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PANEL STRUCTURE

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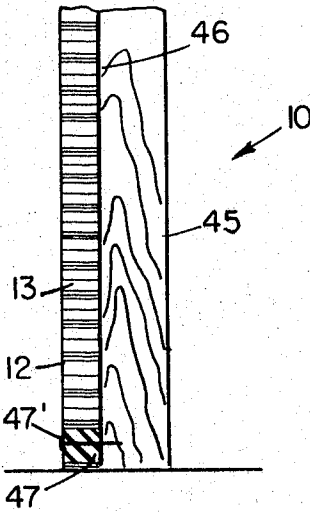


Fig. 1

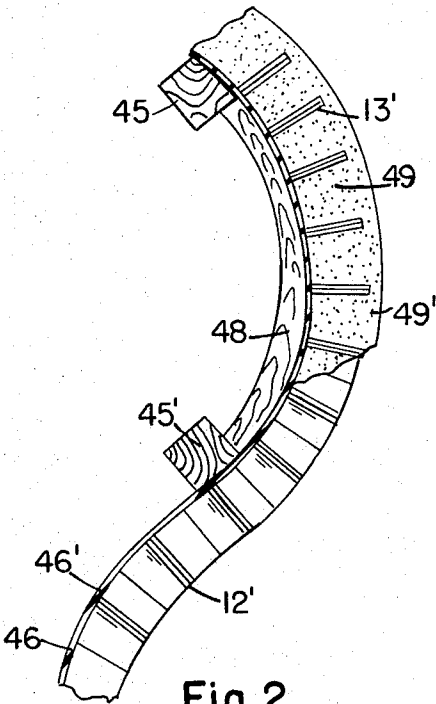


Fig. 2

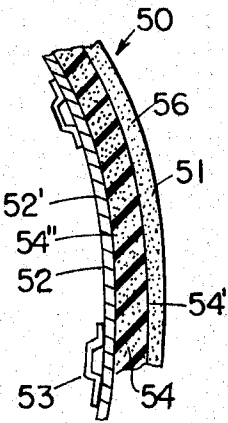


Fig. 3

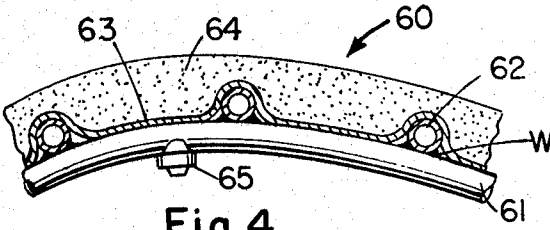


Fig. 4

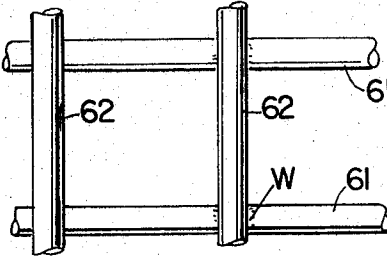


Fig. 5

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PANEL STRUCTURE

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This invention relates to panel construction applicable to building walls, architectural structures, equipment housings and the like and is a continuation-in-part of my copending application Serial Number 555,146 for Panel Construction which was filed on December 23, 1955, now abandoned.

It is frequently desirable to provide a composite wall panel for architectural purposes which may be used as a wall or ceiling per se in a flat or curved configuration. Conventional panels made of metal, board, plastic or mortar or combinations of these materials serve their intended purposes but have a number of limitations. For example, such panels have generally flat configurations which are assembled edge-to-edge to provide flat walls and partitions. Curved wall structures generally require the fabrication of a skeletal structure on the site from a plurality of ribs joined by cross braces, uprights, etc. Panel structures are provided herein which may be easily made to conform to a desired predetermined shape either prior to or during the erection of a wall or ceiling by employing, as a component of the panel, a base on which the panel is formed which base is capable of being deflected or bent to the shape desired.

Accordingly, it is a primary object of this invention to provide new and improved structures in wall panels and components therefor.

