Nov. 12, 1963 T. N. JEFFRESS 3,110,131

BUILDING CONSTRUCTION

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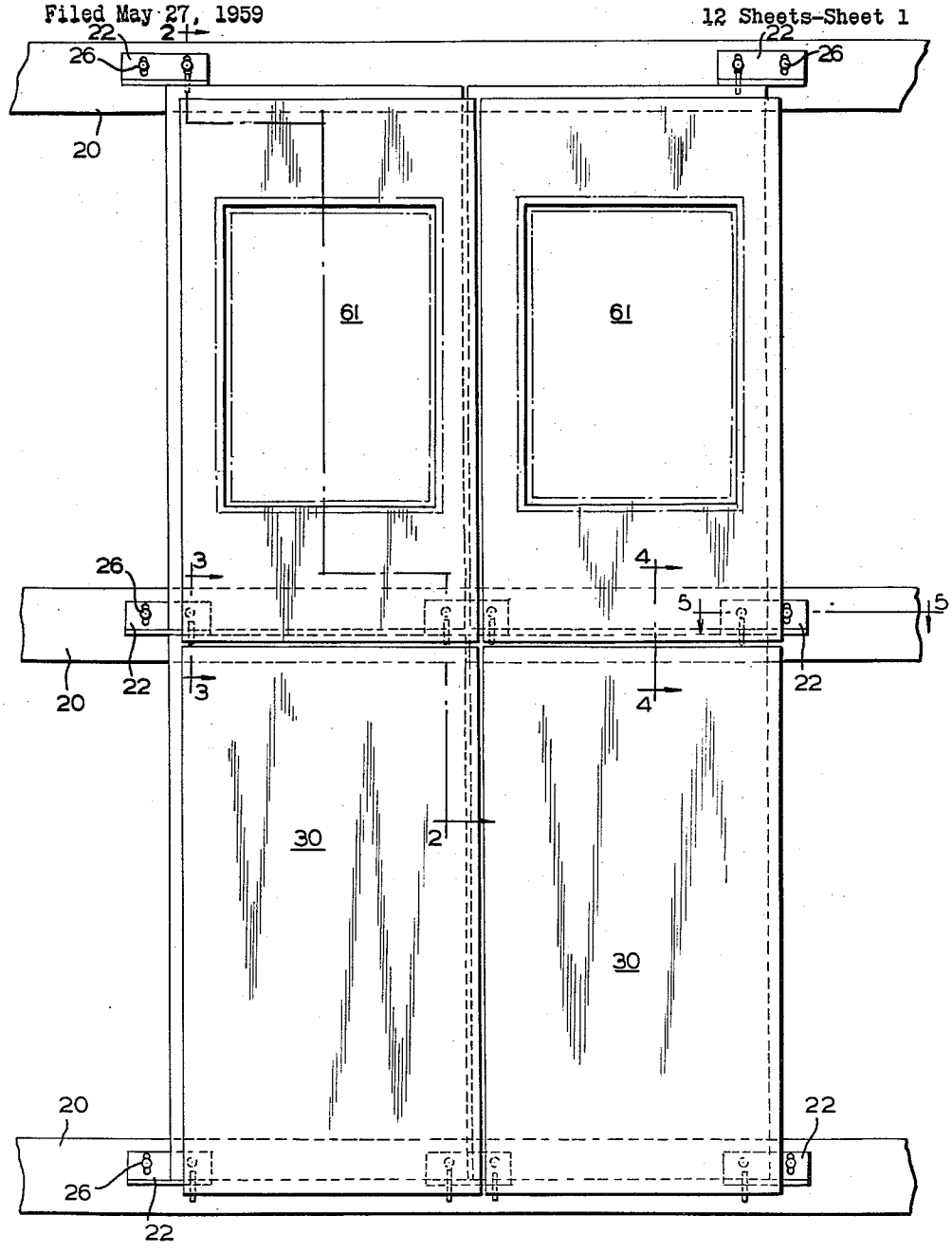

FIG 1.

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BUILDING CONSTRUCTION

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FIG 2.

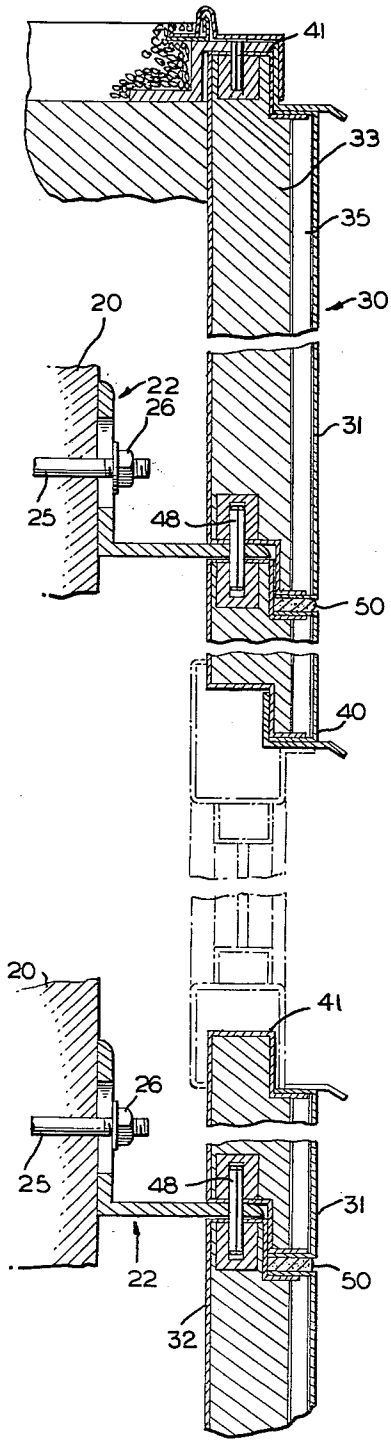
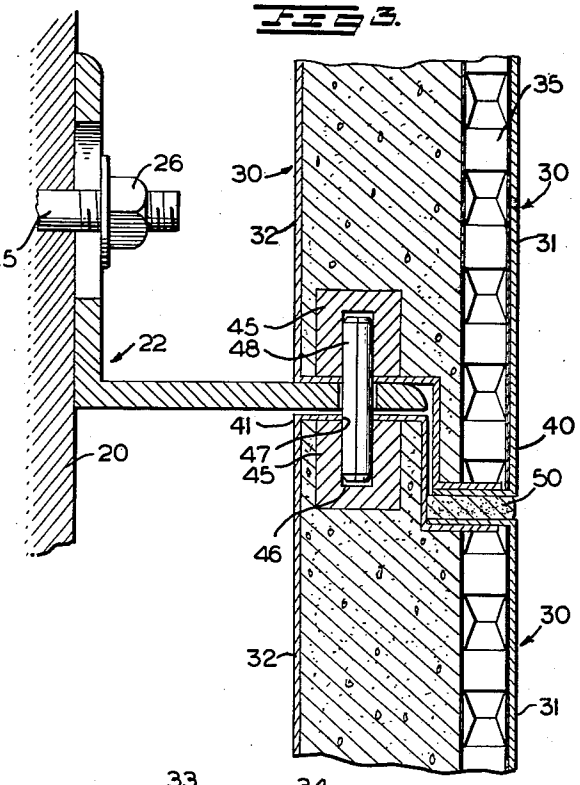


FIG 3.



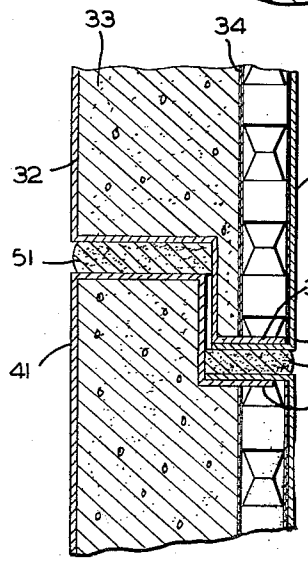


FIG 4.

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BUILDING CONSTRUCTION

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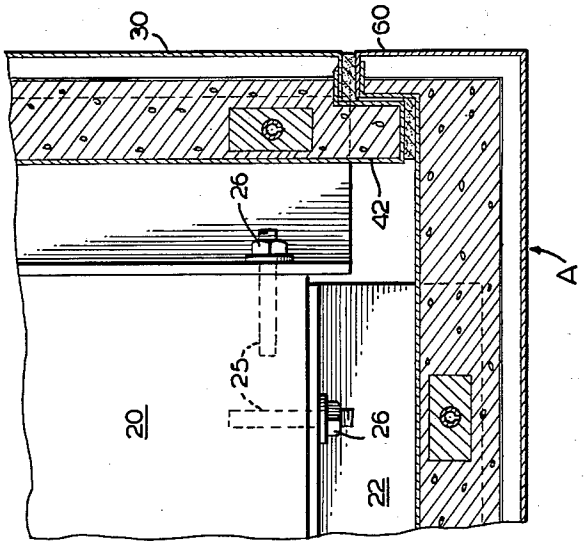
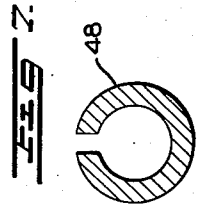


FIG 7.



