

Jan. 6, 1970

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3,487,598

MODULAR BUILDING CONSTRUCTION AND METHOD

Filed March 25, 1966

9 Sheets-Sheet 1

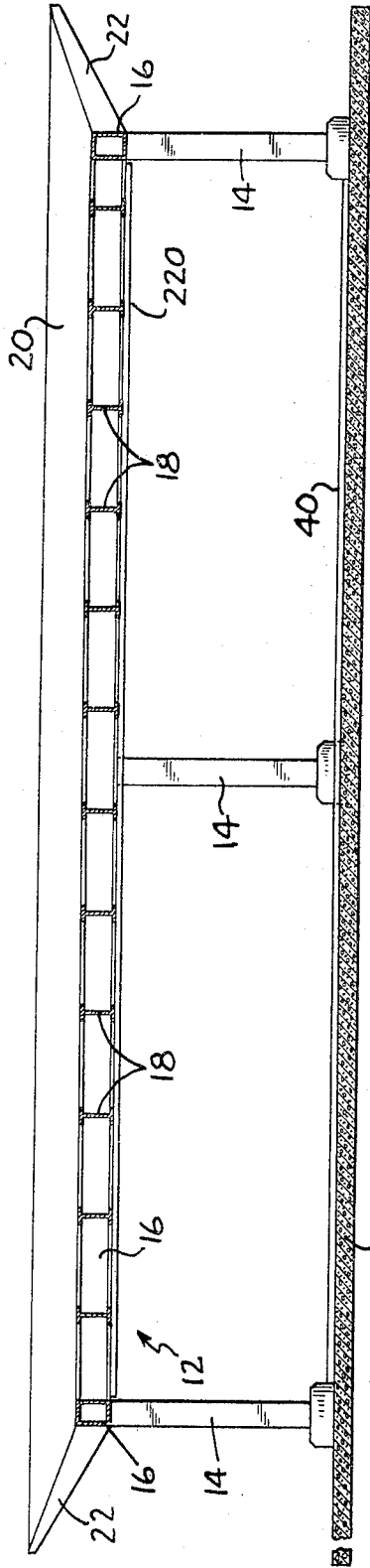


Fig. 1

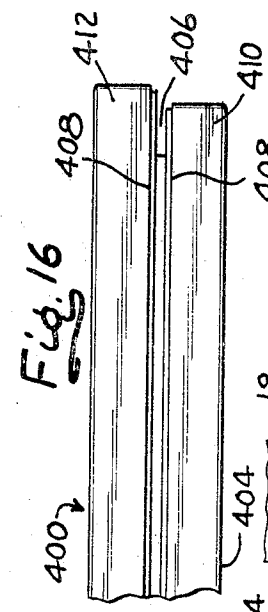


Fig. 16

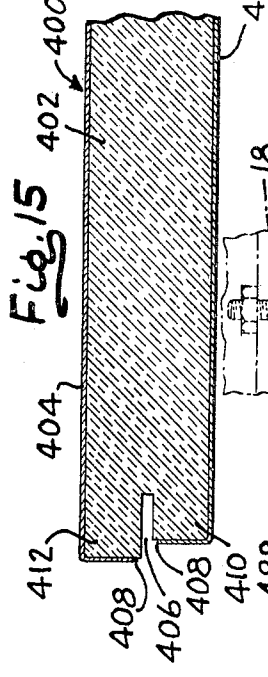


Fig. 15

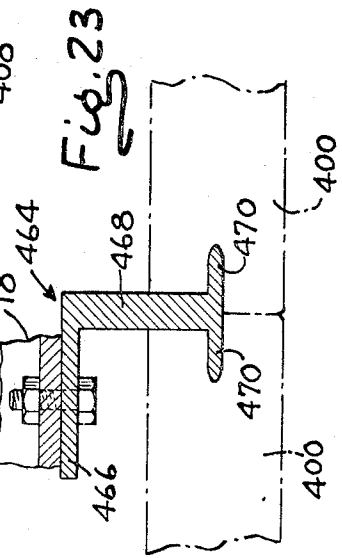


Fig. 23

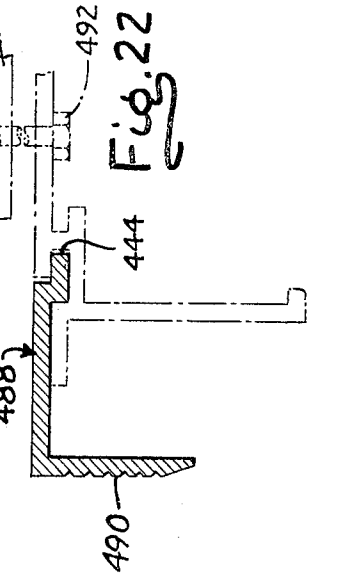


Fig. 22

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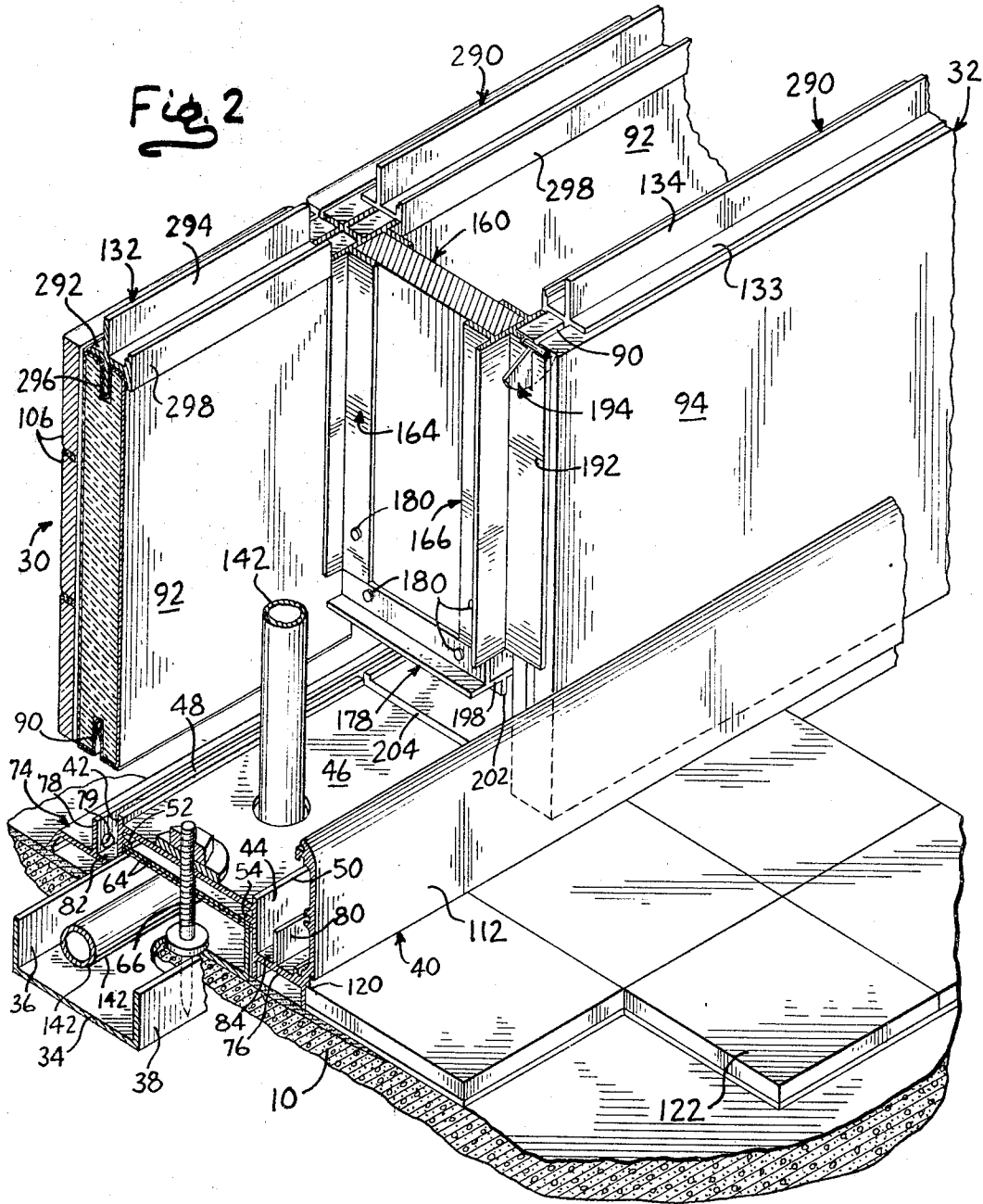
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Filed March 25, 1966

9 Sheets-Sheet 2



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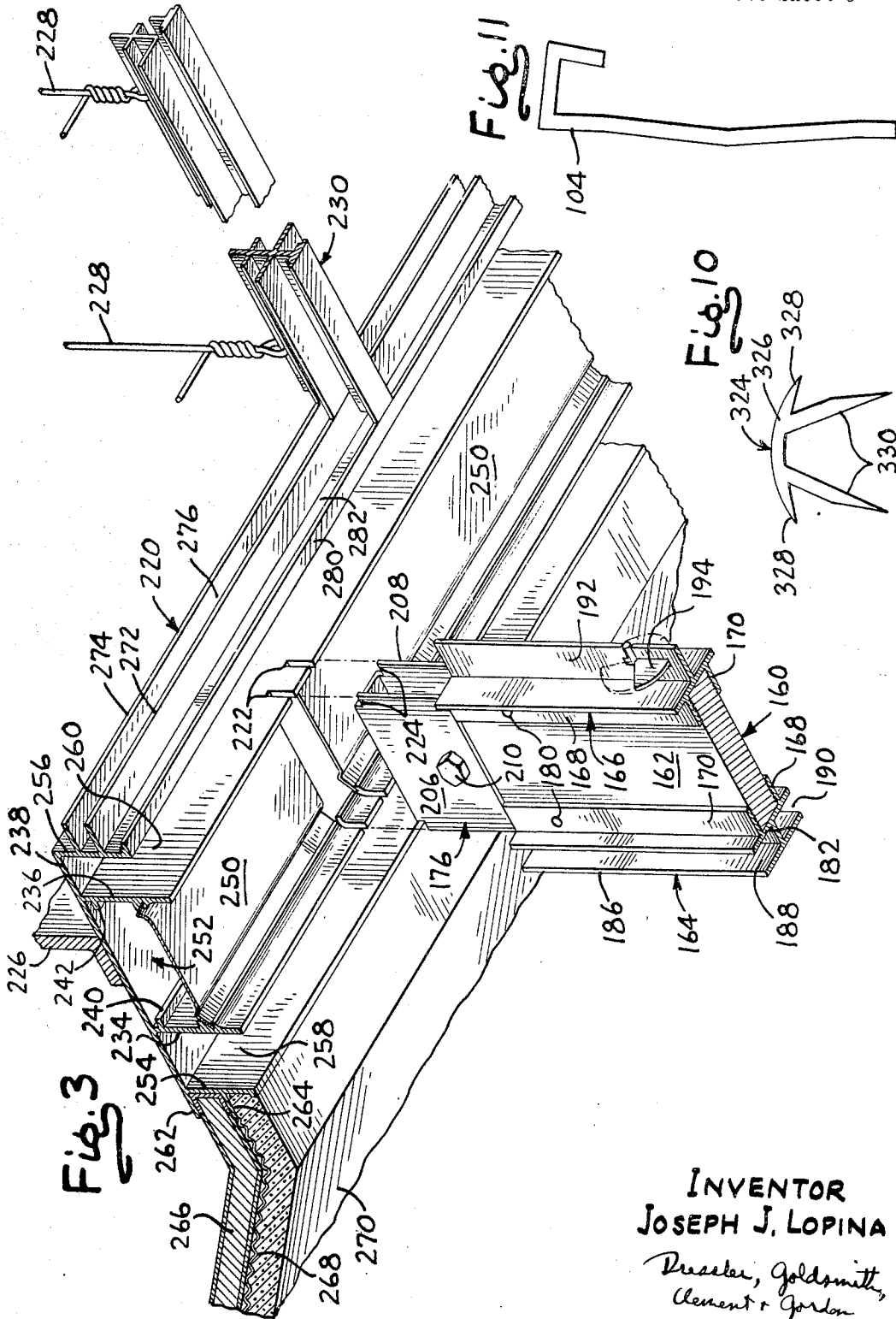
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MODULAR BUILDING CONSTRUCTION AND METHOD

