

[54] SUB-CEILING FOR BUILDINGS

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[52] U.S. Cl.....52/144, 52/726, 287/189.36 A, 52/496

[51] Int. Cl.....E04b 1/82, E04c 3/32

[58] Field of Search.....52/474, 483, 484, 488, 238, 52/240, 241, 475, 144, 726, 712, 714, 496, 303, 145; 287/189.36 A, 189.36 B, 189.36 R; 98/31, 105

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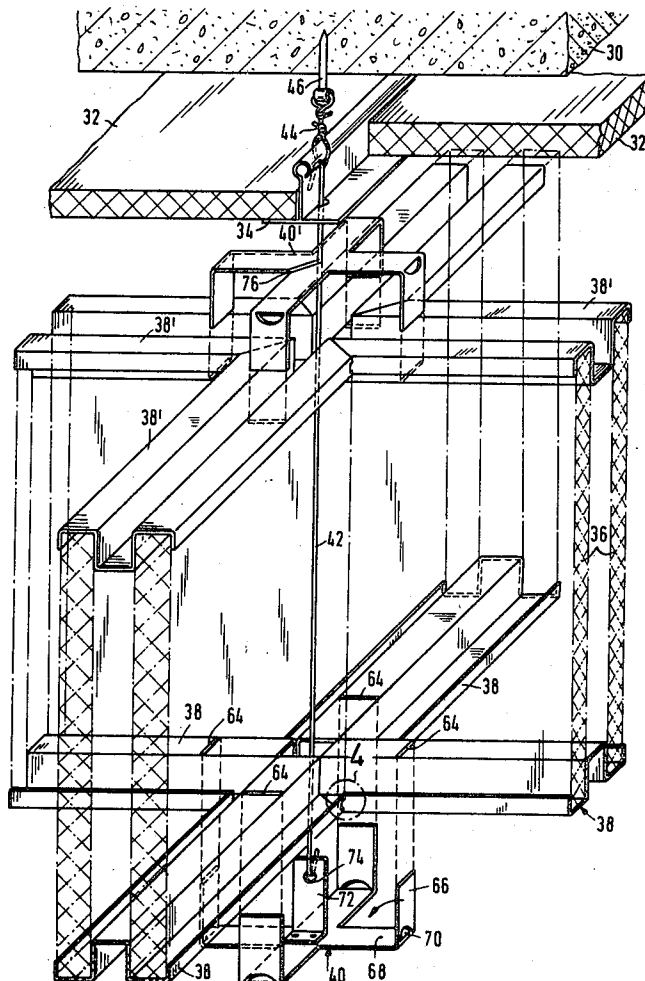
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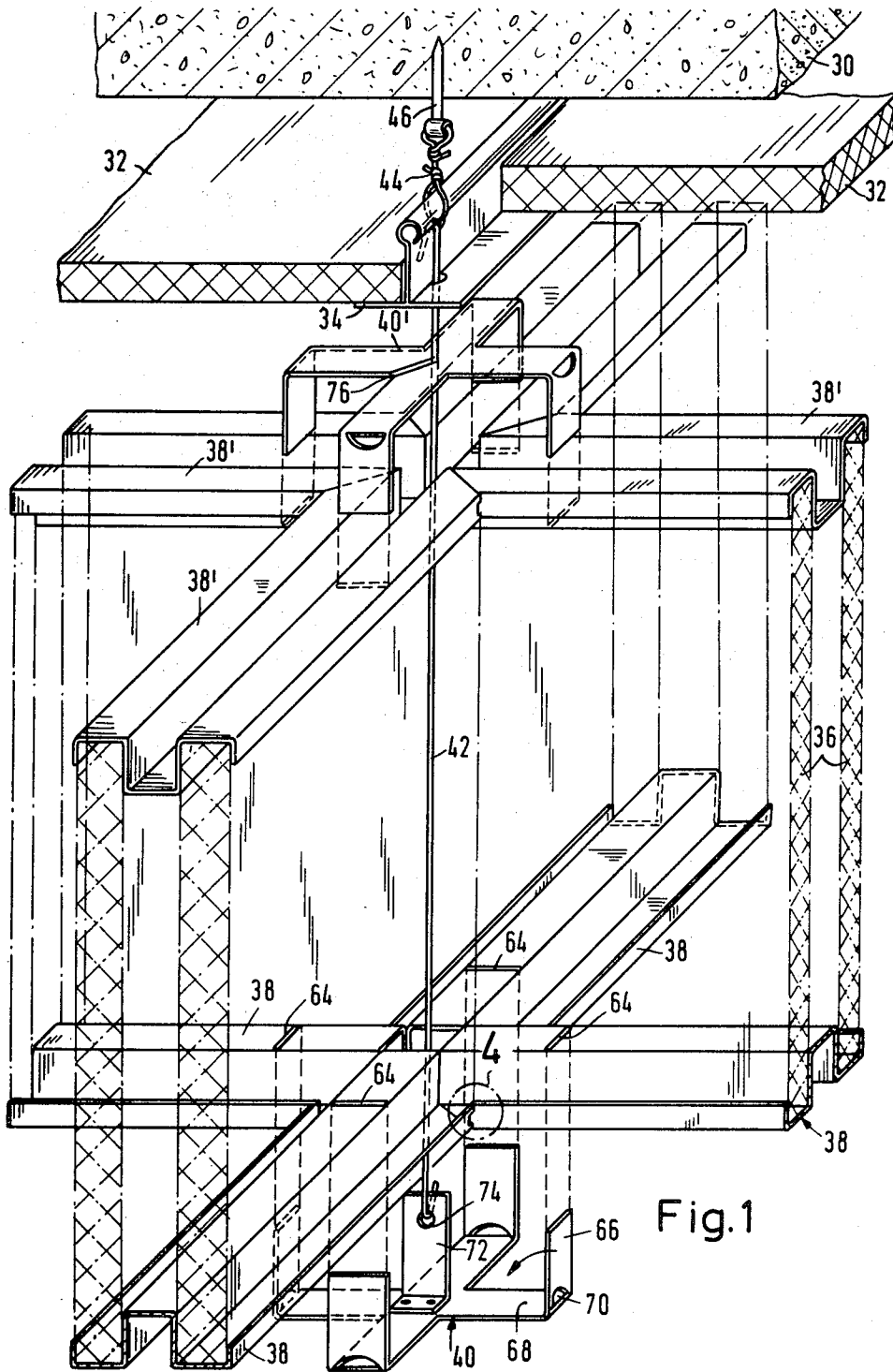
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[57] **ABSTRACT**

A sub-ceiling or false ceiling adjoining the underside of a supporting ceiling structure or being downwardly spaced therefrom, the sub-ceiling including a cellular-, eggcrate- or honeycomb-like system of panels arranged in upright planes and held by essentially horizontal rails, said rails being about horizontally suspended from said ceiling structure and comprise a central downwardly open channel-section portion and lateral upwardly open channel section portions, said panels being fitted into and held by said lateral channel-section portions.

