

[54] **MULTIPLE SERVICE DECKING UNIT**

[76] Inventor: **Mark Dobbins**, 1841 Titlon Drive,
Pittsburgh, Pa. 15241

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174/49

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[58] Field of Search 174/47, 49; 138/116, 117;
52/220, 221

[56] **References Cited**

UNITED STATES PATENTS

2,090,239	8/1937	Strang.....	138/116
3,482,505	12/1969	Sawyer et al.	52/145 X
2,877,990	3/1959	Goemann.....	52/221 X
1,979,804	11/1934	Lutz.....	138/116 X
2,164,394	7/1939	Faber.....	138/116 X
3,148,727	9/1964	Meckler.....	62/3 X
3,202,078	8/1965	Meek et al.....	98/31 X
3,557,511	1/1971	Curran.....	52/584 X

Primary Examiner—Alfred C. Perham

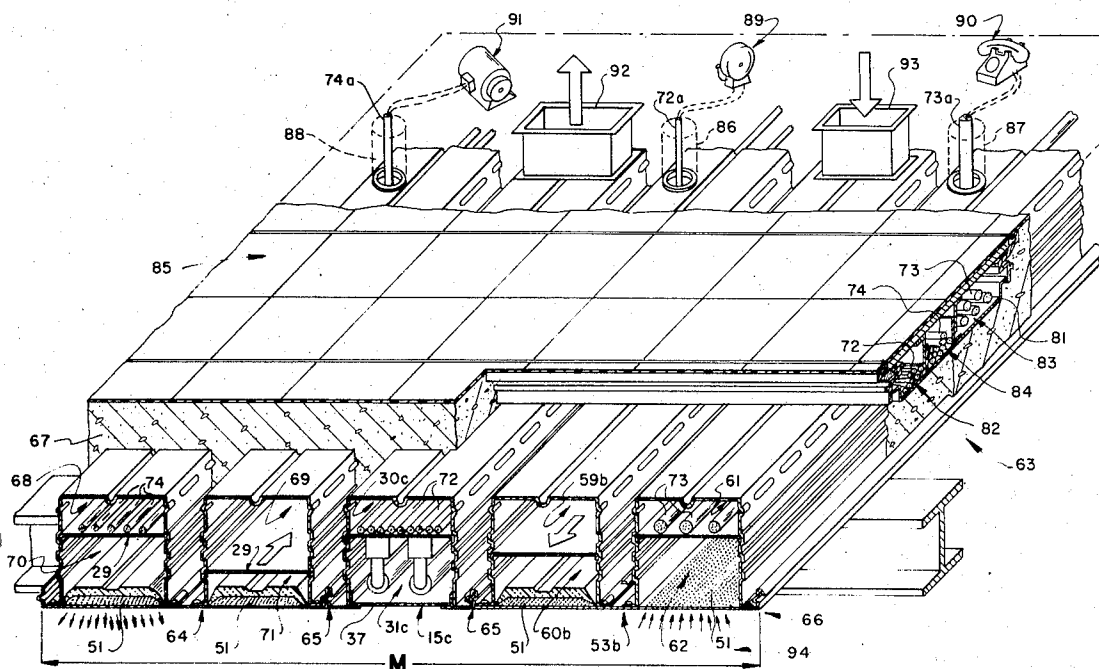
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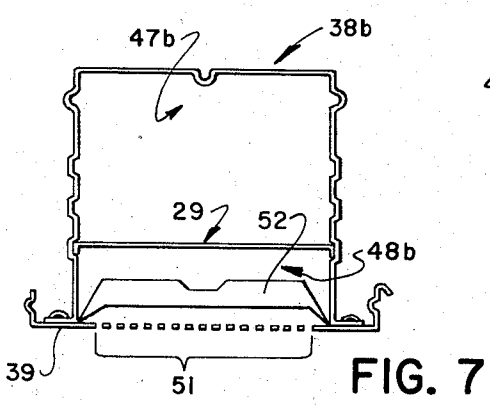
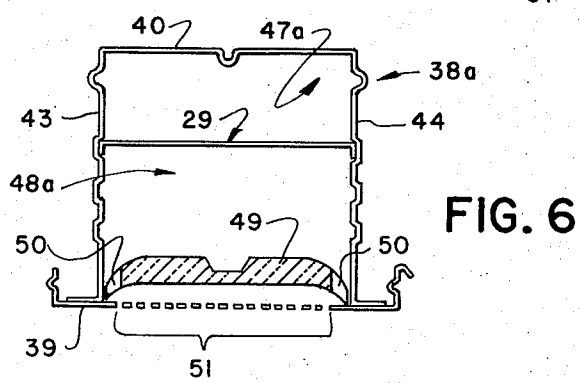
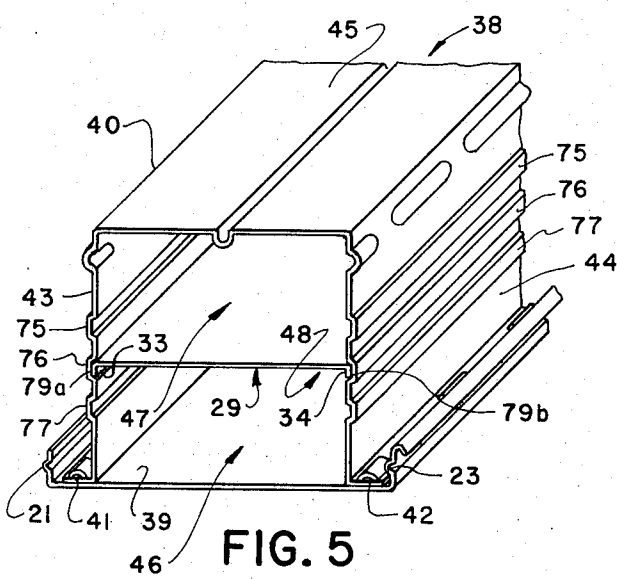
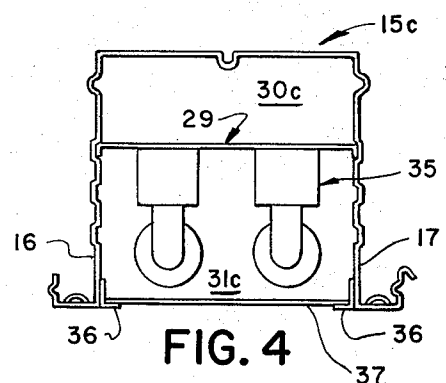
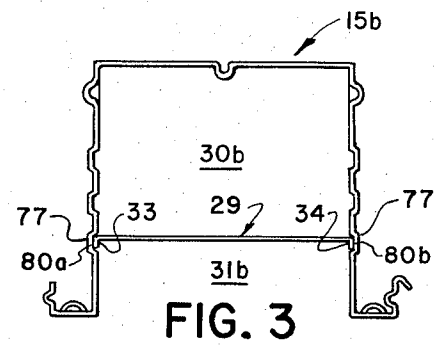
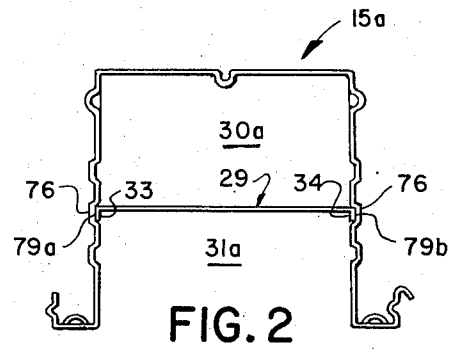
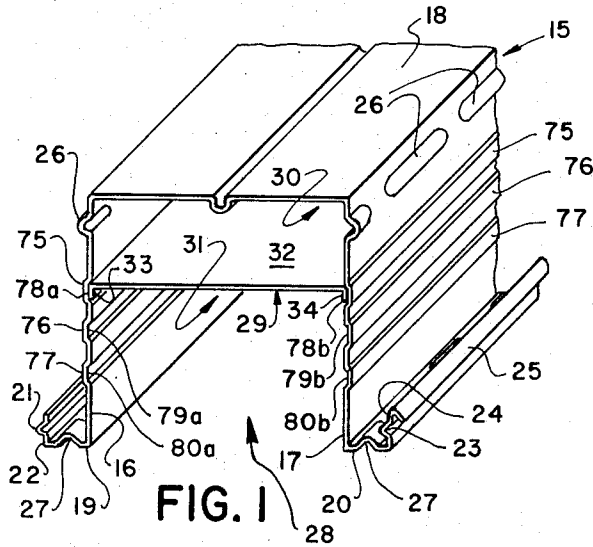
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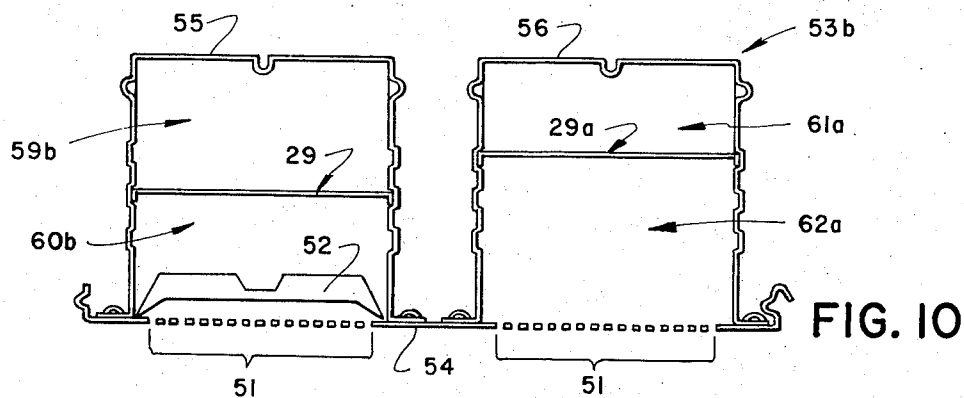
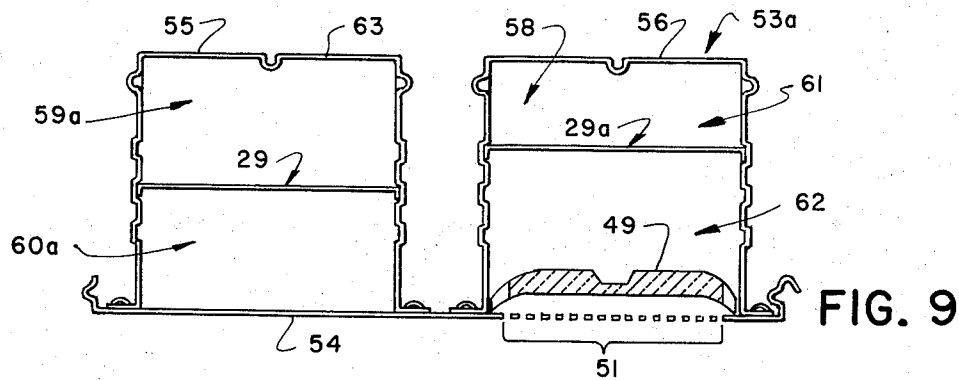
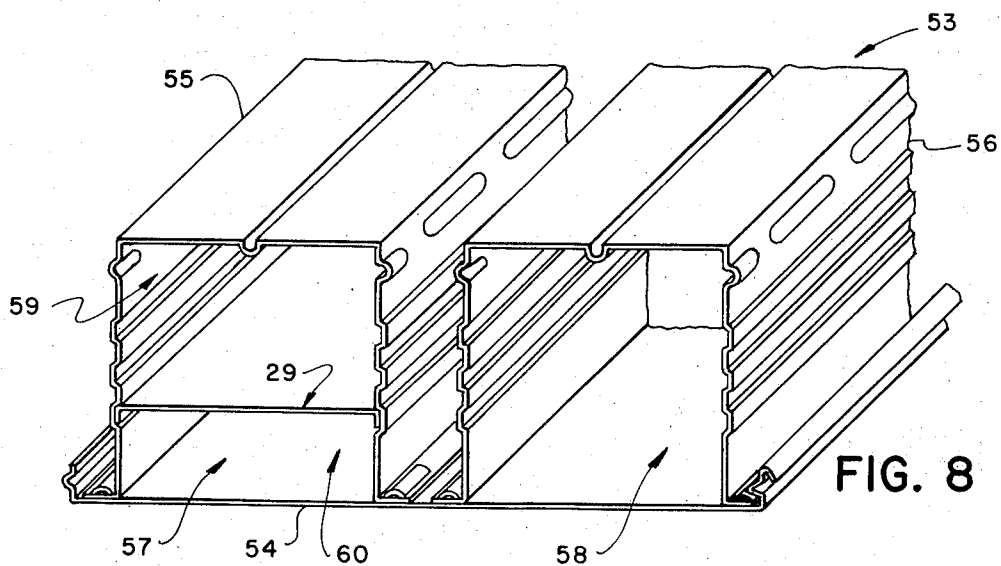
ABSTRACT