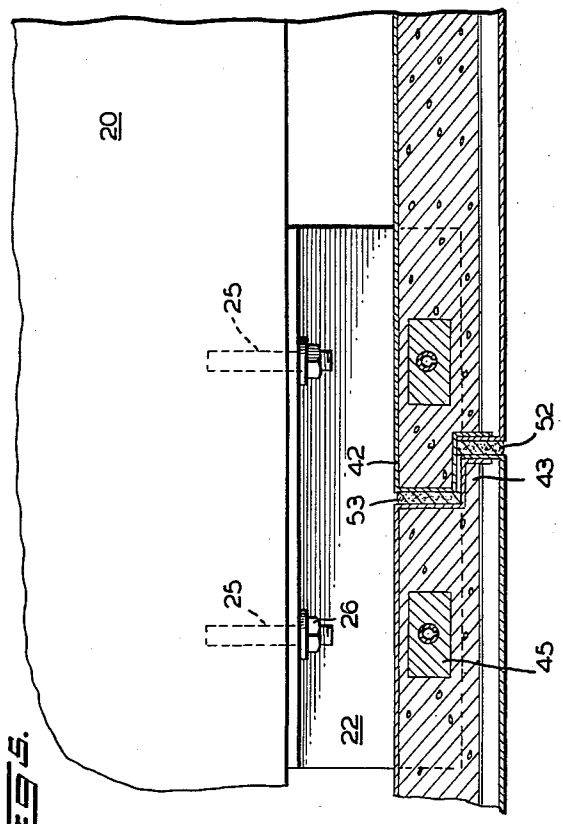


FIG 5.

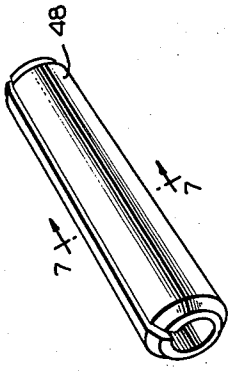


FIG 6.

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BUILDING CONSTRUCTION

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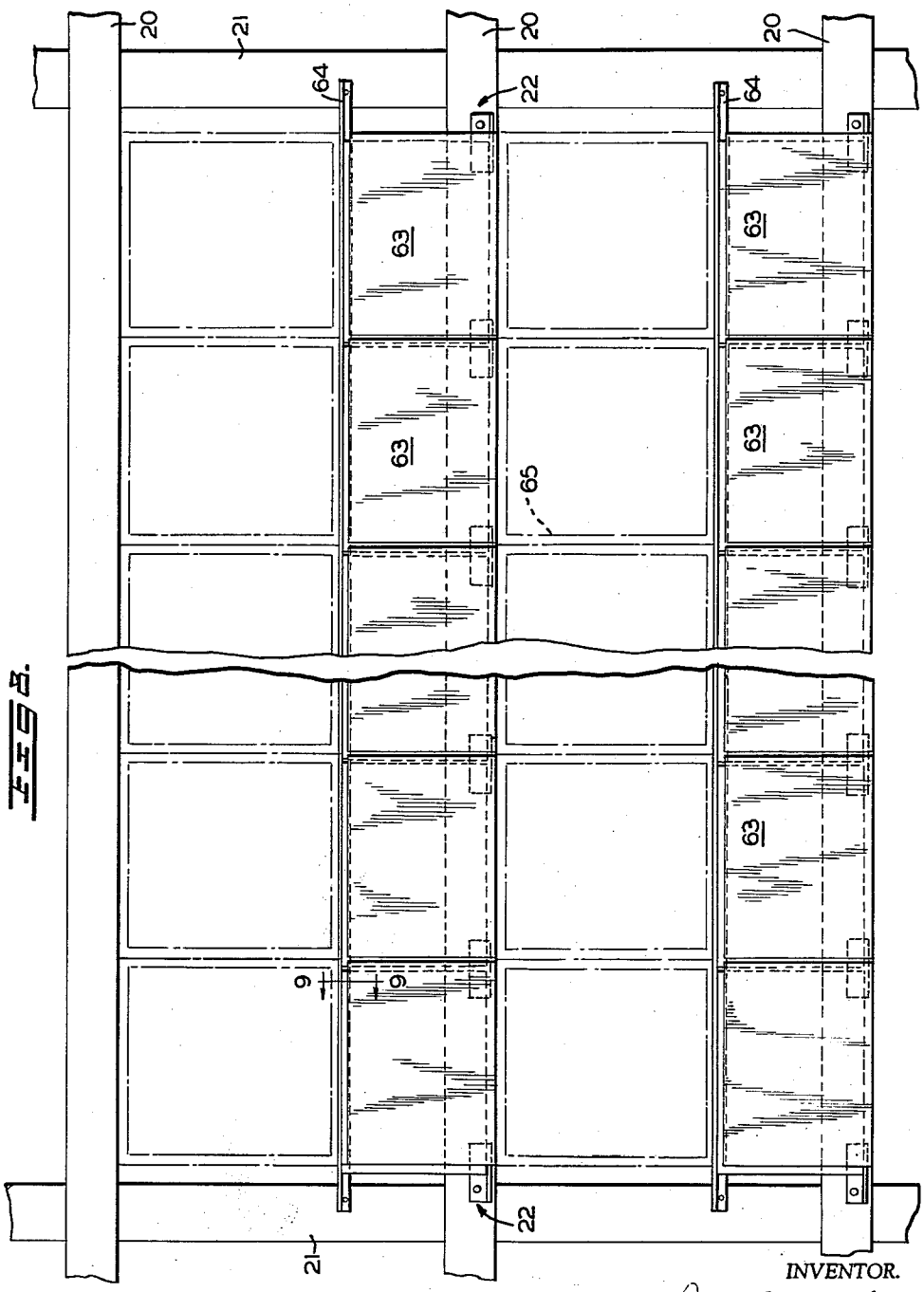

FIG. 12.

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BUILDING CONSTRUCTION

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Fig 9.

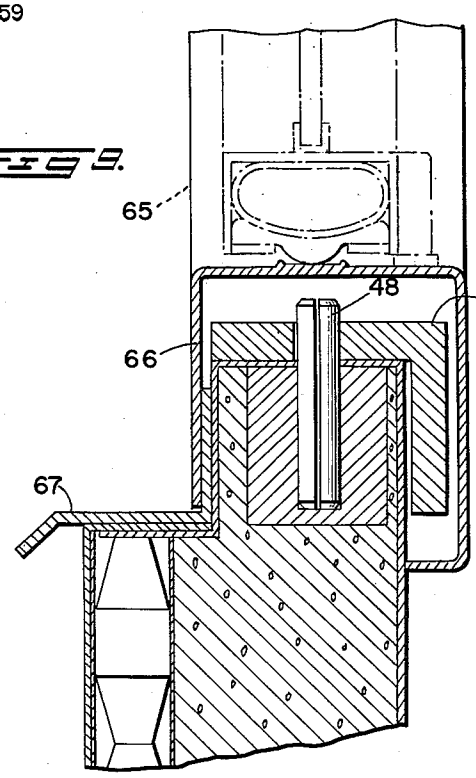
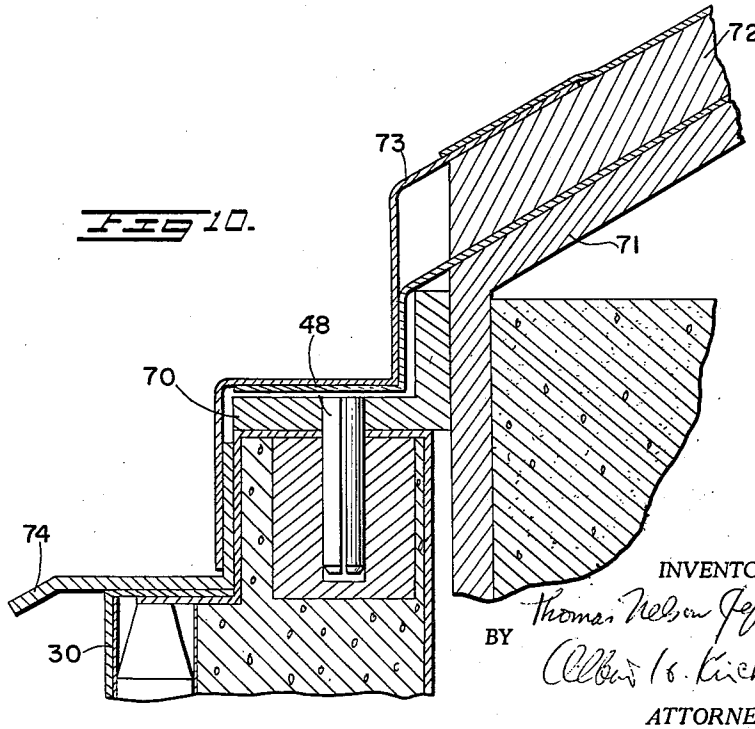


Fig 10.



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BUILDING CONSTRUCTION

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Fig 11.

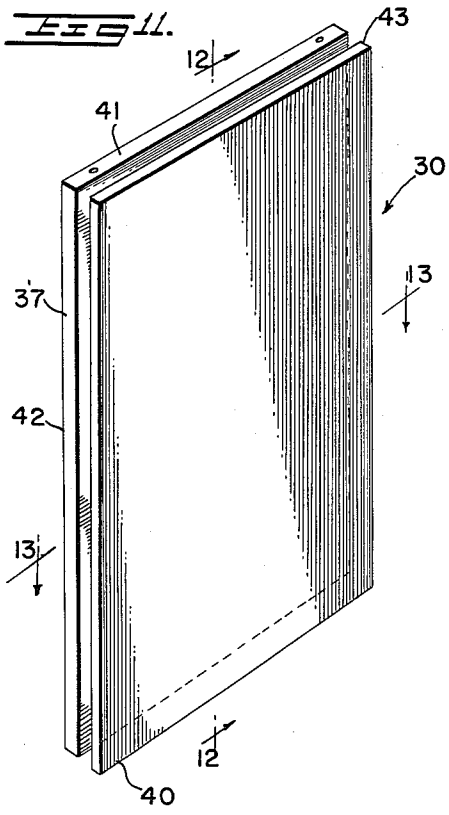


Fig 12.

