March 25, 1952 G. M. RAPP 2,590,123

BUILDING CONSTRUCTION AND STRUCTURAL UNITS THEREFOR

Filed Nov. 19, 1947

6 Sheets-Sheet 1

FIG. 1

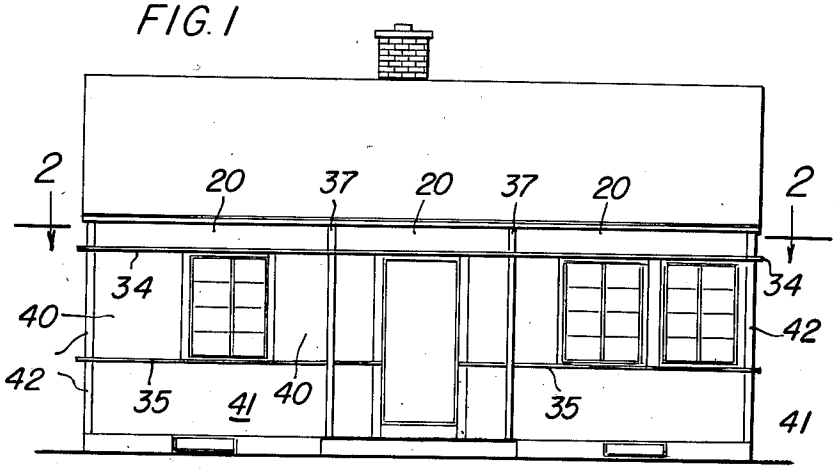
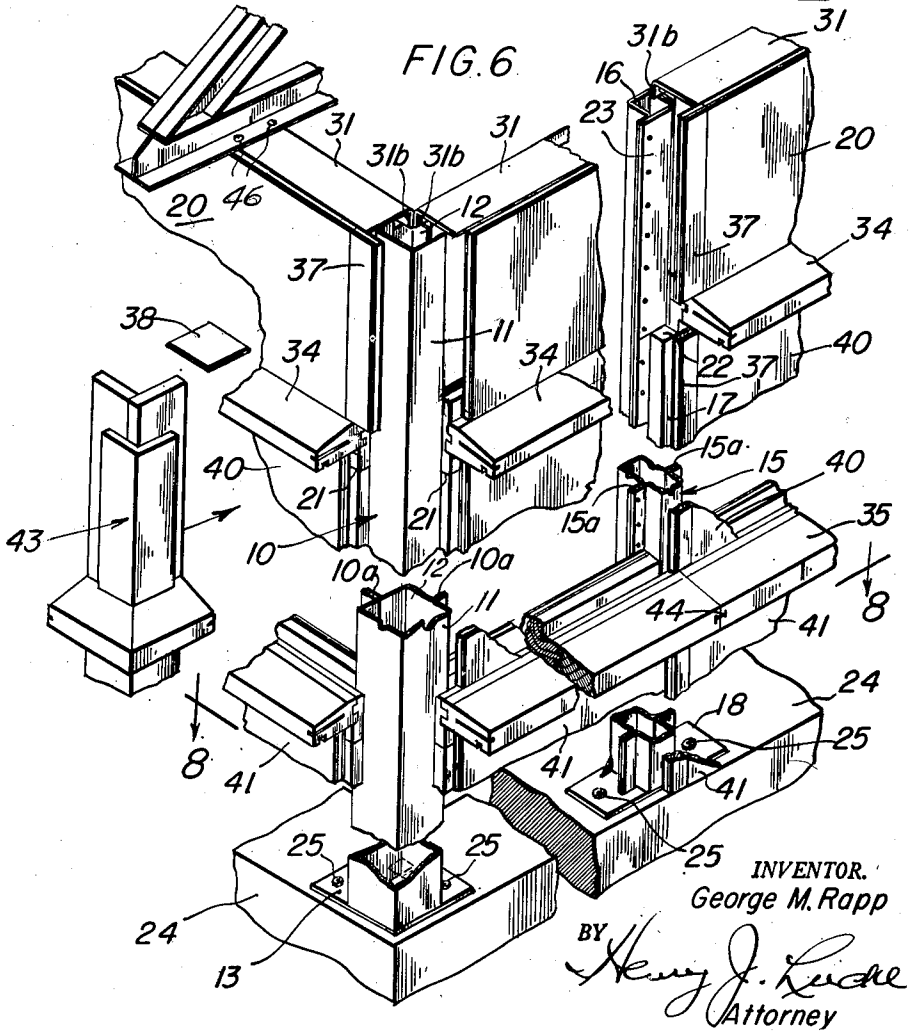


