Nov. 17, 1953 G. P. WAKEFIELD 2,659,807

COMBINATION LUMINOUS AND ACOUSTICAL CEILING

Filed May 16, 1949 4 Sheets-Sheet 1

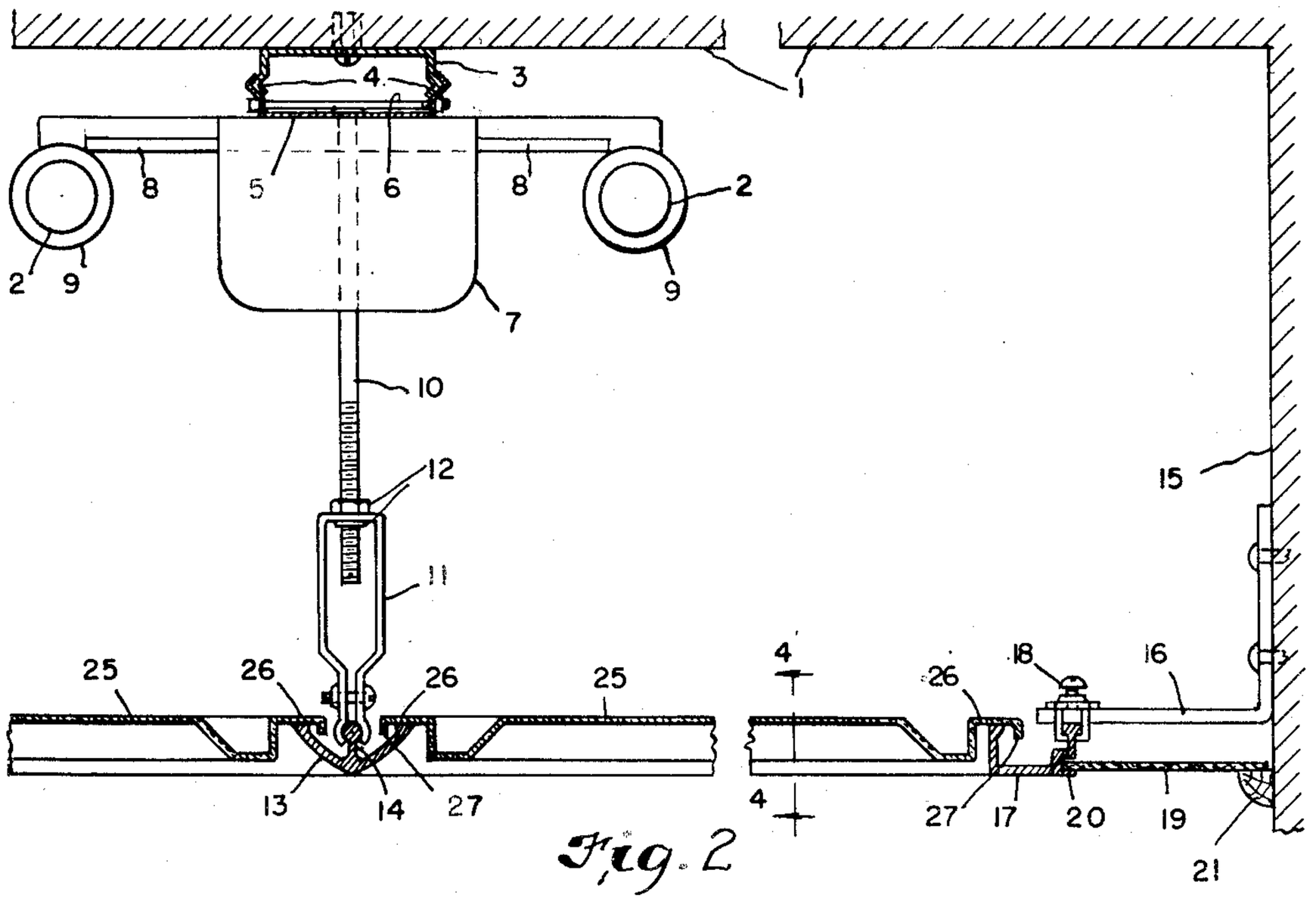