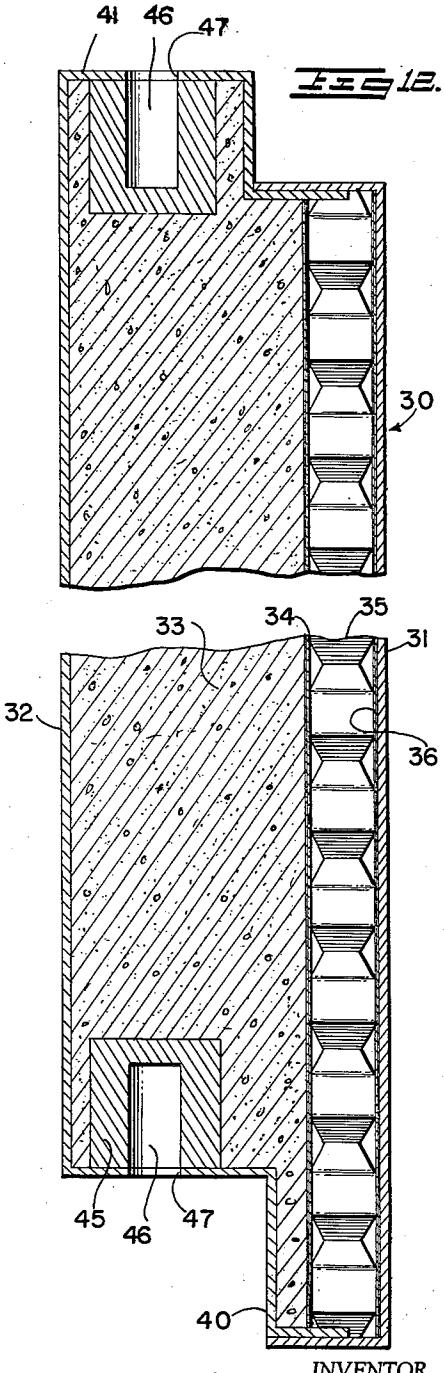
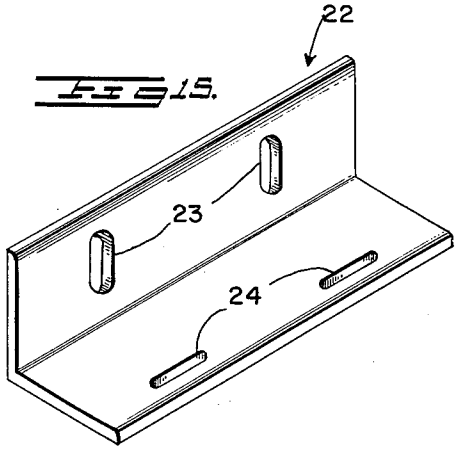


Fig 15.



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BUILDING CONSTRUCTION

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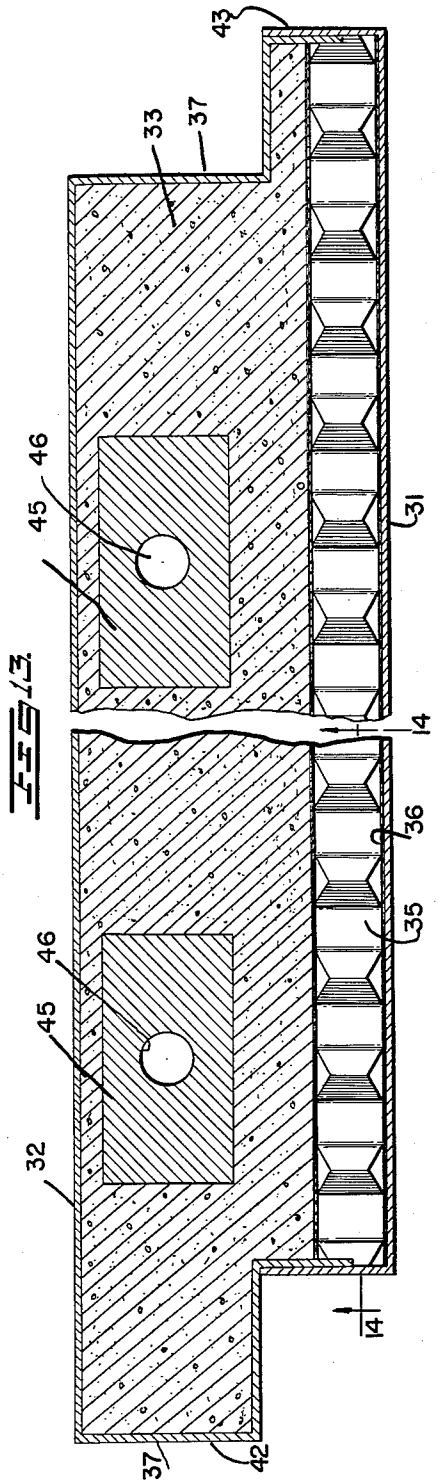

FIG 13.

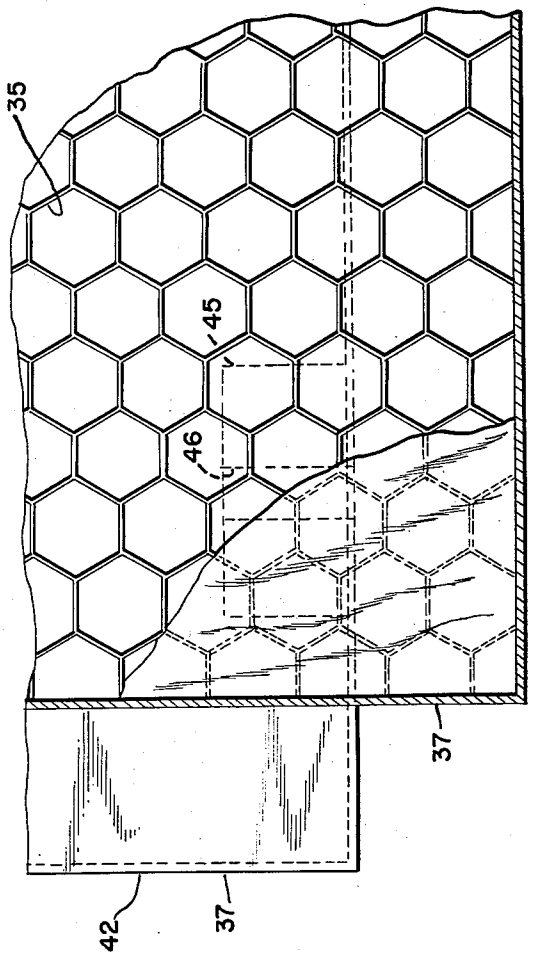

FIG 14.

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BUILDING CONSTRUCTION

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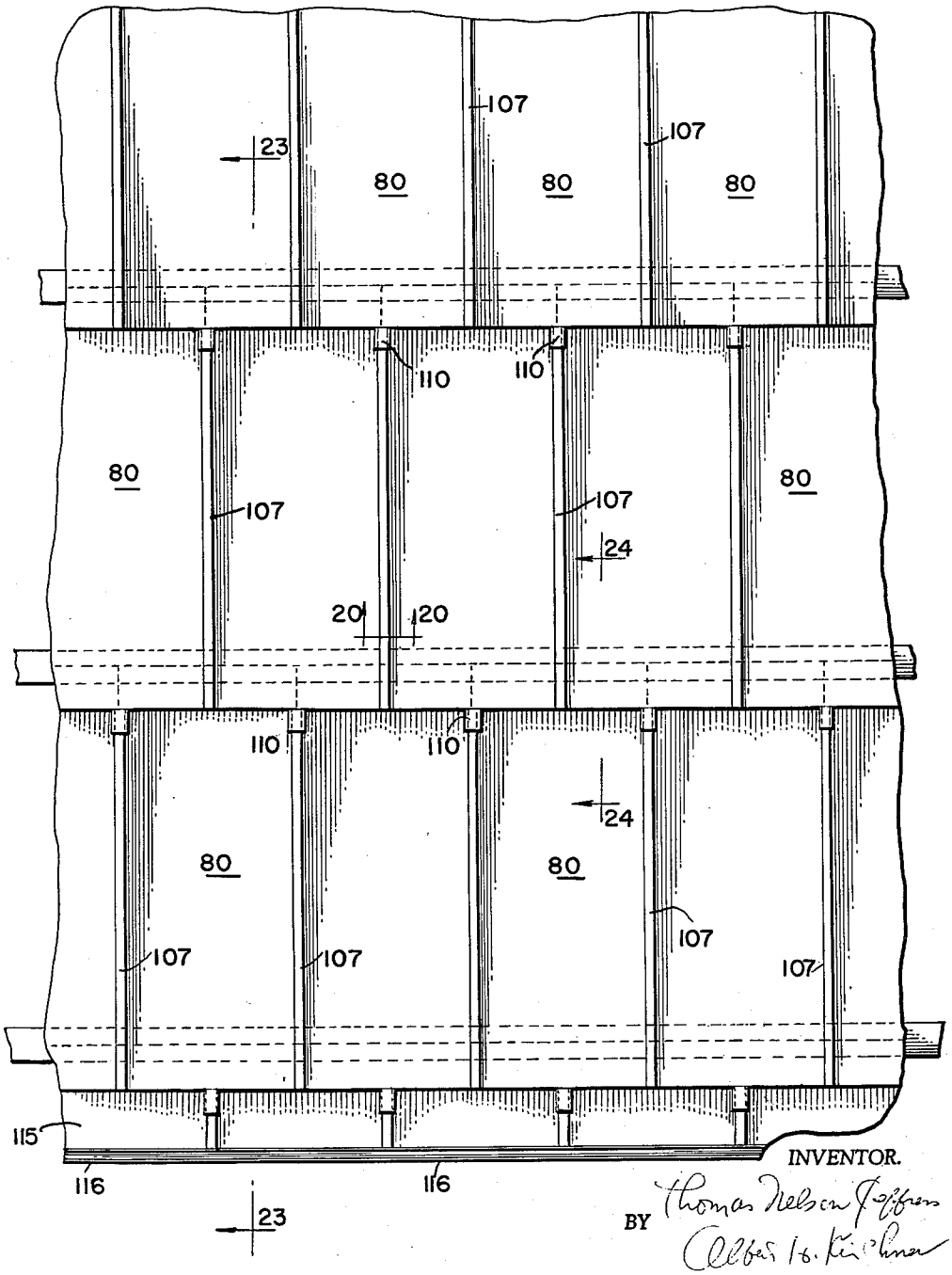
FIG 18.



