United States Patent [19]

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[11] **3,835,614**

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[54] **SUSPENSION SYSTEM**

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[21] Appl. No.: **181,121**

[52] **U.S. Cl.** ..... **52/666,** 52/28, 52/475, 52/484, 98/40 D

[51] **Int. Cl.** **E04b 5/52**

[58] **Field of Search** ..... 52/488, 495, 475, 484, 52/666, 667, 668, 496, 144; 287/189.36 A; 98/40 D, 40 DL, 29, 31, 32

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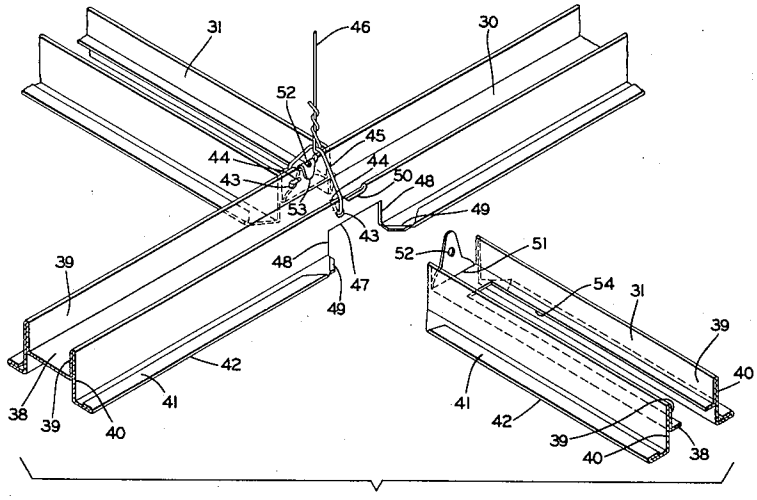
[57] **ABSTRACT**

A suspended ceiling system includes flanged runners having exposed surfaces in planes other than those of the flanges, and may have such runners intersected by similar or different members to form a supporting grid. The spaces between runners or grid members are filled with ceiling panels or light fixtures which may be planar or non-planar shapes, such as recessed truncated pyramids.

Runners having recessed central planes are connected at intersections by lifting a vertical tongue into the space between folded metal sheets of the intersected runner and bending the tongue to lock the joint. Runners having projecting central planes are connected at intersections by cross-shaped inserts which may be weakened to accommodate excessive thermal expansion in case of fire.

Special connecting clips are provided for joining dissimilar grid members and for joining the parts of truncated pyramid frames. Other clips are used to locate partition supporting channels.

2 Claims, 21 Drawing Figures



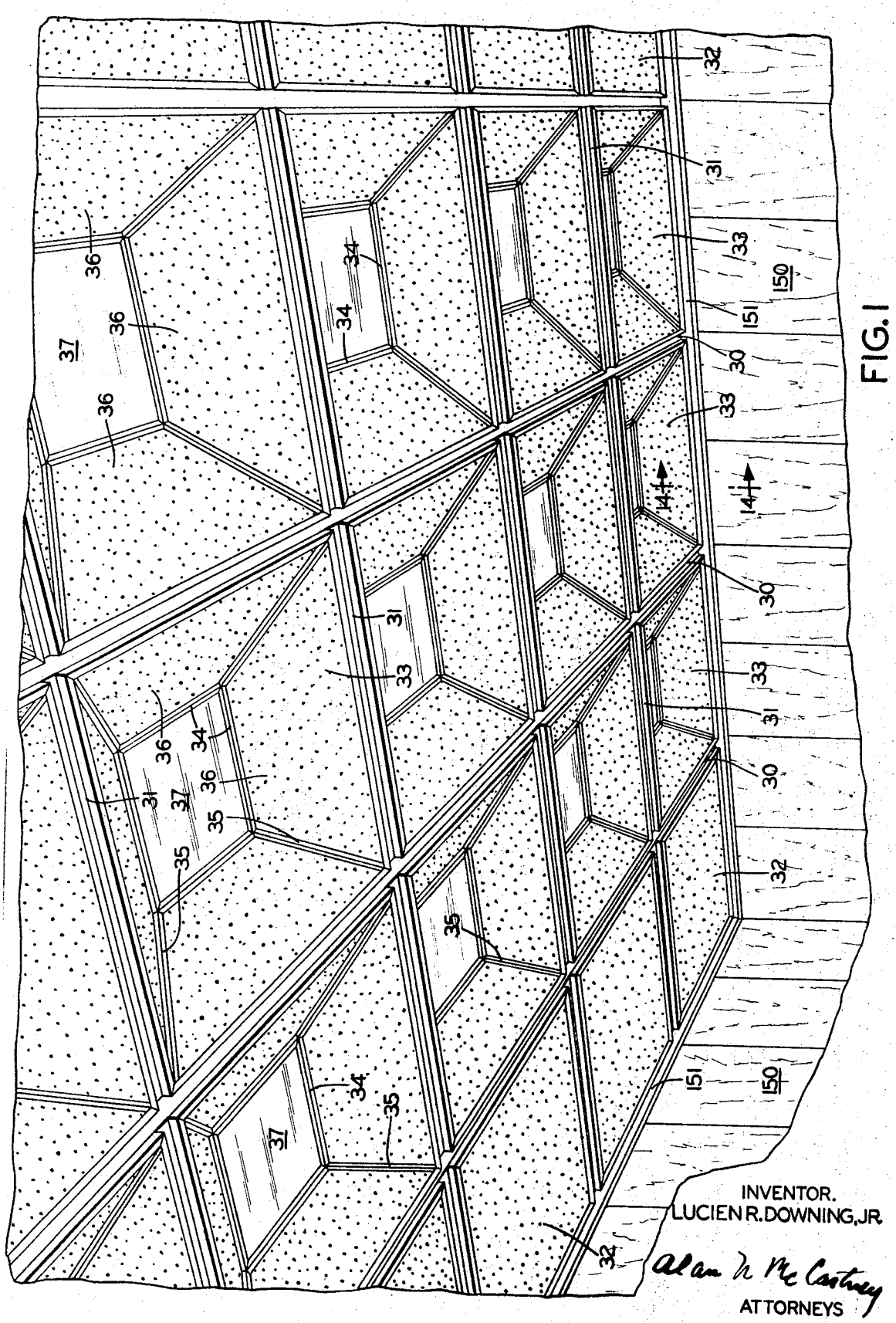


FIG. 1

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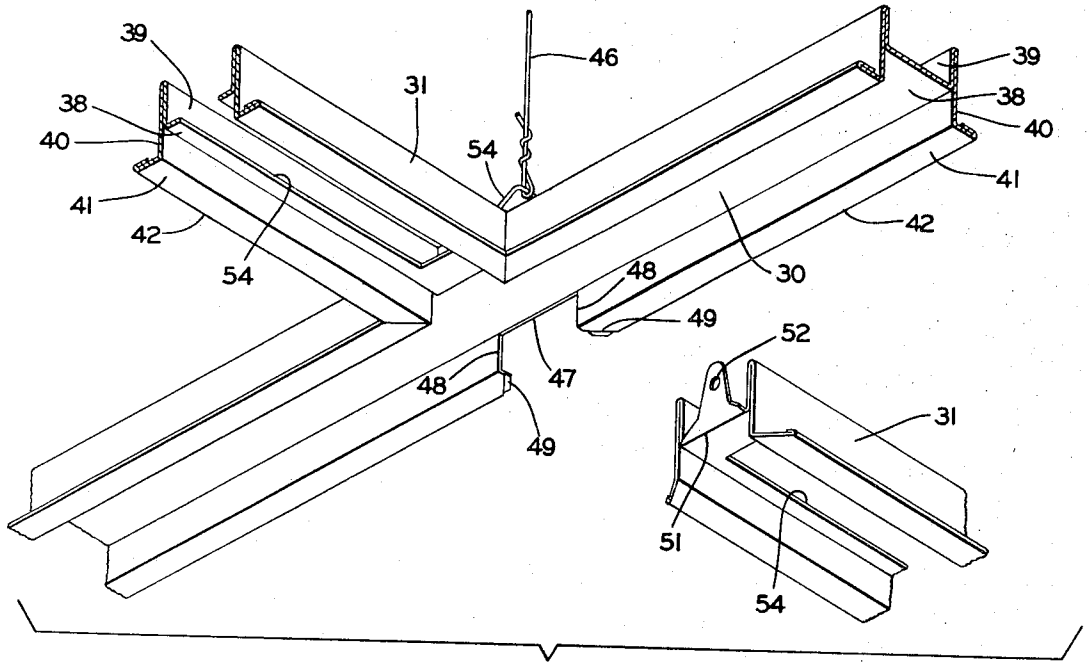