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9 Sheets-Sheet 3



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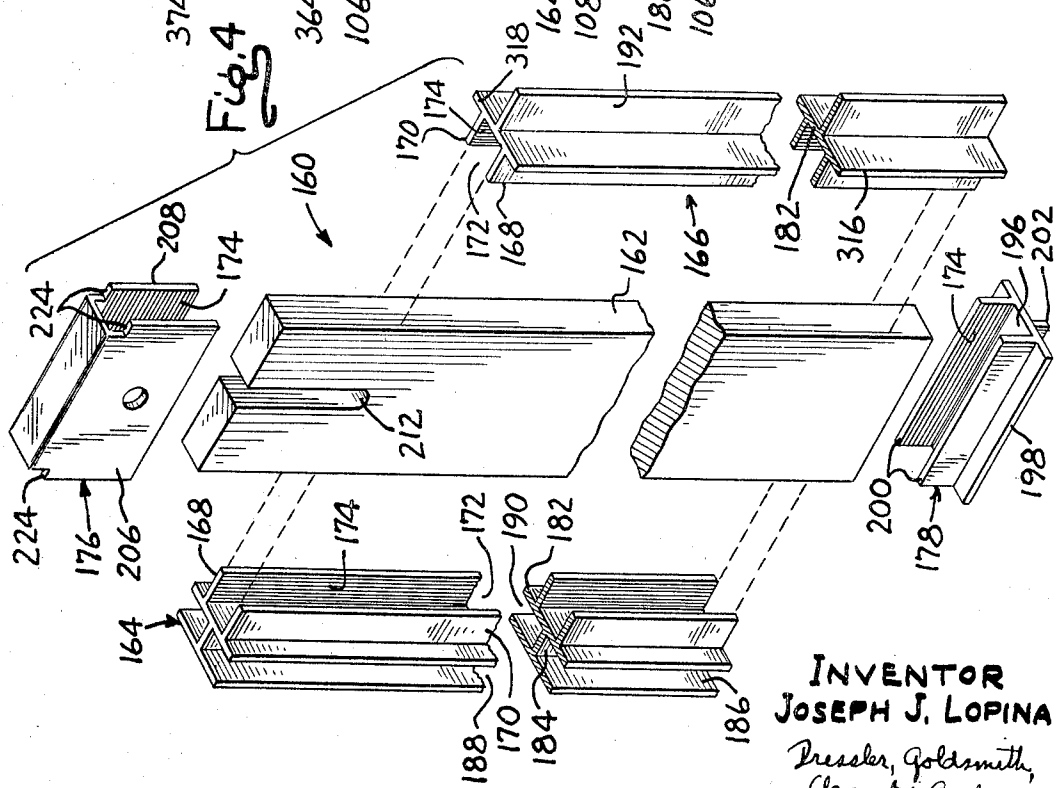
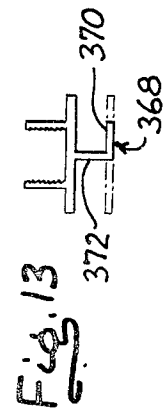
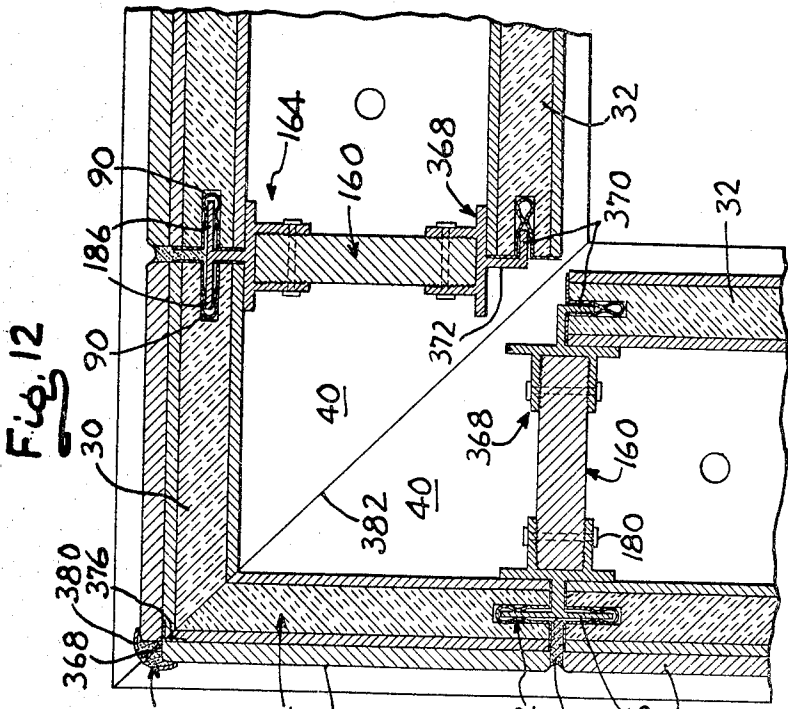
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MODULAR BUILDING CONSTRUCTION AND METHOD

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9 Sheets-Sheet 4



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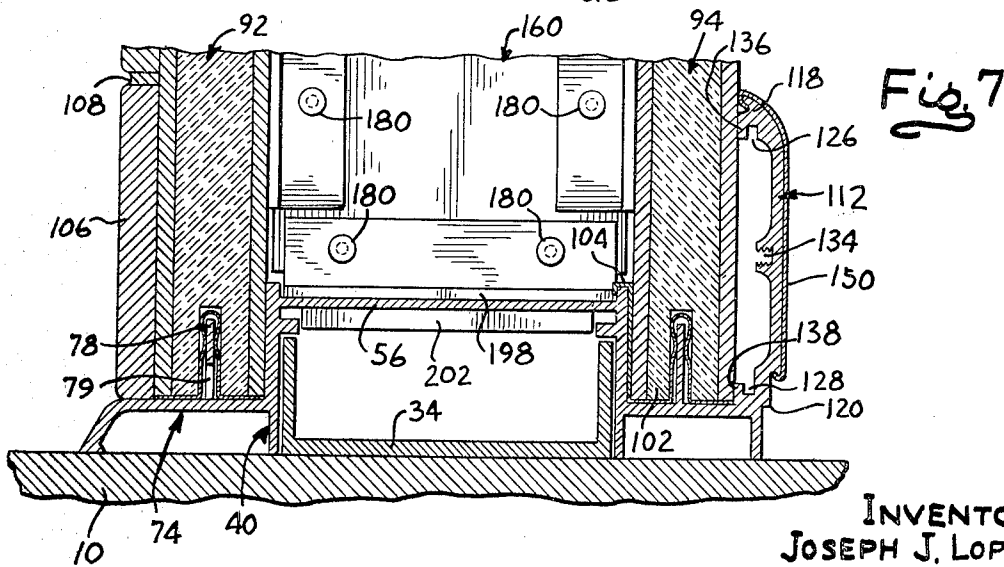
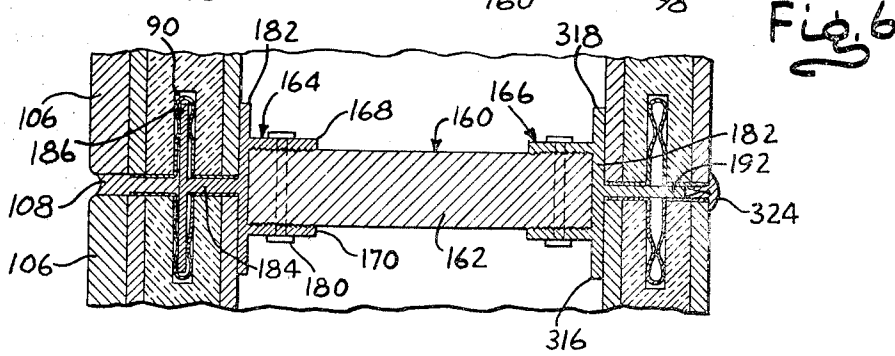
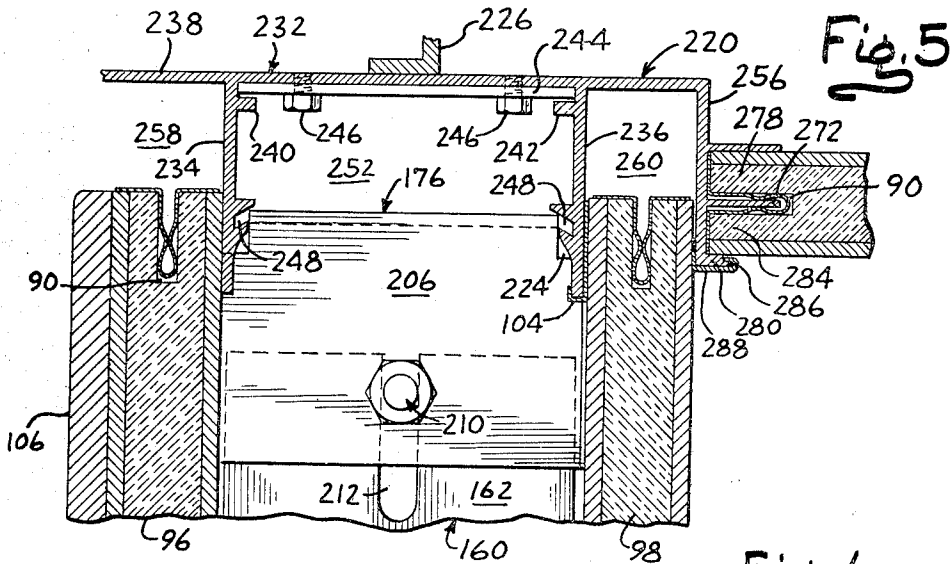
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MODULAR BUILDING CONSTRUCTION AND METHOD

