

Sept. 16, 1969

G. S. NOVEMBER

3,466,828

MODULAR WALL CONSTRUCTION

Filed Nov. 13, 1967

4 Sheets-Sheet 1

FIG. 1

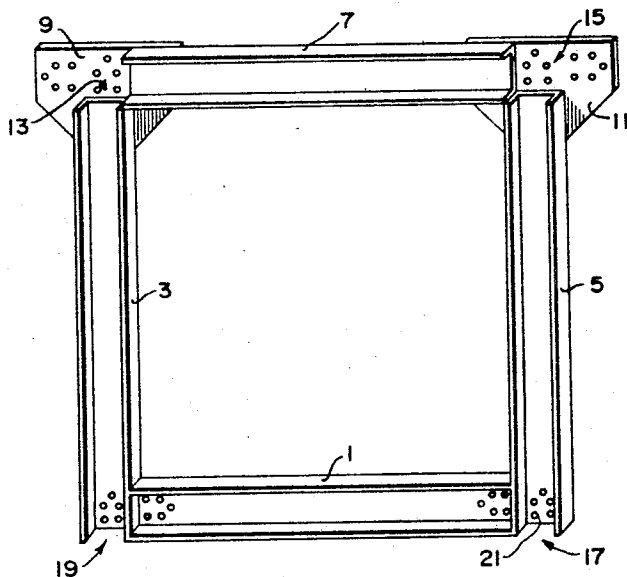
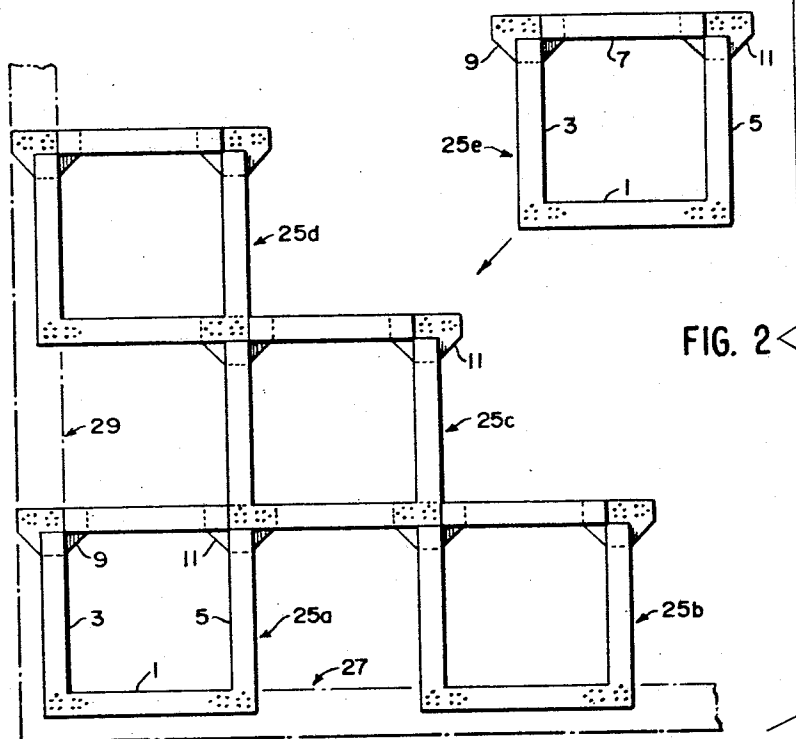


