

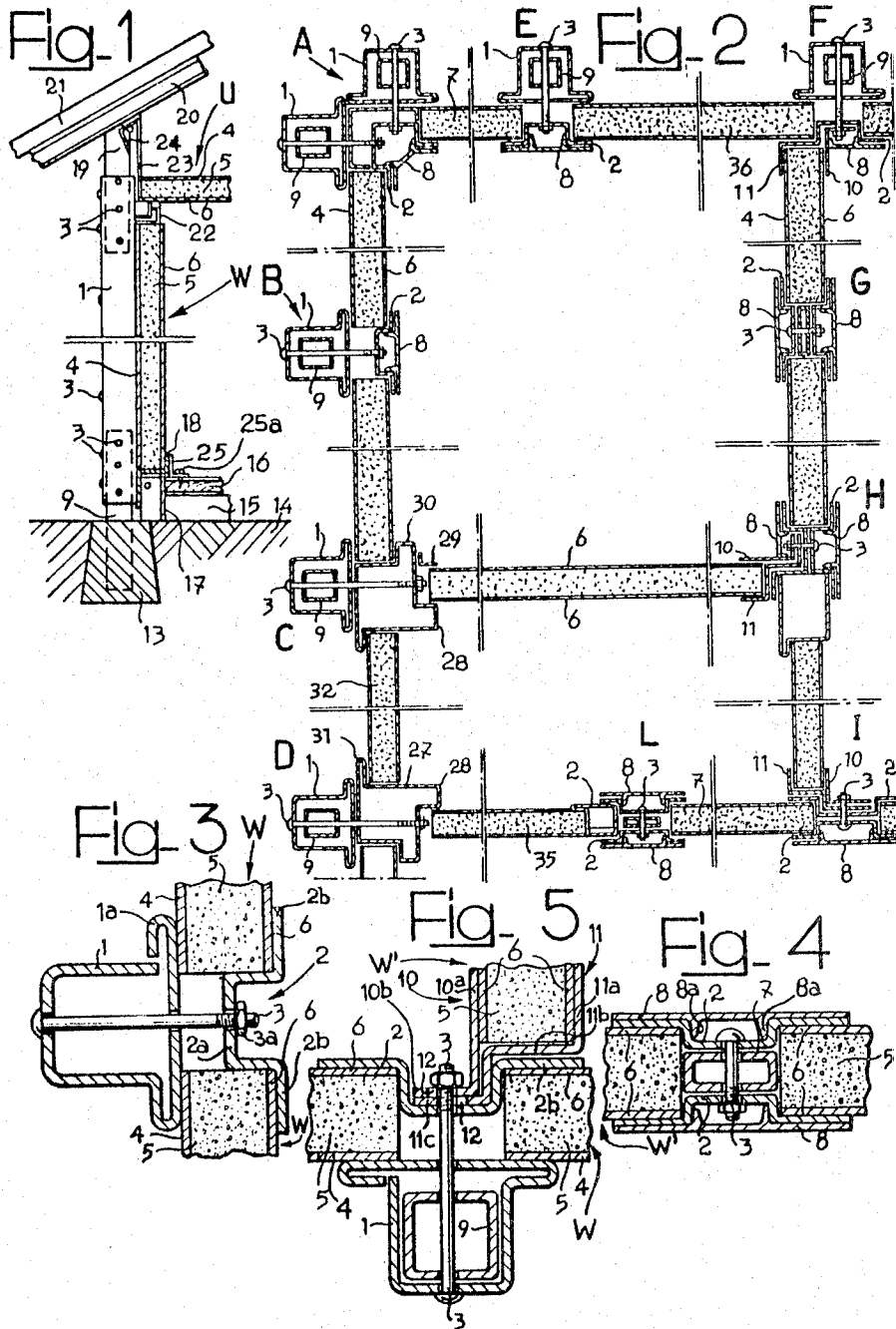
April 4, 1967

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BUILDING CONSTRUCTION

3,312,018

Filed May 20, 1963

2 Sheets-Sheet 1



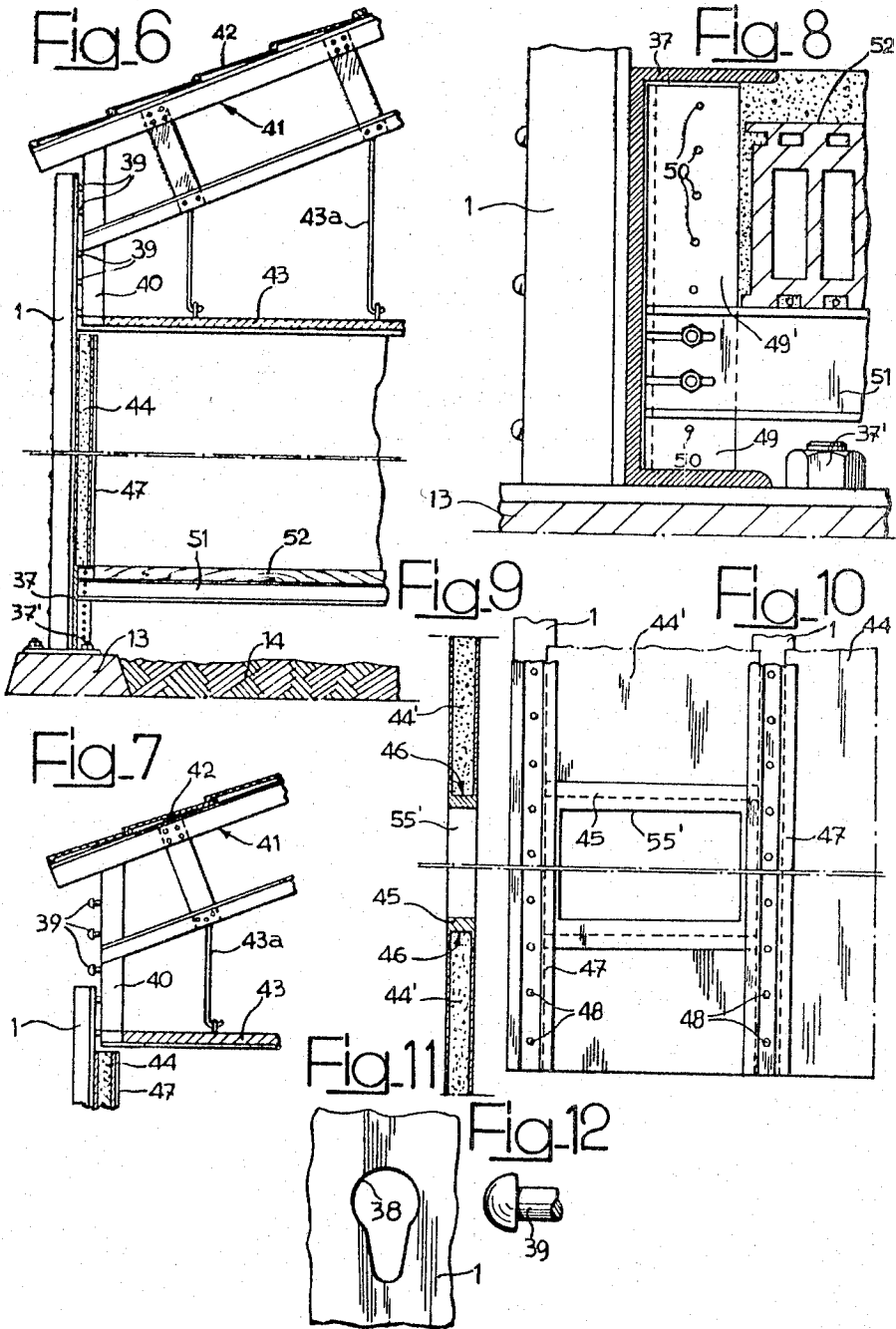
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**BUILDING CONSTRUCTION**

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Filed May 20, 1963, Ser. No. 281,714

Claims priority, application Italy, Aug. 6, 1962,

16,259/62

2 Claims. (Cl. 52—90)

The present invention relates to prefabricated building constructions suitable for both residential and commercial buildings.

The use of prefabricated elements in building construction is known. However, such construction generally has the disadvantage that the prefabricated elements are expensive to manufacture, provide insufficient thermal insulation, are complicated to assemble, and moreover, cannot be conveniently assembled in inclement weather. It is an object of the present invention to provide a prefabricated building construction with none of these disadvantages.

In accordance with the present invention, the prefabricated elements are rigidly locked to one another and to metal supporting structures by means of vice-grip locking devices thereby providing a strong and durable structure.