Fig. 2

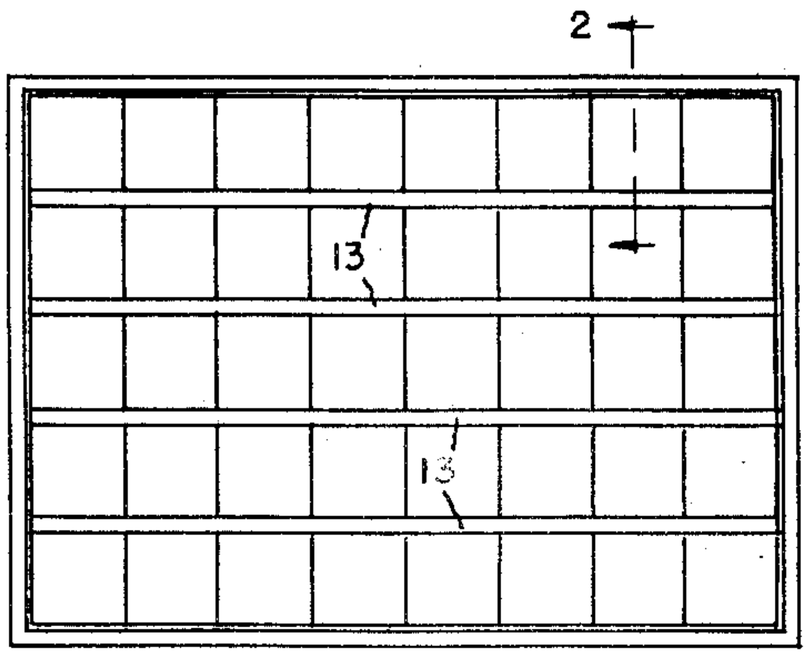

Fig. 1

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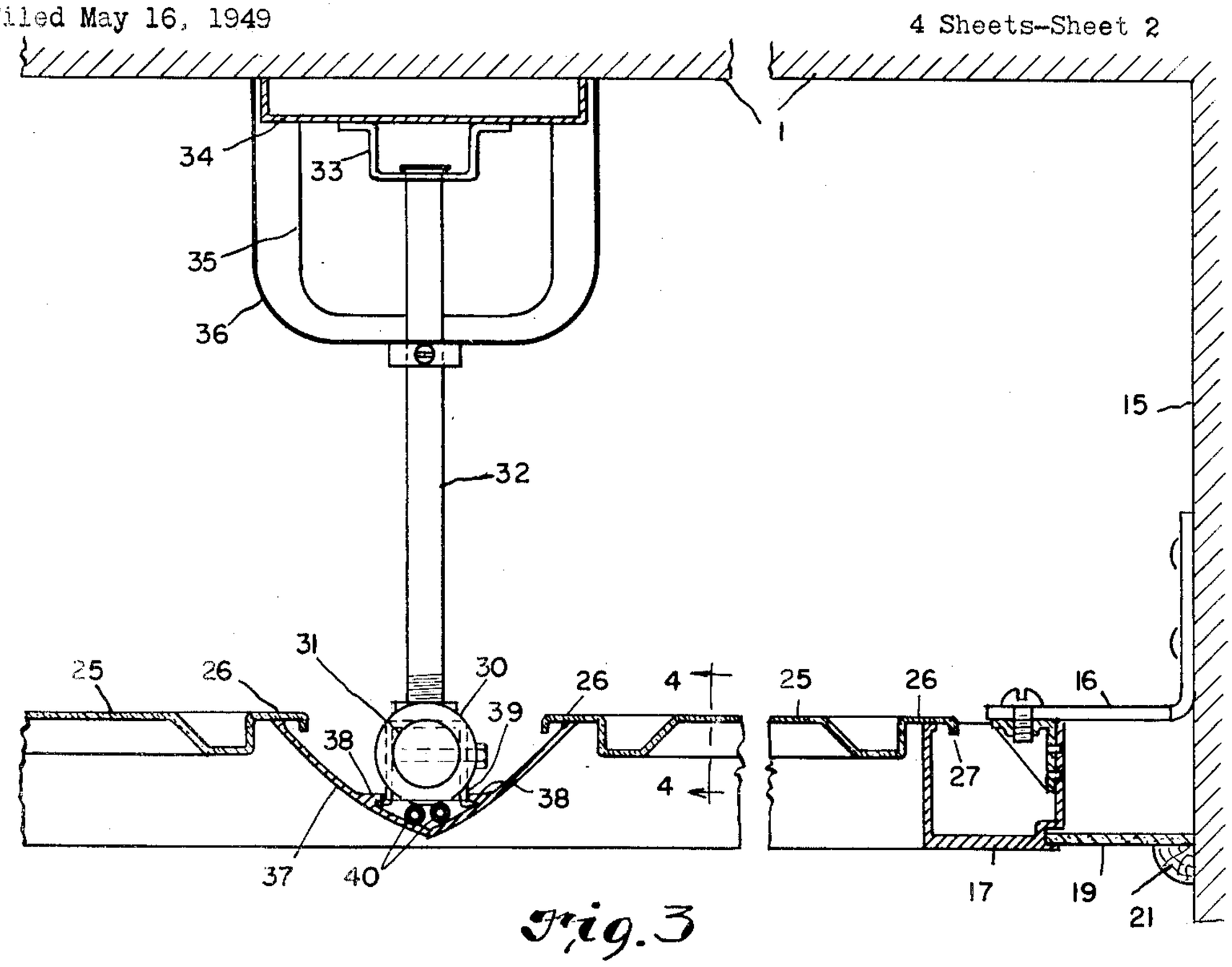