FIG. 6



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BUILDING CONSTRUCTION AND STRUCTURAL UNITS THEREFOR

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FIG. 2

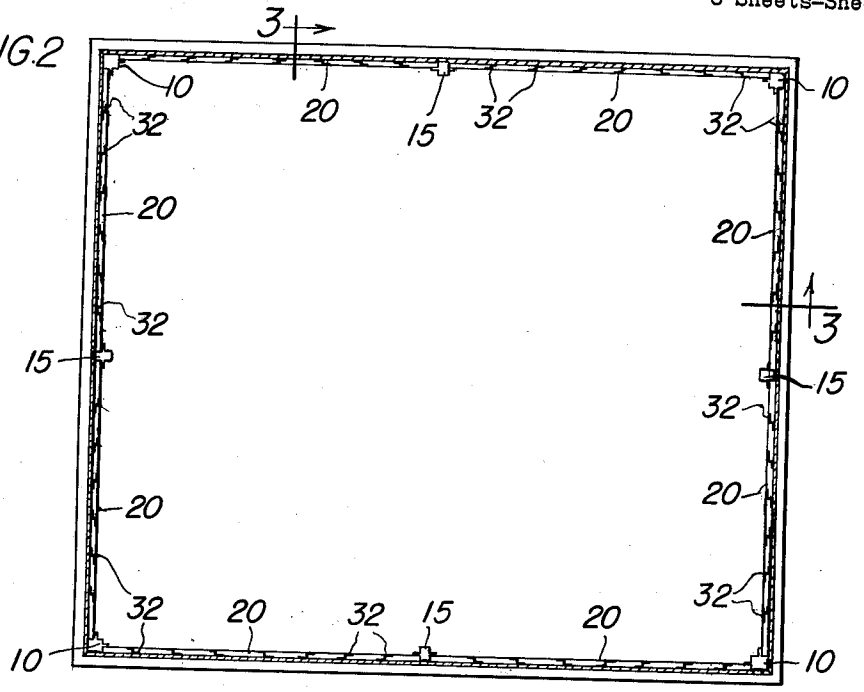
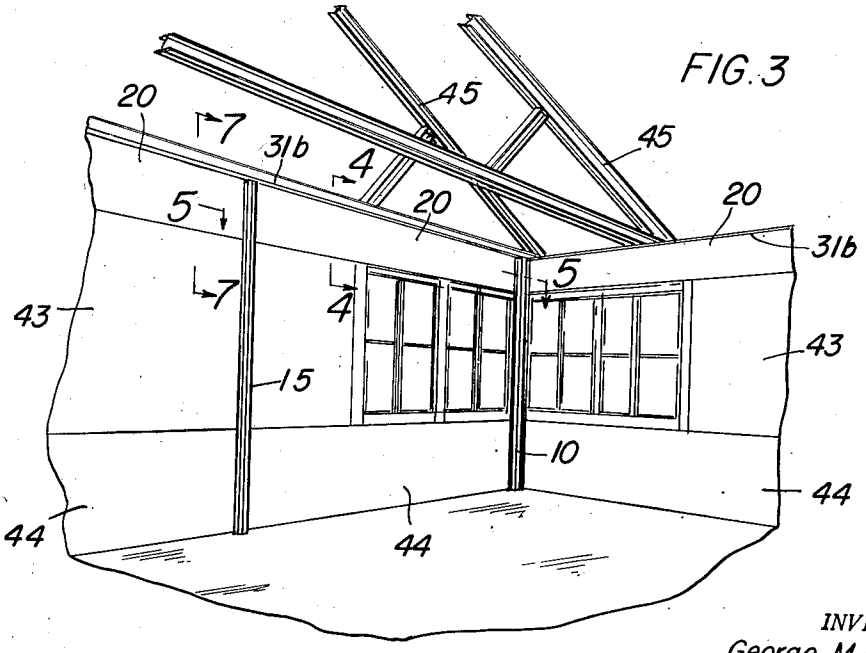