Another object is to provide a structure in a building wall which may be rapidly erected on-the-site with a minimum amount of labor required in relation to that required for the conventional wall panel.

Another object is to provide an improved wall panel employing a deformable component or array of fluid carrying conduits.

Another object is to provide an improved panel including a tubed sheet component.

With the above and other such objects in view as may hereinafter more fully appear, the invention consists of the novel construction, combination and arrangement of parts as will hereinafter be more fully described and illustrated in the accompanying drawings, but it is to be understood that changes, variations and modifications may be resorted to which fall within the scope of the invention as claimed.

In the drawings:

FIG. 1 is a side view with part sectioned for clarity, of a wall panel structure prior to completion; FIG. 2 is an end view with parts broken away for clarity of the panel of FIG. 1 in a further stage of development;

FIG. 3 is an end view in cross section of a fragment of a wall panel employing a cellular plastic portion;

FIG. 4 is a cross sectional view of a panel employing a lattice-like array of tubes for support and heat transfer purposes.

FIG. 5 is a plan view of the tube arrangement of FIG. 4.

There is shown in FIGS. 1 and 2 structural details of a curved wall panel which may be fabricated by the improved method to be described hereafter. Referring first to the structure of the panel, the assembly 10 includes a first panel member 12 which may comprise a flexible array of self supporting elements 13 which may comprise any suitable assembly of strips or bars defining a lattice. In FIG. 2, the lattice panel 12 is shown as comprising a plurality of strips 13 which are shaped or deformed and joined together to define a honeycomb structure. Various types of lattice structures and honeycomb con-

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structions are known in the art, many of which are capable of being flexed or curved without fracturing or permanently yielding the individual elements of the panel. For example, most metal or plastic impregnated paper-board honeycomb structures may be curved or deflected to define a cylindrical or dome-like panel if bent or deflected in at least one direction and will assume a convex bow-like shape if urged in bending in the other direction. Either shape may be used to advantage in architectural structures such as wall or ceiling paneling. Most lattice-like arrays of joined strip or bar elements may be curved or deflected without permanently deforming and may be retained in such condition by the means provided hereinafter or by other suitable means to provide not only a skeletal structure on which to build a mortar, plaster or cement wall but also means for affording at least some support for said plaster or cement after it has set.

Accordingly, the lattice or honeycomb panel 12 is shown supported by a frame-work of beams, of which two beams 45 and 45' are illustrated in FIG. 2, and members 48 which extend between said beams to support the latter and to afford support to the panel 12 as well as to assist in defining its shape. The beams illustrated are suitably made of wood as are the cross-braces 48 which are cut or formed to the desired curved shape whereby they will either support or define the shape of the honeycomb panel 12. The ends of the cross-brace members 48 are fastened to the beams by means of nails or other suitable fasteners and the honeycomb panel 12 is made to conform to the shape defined by the beams and the cross-brace members 48 in one or more of several manners prior to the application of a bulk filler material thereto.

In a preferred embodiment, one face of the panel 12 is shown in FIG. 2 as being capped with a sheet of material 46 which preferably extends across the entire face thereof. The sheet 46, which may comprise any suitable plastic, metal, paperboard or laminations of these materials, is preferably relatively in light gauge and in the order of .010 to .10 inch thick in order to permit it to conform to the curved shape of the honeycomb panel when deformed as illustrated although lighter or heavier gauge plastic or metal sheet may be employed depending on the size of the panel framework structure and degree of bending desired. For certain panel structures which are fabricated by spraying-on the bulk material which eventually comprises the major portion of the panel, the sheet material 46 may comprise a thin, flexible plastic sheet or film in the order of a few thousandths of an inch in thickness particularly if the filler material 49 is build up thereon as a series of sprayed-on coatings each coating suitably being sprayed on after the previous coating has solidified so that said previous coating may, in itself, comprise a support for subsequent layers. However, if it is desired to utilize the inside surface 46' as the wall of the room, sheet 46 may be adhesively bonded or otherwise retained against the face of panel 12.

