

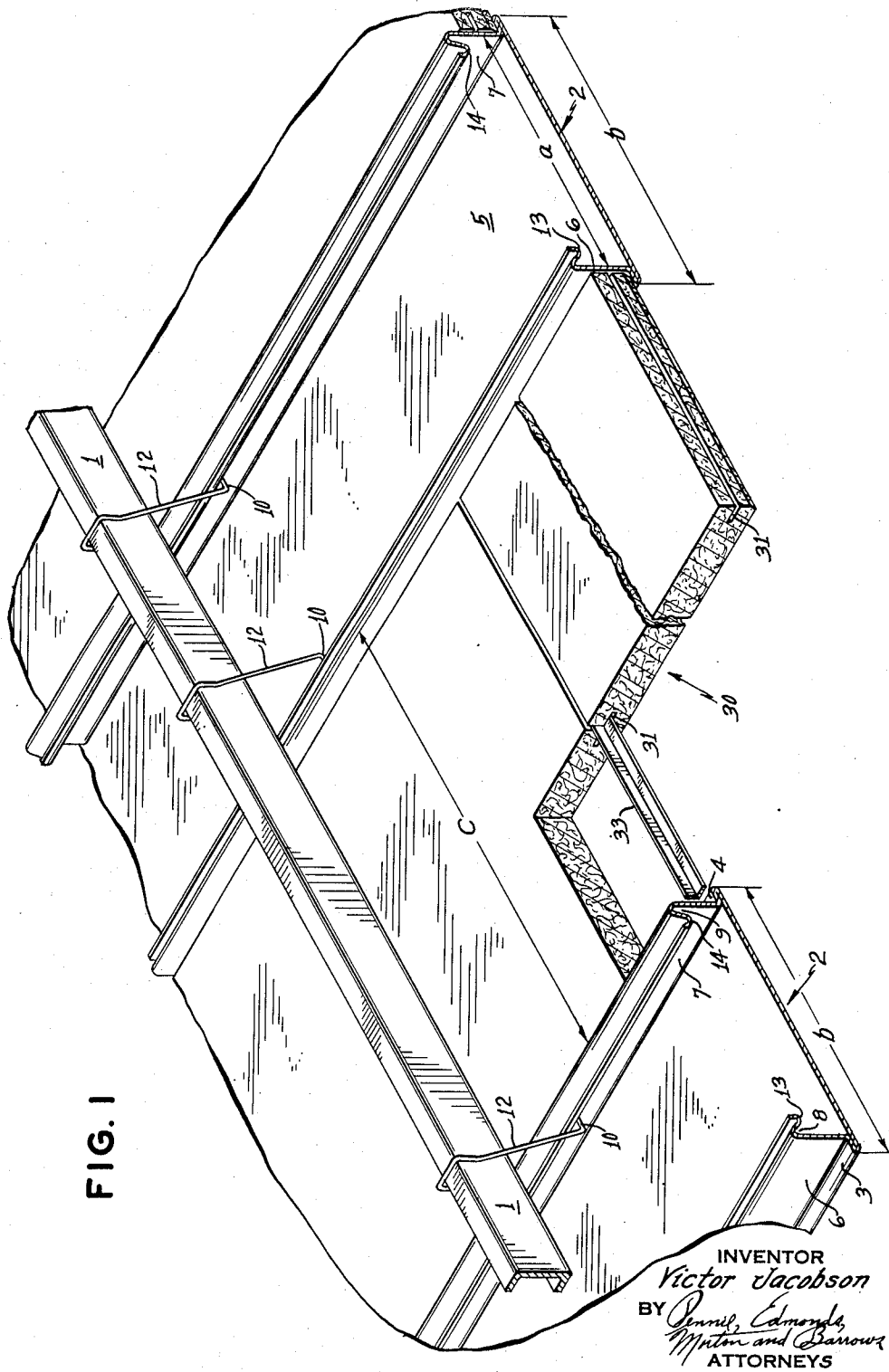
Aug. 11, 1953

V. JACOBSON
CEILING CONSTRUCTION

2,648,102

Filed Nov. 3, 1950

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Aug. 11, 1953

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2,648,102

Filed Nov. 3, 1950

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FIG. 2

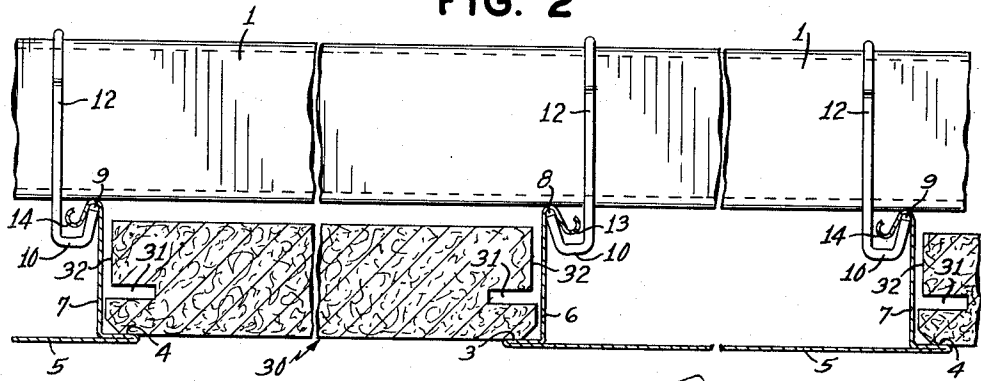


FIG. 3

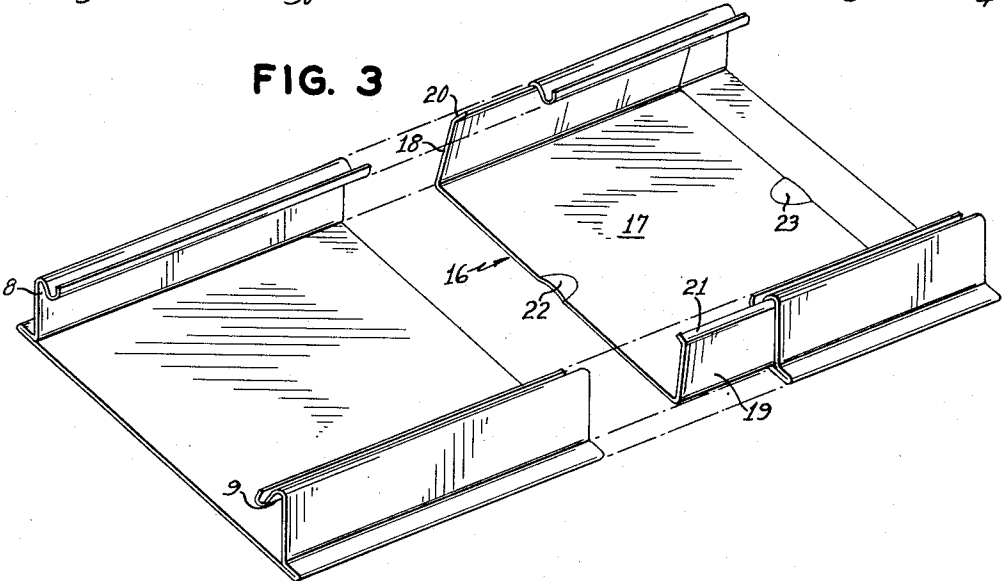
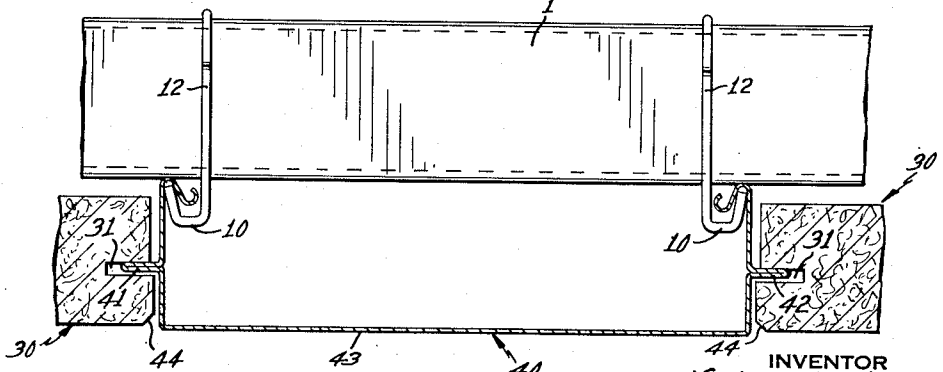


FIG. 4



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2,648,102

CEILING CONSTRUCTION

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Application November 3, 1950, Serial No. 193,827

4 Claims. (Cl. 20—4)

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This invention relates to acoustic corrective ceilings and has for its object the provision of an improved ceiling of this character. More particularly, the invention provides a ceiling combination comprising alternate rows of sound reflective and sound absorptive members. The principal feature of the invention is that the relative widths of the exposed surfaces of the sound reflecting and sound absorptive members are in such proportions or ratios that the ceiling has improved acoustic corrective characteristics. The sound reflective members are thin metal members supported from above and the sound absorptive members are in the form of acoustical tile in edge contact with the sound reflective members.