The construction in accordance with the invention is further characterized by the use of vertical metal structural members fixed to concrete foundations and to the roof structure by means of telescopic joints so that the floor level and roof height can be adjusted as desired. A further feature of the invention is that wall panels including the panels of exterior walls may be fixed to the inner parts of the vertical structural members so that they can be installed from inside the building after the vertical members and roof have been erected. The panels preferably consist of at least two plates, at least one of which is of cement asbestos material and another is of a thermal and acoustical insulating material.

A further feature of the construction in accordance with the invention is that the connection between two contiguous panels is effected by means of metal channels which grip the edges of the panels and are drawn tight on the panels by means of bolts disposed in recessed portions of the channels. When the assembling of the panels is completed, the bolts and the channels are covered by a suitable metal, plastic or other plates secured to the channels.

The construction in accordance with the invention is also characterized by the fact that at least one of the metal structures for holding the panels is provided with suitably shaped surface portions presenting projections for window frames, door frames and the like.

The roof construction is preferably sloping with corrugated cement asbestos sheets supported by metal frames which are mounted by telescopic joints on the vertical structural members so that an opening of a selected depth is provided between the wall panels and the roof to permit air circulation between the roof and ceiling particularly in tropical zones. The vertical structural members are preferably provided at their upper ends with a row of spaced holes adapted to receive rivets, pins, bolts or the like, for securing the roof trusses to the vertical members at different heights.

At their lower ends, the vertical structural members are preferably secured to metal sills or beams which in turn are fixed to a concrete foundation. The metal sills or beams stiffen the structure and avoid the settling of individual vertical members. Inside these sills or beams, which may be of channel cross-section, there are secured

short vertical members provided with rows of holes, eyelets or the like, in which rivets, bolts or other securing means are received to mount floor beams at selected heights. This permits using different types of floors of various structure and thicknesses.

The holes provided in the vertical structures for connection with other vertical members or horizontal members, preferably are keyhole shaped with a substantially round upper portion slightly larger than the heads of the rivets, pins or bolts to be used and lower portions of substantially trapezium shape and of a size to receive the stems of the pins, bolts or rivets. This facilitates the assembly of the members.

The process of erecting prefabricated buildings in accordance with the invention is characterized in that the concrete foundations are first laid down, the base formed by sills or base beams is fastened to the foundation, the vertical structural members are mounted on the base and the roof is erected on the vertical structural members. Thereafter, the floor, exterior and interior walls, and ceiling are installed. The installation of the floor, walls and ceiling can be carried out even in inclement weather since protection is afforded by the previously installed roof.

In panels provided with window and door frames, the frames preferably have the same width as the panel and are provided with grooved portions for receiving other portions of the panel. The composite panel is applied against the inside of the vertical structural members and secured thereto by a frame structure held by screws, bolts or the like.

The objects and advantages of the invention will be more fully understood from the following description and claims in conjunction with the accompanying drawings which show by way of example two preferred embodiments of the invention.

In the drawings:

FIG. 1 is a partial vertical section of a building construction in accordance with the invention;

FIG. 2 is a partial horizontal section taken approximately on the line II—II of FIG. 1;

FIGS. 3, 4 and 5 are horizontal sections on an enlarged scale showing details of the construction;

FIG. 6 is a schematic vertical partial section of another embodiment of the invention;

FIG. 7 is a fragmentary vertical section similar to a portion of FIG. 6 and illustrating location of the roof structure at a different height with respect to the walls;

FIG. 8 is a fragmentary vertical section showing on a larger scale the base beam illustrated in FIG. 6 with a different kind of flooring;

FIG. 9 is a fragmentary vertical section illustrating a panel provided with a window frame;

FIG. 10 is a front view of the panel shown in FIG. 9;

FIG. 11 is a schematic view on a larger scale illustrating the shape of holes preferably used on the vertical structural members; and

FIG. 12 is a side view of the head portion of a rivet adapted to be received in the hole illustrated in FIG. 11.

The building construction illustrated by way of example in FIGS. 1 to 5 of the drawings, comprises vertical metal structural members 1 which are shown as being hollow and of substantially rectangular or square cross-section (FIG. 3) but with opposite, laterally projecting ear portions 1a on one side. Cooperating with the vertical member 1 is a second vertical member 2 having a channel portion 2a and laterally projecting wing portions 2b. The vertical members 1 and 2 are secured together by a bolt 3 passing through aligned holes in the mem-

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ers and provided with a nut 3a which is received in the channel portion 2a of the vertical member 2. As illustrated in FIG. 3, wall panels W are clamped securely between the vertical members 1 and 2 by tightening the bolts 3. The wall panels W are illustrated as being formed of a hinner outer layer 4 which may be formed, for example, of asbestos cement or other attractive and weather resisting material, a thicker intermediate layer 5 formed of cellular, porous or other lightweight material having good thermal and acoustical insulating properties and a thinner inner layer 6 which is formed of decorative material and may, for example, be plastic, paper, fabric or paint.