Retention of the panel 12 against the beams 45 may be obtained by fastening the sheet member 46 thereto and/or by the means illustrated in FIG. 1. A block of wood 47 or other suitable material is shown filling and secured within at least one of the cells of the honeycomb panel 12 by adhesive means. A fastener 47' driven through the block 47 from the uncapped face of the panel is shown driven into the beam 45 and retains the assembly thereagainst.

In the partially sectioned view shown in FIG. 2, filler material 49 which may comprise any suitable mortar, plaster, Portland cement, plastic or foamed plastic is shown completely filling the cells of the lattice or honeycomb panel member 12 and extends a distance beyond the exposed face 12' of panel 12 as a layer 49' so that the edge of the panel 12 is completely covered over and may

not be seen. The bulk material 49 is preferably applied by spraying it or flowing it into the cells of the panel 12 in a plurality of coating operations so that previous layers, when hardened or set, will offer support to subsequent layers applied thereto. As a result, a minimum amount of deformation will be experienced in the strips or wall portions 13 of the panel 12 due to the weight of the filler material 49. The manner in which the filler material is applied to the panel assembly will depend on a number of factors including, in addition to the geometry and stiffness of panel 12, the means for supporting said panel, and the attitude of the panel. For example, if the panel 12 is disposed substantially vertically when supported, spraying or flowing the bulk material into the cells may be the best way to apply it thereto. If the panel is disposed in a horizontal attitude or obliquely to the horizontal and the capping sheet 46 is bonded to the undersurface of the honeycomb panel 12 with sufficient strength to support enough bulk material to fill the cells of the panel, it may suffice to pour the bulk filler material into the cells or to combine the process of flowing and spraying said material.

Once the bulk material has set or hardened, the supporting frame or members 45, 45', 48 etc. may be removed, or retained for providing additional support. The capping sheet 46 may also be stripped off or may serve as a working surface. A further operation may include spraying additional bulk material or cement against the outer surface 46' of sheet 46 to give the appearance that the entire panel is made of said material and to provide a wall surface of simple appearance. In a further embodiment, if the panel 12 is disposed substantially horizontally or curved in a generally horizontal attitude, the capping sheet 46 may be applied to the surface 12' of panel 12 provided that said surface faces upwardly and mortar or cement may be applied to the outer surface of sheet 46 by spraying means without applying said mortar to the cells of the honeycomb panel member 12 to provide an improved method for forming a curved ceiling member or roof. For such a structure, the beams 45 and 45' as well as the framework 48 therebetween may be retained in place and supported by vertical columns or removed after the mortar or cement has hardened.

It is to be noted that the honeycomb panel member on which the mortar or cement is applied as a series of successive layers may be replaced by other suitable panel members which, although they may not exhibit similar strength and bending characteristics, will serve the important function of providing a base which will retain said Portland cement, mortar or the like when it is applied by spraying or flowing on in successive layers. For example, flexible plastic, sponge-like or foamed materials are available in slab or sheet form which have open surface cells into which the lay-up material or mortar will flow when applied thereto as a fluent material. Due to the irregularity of the cell walls, which may be provided in many different sizes, flexibility and configurations for such expanded plastics as urethanes, vinyls, silicone resins, styrenes and the like, the first layer or coating applied to the face of a sheet of supported foamed plastic having open surface cells may be substantially secured to the surface thereof to retain a substantial build-up of material against the base panel even though the adhesion between the two materials is poor. After the applied material has set or hardened, the cellular plastic base sheet may be retained in place with or without retention of the frame or other means for supporting said plastic or, both may be removed by stripping off the plastic. The remaining hardened shell may then have the surface from which the plastic is removed, resurfaced by spraying, etc. Or, the foamed plastic base may be retained as an insulating means and its other surface capped or coated with additional mortar or the like of the same or different thickness than the layers first applied thereto.