9 Claims, 24 Drawing Figures





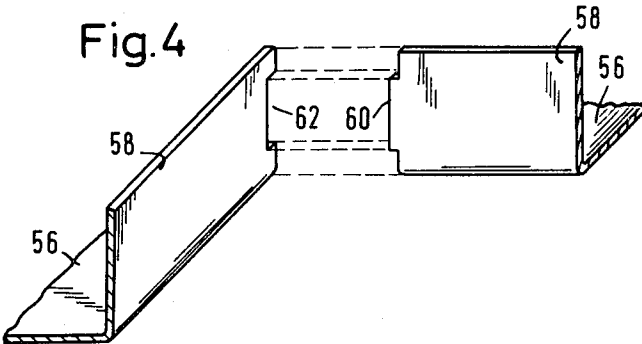
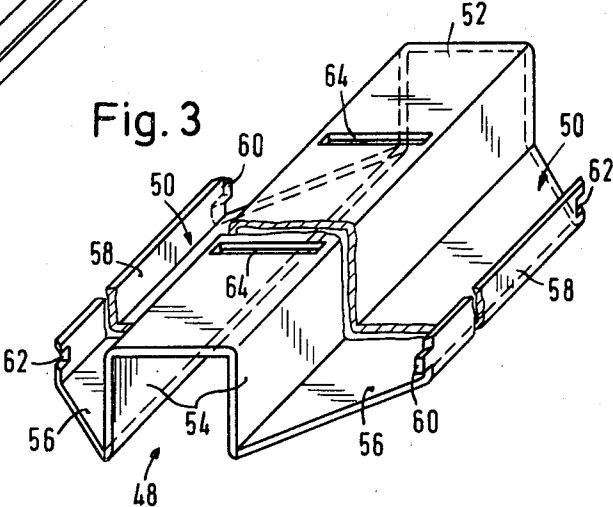
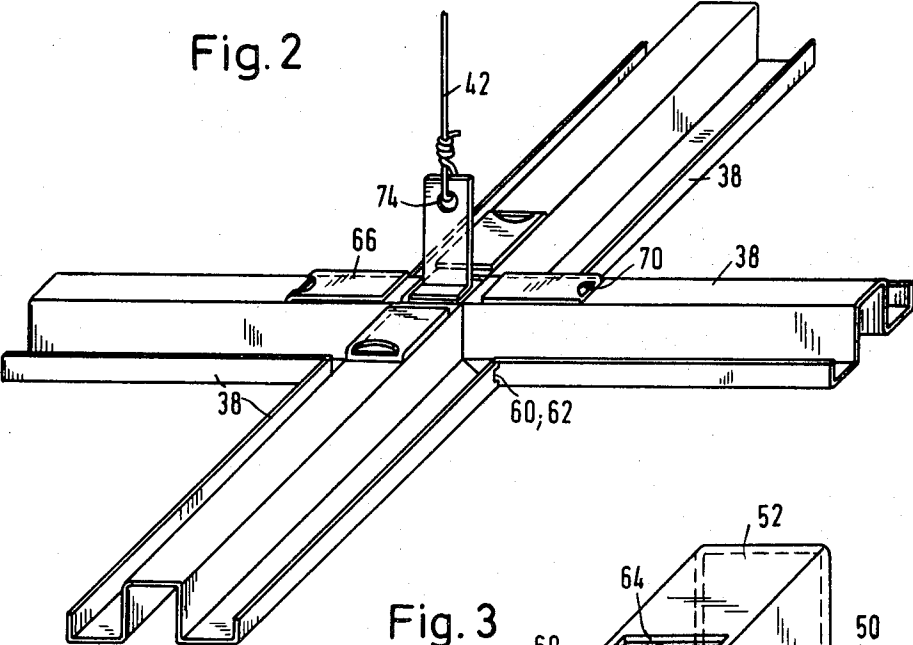