FIG.2

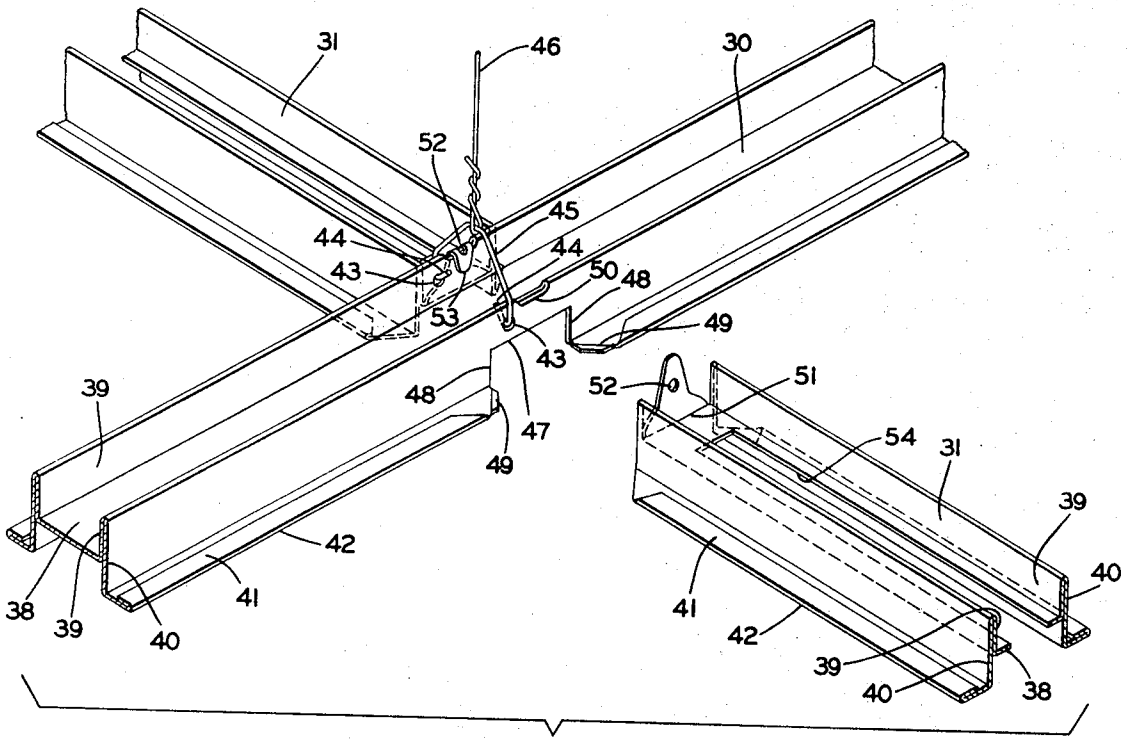

FIG.3

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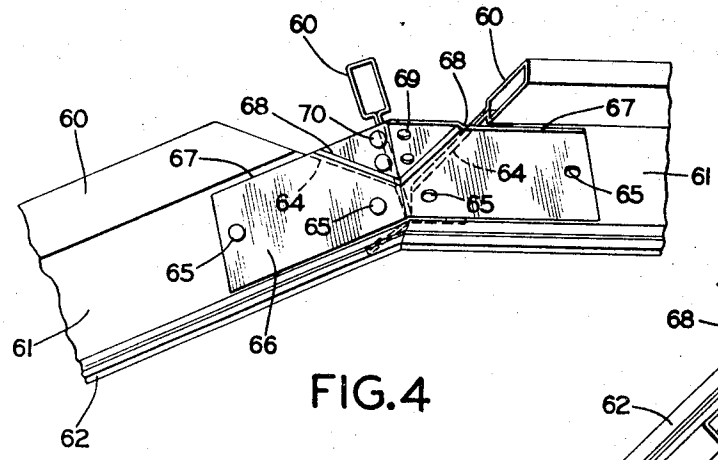