In FIG. 4 there is illustrated an alternative construction using two of the channelled members 2 with a bolt 3 extending between them and drawing them together to grip the edge portions of wall panels W'. This construction is particularly suitable for inside walls where there is less load to be carried by the vertical members. If desired, a vertical member 7 of rectangular cross-section is positioned between the edges of the wall panels and between the two vertical members 2 in order to provide greater strength. The panels W', being intended for interior walls, are shown as having a central core portion 8 of acoustical insulating material and opposite layers 9 of decorative material suitable for finishing the walls. The channel members 2 and connecting bolts 3 are covered by thin cover plates 8 which may be secured by suitable adhesive, or by ears or flanges 8a which fit inside the channel portions of the vertical members 2 and frictionally hold the cover plates 8 in place.

The vertical structural members 1 are mounted on a concrete foundation 13 (FIG. 1) by means of short vertical columns 9 having lower end portions embedded in the concrete foundation and upper end portions received telescopically inside the vertical members 1 (FIG. 1). Vertically spaced holes are preferably provided in the upper end portions of members 9 and lower end portions of the vertical members 1 so that bolts may be inserted through selected holes in order to mount the vertical members 1 at the desired height with respect to the foundation.

A junction between two walls, for example an inner wall and an outer wall, is formed as illustrated in FIG. 5 by means of vertical metal members 10 and 11. The member 10 is substantially L-shaped in cross-section with a portion 10a engaging the panel W' and a portion 10b received in the channel portion of the vertical member 2 and provided with holes for receiving the bolts 3. The vertical member 11 has a portion 11a engaging the panel W', a portion 11b engaging the edge of the panel W' and an L-shaped portion 11c which extends into the channel of member 2 and is similarly held by the bolts 3. The portion 11a is preferably at an angle of less than 90° to the portion 11b in relaxed condition. When the bolts are tightened, the portion 11a is flexed and adheres closely to the panel W' through its length.

Supporting members 15 of the floor 16 are laid on the ground or suitable concrete apron 14. The outer wall panels W (FIG. 1) are supported by channel or L-shaped members 17 similarly supported on the ground or foundation. A moisture seal 18, preferably formed of plastic sheet material, is disposed between the lower edge of the wall panel W and the supporting member 17. An outer edge portion of the seal 18 is bent downwardly and disposed between the member 17 and the vertical members 1, while an inner edge portion is bent upwardly and held by an angle 25 secured by screws 25a to the floor 16 adjacent the wall.

The roof is supported by short vertical members 19 which are preferably of box cross-section similar to the members 9 and are telescopically received in the upper end portions of the vertical structural members 1. The vertical members 1 and 19 are provided with vertically spaced holes for receiving bolts which permit the members 19 to be adjusted to selected vertical positions.

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Roof frame or rafter members 20 are mounted on the vertical members 19 by angular members 24 and carry the roof 21 which is preferably of corrugated asbestos sheet material.

The ceiling U is illustrated as being formed of panels like those used on the outside walls, supported by a horizontal member 22 providing a waterproof seal. The member 22 is secured to the vertical structure members 1 and has a ledge portion for supporting the ceiling panels. The space between the ceiling and the roof is wholly or partially closed off by metal or asbestos sheet material 23 secured to the roof frame 20 by angular members 24.

The assembling of the construction in accordance with the invention is carried out in the following manner. The ground or platform 14 is suitably prepared and the concrete foundation 13 is laid, with the vertical members 9 partially embedded in the foundation and projecting up above its surface. The vertical structural members 1 are then mounted on the members 9 and fastened at the desired height by means of bolts 3. The upper vertical members 19 are installed on the upper ends of the vertical members 1 and adjusted to the desired height. The roof frame 20 and roof 21 are then assembled on the vertical members 19. The roof is thus installed at an early stage in the process and provides protection for carrying out the following steps even though the weather is inclement.