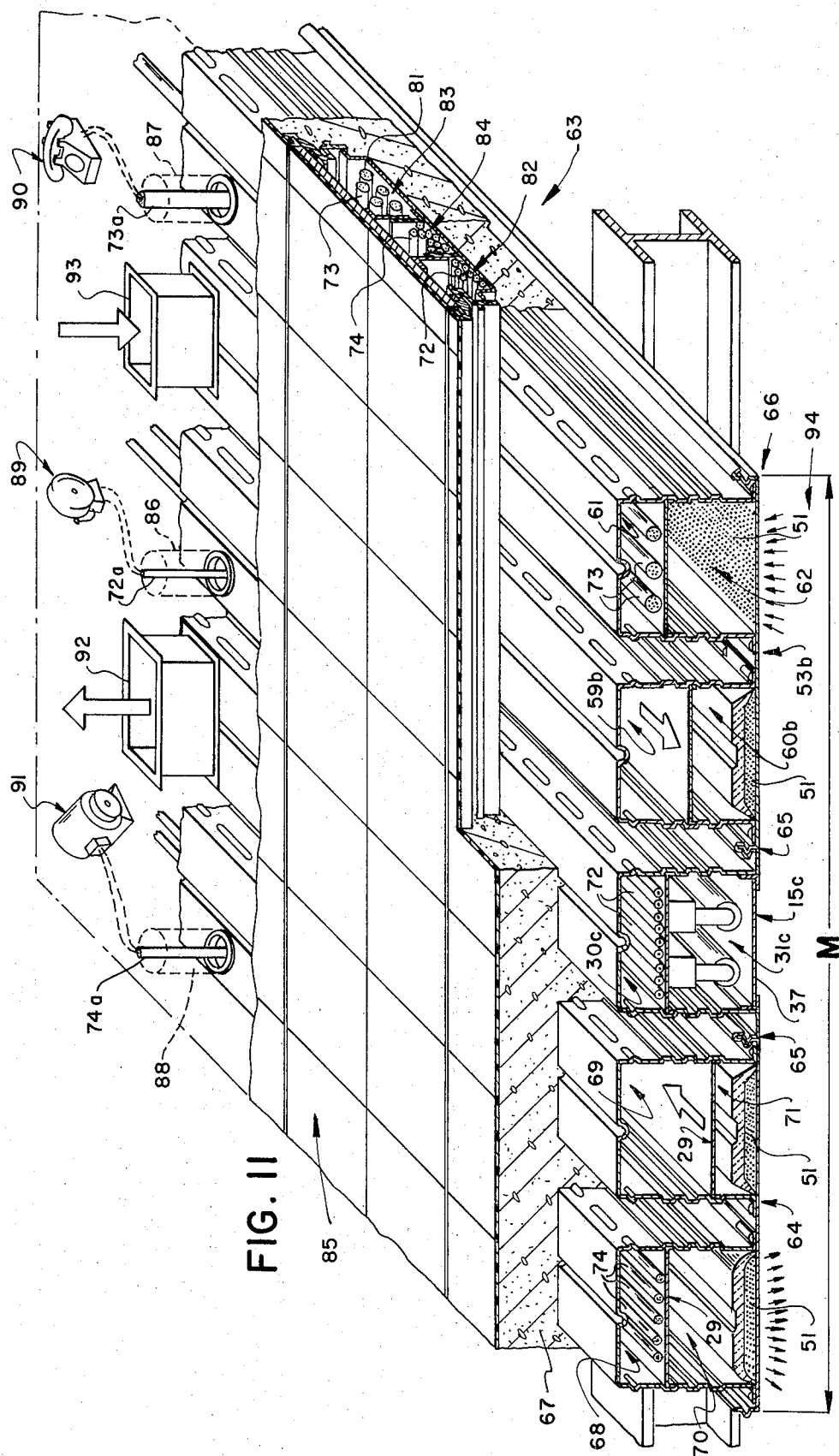
A decking unit presenting one or more main cells and incorporating partition means in at least one of the main cells which divides the same into separate upper and lower sub-cells. The decking units are assembled with an overlying layer of concrete to provide an integrated floor/ceiling structure wherein the sub-cells accommodate mechanical services, such as, acoustical control, electrical distribution, recessed ceiling lighting, ventilation and exhaust. The arrangement is such that the upper sub-cells provide selected mechanical services for the space above the floor/ceiling structure; and the lower sub-cells provide selected mechanical services for the space below the floor/ceiling structure. The sub-cells of the present integrated floor/ceiling accommodate the aforesaid mechanical services within an acceptable modular distance, whereby an adequate repetition of each mechanical service is provided throughout the floor/ceiling structure.