FIG.4

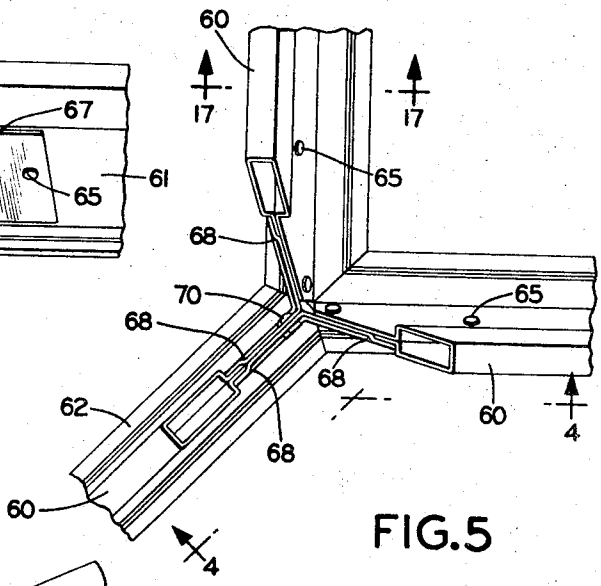

FIG.5

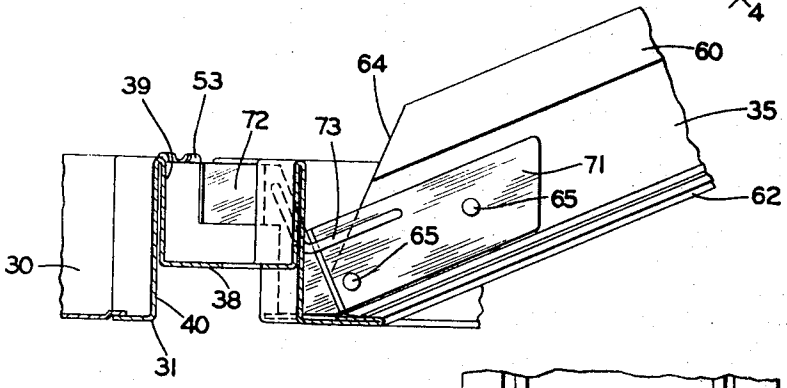

FIG.6

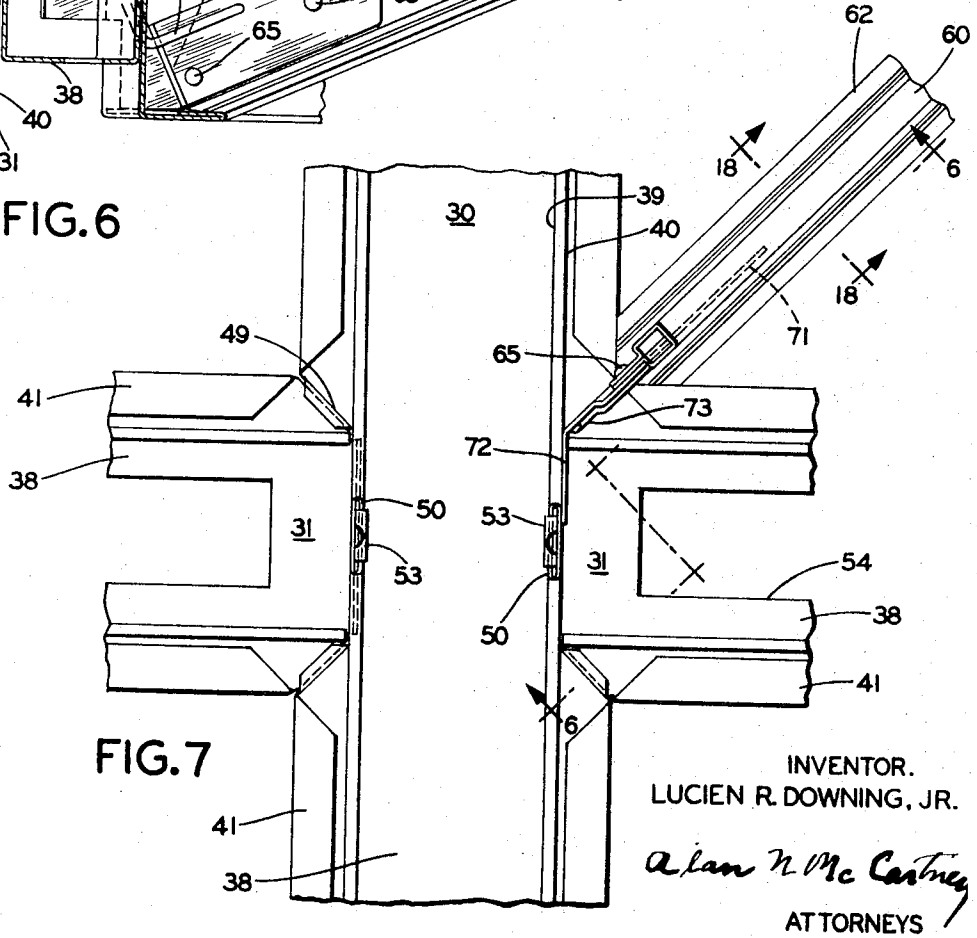

FIG.7

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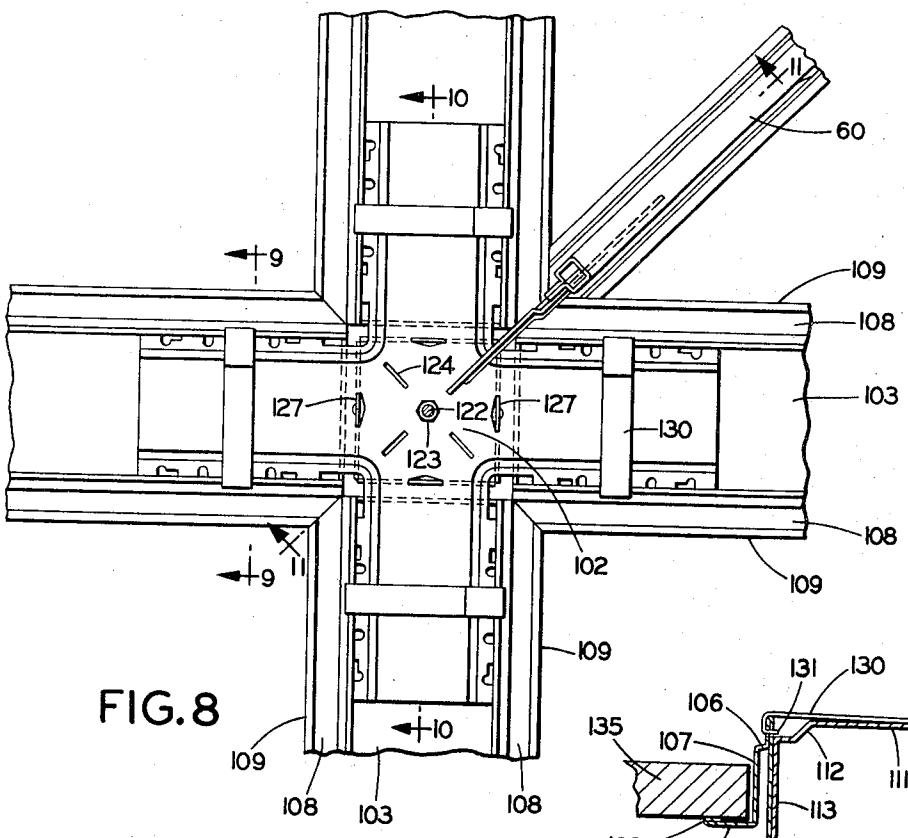