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BUILDING CONSTRUCTION

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Fig 17

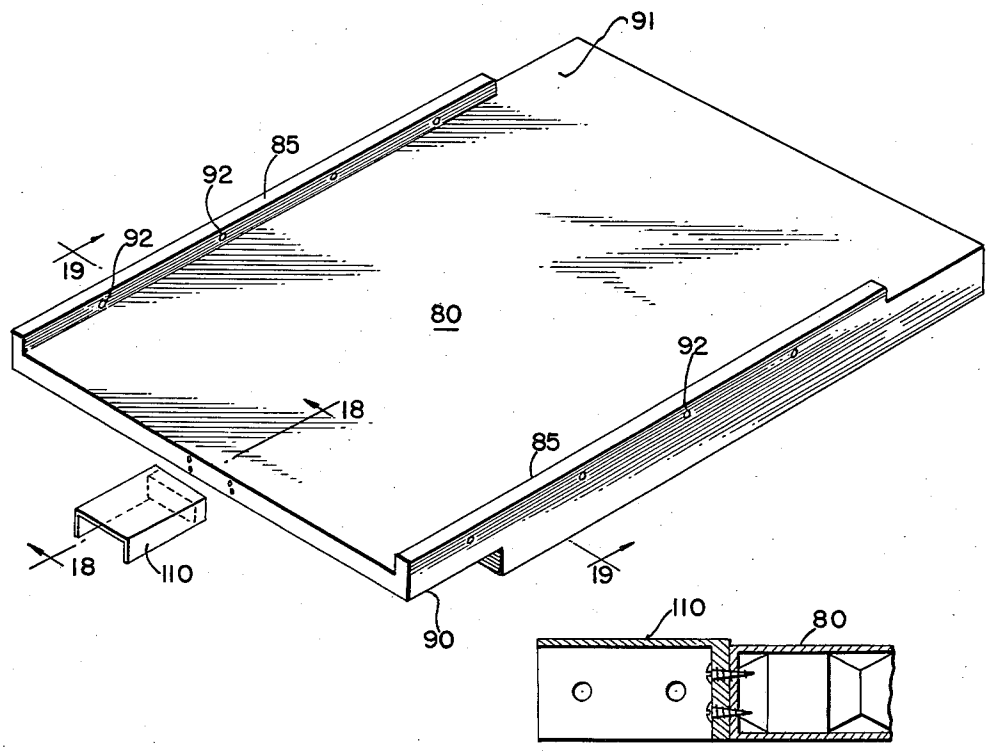

Fig 18.

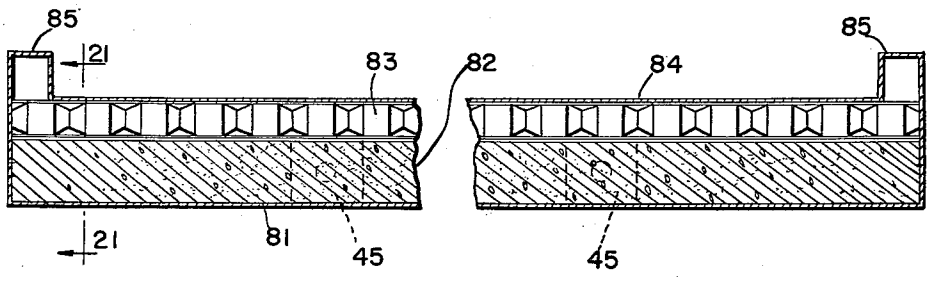

Fig 19.

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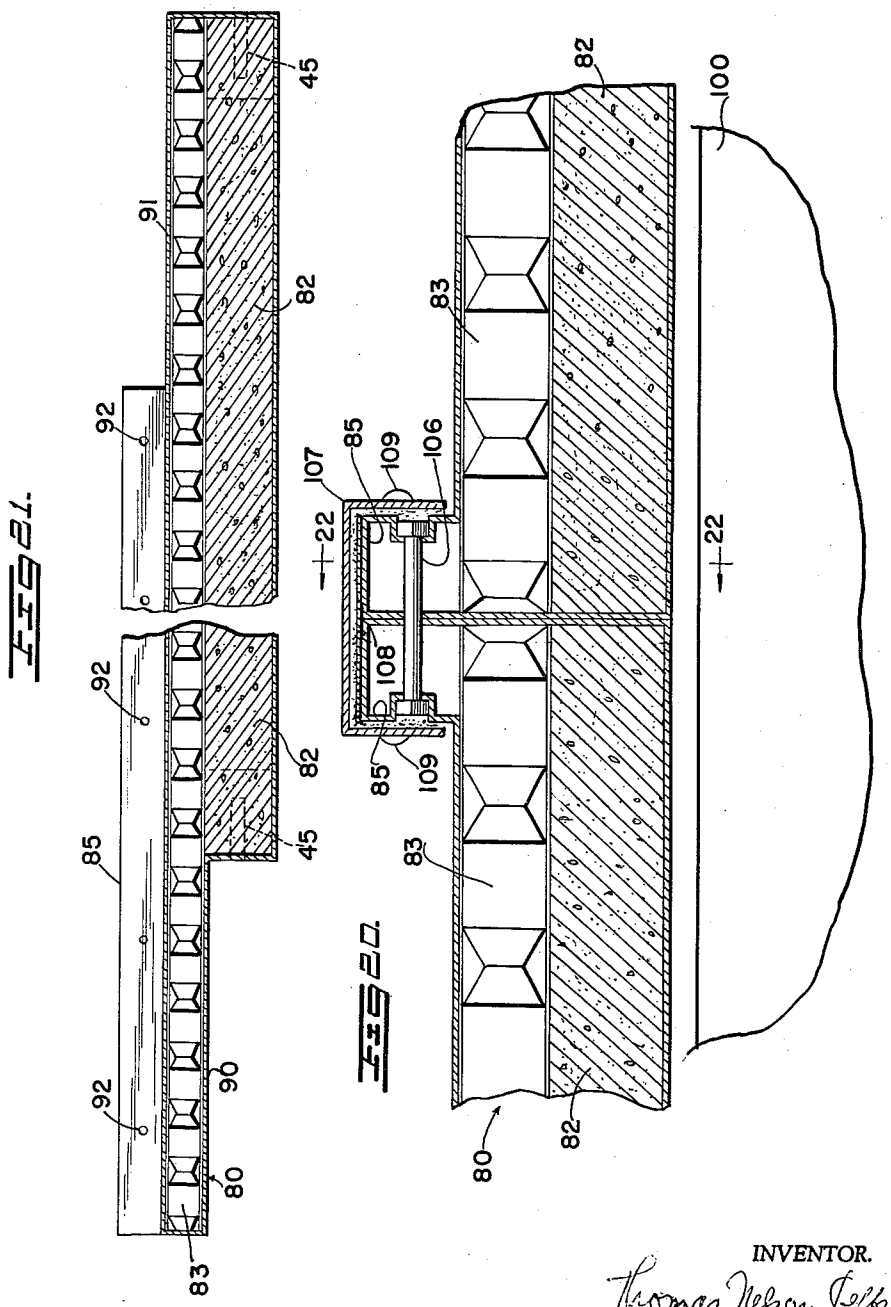

FIG. 21.

FIG. 20.

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Nov. 12, 1963 T. N. JEFFRESS 3,110,131

BUILDING CONSTRUCTION

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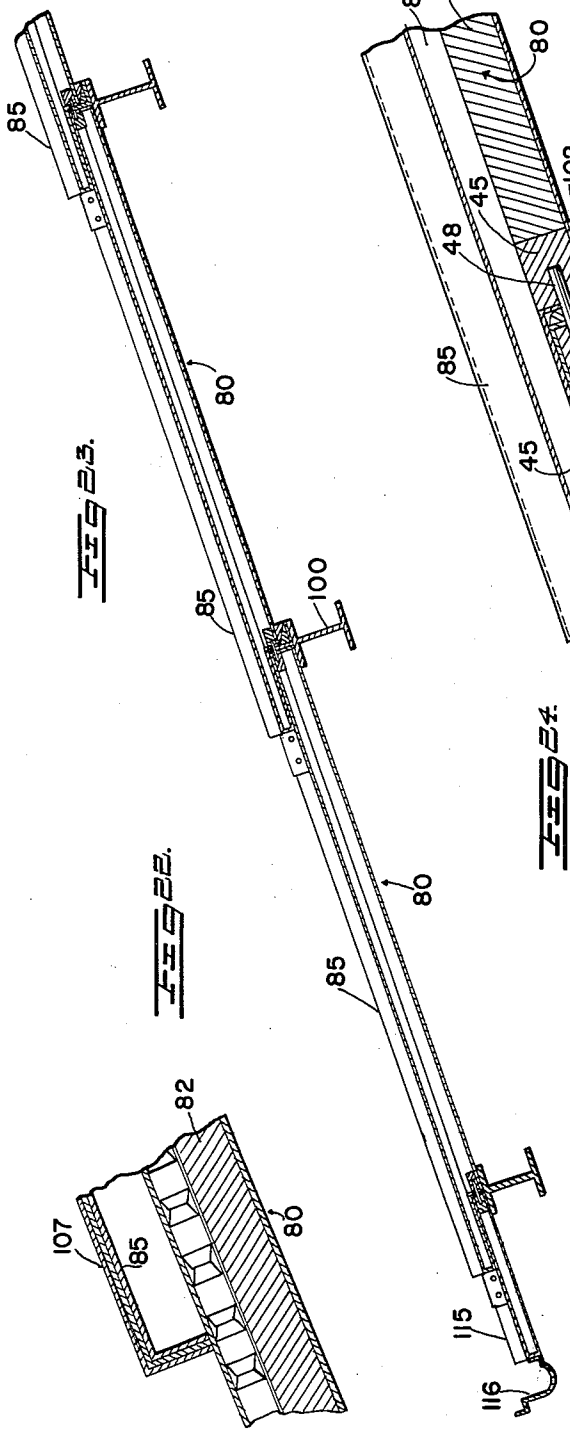

FIG 23.