Fig. 5

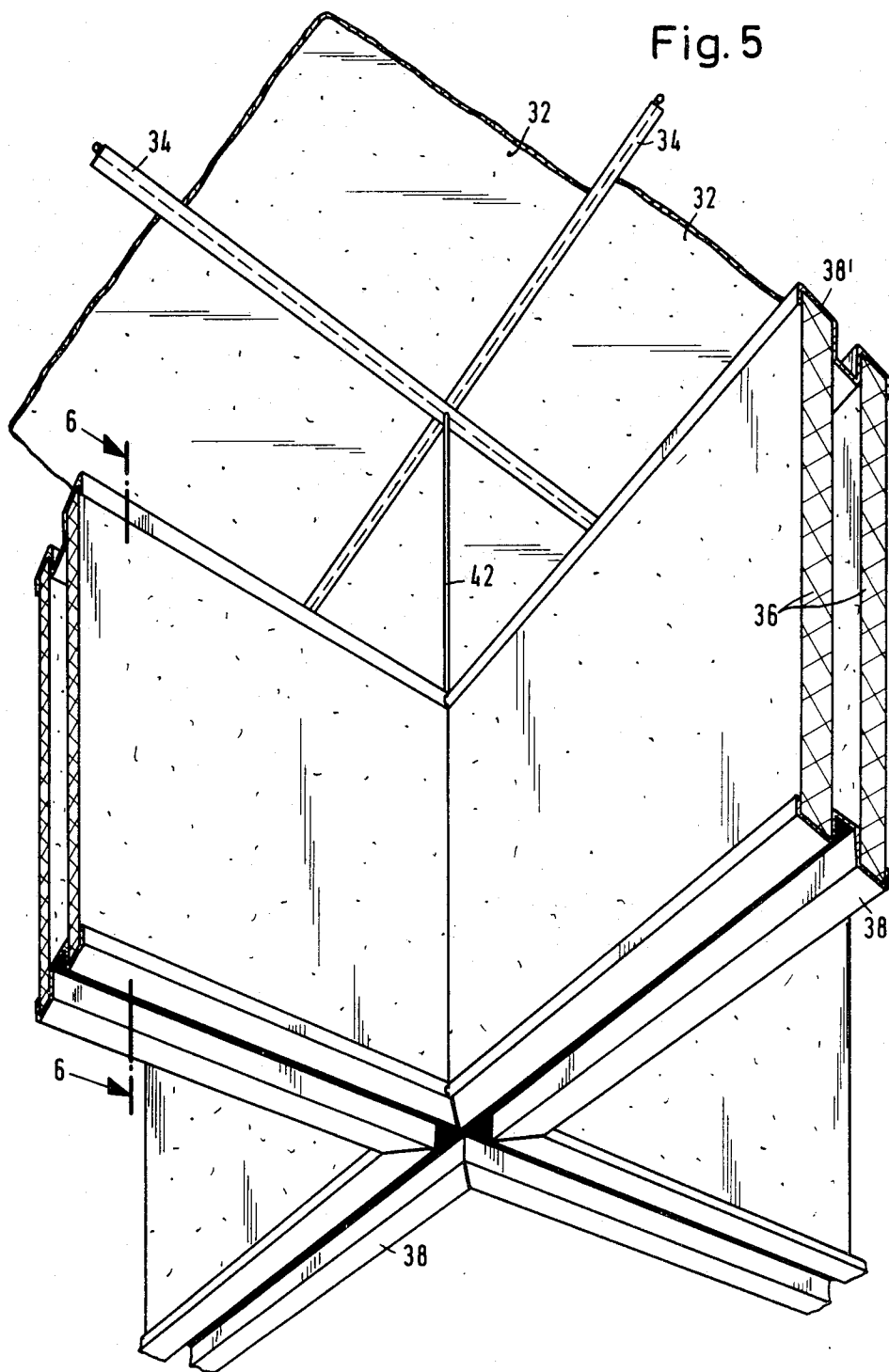


Fig.6

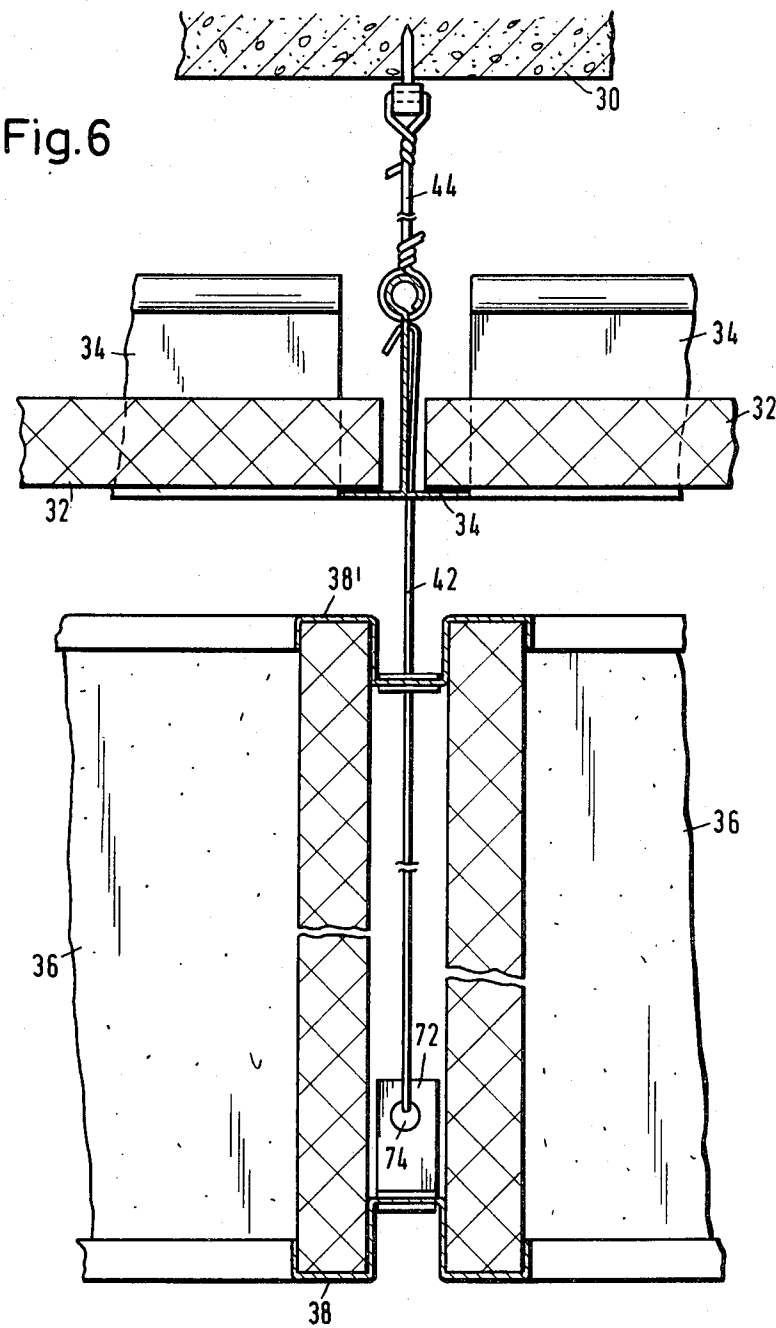


Fig. 7

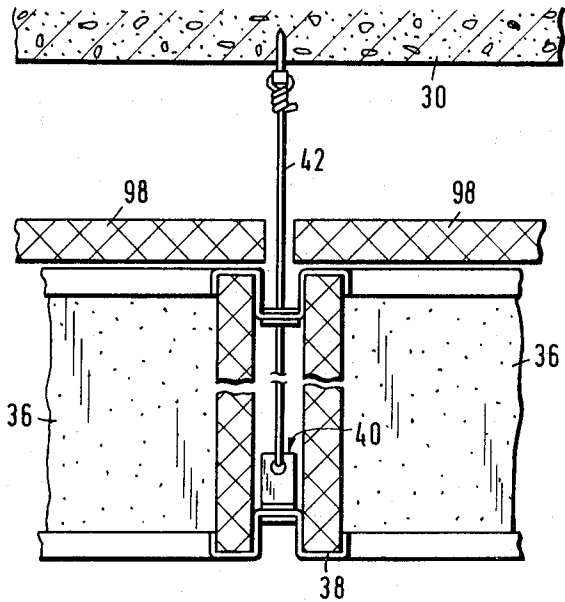
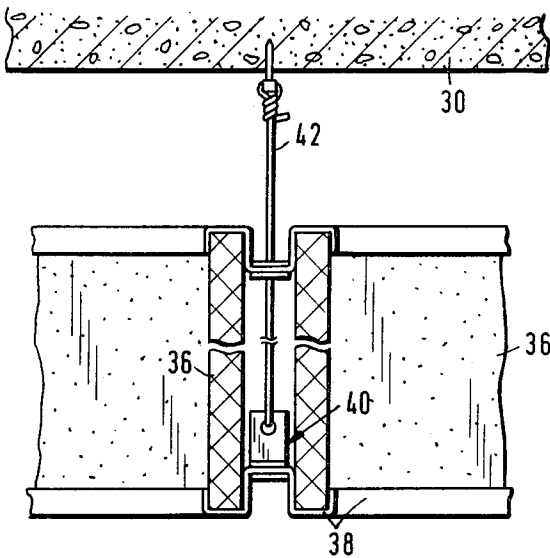


Fig. 8



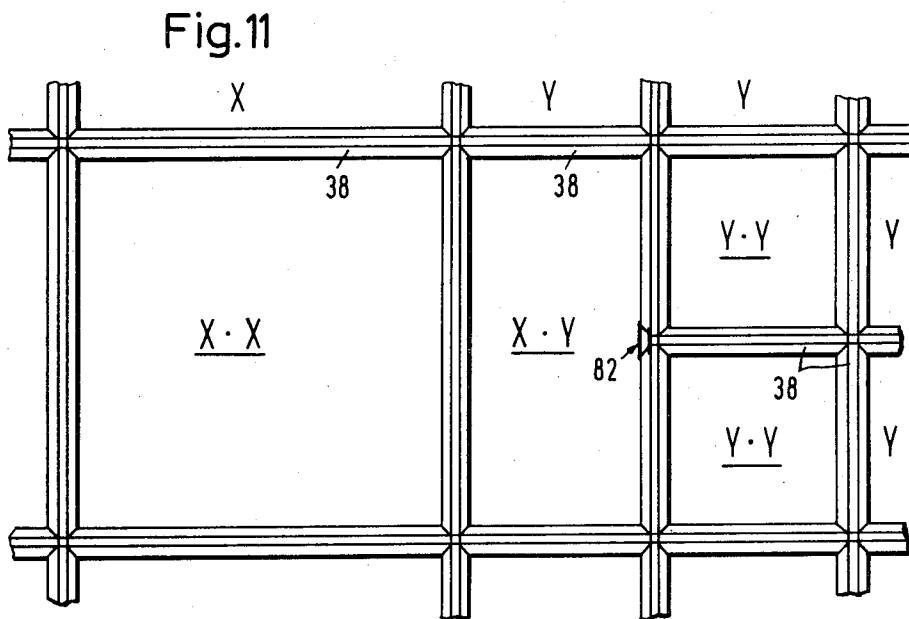
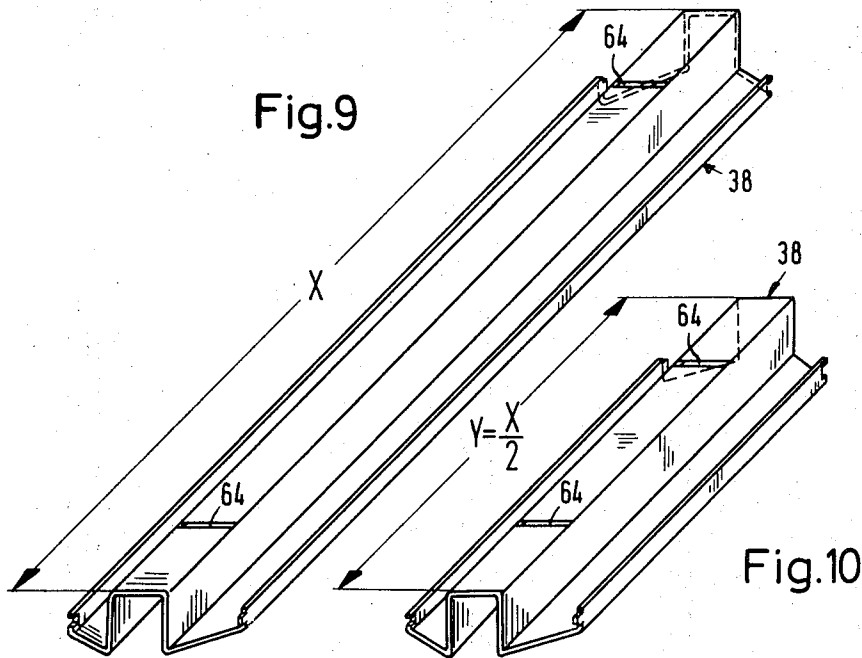