FIG. 8

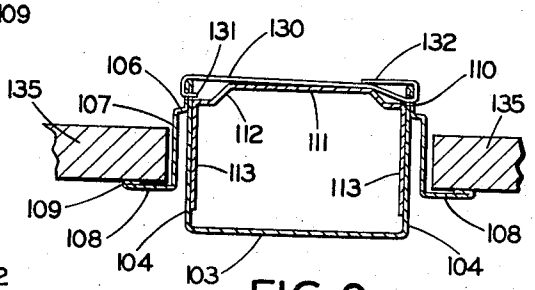

FIG. 9

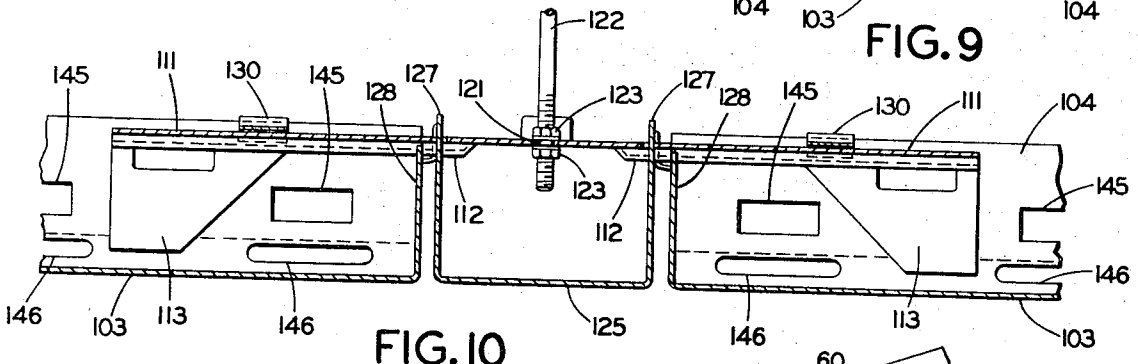

FIG. 10

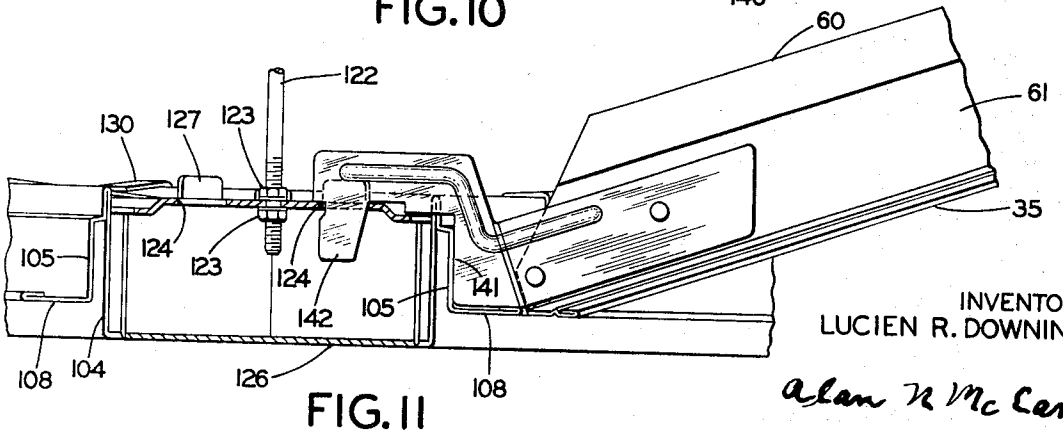

FIG. 11

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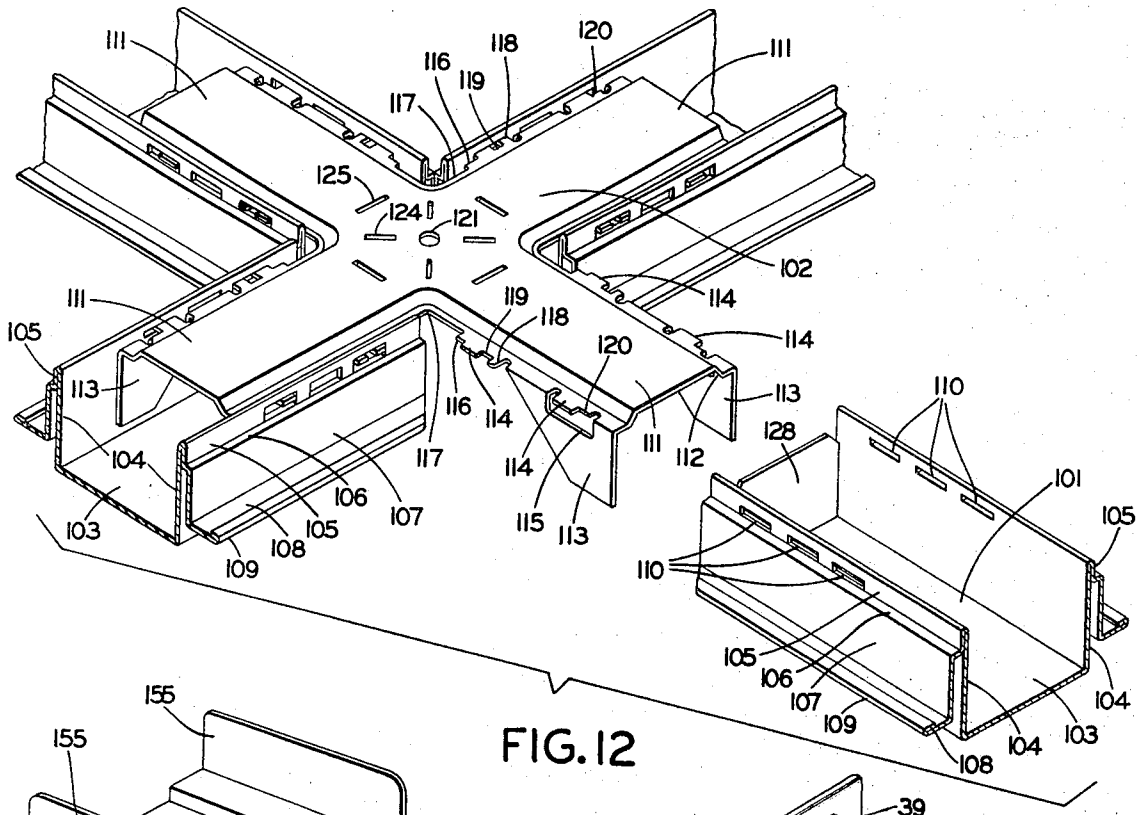

FIG. 12

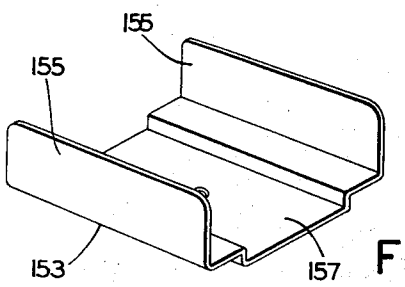

FIG. 15

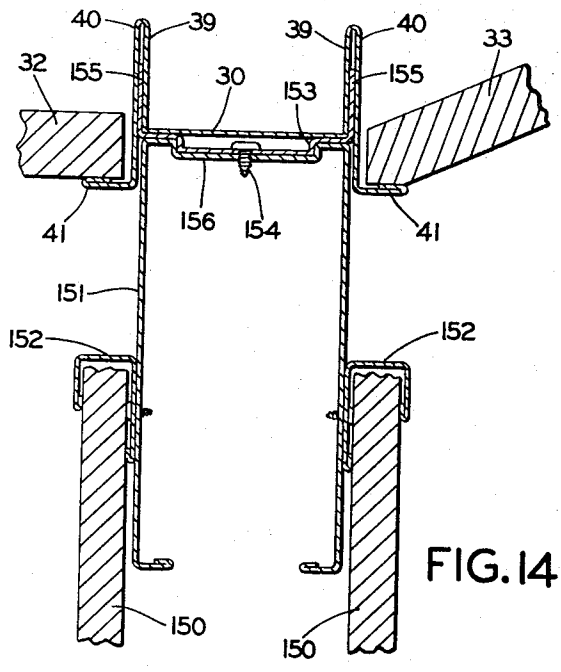

FIG. 14

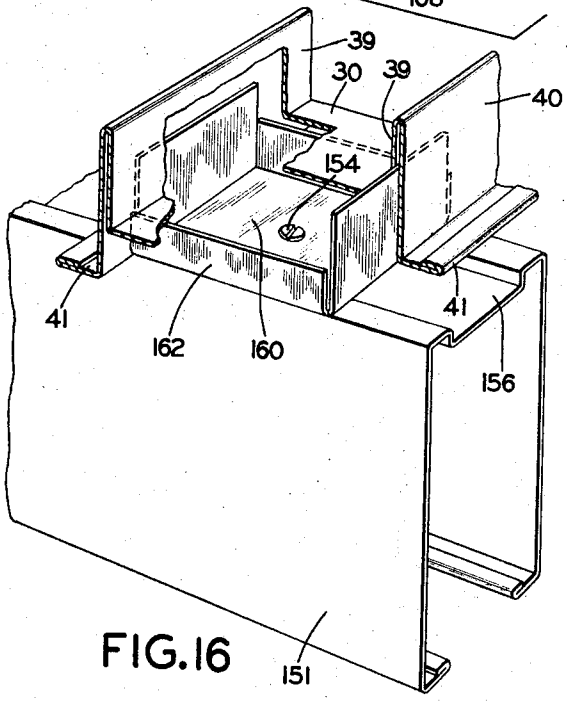

FIG. 16

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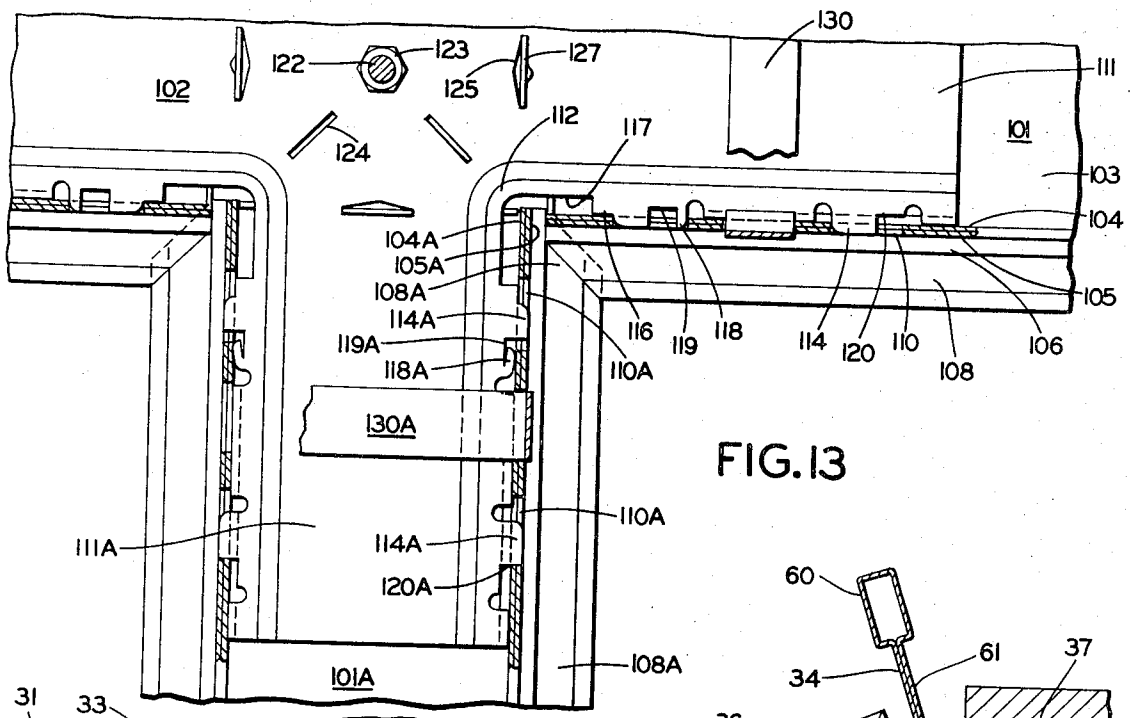