FIG. 3



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BUILDING CONSTRUCTION AND STRUCTURAL UNITS THEREFOR

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FIG. 5

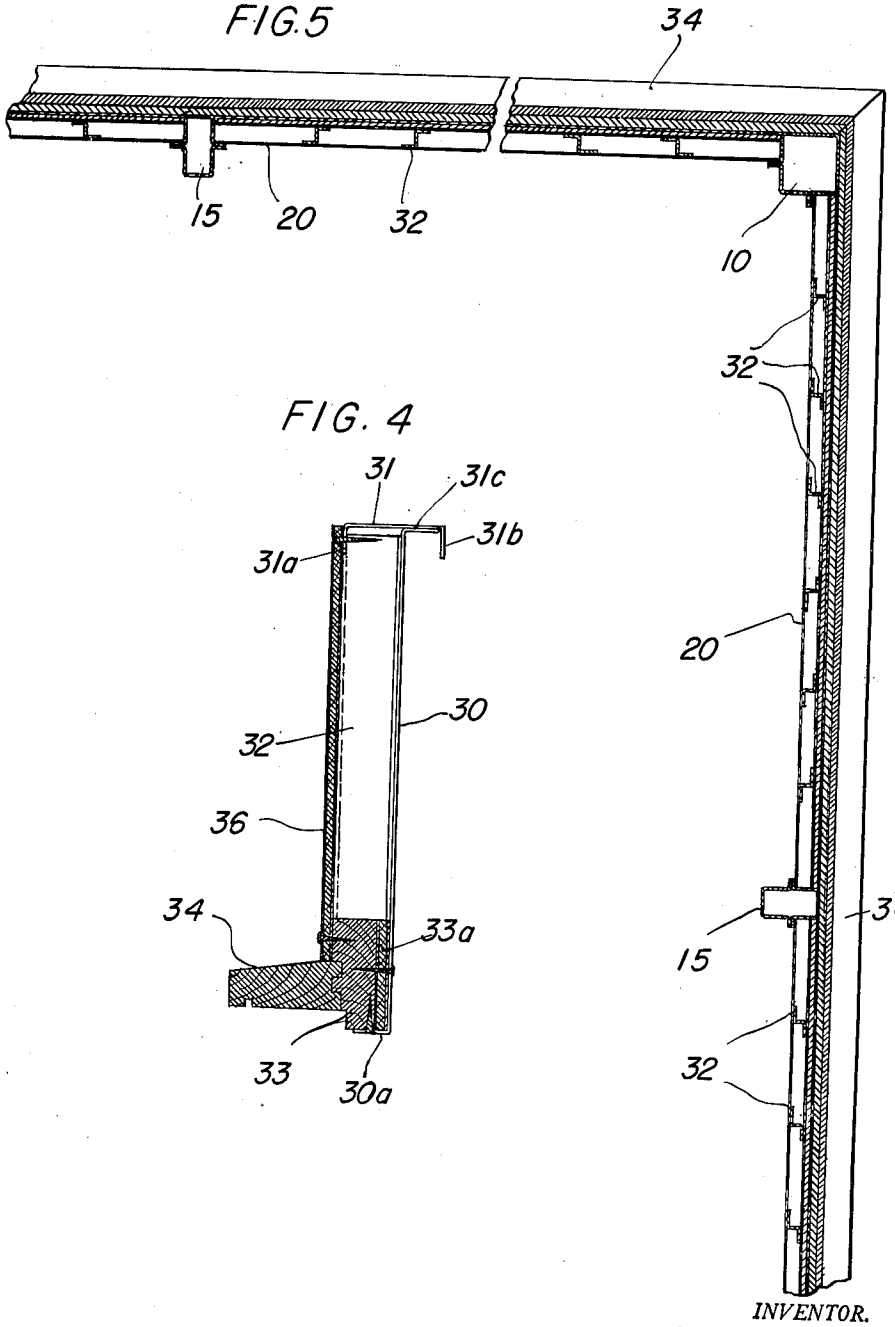


FIG. 4

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FIG. 8

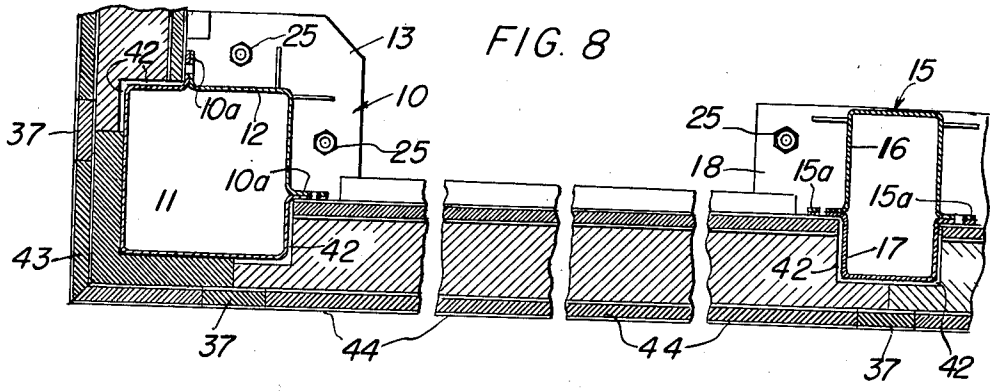


FIG. 7

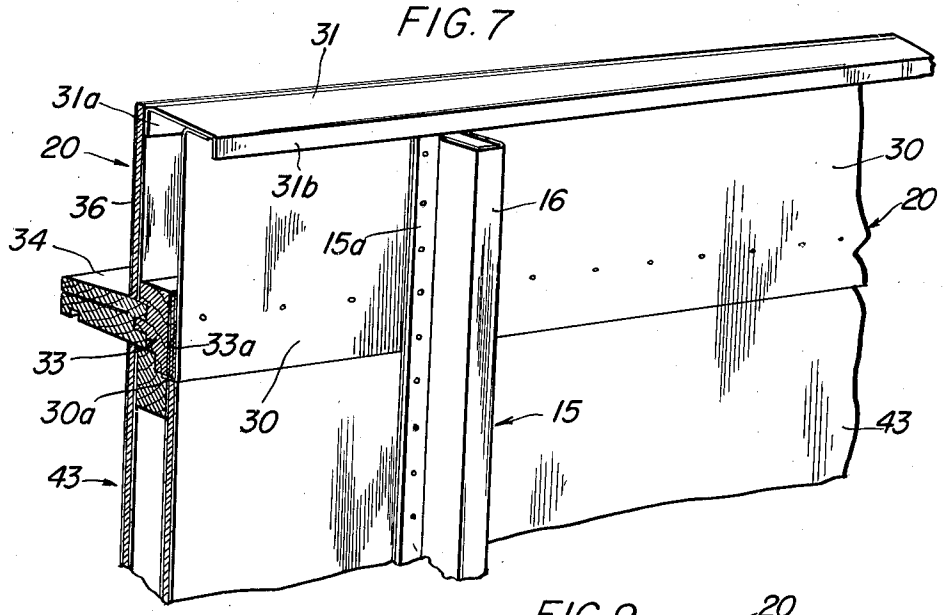
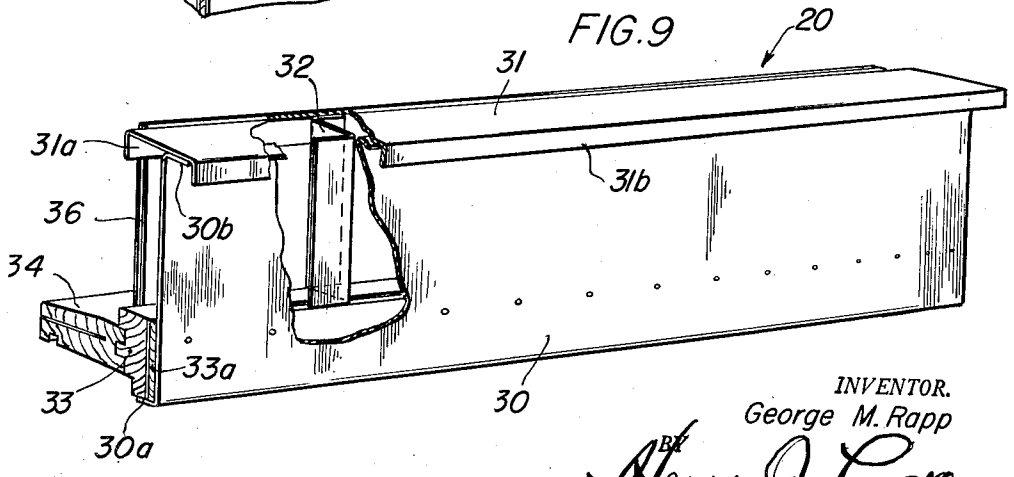


