This invention relates to a wall, ceiling or partition acoustic surfacing and particularly to the various units designed to compose the same.

The principal object of the present invention is to provide an acoustic tile of suitable resonant sound vibratory material, which may be manufactured, packed and shipped in the form of substantial flat sheets, requiring a minimum shipping space, and which tile may be conveniently and rapidly folded and assembled into substantially box-like units at the location where the tiles are to be applied to the walls, ceiling, partition or other surfaces to be treated.

A further object of the present invention is to provide an acoustic tile in which is embodied a surface diaphragm and one or more secondary diaphragms thereunder, all of which are preferably made from materials embodying a resonance which will absorb sound vibrations.

A further object of my invention is to provide an acoustic tile having a surface diaphragm, which will permit the passing of sound wave vibrations therethrough, and a secondary diaphragm or plurality of secondary diaphragms under the surface diaphragms, which secondary diaphragm or diaphragms are preferably made from materials embodying resonance or sound wave absorbing qualities.

A further object is to provide an acoustic tile, characterized in that the secondary diaphragms are of irregular shape relative to the surface diaphragm so as to break up the sound wave vibrations in the box-like unit as well as absorb the same.

A further object is to provide an acoustic tile, characterized in that I provide compartments in the box-like unit, in which the sound wave vibrations are broken up and absorbed, said compartments being successively spaced from or angularly aligned relative to the surface diaphragm.

A further object is to provide an acoustic tile, characterized in that I provide a sound post intermediate said secondary resonant diaphragms, with the foregoing and other objects in view, as will appear as the description proceeds, the invention consists of the novel construction, combination and arrangement of co-operating elements as hereinafter more specifically set forth, and as claimed and shown in the accompanying drawings, forming a part of the present application, in which:

Fig. 1 is a sectional view of one embodiment of my box-like unit, which may be used as an acoustic tile.

Figs. 2, 3 and 4 are sectional views of modified forms of my invention.

Figs. 5, 6 and 7 are detail views of construction.

Figs. 8 and 9 are top plan views of my acoustic tile, showing the surface diaphragm as being provided with spaced openings therethrough.

Figs. 10, 11, 12, 13, 14, 15, 16 and 17 show sectional views of further modifications of my acoustic tile.

Like numerals of reference designate corresponding parts throughout the different views.

The general principle of the acoustic tile as set forth in this application embodies supporting sides of any desired material or make-up, which are not substantially important as a feature of the invention other than they are supporting sides for diaphragm constructions referred to hereinafter. These side walls may be an integral portion of the diaphragm hereinafter referred to as the surface diaphragm or may be a separate part to which the surface diaphragm and the secondary diaphragms are attached.

I provide, in other pending applications or patents granted to me, for side flanges by which my acoustic tiles may be interlocked and attached to a wall, ceiling, partitions or other surfaces to be treated and which side flanges and interlocking means may be associated with the herein described box-like units to make a complete article of manufacture.

Referring to Fig. 1, 15 is a surface diaphragm made from any suitable resonant or sound wave vibratory material, which in this disclosure is provided with integral side walls 16 to which the bottom 17 is attached in any suitable desired manner, such as by stitching as at 18. In this disclosure, I provide secondary diaphragms 18 and 20 supported from the side walls 16 and under the surface resonant diaphragm 15. In some particular cases, it is desirable to provide a sound post 21, which may be located any place desired across and extending between the opposing surfaces of the resonant diaphragms 19 and 20 according to the calculation of the sound vibrations set up inside my box-like unit.

Referring to Fig. 2, the surface resonant diaphragm 22 is attached over a separate side wall form 23 and the secondary resonant diaphragms 24, 25 and 26 are provided with angularly-bent tongues 27, which fit into the loops 28 formed in the side walls 23. The secondary resonant diaphragms may be held in position relative to the side walls 23 by means of corrugations...
formed ledges 29 between which the marginal edges of the resonant diaphragms 24, 25 and 26 may be pressed and retained. Furthermore, the side walls 23 may be provided with slots 30 in which the tongues 31 of the secondary resonant diaphragm 25 may be inserted. By these methods, the resonant diaphragms 24, 25 and 26 may be supported by the separate side wall portions 23.

10 Referring to Figs. 3 and 4, I provide a surface diaphragm 32 and a plurality of secondary diaphragms 33, 34 and 35, which in Fig. 2 are shown as adhesively attached or stapled direct to the ceiling 36, while in Fig. 4, they are similarly attached to a backing 31, which is attached adhesively or in any other desired manner to the walls, ceiling or partition.

15 Referring to Figs. 8 and 9, I have shown the surface diaphragm as being provided with a plurality of openings. In Fig. 8, the openings 38 are formed in the surface diaphragm, while in the illustration shown in Fig. 9, the openings are provided intermediate the warp and woof members of the surface diaphragm as at 39.

20 Referring to Figs. 10, 11, 12, 13, 14, 15 and 16, I have illustrated various means of providing a plurality of secondary diaphragms in my box-like units for use in acoustical arrangements. By consideration of the various disclosures, it will be realized that a multitude of formations may be made to provide a plurality of space diaphragm surfaces and compartments within the box-like unit and under the surface diaphragm. Thus, I do not wish to be limited to only the specific disclosures set forth in this application.