3 Claims, 11 Drawing Figures









MULTIPLE SERVICE DECKING UNIT

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an integrated floor/ceiling system assembled from decking units and an overlying layer of concrete and more particularly to improvements in the decking unit.

2. Description of the Prior Art

Inverted U-shaped decking units having marginal connecting means along their opposite longitudinal edges, are known in the prior art. See U.S. Pat. No. 3,049,199 (GRUBER et al., Aug. 14, 1962). The GRUBER et al. decking units can be assembled in side-by-side relation to provide a roof and ceiling construction or a floor and ceiling construction. The individual GRUBER et al. decking units are adapted to provide acoustical treatment, recessed lighting, or passageways for electrical wiring distribution.

Cellular decking units of the type having a flat bottom sheet and one or more inverted U-shaped members secured thereto, also are known in the art. See U.S. Pat. Nos. 2,897,551 (GRUBER et al., Aug. 4, 1959); 2,944,622 (DOBBINS, July 12, 1960); 3,202,078 (MEEK et al., Aug. 24, 1965); 3,482,505 (SAWYER et al., Dec. 9, 1969). The GRUBER et al. '551 and DOBBINS decking units have no air distributing features and include a perforated bottom element; a corrugated upper element secured thereto to create a lengthwise cell and acoustical insulation disposed within the cell. The MEEK et al. U.S. Pat. No. 3,202,078 provides modifications of prior art decking units peculiarly adapted to distributing ventilation air throughout the building in which such units are employed. The SAWYER et al. decking unit is a structural element which provides acoustical insulation for the sub-adjacent room and also serves as a ventilation air distributing passageway to permit uniform ingress of ventilation air into the subadjacent room.