FIG 22.

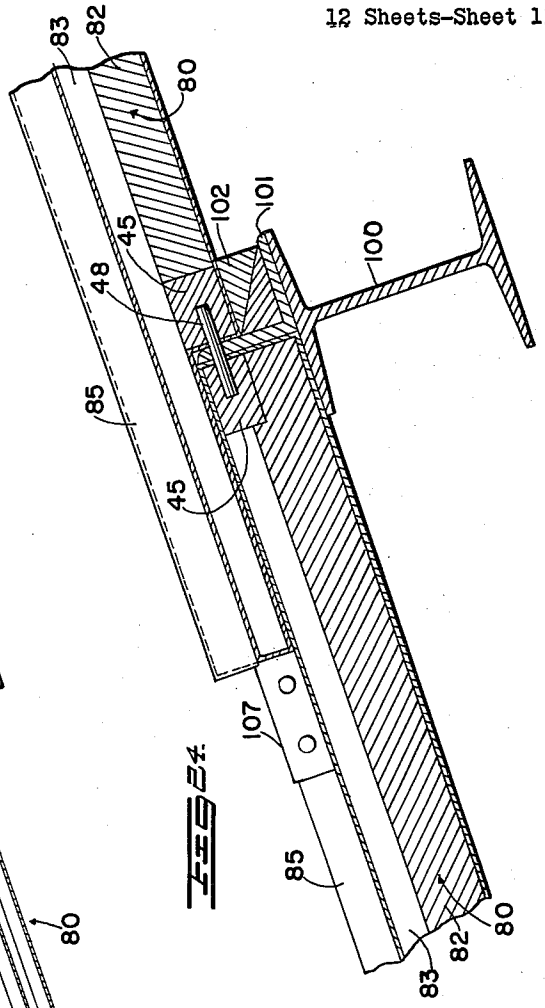

FIG 24.

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BUILDING CONSTRUCTION

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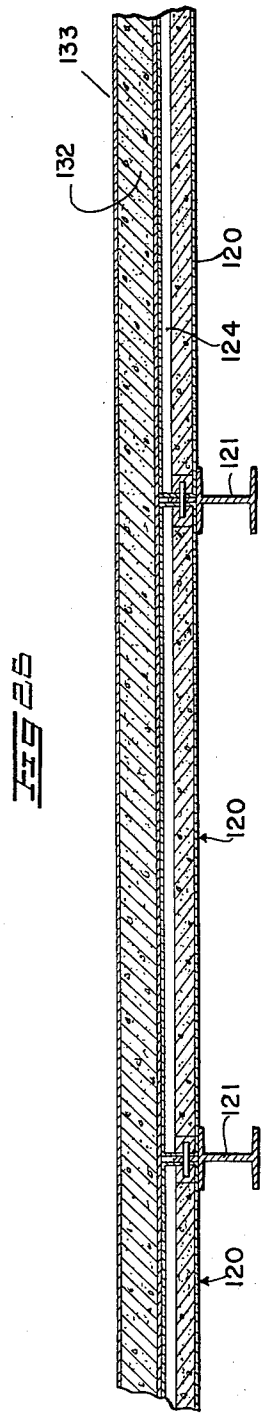

FIG 25

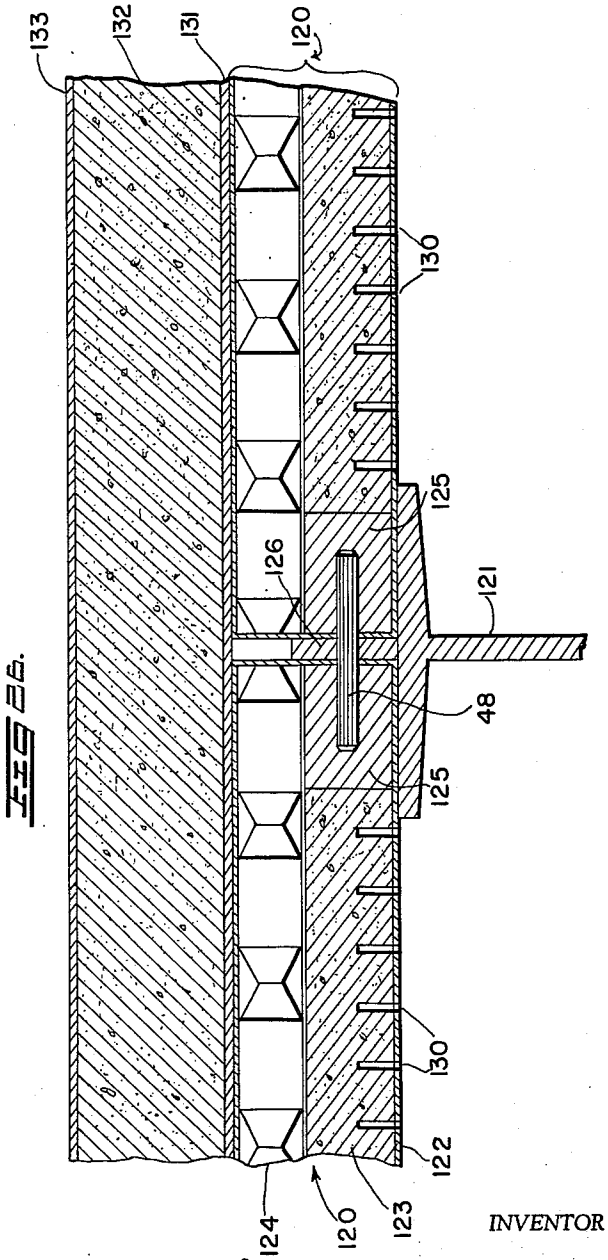

FIG 26.

INVENTOR

Thomas Nelson Jeffress

BY Albert W. Kirchner

ATTORNEY

United States Patent Office 3,110,131 Patented Nov. 12, 1963

3,110,131

BUILDING CONSTRUCTION

Thomas Nelson Jeffress, Washington, D.C., asignor to Jeffress-Dyer, Inc., Washington, D.C., a corporation of the District of Columbia

Filed May 27, 1959, Ser. No. 816,250
1 Claim. (Cl. 50—399)

The present invention relates to building construction and more particularly to structural surfacing components of buildings and to panel elements of such components.

The structural surfacing components comprise walls, including principally exterior walls, as well as roofs and floors. These components, forming structural parts of the building as distinguished from merely surface coatings or finishes, are made up in each case of assemblies of composite panels of special construction, and the panels are assembled in certain new relationships and, further in accordance with the principles of the present invention, the assemblies are mounted on structural framework members of the building; and each of the panels, the assembly thereof in a wall, roof or floor component, and the manner of mounting the assemblies in position in the building, is believed to be inventively new and is to be hereinafter claimed as part of the present invention.

A principal object of the invention is to provide a new kind of wall, roof or floor component of a building structure, hereinafter called generically a structural surfacing component, that will be superior to the best such components of the prior art in respect of appearance, ease of erection, economy of manufacture, resistance to fire, insulating value, both thermal and sound, lightness of weight, impermeability to moisture, freedom from maintenance requirements, general durability, and other desirable qualities.

A related object is to produce certain individual elements for assembly into a component of the type indicated, e.g., panel elements, bracket fixtures for securing the panels to the building framework, pin elements for fixing the panels together and to the brackets, gasket or caulking means for sealing the panels to each other, and other cooperating elements of the finished assembly.

Another and more specific object of one form of embodiment of the invention is to provide an exterior wall capable of being erected speedily by mounting preformed and prefinished panels onto a building framework support so that the initial assembly will constitute the final and complete operation, requiring no application of surface coating, caulking, pointing or other work normally required to complete a laid up wall of block or panel elements or the like.

A related specific object of another form of embodiment of the invention is to provide a roof capable of being erected speedily and expeditiously by mounting similar preformed and prefinished panels on more or less conventional framework members so that the installed assembly can if desired be left unfinished, after the application of certain simple joint or seam coverings, requiring the application of no surface coating or finish.

Another specific object, in the case of still another form of embodiment of the invention, is to provide a floor construction composed of an assembly of panels made in general like those of the wall and roof assemblies which can be easily and rapidly laid on suitable more or less conventional beams or joists so as to present an upper surface that will serve as a foundation for the application of any conventional type of flooring material and at the same time provide an under surface that will serve, without the application of any coating, covering, finish or the like, as a decorative and thermally and acoustically insulated ceiling.