FIG. 2



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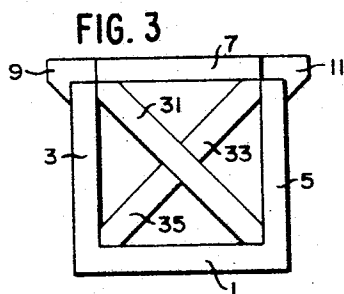
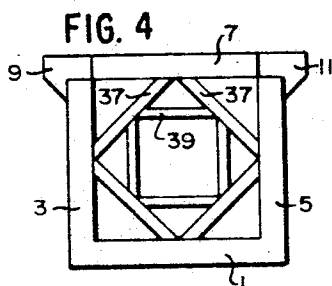
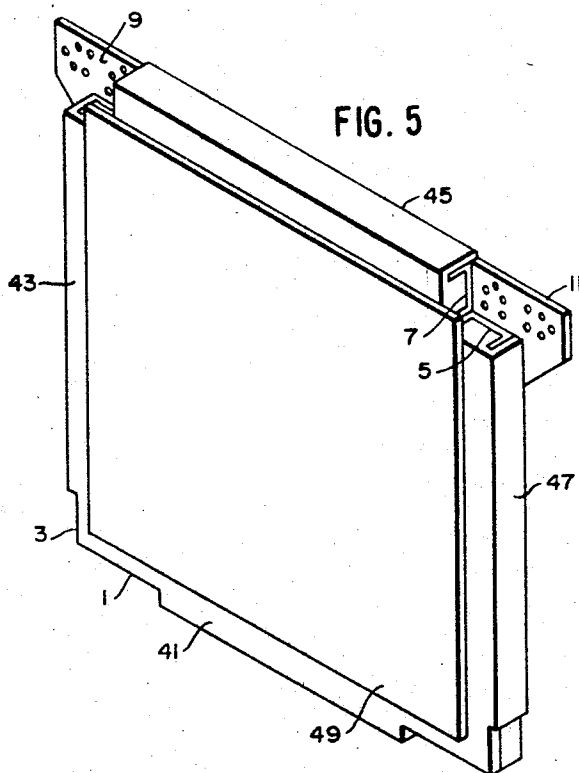
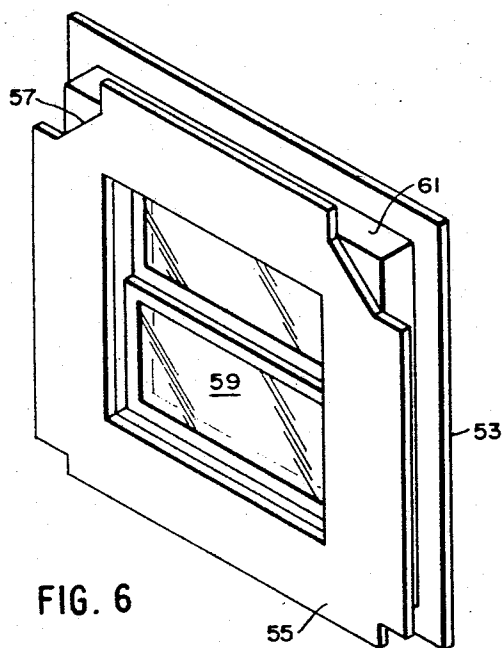
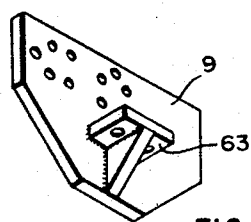
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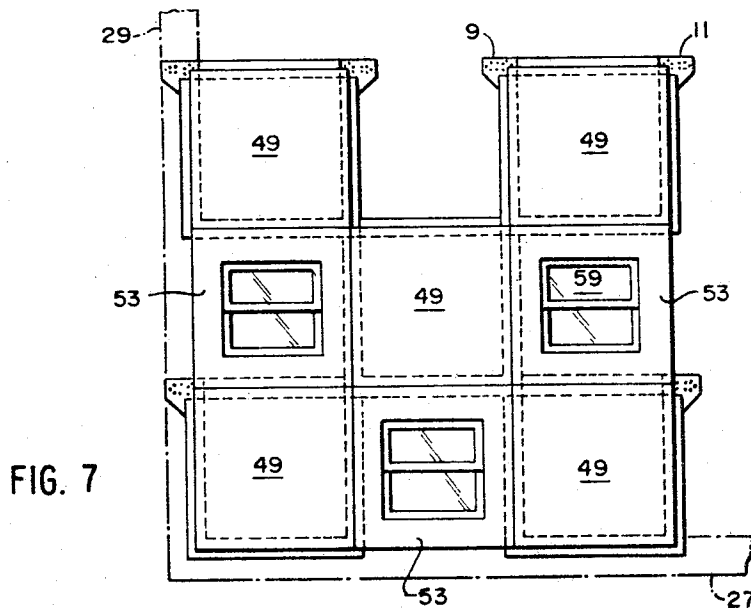
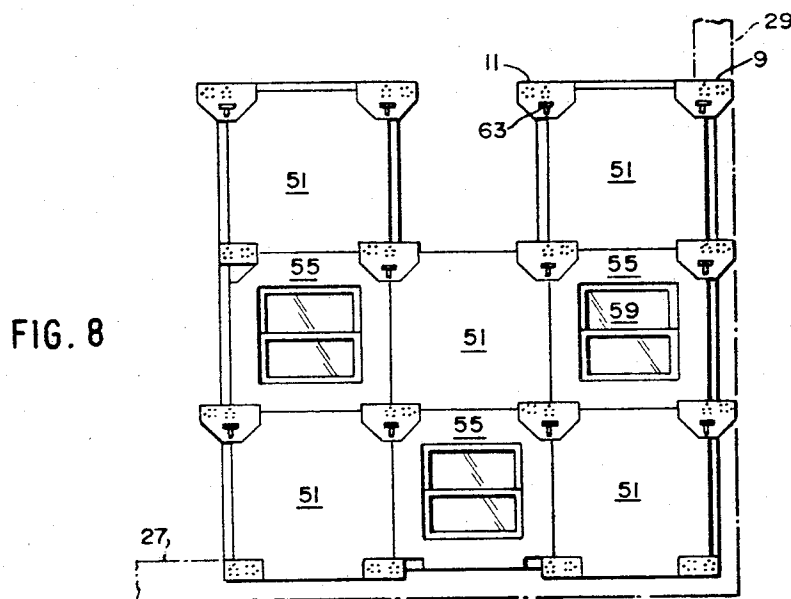
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MODULAR WALL CONSTRUCTION