Fig. 3

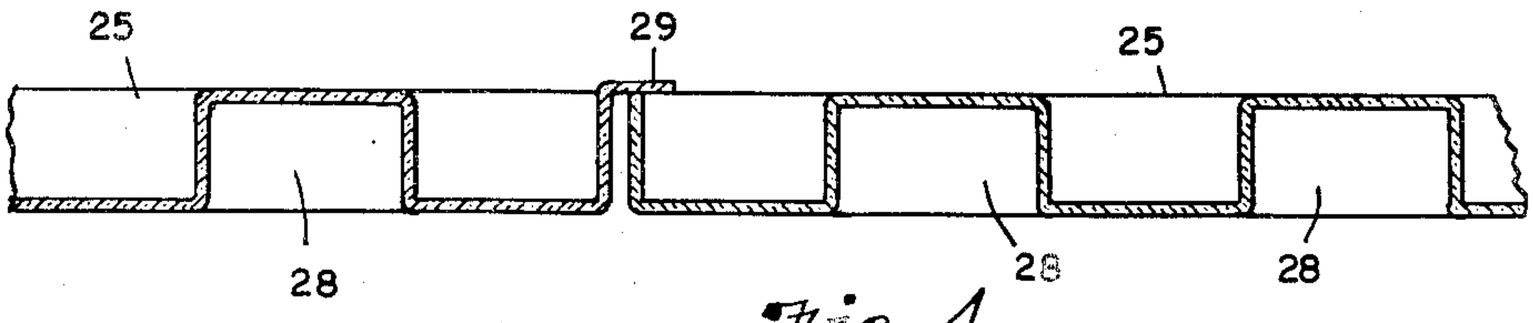

Fig. 4

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COMBINATION LUMINOUS AND ACOUSTICAL CEILING

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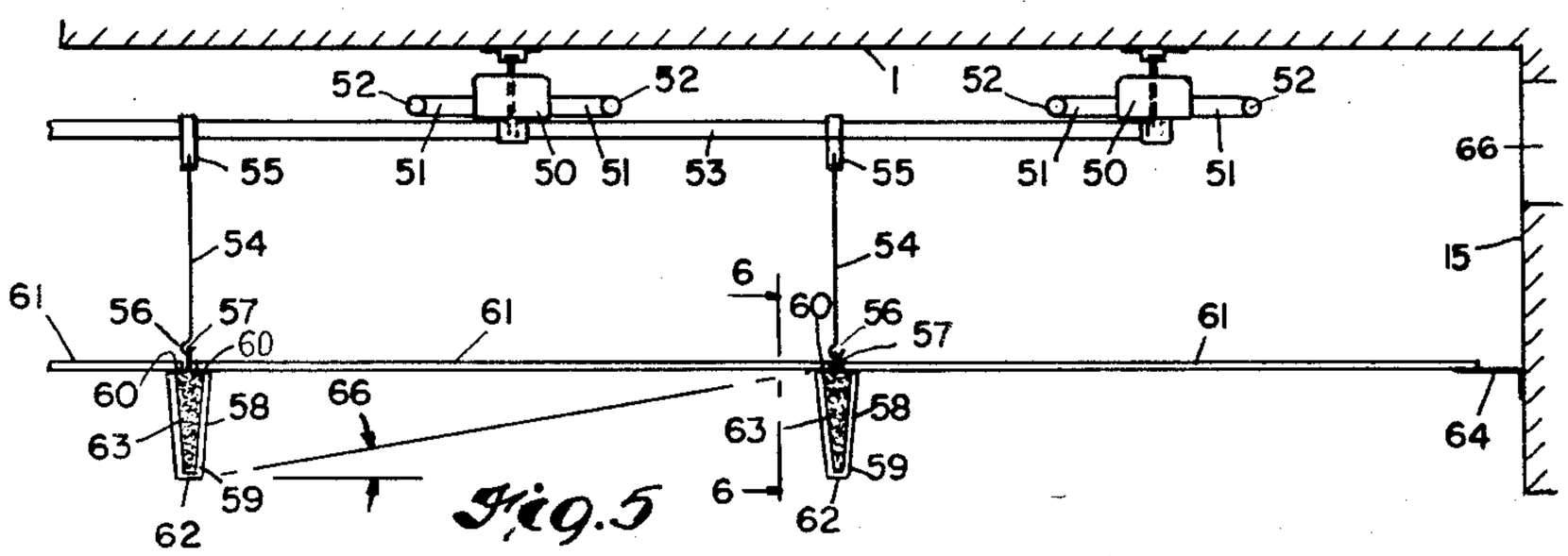