In its more complete and preferred embodiment, the acoustic ceiling of the invention comprises reflective members formed of thin sheet metal each having a flat web portion, and absorptive members formed of acoustical tile, the total under surfaces of which comprise a substantial part of the exposed surface of the ceiling. The sound reflective members are constructed and arranged to function by diaphragmatic action caused by the impingement of the sound waves thereon, and the absorptive members are formed of a porous or cellular material which dissipates the sound by the friction the material offers to the sound waves which enter or penetrate the material.

The reflective members and absorptive members are suspended in alternate adjoining rows of any desired length. I have discovered, however, that when the widths of the members are in a critical relationship, the ceiling has improved acoustic corrective properties. This critical width relationship is advantageously expressible in terms of ratios and to this end the acoustic corrective ceiling of my invention has ratios of reflective member width to absorptive member width varying from 1 to 2 to 1 to 8.

These and other objects of the invention will be better understood after considering the following discussion taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a perspective view of part of a ceiling embodying the invention;

Fig. 2 is a sectional view at 2—2 of Fig. 1;

Fig. 3 is a perspective view of the connection of two abutting sound reflective members, and

Fig. 4 is a sectional view similar to Fig. 2 of another embodiment of the invention.

The embodiment of the invention illustrated in Fig. 1 comprises a channel bar 1 which is a pri-

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mary ceiling supporting member connected to the building by means commonly used. Any number of similar or equivalent members may be used and in any constructional arrangement to support the ceiling members of my invention. The ceiling of my invention comprises sound reflective members 2 formed of any suitable metal and of such thinness that they have diaphragmatic action. When the member is made of a metal such as steel or aluminum, the thickness may vary from 0.019 to 0.025 inch. Should this thickness become greater than 0.025 inch, the diaphragmatic action would be lost from this member. The metal is folded upon itself to form the longitudinal ribs or shelves 3 and 4 and the flat interconnecting web portion 5 inside these shelves is the freely vibratory portion which is the effective width of the sound reflective member. From the shelves the metal is turned upwardly, preferably at right angles, to form the flanges 6 and 7 and the upper edge portions of the flanges are bent inwardly and downwardly to form the channels 8 and 9 for receiving the hooks 10 of the hangers 12. The extreme edges are preferably given additional curved bends 13 and 14 to impart stiffness. The width a of the web 5 of the sound reflective member is the distance between the flanges 6 and 7 excluding the relatively stiff non-vibratory metal of the ribs or shelves 3 and 4, and is the width measure of the sound reflective member used in the ratios. The sound reflective members have flat under surfaces in the ceiling area the width b .

Where the ceiling proportions require the reflective members to be joined end-for-end, I provide a splicer 16, Fig. 3, in the general form of a channel having a web 17, side flanges 18 and 19, and edge breaks 20 and 21 which effect a snug engagement with the channels 8 and 9. The upwardly pressed tabs 22 and 23 facilitate sliding the splicer into position. A ceiling construction employing sound reflective members as shown in Figs. 1 to 3 is claimed in my copending application Serial No. 58,439, filed November 5, 1948, of which this application is a continuation-in-part.

The sound absorptive member 30 is in the form of relatively thick, say, $\frac{1}{2}$ inch to $1\frac{1}{2}$ inches, slabs or tiles of a cellular or porous material. Acoustic corrective material has been widely used heretofore for ceilings and walls, said material for best advantages being cheaply and satisfactorily formed in sheets or tiles of more or less loosely compacted fibers of vegetable or other material, having myriads of irregular cells, interstices, or openings communicating with the

exterior surfaces, into which cells or openings sound waves may enter and be substantially completely absorbed through friction so that the sound waves will become dissipated, thereby rendering a room extremely quiet as compared to a room, the ceiling and walls of which are of dense material. In some instances the exposed surface portion of the tiles of acoustical material has been purposely provided with mechanically drilled relatively large openings or cells for better penetration and entrapment of the sound waves therein. It is to be understood that, according to this invention, there may be employed any satisfactory acoustical material which has the characteristic of frictionally absorbing sound waves, though preferably such acoustical material should be formed in sheets or tiles of relative rigidity for ease in handling and applying to the ceiling. One satisfactory type of material is sold under the name of Acousti-Celotex.

