

Feb. 2, 1954

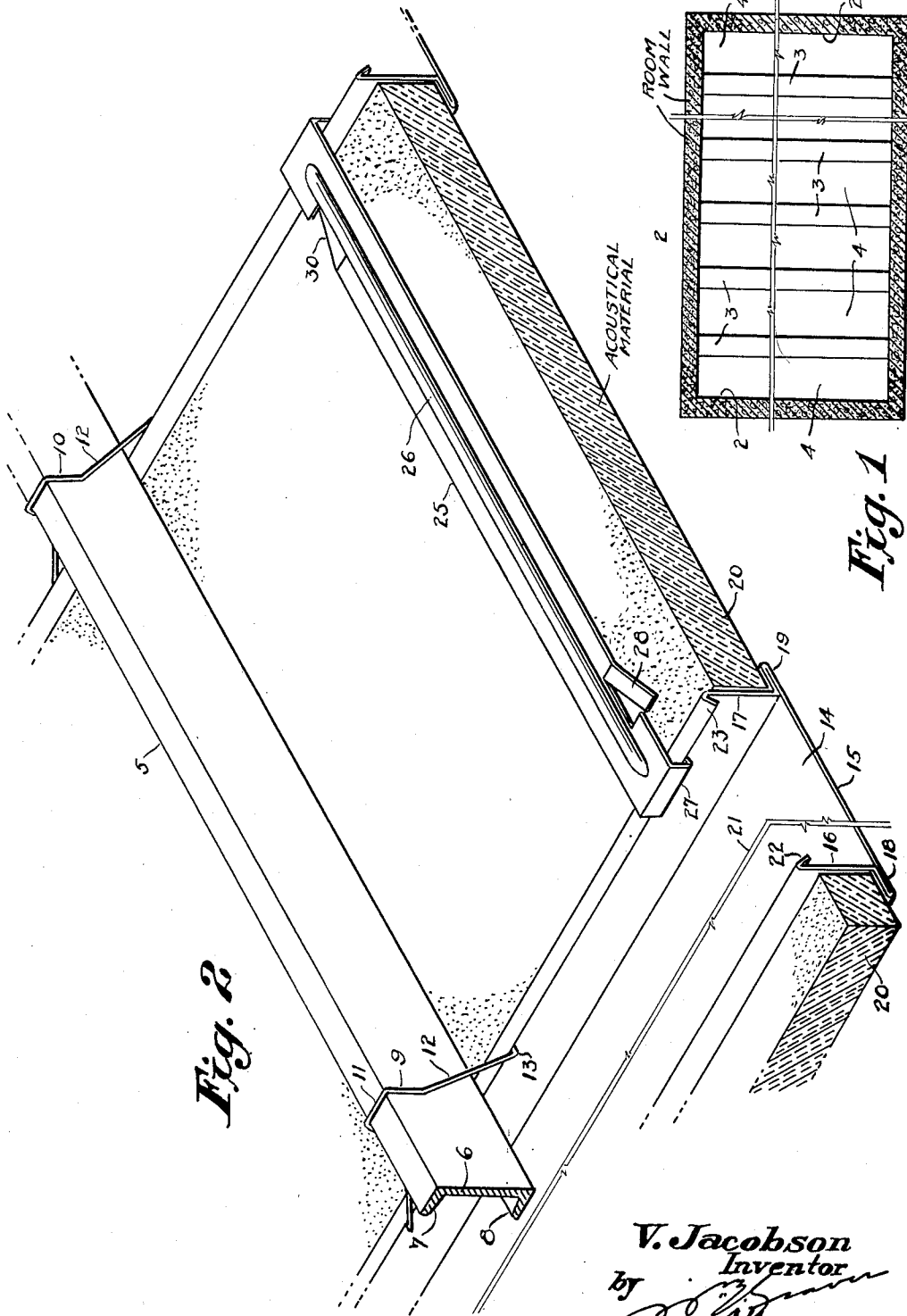
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ACOUSTIC CEILING CONSTRUCTION