Fig. 5

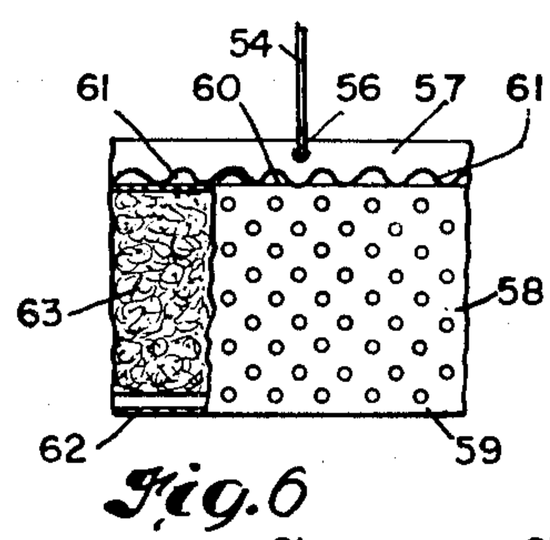

Fig. 6

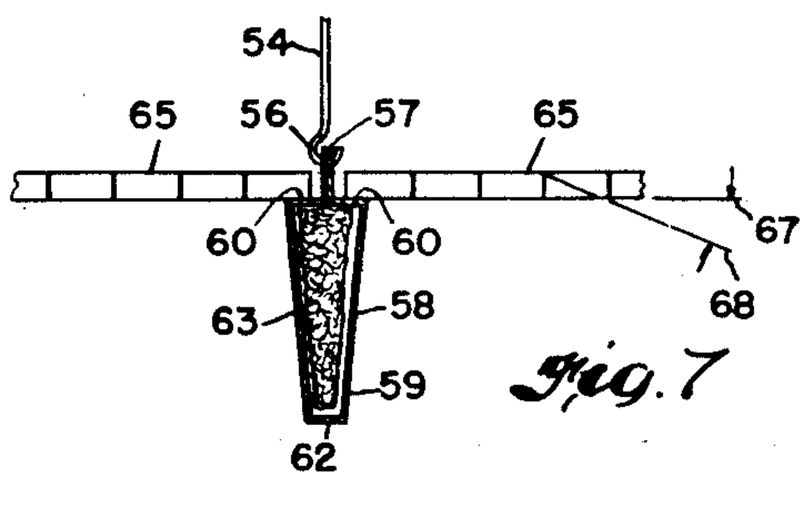

Fig. 7

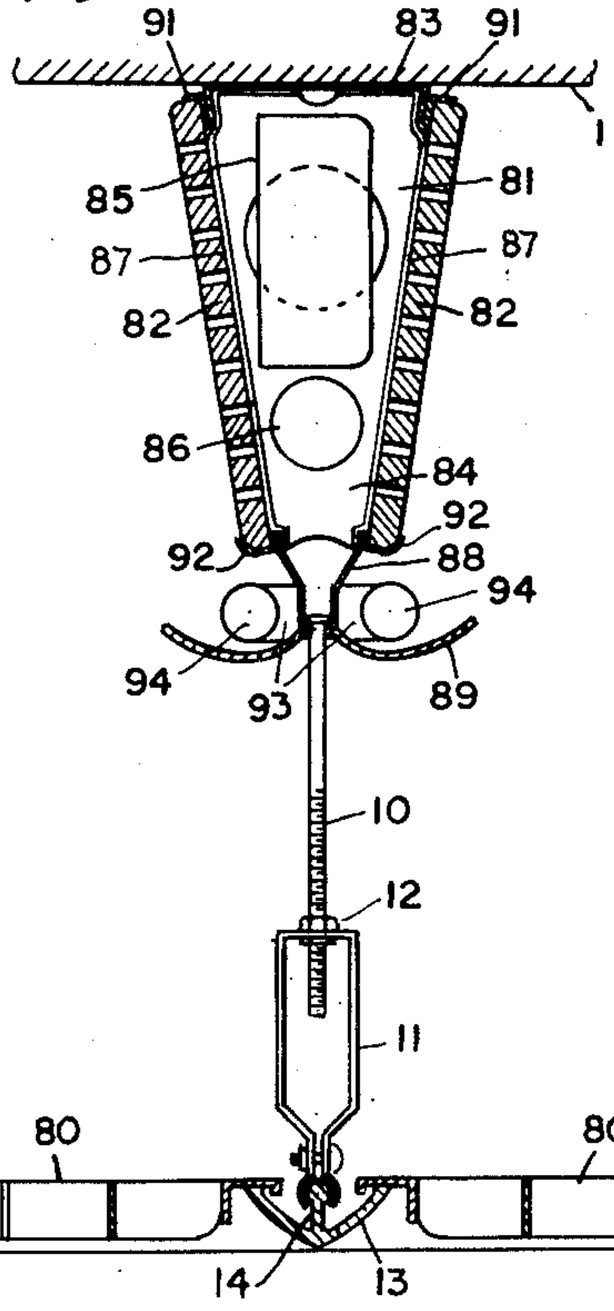

Fig. 11

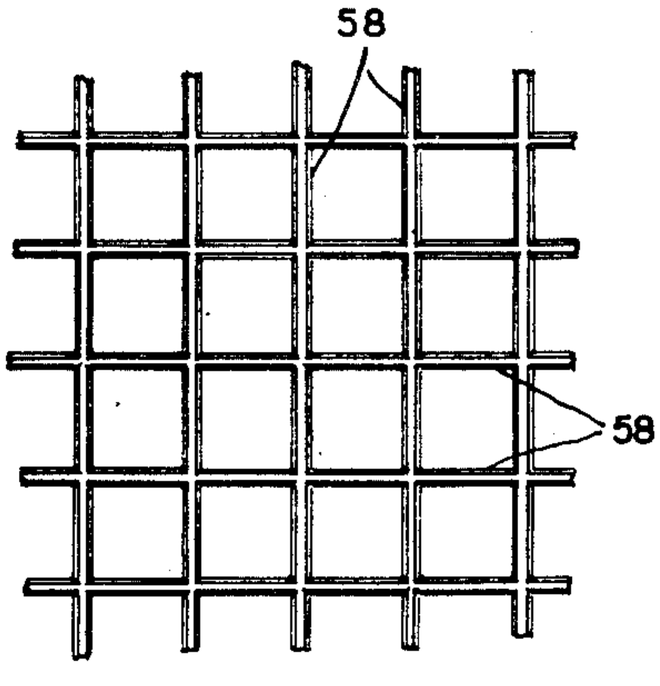

Fig. 8

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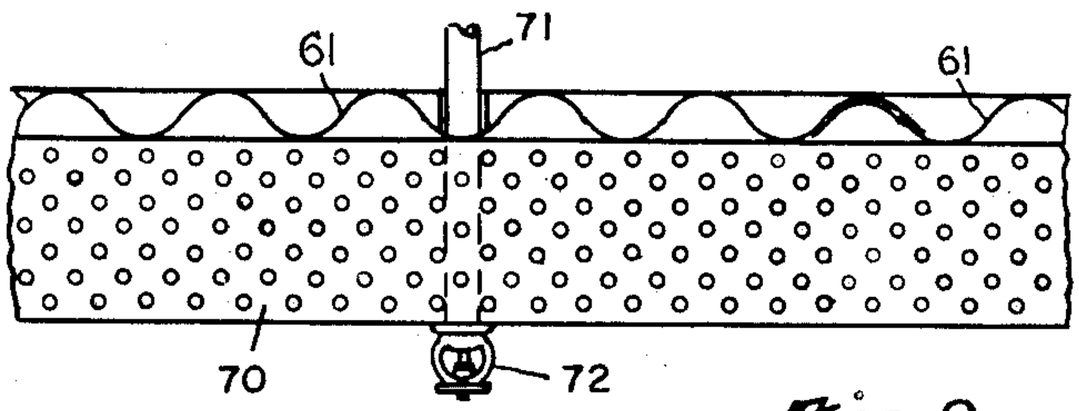