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4 Sheets-Sheet 3



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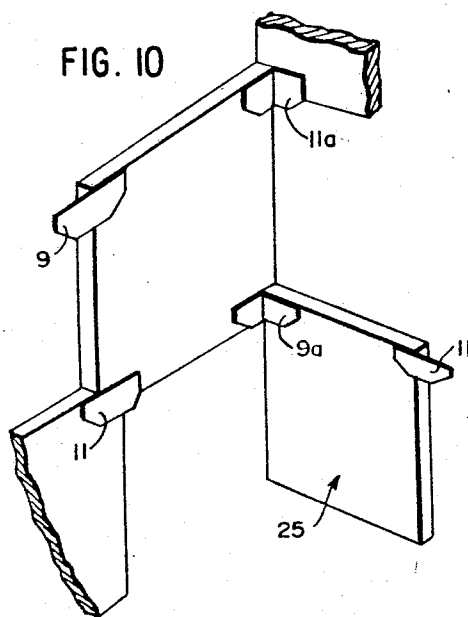
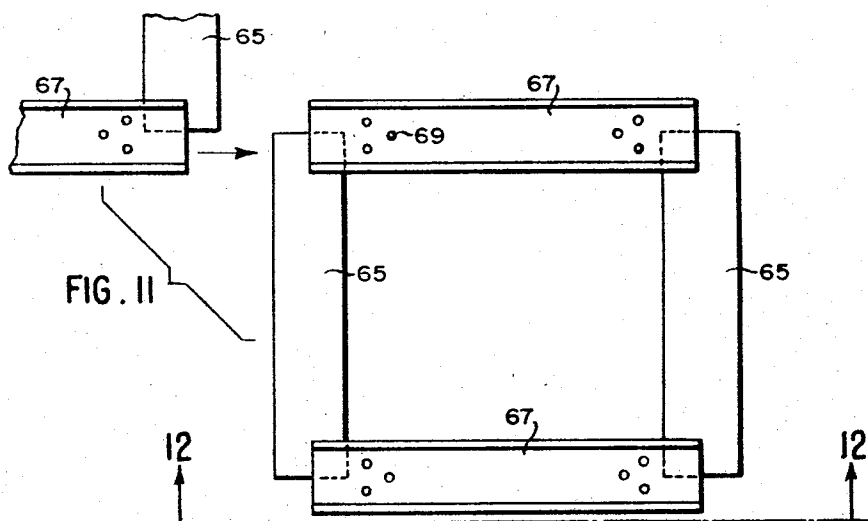
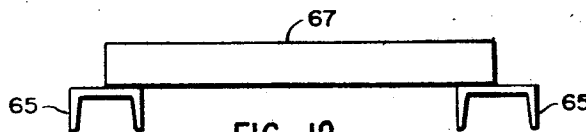
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MODULAR WALL CONSTRUCTION