25 In Fig. 10, the secondary diaphragms 40 and 41 are slotted substantially half their longitudinal distance so that they may be interlocked in X-shaped relative position as shown. This provides distinct compartments made by two secondary diaphragms 40 and 41 inside the box-like unit, having a surface diaphragm 42.

30 In Fig. 11, the secondary diaphragm 43 is formed in a spiral curvature to substantially form an upper diaphragm portion 43a and a lower diaphragm portion 43b.

35 Referring to Fig. 12, I have shown the surface diaphragm 44 as being corrugated and the secondary diaphragms 45 and 46 oppositely corrugated relative to each other.

40 Referring to Fig. 13, I provide the secondary diaphragms 47 and 48 as being dished outwardly from each other and having a sound post 49 positioned intermediate thereof.

45 Referring to Fig. 14, I provide the secondary diaphragms 50 and 51 with a plurality of oppositely directed formations which may be conical, pyramidal of or any other desired shape so as to provide an irregular surface, the purpose of which will be hereinafter referred to. It will be noted that in Fig. 13, I have shown the secondary diaphragms 47 and 48 as dished in opposite directions and, in Fig. 14, the diaphragms 50 and 51 are provided with oppositely directed formations. These diaphragms may be similarly formed instead of oppositely formed as shown.

The modification, as disclosed in Fig. 15, shows the secondary diaphragms 52 and 53 as resting on ledges, formed by corrugations 54 in the nested side walls at a predetermined depth.

The modification, as disclosed in Fig. 16, shows an inner support 57, the side walls of which are preferably stepped to provide ledges upon which the secondary diaphragms 55 and 56 may be placed.

The modification, as disclosed in Fig. 17, shows the secondary diaphragms 58 and 59 disposed at substantially a right angle to the plane of the surface diaphragm 58, supported from the base member 50 and retained apart at their free ends by the slotted spacer member 61 into the slots of which their free ends are fitted. The secondary diaphragms may be flat as shown at 58' or corrugated as at 59.

10 I have found that a better sound resonance is obtained by providing an acoustic tile in which there is a surface diaphragm and a plurality of secondary diaphragms under and in conjunction therewith in the same unit attached to the surface being treated. As set forth in the drawings and as hereinafore described, this surface diaphragm may be formed with integral wall portions or attached to the wall portions to provide a box-like unit. Furthermore, the surface diaphragm may be formed with a plurality of small openings therethrough so as to permit easy absorption of a portion of the sound wave vibrations therethrough while the remaining sound wave vibrations contact with the resonant surface and are absorbed by the same. In other words, the sound wave vibrations striking the surface diaphragm are primarily broken up, part passing through the openings while the remaining portions pass through the resonant material from which the surface diaphragm is made. On passing through the diaphragm with or without a plurality of openings therein, the sound wave vibrations contact with the secondary diaphragms, which may be of a like or different material to that of the surface diaphragm. The sound wave vibrations are enclosed in the compartments in the box-like unit and are absorbed and broken up by the secondary diaphragms, which may be in parallel relationship to the surface diaphragm as shown in Figs. 1 and 2, may be in box-like relationship as shown in Figs. 3 and 4 or may be broken up in a multitude of different forms, certain of which are shown in Figs. 10, 11, 12, 13, 14, 15, 16 and 17, all of which provide a plurality of interior compartments. The principle back of all the illustrations herein disclosed and described is that the sound wave vibrations are allowed to strike the surface resonator through which they pass and are enclosed in a box-like unit in which is provided a plurality of compartments formed by a plurality of secondary resonators, which may be termed as the sound wave breaking-up and absorbing resonators.

The foregoing specification and annexed drawings disclose the preferred embodiment of my invention, but it is to be understood that minor changes may be resorted to in the commercial adaptation of my invention without departing from the scope of the invention as hereinafter claimed.

What I claim is new:

1. An acoustic surface for walls, ceilings, partitions or the like, comprising a hollow box-like unit having a surface diaphragm for initially receiving the sound vibrations with such surface diaphragm restrained against responsive action to the sound vibrations only at its edges, and a plurality of interior secondary diaphragms arranged substantially in parallelism with the surface diaphragm and providing secondary vibrational absorbing means, said secondary di-
phragms being responsive only to sound vibrations transmitted from the surface diaphragm.

2. A construction as defined in claim 1, wherein the secondary diaphragms are coextensive with the interior dimensions of the box-like body.

3. A construction as defined in claim 1, wherein the secondary diaphragms are successively of less surface area inwardly of the surface diaphragm.

4. A construction as defined in claim 1, wherein the secondary diaphragms have a rigid connection with each other at about their central points.

5. An acoustic surfaced for walls, ceilings, partitions or the like, comprising a hollow box-like unit having a surface diaphragm to initially receive sound vibrations with such diaphragm secured at its free edges to the side walls of the unit and being substantially free for its remaining area to respond to the sound vibrations, and a plurality of secondary diaphragms secured in substantial parallelism to the surface diaphragm and secured at their edges to the side walls of the unit and being otherwise substantially free for vibration, the secondary diaphragms receiving vibrations transmitted from the surface diaphragm for dispersion and absorption of such transmitted vibrations.

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