Fig. 9

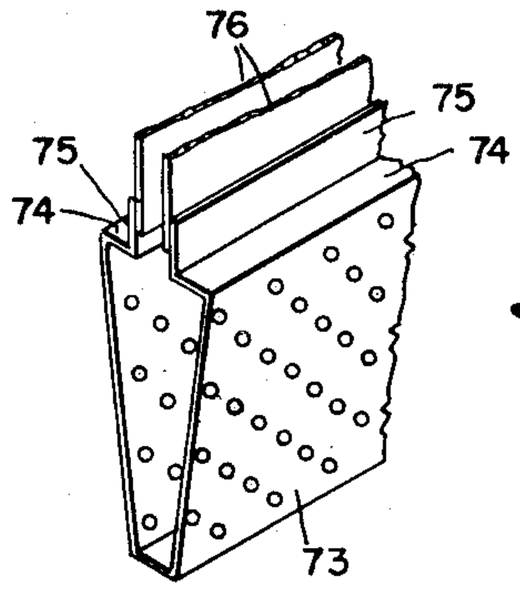

Fig. 10

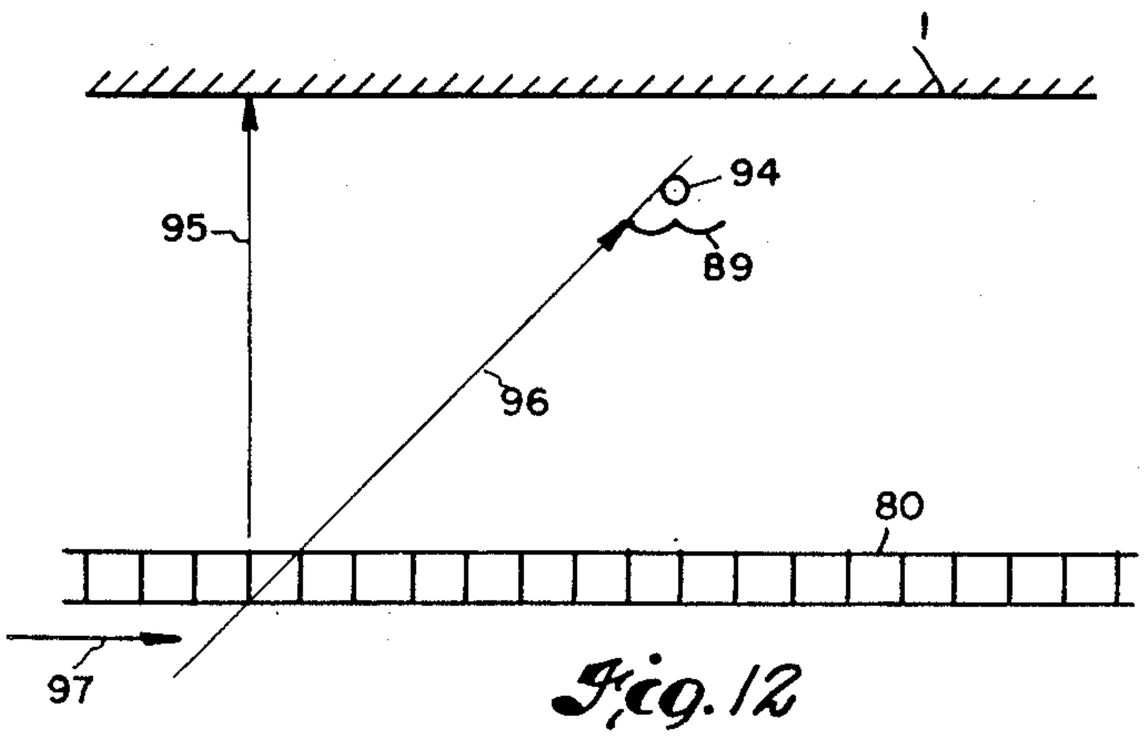

Fig. 12

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UNITED STATES PATENT OFFICE

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COMBINATION LUMINOUS AND ACOUSTICAL CEILING

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Application May 16, 1949, Serial No. 93,620

9 Claims. (Cl. 240—9)

1

The present improvements relate to combination luminous and acoustical ceiling constructions in which lighting and sound-absorbing means are incorporated for illuminating the room or other space beneath such ceiling and for deadening sounds in such room. The present application is a continuation-in-part of my copending application for "Luminous Ceilings," Serial No. 599,868, filed June 16, 1945, now abandoned.

I am aware that so-called luminous ceilings have heretofore been provided in which the light source has been wholly or partially inset. However, the object of the present invention is to render luminous the entire ceiling, or such portion thereof as may be desired, by the use of a suitable source of illumination located above the ceiling, which may be disposed so as to serve either as a direct or an indirect source of light. A further object is to provide a luminous ceiling construction in which illuminated tubular lighting elements, and particularly so-called fluorescent lamps, may be utilized as the light source. At the same time the ceiling is of such construction as to act as a sound deadening medium without affecting its function as a light transmitting medium or means of illumination.

A still further object is to provide a so-called "low brightness" luminous ceiling construction affording uniform illumination without glare.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims.

The annexed drawings and the following description set forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawings:

Fig. 1 is a bottom plan view, more or less diagrammatic in character, of a luminous ceiling embodying my present improvements;

Fig. 2 is a vertical broken sectional view of a portion of such luminous ceiling showing the manner in which it is suspended from the ceiling proper and attached to an adjacent side wall, also showing incorporated in the supporting means a fixture adapted to carry lighting elements of the type referred to so as to provide a direct source of illumination for the ceiling;

Fig. 3 is a similar sectional view to that of Fig. 2 but showing a modification in the supporting means whereby the lighting elements are

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mounted so as to provide an indirect source of illumination for the ceiling;

Fig. 4 is a vertical sectional view of several adjacent ceiling elements taken at right angles to the plane of the section in Figs. 2 and 3, as indicated by the line 4—4 thereon;

Fig. 5 is a vertical broken sectional view of a modified ceiling construction having vertically disposed baffles extending downwardly from the luminous ceiling;

Fig. 6 is a cross-sectional view taken substantially along the line 6—6, Fig. 5;

Fig. 7 is a fragmentary cross-sectional view of a ceiling construction similar to that illustrated in Fig. 5;

Fig. 8 is a bottom plan view of a ceiling construction in which there are provided intersecting sets of baffles extending downwardly from the luminous ceiling;

Fig. 9 is a cross-sectional view similar to Fig. 6 except illustrating a modified support for the baffles;

Fig. 10 is a perspective view of a modified form of baffle which constitutes a portion of the ductwork for a ventilating or air conditioning system;

Fig. 11 is a view similar to Fig. 2 illustrating a modification in the support members on which the luminous ceiling is carried; and

Fig. 12 is a diagrammatic view of the Fig. 11 construction to show one way of accomplishing low brightness in the luminous ceiling at all angles of view from beneath the luminous ceiling.

As indicated, my improved luminous ceiling, as shown in bottom plan view in Fig. 1, is designed to be suspended a suitable distance below the main or permanent ceiling 1 (Figs. 2 and 3), the ceiling suspending means being also utilized as supports or carriers for the illuminating means. Conversely stated, the lighting fixture or fixtures which provide the source of illumination at the same time serve thus to support the ceiling which becomes in effect a part of what may be regarded as an inclusive or overall lighting fixture for the room.