The floor supporting structures 15 and the wall supporting the structures 17 are then installed, taking care that a portion of the moisture seal 18 is placed between them and the vertical members 1. The external walls and the floors are then assembled. The moisture seal 18 is bent inwardly so as to lie between the lower edges of the wall panels and the supporting member 17 and then upwardly so as to overlie the inner face of the lower edge portion of the panel, being secured in place by the angle member or base board 25. The ceiling supporting structures 22, ceiling panels U and sheets 23 are then installed, the sheets 23 being fastened in place by the angular members 24. If desired, the space between the ceiling and the roof may be left more or less open in order to obtain air circulation. This is particularly desirable in tropical areas. Finally, the inside walls and frames are installed.

Various types or junctions between the wall panels and the metal structures are illustrated in FIG. 2 where they are designated by the letters A to L.

The fastening of the outer wall panels W to the vertical members 1 (FIGS. 1 and 3) is effected by resting the panels on the supporting members 17 with vertical edge portions leaning against the laterally projecting ear portions 1a of the vertical members 1. The vertical channel member 2 is then positioned with the channel portion 2a between the edges of the panels and the wing portions 2b overlying edge portions of the inner layers 6 of the panels. Bolts 3 are then inserted through the holes provided in members 1 and 2 and are tightened to draw the member 2 toward the member 1 and thereby rigidly lock the panels W in place.

As illustrated in FIG. 4, adjacent wall panels, for example of an interior wall, are joined by means of two channel members 2 which are applied to the edge portions as shown and drawn toward one another by bolts 3. If greater strength is required, the member 7 is inserted between the edges of the panels before the channel members 2 are applied. After the bolts 3 have been tightened, the covering plates 8 are applied and secured in place.

Where it is desired to join an inside wall to an outside wall, the parts are assembled as shown in FIGURE 5. The portion 11a of member 11 is initially at an angle of less than 90° to the portion 11b as indicated in dotted lines. When the bolts 3 are tightened, the portion 11a of member 11 flexes slightly so that the edge of the panel is held tightly between members 10 and 11.

It will be seen that the details shown in FIGURES 3

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to 5 correspond to some of those represented in FIGURE 2. Thus, FIGURE 3 corresponds to details B and E, FIGURE 4 to details G and L and FIGURE 5 to detail F. Details H and I represent a variant of the detail illustrated in FIGURE 5, the member 1 being replaced by a second member 2.

Detail A represents one corner of the building construction. A single member 2' is secured by separate sets of bolts 3 to two vertical members 1 disposed at right angles to one another. The member 2' has laterally projecting wings like the wings 2b of members 2 which engage and hold the edge portions of the two panels. A vertical angle member 6 is placed between the members 1 and the member 2' when greater strength is desired.

Details C and D illustrate the application of elements for supporting a door frame. Detail C illustrates a vertical structural member 1 connected by bolts 3 to a structure 27 having a projecting portion 28 which, together with an angle 29, is used to block the adjacent internal wall in the required position. Moreover, member 28 has a projecting portion 30 co-operating with the laterally projecting ear portion of member 1 to hold the adjacent panel of the outer wall securely in place. A further projection 31 on structure 27 serves as a door stop for a door 32 hingedly mounted on the structure 27 by hinges 33.

Detail D shows a structure 27 symmetrical to that shown in detail C providing a door frame at the opposite side of the door. An inner door 35 is mounted on the structure 27 of detail D by hinges 34.

Another embodiment of the invention is illustrated in FIGURES 6 to 12 where parts like those of FIGURES 1 to 5 are designated by the same reference numerals. The lower end portions of vertical structure members 1 are secured, for example by bolts, to a beam 37 which is mounted on the concrete foundation 13, for example by bolts 37'. The upper portions of vertical structure members 1 are provided with vertically spaced holes 38 adapted to receive rivets 39 which are fixed in and project from vertical members 40. Preferably the holes 38 are of key-hole shape as illustrated in FIGURE 11, with an upper circular portion large enough to receive the head 39a of a rivet 39 and a lower portion which is trapezoidal and of a size to receive the shank of the rivet. This facilitates assembly of the structure since it permits members 40 to be mounted on the upper portion of vertical members 1 merely by inserting the heads of the rivets 39 on member 40 into selected holes 38 of the vertical member 1. The vertical position of member 40 can be adjusted by selection of the holes into which the rivets are inserted. The members 40 support the roof structure of the building comprising trusses 41 and roofing material 42 which is illustrated by way of example as asbestos shingles. The roof trusses 41 are shown as comprising an upper member 41a on which the roof material is laid, a lower parallel member 41b and connecting members 41c. Ceiling panels 43 are suspended from the trusses 41 by means of hangers 43a.