Fig.12

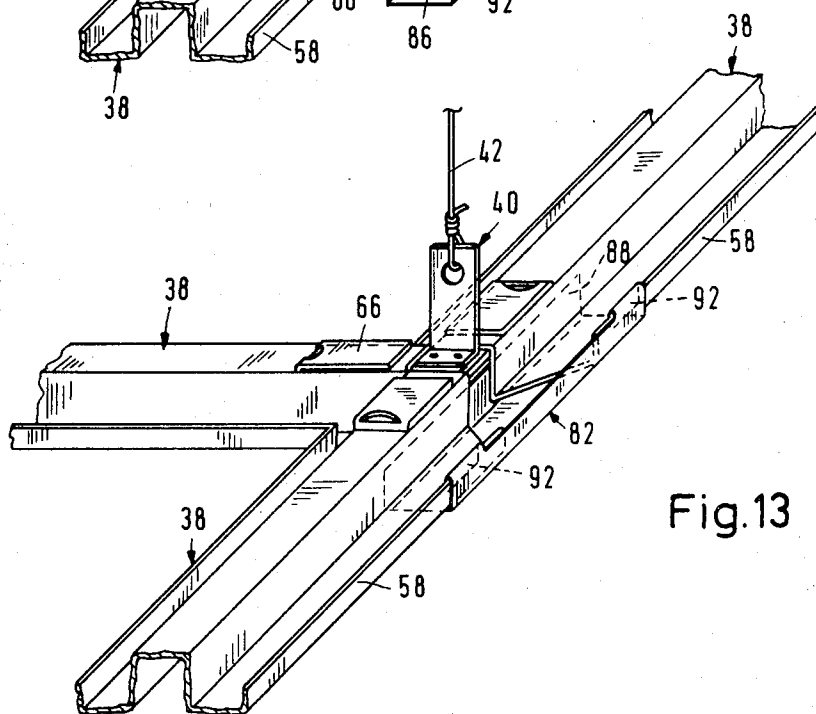
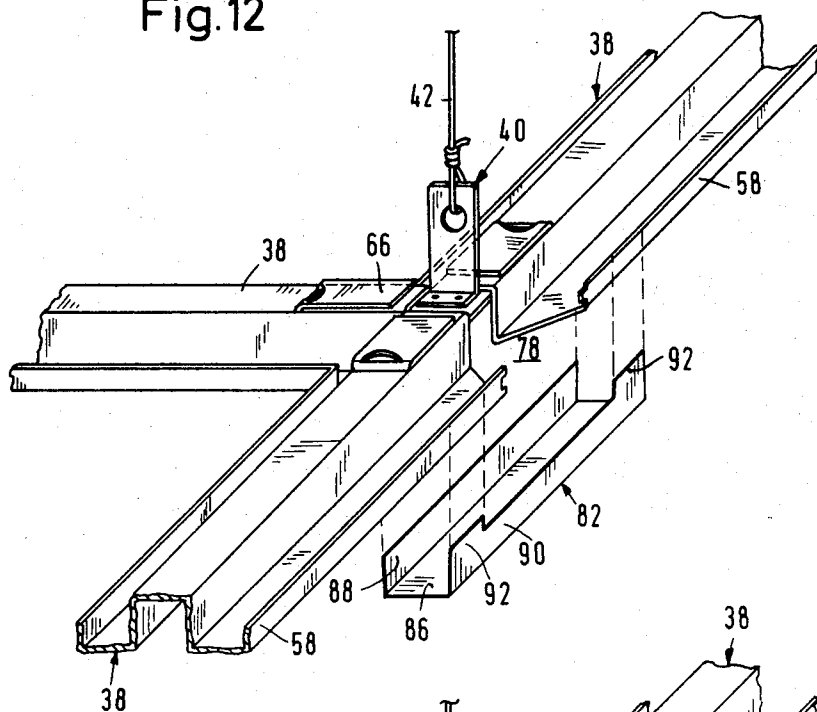


Fig.13

Fig.14

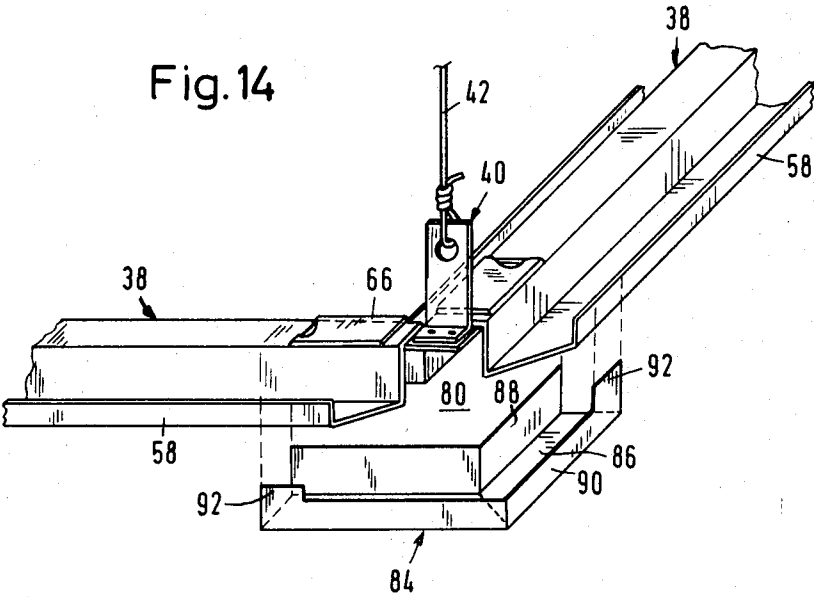


Fig.15

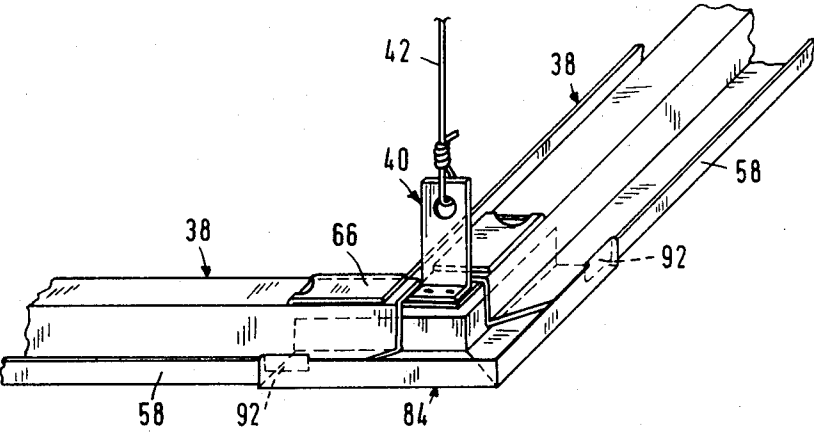
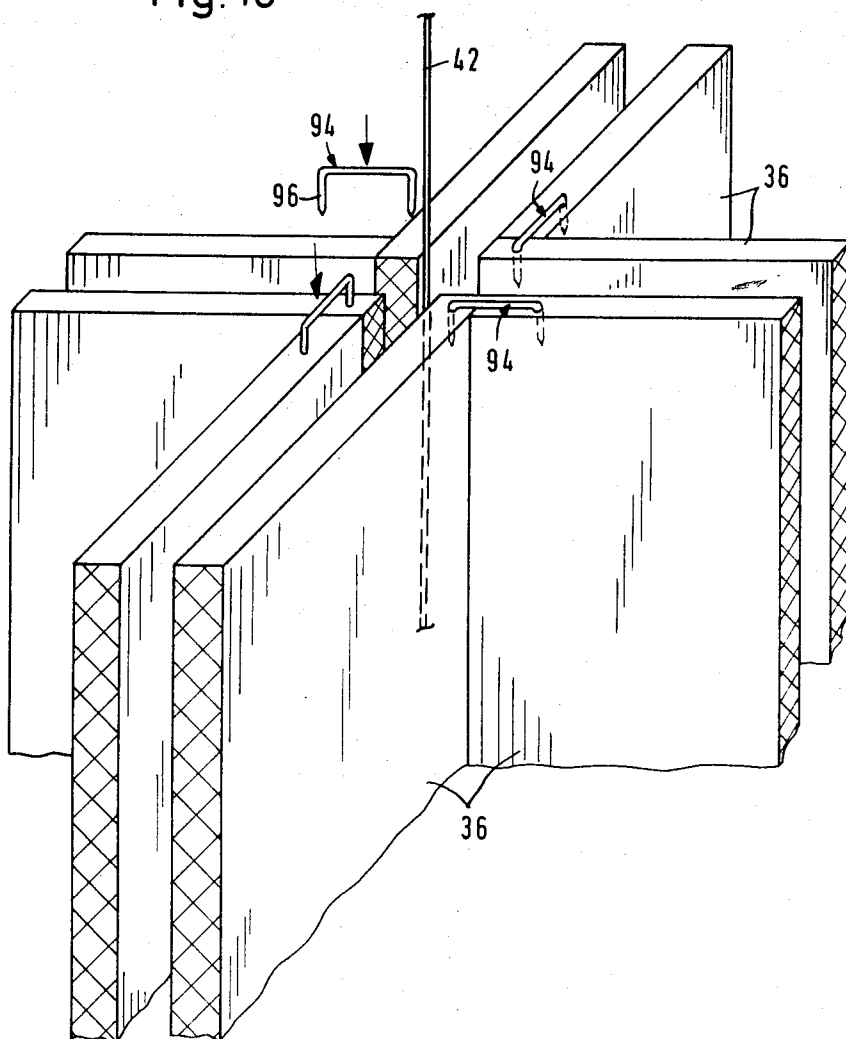