Filed Nov. 5, 1948

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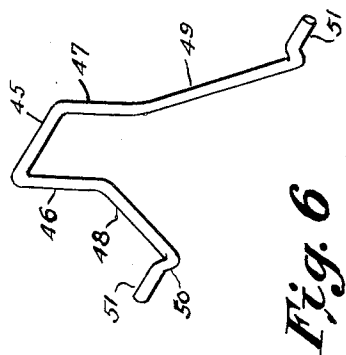
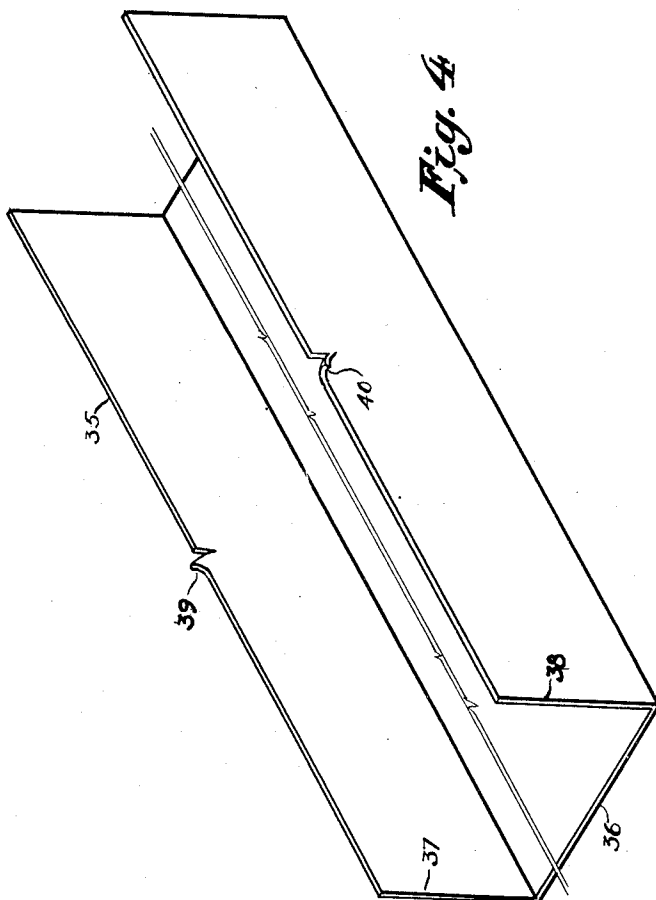
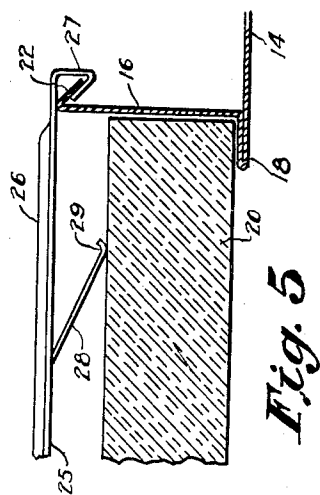
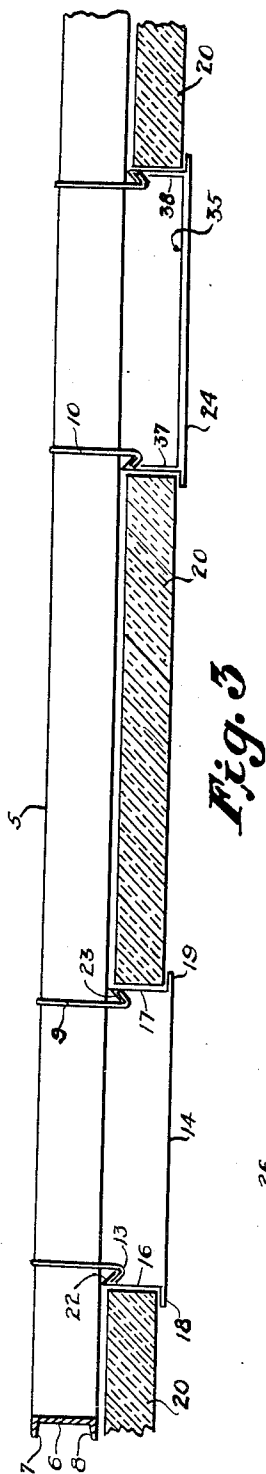
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5 Sheets-Sheet 3

Fig. 7

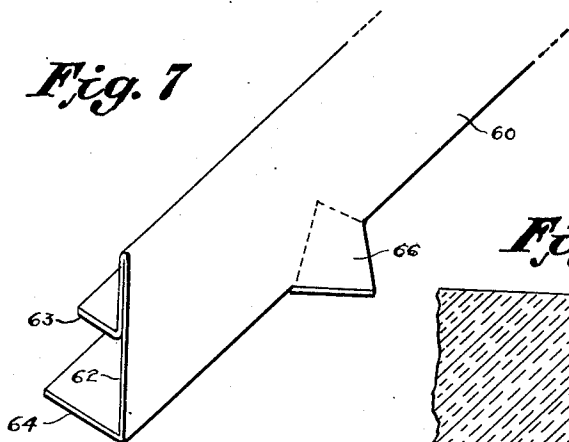


Fig. 8

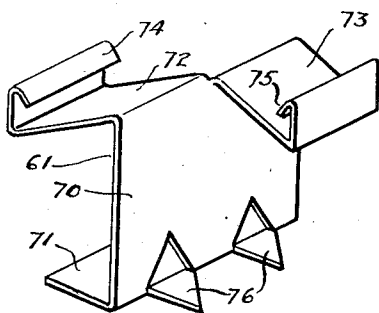
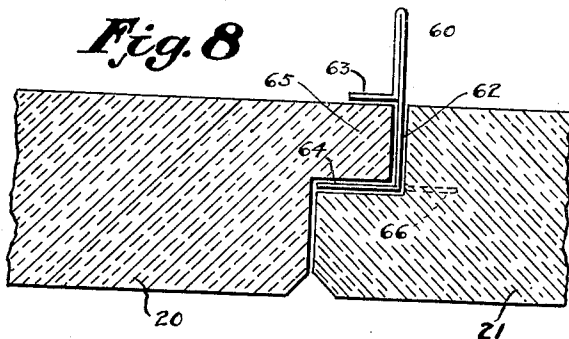