FIG. 3 illustrates another structure in a wall panel

50, hereinabove mentioned, in which a sheet or slab or deformable foamed, cellular plastic material such as expanded polystyrene, urethane or the like serves as a base for retaining a plurality of layers of mortar or cement applied thereto by spraying or other means to define a building wall or similar structure. A slab 54 suitably of foamed, cellular plastic material, as described, is shown retained against a frame or other support means 52 to define a particular shape for the wall 51. In FIG. 3, the frame comprises a plurality of ribs 52' which are joined by crossmembers 53 shown as flanged channels welded thereto. The frame, of course, may be made of any suitable material such as wood, rod, tubing of steel or aluminum. Secured to one side of the frame there is shown a slab 54 of said cellular plastic material which may be held thereon by means of fasteners, wire stitching, adhesive or other means. Depending on the shape of the frame, the cellular plastic slab may be curved or deformed to any desirable shape to conform to the frame, after which, a layer of Portland cement, mortar or any suitable self setting building material including additional layers of rigid foamed plastic may be applied to the outer surface 54' of cellular plastic slab 54. The capping material 56 may be formed of a plurality of layers applied by means of a spray gun whereby each previous layer is allowed to set or harden prior to applying the next layer thereon until a wall of a predetermined thickness is derived. Depending on the thickness of the cement or mortar capping layer 56, the frame comprising members 52', 53 may be retained in place or removed thereafter. Furthermore the other surface 54'' of the cellular plastic slab or sheet 54 may also be coated or built-up with a layer of mortar or cement of predetermined thickness by spraying thereon. The interlayer i.e. slab 54 of foamed plastic will thus serve as a vapor barrier and insulating medium within the wall 51.

Other forms of the invention include, (a) applying to the honeycomb, metal or panel assemblies described, a self-foaming plastic such as urethane or vinyl chloride adapted to self-expand, by spraying said plastic or flowing it onto said base. The sprayed-on, foamed cellular plastic material may thereafter be capped or coated with plaster, cement, plastic, paint or metal sheet.

Any suitable base panel or sheet may be utilized which will conform to the desired shape and will retain the mortar or plastic material applied thereto. FIGS. 4 and 5 show panel configurations having as a component thereof metal sheeting which may be used as a replacement for the honeycomb panel or combined therewith. The sheet formations may be fabricated of such metals as steel or aluminum sheeting on a continuous basis in roll or flat stock form by means of roller or flat dies.

In FIG. 1 a panel assembly 60 employs a supporting frame made of metal tubing. After completion of the panel, the tubing may serve as means for conducting heat transfer fluid for heating and/or cooling the space immediately adjacent the wall panel. The panel 60 is defined by a plurality of longitudinal metal tubes or pipes 61 which may be curved or bent as illustrated prior to assembly with a plurality of laterally disposed tubes or pipes 62 to eventually define a curved wall, ceiling or other building structure capable of self support. The lattice-like array of tubes 61 and 62 may also be curved, bent or bowed upon erection on a further frame (not illustrated) or, as defined by other restraining means such as taut wires or the effect of gravity thereon. The tubes are shown welded to each other at points W where they cross although other fastening means such as bent wire, U shaped bolts or the like may also be employed to assemble the tubing in the desired lattice-like array. The panel 60 may also comprise tubing joined by tubing plus rods, angles, ribs or other solid shapes depending on the design parameters and the heat transfer effects desired.

In order to construct a wall panel of such lattice-like array 60, a sheet 63 of plastic, metal, cloth or laminations

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of these materials is disposed against the upper face of the panel structure 60 and a layer or plurality of layers of mortar or cement are then built-up thereon by spraying, direct flow or other means to define the wall layer 64. The panel structure 60 illustrated in FIG. 4 may comprise, in addition to a wall, a dome or ceiling or a building which may be rapidly constructed in place with minimum labor by, for example, spraying mortar, cement or self foaming plastic against the sheet or film 63 after it is laid on or secured to the lattice-like structure.