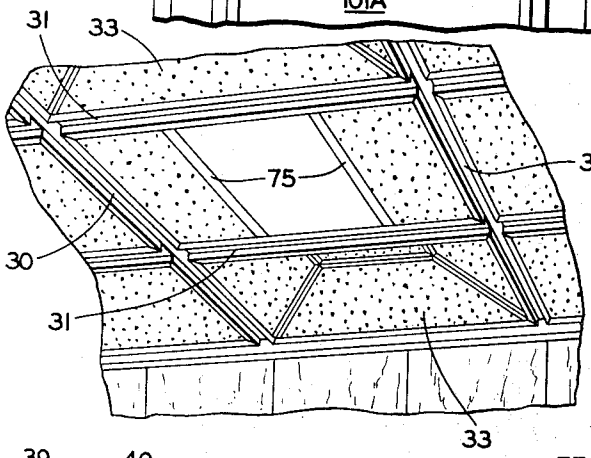

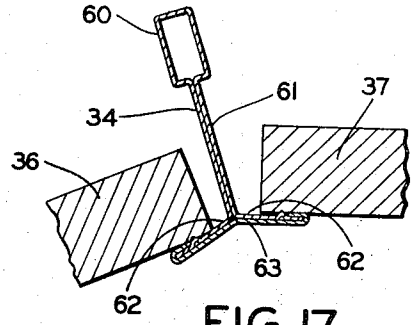

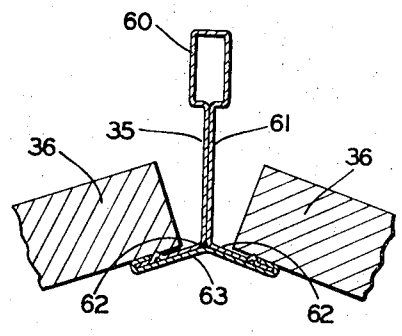

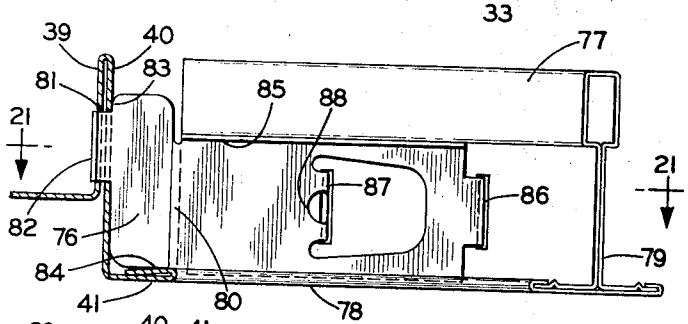

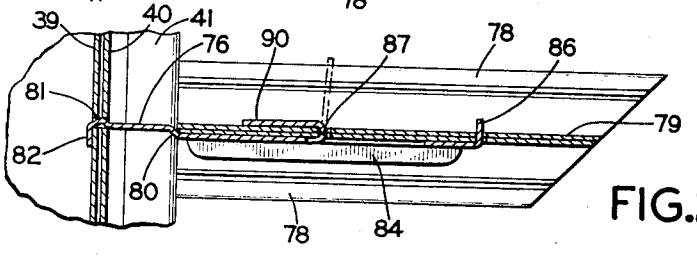

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SUSPENSION SYSTEM

BACKGROUND OF THE INVENTION

Ceilings of offices, schools, and commercial buildings are now frequently composed of suspended grids which support ceiling panels, some of the panels containing lighting fixtures or other functional devices, with the space between the suspended ceiling and the supporting structure serving to contain piping, ducts, electrical wiring, and the like.

The suspended grids which support the actual ceiling panels have sometimes been excessively flimsy so that they are difficult to install and maintain, sometimes excessively massive so that they are expensive and awkward to install, and generally lacking in esthetic qualities necessary to good architectural design. Those grid structures which are inherently attractive, because of exposed width permitting them to form a part of the architect's decorative ceiling design, have often lacked the versatility required for accommodation to different structural needs and decorative plans.

SUMMARY OF THE INVENTION

This invention involves a system of suspended ceiling elements, including grid elements of substantial width, and supported units especially designed for cooperation with the wide grid.

The main grid elements are made by folding of sheet metal to provide suitable flanges for receiving the supported units and to provide longitudinal surfaces for decorative, and optionally special functional, purposes. These decorative surfaces may be either recessed so that they lie above the plane of the supporting flanges or projecting so that they are below the plane of the supporting flanges.

The supported units may include transverse or intersecting grid elements, either similar to or different from the main grid elements.

The supported units will also include ceiling panels of some kind, either plain or of porous "acoustic" material, or transparent or translucent if light is to be supplied from above. Other kinds of supported units may include frames or panels, or combinations of frames and panels, to constitute non-planar ceiling elements such as pyramids, truncated pyramids, cones, cylinders, hemispheres, waves, prisms, and other decorative shapes. In addition, provision may be made for direct or indirect support of lighting fixtures, ventilating duct openings, sprinkler heads, sound transmission equipment, and the like.

Because of the inherent strength and rigidity of the grid elements of this invention, they have been found to be suitable for positioning and lateral bracing of the tops of partitions, and this invention includes connecting elements for that purpose.

All of the various kinds of elements mentioned may be brought together in a multitude of different arrangements, to provide for functional needs of different kinds, and also to provide scope for the creative imagination of the architect in providing functional and decoratively distinctive ceiling designs.

THE DRAWINGS

FIG. **1** is a perspective view of one embodiment of a suspended ceiling according to this invention.

FIG. **2** is a bottom perspective view and FIG. **3** is a top perspective view of a crossing of the grid of the ceiling in FIG. **1.**

FIG. **4** is a sectional along line **4—4** of FIG. **5** and FIG. **5** shows a joint in one of the truncated pyramidal frames of FIG. **1,** FIG. **6** is a section along the line **6—6** of FIG. **7** and FIG. **7** shows how the pyramidal frame is supported on the ceiling grid.

FIG. **8** is a plan view of another embodiment at a crossing of the ceiling grid. FIG. **9** is a cross-sectional detail of FIG. **8** on the line **9—9,** FIG. **10** is a section on the line **10—10** of FIG. **8,** and FIG. **11** is a view partly in section on the line **11—11** of FIG. **8.** FIG. **12** is an exploded perspective view of the crossing.

FIG. **13** is a plan view on an enlarged scale of a part of the structure of FIG. **8** illustrating its accommodation to excessive expansional forces.

FIG. **14** is a sectional view along line **14—14** of FIG. **1** illustrating attachment of a partition along one of the grid members, and FIG. **15** is a perspective view of a fastening clip used in partition attachment.

FIG. **16** is a perspective view illustrating attachment of a partition transverse to the grid members.

FIG. **17** and FIG. **18** are sectional views with sections taken on lines **17—17** and **18—18** respectively on FIGS. **5** and **7,** showing how ceiling panels are supported on the truncated pyramidal frames of FIG. **1.**

FIG. **19** is a perspective view of a modification of the suspended ceiling arrangement shown in FIG. **1,** in which one of the flat areas is subdivided.

FIG. **20** shows the manner in which a supplemental T-beam is connected to the main grid of FIG. **19,** and FIG. **21** is a section on the line **21—21.**

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. **1,** the suspended ceiling system of this invention in a preferred embodiment includes a rectangular grid composed of parallel main runners **30** and cross runners **31** intersecting the main runners at desired intervals, which may be the same as the spacing between the main runners **30.**

Supported on the grid of main runners **30** and cross runners **31** are ceiling elements of the appropriate size and shape to fill the openings in the grid, such ceiling elements in this case including flat ceiling panels **32.** The panels **32** may be of any desired or suitable material such as porous or perforated sound-absorbing "acoustic" ceiling tile.

In the particular arrangement shown in FIG. **1,** certain of the openings are provided with lighting fixtures which may be in any desired pattern, such as solid rows or blocks, to suit the needs of the particular design for intensity and distribution of illumination and for decorative appearance. In this instance, there are three rows of recessed truncated pyramids **33** between two rows of flat panels **32.** Each truncated pyramid **33** consists of a rectangular frame **34** supported through splay legs **35** on the corners of intersecting main runners **30** and cross runners **31.** The trapezoidal spaces between the frame members **34,** splay legs **35,** and main or cross runners **30** or **31,** are occupied by additional trapezoidal ceiling panels **36.** The spaces in the rectangular frames **34** are filled by lighting fixtures, of which only the translucent diffuser panel **37** is visible.