Fig. 9

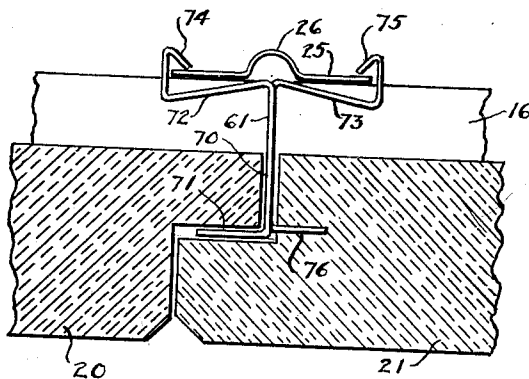


Fig. 10

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2,667,667

ACOUSTIC CEILING CONSTRUCTION

Filed Nov. 5, 1948

5 Sheets-Sheet 4

Fig. 11

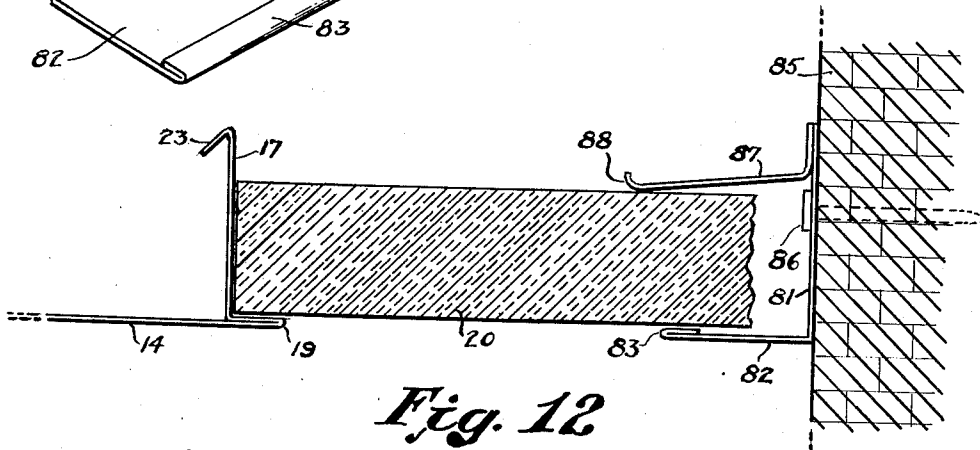
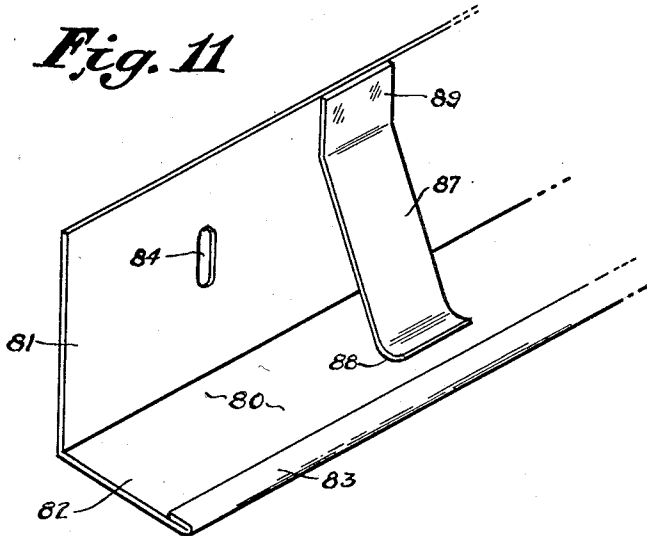