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4 Sheets-Sheet 4



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MODULAR WALL CONSTRUCTION

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5 Claims

ABSTRACT OF THE DISCLOSURE

A wall construction in which load-bearing wall panels are secured together in a checkerboard array, and non-load-bearing wall panels are inserted between the load-bearing panels to form the wall. The full specification should be consulted for an understanding of the invention.

My invention relates to the building art, and particularly to a novel method and apparatus for constructing a building.

This invention is a system of making a complete steel bearing wall with modular panels. Its objective is to reduce the number of steps required at a construction site to build a wall.

The panels can contain all the elements required by a wall, e.g., supporting structure, weather resistant outside surface, finished inside surface, insulation, windows, fireproofing, vapor barrier, etc. They can also contain: wind bracing, utility piping, and air conditioners.

By incorporating the above items within the panels at the factory, the steps usually required at the site to install them are eliminated. Thus, they will reduce site labor costs, and allow a wall to be built in less time.

Briefly, the above and other objects of my invention are attained by a building construction making use of two different modular building units. One unit comprises a structural load-bearing panel including a frame of structural elements on which a wall panel is mounted. Fastening means are provided on the corners of each such frame, and are adapted to be connected to the other corners of a similar frame. One step in the construction of a building in accordance with my invention is to interconnect these structural panels in a checkerboard array. Such an array constitutes the load-bearing portion of the wall of the building, and provides part of the wall surface. The interconnected structural panels provide support for the building. And, if reinforced for the purpose, they may be used to provide a cross-braced structure that is well adapted to resist the shear forces caused by wind.

The load-bearing walls formed by interconnecting the load-bearing panels of my invention may be joined together to form a frame approximating any desired cross-section in plan, or they may be joined at the corners by conventional columns. Floor support is provided by conventional floor joists.

The second modular unit comprises a non-load-bearing panel. These panels are simply required to provide wall surface, and can consequently be light in weight. The non-load-bearing panels are inserted between the load-bearing panels to complete the outer surface of the building. Since the non-load-bearing panels are not required to support any appreciable load, they may be very simply secured to the structural panels by light fastenings or by adhesive resins, glues or the like.

The assembly of the frame and walls of a building in accordance with my invention requires relatively few connections to be made at the building site. Mullions, which contribute largely to the cost and time required to construct a conventional curtain wall building, are not needed. And as the resultant construction can be made to resist high shear loads with relatively light framing elements,

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it can be especially well adapted for multiple story buildings.

In accordance with a preferred embodiment of my invention, the structural frame of the load-bearing panel, and the exterior surfaces of both the load-bearing and non-load-bearing panels of my invention, cooperate to form tongue and groove joints. The combined interlocked checkerboard arrays of load-bearing and non-load-bearing panels form smooth, weather-tight, continuous wall surfaces.

The manner in which the structural modules of my invention are constructed, and the mode of construction of a building therewith, will best be understood in the light of the following detailed description, together with the accompanying drawings, of various illustrative embodiments thereof.

In the drawings,

FIG. 1 is an elevational perspective sketch of a frame forming the load-bearing element of a structural panel in accordance with my invention;

FIG. 2 is a diagrammatic sketch, with parts shown removed and associated parts shown in broken lines, of a portion of the frame of a building assembled in accordance with my invention;

FIG. 3 is a schematic plan view of a modification of the frame of FIG. 1;

FIG. 4 is a schematic diagram of another modification of the frame of FIG. 1;

FIG. 5 is an orthogonal sketch of a completed load-bearing panel in accordance with my invention;

FIG. 6 is an orthogonal sketch of a finished, non-load-bearing panel in accordance with my invention;

FIG. 7 is a diagrammatic sketch of the outside of a portion of a complete wall built in accordance with my invention;

FIG. 8 shows the appearance of the inside of a portion of a complete wall in accordance with my invention;

FIG. 9 is an orthogonal sketch of a connecting plate forming a part of the load-bearing structural panel in accordance with my invention;

FIG. 10 is a schematic diagram indicating the manner in which a corner can be formed in accordance with my invention;

FIG. 11 is a plan view, with parts broken away, showing a structural frame in accordance with a modification of my invention adjacent a portion of a similar frame; and

FIG. 12 is an elevational view of the complete frame shown in FIG. 11, taken substantially along the lines 12—12 in FIG. 11.