The above-described decking units can be assembled with an overlying layer of concrete to provide a combination floor/ceiling structure, the cells of which accommodate mechanical services, such as, acoustical control, electrical and communications wiring distribution, recessed lighting, air distribution and air diffusion. However, each of the cells of such prior art combination structures accommodates only a single mechanical service. Thus such prior art combination structures are not capable of providing an adequate repetition of mechanical services throughout the entire floor/ceiling structure.

A structural decking unit is known which is assembled from three distinct components — a profiled upper sheet, a profiled lower sheet and a flat intermediate sheet — to provide four upper cells and two relatively large lower cells, see U.S. Pat. No. 3,148,727 (MECKLER, Sept. 15, 1964). The MECKLER decking units can be assembled with an overlying layer of concrete to provide a cellular structural floor. In the MECKLER floor structure, the upper cells serve only as raceways for distributing electrical wiring throughout the space above the floor structure. The lower cells serve only as air conduits which carry ventilation air to and exhaust air from the space below the floor structure. Mechanical services such as recessed lighting, acoustical control and air diffusion for the space below

the MECKLER floor structure are provided by a separate suspended ceiling.

SUMMARY OF THE INVENTION

The principal objects of this invention are to provide improvements in cellular or non-cellular decking units and to provide an improved integrated floor/ceiling structure assembled from such decking units.

Another object of this invention is to provide an integrated floor/ceiling structure wherein the upper sub-cells accommodate selected mechanical services for the space above the floor/ceiling structure; and wherein the lower sub-cells accommodate selected mechanical services for the space below the floor/ceiling structure.

A further object of this invention is to provide an integrated floor/ceiling structure the sub-cells of which accommodate the aforesaid mechanical services within an acceptable modular distance, whereby an adequate repetition of each mechanical service is provided throughout the floor/ceiling structure.

The present invention provides improvements in decking units comprising (a) an inverted U-shaped structural element having walls defining a main cell, or (b) a flat bottom sheet and one or more inverted U-shaped members secured to the flat bottom sheet and cooperating therewith to provide one or more main cells. The decking units are provided with marginal connecting means along their opposite longitudinal edges adapting the decking units for assembly in side-by-side interconnected relations with other decking units.

In accordance with the present invention partition means is provided within the decking unit for dividing the main cell into separate sub-cells. Each sub-cell is adapted to house one of the aforesaid mechanical services. The partition means comprises a plate formed, for example, from sheet metal which spans the distance between spaced-apart side walls of the decking unit and is coextensive in length with the main cell. The partition is generally parallel with the upper wall of the decking unit and may be positioned at different distances from the upper wall to provide sub-cells having equal or unequal cross-sectional areas.

Further in accordance with the present invention, the decking units can be assembled with an overlying layer of concrete to provide an integrated floor/ceiling structure, wherein the upper sub-cells provide selected mechanical services for the space above the floor/ceiling structure, and wherein the lower sub-cells provide selected mechanical services for the space below the floor/ceiling structure. For example, the upper sub-cells can serve as raceways for distributing high voltage power wiring, low voltage telephone wiring, and low voltage internal communications wiring; and as ventilation air and exhaust air conduits. The lower sub-cells can provide acoustical insulation and recessed lighting, and can serve as a ventilation air distributing passageway having acoustical insulation features, and as exhaust air passageways.

BRIEF DESCRIPTION OF THE DRAWING(S)

FIG. 1 is a fragmentary isometric view of an inverted U-shaped decking unit incorporating the partition means of this invention;

FIGS. 2 and 3 are end views of an inverted U-shaped decking unit illustrating alternative positions of the partition means;

FIG. 4 is an end view of the decking unit of FIG. 1 incorporating a light fixture;

FIG. 5 is a fragmentary isometric view of a cellular decking unit incorporating the partition means of this invention;

FIGS. 6 and 7 are end views of a cellular decking unit illustrating alternative positions of the partition means and illustrating adaptation of the lower sub-cell for use in air diffusion and acoustical control, respectively;

FIG. 8 is a fragmentary isometric view of a cellular decking unit presenting two main cells and the partition means of this invention;

FIGS. 9 and 10 are end views of a cellular decking unit providing two main cells and illustrating alternative positions of the partition means; and

FIG. 11 is a fragmentary isometric view of an integrated floor/ceiling structure assembled from the decking units of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