Fig. 12

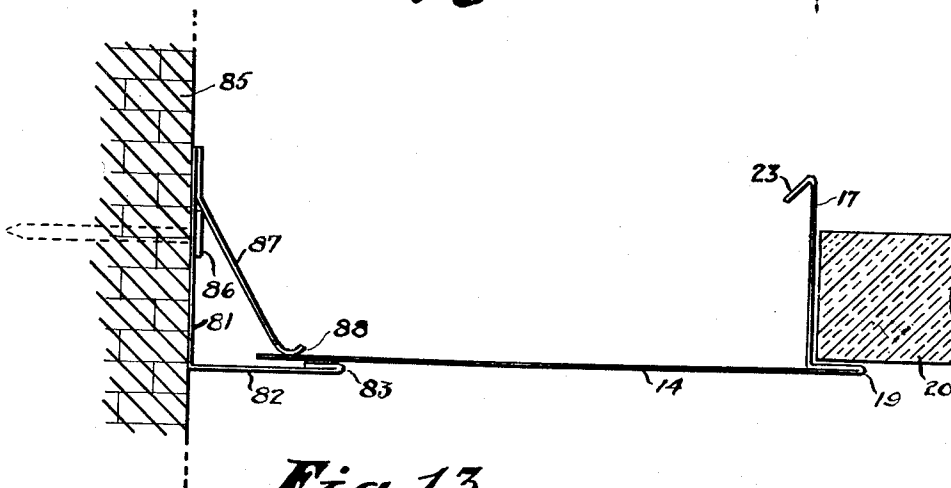


Fig. 13

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Feb. 2, 1954

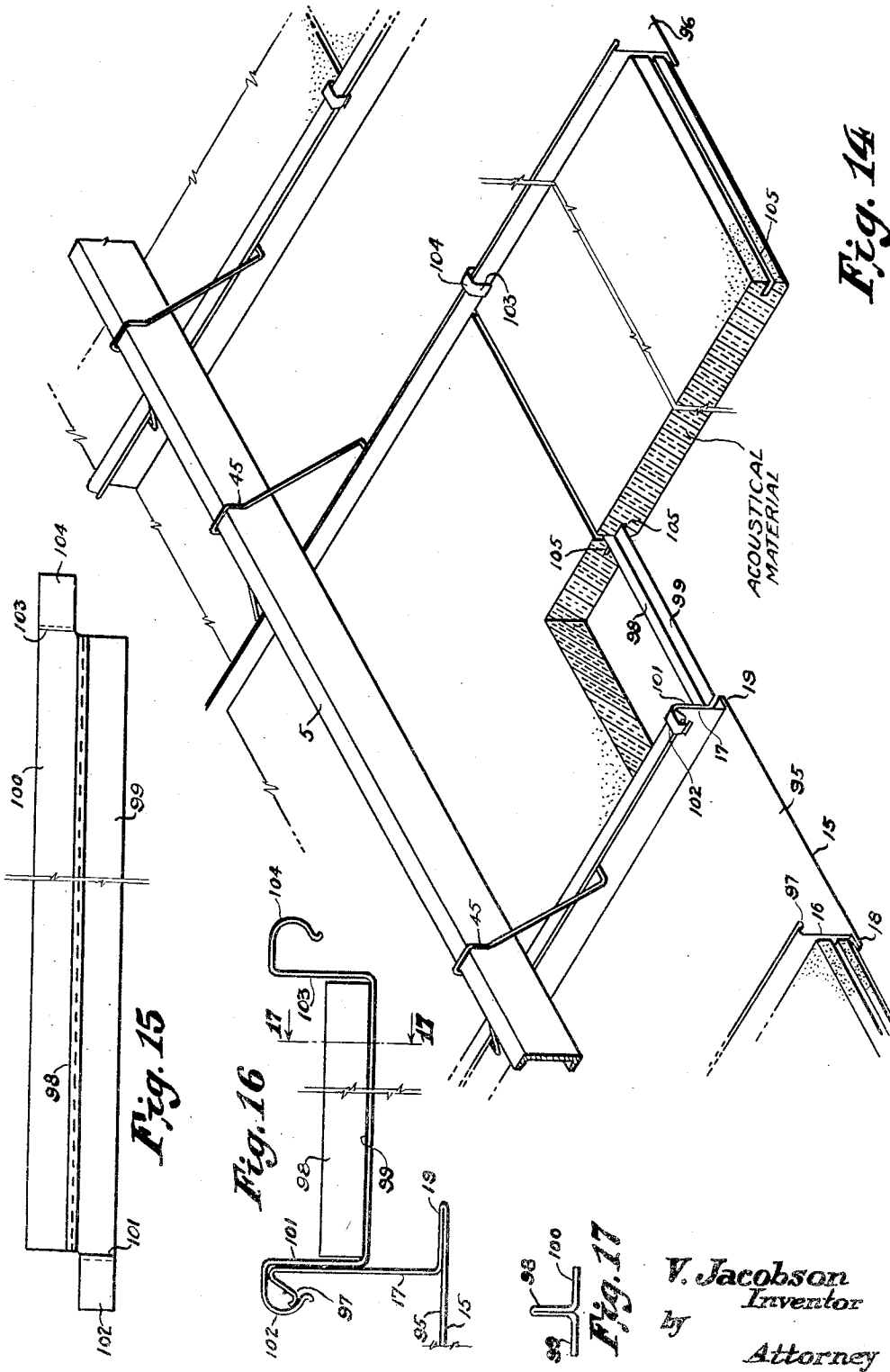
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5 Sheets-Sheet 5



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ACOUSTIC CEILING CONSTRUCTION

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Application November 5, 1948, Serial No. 58,439

3 Claims. (Cl. 20—4)

1

This invention relates to ceiling constructions and more particularly to those of acoustic corrective nature, the invention having for its principal object to provide a ceiling construction which can be readily and quickly erected at a cost which is less than heretofore possible.

Another object of the invention is to provide a suspended ceiling wherein the total of the exposed surface area of the sound absorptive material is considerably less than the areas heretofore thought necessary to accomplish the same degree of acoustic correction.

Another object of the invention resides in an acoustical ceiling comprising primary and secondary supporting members, the secondary members having portions extending through to and forming a part of the exposed surface of the ceiling.

A further object of the invention is to provide for the installation of acoustical tile, mechanically suspended, as distinguished from heretofore known and usual types of ceilings depending for their securement upon nailing, cementing, screwing and the like.

A still further object of the invention is to provide a ceiling the total of the exposed surface area of which comprises a combination of different sound dissipating materials, one material functioning by friction of the sound waves received, and the other material functioning by diaphragmatic action caused by the impingement of the sound waves thereon, these materials hereinafter referred to generally as being sound absorptive and sound reflective.

Other objects and advantages of the invention will become apparent from a study of the following description and the drawings of a preferred embodiment of the invention.

With these and other objects in view the invention resides in the novel details of construction and combinations of parts as will be disclosed more fully hereinafter and particularly covered by the claims.