Fig. 16



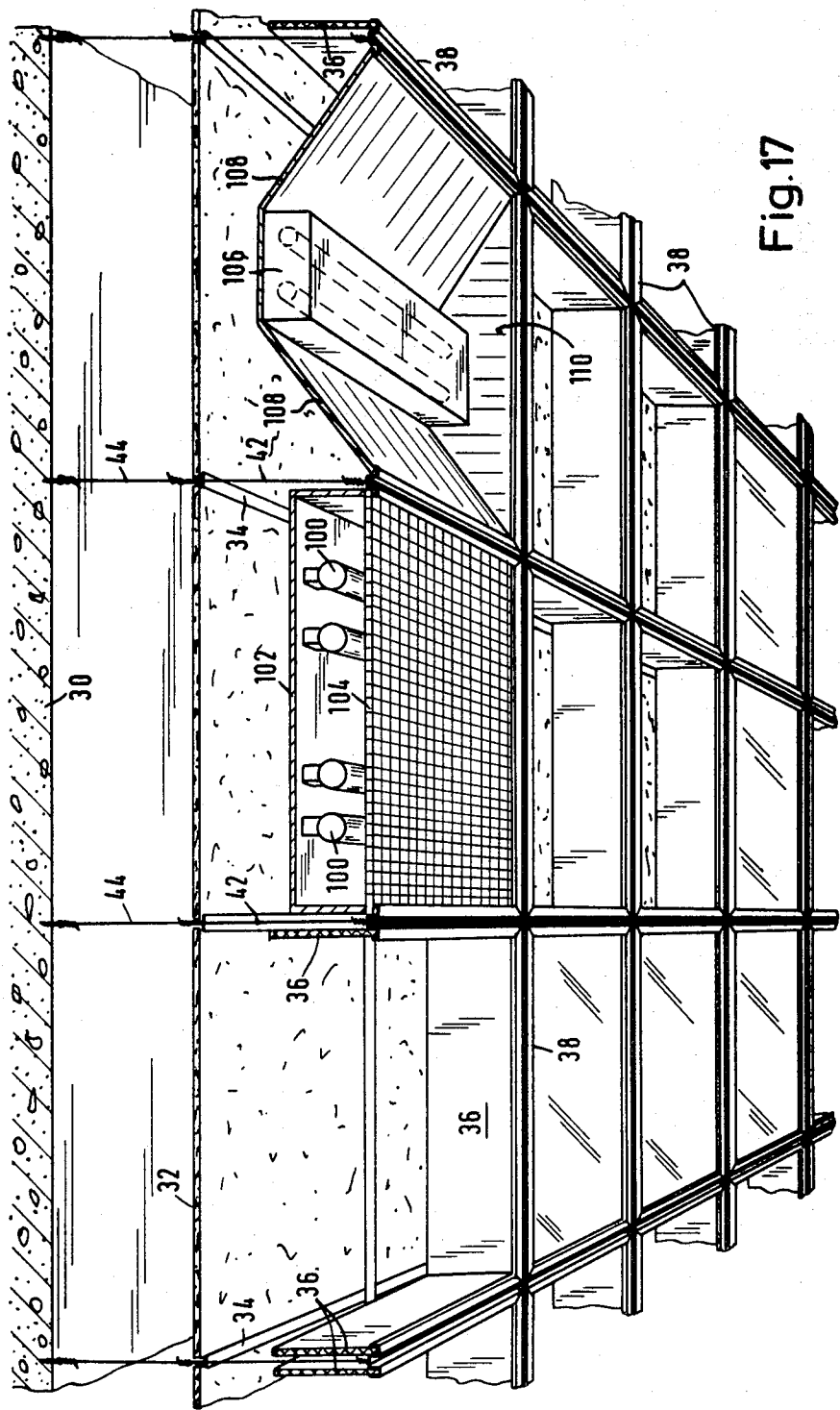


Fig. 17

Fig. 18

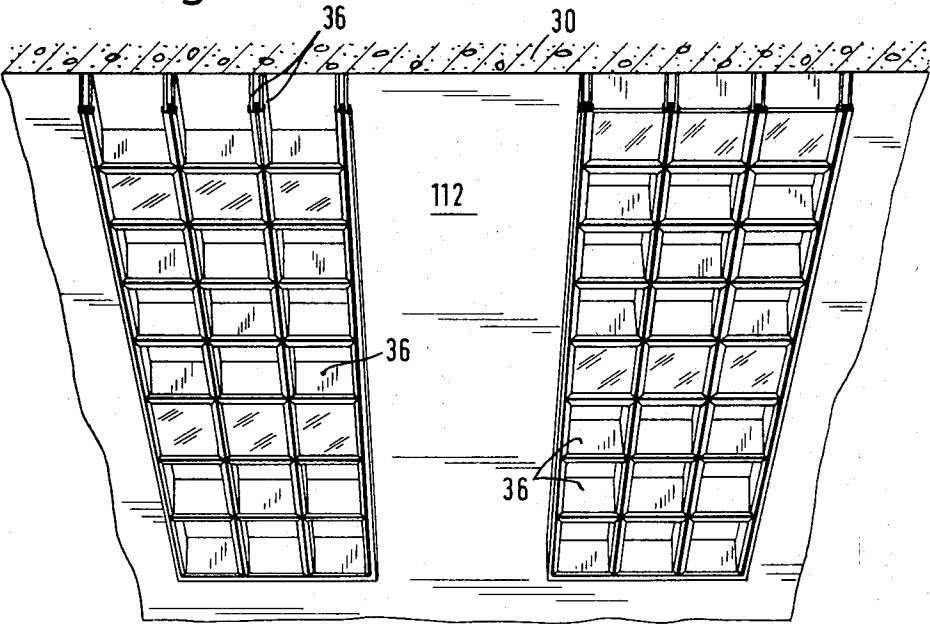


Fig. 19

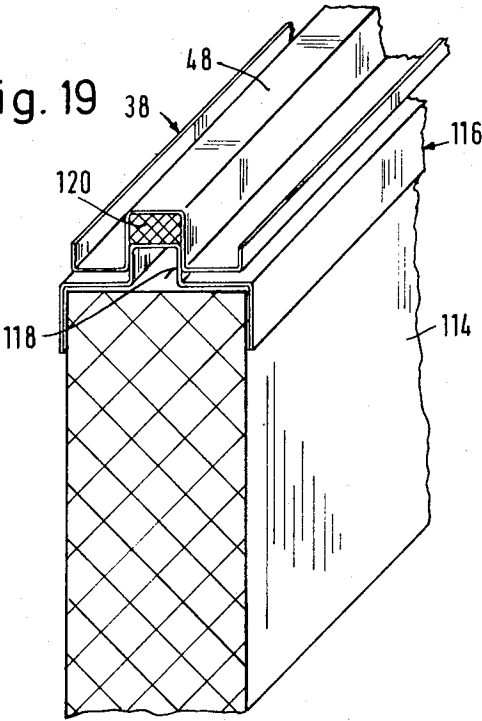


Fig. 20

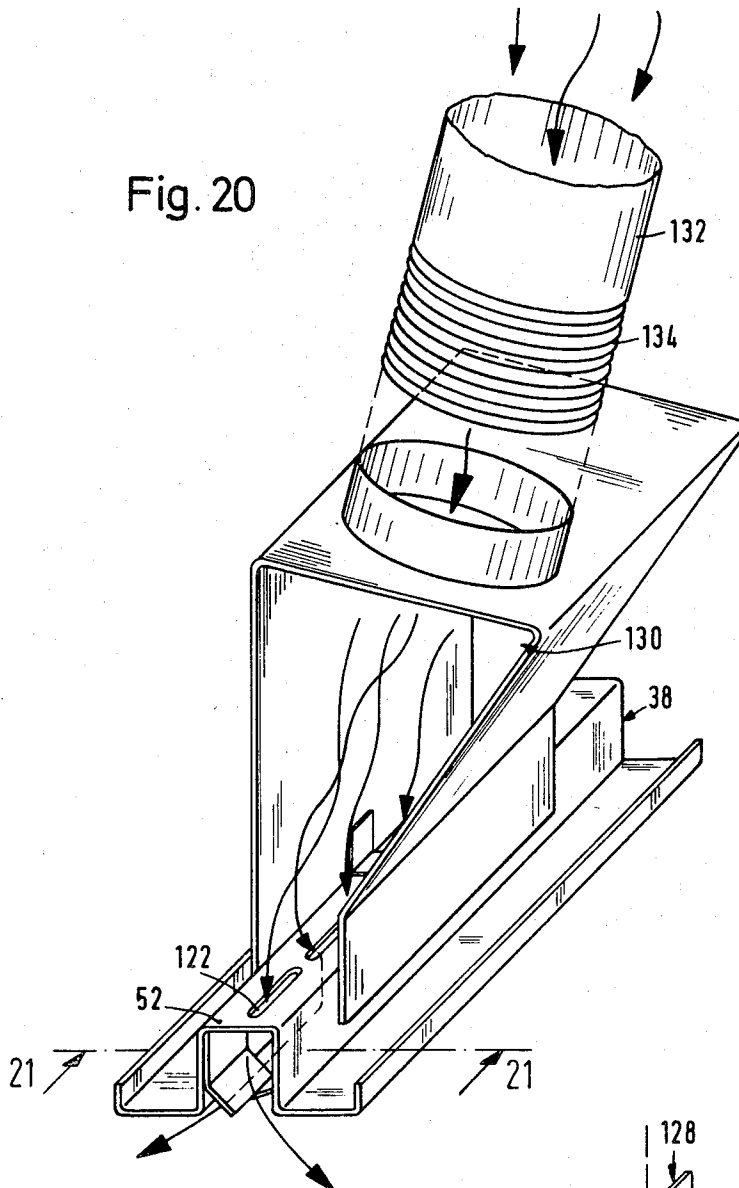


Fig. 21

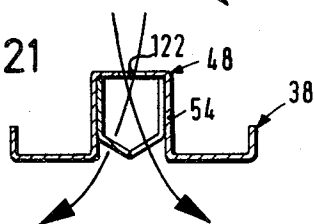
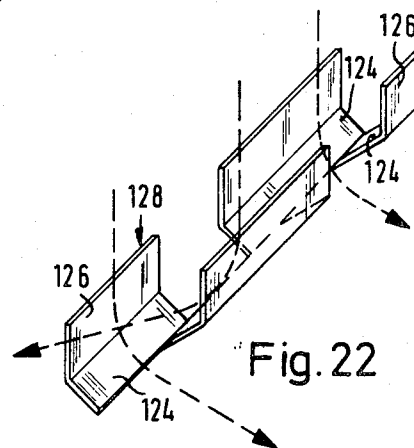
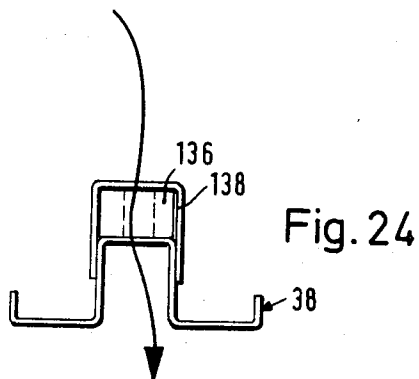
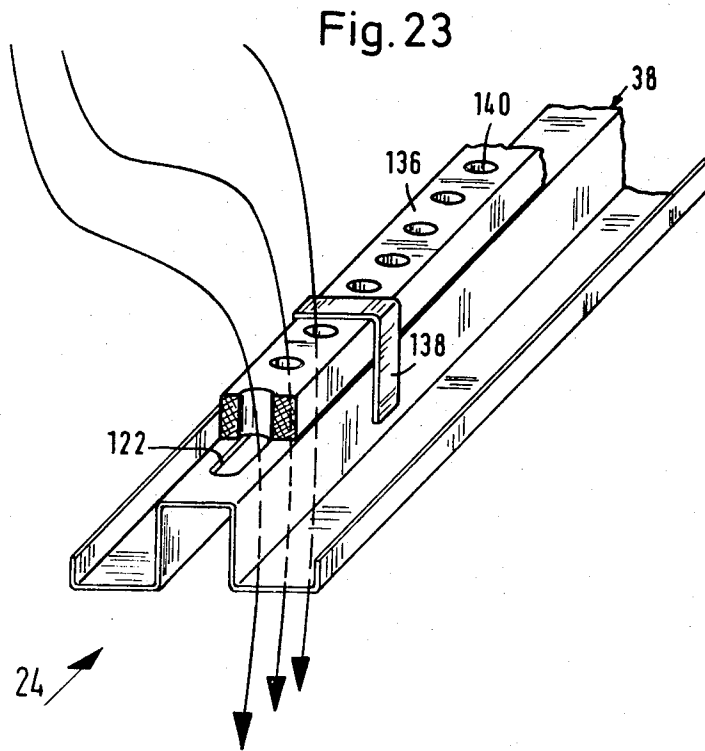


Fig. 22





SUB-CEILING FOR BUILDINGS

The invention relates to a ceiling or, more precisely, a ceiling covering or sub-ceiling for the rooms of buildings, and particularly to a structure of this kind which may be called a honeycomb ceiling, an eggcrate ceiling or a cellular ceiling.

The purpose of this kind of sub-ceiling is mainly to reduce noise to a considerably greater extent than is possible with the normal noise-reducing panels which are laid flat on or below the supporting ceiling structure. This object is achieved by means of a network- or cell- or eggcrate- or honeycomb-system of panels, preferably the so-called noise-reducing panels, which network or system extends substantially vertically from the supporting ceiling structure into the room.

Known systems for such ceilings had to be assembled by the use of troublesome and therefore costly and time-consuming separate or matching operations and such assembling had to be carried out by skilled artisans.

A primary object of the present invention is the provision of a suspension system for honeycomb or the like ceilings and of components of such systems whereby the honeycomb ceiling and its suspension system can be factory-produced, and the ceiling can be built up or assembled in situ by more or less unskilled labor.

Another object of the invention is the provision of special constructions of honeycomb ceiling and components thereof which render the honeycomb ceiling suitable for the fitting of lighting units and ventilation and air-conditioning means.

With the aforesaid and other objects in view, a main feature of the invention consists in the provision of supporting rail units having a central channel section open on one side and adjoining channel sections open in the opposite direction, these latter sections being adapted to receive and hold the edges of the panels arranged in honeycomb fashion.

An important feature of the invention also consists in the provision of cross- or star-shaped connecting and suspension elements which, through end tongues, enter and engage in openings provided in the abutting ends of the supporting rails and hold these together, and are adapted to be connected to an element, as for example a wire, hanging from and being secured to the supporting ceiling structure.

Further features and details of the invention, its advantages, its forms for special purposes etc. will emerge from the following description of some embodiments and from the drawings illustrating these embodiments.