FIG. 9



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FIG. 11

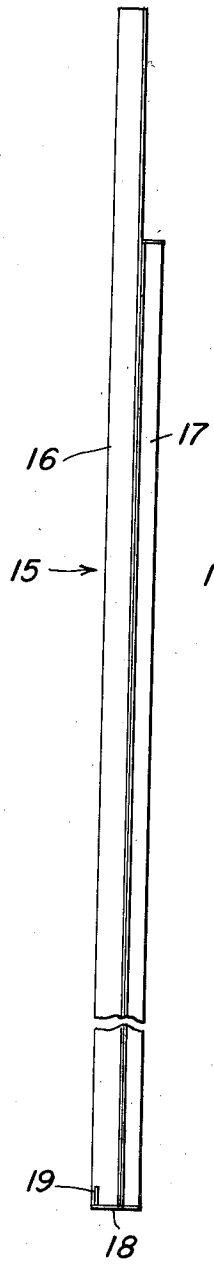


FIG. 10

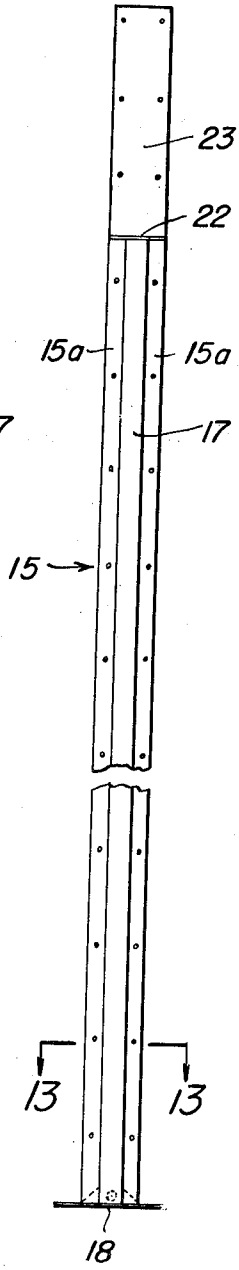


FIG. 12

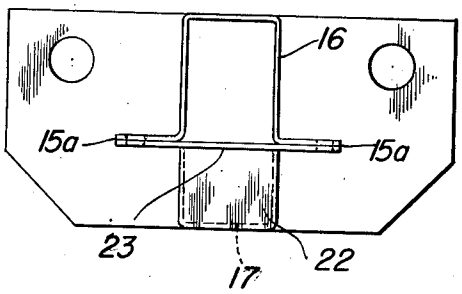
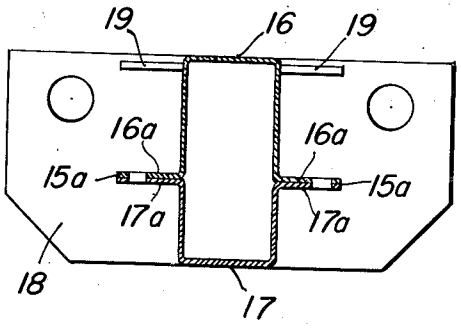


FIG. 13



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March 25, 1952 G. M. RAPP 2,590,123