The grid construction is shown in FIGS. **2** and **3,** in which upper and lower perspective views are presented

of an intersection of a main runner **30** and two opposing cross runners **31.** In this construction the runners **30** and **31** are identical in cross-sectional shape. Each runner is composed of a single sheet of metal folded to a symmetrical shape having a central horizontal portion **38,** on each edge of which the sheet is folded upward to form a vertical inner web **39** and then folded downward to form a vertical outer web **40** extending below the horizontal portion **38.** A short distance below the central horizontal portion **38** the sheet on each side is folded outward to form a horizontal flange **41,** the edge of which is folded back over itself for stiffness and to form a smooth rounded margin **42.**

At the location of each intersection holes **43** extend through the vertical inner web **39** and outer web **40** to receive the hooked ends **44** of a stiff wire stirrup **45,** which in turn is hung from the structural ceiling by a flexible wire hanger **46.** The several hangers **46** can be shortened or lengthened in the usual manner for precise leveling of the structure.

At each intersection the vertical outer web **40** is cut away to leave a notch with an upper edge **47** aligned with the top surface of the central horizontal portion **38** of the runner and with side edges **48** spaced the same distance as the space between the two vertical inner webs **39.** In addition the notch extends through the width of each flange **41,** but with a slightly greater width corresponding to the distance between the outer faces of outer webs **40.** The flange **41** on either side of the notch is offset upward by the thickness of the sheet along a line extending outward at 45° from the intersection of flange **41** and outer web **40,** so as to form a mitered shoulder **49.** Preferably the margin **42** of the flange is omitted at this location to facilitate formation of the mitered shoulder **49.** In addition, the material at the folded upper edge of vertical inner and outer webs **39** and **40** is removed to provide an opening **50** into the space between webs **39** and **40** on each side.

The ends of the cross runners **31** are shaped to match snugly with the main runners **30** at the intersection by a square cut of vertical inner and outer webs **39** and **40** to fit accurately against the outer web **40** of the main runner **30.** In addition, the flanges **41** on either side are mitered and the margin **42** is omitted above the mitered portion of each flange. The central horizontal portion **38** of each end is cut in the shape of a tongue with its base **51** of the same width as the space between the sides of the notch **48,** and with its upper end narrowed to permit passage between the vertical inner and outer webs **39** and **40** of the main runner **30** and out through the opening **50.** The tongue is bent upward just beyond the squared ends of the inner and outer webs **39** and **40** of the cross runner, and is weakened by a hole **52** at the location where it will protrude through opening **50.**

Assembly of the cross runners **31** with the main runners **30** is accomplished quickly and accurately by placing the end of cross runner **31** below its final position and lifting it into position with the base **51** of the tongue positioned between sides **48** of the notch in the main runner, and with the tongue lying in the space between inner and outer webs **39** and **40** of the main runner and the tip of the tongue projecting through the opening **50.** When the mitered flanges of the cross runner **31** are seated against the mitered shoulders **49** of the flanges of the main runner **30,** the tip of the tongue is bent over at the location of the hole **52** as shown at **53** in FIG. **3** to lock the assembly together. This forms a strong and rigid joint.

A grid formed of main runners **30** and cross runners **31** intersecting in the manner just described, will present an attractive appearance because the flanges come together in neat mitered joints as shown in FIG. **1** and FIG. **2** and because the recessed central portion **38** presents a pleasing contrast of location. If desired, a contrast of appearance can also be provided by finishing the different portions of the runners in different colors or tones so as to accentuate the existence of different visible planes. In addition, a difference in color or texture can be provided between the visible lower surfaces of flanges **41** and the ceiling panels **32** which rest on the upper surfaces of the flanges.

In case it is desired to provide heating, cooling, or ventilation through the ceiling, inlets or outlets for the circulation of air can be provided in any or all of the supported panels, or in the supporting grid. Thus, if it is desired to use the space between the structural ceiling and the suspended ceiling as a plenum chamber for the circulating air, openings for the communication of the air with the room below the suspended ceiling are easily provided. As shown in FIGS. **2** and **3,** ventilating slots **54** may be provided in the central horizontal portion **38** of some or all of the runners. Since the space above the suspended ceiling is generally completely dark, it will often be preferred to make the central horizontal portion **38,** in which the ventilating slots are made, black or a dark color so that the existence and location of the slots will not be unnecessarily conspicuous.

The truncated pyramids **33** shown in FIG. **1** are constructed on a frame **34** resting on splay legs **35,** as previously stated. Both the splay legs **35** and the members forming the frame **34** are preferably made from the known type of structural beam shown in FIGS. **17** and **18.** This beam has the general shape of an inverted T so as to present flanges for supporting the several panels making up the truncated pyramidal surface.

This structural beam may be made from sheet metal folded to form a box-shaped stiffening bead **60** along one edge of a double web **61,** and with the edges of the two thicknesses of metal forming the web **61** flared out to form two flanges **62.** Separation of the flanges is prevented, and a finished appearance is provided by capping the flanges **62** with a metal strip **63** having the desired color and finish, applied below the flanges and with its edges folded over the top of the flanges. In this construction the several panels of the truncated pyramid meet at obtuse angles, and the flanges **62** along with the cap strip **63** form an obtuse angle approximating that of the adjoining panels. To permit a single size and kind of beam to be used both for the frame **34** and the splay legs **35,** the members of the frame **34** are canted so that the symmetrically placed flanges **62** will lie respectively in the approximate plane of the central light diffuser panel **37** and trapezoidal panel **36,** which means that the upper edges of the webs **61** will be tilted away from one another, as shown in FIG. **17.** On the other hand, the splay legs **35** will have their webs **61** each in a vertical plane as shown in FIG. **18.**

The assembly of a rectangular frame **34** with its splay legs **25** is accomplished by cutting off the bead **60** and the adjoining portion of the web **61** at both ends of each member of the frame **34** and both ends of each

splay leg 35 at an angle such as 45° to form a sloping web end 64, and also making a pair of fastener holes 65 in the adjacent end portion of each web 61. At the same time, the flanges 62 are mitered at approximately 45° on the side of each member of the frame 34 turned toward the inside of the frame, so they will form a tight joint, and the flanges on the outside, as well as on both sides of the upper end of the splay legs 35, are cut off at an angle half that of the angle between the frame member and the splay leg.

Stiff metal intersection clips 66 are made by stamping the metal in a symmetrical shape about a plane of symmetry representing the plane of contact of a splay leg 35 and a member of the frame 34. Each end 67 of the clip 66 is a width to fit against the web 61 and between the bead 60 and flange 62 of one of the members to be joined, and has holes corresponding in position to the holes 65 in the webs. The portion of the clip extending over the sloping web end 64 is offset by half of the thickness of the web 61 (that is, by the thickness of one of the two thicknesses of metal making up the web) to form a shoulder 68 engaging the sloping web end 64. The offset portion is also provided with symmetrically located fastener holes 69, preferably four such holes, or still better, three holes with the location of the fourth occupied by a dimple 70 pressed out of the metal.

In assembly of the truncated pyramid, the four members of the rectangular frame 34 have an intersection clip 66 riveted to the outer side of each end through the fastener holes 65. The four members are then brought together with the protruding half of a clip 66 at each end of each member facing a protruding half of a corresponding clip 66 on the adjacent member, and the dimple 70 on one clip of each facing pair is slipped into the corresponding hole 69 of the other clip of each pair. With the adjoining parts thus properly located, the pair of clips at each corner of the frame 34 are fastened by a rivet through the other hole 69. This leaves two holes 69 unused in each clip 66, (or a hole and a dimple, as the case may be), these unused holes being provided simply for purpose of symmetry to avoid a need for right and left hand clips and to permit the clips to be put in place without troubling to determine whether the proper end is in the proper location. At this stage the frame 34 is complete and can be handled or shipped as a subassembly.

For completion of the assembly, it will be found that the protruding ends of the pairs of clips 66 at each corner of the frame 34 are spaced apart by exactly the thickness of the web 61 of the splay leg 35, because of the offset at the shoulder 68 of each clip. Consequently, the web 61 of the upper end of a splay leg 35 is slipped into the space between the ends of a pair of clips at a corner of the frame 34 until the sloping web end 64 engages the shoulders 68 and the fastener holes 65 match up, and is connected by riveting through the holes 65.

