped openings OP and OPl, best seen in Fig. 2, in the corrugated cardboard plates 10 and 11, respectively. The rear disposed cardboard plate 11 has its peripheral vertical edges 18 bent in lines parallel to the plane surface of this plate as shown in Fig. 1, to serve as spacer members between this plate and the surface of an adjacently disposed metallic plate 19 which may form the outer disposed sheet of a telephone booth wall, or the wall of a room it is desired to sound-proof. The back paper layer of the corrugated cardboard plate 11 has its vertically disposed peripheral edges 20 bent parallel to the plane surface of this plate as shown in Figs. 1 and 2 to serve as spacer members between the cardboard plate 11 and a perforated metallic plate 21 which may form the inner disposed sheet of the telephone booth wall, while protecting the cardboard sheet 10 from injury, the perforations 22 in the metallic plate 21 serving to prevent the diaphragm action of this plate.

The partitions 13, 14, 15, 16, etc. are arranged by pairs such as 13, 14 and 15, 16 and there may be as many pairs as required for the construction of a panel of the desired size. These partitions are provided along their lengths with coaxially disposed openings OS, Fig. 2, for receiving the ends of tubes or conduits 23. These conduits are formed by cutting, as on lines L2 and L3 as shown in Fig. 11, predetermined lengths of the paper ribbon 20x and rolling these portions of the ribbons in the form of cylinders, the resiliency of the material affording sufficient friction to hold the conduits thus formed in assembled relation in the holes formed in the partitions 13, 14, 15, 16, etc.

The cardboard plate 10 is provided with rows of openings such as 24, leading into a chamber formed by this plate, the rear plate 11 and the partitions 14 and 15 and top and bottom end walls as 25 shown in Figs. 1 and 2, such chambers communicating with adjacent ends of conduits 23 in a row, while the other ends of the conduits terminate in expansion chambers such as 26 and 27 opened at both upper and lower

ends of the panel and bounded by the plates 10 and 11 and the partitions 12, 13 and 16, 17. The series of perforations 28 in the tubing 23 form resistance or impedance paths leading into the expansion chambers 29, 30 and 31 while the needle holes 33 in the cardboard plate 11 form impedance paths leading to a common expansion chamber 32 open at the top and bottom formed by the cardboard plate 11 and metallic plate 19.

In the modification shown in Figs. 3 and 4, the corrugated cardboard partitions 13A, 14A, 15A, 16A, 17A and 18A are of substantially channel-shaped cross-section and are provided with kerfs as P and P' shown in Fig. 3 for permitting relative movement of the corrugated cardboard plates 10A and 11A relative to each other so as to make possible the fitting of the panel thus formed around concave and convex wall surfaces of airplane cabins, automobile bodies and the like enclosures without the liability of damaging the operating elements of the panel.

The front cardboard plate 10A is provided with needle holes 33A on its entire surface in addition to perforations 24A, Fig. 4, connecting with ends of adjacent conduits 23A in a chamber C while the cardboard plate 11A at its portions which form the walls of expansion chambers 29A, 30A and 31A as shown in Figs. 3 and 4 is provided with series of needle holes as 33A forming a second impedance path connecting with the common expansion chamber 32A formed by corrugated cardboard plate 11A and the metallic plate 19A which in this modification may form a part of the structure it is desired to sound-proof. The corrugated cardboard plate 11A is bent at right angles at both top and bottom ends, overlapping the partitions 14A, 15A, etc. to form a wall 25W at the top and lower ends of the expansion chambers 29A, 30A and 31A.

In the modification shown in Figs. 5 and 6 and in exploded view in Fig. 7, the corrugated cardboard plates 10B and 11B are held in spaced relation to each other by the cardboard partitions 13B, 14B, 15B, 16B and 17B and forming with the cardboard plates series of expansion chambers X1, X2, X3, X4. The partitions 13B, 14B, 15B, etc. are provided with coaxially disposed openings OCB, Fig. 7, for receiving the tubing 23B, the latter having series of needle holes 28B, connected with the expansion chambers formed by the partitions 13B, 14B, 15B, etc. and the corrugated plates 10B and 11B.

The plates 10B and 11B are each provided with rows of needle holes as 23B, 33B best seen in Figs. 6 and 7. The holes 33B lead into the expansion chambers formed by the plates 10B and 11B and the spacer members 13B, 14B, 15B, etc. while the needle holes 33B in plate 11B form impedance paths leading from such chambers to the common expansion chamber formed by the corrugated plate 11B and the metallic plate 19B, the corrugated cardboard plate 10B having rows of comparatively large perforations 24B leading into chambers HB formed by the plates 10B and 11B and the partitions 17B and 18B, while the corrugated plate 11B is provided with rows of openings as 24B leading to common expansion chambers 32B formed by the plate 11B and the metallic plate 19B, the metallic plate 21B which may form the inner disposed sheet of a telephone booth being provided with openings such as 22B which like those in the plate 21, Figs. 1 and 2, are of a size corresponding to substantially 20 per cent of the surface area of the plate.