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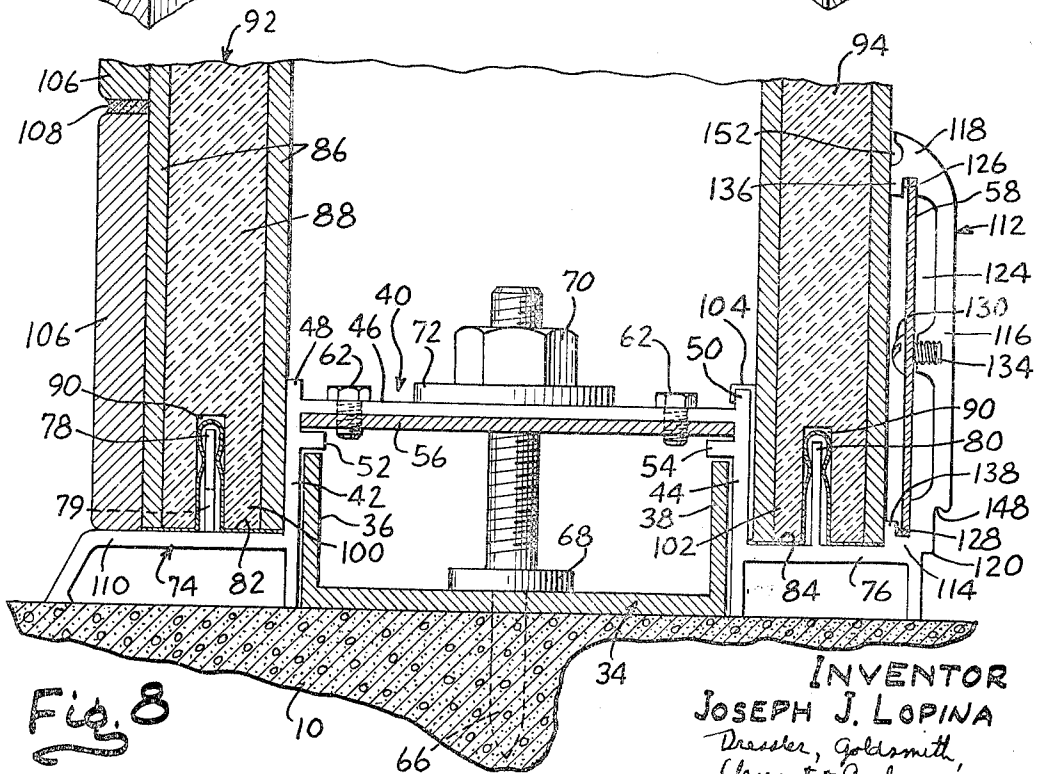
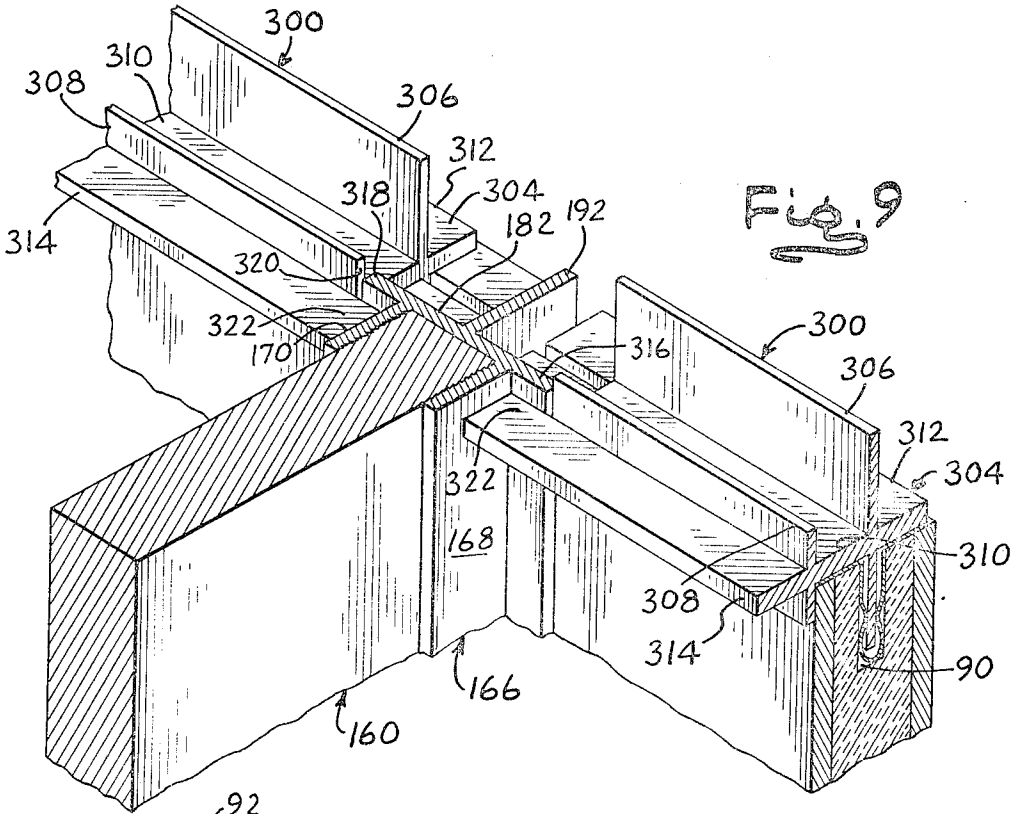
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MODULAR BUILDING CONSTRUCTION AND METHOD

Filed March 25, 1966

9 Sheets-Sheet 6



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MODULAR BUILDING CONSTRUCTION AND METHOD

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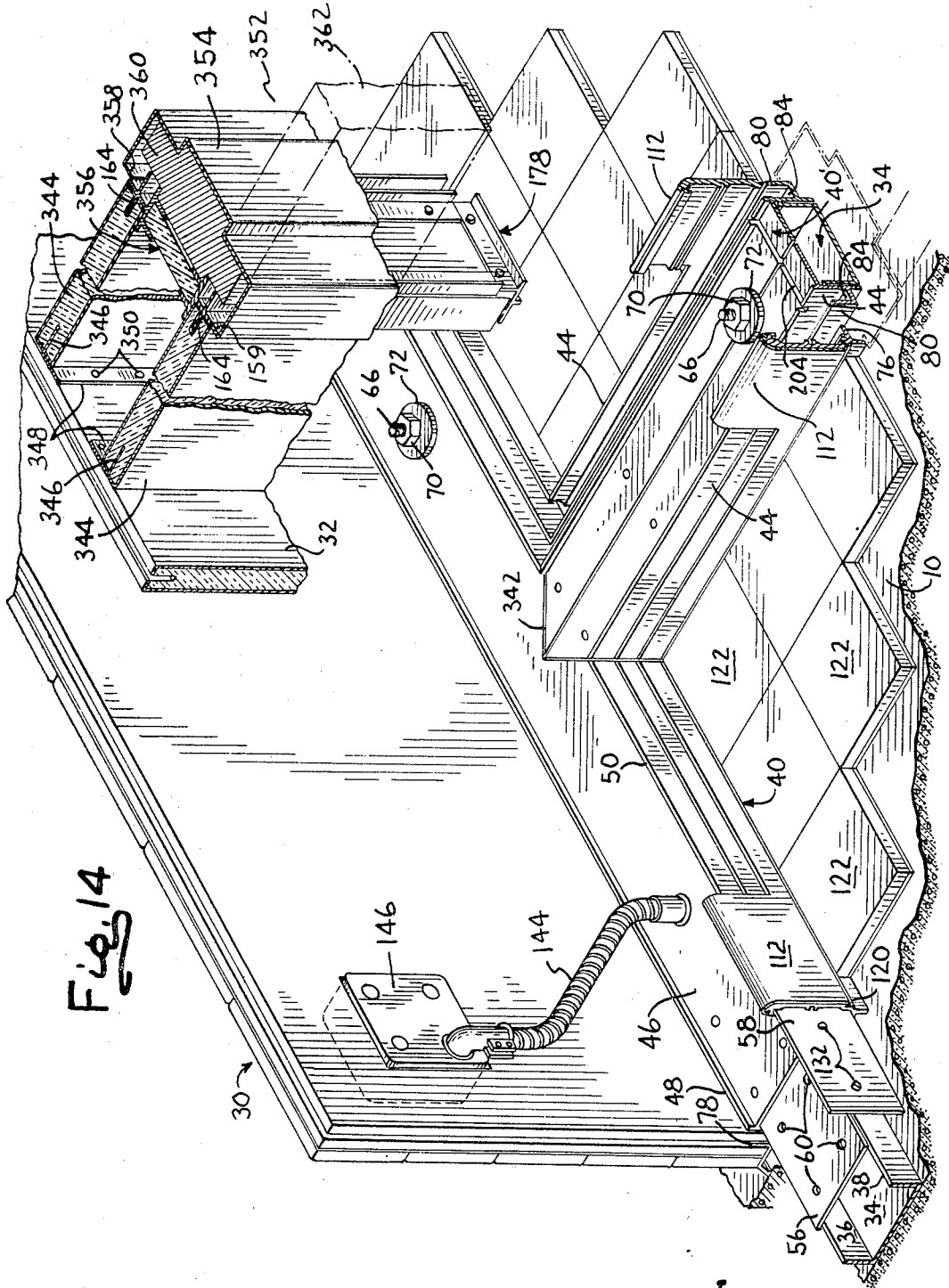


Fig. 14

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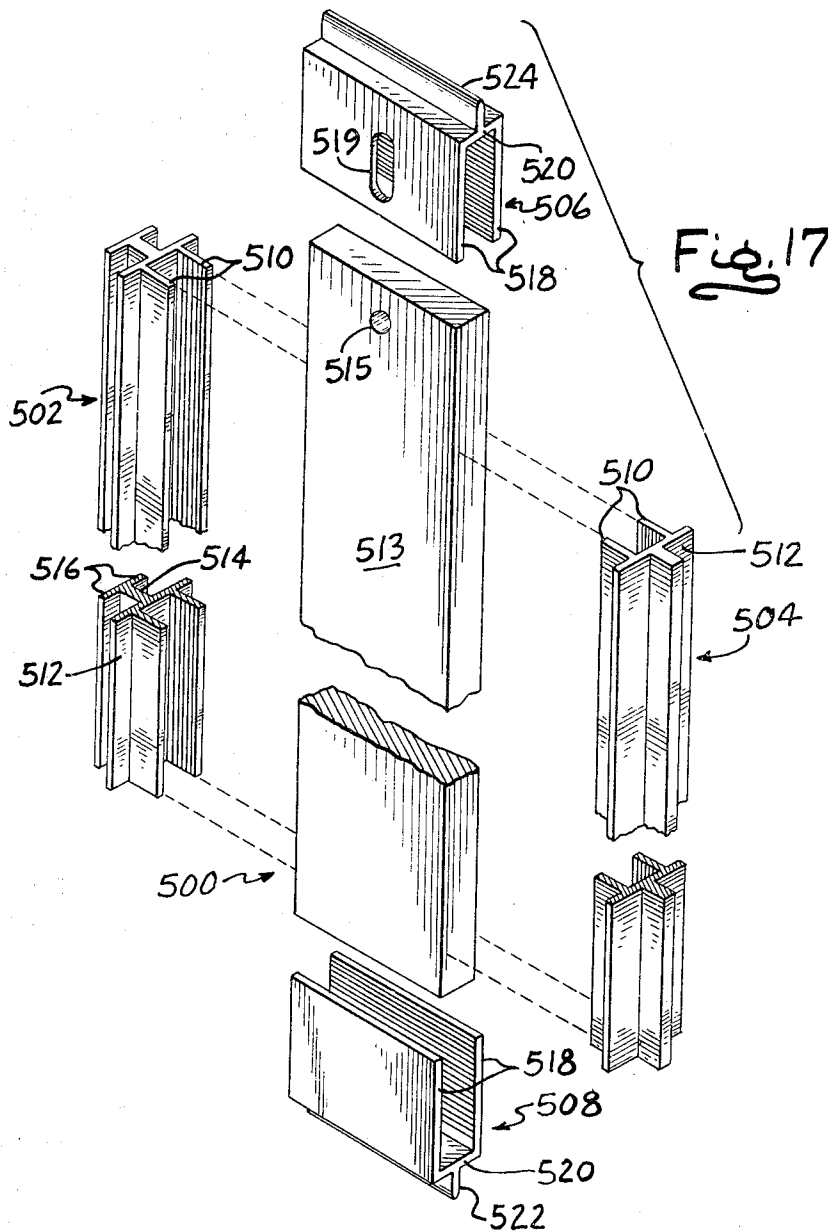
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MODULAR BUILDING CONSTRUCTION AND METHOD

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MODULAR BUILDING CONSTRUCTION AND METHOD

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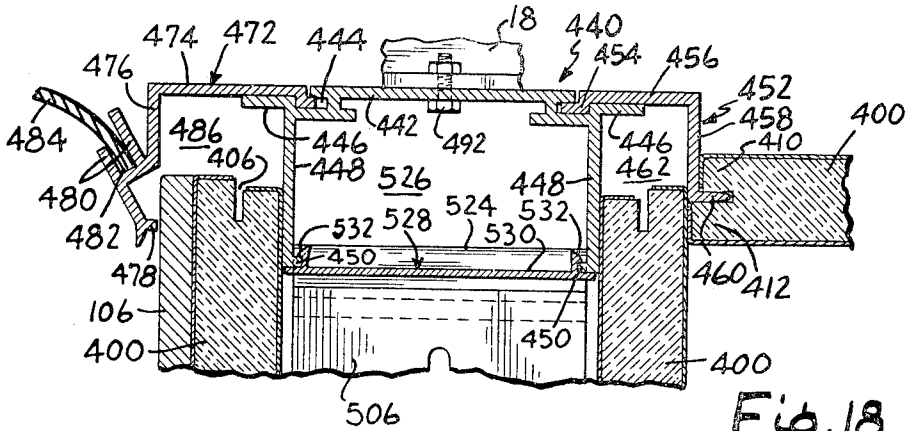