As a matter of convenience, the novel features of construction which are comprised in the ceiling proper will be described in connection with the type of lighting fixture designed to provide a direct light source, as illustrated in Fig. 2. Where direct illumination is desired, the fluorescent tubes 2 or equivalent elongated light elements will be supported preferably in pairs, closely adjacent the permanent ceiling 1. This will be conveniently accomplished by attaching to the latter a downwardly directed channel 3,

the side walls of which are formed with lateral projecting ribs or beads 4 wherewith a series of clamps 5 may be securely engaged at spaced intervals by means of clamp bolts 6. In this manner there will be attached to said channel in parallel relation such ballast box or boxes 7, laterally projecting socket arms 8 and sockets 9, as may be required to carry the necessary number of tubular lighting elements to extend substantially across the ceiling from one side wall of the room space to the other.

Likewise supported by each clamp 5 is a vertically depending rod support 10. To the lower end of such rod support is in turn attached another clamp 11 which may be adjusted up and down said rod by means of nuts 12. The series of clamps 11 thus provided will of course be aligned with the lamps 2 carried in the upper part of the fixture, and this is likewise true of the channel molding or rail 13 of special form that is detachably secured to said clamps 11. Molding or rail 13 may be made of metal, extruded plastic, or other material, and as shown in Fig. 2 is desirably of flattened V-shape in cross section with a central upstanding rib 14 wherewith clamp 11 is adapted to engage at any selected point. As apparent, the moldings or rails 13 may be disposed crosswise of the series of support members and lamps, if desired.

As shown in Fig. 1, a series of these channel molding strips will be thus supported in parallel, equally spaced, relation transversely of the area occupied by the ceiling. Supported from each of the side walls 15 of the room space by means of brackets 16 is another channel molding 17. The latter is thus supported in the same horizontal plane as are the moldings 13, provision being made for their adjustment with respect to the wall from which they are supported by suitable fittings 18 on the lower horizontal arms of brackets 16. The space between these channels 17 and the adjacent side wall will be desirably closed off with an opaque filler strip 19 of composition board or other suitable material, the channel 17 being formed with a lip 20 adapted to engage the inner edge of such strip, the outer edge being secured in place by means of a molding strip 21.

The entire area between each side channel 17 and intermediate channel 13, as well as between successive pairs of the latter, is filled by means of a series of horizontally disposed light diffusing panels, herein translucent panels 25, preferably made of plastic material, these panels in assembled condition constituting what may be appropriately described as a luminous ceiling, since when the lamps 2 are activated the rays of light directed downwardly therefrom will pass through such panels and thereby be evenly distributed through the space beneath the ceiling.

As best shown in Fig. 2, these luminous panels 25 are formed with lateral flanges 26 that are adapted to overlie the juxtaposed side walls of adjacent pairs of the channel moldings 13 or of such a channel molding and the adjacent wall molding 17, as the case may be. Flanges 26 are of sufficient width to permit a certain amount of lateral shifting of the panel to accommodate any slight irregularity in the alignment of said channels from which the panel is thus supported; said flanges are also formed with down-turned lips 27 which interlock with the respective channels while still permitting such adjustment thereof.

As previously indicated, the luminous panels 25 may be designed also to serve as sound deadening means, and to this end they will desirably be

made of undulating form in cross-section at right angles to that of Fig. 2 so that each panel will provide a plurality of sound traps 28. The particular shape of the undulations in the panel and thus of these sound traps, which as shown are of general rectangular cross-section, may be varied so as to secure the most efficient sound-deadening effect, and where the panels are formed of plastic material they may be readily molded to present on their lower faces sound traps or pockets of any shape desired.

The modification illustrated in Fig. 3 relates wholly to what may be referred to as the lighting fixture proper, the construction of the luminous ceiling being unchanged from that just described in connection with Figs. 1, 2 and 4. This fixture, in contradistinction to the first one, is designed to provide an indirect source of illumination for the ceiling panels 25. Accordingly, the sockets 30, which in this case carry a single aligned series of tubular light elements 31, are supported substantially in the plane of the luminous ceiling composed of panels 25, being attached to depending stems 32 which are in turn secured to the ceiling at properly spaced points by means of brackets 33 on the under side of a top plate 34. The ballast box 35 where required, as in the case of fluorescent lamps, will likewise be supported from such top plate and the whole upper structure enclosed in a housing 36, the outer surface of which will preferably be of reflector character. Likewise, the surface of the main ceiling 1, as well as of the side walls 15 lying above the plane of the luminous ceiling, will desirably have a light-reflecting coating.

The longitudinally extending channel molding or rail 37 which engages and supports the lateral flanges 26 of the adjacent series of luminous panels 25 is substantially of the same form as channel 13 in the previously described construction, but while opaque, will desirably have its interior surface likewise of light-reflecting character so that the light from the tubes 31 will be directed upwardly against the previously described reflecting surfaces and thence downwardly through the translucent panels 25. Channel 37 is adapted for attachment to the lower end of stem 32 by being formed with opposite inwardly directed lugs or ribs 38 wherewith the arms of an expanding clamp 39 on such thin end may engage. Sufficient space will be left below the ribs 38 as well as below the sockets 30 to provide a wireway for wires 40, as shown.

From the foregoing description it will be seen that by utilizing the fixtures which carry the lighting means as supports also for a secondary ceiling composed of light diffusing members in the form of translucent panels, a very simple and yet effective form of luminous ceiling for a room or like space is provided. The construction, furthermore, is such that access to the lighting fixtures which are normally completely enclosed and hidden by such ceiling may be readily had since the latter is made up of displaceable panels which may be raised clear of the supporting means at any point in the ceiling and then returned to proper place. Finally, by making such component panels of the ceiling in the form described, they are adapted to serve also as a sound deadening medium for the ceiling.