In the acoustic wave filter panel of the inven-

tion as shown in the modification in Figs. 8 and 9, a plurality of corrugated cardboard plates 11C, 12C and 13C are held in spaced and parallel relation to each other by members as 13C, 14C, 15C, 16C, 17C and 18C having staggered oppositely disposed lug portions such as LC and LC' along their length fitted in similarly shaped openings OC and OC' in the plates 11C, 12C and 13C. These plates are provided with rows of openings CN, NC' and NC2, respectively connecting with expansion chambers HC and HC', the spacer members 13C, 14C, 15C, etc. being provided with needle holes such as 33C interconnecting with the expansion chambers HC and HC'. The openings NC, NC' and NC2 in the partitions 11C, 12C and 13C simulating the tubings 23, 23A, 23B, shown in Figs. 1, 3 and 5.

As shown in Fig. 10, the needle holes 33 in the corrugated cardboard plates in cooperation with the enclosure X formed by the undulations of the intermediate sheet Y have been found to form series of impedance paths and expansion chambers which considerably increase the range of frequencies it is desired to suppress over the disclosure of the Stewart patent above referred to. For example, an acoustic wave filter panel consisting of a small number of plates having needle holes as shown in Fig. 10 and places flatwise against each other has been found in actual test to possess an acoustic wave filter effect equivalent to the sound absorption characteristics of an equal thickness of so-called rock wool material heretofore used.

It is understood that the construction of this acoustic filter panel could be modified in accordance with the theory of the patent above mentioned so as to include any number of corrugated cardboard plates with or without partitions and any number of plates and partitions in combination depending upon the character of sound encountered in the enclosure it is desired to sound-proof and this without departing from the scope of the appended claims.

What is claimed is:

1. A self-supporting acoustic wave filter panel comprising at least two elements disposed adjacent and in parallel relation to each other, each of said elements consisting of a corrugated plate and a flat plate, on one side of each of said corrugated plates, said corrugated plates and one of said flat plates being perforated.

2. An acoustic wave filter panel comprising multi-layer perforated elements and a plurality of perforated partitions, each partition holding said elements in spaced relation to each other, said elements cooperating with said partitions to form series of impedance and expansion paths to the acoustic waves.

3. An acoustic wave filter panel comprising perforated corrugated cardboard sheets and a plurality of perforated cardboard partitions secured to said cardboard sheets, said partitions having portions of reduced stiffness for permitting the movement of said sheets relative to each other.

4. An acoustic wave filter panel comprising perforated corrugated cardboard elements having rows of openings, other cardboard elements disposed at an angle relative to the first-mentioned elements and having openings differing in size from the openings of the first-mentioned elements.

5. A self-supporting acoustic wave filter panel comprising perforated corrugated cardboard elements held in spaced relation by perforated

strips of corrugated cardboard disposed at an angle relative to said elements to form therewith series of expansion chambers, perforated tubings supported by said strips, the perforations in said elements and said strips forming resistance paths to sound waves leading to said expansion chambers through said tubings.

6. An acoustic wave filter panel comprising a plurality of corrugated cardboard elements, a plurality of partitions for holding said elements in assembled parallel relation to each other, said elements and said partitions having acoustic paths forming series of impedances to sound waves impinged on said panel said impedances connecting with expansion chambers formed by the assembly of said elements and said partitions.

7. An acoustic wave filter panel comprising perforated corrugated cardboard elements and a plurality of perforated corrugated cardboard strips serving as spacer members for said ele-

ments and forming therewith a plurality of expansion chambers connected by the air paths formed by the perforations in said strips and in said elements, said elements and said strips being formed with interengaging means to form a panel of unit structure.

8. An acoustic wave filter panel comprising perforated cardboard elements and a plurality of cardboard partitions, said partitions being disposed at an angle relative to said elements and forming therewith series of sound impedance paths and expansion chambers.

9. An acoustic wave filter panel comprising perforated corrugated cardboard elements and a plurality of partitions, said partitions having coaxially disposed openings, conduits having series of perforations and fitted in said openings, said partitions cooperating with said elements and said conduits to form series of expansion chambers to sound waves impinged on said panel.

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