The lower end of each splay leg is provided with a splay clip 71 as shown in FIGS. 6 and 7. Each splay clip 71 is riveted to the end of the web 61 of the splay leg in a manner similar to that of fastening the intersection clips 66 to the frame 34. The free end 72 of the splay clip has a shape somewhat like a letter Z so that the very end can b slipped between the end face of inner and outer web 39 and 40 of the cross runner 31 and the side of outer web 40 of the main runner 30, at a level above that of the tongue 51. Since the splay clip 71 is necessarily very thin to permit placement of its free end 72 in the space just mentioned, it is preferably stiffened by striking a welt 73 in the material.

The free end 72 of splay clip 71 is bent at a 45° angle because of the diagonal position of the splay leg 35 to which its other end is attached. Two of the four splay clips 72 needed for each truncated pyramid 33 will have a bend to the right and the other two will have a bend to the left to permit them to fit against the web of the main runner 30 at the intersection.

As mentioned above, it is not necessary that the grid be composed of members of identical appearance. This is particularly the case if it is desired to subdivide the area enclosed by a pair of main runners 30 and cross runners 31, as shown in FIG. 19. For example, it may be desired to alternate truncated pyramids in one row with subdivided flat areas having the subdivisions separated and supported by T-beams 75. The T-beams may be of any desired construction, but a preferred construction is similar to that of the rectangular frames 34 and splay legs 35 in FIGS. 17 and 18, except that the flanges are in a single plane perpendicular to the web.

When T-beams are used, there will be one or more T-beams 75 in any particular grid opening, depending on whether the opening is subdivided into two spaces, or three spaces as shown in FIG. 19, or even more. Also, cross runners 31 can be omitted entirely, with ceiling panels abutting one another along the length of the main runners 30, or if preferred, cross runners 31 can be replaced or supplemented by T-beams 75, supported on the main runners 30 rather than on the cross runners 31 as shown in FIG. 19. In any such arrangement, the ceiling panels or other supported units can be similar or different, to suit needs or preferences of the designers and users.

The support of the T-beams 75 is accomplished by end clips 76 fitting snugly between T-beam bead 77 and T-beam flange 78, and fastened to T-beam web 79. The part of end clip 76 projecting beyond the end of T-beam 75 has an offset 80 so that it forms a continuation of web 79 and will fit in a slot which is in exact alignment with the web 79. A vertical slot 81 is provided in the webs 39 and 40 of a main runner 30 or cross runner 31, as the case may be, and the projecting end clip tip 81 is made of a width and location to fit the slot, and is bent at a right angle to hook against the face of the inner web 39 of the runner. The bottom edge 84 of the offset portion of the clip is so located as to rest on flange 41 of the runner with the bottom of T-beam flange 78 aligned with the bottom of runner flange 41. The top of the offset portion of the clip is also shaped to space the top of T-beam 75 from the outer web 40 of the runner by the exact amount required for precise horizontal alignment of the visible bottom faces of flanges 78 and 41, which is easily accomplished by providing a vertical end surface 83 adjacent to the tip 82 of the end clip 76, with the end surface 83 spaced from the proximal face of the offset 80 by the width of runner flange 41.

The end clip 76 has its top and bottom edges bent over to form top and bottom stiffening flanges 85 which bear respectively against T-beam bead 77 and T-beam flange 78. The proximal end 86 of the clip is of restricted width and is bent at right angles in the direction opposite to the stiffening flanges 85. In the body of the clip a U-shaped cut is made with the tips of the U midway between the proximal end 86 and the offset 80,

leaving a tab 87. Preferably, the base of tab 87 is weakened, to facilitate bending, by a hole 88, and the tab is bent at a right angle parallel to proximal end 86. Vertical slots 89 are placed in T-beam web 79 in locations corresponding to tab 87 and proximal end 86.

The T-beams are affixed to a pair of runners 30 or 31 having slots 81 in directly opposed locations by hooking the free end or tip 82 of an end clip 76 in each of the slots and positoning the T-beam with its web 79 in alignment with the slots and its flange 78 in horizontal alignment with the runner flange 41. Each clip 76 is then swung toward the T-beam web 79 so that tab 87 and proximal end 86 can be slipped through the slots provided for them. When the clip is in firm contact with T-beam web 79, the tab 87 is bent through a 90° arc into a position 90 engaging the opposite face of the web 79. All this takes only a moment to accomplish and locks T-beam 75 into an accurate and immovable relationship to the runner 30 or 31.

After assembly of the grid, consisting of main runners and cross runners, or main runners and T-beams, or main runners and cross runners plus subdividing T-beams, in the simple and rapidly accomplished procedures described above, the ceiling is completed by simply dropping a supported element such as a ceiling panel, light fixture, or other functional unit, having the proper size and shape, on the flanges circumscribing each opening in the grid.

As an alternative to the grid described above with a recessed center surface in the runners, a construction can be provided having a central horizontal portion of the runners projecting downward to a position below the flanges which support the ceiling panels, as shown in FIGS. 8, 9 and 10.

In this alternative construction, when the grid is composed of runners 101 of identical appearance in both directions, lengthwise and crosswise, it is presently preferred to supply the runners in lengths extending from one main intersection to another, and to join them by cross-shaped connectors 102 shown in assembled position in FIG. 8 and partly disassembled in FIG. 12.

The runners 101 in this embodiment are made of a strip of sheet metal folded to provide a central horizontal surface 103, on either edge of which is an upwardly extending inner web 104, which is folded tightly on itself to form an outer web 105, interrupted by a horizontal shoulder 106, so that the outer web bottom 107 is spaced from the inner web 104 by a downwardly opening groove. Each outer web bottom 107 terminates in a horizontal flange 108 at a level somewhat above that of the central horizontal portion 103 so that a significant portion of the inner web 104 is exposed. The edge of the sheet metal is folded back over itself for stiffness and to form a smooth rounded margin 109 on the flange 108.

If desired, a projecting continuation of the central horizontal portion may be turned up to form a closure 128 at each end of each runner 101. Near each end of each runner 101 a series of three slots 110 is cut through the combined thickness of inner web 104 and outer web 105 just above the shoulder 106 on both sides.

The cross-shaped connectors 102 are metal stampings consisting of a body with four arms 111, which are stiffened by having a rabbet 112 formed along the edges of the arms and particularly around the junctions of the arms. On both sides of each arm 111 downturned flanges 113 have outer faces spaced by exactly the distance between the inner faces of inner webs 104 of the runners 101. Projecting beyond the outer faces of down-turned flanges 113 on either side of each arm are a pair of tongues 114 spaced to engage the first and last of each group of three slots 110. Where such a tongue 114 coincides in location with the top of downturned flange 113, the corner of the flange 113 and edge of the rabbet 112 is interrupted by a U-shaped hole 115, leaving the tongue 114 projecting between the arms of the U-shaped hole. Where a tongue 114 does not coincide with the location of downturned flange 113 the rabbet 112 should terminate near the tongue in an edge 116 lying in the same plane as flange 113.

It is preferred to modify the structure of tongues 114 to permit thermal expansion of runners 101 in the event of a fire as will be explained below. This modification may include all or several of the following. Rabbet 112 is relieved at the intersection 117 of the arms 111. One of the tongues on each side of each arm 111, in this case the tongue closest to intersection 117, is notched so as to leave a slender remnant 118 separated from the remainder of the tongue 114 by notch 119 of a width corresponding to the magnitude of the anticipated thermal expansion. The other tongue 114 has a corner 120 removed to the same width as notch 119.

The center of the cross-shaped connector 102 is provided with several openings. At the center is a hole 121 for a vertical supporting rod 122 which may have adjusting nuts 123 for precise leveling of the grid. Four slots 124 radiate from the center toward the intersections of arms 111, in order to receive splay leg supporting clips. Four slots 125 extend transversely of the arms 111 for supporting an intersection cover cap 126 whose bottom surface is in the same plane and of the same width as the central horizontal portion of runners 103. The cap 126 is box-shaped with each side having a tab 127 to fit one of the transverse slots 125, and at least two of the tabs are formed with dimples to snap into position behind the top of the connector 102, and to release the cap when pressed in the direction away from the dimple.

Assembly of the grid is easily accomplished by supporting the connectors 102 in approximately the proper final position on supporting rods 122 and lifting the runners 101 so that the inner webs 104 slip over the downturned flanges 113 of the connector arms 111. The webs are then sprung slightly apart so they will slip over the tongues 114 until the tongues snap into the slots 110 in the webs. In this position the runners 101 are held rigidly in position by engagement of connector flanges 113 and rabbet edges 116 with inner webs 104, and by engagement of the tongues 114 in the slots 110, with the full width tongue 114 nearest the center (the one containing the notch 119) holding against longitudinal motion under normal stresses.