Referring to the accompanying drawings forming a part of this specification and in which like numerals designate like parts in all the views—

Fig. 1 is a diagrammatic representation of the appearance of a ceiling made in accordance with this invention and showing alternate strips of sound absorptive and sound reflective material;

Fig. 2 is a partial perspective view of a ceiling suspension incorporating the elements comprising this invention;

Fig. 3 is a vertical sectional view taken transversely of the alternated strips of absorptive and

2

reflective materials, and illustrating their suspension from a primary ceiling structural member;

Fig. 4 is a perspective view of a splicer utilized to align two abutting pans constituting the sound reflective medium employed in the ceiling construction;

Fig. 5 is a detail view partly in section illustrating the securement of the sound absorptive material by a clip bar with respect to the pans of sound reflective material;

Fig. 6 is a perspective view of a modified form of hanger for suspending the pans of sound reflective material from a primary ceiling structural member;

Fig. 7 is a partial perspective view of a reinforcing strip for the butt joint between adjacent blocks of sound absorptive material;

Fig. 8 is a detail sectional view of a butt joint illustrating the application thereto of the reinforcing strip shown in Fig. 7;

Fig. 9 is a perspective view of a suspension clip for use with a clip bar at a butt joint between adjacent blocks of sound absorptive material;

Fig. 10 is a vertical sectional view of a butt joint with the suspension clip of Fig. 9 applied thereto;

Fig. 11 is a partial perspective view of a strip of finish moulding to be applied at the joint between the ceiling and a vertical wall surface of a room;

Fig. 12 is a vertical sectional view through the finish moulding and illustrating its coaction with a block of sound absorptive material;

Fig. 13 is a view similar to Fig. 12 but illustrating the coaction between the finish moulding and a pan of sound reflective material.

Fig. 14 is a partial perspective view of a ceiling suspension generally similar to that shown in Fig. 2, but incorporating a combined spreader bar and reinforcing strip which performs the functions of the structures shown in Figs. 2, 5, 7 and 8;

Figs. 15 and 16 are respectively a foreshortened top plan view, and a foreshortened side elevational view, of the combined spreader bar and reinforcing strip; and

Fig. 17 is a vertical transverse sectional view of the strip, said view being taken as on the line 17—17 of Fig. 16 and looking in the direction of the arrows.

Acoustical correction material has been proposed heretofore for ceilings and walls, said material for best advantages being cheaply and satisfactorily formed in sheets or blocks of more or less loosely compacted fibers of vegetable and/or cellulosic material, resulting in myriads of ir-

regular 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 said waves will become dissipated, thereby rendering a room extremely quiet as compared to a room the ceilings and walls of which are not so treated for acoustical correction. In some instances the exposed surface portion of the blocks of acoustical material has been purposely provided with mechanically drilled relatively large openings or cells for better penetration and entrapment of the sound waves within the block. 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 blocks of relative rigidity for ease in handling and application to the wall or ceiling.

Also, in acoustical treatment of a room, there has been proposed the utilization of material which is sound reflective rather than absorptive, the benefit and advantage of the sound reflective material being due to the fact that the impingement of the sound waves thereon sets up diaphragmatic action or vibrations in the material chiefly due to the relative thinness of said material. These said vibrations change, modify, damp and/or otherwise affect the amplitude and/or rhythmic pulse of the original sound waves whereby the reflected sound waves are not harmonious therewith and hence counteract if not nullify the original sound waves to render the treated room more quiet. Here again latitude is desired in the selection of the sound reflective material though metal of extreme thinness, bent into the shape of a pan, has been found extremely practical and hence is preferred for its fire resistance and strength.

Heretofore, acoustical correction has comprised the application of material of the same kind to substantially the entire room surface, and chief of the acoustical materials is a product identified and sold in the building construction market under the trade-mark "Acousti-Celotex" which is made as a fibrous deposition in blocks, of the order of 12" x 12" dimensions and/or multiples thereof, in various thicknesses even up to approximately 1½". These blocks, however, have required nailing to studs or furring strips, requiring considerable time and labor expense in their application, and it is an object of this invention to do away with this costly construction of a ceiling, for example, by making possible the sliding of such blocks into position with their sole support upon flanges of secondary supporting members of the ceiling, which secondary members are in turn suspended or hung on the primary members of the ceiling, thereby doing away entirely with nailing operations. Obviously this improvement in ceiling construction is also advantageous when repairs are necessary. The secondary ceiling members comprise the metallic pans or channels having sound reflective but vibratory characteristics, and these members have portions which extend through to and are exposed to the room area for receiving the sound waves thereon, said portions lying substantially in the plane of the exposed ceiling area and having the appearance of strips interposed between and separating the parallel rows of abutting blocks of sound absorbing material, such as "Acousti-Celotex."

In Fig. 1 is depicted diagrammatically the appearance of a ceiling made in accordance with this invention, wherein the side walls of the room are indicated by the numeral 2, the strips 3 representing the exposed surfaces of the pans of sound reflective material, the numeral 4 representing the ceiling area composed of rows of abutting blocks of sound absorptive material. The widths of the pan strips 3 may be made as desired, even up to the order of 7¾" where the width of the exposed area of the rows of sound absorptive material is of the order of 11¾", this pan width having been found by experiment to be substantially the maximum in this combination of acoustical materials for practical results. In cases where exceptional noise is to be corrected, the total of the exposed pan surfaces may be lessened to thereby relatively increase the total of the exposed area of the sound absorptive material in the ceiling as a whole. This may be done in several ways for example, as by providing pans of lesser width while retaining the same width of fibrous block, or by utilizing the same 7¾ inch width of pan with blocks of greater multiple width (24" width for example). A generally true statement is that the relationship of the width of the fibrous blocks to the width of the pans may be changed or made to vary by virtue of the fact that the centering of the pans can be so located as to provide for an acoustical tile or block 12" in width, or 24" in width, and so forth, depending upon whatever performance may be required to meet the existing condition of noise. Per unit of exposed surface, the cost of the sound absorptive material is greater than the cost of the sound reflective material, and therefore by this invention the cost of a complete ceiling may be materially reduced by the use of the less expensive sound reflective material.