In the drawings:

FIG. 1 is a perspective view, partly in section, of the construction and suspension of a honeycomb ceiling at the point where a number of abutting panels meet, the individual parts, prior to their final connection with other parts, being shown;

FIG. 2 is a perspective illustration of a junction of four supporting rails and of a star-shaped suspension element for connecting them;

FIG. 3 is a perspective illustration of one end of a bearing rail;

FIG. 4 is a fragmentary perspective view of the adjoining ends of two bearing rails prior to their connection;

FIG. 5 shows a perspective view from below of the junction illustrated in FIG. 1, after completion of the assembly;

FIG. 6 is a fragmentary section in the plane of line 5 6—6 of FIG. 5;

FIG. 7 is a section through horizontal ceiling covering panels in an arrangement different from those of FIGS. 1 and 5;

FIG. 8 shows, in a sectional view corresponding to that of FIG. 7, a further variation of the method of suspending the new honeycomb ceiling in relation to the supporting construction;

FIG. 9 is a perspective view of a supporting rail unit;

FIG. 10 is a perspective view of a supporting rail unit which corresponds to but is shorter than that of FIG. 9;

FIG. 11 is a view of various combinations of the units illustrated in FIGS. 9 and 10;

FIG. 12 is a fragmentary perspective view of an edge connection involving three supporting rails, with a covering element not yet brought into position;

FIG. 13 illustrates the edge connection of FIG. 12 after securement of the covering element;

FIG. 14 is a fragmentary perspective view of two supporting rails meeting at the outside corner of a honeycomb sub-ceiling and of a corner covering element not yet secured in place;

FIG. 15 shows the corner connection of the bearing rails illustrated in FIG. 14 securement of the corner covering element;

FIG. 16 is a fragmentary perspective view of a modified form of the connection of the upper corners of adjacent panels, this arrangement avoiding the use of the upper retaining rails illustrated in the previous embodiments;

FIG. 17 is a fragmentary schematic perspective view of a honeycomb ceiling with various means for fitting lighting units therein;

FIG. 18 is a fragmentary schematic perspective view of a ceiling covering of the invention divided into a plurality of honeycomb groups;

FIG. 19 is a fragmentary sectional perspective view of the connection of a bearing rail to a wall adjoining it from underneath;

FIG. 20 is a fragmentary perspective view of the form of a supporting rail used for ventilation, air-conditioning or heating purposes;

FIG. 21 is a section on line 21—21 of FIG. 20;

FIG. 22 is a fragmentary perspective view of the sheet-metal, cooling baffle fitted into the supporting rail shown in FIGS. 20 and 21;

FIG. 23 is a fragmentary perspective view of a supporting rail comprising adjustable air-vents; and

FIG. 24 is an end view of the arrangement illustrated in FIG. 23 seen in the direction of the arrow 24 in the latter figure.

FIG. 1 shows a supporting ceiling structure 30, at a short distance below which horizontal covering panels 32 are suspended by means of rails 34 of inverted T-section. At a short distance below the panels 32 there is a honey-comb system comprising pairs of vertical panels 36, the panels of each pair being separated by a small space. These panels 36 are supported along their lower edges by rails 38. The upper edges of the panels 36 can be held by corresponding upper rails 38'. The adjacent ends of the rails 38 are supported by star-

shaped elements 40 which, in turn, are supported by means of wires 42 extending from and attached to the ceiling structure 30, possibly by way of the rail 34 and with the help of an intermediate wire 44 and a bolt 46 shot into the ceiling 30. As can be seen from FIGS. 1 and 6, the wire 42 can be simply suspended by its upper end, bent into the form of a hook, in an opening in the web of the supporting rail 34 for the horizontal panels 32 and may pass through an opening in one of the flanges of rail 34. The other supporting rails 38 are held together at the point where they meet by means of a cross- or star-shaped element 40' similar to element 40.

Each of the rails 38 is bent from sheet-metal in such a way that it has a central channel 48 opening downwards and two lateral channels 50 opening upwards. Channel 48 is formed by a web or bottom wall 52 and sidewalls 54, whereas the lateral channels have a web or bottom wall 56, a sidewall 54, common to the central channel, and an outer sidewall 58 of reduced width or depth.

When the rails 38 are arranged at right-angles to each other, the edges defining the ends of the bottom walls 56 of their outer channels 50 extend at an angle of 45° to the longitudinal directions of the rail in question, whereas the end edges of the bottom wall 52 of their central channels 48 run at right-angles to such longitudinal directions.

As can be seen from FIGS. 3 and 4, the outer walls 58 are provided at their diagonally opposite ends with matching projections 60 and recesses 62, respectively. Upon fitting together the adjacent ends of rails 38, in the arrangement shown in FIGS. 1 and 2 for example, projection 60 on one rail 38 extends into a complementary recess 62 in an adjoining rail 38, so that the horizontal walls 58, which can be seen particularly clearly from below, are brought into precise alignment with each other so that no objectionable unsightly gaps or shoulders occur at the junctions.

The central bottom walls 52 of the supporting rails 38 (or 38') are provided with a transverse slot 64 each at a certain distance from their end. Upwardly angled-off ends 66 of cross- or star-shaped supporting elements 40 (or 40') extend through these transverse slots 64. Those ends 66 are then bent over, as shown in particular in FIG. 2, to establish a permanent connection. To facilitate bending along the required lines, section-reducing openings 70 are provided between the ends 66 and the adjacent portions 68 of the star-shaped elements 40. At their middle, the elements 40 are provided with or connected, e.g. spot-welded, to a lug 72. A supporting wire 42 extends through and is secured in a hole 74 in this lug 72.

Obviously, the adjacent ends of rails 38 can be extremely simply interconnected by means of the star-shaped elements 40 by unskilled labor and can be suspended from the supporting ceiling structure by means of the wires 42, the mutual alignment of the ends being achieved practically automatically by means of the projections 60 and recesses 62. The various suspension means for the rails can be aligned by using suspension wires 42 of appropriate lengths, and if necessary these wires can be shortened or lengthened within the limits in question by providing loops in the wire or by straightening out existing loops. The lugs 72 or special elements (not shown) combined with the wires may also be used for vertical alignment purposes.

The upper rails 38' may be identical to the lower rails 38. The star-shaped elements 40' which hold the upper rails 38' together differ from the lower elements 40 in that they do not have a lug 72 but instead are provided with slots 76 whereby they can be pushed from the side over wire 42 before being pushed downwards so that their ends enter the slots in rails 38'.

An important feature of the novel structure resides in the fact that, as illustrated particularly in FIG. 5, the underside of central bottom wall 52 is given a very dark, preferably black, coating; the same coating is applied to at least the underside of the star-shaped elements 40. This renders the connections between rails 38 and the arms 68 of elements 40, resting against those bottom walls 52, practically invisible, so that no additional measures are required for masking the junctions between adjoining rails and the connections of the rails to the star-shaped elements 40. While the dark coloring on rails 38 is preferably limited to the underside of their bottom walls 52 or to this underside and the inside surfaces of the adjoining sidewalls 54, it has been found that, for manufacturing reasons, it is best to paint the whole of each star-shaped element dark or black, although this has not been shown in the drawings in order to illustrate the form of the star-shaped elements more clearly.

A large number of possible arrangements, not requiring the rails to be cut to length individually on the building site, can be obtained by factory-manufacture of a number of different standard length of rail 38 (or 38') as they are illustrated in FIGS. 9 to 11. Even two standard lengths only, one length X and a second length $Y = X/2$, offer a large number of possible arrangements and combinations, some of which are illustrated in FIG. 11. Here, as also seen in FIG. 11, it will be observed that different arrangements can be used for one and the same ceiling in different regions thereof.

Special forms of connections for the rails 38 along the outer edges or at the corners of a sub-ceiling are illustrated in FIGS. 12 to 15. These formations avoid the use of special rails for those locations where not four, but only three rails 38 meet at the edge (FIGS. 12 and 13) or where only two rails meet at a corner (FIGS. 14 and 15). Firstly, for the purpose of suspending the rails at such locations, use is made of star-shaped elements 40 and 40' similar to those employed for the junctions involving four rails, as illustrated in FIGS. 1 and 2, but with the difference that one arm or two arms 66, 68, respectively, of the star-shaped element 40 concerned is or are simply cut off with a pair of ordinary sheet-metal shears. Star-shaped elements reduced in this way may of course also be supplied direct from the factory.