The assembly is then locked against accidental separation by means of metal straps 130, shown especially in FIG. 9. Each strap 130 has one end formed into a square hook 131. The opposite end 132 of the strap 130 is slipped from inside toward the outside through the middle slot 110 in a runner web until hook 131 enters the middle slot 110 in the opposing web from outside toward the inside. The end 132 of the strap is then pulled up tight and bent back over the top of the runner to prevent accidental separation of the webs and thus lock the assembly in position.

At this stage the grid may be leveled by use of the adjusting nuts **123**, which are then hidden by snapping an intersection cap in place. The ceiling may be completed by placement of appropriate panels **135** on the runner flanges **108**.

In those locations in which it may be desired to provide truncated pyramid ceiling units, rectangular frames **34** supported on splay legs **35** may be fabricated with the help of intersection clips **66** as previously described. In this instance, the bottom ends of splay legs **35** are provided with hooked splay clips **140** firmly riveted to web **61** of each splay leg, as shown in FIGS. **8** and **11**. Each hooked splay clip is shaped to rest on the runner flange **108** with a vertical edge **141** in the corner of two adjoining runner outer webs **105**, and with its hooked end **142** inserted in the closest one of the radiating slots **124**. Preferably the clip **140** is stiffened by pressing a welt **143** along its length.

The truncated pyramids may be finished by application of trapezoidal panels **36** and lighting units **37** as described in connection with FIG. **1**, or with any other appropriate units which will occupy the sloping side spaces and the rectangular top space of the truncated pyramid.

If it is desired to make special provision for ventilation, slots can be provided in the inner web **104** of the runners **101**. Thus, if it is preferred to have ventilating air moving vertically in the groove between inner web **104** and outer web bottom **107**, ventilating slots **145** are provided in the inner web **104** near the top of the groove. If it is preferred to have the air moving horizontally, ventilating slots **146** are provided in the bottom part of inner web **104** below the level of flange **108**. In some situations, ventilating slots in both locations may be found desirable.

As was mentioned above, provision for thermal expansion in the event of fire is desirable, as the expansion would otherwise tend to buckle the runners of the grid and permit the ceiling panels to fall, which would permit access of heat and flames to the space between the suspended ceiling and the supporting structure and result in acceleration of spread of the fire. The manner in which thermal expansion is accommodated is shown in FIG. **13**.

In this figure the runner **101A** depicted in a vertical position in the drawing is shown in its position after thermal expansion or some other excessive force has moved its end toward the connector **102**. This causes the end of combined inner and outer webs **104A** and **105A** to project into the relieved corner of rabbet **117**, while the mitered corner of flange **108A** slips past the corresponding corner of the adjacent flange of the other runner. At the same time the portion of the webs containing slots **110A** moves so as to occupy the space provided by removal of the corner **120A** of one of the tongues **114A**, and to bend over the remnant **118A** of the other tongue **114A** into the notch **119A**. The same action takes place on both sides of the runner and may take place at both ends if the expansion is of sufficient magnitude. Thus, it is apparent that the remnant **118A** of one of the tongues holds the parts in their normal position so long as only normal forces exist, but is weak enough to permit a shift to accommodate abnormal forces without collapse of the structure.

A further modification of structure involves use of the ceiling grid to locate and brace movable partitions. As is well known, movable partitions are commonly held to the floor by means of clips or fasteners, but are best held in position by some kind of fastener or brace also at ceiling level. This is easily accomplished in an attractive way by simple auxiliary elements such as those shown in FIGS. **14**, **15** and **16**.

FIG. **1** shows a ceiling grid with vertical walls along two intersecting runners. These walls may be movable partitions held in the manner shown in FIG. **14**, in which a runner **30** has flat ceiling panels **32** or the sloping panels of a truncated pyramidal ceiling unit **33** on either side of a partition defined by a pair of wall panels **150**. The wall panels are held against a metal channel **151** by means of cap strips **152** or in any other convenient manner.

In this particular combination the runner **30** has a recessed center, and the channel **151** fits into the recess. At intervals along the channel recessed partition clips **153** are fastened, as by sheet metal screws **154**. Each clip **153**, as shown in FIG. **15**, is shaped to conform to the top surface of channel **151** and be held immovably by screw **154**. In addition, each clip has two legs **155** spaced to fit between inner web **39** and outer web **40** on either side of runner **30**, and of a thickness to be firmly held by frictional engagement with the web surfaces. Preferably the top of channel **151** is formed with a longitudinal groove **156** and clip **153** has a correspondingly depressed center, which provides space for the head of screw **154** and also holds the clip in position on the channel.

In case it should be desired to install a partition in a location other than longitudinally of a runner, that is accomplished with similar ease using a slightly different box-shaped clip **160**. The clip **160** (like the clip **153**) has a pair of legs **161** so spaced and of such thickness as to be frictionally held in the proper position between inner webs **39** and outer webs **40** of the runner. The clip **160** also has a pair of turned up sides **162** fitting in the spaces between legs **161**, but of a reduced height corresponding to the depth of the recessed center of the runner, so that the bottom of clip **160**, when pushed home in the recessed part of the runner, will be flush with the bottoms of runner flanges **41**. One of the clips **160** will accordingly be fastened to a partition locating channel **151** at each position where it is to cross under a runner, by a fastener such as screw **154**.

The channel **151** is then supported below the runners by pressing or tapping the attached clips into place in the runners. The wall panels are then fastened in any desired manner, as by being slipped under wall panel cap strips **152** attached to the channel, as previously described.

In case partitions are to be attached to runners with projecting rather than recessed centers, all that is required is to make the partition locating channel **151** with a longitudinal groove **156** of such size and shape as to fit around the projecting portion of the runners. The channel is then easily held in place by separate clips or by screws or by any other desired type of fastener.

The suspended ceiling system of this invention consists of simple, easily fabricated components, which can be assembled rapidly and easily by unskilled labor. The components are nevertheless attractive, so that they can be more than neutral structural units, but instead can form a definite part of a decorative ceiling design. At the same time, the system easily provides a great versatility in providing for a wide variety of functional

needs while permitting the architect to combine the elements in many ways to provide a rich variety of ceiling designs to satisfy the decorative purposes of the particular ceiling in which the system is used.

I claim:

1. A suspended ceiling system comprising:

a. flanged suspended runners and ceiling elements resting on the flanges of the runner, the runners having exposed surfaces between the visible bottom surfaces of the flanges of the runners, at least one exposed surface being recessed in a plane above that of the flanges;

b. runners of identical cross section intersecting at right angles;

c. runners comprising of a single sheet of metal folded to provide an upwardly recessed central horizontal portion, an upwardly extending inner web and downwardly extending outer web on each side of the central portion, the inner and outer webs separated by a space equal to the thickness of the sheet metal, the outer webs terminating in horizontal flanges in a plane below the recessed central horizontal position;

d. some runners having notches in the flanges to receive end portions of intersecting runners; and,

e. intersecting runners having ends shaped to fit notches in intersected runners and having upwardly extending transverse tongues located for reception into the space between inner and outer webs of intersected runners.

2. A suspended ceiling system comprising:

a. flanged suspended runners and ceiling elements resting on the flanges of the runner, the runners having exposed surfaces between the visible bottom surfaces of the flanges of the runners, at least one exposed surface being recessed in a plane above that of the flanges;

b. runners of identical cross section intersecting at right angles;

c. runners comprising of a single sheet of metal folded to provide an upwardly recessed central horizontal portion, an upwardly extending inner web and downwardly extending outer web on each side of the central portion, the inner and outer webs separated by a space equal to the thickness of the sheet metal, the outer webs terminating in horizontal flanges in a plane below the recessed central horizontal position;

d. some runners having notches in the flanges to receive end portions of intersecting runners;

e. intersecting runners having ends shaped to fit notches in intersected runners and having upwardly extending transverse tongues located for reception into the space between inner and outer webs of intersected runners; and,

f. the tops of webs of intersected runners having openings through which tongues of intersecting runners can protrude and tongues of intersecting runners protruding through the openings are bent to lock together the runners.

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