Referring to FIG. 1, the load-bearing element of a structural panel in accordance with my invention may comprise an essentially rectangular frame made from structural steel beams, such as the channel beams shown. The frame may be made by butt welding the ends of a first beam 1 to a pair of channel beams 3 and 5 to form one end. A beam 7, parallel to the beam 1, is joined to the beams 3 and 5 by a pair of connecting plates 9 and 11 which may be welded or otherwise secured to the beams to complete the frame.

The frame so formed has open corners at 13 and 15, and is thereby adapted to receive in these corners a corner of another similar frame, such as one of the corners 17 and 19 at the lower portion of the frame. As shown, the channels adjacent the lower corners 17 and 19 are adapted to be connected to the connecting plates such as 9 and 11 of another frame, as by welding or by drilling them with a series of holes such as 21 to receive cooperating bolts or blind rivets. The connecting plates such as 9 and 11 are correspondingly provided with holes, as at 23, to cooperate with the plain corners of another panel.

FIG. 2 indicates the manner in which the panels of FIG. 1 are interconnected to form the frame of a building. As shown, the first tier of spaced frames such as the frames 25a and 25b are connected to a sill beam 27 and to a corner column 29, both indicated in broken lines. As indicated, this connection may be made with the use of the connecting plate 9 for the frame 25a and by the bolt holes provided in the beams 1, 3 and 5. A second tier is constructed above the first, as by connecting the lower corners of a frame such as 25c to the connecting plates for the lower frames 25a and 25b. Construction would then continue to make a building as high as desired, with each side frame such as 25d being connected to the corner column 29 at the edge of the wall. The frame 25e is shown somewhat removed from its cooperating relationship with the connecting plate 11 for the frame 25c to illustrate the manner of assembly.

Conveniently, the frames 25 may be made to the height of a floor of the building. As illustrated in FIG. 2, they are joined in a checkerboard pattern that can inherently provide the diagonal cross-bracing needed to resist wind forces. The individual frames may be made to resist the forces on them in various ways. For example, the beams 1 and 7 in FIG. 1 could be made as deep as desired to transmit the shear forces imposed on them between columns. Alternatively, as shown in FIG. 3, cross-bracing may be added in the form of additional beams such as the beams 31, 33 and 35. Another form of bracing beams such as 37 connected intermediate the ends of the outer beams to provide for the reception of beams 39 to form a window frame, for example. Any of these constructions and others that may occur to the artisan, may be used to achieve various architectural effects.

FIG. 5 shows a complete structural panel incorporating the frame of FIG. 1. As shown, the beams 1, 3, 5 and 7 may be fireproofed, by encasing them in concrete or other fireproofing material. Thus, the beam 1 is encased in a fireproofing concrete block 41, the beam 3 is incased in a concrete block 43, the beam 5 is encased in a concrete block 45, and the beam 7 is encased in a concrete block 47. If desired, prior to encasing the channels such as 5, service lines, such as water, gas pipes and electrical conductors, may be placed in the channels to facilitate plumbing and wiring of the building.

On the side of the frame which is to be the outside, a panel 49 is secured to the frame. This panel is primarily to serve as a wall, contributing to the appearance of the building and providing insulation and weatherproofing. As it is not expected to contribute materially to the strength of the building, it may be lightly attached to the frame, as by a suitable cement. The panel 49 can be of wood, cement, stone, plastic or any other suitable building material. On the other side of the frame, a wall panel 51 (FIG. 8) may be attached in the same manner as the panel 49. Panels 49 and 51 may be provided with window frames, or otherwise treated for architectural or decorative effect. Between the panels 49 and 51, insulating material can be installed.