Other specific objects are concerned with improvements

in the panels per se by which they are made well adapted to quantity production at low cost out of die stamped sheet metal sheathing and an internal filling of poured cementitious stiffening material, or a precast rigid board or slab, combined with a cooperating layer of preformed honeycomb or analogous insulating sheet material.

Other objects and advantages will be apparent to those skilled in the art from the following description of certain preferred forms of embodiment which are illustrated in the accompanying drawings in which

FIGURE 1 is a front elevational view of a plurality of panels mounted on certain structural members of a building framework and constituting a portion of the exterior wall of the building;

FIG. 2 is a vertical sectional view, such as would be produced on the line 2—2 of FIG. 1, but showing the manner in which the new wall may be joined to a conventional form of roof structure appearing at the upper end of the figure;

FIG. 3 is a vertical sectional view on a relatively enlarged scale, taken on the line 3—3 of FIG. 1;

FIG. 4 is a similar view taken on the line 4—4 of FIG. 1;

FIG. 5 is a horizontal sectional view, such as would be produced on the line 5—5 of FIG. 1, but showing a corner construction at the right hand side of the figure;

FIG. 6 is a perspective view of a pin element used in the construction

FIG. 7 is a cross sectional view taken on the line 7—7 of FIG. 6;

FIG. 8 is a front elevational view, like that of FIG. 1, but showing a specifically different form of panel used in assembling the wall;

FIG. 9 is a vertical sectional fragmentary view taken on the line 9—9 of FIG. 8 showing, on a relatively enlarged scale, the manner of mounting a wall panel and connecting a window unit;

FIG. 10 is a similar type of view showing a form of connection between a wall and roof;

FIG. 11 is a perspective view of one type of panel adapted to be used in the wall provided by the invention;

FIG. 12 is a lengthwise or vertical sectional view taken on the line 12—12 of FIG. 11, but on a relatively enlarged scale;

FIG. 13 is a transverse or horizontal sectional view taken on the line 13—13 of FIG. 11, on the scale of FIG. 12;

FIG. 14 is a cross sectional view taken on the line 14—14 of FIG. 13;

FIG. 15 is a perspective view of one of the angle brackets used in mounting the wall panels on the building framework.

FIG. 16 is a top plan view of a portion of a roof assembled in accordance with the principles of the invention, employing an assembly of panels provided by the invention;

FIG. 17 is a perspective view of one of the panels used in assembling the roof shown in FIG. 16;

FIG. 18 is a detail sectional view taken on the line 18—18 of FIG. 17;

FIG. 19 is a cross sectional view taken on the line 19—19 of FIG. 17;

FIG. 20 is a detail cross sectional view of the joint between adjacent panels of the roof, taken on the line 20—20 of FIG. 16;

FIG. 21 is a lengthwise cross sectional view taken on the line 21—21 of FIG. 19;

FIG. 22 is a detail lengthwise cross sectional view taken on the line 22—22 of FIG. 20;

FIG. 23 is a lengthwise vertical cross sectional view taken on the line 23—23 of FIG. 16;

FIG. 24 is an enlarged detail view of one of the

joints shown in FIG. 23, comprising a lengthwise section taken on the line 24—24 of FIG. 16;

FIG. 25 is a vertical sectional view taken through a completed floor showing floor-type panels assembled on supporting joists and covered by appropriate finishing material; and

FIG. 26 is an enlarged detail sectional view of FIG. 26 showing the internal structure of the floor panels and the detail of the inter-panel joint.

It is to be understood that these preferred embodiments of the invention are disclosed merely for the purpose of illustrating the inventive principles that are intended to be covered by the appended claims and that not all of the details illustrated and described need be used in the particular forms or combinations shown but that all are capable of modification within the broad principles of the invention and the scope and purview of the broader of the claims.

In the drawings, and referring first to FIGS. 1–16, which illustrate the wall embodiment of the invention, the refer numeral **20** designates generally and generically any rigid horizontal framework member of a wall, particularly an exterior wall, of a building or analogous structure. These members may be steel beams or girders, reinforced concrete elements or any equivalent components forming a framework structure to which a wall surfacing assembly is to be applied. The present invention, it will be understood, is concerned with the structural surfacing per se, the elements thereof, and the means and manner of erecting the assembly and securing it to the supporting framework and not to the framework itself.

The members **20** are positioned in the building framework at vertically spaced intervals preferably conforming substantially to the floor spacing, although in some cases it is possible to arrange them at a spacing equal to some aliquot part of the distance between adjacent floors. The members **20** are fixed in position in the framework by cooperating framework members of any appropriate kind and any suitable arrangement, such as the vertical members **21** shown in the embodiment of the invention illustrated in FIG. 8.

Secured to the horizontal members **20**, at horizontally spaced intervals, are a series of brackets **22**, each consisting of a short length of angle iron. The brackets may be welded directly to the horizontal members if the latter are of steel. They may be welded to steel channel or angle inserts cast into concrete members and presenting a steel surface flush with the vertical exterior face of the member. They may be otherwise secured to the members, such as the manner shown in the drawings in which, as best appears in FIG. 15, each of these brackets has one of its flanges provided with a pair of spaced parallel slots **23** that are normal to the vertex between the flanges, and the other flange is provided with a pair of spaced aligned slots **24** that are parallel to the vertex. The parallel slots **23** are intended to pass the shanks of bolts **25** or equivalent studs or threaded rods that project horizontally from the horizontal framing members **20**. Nuts **26** threaded onto the ends of the bolts **25** serve to hold the brackets **22** on the framing members **20** by clamping the flanges thereof containing the slots **23** fast against the surfaces of the members, with the brackets secured to each member adjusted to accurate horizontal alignment, and with the brackets secured to vertically spaced superposed members **20** arranged with their slots **24** arranged in vertical alignment. It will be appreciated that this horizontal alignment is facilitated and easily accomplished by reason of the slots **23** being considerably longer than the diameter of the bolt shanks that extend through them, and because the length of the slots **24** makes it easy to position vertically superposed brackets with substantial portions at least of the slots **24** overlapping. The bolts **25** are mounted in the members **20** by embedding their heads in the concrete, if the members **20** be of concrete, or by extending the headed bolts through holes in the metal of the members **20** if the members be of structural steel. Other modes of mounting the bolts in other types of members are of course possible, so long as the bolts are secure and function to fix rigidly the brackets in the required adjusted position of horizontal and vertical alignment that has been described.

Such factors as the size of the brackets **22**, and the spacings and numbers in which they are mounted, form no part of the invention and will be determined by the character and size of the wall to be erected. However, in the interest of disclosing a preferred operative embodiment of the invention, it may be stated that brackets of the approximate dimensions of one foot in length with flanges four inches wide are appropriate for use with panels of ten feet in height by four feet wide, such as will now be described. In such a construction the brackets may be set on four feet centers, as shown in FIG. 1.

A preferred form of panel proposed by the invention is designated generally **30** and consists generally of a rectangular, preferably oblong, body having an outer sheath or shell of sheet metal completely enclosing a specially formed interior filling providing any required amount of stiffness and having a high degree of sound and thermal insulating value. The sheet metal may be, for example, sheet steel of 16 to 20 gauge, having its outer surface finished with enamel, lacquer or other appropriate coating, or aluminum, bronze or other metal may be used. The shell is best made in the form of two shallow pans, providing respectively an outer face **31** and an inner face **32** and having perimetric edge flanges **37** interfitted and secured together, as by spot welding or the equivalent, to form a weathertight enclosure for the filling.

The filling is of special character, preferably comprising several different layers superposed one on another successively when the panel is being fabricated by laying the inner-face-forming pan element **32** on a horizontal surface with its open side up. Thus positioned, the filling is inserted. This may comprise a stiffening slab **33** fitted into the lower zone of the pan element **32** which is preferably made by separately and externally precasting in a suitable form a plastic cementitious aggregate of perlite with gypsum plaster, preferably with a light reinforcement of wire mesh, which is either originally cast to size or may be cut from larger slabs. The separate precasting is preferred to casting in the pan element **32** to insure proper curing and moisture control of the fill, so that all problems of rust, corrosion and the like concomitants of wet fillings are obviated in the finished panel. However, it is quite possible in some instances, particularly where there is no objection to allowing the pan elements **32** to stand open with their fills curing over a relatively long period of time, to pour the cementitious stiffening fill directly into them while in wet, plastic condition and allow it to set to proper hardness and low moisture content. In either case the lightweight, stiffening, fireproofing fill indicated at **33** in the drawings is provided in the lower zone of the pan element **32** up to or slightly beyond the offsets hereinafter to be described. This portion of the fill thus occupies only about three-quarters to four-fifths of the depth of the pan. Over it is laid a sheet of aluminum foil **34**, and superposed on that sheet is laid a layer of special honeycomb insulation **35**, which in turn is covered by a sheet of aluminum foil **36**. If desired or found necessary to bring the level of the precast cementitious fill **33** up beyond the level of the offsets hereinafter to be described, some additional plastic fill of the same ingredients may be poured in place. The drawings show the fill **33** as extending homogeneously over into the offsets, and this is intended to indicate the use of either the precast type of fill, which is preferred, whether cut or molded exactly to size, or whether supplemented by plastic additions after insertion,

and to indicate also the result of the poured in place type of fill.

It is to be understood that all references in this specification and in the appended claims to the cementitious fill, or the plastic fill, or the stiffening fill 33 designated in any manner to distinguish it from the insulating fill 35, are intended to comprehend the fill 33 of perlite or equivalent lightweight aggregate as hereinabove described, whether precast as preferred or poured in situ, as is also contemplated.