However, when using standard-length rails 38 having the ends of their outer bottom walls 56 cut at an angle, troublesome and therefore inadmissible gaps 78 and 80 would be left between the ends of adjacent rails 38, as can be seen from FIGS. 12 and 14. According to the invention, these gaps are covered by separate straight fit-on parts 82 (FIGS. 12 and 13) or angle-shaped fit-on parts 84 (FIGS. 14 and 15). These parts 82 and 84 are formed as channels having a bottom wall 86, an inner-side wall 88 and an outside wall 90. The widths of these walls correspond substantially to the widths of the walls 54, 56 and 58 of the channels 50 of the rails 38. The ends of the outer wall 90 of the parts 82 and 84 are provided with upwardly extending tabs 92, which, as

seen from FIGS. 13 and 15, are adapted to be bent over and around the upper edges of channel-walls 58 so as to secure the parts 82 and 84 to the supporting channel-section rails 38. The parts 82 and 84 are made of very thin material, e.g. soft sheet steel, so that the tabs thereon can be easily bent over by hand. Because of their small thickness, the parts 82 and 84 hardly stand out and are therefore scarcely visible after having been properly fitted. Just as the channels 38 and 38' and the star-shaped elements 40 and 40' are painted, lacquered or otherwise surface-treated in the factory, the parts 82 and 84 are also given a suitable surface-treatment at the factory so that painting or other surface-treatment is not necessary when or after they are fitted to the rails at the building site.

Instead of holding the upper edges of the panels 36 by means of channels 38' and star-shaped elements 40', it is often sufficient simply to hold the panels together along their upper adjacent corners by means of U-shaped wire clips 94 or the like, the free portions 96 of which can be pressed into the top faces of the panels 38, as shown in FIG. 16.

Instead of, as shown in FIGS. 1, 5 and 6, arranging the vertical panels 36 at a distance from the horizontal panels 32 disposed below the supporting ceiling structure 31, one of the arrangements shown in FIGS. 7 and 8 may also be employed. In these latter two arrangements, the vertical panels 36 are suspended directly from the supporting ceiling 30 without any horizontal panels 32 being suspended therebetween. In the arrangement shown in FIG. 7, the horizontal panels 98 rest directly on the upright panels 36, whereas in the system shown in FIG. 8, the supporting structure 30 itself constitutes the upper enclosure. It is of course possible to use at different locations, in one and the same room, any combination of the various arrangements illustrated in FIGS. 1, 5, 6, 7 and 8.

As can be seen from FIG. 17, the new ceiling covering system is particularly suitable for a wide variety of lighting arrangements, which again may be used at various points in the same room. Thus there are, in the center of FIG. 17, lighting conduits 100 provided in a duct 102, the duct being closed at the bottom by a screen or grating 104. This duct plus its screen rests on the supporting rails 38. On the left-hand side of FIG. 17, a lighting unit 106 is supported on inclined plates 108 resting on the supporting rails 38, and from end-walls 110, likewise resting on supporting rails 38.

FIG. 18 shows that certain parts of one and the same ceiling 30 may in accordance with the present invention, be fitted with suspended upright panels 36 whereas intermediate portions 112 of the ceiling are kept free of such panels.

FIG. 19 illustrates schematically the use of one of the supporting rails 38 for fitting a dividing wall 114. The upper margin of the dividing wall 114 is equipped with a downwardly facing U-shaped rail 116. This rail has a central longitudinal projection or ridge 118 which extends into the central channel 48 of the supporting rail 38. A seal 120 may be fitted between the channels 118 and 48.

FIGS. 20 to 22 illustrate the use of the new supporting rail 38 for ventilation and heating purposes. The bottom wall 52 of the central channel of this rail 38 is provided with slots of holes 122. The channel 48 con-

tains air baffle plates 124 which are formed on a continuous sheet-metal strip 128 inserted into channel 48 and secured, e.g. welded, by its sidewalls 126 to the sidewalls 54 of the channel 48. For the purpose of supplying or withdrawing air, the central channel 48 of rail 38 is covered by a duct 130 which is connected to an air conduit 132, a flexible connection 134 being preferably interposed.

FIGS. 23 and 24 show how the ventilating slots 122 may be adjusted by means of a slide 136 which is secured to the top of the rail by means of brackets 138 and which can be displaced by suitable means (not illustrated). Slide 136 is provided with holes 140 which, in varying numbers, can be brought into register with the holes 122 in the rail 38, so that a varying amount of air is allowed to pass through.

The materials used in the constructions described and illustrated are generally as follows. The supporting rails 34, 38 and 38' and the star-shaped support elements 40 and 40' are preferably made of a suitable sheet steel and are preferably supplied ready for assembly, i.e. lacquered where necessary, and are provided with the dark or black coating on the base of the central channel 48 of the supporting rails 38. The fit-on parts 82 and 84 can be made of thin, ductile sheet metal, preferably sheet iron, or of another suitable material such as a plastics material. The panels 32, 36 and 98 and the panels 108 and 110, where used, are preferably the commercially available noise-reducing, fire resistant fiber panels. Duct 130, baffle plates 128 and air conduits 132 preferably are likewise made of sheet steel, the baffle plates 128 being preferably fitted into the rails 38 and lacquered at the factory. Other parts not referred to at this point can be manufactured from suitable materials familiar to technicians for the purpose.

While there have been described what at present are believed to be the preferred embodiments of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is aimed, therefore, to cover in the appended claims all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In a sub-ceiling suspended beneath a supporting ceiling structure, a honeycomb-like system of panels arranged in upright vertical planes and held in place by essentially supporting rails, said panels being spaced a substantial distance from the underlying floor, said rails being suspended from the ceiling structure in a horizontal plane, a first group of said rails comprising a central channel-section portion open downwardly in the direction away from the supporting ceiling and lateral channel-section portions adjacent either side of the central channel-section and open in the opposite direction upwardly, a second group of rails spaced from said first group of rails with the central and lateral channels opening in directions opposite to those of the first group of rails and said panels being fitted into and held by said lateral channel-section portions upwardly of the lateral channel-section to provide a double-faced panel structure formed from the panels with an open area between the panels and above the central channel-section.

2. In a sub-ceiling according to claim 1, in which said supporting rails consist of short lengths of material, the lengths corresponding to the lengths of said panels to be supported, said rails being bevelled at their ends in plan view for the purpose of fitting adjacent rails closely together.

3. In a sub-ceiling according to claim 1 in which said supporting rails have outer walls, said outer walls being provided with projections at diagonally opposite corners of said rails and the two other corners of said rails being provided with mating recesses adapted to receive said projections of adjoining ones of said rails.

4. A sub-ceiling according to claim 1 wherein an ordinary horizontal ceiling covering is suspended from said supporting ceiling structure and said sub-ceiling is suspended from said ceiling covering.

5. A sub-ceiling according to claim 1 having horizontal panels placed on the upper margins of said upright panels.

6. A sub-ceiling according to claim 1 having a lighting unit supported by rails.

7. In a sub-ceiling according to claim 1 the combination with an upright partition wall, said wall having a projection along its upper margin, said projection extending into said central downwardly open channel-section portion of said rail and being held thereby.

8. In a sub-ceiling according to claim 1 in which said

central channel-section portion of said rail has a bottom wall, the latter being provided with ventilation openings.

9. In a sub-ceiling suspended beneath a supporting ceiling structure, a honeycomb-like system of panels arranged in upright vertical planes and held in place by essentially supporting rails, said panels being spaced a substantial distance from the underlying floor, said rails being suspended from the ceiling structure in a horizontal plane, a first group of said rails comprising a central channel-section portion open downwardly in the direction away from the supporting ceiling and lateral channel-section portions adjacent either side of the central channel-section and open in the opposite direction upwardly, a second group of rails spaced from said first group of rails with the central and lateral channels opening in directions opposite to those of the first group of rails and said panels being fitted into and held by said lateral channel-section portions upwardly of the lateral channel-sections to provide a double-faced panel structure formed from the panels with an open area between the panels and above the central channel-section, wherein said central channel-section portion of said rail has a bottom wall, the latter being provided with ventilation openings.

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