Fig. 18

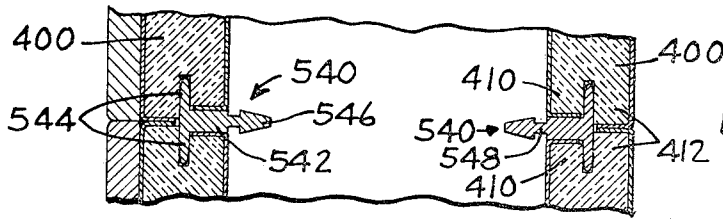


Fig. 21

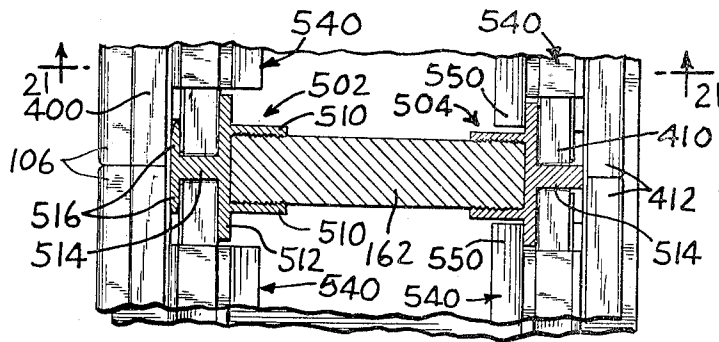


Fig. 19

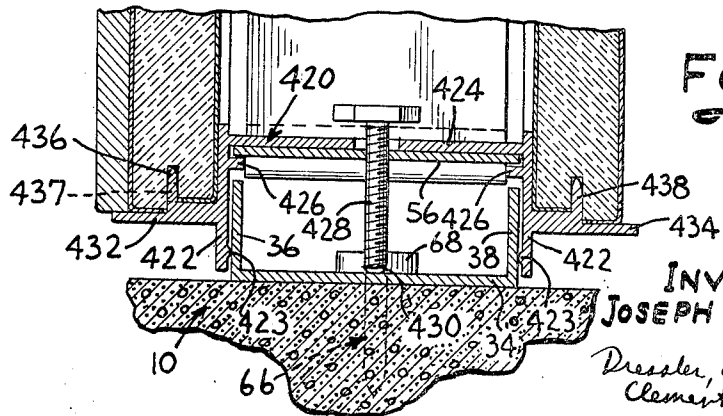


Fig. 20

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3,487,598

MODULAR BUILDING CONSTRUCTION AND METHOD

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Continuation-in-part of application Ser. No. 501,181, Oct. 22, 1965. This application Mar. 25, 1966, Ser. No. 537,340

Int. Cl. E04g 21/00; E04b 2/28; E04f 17/00

U.S. Cl. 52-122

13 Claims

ABSTRACT OF THE DISCLOSURE

Disclosed herein is a method for erecting and a pre-fabricated modular building construction embodying pairs of spaced apart panel walls defining a space therebetween. The construction is particularly adapted for use as an outside wall which is exposed to the weather, and includes slidably interlocked members including top and base runners, studs and panels. The outer panels are locked in position when assembly is complete, whereas the inner panels remain removable. A lifter means is provided for the base runner. The construction disclosed herein includes a number of interrelated features usable as a system in erecting and constructing the double panel wall construction.

This application is a continuation-in-part of application Ser. No. 501,181 filed Oct. 22, 1965, and now abandoned, Ser. No. 503,374 filed Oct. 23, 1965, now abandoned and Ser. No. 503,908 filed Oct. 23, 1965, now U.S. Patent No. 3,391,152, the disclosures of which are hereby incorporated by reference.

This invention relates to a modular building construction and to the method of erecting the same. The modular building construction of this invention is characterized by a plurality of interrelated and interchangeable elements and components which facilitate the rapid erection of a modular building, the construction being adapted and adaptable to a variety of diverse types of buildings. The construction is also adapted to the erection of partition walls and to the addition of walls and other additions to existing buildings.

In erecting a building many factors and considerations must be taken into account. Of prime importance is the structural integrity of the building. It must be suited to the environment and must withstand the abuses ordinarily encountered. It should desirably meet varying building code regulations. The construction of this invention is intended to meet these criteria and to withstand the rigors of climates which range from the hot and humid to the very cold, as well as wind loads and seismic conditions. Such conditions many currently available partition wall and modular constructions are not suited to meet.

Another important consideration is the ease of construction of a building, i.e. one which is simple to erect by relatively unskilled personnel. The construction of this invention utilizes a minimum of interrelated parts which are simply and rapidly interconnectable by the relatively unskilled.

Yet another consideration is the speed with which a building may be erected. This is important for a number of reasons, not the least of which is to place the building in service at the earliest possible time. For example in the operation of a franchise-type drive-in restaurant business, the sooner a new location is operating the sooner a franchisor begins to receive income. Where a plurality of restaurants are to be constructed a saving in erection time even two to three weeks at each site can mean a substantial increase in income. The modular construction of this invention and the method of erecting the modular con-

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struction facilitate the placing of raw or undeveloped sites in service much more rapidly than present building methods at a cost commensurate with the advantages gained.

Where desired this invention facilitates the work of those adding service facilities to the building. Thus it is possible to enclose the building by erecting a roof and an outer wall. Thereafter electrical, plumbing, water, telephone and like facilities may be properly positioned in a wall space after which an inside wall is erected to form, with the outer wall, an insulated double wall construction. As such, services may be installed regardless of environmental conditions which might otherwise limit or preclude their installation. That capacity of this invention, of course, makes possible the more rapid erection of a building.

The invention permits the following of a uniform pattern in erecting a weather exposed modular building. As such, it is possible first to lay a pad such as of concrete, thereafter to erect a structural framework and then to position a roof. That may all be done before work on the wall and ceiling structures are undertaken and before services are installed to provide a protected area in which to work. Thereafter the wall structure may be partially erected, services installed and the ceiling installed as service work is being performed. At the same time installation of interior walls, of flooring and of fixtures of the type to be utilized in the building may take place. With that completed and when the inside wall of a double wall is positioned the building is ready for immediate use.

It is therefore apparent that the modular building construction and method of this invention provide a building possessed of a suitable integrity which is reasonable in cost, which is rapidly and easily erected and which permits a highly advantageous ordered erection to minimize construction time and to facilitate the development of a raw site into a finished building ready to serve its intended purpose in a minimum of time.

The foregoing and other objects, features and advantages of the present invention will become more apparent upon consideration of the following description when considered in conjunction with the accompanying drawings of which:

FIGURE 1 is a side sectional view of a building framework and supporting assembly as viewed from the interior of the building;

FIG. 2 is a perspective view of a lower fragment of a wall constructed in accordance with the present invention;

FIG. 3 is a perspective view of an upper fragment of the wall of FIG. 2 conditioned prior to mounting of wall and ceiling forming panels;

FIG. 4 is an exploded view in perspective of a stud of this invention, a medial portion having been broken out in the interest of conservation of drawing area;

FIG. 5 is a view in a vertical plane transversely of a top runner and showing the upper portion of a stud in side elevation;

FIG. 6 is a view in a horizontal plane transversely of a wall and showing a stud in transverse section;

FIG. 7 is a view in the plane of FIG. 5 transversely of the base of the wall and showing the lower portion of a stud in elevation;

FIG. 8 is a view in a plane parallel to the plane of FIG. 7, but out of the plane of said stud;

FIG. 9 is a perspective view of a fragment of a wall constructed according to the invention and illustrating alternate means for interlocking inner panels to a stud and to each other;

FIG. 10 is an end view of a wall joint covering employable in the illustrated wall;

FIG. 11 is an end view of a spring shim;

FIG. 12 is a view in a horizontal plane below the top

runner of a wall structure in accordance with the present invention illustrating a corner construction;

FIG. 13 is an end view of a panel connecting runner modified for corner formation;

FIG. 14 is a perspective view of a fragment of a building constructed according to the present invention and illustrating the formation of an inside partition and a door opening, parts being omitted, parts being broken away and parts shown in phantom for convenience of illustration;

FIG. 15 is a fragmentary cross-sectional view of a modified panel construction;

FIG. 16 is a fragmentary side elevation of the modified panel of FIG. 15;

FIG. 17 is an exploded view in perspective similar to FIG. 4 of a further stud of this invention;

FIG. 18 is a view in a vertical plane transversely of a top runner and its associated structure and being generally similar to FIG. 5;

FIG. 19 is a view in a horizontal plane transversely of a wall showing a stud in transverse section and being generally similar to FIG. 6;

FIG. 20 is a view in the plane of FIG. 18 transversely of the base of a wall and being generally similar to FIG. 7;

FIG. 21 is a cross-sectional view taken substantially along the line 21—21 of FIG. 19;

FIG. 22 shows a further extrusion keyable with the top runner of FIG. 18; and

FIG. 23 shows a ceiling runner adaptable for use with panels of FIGS. 15 and 16.

As seen in FIG. 1 a modular building construction of this invention may be erected upon a raw or undeveloped site by providing a suitable concrete slab or pad 10 in the desired location on the site. Thereafter a suitable framework 12 such as of steel columns, beams and joists are suitably secured to pad 10. Thus a plurality of vertical columns 14 spaced appropriately around the periphery of the building to be erected are provided. Thereafter a suitable number of appropriately positioned beams 16 are secured to column 14 to form part of a roof supporting structure. Suitable joists 18 are then secured to beams 16 to span the space between parallel beams to provide a suitably strong roof supporting structure. Thereafter roof 20 is positioned with overhanging canopy portions 22 as desired. The thusly formed building shell or framework defines open vertical wall regions as well as an open ceiling region.

Once the framework has been erected, and before or after the roof has been positioned and roofing material applied, the erection of a finishing wall structure of this invention may commence as in the manner to be described.

Referring now to the drawings which illustrate one of the presently preferred embodiments of this invention (i.e. FIGS. 1 to 14) and first to FIGS. 2, 7, 8 and 14, a building constructed in accordance with the present invention includes an outside double wall construction characterized by a spaced apart double wall array including an outer panel formed wall section 30 and an inner panel formed wall section 32. The wall sections are mounted along a horizontal wall frame, member or a base which includes a U-shaped member or base channel 34 which may be of aluminum fabrication extruded in uniform lengths. Base channel 34 is adapted to be disposed along or upon supporting slab 10 which is poured or otherwise suitably formed such as of concrete or the like along the ground. The opposite upwardly extending sides 36 and 38 of the base channel serve as guides and/or as support means nesting within and for mounting an elongated base runner 40 above and upon the base channel and slab 10.

Base runner 40 may be an extrusion of aluminum fabrication and comprises a medial U-shaped part defined by a pair of vertical spaced apart sides 42 and 44 which extend longitudinally of said base runner means and when

mounted in operative position are disposed outwardly and adjacent base channel sides 36 and 38, as best seen in FIGS. 7 and 8. An elongated integral horizontal bridge or web 46 which is disposed normal to the sides 42 and 44 extends longitudinally of said base runner 40 and connects said sides together. Web 46 is disposed slightly downwardly from the upper ends of the sides 42 and 44 whose upper extensions 48 and 50, respectively, form a pair of parallel spaced apart lips extending longitudinally of base runner 40.

A pair of opposed spaced apart ribs or bosses 52 and 54 which are fashioned integrally with the base runner sides 42 and 44 project therefrom in transverse alignment parallel to and spaced slightly below web 46. Bosses 52 and 54 together with web 46 define opposed holding means or a head guideway between the base runner sides 42 and 44 in which the opposite sides of a horizontal tie plate 56 are adapted to engage as best seen in FIGS. 8 and 14. Tie plate 56, as well as a vertical tie plate 58 to be described, is adapted to splice together pairs of adjoining colinearly associated sections of base runner 40. To that end, the plate 56 is provided with a plurality of holes such as internally threaded holes 60 adapted to operably receive fastening means such as screws 62. Screws 62 are received by complementary holes or apertures in web 46.

As best seen in FIGS. 7 and 8, base runner sides 42 and 44 are arranged and proportioned in a manner such that when their lower ends engage slab 10, the bosses 52 and 54 extend over and may be normally spaced slightly above the upper edges of base channel sides 36, 38. However, from time to time, it may be found necessary to adjust the level of base runner 40, for example where slab 10 is not truly horizontal or level throughout. For that purpose load transmitting shim means 64 such as one or more thin metal plates (as illustrated in FIG. 2) may be interposed between bosses 52 and 54 and the upper edges of base channel sides 36 and 38 to raise the level of base runner 40 at the shim location. In that manner the base runner 40 may be made truly level, if desired, around the entire periphery of the building.