The two sheets of foil 34 and 36 serve as thermal insulation, and the honeycomb layer 35 functions to insulate the wall both thermally and acoustically. The honeycomb layer is best made of paper, impregnated with a non-flamable glue, convoluted to provide a multiplicity of hollow cells of some such shape as the hexagonal one shown in the illustrated embodiment of the panel, all fixed in position and shape by the set glue, and all cooperating to provide a multiplicity of dead air spaces, as will be understood. The layer 35 may be faced with paper or light cardboard, in addition to the foil sheets, if desired, and the assembly of layer, foil and/or sheets may be bonded to the plastic fill 33 by means of a coating of industrial adhesive such as "3M Adhesive Formula EC–1357" produced by Minnesota Mining & Manufacturing Company, of St. Paul, Minnesota, or "Armstrong's D–253 Adhesive" made by Armstrong Cork Company, of Lancaster, Pennsylvania.

As shown in the drawing, and particularly FIGS. 1, 2, 5, 11 and 12, each of the edges of the panel 30 is offset or stepped, so that the lower edge of the front face is downwardly flanged, as shown at 40, the rear face is upwardly flanged, as shown at 41, and one of the two lateral or vertical edges, for example the lefthand edge 42, is outwardly flanged at the back face, and the other verical edge is outwardly flanged at the front face, as shown at 43. This is for the purpose of enabling the panels to be mounted in overlapping edged relation in the wall, as will be hereinafter explained, and to provide offset joints between the panels to enhance the weatherproof qualities of the wall.

Each of the panels 30 is provided with internal sockets for reception of pins mounting the panel on the brackets 22. An acceptable type of socket-forming element is shown at 45 in the drawings. It consists simply of a metal block of more or less cube shape spot welded or otherwise affixed to the inner surface of the upper and lower edge flanges of that pan element of the panel which received the plastic fill 33 when the panel was being made, i.e., the upper flange 41 and the lower end wall behind the lower flange 40. The block is bored through a portion only of its depth, as shown at 46, and the bore is aligned with a hole 47 in the panel end wall. Thus the block provides a seat for a pin 48, of substantially the diameter of the socket bore 46 and the panel end wall hole 47, which is approximately the dimension of the width (not the length) of the slots 24 in the outstanding flanges of the brackets 22. Blocks 45 are provided in each panel in sufficient number, and at proper spacing, to conform and correspond to the slots 24 in the brackets 22 on which the panel is to be mounted. Thus, in the illustrated wall embodiment of the invention, each panel has four of the blocks, one near each of its four corners, and all four being mounted in the edges of the panel which are horizontal when the panel is assembled in the wall. The bores 46 of two of the blocks open downwardly from the upper end edge of the panel in that step of the two steps of the offset edge which is the higher and innermost of the two when the panel is mounted in the wall, and the bores 46 of the other two blocks open upwardly from the lower end edge of the panel in that step of the two steps of the offset edge which is the higher and innermost of the two when the panel is mounted in the wall. The arrangement, properly oriented as to panel position, is shown in FIG. 12.

A wall is erected by assembling a plurality of the panels 30 on a framework provided with brackets 22 in the following manner:

With the brackets 22 properly secured in place on the horizontal members 20 by the fastening means 25, 26 or their equivalent, a lower course of panels 30 is set in place, in horizontal alignment, with the lateral, vertical edges of adjacent panels overlapping by interfit of the side flanges 42 and with the lower front flanges 40 depending below the horizontal flanges of the lower brackets 22 and the rear steps of the lower edges of the panels seated on those flanges, and with the bores 46 of the socket blocks 45 aligned with the slots 24 in the brackets. The rear steps of the upper edges of the panels are abutted up against the under surfaces of the outstanding flanges of the next higher line of brackets 22, with the bores similarly aligned. Then pins 48 are driven up through the slots 24 and into the socket block bores in the bottoms of the panels so as to fix the panels securely to the flanges of the lower brackets. For this purpose the pins are best made hollow, of relatively resilient metal, with the periphery broken by a slot, and with their ends beveled, as best shown in FIG. 6, so that they seat with a friction drive fit in the slots and bores. The pins are long enough to protrude with about half their length beyond the flange of the bracket when they are driven home to seat in the bottoms of the socket bores. Thus, as the assembling operation proceeds and pins are driven down through the next higher line of brackets and into the upper edges of the panels, these pins will project above the surfaces of the bracket flanges to seat in the socket bores of an upper course of panels seated on top of the bracket flanges, as best shown in FIGS. 2 and 3.

It is believed to be evident that a wall can be erected in the foregoing manner with great rapidity and with accurately correct placement and relationship of the panels once the brackets 22 are properly adjusted on the framing members 20. Of course the panels should be of identical dimensions, so that they are interchangeable and quick and proper fitting into place is possible. However, because it is practically desirable, if not absolutely necessary, that some manufacturing tolerances be provided for, it is best to arrange the bottom edges of the panels to seat on the supporting bracket flanges and to allow a slight clearance between the top edges and the superjacent bracket flange, as best shown in FIG. 3. A considerable degree of waterproofing is obtained by the offset horizontal edges of the panels, by which the front surface at the bottom of each panel overlaps the body of the next adjacent lower panel, but the joint may be made absolutely water proof and windproof by interposing a suitable gasket.

Such a gasket may take the form of a simple strip of neoprene or equivalent preformed rubberlike material. These strips may be bedded on the two steps of the top end walls of the panels, being continuous along the front or lower step as shown at 50, and being interrupted in the form of an otherwise similar strip 51 along the back or higher step to admit the bracket flanges, as will be evident from a comparison of FIGS. 3 and 4. The gasket material being compressible, or at least yieldable and distortable, forms an excellent seal in the inter-panel joint. Similar gasket strips 52 and 53 are installed in the offset surfaces of the vertical joints between adjacent panels, as shown in FIG. 5.

An unobvious but very considerable advantage of the stepped formation of the upper and lower edges of the panels is the capacity of these edges to be made with the outer low step of each lower edge disposed farther below the inner high step of said lower edge than the distance by which the outer low step of the upper edge of the panel extends below the inner high step of said upper edge. Such a relationship of step proportons is shown in the FIG. 3. Obviously the difference in step heights there shown, which is relatively small, can be varied and great-

ly increased, so as to provide for the use of brackets having lower (horizontal) flanges of greater thickness, and/or sealing strips of less thickness, if desired. This makes it possible to mount the panels on brackets 22 each having a horizontal flange of any thickness desired, without correspondingly or unduly increasing the inter-panel space between the outer low steps to be filled by the gasket 50, and this is therefore deemed to be an important feature of the use of the stepped upper and lower edges in combination with the brackets—a feature of unobvious advantage in addition to the expected advantage of weatherproofing.

It is believed that the structure of the panel elements and the assembly of the elements into a wall or exterior wall surface in accordance with the principles of the invention will be sufficiently clear from the foregoing description. It may be added, however, that special panel shapes may be provided at the corners, where two walls intersect, as shown at the righthand side of FIG. 5 where the endmost panel A of the front wall is seen formed with a rearwardly projecting flange 60 to complement and interfit the standard vertical side flange 42 of the endmost standard panel 30 of the intersecting end wall.

Similarly, the panels may be formed with openings for the mounting of windows, grills, doorways and the like. Window openings are shown at 61 in FIG. 1. It will be understood that these are virtually cut-outs preformed in the panels and are adapted to have mounted in them any of the many independent preformed window and frame assemblies that are currently in vogue in building wall constructions, particularly for large commercial structures.

The details of these window and frame inserts form no part of the present invention. It may be stated here simply that they commonly comprise lower sill and upper head elements which, as indicated in broken lines in FIG. 2, may be interfitted with the margins of the openings 61, and which connect side jambs or stiles for pivoted or fixed panes.

A further specifically modified type of panel structure is shown in FIGS. 8 and 9. There the panels 63 are of half-height, or even shorter, and have their upper ends secured to supplemental framing members 64 which may be formed of angle stock, slotted in their horizontal flanges, thus rendering the use of separate brackets 22 unnecessary. The vertical spaces between these shortened panels 63 may be filled with window frames 65 which, in the installation selected to illustrate this form of the invention, extend continuously, in mutually abutting relation, laterally along the whole length of the assembly of shortened panels, as shown in FIG. 8. The details of these window inserts are not material to the present invention. Suffice it to say that they may include sill and head members interfitted with the lower and upper edges of the panels in some such manner as the sill member 66 which in FIG. 9 is shown capped over the upper edge of the subjacent panel and the supplemental framing member 64, with a flashing element 67 interposed on the outer face of the joint.

The uppermost course of panel elements may be connected to the roof in any convenient manner, depending on the specific design of the roof and the presence or absence of eaves, cornice, etc. A basic arrangement is depicted in FIG. 10, where the upper edge of the topmost panel 30 is shown secured by the pin 48 to the outstanding horizontal flange of an angle iron 70 whose inner vertical flange is fixed in any appropriate way to an adjacent framing member conventionally indicated at 71. The latter member may support the roof structure, broadly designated 72, and suitable flashing 73 may trim the roofing edge and cap the angle iron 70 and the upper edge of the panel, with a drip flashing, gutter or the like interposed.

It will be appreciated that other special shapes of wall panels and special features of design details are contemplated by the invention in its embodiment in wall constructions. All of these are believed to be within the competence of those skilled in the art and hence not to require detailed discussion in this application, which is necessarily concerned only with the broad basic principles of the invention as defined by the appended claims.

FIGS. 16–24 show an application of the inventive principles to the assembly of a roof, particularly although not necessarily a slightly pitched roof as indicated in FIGS. 23 and 24.