FIG. 1 illustrates a decking unit 15 having an inverted u-shaped profile and including spaced-apart side walls 16, 17, an upper wall 18 connecting the corresponding upper edges of the side walls 16, 17, and oppositely extending flanges 19, 20, one joined to the lower edge of each of the spaced-apart side walls 16, 17. The decking unit 15 is provided with marginal connecting means adapting the decking unit 15 for connection with adjacent decking units. The marginal connecting means may comprise, for example, a bead 21 formed lengthwise of the first upstanding flange 22 adjoining the horizontal flange 19; and a complementary groove 23 formed lengthwise of a second upstanding flange 24 which adjoins the horizontal flange 20. An outwardly and downwardly depending flange 25 may be provided along the upper edge of the second upstanding flange 24. The overall arrangement of the marginal connecting means is such that the lengthwise bead 21 of one decking unit is introduced into the complementary groove 23 of an adjacent decking unit. Thereafter, the depending flange 25 is clinched at selected locations along its length to retain the bead 21 engaged with the complementary groove 23.

The decking unit 15 may be provided with composite features such as hold-down means comprising embossments 26 in the side walls 16, 17 and shear resisting means such as embossments 27 formed in the horizontal flanges 19, 20. The decking unit 15 is intended for use in composite floor construction wherein it achieves a positive mechanical combination with the concrete layer which is poured thereover. The resulting floor develops predictable and reliable composite coaction between the concrete layer and the sheet metal decking unit throughout the lifetime of the building.

It will be observed in FIG. 1 that the spaced-apart side walls 16, 17 and the upper wall 18 cooperate to define a lengthwise channel which may be identified as a main cell 28, notwithstanding the fact that the main cell 28 is open at the bottom.

In accordance with the present invention, partition means 29 is provided within the decking unit 15 for dividing the main cell 28 into upper and lower sub-cells 30, 31. The partition means 29 may comprise a sheet

metal plate 32 which extends between the spaced-apart side walls 16, 17 and which is coextensive in length with the decking unit 15. The sheet metal plate 32 presents downturned flanges 33, 34 along its opposite longitudinal edges, which are secured to the side walls 16, 17 preferably by means of seam welds (not illustrated). The seam weld provides an adequate seal of each of the joints between the downturned flanges 33, 34 and the side walls 16, 17, whereby the sub-cell 30 may be used to convey ventilation air with substantially no air leakage.

It will be observed in FIG. 1 that each of the side walls 16, 17 has ribs 75, 76, 77 formed lengthwise thereof and at selected distances from the upper wall 18. The ribs 75, 76, 77 strengthen each side wall 16, 17 and serve as hold-down means which supplement the hold-down function of the embossments 26.

It will also be observed in FIG. 1 that the pair of ribs 75 of the side walls 16, 17 present opposed grooves 78a, 78b which receive and retain the downturned flanges 33, 34, respectively of the partition means 29. The pairs of ribs 76 and 77 also present opposed grooves 79a, 79b and 80a, 80b. Thus the pairs of ribs 75, 76 and 77 serve also to position the partition means 29 at a selected distance from the upper wall 18, for example. In the decking unit 15, the partition means is positioned such that the sub-cells 30, 31 have unequal cross-sectional areas.

FIG. 2 illustrates a decking unit 15a wherein the flanges 33, 34 of the partition means 29 are engaged with the opposed grooves 79a, 79b of the pair of ribs 76. The decking unit 15a presents sub-cells 30a, 31a having substantially equal cross-sectional areas.

FIG. 3 illustrates a decking unit 15b wherein the flanges 33, 34 of the partition means 29 are engaged with the opposed grooves 80a, 80b of the pair of ribs 77. The decking unit 15b presents upper and lower sub-cells 30b, 31b respectively of unequal cross-sectional areas.

FIG. 4 illustrates a decking unit 15c having a light fixture 35 positioned within the lower sub-cell 31c and secured to the partition means 29. Angle members 36 which are secured to the lower edges of the opposite side walls 16, 17, support a light diffuser plate 37 formed from suitable translucent material. The lower sub-cell 31c serves as a recessed lighting assembly.

FIG. 5 illustrates a cellular decking unit 38 assembled from a flat bottom sheet 39 provided with marginal connecting means 21, 23 and an inverted U-shaped member 40 presenting oppositely extending horizontal flanges 41, 42 overlying the flat bottom sheet 39 and secured thereto by a plurality of spaced spot welds (not visible). The inverted U-shaped member 40 additionally presents spaced-apart side walls 43, 44 and an upper wall 45 which cooperate with the flat bottom sheet 39 to define a lengthwise main cell 46. The side walls 43, 44 are provided with the pairs of ribs 75, 76, 77. The decking unit 38 is provided with partition means 29 having downturned flanges 33, 34 engaged with the opposed grooves 79a, 79b of the pair of ribs 76. The partition means 29 divides the main cell 46 into upper and lower sub-cells 47, 48. The sub-cells 47, 48 have substantially identical cross-sectional areas.