The ceiling construction illustrated in Figs. 5 and 6 comprises parallel series of longitudinally aligned fixtures 50 secured to the permanent ceiling 1 and extending for example from one end to the other of the room space, each said

fixture including oppositely extending lateral arms 51 at longitudinally spaced intervals carrying sockets (not shown) at their outer ends for receiving the ends of tubular lamps 52. Extending across the series of fixtures 50 at suitably spaced intervals and secured to the bottom of the fixtures are upwardly directed channel supports 53 providing convenient wireways for electrically interconnecting the series of fixtures.

Fixed on said supports 53 intermediate each pair of adjacent series or rows of fixtures is a support rod 54 vertically adjustable as by a nut 55 threaded thereonto and formed with a hook 56 or the like at its lower end engaged in a perforation in the flange portion 57 of an acoustic baffle 58. As shown, said baffle 58 is disposed vertically and preferably comprises a perforated casing or shell 59 of metal, plastic, or other relatively stiff material providing horizontal ledges or rails 60 upon which the hereinafter described light diffusing panels 61 are adapted to rest. The opposite sides of said casing 59 are inclined from vertical and are connected together at their lower edges by a relatively narrow web portion 62. Within said casing 59 and spaced from the walls thereof is a body 63 of sound-absorbent material.

An acoustic baffle 58 of the character described when fabricated from sheet metal will not affect the sound-deadening properties thereof when the casing 59 is repainted as is the case with known acoustic panels which are formed simply by compressing fibrous material into panel form.

As previously indicated, the light diffusing panels 61 laterally rest upon the ledges 60 of the baffles, the panels 61 which are next to the side walls 15 of the room space being supported as by filler strips 64 secured to and projecting laterally from the side walls.

The light diffusing panels 61 may be translucent panels 25 as in Figs. 1–4 for example, or louvered panels 65 as in Fig. 7. However, for ventilating the space above the luminous ceiling the light diffusing panels 61 in Figs. 5 and 6 when made of translucent plastic or like material are corrugated at least at their opposite edges to define passages with the ledges 60 through which air can circulate between the room space above and beneath the luminous ceiling and, of course, an air duct 66 may enter the space above to supply or to exhaust air as desired and thus establish air flow through said passages as defined between the corrugated panels 61 and said ledges or rails 60. When said panels are fabricated from sheet material with the corrugations extending thereacross, adjacent panels in each row may be overlapped as best shown in Fig. 6.

From the foregoing it can be seen that the sides of the acoustic baffles 58 will be illuminated through the light diffusing panels 61 and when the ceiling is viewed at any angle from horizontal between zero and angle 66, said baffles will conceal the panels 61 from direct view and only the low brightness of the reflected light from the baffles will be visible. Moreover, because the bottom web portions 62 of the baffles are relatively narrow, the fact that such portions are unilluminated does not detract appreciably from the effect of overall illumination.

Furthermore, the provision of supports intermediate the series of fixtures enables mounting of the end series of fixtures closely adjacent the side walls 15 of the room space whereby to provide adequate illumination thereat.

The modification illustrated in Fig. 7 is the same as that of Figs. 5 and 6 except that louvered panels 65 have been substituted for the panels 61. In this form of the invention it is preferred that shields be mounted beneath the lamps 52 to conceal the same from direct view from beneath the panels. Of course the louvers themselves will hide the lamps when the angle of view is between the lines 67 and 68. With respect to the sound-deadening features of the Fig. 7 construction, the sound waves reflected from the permanent ceiling 1 will pass through the louvered panels 65 and strike against the opposite sides of the baffles 58.

With luminous and acoustical ceilings as just described sound waves reflected by the luminous ceiling when said ceiling comprises imperforate light diffusing panels 61 will be effectively deadened or absorbed by the baffles 58, said baffles further functioning as aforesaid to reflect light passing through the panels.

If desired, additional baffles 58 which extend crosswise of the fixtures as shown in Fig. 8 may be provided in which case the intersecting baffles will define spaces partially concealing the panels 61 from direct view from all areas around the room space. In this case the baffles 58 will be in the nature of large-size louvers spanned at the top by the light diffusing panels 61 or 65.

A still further modification as illustrated in Fig. 9 comprises supporting acoustic baffles 70, similar to the baffles 58, from vertically disposed pipes 71 extending through the baffles and having sprinkler heads 72 on the lower ends thereof, the upper ends of said pipes leading to a water supply conduit in the permanent ceiling 1 or preferably to a water supply conduit carried in the longitudinally extending members 53. In any event the baffles 70 provide ledges upon which luminous panels such as the panels 61 shown laterally rest and span the space between adjacent baffles.

In lieu of the sound-deadening acoustic baffles 58 and 70 said baffles may be of the form illustrated in Fig. 10 wherein the perforated baffles 73 are provided with ledges or rails 74 upon which light diffusing panels are adapted to laterally rest, and with spaced flanges 75 adapted to fit within or about an air duct 76 extending downwardly from the permanent ceiling 1, said duct and baffle affording ventilation for the room area above the luminous ceiling or constituting part of an air conditioning system for supplying fresh and cooled air to the room area below the luminous ceiling.

From the foregoing description of Figs. 5 through 10 it is evident that the downwardly depending baffles may optionally perform any one or more of several functions, viz. provide an acoustic ceiling construction, provide a louver effect to cut down the ceiling brightness to the light reflected from the opposite sides faces of the baffles, or to function as a part of the ductwork of a ventilating or air conditioning system.

A still further modification as illustrated in Fig. 11 is generally similar to the construction of Fig. 2 with the exception of the substitution of light diffusing panels 80 in the form of egg crate type louver panels for the transparent panels 25 and support members 81 from which the parts 10 to 14 are suspended, said fixtures 81 supplying the sound-deadening qualities absent in said louvered panels 80 through the mounting of acoustic panels 82 preferably perforated as shown thereon and constituting a part of said fixtures and additionally functioning as reflectors. As shown, each said fixture 80 comprises a down-

wardly directed channel 83 attached to the permanent ceiling 1 and to which channel in turn are secured in longitudinally spaced relation end plates 84 mounting the necessary ballast box 85 and starter 86 and providing flanges 87 on opposite sides supporting the acoustic panels. A wireway 88 extends longitudinally beneath the bottom edges of the end plates 84 and has secured thereto a shield 89. Said channel and wireway are further provided with flanges 91 and 92 respectively engaging the upper and lower edges of the panels 82. Said wireway 88 has laterally extending arms 93 thereon mounting conventional sockets for the ends of tubular lamps 94.