In Fig. 2 there is indicated at 5 a primary ceiling structural member (of which there may be many in the complete ceiling), which member as shown comprises a metallic channel having its web 6 disposed vertically and the parallel flanges 7 and 8 disposed horizontally. At spaced intervals, hangers indicated generally at 9 and 10 are fitted over the uppermost flange 7, each hanger having an inverted U-shaped portion 11 at its middle which closely fits the width of said flange, the opposite end portions of the hanger comprising angularly disposed legs such as 12 with upwardly directed hook-like bends 13 at their extremities for engaging a metallic sound reflective pan generally identified by the numeral 14, so that said pan substantially contacts the outer surface of the lowermost flange 8 of the structural member 5 (see Fig. 3).

Each pan is bent or pressed out of thin metallic sheet material in substantially channel shaped formation as clearly shown in Fig. 2, the bottom or web portion thereof being indicated at 15 and adapted to lie in the plane of the exposed surface of the ceiling, the opposite parallel flange portions 16 and 17 extending vertically upward and connected to the web portion 15 by the oppositely and outwardly extending bends 18 and 19 respectively, which bends constitute shelves or shoulders upon which may be seated the side edges of the blocks such as 20 of the sound absorptive material. The broken line 21 indicates that the width of the pan may be made as desired, though preferably all pans will be made of a uniform or standard width, and variations in ceiling performance will be accomplished by altering the centering of the pan rows, i. e.

5

by using blocks of different widths. The uppermost edge portion of the flanges 16 and 17 is angularly bent inwardly and downwardly, of the pan, as indicated at 22 and 23 respectively, to provide a hook-like formation under which the hooks 13 of the hangers may be sprung.

To correctly position or space a pan such as 14 from the next adjacent pan such as 24 and thus insure the retention of the interposed blocks 20 of sound absorptive material, there is provided a plurality of spaced clip bars such as 25. Each clip bar is of sheet material and may be suitably reinforced as by a central impressed rib 26; the opposite ends of said bar being downwardly and inwardly bent as clearly shown at 27 in Fig. 5 to form a hook-like edge to engage under the complementally formed hook-like edge 22 of the flange such as 16 of a pan such as 14, this snap engagement being permitted by the yieldable springiness of said bar. To hold the block 20 of sound absorptive material down on the shelf or shoulder portion such as 19 of said pan, an edge portion of the clip bar adjacent one end thereof has a tongue 28 struck downwardly from the general plan of said bar, the extremity of said tongue preferably being curled or rounded as indicated at 29 to smoothly engage the upper surface of the fiber block 20, and adjacent the opposite end of said bar but preferably in the opposite edge portion thereof, a similar tongue 30 may be formed.

The pans will be made in appropriate lengths wherefore it may be possible that a plurality of pans will be required, with their ends in abutment with each other, to make up one of the strips or rows shown at 3 in Fig. 1 separating two adjacent rows of fiber blocks of sound absorbing material. In such case, and for the pleasing appearance of the finished ceiling it will be advisable to insure the abutting pans being in planar registry with each other, and to this end a splicer, generally identified by the numeral 35 and such as illustrated in Fig. 4, is employed. This splicer is preferably though not necessarily made of the same thin gauge of sheet metal as the pans, and is formed of channel shaped transverse section providing the web portion 36 and two parallel upwardly extending flange portions 37 and 38; the transverse dimension of the splicer being such as to closely fit within the flanges of the pans, as indicated in Fig. 3.

To facilitate the correct positioning of the splicer, the upper edge portions of the flanges thereof are provided at their median points with outwardly extending tabs such as 39 and 40 which preferably may be formed by vertical cuts and deflection of the material (on one side of the cut) out of the plane of the flange, all as clearly illustrated. Thus it is only necessary to slide the splicer into one end of a pan section until said tabs strike the end edge of the pan, and then slide the next pan section over the protruding end of the splicer and tap it up into abutting relation with the first pan section, said tabs yielding in an inward direction to permit the abutment of the two pans; due to the relative thinness of the sheet metal from which the splicer is made.

Two modifications of the pan hangers are illustrated in Figs. 3 and 6, in the latter the hanger 45 comprising a wire formation the middle portion of which is formed of inverted U-shape providing the two parallel portions 46 and 47 and the oppositely inclined downwardly di-

6

vergent leg portions 48 and 49 respectively, all of which are in a common vertical plane. The end portions of the legs are bent upwardly laterally and angularly as indicated at 50 to complementally engage the angularly bent edge portion such as 22 of a flange of a pan. This construction is common in both modifications of the hanger. The difference in the modifications lies in the extreme end formation of the hangers, the hanger of Fig. 6 having the extreme ends additionally bent as indicated at 51 to provide coaxial portions which will smoothly fit and be in surface contact with the inner surface of the hook-like bend of the edge portion of the pan flange, whereas in the other modification shown in Fig. 3 the extreme ends do not have this additional coaxial end formation and thus said extreme ends terminate with the angular bend such as 50, and hence are sharply capable of "biting" into the surface of the pan flange.

The dimension of a block 20 in a direction parallel to the adjacent supporting pans, may be variable, and it is contemplated having a plurality of blocks filling the space between two such adjacent pans, said plurality of blocks being in end abutting relation with each other. Any suitable formation may be given to these abutting ends; in Figs. 8 and 10 there is indicated complemental rabbeted or ship-lap formations as between the abutting blocks 20 and 21. Since a standard 12" x 24" fibrous block or tile could be employed with either of its dimensions spanning the space between the two adjacent supporting pans, it is possible that one of such blocks might sag with respect to its adjacent block and thus provide an unsightly appearance to the finished ceiling. Therefore it is contemplated providing a metallic reinforcing strip 60 such as indicated in Figs. 7 and 8, and/or a suspension clip 61 such as illustrated in Figs. 9 and 10, to insure planar registration of the abutting blocks at all times.