In the construction, once the desired relationship between the base channel 34 and the base runner 40 has been established, the assembly may be connected together and to the supporting slab as by threaded anchoring studs 66, the anchoring portion of which projects through the base channel 34 and becomes set in slab 10. As seen in FIG. 8 anchoring stud 66 includes a shoulder 68 which limits the depth of penetration of the anchoring end in slab 10 and which urges channel 34 against slab 10 when stud 66 is set. A threaded nut 70 mounted on the upper threaded portion of said stud impinges a washer 72 disposed about a stud passing aperture in web 46 thereby to urge the base runner 40 downwardly toward and against base channel 34 to secure those base members together to slab 10. The construction is balanced in a manner which obviates need for the base runner 40 to engage the slab 10 (as by sides 42 and 44), base channel 34 providing support adequate for said base runner. However, those portions of the base runner 40 as well as of the base channel 34 which engage slab 10 should be treated or coated with an inert substance, such as an asphaltic paint, to preclude chemical reaction as between the metal members and the lime of slab 10 where slab 10 is of concrete.

A pair of horizontal supports 74 and 76 are fashioned with and extend longitudinally of base runner 40. They project normally from base runner sides 42 and 44, respectively. From a medial portion of said supports, there projects vertically upwardly a pair of integral splines 78 and 80, respectively, which extend longitudinally of said base runner in parallel relationship with its said sides. The support 74, its spline 78 and the side 42 define the outside of the base runner while support 76, spline 80 and the side 44 define the inside of said base runner.

Preferably each of the splines **78** and **80** is spaced from its associated side **42**, **44** substantially the same distance as the other thereby to provide along opposite sides of the base a pair of substantially uniform elongated wells or pockets **82** and **84**, as illustrated in FIG. 2. Additionally outer spline **78** is provided with a plurality of longitudinally spaced venting apertures **79** to allow condensate which may deposit on support **74** to flow outwardly of the outer wall section **30**. Each of the supports **74** and **76** includes a downwardly extending leg which may contact slab **10** to enhance the supporting capacity of supports **74** and **76**.

Each of the wall sections **30** and **32** comprises a panel means which may comprise a plurality of panels which may be constructed according to application Ser. No. 503,374, filed Oct. 23, 1965. Alternatively the panels may be of the perimetric grooved construction illustrated in said application, but may have suitably surfaced hard-board facings **86** adhered to a fire-resistant foam core **88** such as illustrated in the drawings of FIGS. 2 to 14, the panels defining a perimetric groove means **90**. The panels are arranged vertically in tiers, the panels for convenience of discussion of the lowest tier in each outer wall section being designated **92** and in each inner wall section being designated **94**, and those of the top tier being designated for the outer wall **96** and for the inner wall **98**. The splines **78** and **80** are adapted to slideably engage and key in those parts in grooves **90** formed in the lower edges of the panels **92**, **94**. Moreover, panels **92**, **94** may be proportioned in a manner such that the edge or lower portions **100**, **102**, respectively, slideably engage in the pockets **82** and **84** fit snugly, to the end that the panels when disposed in mounted position will assume an erect or vertical aspect. As such the base runner may be said to provide a main body portion flanked by panel edge receiving and interlocking formations along opposite lengthwise edges of the main body portion for edge keying panels therewith.

Notwithstanding the snug fit however which may exist because of the proportioning of the splines, supports, base channel sides and panel and its groove, it may be desired to further minimize likelihood of in and out play of the panels and other panels to hereinafter be described in connection with, for example, FIG. 5. To that end, there may be employed a spring shim **104** (FIG. 11) which may be anchored on a projecting part such as extension **50** and wedged between a panel and an adjacent runner side, as illustrated in FIGS. 7 and 8.

The outer surfaces of the panels of the outer wall section **30** are adapted to be suitably covered as by weather resistant tiles **106** adhered thereto as by an epoxy cement with grouting **108** such as the same epoxy cement or a suitable elastomeric sealant being applied between the tiles and between the tiles of horizontally and vertically adjacent panels. To provide a rest or base for the tiles **106**, a portion of support **74** extends outwardly beyond the panels **92**, as illustrated in FIGS. 7 and 8.

On the inside wall portion of base runner **40**, a base trim or molding strip **112** which may be integrally fashioned therewith extends longitudinally of said base runner, said strip projecting upwardly from the outermost portion **114** of the support **76**. A medial section **116** of finishing strip **112** is spaced from the inner panels **94** and merges into an upper curved part **118** which is adapted to engage mounted inner panels **94**. An elongated horizontal shoulder **120** is generated along the base of strip **112** at its junction with horizontal support portion **114** at a level sufficient to permit engagement thereunder of the edges of slab covering tiles **122**, as illustrated in FIGS. 2 and 14.

When the panels are in position, the foregoing arrangement generates a cavity **124** within the base molding strip. A pair of vertically aligned recesses **126** and **128** which may be said to be fashioned in the wall of strip **112** open

into said cavity to define a vertically projecting side guide-way. Recesses **126** and **128** are adapted to receive the upper and lower ends of vertical tie plate **58** best seen in FIGS. 8 and 14. Securance of said tie plate to the base molding strip may be by means of screws **130** (FIG. 8) which are projected through holes **132** (FIG. 14) in said tie plate and operably engaged by the internal threads of a socket **134** fashioned in the internal surface of base finishing strips **112** substantially midway between the recesses **126** and **128**. By means of tie plate **58** (and tie plate **56**) adjacent sections of base runner **40** may be secured to each other.

As illustrated in FIGS. 7 and 8 the recesses **126** and **128** are defined by a pair of downwardly and upwardly projecting extensions **136** and **138** which are adapted for vertical alignment. Said extensions are fashioned integrally with finishing strip **112** and provide thereon a pair of inner flats adapted as abutments against which the panel **94** of the inner wall section **32** are positioned. A pocket **140** is generated by extension **138** and spline **80**. Said pocket is proportioned so that the part of the inner panels **94** engaged therein may be tightly held.

The foregoing base construction provides a covered course in the base channel **34** for water pipes, electrical conduits and the like. As illustrated in FIG. 2, the spaced apart inner and outer wall sections are adapted to accommodate therebetween, for example, a vertically extending portion of water pipe **142**, as well as an exemplary electrical conduit **144** which is shown in FIG. 14 projecting upwardly through the web **46** for connection to an electrical receptacle **146** mounted on the inner surface of the outer wall section. Exemplary receptacle **146** may have a part (not seen) operably exposed through the outer surface of the tiles **106**.

An overhung groove **148** formed in the base molding strip **112** and opening to the exposed surface thereof provides a means for anchoring the lower end of an elongated base finishing strip cover **150**. As illustrated in FIG. 7, the upper end of the cover **150** is adapted to be secured between panels **94** and the strip **112** in the recess **152** fashioned in the finishing strip part **118** and opening on its unexposed side. The cover **150** may be fabricated of a suitable plastic material which is adapted for extrusion in a customary manner.

Vertical support for the panels of the inner and outer wall sections is provided by a plurality of regular vertical wall framing members or studs generally designated **160** (see FIG. 4). In a preferred embodiment said stud comprises an elongated or rectilinear web or core **162** fabricated from a sandwich-type laminate manufactured from resin treated wood particles treated for fire resistance. Such a material is substantially non-conductive whereby it serves to prevent transmission of heat and cold between the runner components thereof, hence between outside and inside walls. The studs are adapted for horizontal spacing for framing of the wall structure. Stud **160** includes elongate vertical panel edge receiving and interlocking formations comprising an outer vertical runner generally designated **164** and an inner vertical runner generally designated **166** which are rigidly secured on opposite sides of core **162**. Said runners provide the means by which the panels comprising the inner and outer wall sections may be slidably fastened or secured in wall forming attitude. As will appear studs **160** need not be load bearing, i.e., they need not support vertical loads, although they may where desirable.

In the preferred embodiment, each of the outer and inner runners **164** and **166** is an aluminum extrusion having a pair of elongated core gripping or core embracing flanges **168** and **170** which form pockets **172** in which a respective vertical core side is secured, as seen for example in FIGS. 2 and 4. To facilitate the securance frictional biting means such as a plurality of ridges or teeth **174** may be fashioned in the core engaging surfaces of flanges **168** and **170** as well as in the core engaging sur-

faces of upper and lower stud connectors **176** and **178** as illustrated in FIG. 4. As best seen in FIG. 6, teeth **174** are disposed to resist sidewise removal of the core gripping runner flanges from core **162**. If desired fasteners such as nails or rivets **180** may be driven through the flanges or runners **164** and **166** as well as through the bottom stud connector **178** to enhance connection thereof said core **162**.

Each of the runners **164** and **166** comprises an integral plate **182** which spans associated gripping flanges **168** and **170** and therewith defines its pocket **172**. Moreover, the outer runner **164** comprises an integral vertical web **184** projecting normally outwardly from its associated plate **182**. On its outermost end, web **184** carries a spline **186** disposed parallel to its associated plate **182** and projecting equidistant on opposite sides of said web. The web **184** may be disposed midway between the flanges **168** and **170** of its runner and thereby to form a pair of uniform pockets **188** and **190** on opposite sides thereof between the plate **182** of runner **164** and spline **186**.

As illustrated in FIG. 6, the oppositely projecting parts of spline **186** are adapted to engage in vertical portions of groove **90** formed in the vertical edges of horizontally adjacent outer panels for connection thereof along adjoining vertical sides to an associated runner **164**. It is appreciated that each runner **164** may be of sufficient length to accommodate all of the outer panels in a vertical stack and that sufficient studs will be provided for anchoring all of the vertical stacks of panels in the outer wall section.

Each inner runner **166** comprises an integral web **192** which is the counterpart of the web **184** of an associated runner **164**. However, in the illustrated embodiment web **192** projects away from its plate **182** a distance greater than the web **184** projects from its plate **182**. In the form of the inventions shown in FIGS. 2 and 3, web **192** serves as a mount for a rockable spline **194** by reason of which horizontally adjoining panels in each panel tier of the inner wall section **32** may be releasably connected together and to the stud. The spline **194** is not described in detail as its construction and interrelationship with web **192** may be that shown and described in co-pending application Ser. No. 503,908, filed Oct. 23, 1965.

As illustrated the runners **164** and **166** terminate short of the upper and lower ends of their respective stud cores. The lower stud connector **178** comprises an extrusion which may be fashioned like the runner **166**. However it is disposed at right angles thereto as illustrated in FIGS. 2, 4 and 7. That is to say, lower connector **178** comprises a channel **196** defined by plate **198** and stud core engaging sides **200** between which the lower end portion of the stud core is secured as by fastening means **180**. Plate **198** serves as a stud support which engages the base runner web **46** when the stud is operably mounted with its depending boss **202** slideably projected through a transverse slot **204** formed in the connecting web **46** of base runner **40** for interlocking engagement therewith. Transverse slots **204** are formed at predetermined intervals longitudinally of the base runner to correspond to the stud spacing to be provided in the finished construction. The mounted position of a stud is shown in FIG. 7. In FIG. 2 however, stud connecting member **178** as well as the outer panels are shown elevated from the base runner for the purpose of illustration. As seen in FIG. 7 lower stud connector **178** fits snugly between upper extensions **48** and **50** to minimize or prevent transverse movement of the stud with respect to the base runner when interlocked therewith.

The upper stud connector **176**, as illustrated in FIGS. 3, 4 and 5, comprises an inverted channel having opposite gripping sides **206** and **208** between which the upper end portion of the stud core is secured. A bolt **210** which projects through apertures in said opposite gripping sides transversely of stud connector **176** is adapted for vertical adjusting movement in a vertical slot **212**

(FIG. 4) formed in the upper end of the stud core to facilitate stud length adjustment. Bolt **210** may be threaded to the end that the connector **176** may be releasably secured in vertical adjustment by an opposed nut (not shown). Bearing in mind that even when the nut is loosened to permit vertical adjustment of the stud connector **176**, the core will be gripped by teeth **174** formed on the inner surfaces of the connector sides **206** and **208** and accordingly for adjustment of the length of a stud, substantial force is required. Stud adjustability serves to permit stud mounting by expansion into interlocking engagement with the base runner **40** and a top runner generally designated **220** and illustrated in FIGS. 3 and 5.