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FIG. 15

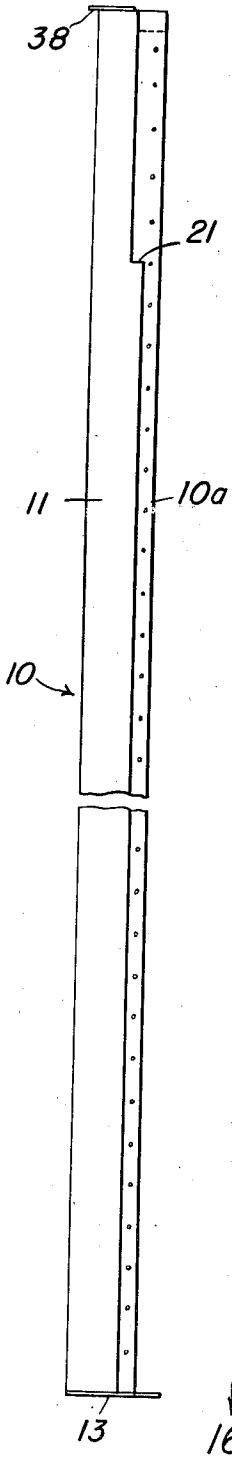


FIG. 14

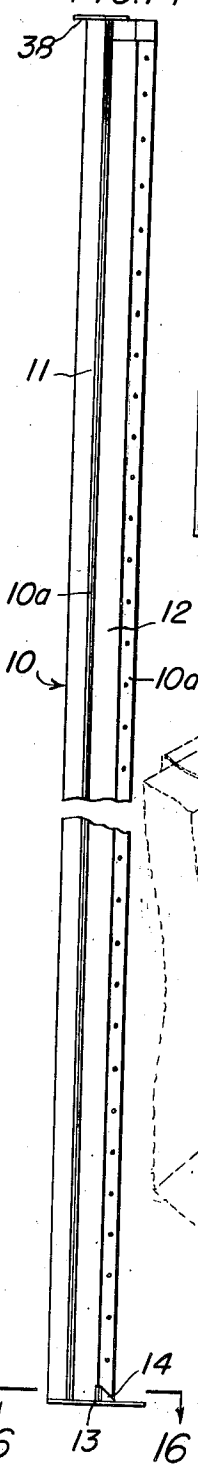


FIG. 17

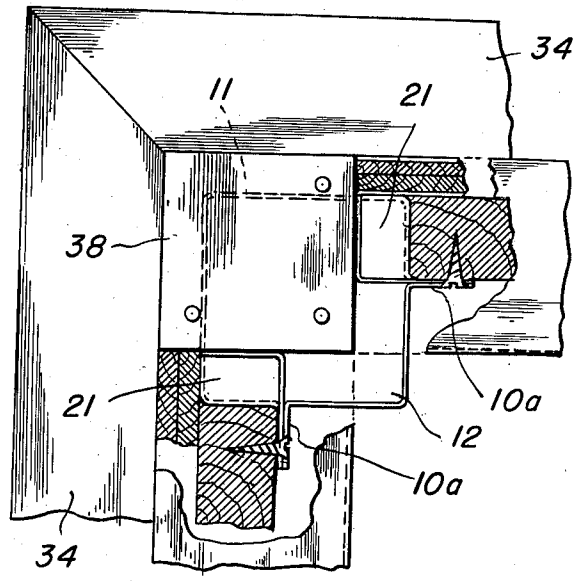


FIG. 18

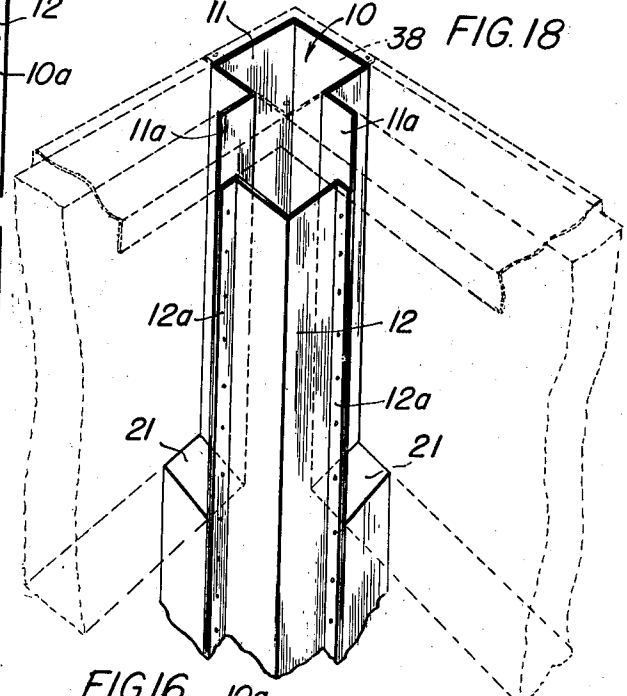
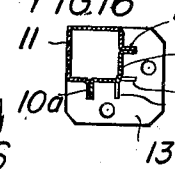


FIG. 16



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Patented Mar. 25, 1952

2,590,123

UNITED STATES PATENT OFFICE

2,590,123

BUILDING CONSTRUCTION AND STRUCTURAL UNITS THEREFOR

George M. Rapp, New Haven, Conn., assignor to John B. Pierce Foundation, New York, N. Y., a corporation of New York

Application November 19, 1947, Serial No. 786,887

13 Claims. (Cl. 189—1)

1

This invention relates to wall construction wherein panels are employed as a structural material. It has particular reference to the general type of wall construction disclosed in U. S. Patent No. 2,235,811 entitled Panel Wall Structural Unit and Building Construction issued March 25, 1941 to Robert L. Davison, in which long panel units are disposed with their lengths horizontally bridging widely spaced uprights or columns to serve as load-carrying deep beams or girders.

It is an object of the present invention to utilize structural metal members for carrying vertical loads, while permitting use of plywood panel facing or the like to participate in the carrying of such loads.

For this purpose a novel type of lintel girder is utilized in combination with a novel type of structural metal column, preferably light-gauge structural steel.

The lintel girder is of box type, made up of a novel assembly of structural metal shapes, inclusive of a panel member, all preferably light-gauge structural steel, the entire assembly being combined with a plywood panel such that both the metal and the plywood serve to jointly carry superimposed vertical loads and transmit them to the columns. The structural metal assembly is the main load-carrying component, though the plywood panel participates to a considerable extent and also serves as a fascia to characterize the exterior of the structure in wood.

With respect to the novel columns, it is an object of the invention to achieve both adequate depth for bracing and adequate width to prevent elastic buckling, and with respect to both the columns and the lintel girders it is an object to prevent thermal short-circuiting.

Thermal short-circuiting is one of the principal problems encountered in the use of metal in insulated buildings, a problem which is often critical. Metal provides a through conductive path for heat, and, when extending between warm interior wall surfaces and cold exterior wall surfaces, produces localized cold spots at such interior wall surfaces. Moisture condenses on the wall surfaces at the cold spots, resulting in unsightly markings.

Each column is composed of two longitudinally recessed, shaped, columnar parts, preferably channel-shaped for intermediate columns and angle-shaped for corner columns, such parts having laterally projecting and longitudinally extending flanges, the two parts being disposed, and joined, with their respective recesses and

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flanges in face-to-face relation. The resulting composite wing flanges extend outwardly of the hollow main body of the column, intermediate the depth thereof, and provide lateral securement and reinforcing members. The respective columnar parts, disposed as they are forwardly and backwardly of the securement flanges, provide adequate footing and depth for bracing purposes. The composite wing securement flanges provide adequate width to prevent elastic buckling.

Thermal short-circuiting is prevented by reason of the fact that, as installed in the wall construction, the exterior portions of the columns are completely sheathed by wood, which possesses a relatively high thermal resistance. In the lintel girder units the same effect is achieved by the exterior plywood panel components. Furthermore, small but definite airgaps are provided around the metal columns. There are no through metallic conductors between exterior and interior wall surfaces.

Moment connection of load-receiving and load-transmitting elements of the roof construction, for instance light-gauge steel trusses, is made with appropriate parts of the lintel girder units to resist any tendency for such roof elements and such wall units to twist relative to each other, the positioning of such roof elements being in registry with bearing stiffener components of such lintel girder wall units.

Further objects and features of the invention will appear from the detailed description of the preferred form illustrated in the accompanying drawings.