The reinforcing strip 60 is formed of thin sheet metal to provide a vertically disposed web portion 62 the edge portions of which are bent two parallel horizontally disposed flange portions 63 and 64, the spacing between said flanges being substantially equal to the thickness of the tongue portion 65 of the rabbeted edge of the block 20. In other words, said tongue is adapted to fit closely between said flanges as clearly shown in Fig. 8, and the vertical web portion 62 of the strip and the lower flange 64 thereof are adapted to fit closely within the rabbet of the next adjacent block. A tab 66, preferably of triangular shape, is struck out of either the web 62 or the flange 64 and bent laterally of the strip to assume a position substantially in the plane of said flange, wherefore the point of said tab may readily enter the material of block 21 at its approximate center and constitute a means for insuring planar registration of the abutting ends of blocks 20 and 21. The strip 60 may be made of a length to fit between the flanges of two adjacent pans and may be provided with a suitable number of tabs for accomplishing the desired result, only one tab being illustrated in Fig. 7 in the interest of simplicity of drawing.

The suspension clip 61 has a vertical web portion 70 with a horizontal lower flange 71, and two oppositely extending upper flanges 72 and 73 whose outer end portions are bent upwardly and inwardly to terminate in hook-like edges 74 and 75 respectively, adapted to spring over and engage the opposite edge portions of a clip bar

25, wherefore this suspension clip is intended for use where the ship-lap joint between adjacent blocks 20 and 21 underlies a clip bar. Out of the web 70 any suitable number of tabs such as 76 are struck and bent to lie substantially in the plane of the lower flange 71. This clip may be of any suitable length, and one or more may be provided in the row of blocks between two adjacent pans, the clip being applied to the ship-lap joint between the blocks as clearly illustrated in Fig. 10 with the tabs 76 pressed into the body of the block 21 and the flange 71 supporting the tongue portion of the other block 20.

Where the ceiling joins a vertical wall, there may be provided a strip of finishing moulding generally identified by the numeral 30 in order to support the pans and/or the fiber blocks in the area of the wall, a foreshortened perspective view of such a finishing strip being shown in Fig. 11. This strip is formed of sheet metal bent to provide the vertical wall-engaging flange 81 and the horizontal ceiling-supporting flange 82, the edge of the latter being turned over or rolled to form a smooth bearing surface 83 for the supported block or pan. These strips may be of any suitable length and each is provided in the flange portion 81 thereof with a plurality of apertures 84 which preferably are elongated vertically as shown in order to provide adjustability when securing said strip to the wall 85 as by the nails 86 shown in Figs. 12 and 13. To hold the pan or fiber block in contacting engagement with the supporting flange 82, said strip is provided with a tongue 87 secured at its upper end to the wall flange 81 in any convenient manner, the lower end of said tongue preferably being rounded as shown at 88 to provide a smooth bearing surface against the pan or block with which it is adapted to engage. Thus the tongue may be pressed out of the wall flange 81 or may be secured thereto by soldering or spot welding, the latter being indicated in Fig. 11 by the numeral 89. As shown in Figs. 12 and 13 it may be necessary to break or cut a block or pan in order to provide symmetry of design at the wall areas of the ceiling, but the construction of the strip of finish moulding takes care of this necessity and hides any broken or cut edges.

In Figs. 14 to 17 there is illustrated a modification of the ceiling suspension where there is incorporated a combined spreader bar and reinforcing strip which performs the functions of the structures shown in Figs. 2, 5, 7 and 8. This suspension comprises a plurality of spaced rigid structural members such as the member 5 heretofore described, and to which the sound reflective secondary members are attached by the hangers 45 particularly illustrated in Fig. 6, the subsidiary members of this ceiling suspension comprising a plurality of blocks of sound absorbing material mainly supported by underlying portions of the secondary members.

The secondary members comprise a plurality of pans such as 95 and 96 parallelly spaced from each other and substantially of the general formation of the pans heretofore described in that each has the bottom or web portion 15 and the opposite upwardly extending or vertical and parallel flange portions 16 and 17 joined to the web portion to form the outwardly extending bends 13 and 19, which bends constitute shelves or shoulders upon which may be seated the side edge portions of the blocks of sound absorptive material. However, in this modified construc-

tion the uppermost edge portion of the flanges is formed with an ogee or S-shaped bend as shown, in order to provide a rounded extreme edge portion 97 (see Figs. 14 and 16) for additional longitudinal reinforcing, and for smoothly engaging the combined spreader bar and reinforcing strip, the ends of a hanger 45 engaging said bend.

The combined spreader bar and reinforcing strip is shown in detail in Figs. 15, 16 and 17, and is generally of an inverted T shape. In a practical and economically produced form, it comprises a strip of sheet metal bent to provide a longitudinally extending central vertical web 98 (of double thickness as shown) and two oppositely extending horizontal flanges 99 and 100. The web is of a length substantially equal to the distance between a vertical flange of one pan and the vertical flange of the next adjacent pan, but each horizontal flange of this combined spreader bar and reinforcing strip is extended beyond said web and bent upwardly and outwardly to form a hook by means of which said strip is suspended from the upper edge portion of a pan flange.