Notation 65 refers to a nozzle defining an opening in the tubing 61 through which water may be dispensed as a spray in the event of a fire occurring within the room defined by the wall panel structure 60. The nozzle 65 may also contain the conventional relief valve operated by heat for dispensing water therefrom. The lattice-like structure may thus be utilized to perform a plurality of functions including, in addition to providing means for supporting the plaster or cement layer 64 during the lay-up thereof, means for providing conduits for the transfer of heat to cool or heat the room and means for dispensing liquid in the form of a spray for the mentioned purposes.

I claim:

1. A composite self-supporting panel structure for use in buildings and the like comprising an assembly of a first panel member including a sheet of foamed plastic material having open surface cells, skeletal means for supporting said sheet of foamed plastic, a material having a greater rigidity than said foamed plastic sheet solidified in situ on and covering one face of said foamed plastic sheet, said covering material being formed as a plurality of layers on said foamed plastic sheet with the base layer of said covering material penetrating the open surface cells of said foamed plastic and being integrally secured thereto by virtue of the retention of said base layer within said cells, said foamed plastic sheet defining a base for supporting said layer of covering material.

2. A panel structure in accordance with claim 1, said skeletal means comprising a cellular honeycomb panel, supporting means for said honeycomb panel, said foamed plastic sheet being bonded to a surface of said honeycomb panel, and means covering the other face of said honeycomb panel to close off the cells thereof.

3. A panel structure in accordance with claim 2, said means covering the other face of said honeycomb panel comprising a metal sheet disposed against the other face of said honeycomb panel.

4. A panel structure comprising in combination, a first panel member having a honeycomb cellular structure, means secured to said first panel member for supporting said honeycomb structure, the cells of said honeycomb structure containing a foamed plastic material bonded to the walls of said cells, said foamed plastic material having open surface cells, and a cold-setting mortar material secured to a face of said first panel member and penetrating the surface cells of said foamed plastic material whereby said mortar is integrally secured to said plastic and retained thereby in assembly with said honeycomb structure.

5. A panel structure comprising a honeycomb panel member, defining a plurality of adjacent cells, a sheet of deformable material bonded to a first surface of said honeycomb member and closing off the cells thereof, supporting means for said panel, means for securing said panel to said support means in a curved or bowed condition, and a foamed plastic material filling the cells of said honeycomb member and extending outward from the other face thereof.

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6. A panel structure comprising a first panel member made of a sheet of foamed plastic material having open surface cells, means disposed against and secured to said foamed member for supporting same and defining the contour thereof, and a second portion of said panel made of a material which is solidified in situ on at least one surface of said first panel member, said solidified material being mechanically secured to said one surface of said foamed plastic material by virtue of the penetration and solidification of said material within said open surface cells thereby forming an integral assembly between the foamed plastic material and solidified material.

7. A composite self-supporting panel comprising in combination:

a first panel member including a sheet of foamed plastic having open surface cells and capable of being bowed without permanently deforming said sheet, skeletal means comprising a plurality of rib-like elements secured together, said skeletal means being anchored for supporting said sheet of foamed plastic, means for fastening said foamed plastic sheet to said skeletal means in a curved configuration, and a second material having a greater rigidity than said foamed plastic sheet secured as an integral layer to one face of said foamed plastic sheet by virtue of retention of a portion of said second material within the cells of said foamed plastic sheet whereby said foamed plastic sheet defines a base with a curved surface for supporting said second material.

8. A composite, self-supporting panel in accordance with claim 7, said second material being a cold setting mortar solidified in situ against said curved surface of said bowed, foamed plastic sheet.

9. A composite panel comprising in combination: a first panel member including a sheet of foamed plastic having open surface cells, skeletal means comprising a plurality of elongated rigid structural members crossing each other in a lattice-like array and anchored for supporting said sheet of foamed plastic, at least certain of said structural members being tubular in shape and operative for circulating a heat transfer fluid for conducting heat relative to a surface of said panel, and a sheet of second material integrally bonded against one face of said foamed plastic material by virtue of retention of a portion of said second material within the cells of said foamed plastic sheet.

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