FIG. 6 illustrates a decking unit 38a presenting sub-cells 47a, 48a. The cross-sectional area of the sub-cell 48a is larger than that of the sub-cell 47a. The sub-cell 48a may be adapted, in accordance with the teachings

of the SAWYER et al., U.S. Pat. No. 3,482,505, to provide acoustical insulation for a subjacent room and also to serve as a ventilation air distributing passageway to permit uniform ingress of ventilation air in a relatively quiet manner. The sub-cell 48a thus is provided with an arch-shaped pre-formed acoustical insulating batt 49 having opposite longitudinal edges supported by the bottom plate 39. The opposite longitudinal edges of the batt 49 are provided with a plurality of longitudinally spaced notches 50. The bottom plate 39 is provided with a perforated region 51 disposed as a band along the length of the bottom plate 39 in the region between the vertical side walls 43, 44 of the U-shaped element 40. Ventilation air flowing through that portion of the sub-cell 48a above the batt 49, flows through the notches 50 and through the perforated region 51 and is introduced, in a relatively quiet manner, into the subjacent room. The upper sub-cell 47a may serve as a return air conduit or as a raceway for distributing electrical wiring of a particular service, such as, power, internal communications or telephone services.

FIG. 7 illustrates a decking unit 38b wherein the partition means 29 is positioned to provide a relatively large upper sub-cell 47b and a smaller lower sub-cell 48b. The lower sub-cell 48b is provided with an acoustical insulating batt 52 supported by the flat bottom sheet 39 and overlying the perforated region 51 thereof. The lower sub-cell 48b thus is adapted to provide acoustical control for a subjacent room. The relatively large upper sub-cell 47b may serve as a return air conduit, a supply air conduit or as a raceway for distributing electrical wiring.

FIG. 8 illustrates a cellular decking unit 53 assembled from a flat bottom sheet 54 and a pair of inverted U-shaped members 55 which cooperate with the flat bottom sheet 54 to provide two main cells 56. In the cellular decking unit 53, at least one of the main cells, for example, the main cell 57, is provided with the partition means 29 and presents upper and lower sub-cells 59, 60. The second main cell 58 may remain undivided if desired.

FIG. 9 illustrates a cellular decking unit 53a wherein the second main cell 58 is provided with second partition means 29a and presents upper and lower sub-cells 61, 62. The lower sub-cell 62 may be modified by the provision of the acoustical insulating batt 49 and by the provision of the perforated region or band 51, to provide acoustical insulation for a subjacent room and to serve as a ventilation air distributing passageway, as described above in connection with FIG. 6.

FIG. 10 illustrates a cellular decking unit 53b wherein the lower sub-cell 60b is modified by the inclusion of the insulation pad 52 and by the provision of a second perforated region 51 in the lower metal sheet 54, thereby to provide acoustical insulation for a subjacent room. Also in FIG. 10, the acoustical insulating batt 49 (FIG. 9) has been omitted from the lower sub-cell 62a, whereby the lower sub-cell 62a may serve as a return air conduit by which air is exhausted from a subjacent room.

It will be observed in FIGS. 8 to 10 that the cross-sectional areas of the sub-cells are determined by the position of the partition means 29 relative to the bottom plate 54. For example, in FIG. 9 the upper and lower sub-cells 59a, 60a have substantially equal cross-sectional areas whereas the cross-sectional area of the lower sub-cell 62 is greater than that of the upper sub-

cell 61. It should be readily apparent that numerous combinations of sub-cell sizes can be provided. Thus plurality of any one of the decking units 15, 38 and 53 — including modifications thereof — or combinations thereof can be assembled with an overlying layer of concrete to provide a unique integrated floor/ceiling structure. The principal advantages of the present arrangement are (a) the sub-cells accommodate all of the aforesaid mechanical services as well as other, within an acceptable modular distance; (b) an adequate repetition of each mechanical service is provided throughout the entire floor/ceiling structure; and (c) selected mechanical services are provided for the spaces above and below the floor/ceiling structure by the upper and lower sub-cells, respectively.

FIG. 11 illustrates a portion of an integrated floor/ceiling structure 63 assembled from one of the decking units 53b, one of the decking units 15c, and a decking unit 64 which has not been previously described but which illustrates another possible arrangement. The decking units 53b, 15c and 64 are assembled in side-by-side relation and connected at joints 65. The assembled decking units 53b, 15c and 64 serve as a metal sub-floor 66 over which a layer of concrete 67 is provided.

The decking unit 64 incorporates the partition means 29 and presents upper sub-cells 68, 69 and lower sub-cells 70, 71.