In the drawings:

Fig. 1 is an exterior front elevation of a house whose wall construction is in accordance with the invention;

Fig. 2 is a horizontal section taken through the house of Fig. 1 on the line 2—2;

Fig. 3 is a fragmentary interior view in perspective, illustrating the portion included within lines 3—3, Fig. 2 and showing a typical window arrangement, the ceiling being removed to illustrate how a preferred type of roof construction utilizing light-gauge steel trusses rests upon the wall construction;

Fig. 4 is an enlarged vertical section taken on the line 4—4, Fig. 3;

Fig. 5 is an enlarged horizontal section taken on the line 5—5, Fig. 3;

Fig. 6 is an enlarged fragmentary perspective view looking from the outside of the house and showing a corner of the wall construction in

elevation, certain of the finish and trim members having been moved to the foreground for clarity of illustration, and portions of the walls being broken out to reveal details of column connections;

Fig. 7 is an enlarged fragmentary perspective view partially in vertical section taken on the line 7—7, Fig. 3;

Fig. 8 is an enlarged horizontal section taken on the line 8—8, Fig. 6;

Fig. 9 is an enlarged perspective view of one of the lintel girder units per se;

Fig. 10 is an enlarged inside elevation of one of the intermediate columns per se;

Fig. 11 is an elevation of the side appearing to the left in Fig. 10;

Fig. 12 is a top plan view;

Fig. 13 is a horizontal section taken on the line 13—13, Fig. 10;

Fig. 14 is an enlarged side elevation of one of the corner columns per se, the side shown being one of those with which the wall panel units join;

Fig. 15 is an elevation of the side appearing to the left in Fig. 14;

Fig. 16 is a horizontal section taken on the line 16—16, Fig. 14;

Fig. 17 is a top plan view illustrating how the lintel girder units tie in therewith; and

Fig. 18 is a fragmentary inside perspective similar to Fig. 17.

Referring now to the drawings: the house of Figs. 1 and 2 embodies wall construction pursuant to the invention, the same being made up of factory-fabricated structural units assembled in the field by relatively unskilled labor in a minimum of erection time. The particular architectural plan selected for illustration is a very simple one, and is of course subject to wide variation within the practical limits of the structural units employed for effectuating the purposes of the invention.

In general, the structural principles follow those disclosed broadly in the above-mentioned Davison U. S. Patent No. 2,235,811. Thus, the exterior wall contour of the building is defined by widely spaced columns, which rest on supporting piers or on the foundation walls of a full or partial basement. Horizontally long panel wall units span the distances between adjacent columns to make up the walls of the building. Certain of such panel wall units are structurally so formed and attached to the columns which they span as to serve in the capacity of deep beams or girders for receiving, and for routing to the columns, floor or roof loads.

In accordance with the present invention the columns are specially fabricated in unit form, ready for erection, from longitudinally recessed structural metal columnar shapes made up from light-gauge structural metal strips, preferably steel; and the deep beam or girder units employed as lintels above the window-receiving section, for the support of the roof structure, are also specially fabricated, utilizing certain structural metal and wood components for jointly carrying the loads.

As here illustrated, the corner columns 10, see especially Figs. 2 and 14 through 18, comprise two long angle-shapes 11 and 12 (16 gauge steel strip, bent to proper form, having proven very satisfactory for the purpose), such parts being provided with pairs of outwardly extending flanges, indicated 11*a* and 12*a*, respectively, along their lengths, Fig. 18, and being disposed in face-to-face relation, with their flanges secured together, as by means of rivets, spot welding, or the like. The resulting column is hollow and is provided with laterally and oppositely projecting composite wing flanges 10*a*. A base plate 13 of greater area than the bottom of the column is secured to the bottom of the column, preferably by welding, the connection being strengthened by reinforcing pieces 14. Such base plate extends transversely across the bottom of the column, closing the opening into the hollow interior thereof and providing anchorage. It will be noted that the outer columnar part 11 of each of these corner columns 10 has flanges 11*a*, see Fig. 18, which are themselves of angle shape and re-entrant with respect to the recess of said part, the terminal legs of respective angular flanges being directed outwardly of the part and providing direct face-to-face joinder with the straight flanges 12*a* of the inner columnar part 12.

The intermediate columns 15, see especially Figs. 2, and 11 through 13, comprise two long channel-shapes 16 and 17 provided with outwardly extending flanges 16*a* and 17*a*, respectively, see Fig. 13, forming, when the parts are secured together in face-to-face relationship, a hollow column provided with laterally and oppositely projecting composite wing flanges 15*a*. Like the corner columns 10, the intermediate columns 15 include base plates 18 and reinforcing pieces 19.

These two types of columns are formed at their upper parts to receive and support lintel girder units 20.

For this purpose the outer part 11 of each corner column 10 has its upper portion offset inwardly at each side sufficiently to accommodate respective horizontal seat plates 21, the locations thereof with respect to the length of the column being determined by the height of the lintel girder units 20, see Fig. 18. The horizontal cross-section of the offset upper portion of column part 11 is substantially similar to but less in area than the horizontal cross-section of the lower portion of the part 11.

Likewise, the part 17 of each intermediate column 15 terminates short of the top of the part 16 by an amount sufficient to accommodate a lintel girder unit 20, the top thereof being capped by a horizontal seat plate 22 and the hollow of the part 16, upwardly therefrom, being closed by a face plate 23. For a purpose hereinafter made clear, the part 12 of each corner column is made somewhat shorter than the cooperating part 11, see Fig. 18, and the intermediate columns 15 are, as a whole, made of a length or height which corresponds therewith.

It should be noted that both the corner columns 10 and the intermediate columns 15 provide adequete depth from inside face to outside face for bracing, and adequate overall width to prevent elastic buckling. The outwardly flanged construction enables strong and convenient fastening of the wall panel units thereto.