With respect to the acoustic panels 82, they are preferably inclined slightly from vertical, as shown, both for superior reflective and sound absorbing properties and as apparent sound waves passing through the louvered light diffusing panels 80 are reflected from the permanent ceiling 1 against the acoustic panels.

A further feature of the Fig. 11 ceiling construction is that the same is of low brightness and non-glaring, the lamps 94 being hidden from direct view from all angles beneath the luminous ceiling both by the shields 89 on the fixtures 81 and by the louvers. As best shown in Fig. 12, only the reflected light from the ceiling 1 will be visible at angles of view between lines 95 and 96, the lamps 94 being concealed by shield 89 and of course at angles of view between the lines 96 and 97 only the light reflected by the side faces of the louvers will be visible, such light having already been reflected from the ceiling 1. Accordingly the luminous ceiling will be of low brightness from all angles of view from below.

Other modes of applying the principle of my invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims, or the equivalent of such, be employed.

I therefore particularly point out and distinctly claim as my invention:

1. In an overhead lighting structure designed to be disposed beneath the ceiling proper of a room and to provide overall, diffused illumination of the room area therebelow, the combination of lighting means including parallel rows of longitudinally aligned tubular illuminators disposed in spaced, approximately parallel relation to the ceiling proper, and parallel series of support members secured to the ceiling proper and equipped with electrically joined, paired series of opposed sockets for said illuminators; said support members including parallel rows of hanger rods depending therefrom, rails carried by the respective rows of hanger rods in spaced, approximately parallel relation to the ceiling proper; and a series of light-diffusing panels substantially co-extensive with the ceiling area and having juxtaposed margins aligned with and laterally resting upon said rails, said panels being upwardly displaceable and tiltable relative to said rails for dropping same between adjacent rails to provide access to said lighting means and said illuminators being located to permit such upward displacement and tilting of said panels with respect to said rails.

2. The structure according to claim 1 further characterized in that said support members comprise channels secured to the ceiling proper, and series of clamps secured to the respective channels at longitudinally spaced intervals

therealong, said clamps carrying said hanger rods and said sockets.

3. The structure according to claim 1 further characterized in that said rails are in the form of upwardly open channels, and in that said hanger rods carry said sockets adjacent their lower ends whereby said illuminators extend longitudinally within said rails to serve as an indirect source of illumination for said panels.

4. The structure according to claim 1 further characterized in that said panels are in the form of louvers and in that shields are disposed underneath said illuminators, said panels and shields being effective to conceal said illuminators from direct view at all angles from below said panels.

5. In an overhead lighting structure designed to be disposed beneath the ceiling proper of a room and to provide overall, diffused illumination of the room area therebelow, the combination of parallel rows of longitudinally aligned tubular illuminators disposed in spaced, approximately parallel relation to the ceiling proper; a supporting framework including socket-equipped members secured to the ceiling proper and mounting said illuminators in such parallel rows, and wireways extending between said members having wires therein which electrically join paired series of opposed sockets for the respective illuminators; hanger rods depending downwardly in parallel rows from said framework; rails carried by the respective rows of said hanger rods in spaced, approximately parallel relation to the ceiling proper; and a series of light-diffusing panels substantially co-extensive with the ceiling area and having juxtaposed margins aligned with and laterally resting upon said rails.

6. In an overhead lighting structure designed to be disposed beneath the ceiling proper of a room and to provide overall illumination of the room area therebelow, the combination of parallel rows of longitudinally aligned tubular illuminators disposed in spaced, approximately parallel relation to the ceiling proper; a supporting framework including socket-equipped members secured to the ceiling proper and mounting said illuminators in such parallel rows, wireways extending between said members having wires therein which electrically join paired series of opposed sockets for the respective illuminators; and a parallel series of elongated members suspended from said framework in spaced, approximately parallel relation to the ceiling proper, said elongated members constituting light shields.

7. In an overhead lighting structure designed to be disposed beneath the ceiling proper of a room and to provide overall, diffused illumination of the room area therebelow, the combination of a lighting system disposed in spaced relation beneath the ceiling proper; a series of light-diffusing panels substantially co-extensive with the ceiling area; suspending means for said panels including rails aligned with and underlying juxtaposed margins of said panels and effective to support the latter in spaced, approximately parallel relation to the ceiling proper; and an air duct opening into the space above said panels and clear of said panels, whereby to avoid obstruction of the overall, diffused illumination of the room area below said panels, said rails and the margins of said panels defining opposite series of passages communicating the space above said panels with the room area therebelow.

8. An overhead lighting structure according to claim 7 further characterized in that at least the

margins of said panels are transversely corrugated to define such opposite series of air flow passages with said rails.

9. In an overhead lighting structure designed to be disposed beneath the ceiling proper of a room and to provide overall, diffused illumination of the room area therebelow, the combination of lighting means including parallel rows of longitudinally aligned tubular illuminators disposed in spaced, approximately parallel relation to the ceiling proper, and parallel series of support members secured to the ceiling proper and equipped with electrically joined, paired series of opposed sockets for said illuminators; said support members including parallel rows of hanger rods depending therefrom, rails carried by the respective rows of hanger rods in spaced, approximately parallel relation to the ceiling proper; and a series of light-diffusing panels substantially co-extensive with the ceiling area and having juxtaposed margins aligned with and removably supported upon said rails, said panels being tiltable relative to said rails for dropping same between adjacent rails to provide access to said lighting means and said illuminators being located to permit such tilting of said panels with respect to said rails.

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