An underfloor electrical cable trench 81 extends transversely of the cells of the sub-floor 66. The trench 81 includes a passageway 82 for distributing low voltage, internal communication or signal wiring 72; a passageway 83 for distributing multi-conductor telephone wiring 73; and a passageway 84 for distributing high voltage power wiring 74.

The assembled decking units 35b, 15c and 64 represent an acceptable modular distance M having a typical width of about 5 feet. It will be observed in FIG. 11 that the various sub-cells provided by the metal sub-floor 66 accommodate numerous mechanical services, all within the depth of the integrated floor/ceiling structure 63 and all within the acceptable modular distance M.

In particular, the upper sub-cells 68, 69, 30c, 59b and 61 accommodate selected mechanical services for the space 85 above the structure 63. For example, the upper sub-cell 30c of the decking unit 15c receives low voltage, internal communication or signal wiring 72 from the trench passageway 82. Similarly, the upper sub-cells 61, 68 of the decking units 53b, 64 receive telephone wiring 73 and power wiring 74, respectively, from the trench passageways 83, 84. A selected signal wire 72a, telephone wire 73a, and power wire 74a extend upwardly through suitable outlet means schematically illustrated at 86, 87 and 88, respectively, into the space 85 above the floor/ceiling structure 63. The signal wire 72a may be connected, for example, to an alarm schematically illustrated at 89. The conductors of the multi-conductor telephone cable 73a may be connected to a plurality of telephones, one of which is schematically illustrated at 90. The power wiring 74a may be connected, for example, to a motor schematically illustrated at 91. In addition to electrical distribution, ventilation air is conveyed through the upper sub-cell 69 of the decking unit 64 and is introduced into the space 85 through outlet means, such as, a fitting 92. The upper sub-cell 59b of the decking unit 53b serves as an exhaust air conduit. Exhaust air from the space

85 is introduced into the upper sub-cell 59b through inlet means, such as, a fitting 93. The outlet means 86, 87, 88, 92 and the inlet means 93 provide communication between the upper sub-cells of the sub-floor 66 and the space 85 above the integrated floor/ceiling structure. 5

The lower sub-cells 70, 71, 31c, 60b and 62 accommodate selected mechanical services for the space 94 below the floor/ceiling structure 63. For example, recessed lighting for the space 94 is provided by the lower sub-cell 31c of the decking unit 15c. Acoustical control for the space 94 is provided by the lower sub-cells 70, 71 of the decking unit 64 and by the lower sub-cell 60b of the decking unit 53b. Conditioned air is introduced into the space 94 by the sub-cell 70 of the decking unit 64. The lower sub-cell 62 of the decking unit 53b serves as a return air conduit for exhausting air from the space 94. 10 15

Thus communication between the lower sub-cells of the sub-floor 66 and the space 94 for the purposes of acoustical control, lighting, ventilation and exhaust, is provided by means of the perforated regions 51 of the decking units 53b and 64 and by means of the light diffuser plate 37 of the decking unit 15c. The overall arrangement is such that adequate acoustical control, electrical distribution, lighting, ventilation air and exhaust air can be provided for a building space, by upper and lower integrated floor/ceiling structures of this invention which contain a plurality of the modules M. 20 25

It is to be noted that FIG. 11 is intended to illustrate a typical arrangement of sub-cells and the mechanical services contained thereby. 30

I claim:

1. In an integrated floor/ceiling structure comprising a metal cellular sub-floor and an overlying layer of concrete, the improvement comprising: 35
 - said metal cellular sub-floor being assembled from groups of decking units arranged in side-by-side interconnected relation, wherein the decking units of each group present plural, spaced-apart, parallel 40

main cells each including spaced-apart side walls, an upper wall connecting the corresponding first ends of said spaced-apart side walls and a flat bottom sheet extending between the corresponding opposite ends of said side walls;

partition means disposed within and confronting the upper wall of each of selected ones of said main cells of each group of decking units for dividing the selected main cells into upper and lower sub-cells, said partition means having opposite longitudinal edges secured to said spaced-apart side walls and being positioned at selected distances from the confronting upper walls of the selected main cells thereby to provide upper and lower sub-cells of selected cross-sectional areas;

plural first means, each providing communication between one of the said upper sub-cells and the space above the said integrated floor/ceiling structure; and

plural second means, each providing communication between one of the said lower sub-cells and the space below the said integrated floor/ceiling structure;

said upper sub-cells providing selected mechanical services for the space above said integrated floor/ceiling structure, and simultaneously said lower sub-cells providing selected mechanical services for the space below said floor/ceiling structure, whereby a repetition of each mechanical service is provided by said groups of decking units throughout said integrated floor/ceiling structure.

2. The improvement of claim 1 wherein the upper and lower cells of each of certain selected main cells simultaneously provide different mechanical services for the space above and below said integrated said floor/ceiling structure.

3. The improvement of claim 1 wherein each said partition means is imperforate.

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