The columns are advantageously erected directly upon the foundation structure, here shown as a continuous wall foundation 24. For this purpose bolts 25, Figs. 6 and 8, are embedded therein so that their threaded shanks stand up freely for engaging the base plates of the respective columns through suitably provided receiving holes, such base plates being cinched down tight holes, such base plates being cinched down

tightly by means of nuts applied to the threaded bolt shanks.

The lintel girders 20 are of box formation, dimensioned for spanning the distances between adjacent columns. They are arranged for attachment at their ends directly to the columns which they span, and, as so attached, rest upon the seats provided by the columns.

Each lintel girder 20 comprises a structural metal assembly built up of shaped metal members, an exterior panel facing of wood, preferably plywood, and rail members preferably of milled lumber pieces.

In the illustrated embodiment, see particularly Fig. 9, the structural metal assembly includes an inside panel facing member 30 of sheet steel, preferably 16 gauge as in the columns, having its lower and upper edges oppositely bent at right angles to the panel proper, in simulated Z formation to provide respective outwardly and inwardly turned flanges 30*a* and 30*b* which extend along the length of the unit. Secured to the upper and inwardly turned flange 30*b*, as by spot welding, and extending along the length thereof parallel therewith is an upper plate member 31 of sheet steel, which, together with the flange to which it is secured, projects beyond the inside panel facing and overhangs the latter. In this instance the member 31 is a channel shape disposed in inverted position with its legs directed downwardly, though the exact shape is not critical so long as it provides a cantilever portion which widens the roof-receiving base sufficiently to establish moment connection of roof trusses or like roof structural member with the wall construction. The channel formation is, however, advantageous from the standpoint of strength. Between the outer margin of the plate member 31 (here the leg 31*a* of the channel shape) and the inside panel facing member 30 and at intervals along the length of the unit, are secured, preferably by spot welding to the panel facing member, a plurality of vertically extending, advantageously Z-shaped sheet steel bearing stiffeners 32. Such stiffeners are placed at intervals from end to end of the unit, preferably to correspond with the occurrence of roof trusses in the roof construction. Usually they are spaced at 2 foot or 4 foot intervals, depending upon the spacing of the roof trusses. They abut against the underside of the plate member 31 at their upper ends, and, at their lower ends, terminate sufficiently short of the lower outwardly turned flange 30*a* of the panel facing member 30 to accommodate a wood rail member.

The wood rail member, indicated 33, is advantageously a suitably milled length of standard lumber to which a filler strip 33*a* has been added to provide desired depth. It is positioned in the bend of the lower and outwardly turned flange 30*a* of the inner panel facing member 30, being secured to the latter as by nailing through suitably provided perforations in the panel facing member 30. Interfitted with and glued to such rail member 33, and projecting outwardly beyond the unit proper, is a second rail member 34 of corresponding length, the same serving, structurally, as an integral part of the first rail member 33 and, in an architectural sense, to balance the similarly appearing sill member 35 of the corresponding lower course panel unit, see Figs. 1 and 6.

Applied and secured to the outer face of the rail member 33 above the projecting rail member 34 and to the outer leg 31*a* of the upper plate

member 31 is an outer panel facing member 36, preferably plywood or a material having similar characteristics, which, together with the inner panel facing member 30, serves in a load-carrying capacity. In the illustrated instance the outer panel facing member 36 is cut shorter than the inner panel facing member 30, so that, when the unit is assembled end-to-end with other like units in the building construction of Figs. 1 and 2, batten strips 37 may be inset over the joinders of adjacent units, flush with the outer panel facing members thereof, see Fig. 6.

The outer panel facing member 36, it should be noted, provides an exterior sheath for the structural metal assembly. For this purpose, and also for participating in the load-supporting function of the unit, plywood serves excellently.

The batten strips 37 are also of wood or the like to complete the said exterior sheath over the joinders at the columns.

In assembling the building construction of Figs. 1 and 2 after erection of the columns 10 and 15, the lintel girder units 20 are set into their receiving seats 22, or 21 and 22, as the case may be, and their inner panel facing members 30 are secured to the composite wing flanges 15*a*, or 10*a* and 15*a*, as the case may be, of the columns between which they extend. As so positioned, the inwardly projecting cantilever portion 31*c* of the upper plate member 31 overlies the inner parts 16, or 12 and 16, as the case may be, of the columns between which the unit extends. It should be noted, however, that this cantilever portion, which here includes the inner depending leg 31*b*, actually clears the tops of such inner parts 12 and 16 of the columns and defines small air-gaps therebetween. Cap plates 38, Figs. 6, 14, 15 and 17, are welded to the open tops of the corner columns 10 in offset position, as shown, thereby closing such open tops and providing continuity for the upper plate members 31 of the lintel girder units.

The remainder of the wall construction may be filled in as desired by appropriately fabricated panel units, windows, and doors, see Fig. 1. Here, the intermediate course includes, besides window sash and interposed mullions, panel filler units 40 which are secured to the composite wing flanges of adjacent columns in much the same manner as the afore-described lintel girder units 20. The lower course units 41 are desirably of deep girder construction for receiving and supporting floor loads.

As illustrated in Fig. 8, such deep girder panel units 41 span sets of adjacent columns and are secured at their ends to the wing flanges thereof in much the same manner as the lintel girder units 20.

It will be noted that the wall panel units are so constructed and their joinder with the columns so arranged that small air-gaps, indicated 42 in Figs. 5 and 8, are provided between the panel wall units and the columns proper, this being true in all instances. Such air-gaps 42 break through conductive path for heat from interior wall surface to exterior wall surface which might otherwise be established.