A further horizontal wall framing member, top runner **220**, extends in a generally horizontal plane parallel to and vertically aligned with the underlying associated base runner **40**. The top runner has transverse apertures or slot means **222** which may comprise pairs of slots spaced longitudinally of top runner **220** to correspond to stud spacing and arranged in substantial vertical alignment with a base runner slot **204**. To anchor a stud, its depending boss **202** is slideably engaged in a slot **204** and thereafter its upper connector **176** will be adjusted for slideable engagement in the slot means **220** by moving the connector from the solid line position to the phantom position illustrated in FIG. 3, in the latter position the stud being rigidly, but releasably secured in frame forming attitude. To lock the upper end of a stud of the illustrated embodiment, opposite upper corners of its upper connector **176** are cut away to form shoulders **224** which engage in the slots comprising the slot means **222** (FIG. 5).

Each top runner **220** is rigidly secured to and suspended from a permanent framework represented by member **226** (FIGS. 3 and 5) which may be of structural steel or other suitable fabrication secured to framework **12** or to such as joists **18** thereof. Moreover, from the permanent framework **12**, as by means of hangers **228**, ceiling panel connecting runners **230** (only one of which is shown) can be hung in the plane of top runner **220** and normally thereto for mounting of a modular ceiling which may take the form of and be constructed and completed according to the disclosure of co-pending application Ser. No. 501,181, filed Oct. 22, 1965. Hangers **228** may be secured to framework **12** as to joists **18** thereof or hangers **228** may be omitted and runners **230** directly secured to such as joists **18** in a step-by-step progression. The erection of the ceiling may progress as described in that application.

The top runner **220** may be of extruded metal fabrication and comprises a medial inverted channel portion **232** (illustrated in FIGS. 3 and 5) which is defined as upper surface or top **238** and has a pair of spaced apart depending outer and inner sides **234** and **236**. A pair of integral shelves or shoulders **240** and **242**, when in structure forming position, extend in horizontal alignment toward each other from opposite sides **234** and **236**. Said shelves are spaced slightly from the top **238** of the runner to form a guideway or a track in which opposite sides of an upper tie plate **244** are adapted to engage to connect together colinearly adjoining top runner sections. For the latter purpose, such upper tie plate may be secured in runner section bridging position by means of fasteners such as screws **246** received in suitable apertures in top **238** in a manner similar to that described in connection with tie plate **56**.

At the lower end portions of sides **234** and **236**, a pair of channel opening recesses **248** are formed, those recesses extending longitudinally of the runners and providing anchors for the opposite sides of snap or bridging plates **250**. Snap plates **250** serve as a bottom or floor section for a top runner service chamber or passage **252** adapted as a conduit for wires, pipes and other running structures. By referring to FIG. 3, it is observed that snap plates **250** are spaced apart longitudinally of the top runner

ner to accommodate between pairs thereof the top of a stud.

Spaced from respective sides **234** and **236**, respectively, and parallel thereto are a pair of outer and inner integral top runner walls **254** and **256** (see FIG. 3) which project downwardly from top **238** to provide a pair of elongated downwardly opening outer and inner panel edge receiving and interlocking formations or pockets **258** and **260**, for upward reception of panel edges therein and for lateral restraint of panel edges when the panels positioned therein are supported from below. The outer pocket **258** is wider than the inner pocket **260**, the latter being proportioned to accommodate the thickness of an inner upper wall forming panel **98**, while the outer is proportioned to accommodate an outer upper wall forming panel **96** and the thereto affixed tiles **106**, as illustrated by FIG. 5.

By referring to FIG. 3, it is seen that the outer part of the top runner **220** may be fashioned with an outer extension **262** of top **238** overhanging runner wall **254** and an elongated shelf **264** parallel to the extension **262** and extending outwardly normally from said wall **254**. To fashion a suitable form of overhang or canopy portion **22** for the building, a metal furring channel **266** may have an end portion anchored between extension **262** and the shelf **264**. Metal lath **268** is shown as being secured to the under surface of the furring channel and plaster or other suitable cementitious matter in a form **270** fashioned according to requirements is connected in a usual manner to the lath. The canopy will cover the exposed framework and beams **16** from view from the outside of the building.

The inner wall **256** of the top runner has projected normally from the exposed surface thereof a laterally projecting integral spline **272** adapted to engage in an edge groove of ceiling panels such as those previously referred to. An integral flange **274** disposed above and parallel to the spline **272** therewith forms a pocket **276** dimensioned snugly to hold the therein disposed portion **278** of said ceiling panels (FIG. 5). A second but narrower flange **280** disposed below and parallel to spline **272** therewith forms a pocket **282** and defines the bottom of the runner wall **256** from which said flange **280** projects normally. The pocket **282** is adapted snugly to receive those peripheral portions **284** of the ceiling panels disposed below spline **272**. A lip **286** extending longitudinally of the flange **250** provides an anchor for a finishing strip **288** having resilient characteristics and which may be mounted in the manner illustrated in FIG. 5.

The outside wall of this invention is usually erected after the base and top runners have been positioned in the manner described. Thereafter a study **160** is conditioned for wall formation by locking it to the base and top runners in wall framing attitude in the manner heretofore described. A first outer panel **92** is then tenoned to the stud by keying the panel groove in the lower edge of the panel with spline **186** to one side of the web **184**. Simultaneously such first panel is connected to the base runner by keying on the spline **78**. Thus outer panel **92** is lowered from the position illustrated in FIG. 2 to a connected position such as that illustrated in FIGS. 6 and 7. One or more other panels then may be arranged in a vertical stack with the first panel, each of such others being keyed to a respective upper portion of spline **186**. To further connect the panels in the outer wall section in vertical association, horizontal connectors generally designated **290** are preferably employed, as illustrated in FIG. 2.

Each horizontal connector has a horizontal boss **292** adapted to lie between the adjoining horizontal panel edges. Integral with each horizontal boss is a vertical spline, half **294** of which projects upwardly from its horizontal boss and the other half **296** of which end projects downwardly from horizontal boss **292**. The respective upper and lower portions **294** and **296** are adapted for keying engagement in adjoining grooves of pairs of vertically

arranged panels. An inner plate portion **298** may be provided to define panel portion receiving pockets.

In FIG. 5 it is seen that the uppermost outer panel **96** in a vertical stack comprising the outer wall section **30** is spaced below the top **238** of the runner **220**. Consequently, connection together of such uppermost outer panel with the panel adjoining and below is accomplished by inserting the upper end portion of such uppermost panel as high as possible in the pocket **258** and thereafter sliding it downwardly adjacent runner flange **186** and moving it into locking engagement with a horizontal connector **290** which has theretofore been keyed to the next adjoining panel disposed therebelow and with runner flange **186** in the manner described.

After assembly of a vertical stack of outer panels, a further stud is moved toward the assembled aligned stack for locking the stack proximate part of its runner flange **186** in what then will be the exposed vertical side grooves of the panels of said stack. Thereafter, the further stud is extended to vertically locked position in the top and base runners and another stack of panels is tenoned to that stud in the manner just described. The operation is repeated successively in what may be considered a downstream direction until an entire outer wall section **30** of the outside wall structure has been erected.

Therefore, in accordance with the present invention, the inner wall section **32** may be constructed after the entire outer wall section has been erected facilitating building construction and service installation.

To erect an inner wall section, a vertical stack of inner panels is erected by first keying the lowermost inner panel **94** of such stack to the spline **80**. The side of that panel is then positioned in abutting relation with inner runner web **192** of stud **160**. Through the use of an appropriate number of horizontal connectors **290** the panels comprising said stack are connected to each other. The uppermost panel **98** of said stack is assembled by first elevating it into the chamber **260** (see FIG. 5) and then lowering it upon its horizontal connector **290** to lock it in wall forming condition. In this regard it is appreciated that the upper panels **96** and **98** are proportioned in a manner such that when they are locked in wall forming attitude their upper end portions are engaged in the pockets **258** and **260**, respectively.

Adjustable rockable splines **194** are manipulated to lock the horizontally adjacent panels of said inner wall section on opposite sides of each web **192** in the manner described in the aforesaid application Ser. No. 503,908. However, a modified form of connector generally designated **300** (FIG. 9) may be used in lieu of splines **194** and its associated horizontal connector **290**. The modified locking connector **300** may be formed as from a ceiling connector extrusion **230** (FIG. 2) with its lower flange **302** removed. What remains thereafter in terms of orientation with respect to employment of locking connector **300** comprises a horizontal web **304** having a pair of thereto transversely extending integral cross members **306** and **308**. The latter are adapted for vertical disposition, are parallel to each other and form therebetween a pair of pockets **310** above and below the web **304**. A pair of extensions **312** and **314** of web **304** extend horizontally beyond the cross members **306** and **308**.

The cross member **306** defines a pair of splines projecting above and below the web **304** and serves to lock a pair of vertically adjacent panels to the connector **300** above and below said web in the same manner as splines **294** and **296**. As illustrated in FIGS. 4, 6 and 9, each inner runner plate **182** has a pair of opposite extensions **316** and **318** projecting beyond or overhanging the stud core gripping flanges **168** and **170**, respectively. The runner adjoining faces of horizontally adjoining panels are adapted to engage against said extensions **316** and **318** with adjoining vertical edges abutting opposite faces of an associated runner flange **192**. In such condition, when a pair of horizontally aligned adjoining connectors **300**

are operably mounted, the facing edges 320 of cross member 308 will engage along the vertical edges of the extensions 316 and 318. By uniformly removing portions of each connector 300 without removing corresponding opposite end portions of its web extension 314, the latter thereby forms a pair of opposite bosses or locks 322 which are adapted to engage faces of extensions 316 and 318 of adjoining stud runners opposite to the faces of such extensions engaged by the panels. Thereby, the connectors 300 serve to tenon each stack of inner vertical panels along its opposite sides to a pair of vertical inner runners 166.

It is appreciated that in assembly of each stack of inner panels employing the modified panel locking connectors 300, its lowermost panel 94 is keyed to spline 80 whereafter successive vertically disposed panels in such stack are connected to each other through locking connectors 300 and to the spaced studs between which such stack is arranged. Since the width of locking connectors 300 is greater than the distance between opposed extensions 316 and 318 of spaced apart adjoining stud runners, locking connectors 300 are canted or otherwise angled to facilitate positioning of bosses 322 behind extensions 316 and 318. Thereafter bosses 322 and cross members 306 and 308 are positioned as has been described.

To close the spaces between adjoining inner panels, suitable lengths of wall joint covering may be employed, as illustrated in FIGS. 6 and 10. In the preferred embodiment the wall joint covering may comprise a cap 326 adapted to bridge the space between a pair of panels with opposite panel engaging and overlapping extensions 328. Moreover, said wall joint covering includes a pair of spring legs 330 adapted to engage in the joints between panels to secure the covering in mounted condition and to rigidify the wall construction. The preferred wall joint covering 324 is an extrusion fabricated of a suitable plastic.

Reference is now had to FIG. 14 in which there is disclosed a manner in which the invention may be employed for an interior wall or partition 340. As illustrated to the lower right of FIG. 14, regular base channel 34 may be employed. However, the base runner 40' for the partition is formed from a pair of longitudinal halves of base runner 40 having base finishing strips 112. Such base runner halves are spliced together with tie plates 56 and are secured to their base channel by means of anchoring studs 66 as heretofore described. Accordingly, on opposite sides along the bottom of an interior wall thusly formed, a base finishing strip 112 will be provided. The spliced base runner 40' for the interior wall together with its channel may be mitered as at 342 to the base channel and base runner for the outside wall normal to which the partition wall extends. Suitable horizontal tie plates 56 cut to accommodate the mitered shape of the combined interior wall base runner may be used to connect the latter to the base runner for the outside wall. A top runner (not shown) for interior walls may be constructed by similar fashioning from inside halves of a top runner 220.

Partition 340 may be constructed of two vertical sets of panels 344 which define opposite wall sides and which may be the same as outside wall panels. In FIG. 14, it is seen that the lowermost of the panels 344 will be keyed to splines 80 in base runner 40'. Along the vertical edges of the panels 344 which are disposed adjacent the inner wall section 32 of the outside wall, a pair of vertical splines 346 project normally from said inner wall section 32 into locking engagement with panels 344. A right angular leg 348 of each of said last splines is suitably secured by means such as screws or the like 350 to said wall section 32. Splines 346 may be of metal fabrication and the like and like the other runner members can be fashioned as aluminum extrusions. A plurality of hori-

zontally adjacent wall panel sections may then be erected utilizing stud members of the character herein described. The erection may take place by locking both of the spaced apart panel sections into the studding in the manner in which the outside wall is erected, by erecting both sections as the inside wall is erected or substantially in the manner the building wall is erected as has been described.