Absorptive tile of a type readily available for this and other uses is provided with edge slots 31 and cut-back edge portions 32 to facilitate the use of connecting splines or brackets. These slots and cut-backs serve no useful purposes along those edges which engage the edge flanges 6 and 7 of the reflective members but where one tile joins another, as in Fig. 1, connecting splines 33 are used to hold the edges in even contact.

A ceiling construction, as illustrated in Figs. 1 and 2, comprises alternate rows of reflective members 2 and absorptive members 30, the absorptive members being in edge contact with the reflective members and supported on the shelves 3 and 4. The under surfaces of the reflective and absorptive members form the major or entire ceiling area. The flanges 3 and 4 may be, say, $\frac{3}{8}$ inch wide, and to that extent cover the edges of the absorptive tiles. However, in view of the dissipation of sound energy in the porous material the width of absorptive members, as mentioned herein, is the full width c from edge to edge, notwithstanding the apparent shielding by the shelves 3 and 4.

Acoustic ceilings constructed according to the invention comprise sound reflective members which are relatively narrow, say, from 6 to 12 inches in width, and sound absorptive members which are relatively wider, say, from 12 to 48 inches. When the respective width ratios are 6 to 12 inches or 12 to 24 inches, the performance would be 65% noise reduction coefficient (N. R. C.). When the respective width ratios are 6 to 24 inches or 12 to 48 inches, the performance of the ceiling becomes 70% N. R. C. When the reflective member is 6 inches and the absorptive member is 12 inches, the ratio is 1 to 2, and when the reflective member is 6 inches and the absorptive member is 48 inches, the ratio is 1 to 8. The range of ratios of the invention is from 1 to 2 to 1 to 8, including the intermediate ratios. Such intermediate ratios would be exemplified in a ceiling with a sound reflective member of 12 inches and an absorptive member of 36 inches or a sound reflective member of 6 inches and an absorptive member of 24 inches, etc.

By way of illustrating the effectiveness, constructional and commercial advantages of the invention, the following comparisons are interesting. If a ceiling were constructed with a continuous sheet of the sound absorptive material, it might have, for example, a N. R. C. of, say, 75%. By means of the construction of the invention, the area of the sound absorptive material may be diminished by, say, as much as 20%

by using the sound reflective members without sacrificing to any noticeable degree the N. R. C. Specifically, this very material diminution in area of sound absorptive material gives the practical equivalent sound characteristics. Notwithstanding the 20% decrease in the area thereof, the N. R. C. is reduced merely to about 70%. It must be noted, however, that it is essential to have an alternate arrangement whereby the respective areas are distributed and not concentrated at one particular place.

The metal members 2 have been described as sound reflective members for practical purposes in correcting objectionable noises which have frequencies largely in the reflective range. Actually, the members are reflective in the higher frequencies which are found in most noisy sounds, but absorptive in the very low frequencies such as the low notes of musical instruments. It is to be understood, therefore, that the metal member is reflective in the practical sense for correcting noises.

The embodiment of the invention illustrated in Fig. 4 is similar in all respects to the ceiling of Figs. 1 and 2, with the exception that the sound reflective members 40 have ribs or shelves 41 and 42 which are spaced above the bottom of the web 43. These shelves are positioned and proportioned to enter the slots 31 of the absorptive tiles 30 and support them in position with their under surfaces even with the web surfaces 43. In this form of the invention the beveled edge 44 gives a decorative aspect to the ceiling.

I claim:

1. An acoustic corrective ceiling construction comprising sound reflective members formed of thin metal having freely vibratory web portions and sound absorptive members in the form of tiles of cellular material, said members being arranged in side-by-side adjoining relation and the under surfaces of the web portions and the under surfaces of the sound absorptive members being flat and forming substantially the entire ceiling surface, the web portions of the sound reflective members being of such thickness and having such width that they have diaphragmatic action upon impingement of sound waves of noise frequency thereon, the ratios of the widths of the sound reflective members to the sound absorptive members being from 1 to 2 to 1 to 8.

2. An acoustic ceiling according to claim 1 in which the sound absorptive members are flat tiles varying in thickness from $\frac{1}{2}$ inch to $1\frac{1}{2}$ inches.

3. An acoustic corrective ceiling according to claim 1 in which the thickness of the web portion varies from 0.019 to 0.025 inch and is freely vibratory.

4. An acoustic ceiling according to claim 1 in which the sound reflective members are suspended from above and the sound absorptive members are supported at the edge portions thereof by the sound reflective members.

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