That is to say, the horizontal flange 99 of said strip is extended and bent upwardly at one of its ends to form a vertical hanger plate 101, the end portion of said plate being outwardly and downwardly bent to form the hook 102 adapted to overlap the upper edge portion of the vertical flange such as 17 of a pan (see Fig. 16) and springingly engage the rounded extreme edge 97 of said flange. The other horizontal flange 100 of said strip is similarly extended, bent and formed to provide the hanger plate 103 and the hook 104, but the hooks 102 and 104 as shown are formed at opposite ends of said strip. Hence, when such a formed strip or bar is in place (see Fig. 14) it serves to tie two adjacent pans (95 and 96) together and thus prevents a spreading apart thereof such as might cause a dislodgement of their supported blocks of sound absorptive material. The hooks may be provided at one end only or at both ends of each flange, and the hanger plates may be suitably secured as by welding to the web 98 to give added rigidity if desired or found necessary.

When using this combined spreader bar and reinforcing strip, the blocks of sound absorptive material preferably are provided on all edges with horizontal kerfs such as 105 to positioned as to register with and snugly receive therein the flanges 99 and 100 of said strip, whereby said blocks are reinforced by the strips, as well as additionally supported by the flanges of the strips at the butting joint between two adjacent blocks, thereby insuring the blocks against such sagging movement as might result in an uneven planar registration which would be unsightly. The peripheral kerf described above permits the blocks of sound absorptive material to be placed in either direction relative the supporting pans. Furthermore, said strip serves to seal the joint between two adjacent blocks both as to ventilation and dirt (commonly known as breathing), and makes unnecessary the wasteful rabbeted edge formation of the blocks as shown in Fig. 8.

From the foregoing disclosure it will thus be seen that by this invention there is provided an acoustic ceiling construction comprising rigid primary supporting members such as 5, secondary members such as the pans 14 suspended therefrom and having portions such as 15 lying in the exposed surface area of the ceiling, and subsidiary members such as the blocks 20 suspended by the

underlying portions 18, 19 of said secondary members, said subsidiary members having their lowermost surface lying in the exposed surface area of the ceiling, said secondary and subsidiary members being of material susceptible of acoustic correction in that they are capable of dis- and demountable in the ceiling construction by virtue of such suspension. Said ceiling comprises alternate rows such as 3 of sound reflective elements and such as 4 of sound absorptive elements, the total of the exposed surface areas of the sound reflective elements being less than the total of the exposed surface areas of the sound absorptive elements, and the ratio of these totals is limited substantially to no greater than 7 to 12 respectively. The clip bars 25, hanger springs such as 9, the splicer such as 35, the reinforcing strips such as 60, the suspension clips such as 61, and the finishing moulding such as 80 are provided as hereinabove set forth to make a unitary whole in the ceiling.

It is obvious that those skilled in the art may vary the details of construction and arrangements of parts without departing from the spirit of this invention wherefore it is desired not to be limited to the exact foregoing disclosure except as may be required by the claims.

What is claimed is:

1. An acoustic ceiling construction comprising alternate rows of sound absorptive and sound reflective elements, the sound absorptive elements comprising blocks of cellular material, the sound reflective elements comprising vibratory metallic sheets formed into substantially channel shape to provide a web portion lying in the plane of the exposed surface area of the ceiling, and upwardly extending flange portions having hook-like formations constituting means for suspending the sound reflective elements from a primary ceiling member, said flange portions joined to said web portion by bends providing laterally disposed shelves for supporting said blocks, and clip-bars disposed over said blocks at spaced intervals, said bars having end formations complementary to and engageable with the hook-like formations of the flanges of said sound reflective elements to tie together two laterally adjacent rows of said sound reflective elements.

2. An acoustic ceiling construction comprising alternate rows of sound absorptive and sound reflective elements, the sound absorptive elements comprising blocks of cellular material, the sound reflective elements comprising vibratory metallic sheets formed into substantially channel shape to provide a web portion lying in the plane of the exposed surface area of the ceiling, and upwardly extending flange portions having hook-like for-

mations constituting means for suspending the sound reflective elements from a primary ceiling member, said flange portions joined to said web portion by bends providing laterally disposed shelves for supporting said blocks, and clip-bars disposed over said blocks at spaced intervals, said bars having end formations complementary to and engageable with the hook-like formations of the flanges of said sound reflective elements to tie together two laterally adjacent rows of said sound reflective elements, each clip bar having pressure means to force a block on said shelves.

3. An acoustic ceiling construction comprising alternate rows of sound absorptive and sound reflective elements, the sound absorptive elements comprising blocks of cellular material, the sound reflective elements comprising vibratory metallic sheets formed into substantially channel shape to provide a web portion lying in the plane of the exposed surface area of the ceiling, and upwardly extending flange portions having hook-like formations constituting means for suspending the sound reflective elements from a primary ceiling member, said flange portions joined to said web portion by bends providing laterally disposed shelves for supporting said blocks, and clip-bars disposed over said blocks at spaced intervals, said bars having end formations complementary to and engageable with the hook-like formations of the flanges of said sound reflective elements to tie together two laterally adjacent rows of said sound reflective elements, the blocks in a row arranged in edge abutting relation, two contiguous blocks maintained in planar registry with each other by a suspension clip having portions engaging the edge portions of said contiguous blocks, as well as having hook-like formations engaging a clip bar.

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