In accordance with the present invention should an interior door opening 352 be desired in the partition 340, or for that matter in the outer wall, it may be formed between a pair of spaced apart studs, one of which is shown to the right of FIG. 14. In the preferred embodiment of the invention a pair of regularly spaced apart studs are arranged on opposite sides of a conventional door frame 354. Stud 356 is unlike regular studs 160 in that the former have mounted along their opposite vertical sides a pair of exterior runners 164 rather than runners 164 and 166. Opposite vertical sides 358 of the door frame about the vertical edges of the panels adjacent the door opening and a suitable spacer 360 disposed between the studs 356 and the door frame reinforces the latter member. Both spacer 360 and door frame 354 are interconnected with studs 356 to provide a rigid door supporting structure. A door 362, which is illustrated in phantom to the right of FIG. 14, is hung in the door opening. Inasmuch as the spacing of studs 356 is of regular interval, panels of regular widths may be employed above the door frame without modification where desired. However panel widths and heights can be varied if desired. Stud 356 are secured to the top and base runners in the manner previously described.

In FIG. 12 a suitable construction of a pair of angularly associated outside walls and an included corner is shown. In addition to regular flat rectilinear panels, the outer wall section 30 of the outside wall includes a vertical stack of right angular panels 364 defining each corner. To support panels 364 of a stack thereof a pair of studs 366 are disposed at right angles to each other. Stud 366 differ from studs 160 in that the inner stud-gripping vertical runners 368 are different from the regular inner vertical runners 166. That is to say, each runner 368 is a modified form of external vertical runner 164. To convert a runner 164 into a runner 368, portions of the runner 164 are cut away leaving a spline 370. The cut away portions have been cross-hatched in FIG. 13. Thereby spline 370 extends only in one direction from the web 372, the latter corresponding to the web 184 of runner 164.

One portion of each spline 186 associated with a stud 366 engages in adjacent vertical sections of the side grooves formed in respective angular panels 364. Thereby the angular sections of the panels 364 forming a corner are connected to each stud 366. The other portion of each of said last mentioned splines 186 is keyed to the adjacent regular flat panels. Angular or corner panels 364 may be erected after a corner has been otherwise completed or after one wall is completed and a corner is reached after which the next wall extending from the corner is then erected, as in the embodiment illustrated in FIG. 12.

The exterior surfaces of each angular panel 364 are preferably covered by tiles 106. Where the latter tiles 106 meet at a corner, a vertical angular joint cover 374 comprising a metallic extrusion of suitable shape may be provided. It has a pair of right angularly disposed legs 376 secured between the outer faces of the angular sections of panel 364 and the covering tiles 106. A web 378 extending between tiles 106 at the corner connects legs 376 to a joint covering cap 380.

The arrangement of the inner corner forming runners 368 is such that their splines 370 are disposed at right angles to engage in the vertical grooves of regular panels of a pair of adjacent right angularly disposed vertical stacks of panels meeting and forming an inner wall corner.

The base at the corner comprises a pair of right angularly disposed channels 34 and associated base runners 40 mitered in a joint along a line 382, with the angularly disposed base runners being secured together by horizontal tie plates 56 of modified configuration (not shown) to accommodate the corner arrangement.

Further embodiments of this invention are illustrated by FIGS. 15 to 23. In accordance with one such embodiment a building modulus or panel 400 is provided. Panel 400 which may be rectilinear may be constructed in accordance with that described in the aforementioned U.S. Ser. No. 503,374 and to that end comprises central enlarged fire-resistant polyurethane foam core 402 and exterior pan-like warpage resistant rigidifying cover plates 404. A pocket means such as perimetric groove 406 is provided. In this embodiment groove 406 is circumscribed at both of its exterior edges by flange edges 408 of cover plates 404, edges 408 being spaced apart a distance slightly greater than the splining means to be received by groove 406 to prevent metal to metal contact where the splining means are of metal. The major face portions of the panel core and the major covering portions of the plates are of differing peripheral dimensions. As seen, in this embodiment the periphery of panel 400 defines adjacent perimetric groove 406 flange segments 410 and 412, flange segments 410 and 412 being different from those of panels such as panels 94 in that they are of different sizes. Thus flange segment 410 is of a lesser lateral extent than is flange segment 412 so that when positioned in a manner to be described horizontally and vertically adjacent panels will abut adjacent flange segments 412. Suitable protective or decorative coatings or surfacings may be applied to cover plates 404 and as such panel 400 may have a suitable plastic covering. Alternatively, tiles may be affixed to panels 400 in the manner heretofore described for outside use.

Referring now to FIG. 20 a suitable modified base supporting structure may comprise a base channel 34 secured to slab 10 as by a series of anchoring studs 66 having shoulders 68 to securely anchor base channel 34 to slab 10. A modified base runner 420 may be an extrusion of aluminum fabrication and comprises a medial U-shaped part defined by a pair of vertical spaced apart sides 422 which extend longitudinally of said base runner and which when mounted are disposed outwardly and adjacent base channel sides 36 and 38. An elongated integral horizontal bridge or web 424 connects sides 422 together. Locating bosses 423 which may be elongated ribs extend inwardly of sides 422 and are positioned against base channel sides 36, 38 to provide an assembly which resists transverse movement of base runner 420.

A pair of opposed spaced apart shelves or bosses 426 which are fashioned with the base runner sides 422 project therefrom in a transverse direction parallel to and slightly below web 424. Bosses 426 together with web 422 define opposite holding means between the base runner sides in which opposite sides of a horizontal tie plate 56 are adapted to engage. Tie plate 56 is adapted to connect together, as has been described, pairs of adjoining sections of base runner 420. Tie plate 56 may also serve to assist in adjusting the level of base runner 420, for example where slab 10 is not truly level or horizontal throughout. For that purpose a threaded aperture is provided in tie plate 56, a circular opening is provided thereabove in runner web 424 and a rotatable screw threaded lifter means or jack 428 is threadedly received in the threaded aperture (see FIG. 20). The screw-jack lower end 430 rests in load transmitting relation against the base channel 34 and when rotated may raise or lower base runner 420. Once leveled, anchoring stud nuts 70 are positioned to lock runner 420 to base channel 34. Where racking is a problem a pair of side-by-side screw jacks 428 may be used to provide a truly horizontal orientation for web 424. Once leveling is accomplished a cement or like grouting may be pro-

vided externally of the runner sides and adjacent channel 34 to provide more permanent and more substantial leveling support.

A pair of horizontal supports 432 and 434 are fashioned with base runner 420. They extend normally from base runner sides 422. From a medial portion of said supports there extends upwardly a pair of integral splines 436 and 438, respectively, which are parallel to sides 422 and which are spaced equidistantly from the adjacent side 422 to define a pair of uniform wells or pockets to receive a flange segment 410 of a panel. As seen in FIG. 20 supports 432 and 434 include segments of differing widths to the end that complementarily proportioned panel flange segments may rest thereon. As such the differing width is substantially equal to the difference in the flange segment dimensions. Splines 436 and 438 are proportioned to be snugly fit into the portion of groove 406 into which they reach and to provide a snug firm engagement of flange 410 within the pocket provided between a side 422 and its respective splines 436 and 438. Desirably the splines may be of a slightly greater width than the panel groove width whereby the groove is slightly expanded upon insertion of a spline to more snugly grip and more effectively and securely position a panel. Outer spline 436 may be provided with condensate apertures 437 for the purposes described.

A further top runner 440 is illustrated in FIG. 18. Top runner 440 extends in a generally horizontal plane parallel to and in vertical alignment with associated base runner 420. Top runner 440 is suitably suspended from framework 12 as by securance to joists 18 through its central web 442.

Runner 440 comprises a symmetrical central section of which central web 442 is a part. It defines at each upper side a corner slot comprising longitudinally extending flange receptacle 444 and includes a laterally extending arm 446 from which a runner side 448 depends. At its lower end each runner side includes an inwardly extending rib 450.

Flange receptacles 444 are adapted to accommodate a variety of panel retainer corner sections or flanges each adapted for a particular use. Two such flanges are illustrated in FIG. 18. Inner flange 452 is adapted to cooperate with inner vertical panels and ceiling panels. To that end it includes a key segment or flange segment 454 proportioned to be canted into and to be retained by flange receptacle 444. It also comprises a horizontal arm web 456 supported on arm 446, an integral depending side wall 458 and a laterally extending ceiling panel spline 460. The lateral extent of web 456 is such that it cooperates with runner side 448 and side wall 458 to define a pocket 462 for snugly receiving the upper portion of the uppermost panel of a tier in a manner previously described. The width of side wall 458 is substantially the difference between the lateral extents of flange segments 410 and 412 thereby to facilitate the abutment of a ceiling panel edge against a vertical wall panel as illustrated in FIG. 18.

Cooperable ceiling support runners 464 are suspended in horizontal alignment with key segment 454 to provide a framework suspended splining means (see FIG. 23). To that end flange 466 is suspended from framework 12 as by securance to a joist 18. A depending leg 468 is provided with elongated spline members 470 adapted to be snugly received within groove 406 of adjacent panels 400. The width of leg 468 is such that adjacent flange segments 412 may abut beneath spline members 470 to provide where desired an uninterrupted ceiling panel arrangement when viewed from below.

Flange 472 (FIG. 18) comprises a key segment 454 received in its complementary flange receptacle 444 and is additionally horizontally supported on runner arm 446. Flange 472 also includes a web 474 which terminates outwardly in a depending arm 476 having a downwardly spaced portion 378. Integral with arm 476 is a

pair of spaced apart ribs **480** defining with a base portion a longitudinal pocket **482** adapted to receive an edge of a panel such as fiberglass or other suitable panel sheet **484** which defines part of an exterior canopy construction. The parallel other edge of sheet **484** may be received in a similar complementary pocket means to position and retain it. Thus where a lath and plaster canopy or exterior is not desired decorative plastic or like sheeting may be substituted for the construction illustrated in FIG. 3. However where such is desired an exterior flange embodying the particular pocket defining means of FIG. 3 may be provided in lieu of flange **472**. Arm **476** and portion **478** with web **474** and side **448** define a panel receiving pocket **486** proportioned to snugly receive a tiled panel **400** in a manner previously described.

A further flange **488** adaptable for cooperation with top runner **440** is illustrated in FIG. 22. Flange **488** there is proportioned to receive a panel **400** and is provided with a decorative face **490** which may be exposed to view in the finally constructed building. Such a flange may be secured to a runner intended for accommodation of an inside partition wall and to that end runner **440** may be secured to an in place ceiling comprising a plurality of panels **400** by means of suitable bolt means **492** which may pass through ceiling panel **400** to engage framework **12** to be suspended as from a joist **18**. In that manner an interior partition wall may be positioned, if desired after the ceiling is in place, the wall itself being erected between a top runner and a suitably disposed base runner in a manner herein described.

Referring now to FIG. 17 a modified stud **500** of this invention is seen to include a core **513** and suitable runners and connectors, the particular construction of which in some instances vary from those previously described. Stud **500** includes an outer vertical runner means **502**, an inner vertical runner means **504**, an upper connector **506** and a base connector **508**.

Each of runners **502** and **504** have a pair of toothed core gripping flanges **510** which with webs **512** form core receiving pockets. Securance of core **513** therein may be enhanced such as by fasteners **180**. Core **513** defines a bolt means receiving aperture **515**. Outer runner **502** defines an outwardly extending segment **514** terminating in oppositely extending splines **516** which with segment **514** and web **512** defines a pair of oppositely extending panel portion receiving pockets. Those pockets are proportioned to receive adjacent panel flange segments **410** when splines **516** are received in groove portions **406** whereby flange segments **410** may abut adjacent their peripheral edges.

Runner **504** is similar to runner **502** except that splines **516** are omitted, the panels being otherwise secured to the stud (see FIG. 19).

Upper and lower stud connectors **506** and **508** may be substantially the same. Lower connector **508** comprises a horizontally oriented extrusion defining a pair of core gripping toothed flanges **518** and a horizontal web **520** together defining a core end gripping pocket. Flanges **518** define aligned locking slots **519** to adjustably receive a locking bolt means **210** to adjust the length of the stud. Securance of the core **513** therein may be enhanced as by fasteners **180**. A depending lock member **522** is proportioned to be received in a transverse slot provided as by cutting in web **424**. In that manner stud **500** may be keyed to the base runner construction.