Sheathing for the exterior portions of the corner columns 10 is provided by wood finish assemblies, see 43 Figs. 6 and 8, which are inset into position between corner batten strips 37 and run vertically of the columns from top to bottom thereof. Such finish assemblies include rail and sill members corresponding to the rail members

34 and sill members 35, respectively, of the panel will units 20 and 41. Such rail and sill members of the corner finish assemblies are joined to their respectively corresponding rail and sill members of the wall units by means of I-shaped clamp nails 44.

As illustrated in Fig. 3, the aligned upper plate members 31 of the lintel girder units 20 are adapted to directly receive roof construction. Any desired roof construction may be satisfactorily employed, but it is advantageous and preferred to utilize a type embodying trusses 45, which may be fabricated from light-gauge steel. The spacing of the trusses and the spacing of the bearing stiffeners 32 of the lintel girder units are made to mutually conform, so that a truss will bear directly upon a bearing stiffener. In this manner concentrated loads of the roof construction will be received directly by the bearing stiffener 32 and distributed to the panel members 30 and 36.

Moment connections between trusses 45 and the broad, bearing surfaces of the aligned upper plate members 31 are established by securement of the trusses to opposite margins of the respective plate members upon which they bear, this being accomplished in the illustrated instance by sheet metal screws 46, Fig. 6. These connections resist any tendency of the lintel girders 20 and trusses 45 to twist relative to each other. Thus, the lintel girders are strengthened against horizontal wind loads, and the trusses against vertical loads. Such connections contribute immensely to the rigidity of the structure as a whole.

Whereas this invention is illustrated and described with respect to a preferred specific form thereof, it should be understood that various changes may be made therein and various other forms may be constructed, on the basis of the teachings hereof, by those skilled in the art without departing from the scope of the invention as defined by the following claims.

1. Wall construction, comprising a plurality of spaced vertical columns, each having a long hollow body provided with laterally, oppositely, and outwardly projecting longitudinal flanges which extend vertically along the length of the column, and at least one horizontal seat formed intermediate the length of the column for the reception and support of horizontally positioned lintel girder units; and a plurality of lintel girder units spanning said columns and secured at their ends thereto in supported engagement with the longitudinal seats formed on said columns, said lintel girder units each having mutually spaced and substantially coextensive outer and inner panel members, an upper plate member having a longitudinal cantilever margin which overhangs the said inner panel member, a lower longitudinal framing member, and vertically-extending bearing stiffeners interposed between said outer and inner panel members at intervals along the length of the unit.

2. The combination recited in claim 1 wherein each column comprises two longitudinally recessed, shaped columnar parts having laterally projecting and longitudinally extending flanges, the two parts being disposed and joined with their respective recesses and flanges in face-to-face relation, forming composite wing flanges to which the lintel girder units are secured.

3. The combination recited in claim 1 wherein the upper plate member of each lintel girder unit is a structural channel having its legs directed downwardly.

4. The combination recited in claim 1 wherein the outer panel member of each lintel girder unit is of wood, and the inner panel member is of structural sheet metal.

5. The combination recited in claim 1 wherein the inner panel member of each lintel girder unit is a substantially Z-shaped structural sheet metal part, the upper plate member being superimposed on the upper flange of such Z-shaped part and the lower framing member being fitted in the bend of the lower flange of such Z-shaped part.

6. The combination recited in claim 1 wherein the bearing stiffeners of each lintel girder unit are formed of structural sheet metal bent to substantially Z-formation.

7. A lintel girder unit comprising mutually spaced and substantially coextensive outer and inner panel members; an upper plate member having a longitudinal cantilever margin which overhangs the said inner panel member; a lower longitudinal framing member; and vertically extending bearing stiffeners interposed between said outer and inner panel members at intervals along the length of the unit.

8. The combination recited in claim 7, wherein the inner panel member is a substantially Z-shaped structural sheet metal part, the upper plate member being super-imposed on the upper flange of such Z-shaped part and the lower frame member being fitted in the bend of the lower flange of such Z-shaped part.

9. The combination recited in claim 8, wherein the bearing stiffeners are formed of structural sheet metal bent to substantially Z-formation.

10. The combination recited in claim 9, wherein the outer panel member is of wood.

11. Building construction, comprising a plurality of spaced vertical columns, each having a long hollow body provided with laterally, oppositely, and outwardly projecting longitudinal flanges which extend vertically along the length of the column, and at least one horizontal seat formed intermediate the length of the column for the reception and support of horizontally positioned lintel girder units; a plurality of lintel girder units spanning said columns and secured at their ends thereto in supported engagement with the horizontal seats formed on said columns, said lintel girder units each having mutually spaced and substantially coextensive outer and inner panel members, an upper plate member having a longitudinal cantilever margin which overhangs the said inner panel member, a lower longitudinal framing member, and vertically-extending bearing stiffeners interposed between said outer and inner panel members at intervals along the length of the unit; and roof construction comprising a plurality of spaced load-receiving and load-transmitting elements super-imposed upon the upper plate members of the respective lintel girder unite in registry with respective bearing stiffeners of said lintel girder units.

12. The combination recited in claim 11, wherein the load-receiving and the load-transmitting elements of the roof construction are rigidly secured to the respective lintel girder unit upper plate members both along the outer margins and the inner cantilever margins thereof.

13. The combination recited in claim 1, wherein the lintel girder unit comprises only one of several courses of panel wall units making up the wall structure, such panel wall units extending

between adjacent columns and being secured at their ends thereto; wherein the columns are of structural metal, and the outer panel members of the several wall units are of wood; wherein the joinder of said panel wall units to the respective columns is made through the outwardly projecting longitudinal flanges of the columns, air-gaps being provided between the ends of the said wall units and the main bodies of said columns; and wherein wood finish members are secured to outwardly exposed faces of said columns to cover the same.

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304,787	Butz	Sept. 9, 1884
1,037,099	York	Aug. 27, 1912
2,086,009	Walker	July 6, 1937
2,359,304	Davison	Oct. 3, 1944