FIG. 6 shows a non-load-bearing panel suitable for use with the structural panels of FIG. 5. The mode of construction of this panel is not critical because it is not required to carry any of the loads involved in supporting the building or bracing it against stresses. It comprises a rectangular outside panel 53 and an inside panel 55, also shown in FIGS. 7 and 8. The inside panel 55 is beveled at the upper corners as indicated at 57 to clear the connecting plates such as 9 and 11 on the adjacent structural panels. Windows indicated at 59 may be let into and supported by the panels to admit light. The intermediate frame portion 61 may be of any desired construction, as it serves primarily to separate the panels 53 and 55 and provide insulation. As indicated in FIGS. 7 and 8, the non-structural panels of FIG. 6 are simply inserted into the interstices between the structural panels, and may be attached by any suitable means, as by cement on the inner surface of the outside panel 53.

Comparing FIGS. 8 and 9, the connecting plates such as 9 and 11 may have brackets such as 63 welded to serve as supports for floor joist beams to support the floors of the building.

As will be seen from FIGS. 5, 6, 7 and 8, the external panels 49, 51, 53 and 55 preferably cooperate with the structural frames to form tongue and groove joints. The panels of FIG. 5 and those of FIG. 6 are alternately installed, so that the complete wall is formed as the frame is extended by connecting the load-bearing panels. Preferably, the bolt holes such as 21 in FIG. 1 are threaded, or nuts are welded in place behind them, so that the installation can be accomplished from the inside of the building.

While the corners of a building may be formed in the manner shown in FIGS. 2, 7 and 8, for many purposes it may be preferred to make use of the alternative construction illustrated in FIG. 10. As there shown, the frames 25 at the edge of adjoining plane wall sections may be provided with connecting plates 9a and 11a modified, as by bending, to permit a corner to be formed at essentially any desired angle. In that manner, an entire building can be constructed without the use of corner columns as such, since the side channels 3 and 5 of superposed panels combine to form a corner column. And the cross-section of the building, in plan, can be made to approximate any desired form by suitably choosing the number of corners and their included angles.

FIGS. 11 and 12 show a modification of the frame of FIG. 1. A pair of channel beams 65 form two sides of the frame. The frame is completed by welding two oppositely directed channel beams 67 across them to form four symmetrical open corners. As indicated in FIG. 11, such frames may be interconnected by placing their corners together. The beams such as 67 that are to serve as the horizontal joists may be provided with bolt holes, as at 69, to facilitate their interconnection with tie plates. External panels such as the panels 49 and 51 in FIGS. 7 and 8 can be attached to the frame in the manner described in connection with the embodiment of FIG. 1.

While I have described my invention with respect to the details of various illustrative embodiments thereof, many changes and variations will occur to those skilled in the art upon reading my description. Such may obviously be made without departing from the scope of my invention.

Having thus described my invention, what I claim is:

1. A structural unit for use in wall construction, comprising first and second parallel beams of equal lengths, a third beam extending normal to said first and second beams and connected at its ends to first ends of said first and second beams, a fourth beam parallel to said third beam and equal in length to the distance between said first and second beams, said fourth beam being located adjacent second ends of said first and second beams in position to form open corners with said first and second beams, and a pair of connecting plates, one fastened to the adjacent ends of said first and fourth beams and one fastened to the adjacent ends of said second and fourth beams, said connecting plates protruding over said open corners and each being adapted to be secured to another structural unit such as that first recited at a corner such as that formed at the juncture of said first and third beams.

2. The structural unit of claim 1, further comprising a wall panel mounted on said beams to cover the opening between them.

3. The structural unit of claim 1, further comprising beams connected to and extending diagonally between the corners of the rectangular frame formed by said first, second, third and fourth beams to brace the unit in shear.

4. A structural unit for use in wall construction, comprising first and second parallel beams of equal lengths, third and fourth parallel beams of equal length normal to and connected to said first and second beams, said third and fourth beams extending across said first and second beams to form a rectangular frame and having edges

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projecting beyond the ends of said first and second beams, and said first and second beams having edges projecting beyond the ends of said third and fourth beams, thereby comprising an open-cornered frame adapted to engage corners of like frames.

5. The combination of claim 4, further comprising wall panels secured on opposite sides of the frame formed by said beams.

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U.S. Cl. X.R.

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