In this embodiment of the invention panels 80 are fashioned of sheet metal in the same general way as the panels 30 heretofore described. That is to say, they are of rectangular shape in plan, and each comprises a bottom pan 81 containing a cementitious fill 82 throughout somewhat more than half of its depth, surmounted by a layer of honeycomb insulation 83, with the sheets of foil and/or paper as hereinbefore explained, with a top pan or cover 84 of sheet metal. Thus, in cross section throughout most of its length, the panel 80 is the same as the panel 30. However, to fit it to serve as a roofing element, cooperating with other similar elements in the manner of tile or shingles, each panel 80 is formed with a pair of upper side edge ribs 85 of a height of about half the thickness of the panel, extending from points below the top edge of the panel to the extreme lower edge. The lower edge margin of the panel is undercut, the body of the panel being removed across the lower end zone for a distance equal to the length of each side rib 85 which is in effect removed from the upper zone of the panel. This shape is best shown by the perspective view of FIG. 17, and it will be apparent from that figure that the panel shape there shown lends itself to assembling a plurality of panels in the relationship shown in FIG. 16, where it will be observed that horizontal, or substantially horizontal, courses of panels can be formed by abutting the side ribs 85 of laterally adjacent panels together, and that such courses can be laid above and below each other in overlapping relation, with the combined rib joints of the adjacent courses staggered and with the lower zone of reduced thickness, indicated at 90 in FIG. 17, overlying the upper zone, beyond the ends of the side ribs, indicated at 91 in FIG. 17.

As will be noted by comparing the transverse cross sectional view of FIG. 18 with the lengthwise cross sectional view of FIG. 21, the cementitious fill 82 occupies the entire lower portion of the panel 80, and the honeycomb layer 83 overlies the whole fill 82 and extends into the lower end zone 90 which is reduced to a thickness equal to that of the honeycomb layer alone. The side ribs 85 are left empty and are provided at spaced intervals along their length with openings 92 extending entirely through them. The upper and lower transverse edges of the panel 80 are provided with socket blocks like the blocks 45 heretofore described.

Assuming the roof to have a supporting framework including a series of spaced apart transverse beams 100 (FIGS. 23 and 24) acting as purlins or the equivalent, the panels 80 are assembled by welding or bolting a series of brackets 101, or equivalent angle irons, on top of the beams 100, with horizontally elongated slots provided in the outstanding flanges of the brackets or irons 101. Pins 48 are driven through these holes into the socket blocks 45 and the panels are thus secured to the beams 100. The upper end zone 91 of a lower course panel is overlapped by the lower end zone 90 of the next adjacent upper course panel, and the disparity in thickness of the two panels in the overlapping portions may be compensated, so as to provide support for the upper course panel on the beam 100, by interposing shims, like those shown at 102 in FIG. 24.

The panels 80 of each horizontal course in the roof are set side by side, with the side ribs 85 of adjacent panels in snug engagement with each other and clamped together

by nut and bolt means **106** standing through the holes **92** in the ribs. A capping **107**, in the form of an inverted channel of sheet metal, is then snapped over the two juxtaposed ribs **85**, preferably with a layer of sheet packing material **108** in the form of heavy roofing felt interposed and bonded over the ribs by an application of industrial adhesive, to trim and seal the joint between the ribs and cover the bolt holes **92**. Sheet metal screws **109** of the self-tapping type may be used to affix the capping **107** in place.

Because the joints of adjacent courses are preferably staggered, as shown in FIG. 16, it is desirable to connect the upper or head end of the rib joint of each course with the center portions of the lower edge of the next higher course, to insure proper and accurate placement and relationship of the panels of the two courses. This is easily accomplished by affixing to the lower edge of each panel a short cover element **110** in the form of an inverted channel having its rear end closed and securely engaged by screws or the like to the lower end edge of the panel, as shown in FIG. 18, and having its front open to admit the two ribs of the next adjacent lower course panels, covered by their capping **109**. This arrangement makes it unnecessary to make the panels with any high degree of accuracy in length of ribs **85**. On the contrary, a considerable tolerance is permissible. The ribless upper zone **91** of each panel can be made somewhat wider than the length of the overlap by the lower zone **90**, so that the joined ribs and their capping will not quite reach the lower edge of the next adjacent higher course, with the gap well covered, concealed and sealed by the cover element **110**.

As in the case of the wall panels **30**, the roof panels **80** may be modified in specific dimensions, design and general detail to satisfy special requirements such as openings, corners, edges, and the like. Thus, for example, FIGS. 16 and 23 illustrate shortened panels **115** at the eaves, terminating in a gutter **116**. Other panels may be made for the roof with downturned edge flanges, with central or side openings, with flashing adjuncts, etc., in the manner of the modifications previously described for the wall panels **30**, as will be understood.

FIGS. 25 and 26 show an application of the inventive principles to the assembly of a floor. In this embodiment of the invention a plurality of floor panels, designated generally **120**, are assembled on and secured to a conventional parallel series of supporting joists or beams **121** and also, if desired, an additional parallel series extending right angularly to those shown at **121**. Each of the panels **120** is made in general like the wall and roofing panels heretofore described, comprising a sheet metal sheath **122** enclosing a lower cementitious fill **123** and an upper honeycomb or equivalent insulating layer **124**. The end edges of the panels need not be stepped or offset, but certain pairs of parallel end edges are provided with socket blocks **125** welded to the inner faces of the panel end walls providing sockets open to the outside of the panels, adjacent the corners thereof, as in the case of the previously described panels, for the reception of pins **48**. These are driven through outstanding flanges **126**, here shown in the form of upstanding vertical ribs welded onto the tops of the joists **121** and provided with horizontally elongated perforations aligned with the sockets in the edges of abutting panels. The arrangement will be recognized as similar to that by which the roof panels and the wall panels are assembled and mounted in position on the respective outstanding flanges provided on other parts of the building framework. The differences are of minor import, amounting principally to slight departures in design necessitated by the special horizontal disposition of the floor panels, the load-carrying capacity required of them, and the desirability in some cases of adding some acoustical treatment to the under surface when the bottoms of the panels are to be used, without further finishing, as the ceiling of a space beneath the floor. Thus, for example, the under surface of the floor panels may be drilled with a multiplicity of small holes **130** extending up into the cementitious stiffening layer **123** to function in interrupting and breaking up sound waves and thus eliminate or reduce echo effect and so supplement the acoustical insulating efficacy of the upper layer **124** of honeycomb material.

Again, because this upper layer has relatively small compressive strength per unit or area, it is well to dissipate and spread the loads that will be imposed on the floor. This can be done by covering the assembly of panels with a sheet of relatively heavy gauge metal **131** and covering this with a layer of lightweight concrete or the like **132** topped by any suitable sheet of floor covering **133**, such as linoleum, tile or various materials, or even simply a coating of paint or equivalent finish.

In this connection it may be noted that the combination of the 16 to 20-gauge steel surface of the panel and the immediately subjacent layer of honeycomb insulation, backed up by the cementitious fill, provides surprising strength in compression and resistance to load and impact, so that the floor is sufficiently strong for many uses and purposes without addition of the covering layer **132**. In such cases the upper surfaces of the panels may be left unfinished, or they may be covered with some light finish coating or material, such as paint, flooring tile or the like.

Whether supplemented as suggested, or lightly finished or left unfinished, a floor constructed of assembled panels as described will be found to incorporate all the advantages briefly enumerated in the statement of objects of invention at the outset of this specification and adequately strong for most purposes short of the heaviest type of industrial installations where support must be provided for weighty machinery, warehouse inventory and similar heavy dead loads.

In conclusion it may be stated that the invention, whether considered in its forms of embodiment as wall, roof or floor assemblies of panels, or as a panel per se, is capable of being incorporated in means and designs other than those which have been herein described and illustrated for the purpose of exemplifying typical and preferred species. All such additional means, forms and designs, to the extent that they embody the principles of the invention as defined by the breadth of the appended claim, are to be deemed within the scope and purview theroef.

I claim:

In a building construction, a series of horizontally disposed angle iron brackets each having a vertical flange affixed to a wall member of the building and a horizontal flange protruding from said member, said series of brackets being secured to the wall member in vertically and horizontally aligned spacing, and a wall surfacing assembly mounted on said series of brackets comprising a plurality of wall panels each comprising a rear metallic pan of generally rectangular shape in front elevation having a perimetric stepped flange providing in each of the vertical side and horizontal upper and lower edges of the pan a pair of offset rear and front steps, including a rear high step and a front low step in each of the horizontal upper and lower edges of the pan, and each panel including also a front metallic pan having a perimetric plane flange lapping the front steps only of the rear pan in nested relation and being secured thereto, an insulating filling completely enclosed in said panel by said pans, a metallic socket block welded to the inner surface of each of said rear pan high steps, a pin standing through an opening in the horizontal flange of each bracket and projecting in tightly driven relationship into the vertically aligned socket blocks of an upper panel and a lower panel disposed respectively above and below said bracket and secured by said pin to said horizontal flange against movement toward and away from said vertical flange, and a sealing strip of gasket material filling the space between the ad-

jacent low steps of said two panels, the vertical flange of each of said brackets being provided with a vertical slot and being thereby vertically adjustably secured to the wall member of the building by a bolt standing through said slot, and said opening in the horizontal flange of each bracket being a slot extending parallel to the front edge of said flange, whereby the placement of the pin and hence of the upper and lower panels is laterally adjustable, and the outer low step of the rear pan at the lower edge of each panel being disposed farther below the inner high step of said rear pan at said lower edge than the distance by which the outer low step of the rear pan of the upper edge extends below the inner high step of said rear pan at said upper edge, whereby the space provided between the high steps of the pans of said upper and lower panels for accommodating the horizontal flange of the bracket is greater than the space provided between the low steps of the pans of said panels for filling by said sealing strip.

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