Upper connector **506** also defines an upwardly extending lock member **524** extensible with connector **506** to be received in top runner defined slot means defined by ribs **450**. Thus as seen in FIG. 18 lock member **524** extends upwardly between runner sides **448** and into the plane of ribs in which are provided as by cutting complementary laterally aligned slot means adapted to slidably receive vertical edge portions of lock member **524**. Thus, when lock member **522** is accommodated in the described

manner in base runner **420** and the stud is supported thereon and when lock member **524** is extended into engagement with the top runner and locked with respect to the core, stud **500** is ready for use. Since a plurality of such studs may be utilized in the manners already described for erecting an outer double wall and inner partition walls, that will not be here repeated.

As seen in FIG. 18 an open channel or passage **526** is provided between runner sides **448**, central web **442** and cover plate sections **528**. Cover plate **528** comprises a horizontal web and snap segments **532** which are releasably snap locked to ribs **450**. Cover plate sections **528** are positioned between studs **500** or are otherwise proportioned so that they do not interfere with the keying of upper stud connector **506** to the top runner. It is to be appreciated that with this construction a pair of passages for service facilities may be provided, one at the top runner and one at the base runner. Additionally, if desired cores **162** may be perforated to permit the extension of service facilities therethrough intermediate the pair of passages.

FIGS. 19 and 21 illustrate horizontal connector means for securing vertically adjacent panels to each other such as in the manners described in connection with connectors **290** and **300**. Connectors **540** comprise an elongated horizontal web **542** terminating at one end oppositely disposed panel groove receiving splines **544** and rearwardly in a web extension **546**. Web **542** includes a throat **548** reduced in cross sectional area. Web **542** is proportioned to abut adjacent flange segments **410** of vertically adjacent panels to the end that flange segments **412** thereof abut as seen in FIG. 1. As seen in FIG. 19 outer wall connectors **540** are of a length such that they may be accommodated between the outer runners **502** of adjacent studs **500**. However where, as for example with the inside wall as seen in FIG. 20, means for retaining the panels in wall forming attitude are required the connector extends behind a portion of the runner **504**. Where desired such a connector may be used in the exterior wall as well.

Inner connector **540** is proportioned to be utilized in the manner indicated for connector **300**. That is to say a locking boss **550** is provided adjacent each end which locking boss fits behind a portion of the inner stud runner. In this manner vertically adjacent panels of a stack are keyed to the stud as well as to each other through splines **544** and bosses **550**.

It is apparent in accordance with the foregoing that an exterior finishing wall for an open vertical wall region in a building shell may be rapidly and easily erected with matched sets of interlockable and keyable elements. Horizontal and vertical wall framing members are provided which when interconnected and keyed together successively with the thereby edge supported panel members provide, where desired, a spaced apart double wall panel array, one of which panel arrays is not removable and the other of which is removable to gain access to the space between the arrays and to the thereby masked service facilities. Interior partition walls as well as counter walls and building additions may also be constructed in accordance with this invention.

In accordance with the present invention a modular building construction and a building method are provided which are characterized by inexpensive, uniform and minimal structural components adapted to easy assembly by relatively unskilled labor in advantageous sequences. Moreover, the simplicity of construction in accordance with the present disclosure provides for building costs reduced from those heretofore prevailing.

As this specification makes clear, many substitutions or changes can be made in the above-described construction and method of the invention all of which are within the scope of this invention which can be made without departing from the scope and spirit thereof. It is intended that the matter contained in the accompanying specifi-

cation and drawings shall be interpreted as being illustrative and not in a limiting sense.

I claim:

1. A method of erecting a finishing wall along an open vertical wall region defined in a building shell, comprising installing base and top runners in vertically aligned position, end keying a first stud in fixed engagement between said runners adjacent one extremity of the open wall region, installing a panel wall section full height of the wall region by lifting it upwardly into a top runner pocket, dropping it into keyed engagement with the base runner while retaining the uppermost edge of such section in said top runner pocket and edge keying said section with said first stud, then keying a second stud edgewise with the installed section and endwise with said runners to lock said panel wall section in place so that it is not removable without removing said second stud, then installing additional wall sections and studs in corresponding keying engagement until the width of the open wall region is spanned.

2. A method for erecting a weather exposed exterior wall for a building on a base pad comprising erecting a structural framework, securing a base runner to said base pad, suspending a top runner from said structural framework in vertical alignment with said base runner, extending a stud member into vertical interlocked engagement with said top and base runners, slidably engaging an exterior vertical panel section into keyed engagement with said stud member and said base and top runners, extending a further stud member into vertical interlocked engagement with said top and base runners and into keyed engagement with said exterior panel section to preclude disassembly of said exterior panel section without removal of said further stud member, and repeating said extending and slidably engaging steps until an exterior wall section is completed, removably erecting an interior wall section of said exterior wall by slidably engaging a vertical panel section in keyed engagement with said stud members and with said base and top runners after assembling said exterior wall section, whereby said interior panel section is removable and said exterior panel sections are not removable without removal of said stud members.

3. In the method of claim 2 further comprising slidably engaging ceiling panel means in edge supported relation with said top runner.

4. In the method of claim 2 and wherein said vertical panel section of said interior wall section comprises a plurality of panels, the method further comprising slidably engaging the lowermost panel with the base runner, splining said lowermost panel with a next adjacent vertical panel and releasably interconnecting said panels with a pair of spaced apart adjacent studs, repeating said panel splining and interconnecting steps until an uppermost panel is slidably engaged within said top runner and with said pair of spaced apart adjacent studs.

5. In a weather-exposed double wall construction for a modular building having a floor and a structural framework, an elongated base runner secured to said floor, an elongated top runner suspended from said framework in vertical alignment with said base runner, vertical studs slidably and releasably interconnected with said top and base runners, a plurality of panels, means on said base runner, on said top runner and associated with said studs for slidably receiving edges of said panels and for retaining said panels in interlocked relationship therewith in two horizontally spaced parallel vertical arrays, each of said horizontally spaced parallel arrays comprising vertical courses of panels bridging the space between adjacent studs, the outermost of said vertical courses being retained against removal when said studs are interconnected with said runners, the innermost of said vertical courses being releasably connected to said studs when said studs are interconnected with said runners whereby said innermost vertical course may be temporarily re-

moved to gain access to the space between said horizontally spaced parallel arrays.

6. In a double wall construction, an assembly comprising an elongated base runner secured to a floor, an elongated top runner vertically aligned with said base runner and suspended from an overlying support means, a pair of spaced apart vertical studs slidably extended into interlocking engagement with said base and top runners, each of said studs defining vertically extending panel retaining means at opposite vertical sides thereof, a pair of vertical panel means each defining a wall forming surface, said pair of panel means being spaced apart and each of said panel means being slidably secured at opposite vertical edges to said panel retaining means, means for slidably interlocking the uppermost edge of each said panel means within a pocket for each in said top runner, means for slidably interlocking the lowermost edge of each said panel means with said base runner, one of said panel means being permanently secured to said assembly when said studs are interlocked with said runners, the other of said panel means being releasably secured to and removable from said assembly when said studs are interlocked with said runners.

7. The double wall construction of claim 6 in which at least one of said pair of spaced apart panel means comprises a vertical stack of panels, each pair of said stack being keyed to each other at adjoining horizontal edges thereof.

8. The double wall construction of claim 7 in which each pair of said stack is keyed to each other at adjoining edges and to said pair of spaced apart studs.

9. In a prefabricated wall construction including vertically aligned top and base runners, vertical studs connected to and between said runners and panels edge connected to said runners and studs, said base runner having an elongate main body portion having stud end engaging structure at spaced locations therealong and flanked by panel edge receiving and interlocking formations spaced outwardly of said main body portion along at least one of opposite lengthwise edges of the base runner, said panel edge receiving formations including a vertical side wall along a side wall section of the main body portion and a horizontal wall projecting laterally from such side wall to define a corner pocket between said vertical side wall and side wall section for slidable reception of a panel, one of said horizontal walls terminating in an integral vertically projecting base trim strip spaced from and parallel to the side wall section conjointly to embrace opposite faces of a panel edge disposed in the corner pocket defined thereby, said base runner comprising endwise aligned successive sections, the main portion of each being of inverted U-shape in transverse section and each section including opposed internal ribs spaced to define a head guideway and the base trim strip defining a vertically projecting side guideway, and splicing means comprising a horizontal plate supportedly interlocking into the head guideways of adjacent ends of successive sections, a vertical plate supportedly interlocking into the side guideways of adjacent ends of successive sections and fasteners connecting each plate and each of the successive sections.

10. In a prefabricated wall construction building vertically aligned top and base runners, vertical studs connected to and between said runners and panels edge connected to said runners and studs, said top runner having an elongate main body portion having stud end engaging structure at spaced locations therealong and flanked by at least one upper panel edge receiving and interlocking formation along a lengthwise edge of said runner, said main body portion comprising an extrusion of inverted generally U-shaped transverse section having a central horizontal portion for attachment to mounting structure and having a laterally outwardly opening exterior corner slot selectively to receive one of a number of panel retainer corner sections, each such corner section having a mating laterally projecting flange segment engageable in supported

interlocking relation in the slot, said main body section and a said corner section defining said panel edge receiving formation to receive and restrain said upper panel edge.

11. A method of erecting a finishing wall along an open vertical wall region defined in a building shell, comprising installing base and top runners in vertically aligned position, end keying a first stud in fixed engagement between said runners adjacent one extremity of the open wall region, installing a panel wall section comprising a plurality of vertically oriented panels full height of the wall region by edge keying a bottom panel with the base runner and with the stud, and successively edge keying each upper panel in interlocking relation with the preceding panel and the stud, with the top panel being installed by first lifting it upwardly into a top runner pocket and then dropping it into interlocked engagement with the preceding panel, while retaining the uppermost edge of such panel in said top runner pocket, then keying a second stud edgewise with the installed section and endwise with said runners to lock said panel wall section in place so that it is not removable without removing said second stud, then installing additional wall sections and studs in corresponding keying engagement until the width of the open wall region is spanned.

12. In a prefabricated wall construction including vertically aligned top and base runners, vertical studs connected to and between said runners and panels edge connected to said runners and adjacent studs, said base runner having an elongate main body portion having stud end engaging structure at spaced locations therealong and flanked by panel edge receiving and interlocking formations spaced outwardly of said main body portion along at least one of opposite lengthwise edges of the base runner, a base element fixedly secured to a floor, said base element underlying and nestingly receiving said base runner, and spacing means interposed between said base element and base runner for supporting said base runner upon said base element for adjusting the level of the base runner along its length, said spacing means comprising vertically positioned screw threaded lifter means engaging said base element for adjusting the elevation of said base runner along the length of said base runner, said screw threaded lifter means being in load bearing relation between said base element and said base runner.

13. In a prefabricated wall construction including vertically aligned top and base runners, vertical studs releasably connected to and between said runners, and panels edge connected to said runners and studs, said studs each having an elongate vertical main body portion including

a vertical panel edge receiving and interlocking formation along each vertical edge thereof, each stud main body portion carrying top and base end structures adapted for horizontal releasable interlocking engagement with said runners to fix the stud in interlocked position with said runners, said main body portion comprising an elongate core of thermal insulation material, said panel edge receiving formations being secured in embracing engagement with said main body portion, each of said vertical formations defining a core side edge receiving pocket having frictional biting means therein for frictional biting engagement and retention of said core side edge.

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U.S. Cl. X.R.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,487,598 Dated January 6, 1970

Inventor(s) Joseph J. Lopina

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 1, line 51, "these" should be --those--; Col. 4, line 22, "the" should be --tie--; Col. 4, line 68, "form" should be --from--; Col. 6, line 18, "panel" should be --panels--; Col. 7, line 6, "or" should be --of--; Col. 7, line 7, insert "to" after "thereof"; Col. 8, line 23, "solt" should be --slot--; Col. 8, line 27, "eillustrated" should be --illustrated--; Col. 9, line 51, "study" should be --stud--; Col. 14, line 44, "ceiling" should be --ceilings--; Col. 14, line 75, "378" should be --478--; Col. 15, line 51, "adges" should be --edges--; Col. 18, line 61, "building" should be --including--.

SIGNED AND
SEALED
JUN 16 1970

(SEAL)

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