Outside wall panels 44 are mounted on the vertical members 1 and may be plain panels or panels provided with window or door frames. By way of example, there is shown in FIGURES 9 and 10 a panel in which a window frame 45 is mounted. The upper and lower members of the window frame 45 are provided with panels 46 to receive the edges of panel portions 44' disposed above and below the window frame. The wall panels are mounted on the vertical members 1 by members 47 secured to the vertical members 1 by bolts or screws 48. The members 47 may, for example, be similar to members 2 shown in FIGURE 3.

As shown in FIGURES 6 and 8, the beam members 37 mounted on the foundation 13 preferably have shallow channels defining flanges which are disposed vertically. Between the flanges, there are disposed a plurality of vertical members 49 which may be of angle cross-section and

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are welded or otherwise secured in place and each of which defines a vertical web. A plurality of vertical spaced holes 50 in the members 49 provide for mounting floor beams 51 at any desired height by means of suitable bolts 51a. In FIGURE 6, the floor beams are shown mounted relatively high to support a wooden floor 52 while in FIGURE 7, the floor beams 51 are mounted lower in order to provide for the greater thickness of a reinforced tile floor 52'.

The assembling of the structure shown in FIGURES 6 to 12 is accomplished in the following manner. On the previously prepared concrete foundation 13, beams 37 are fastened to provide a rigid base perimeter for the construction. Vertical structure members 1 are then rigidly fastened to the beams 37 by means of bolts or the like. The vertical extensions 40 are then assembled on the upper end portions of vertical members 1 by means of the rivets 39 inserted into the holes 38. The desired height  $h'$  of the roof structure with respect to the vertical members 1 is attained by a selection of the holes in which the rivets 39 are inserted, as illustrated by a comparison of FIGURE 6 with FIGURE 7. In order to continue working even in rainy weather, the next step is to assemble the roof comprising trusses 41 and roofing material 42 on the vertical members 40.

The floor beams 51 are then mounted on the members 49 in channels 37 (FIGURES 6 and 8), the beams being mounted at the proper height for the type of floor desired.

The flooring 52 or 52' is then laid on the floor beams 51. The panels 44 forming the outer wall are then applied to the inner faces of the vertical members 1 and secured in place by means of the vertical members 47 and screws or bolts 48 which are tightened so as to hold the panels as in a vise. If a window or door frame is to be placed within a panel, it is applied as illustrated in FIGURES 9 and 10 by inserting the edges of panel portions 44' into groove 46 of the window or door frame 45 and then mounting the entire structure on vertical members 1 in the same way as with plain panels.

Finally, the panels making up the inside walls and the ceiling are assembled as described in connection with the previous embodiment, except that the ceiling panels are suspended from the roof structure by hangers 43a.

A building erected in accordance with the present invention has important advantages over earlier prefabricated construction. It is exceptionally strong by reason of the panels being held in a vise-like grip. It will thereby resist damage by wind, flood or earthquake. The building is very easy and economical to assemble and may also be easily disassembled, for example when it is desired to move the building or to modify or enlarge it. The height of the floor and the height of the ceiling and roof can be readily adjusted according to requirements. Ventilation is provided as desired between the roof and ceiling, or between the floor and ground. Vertical adjustability of the floor supporting structure permits the utilization of various kinds of flooring while keeping the floor level constant.

While preferred embodiments of the invention have been shown and described by way of example, it will be understood that a number of changes and variations may be effected without departing from the spirit of invention and that the invention is in no way limited to the embodiments shown by way of example in the drawings.

I claim:

1. A prefabricated building construction comprising a foundation, a plurality of hollow members of substantially rectangular cross section supported by and arranged on the foundation to define the perimeter of the building, a plurality of panels, each of said panels being arranged vertically between a pair of said hollow members, a plurality of elongated plate members, each of said plate members having a lengthwise channel and a lengthwise flat flange at each side of said channel and being arranged vertically and adjacent one of said hollow mem-

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members with said flanges facing a pair of said panels, each flange thus defining a vertical space enclosing an edge of a respective one of said panels, means for drawing said plate members toward said panels for clamping of said panels, a roof arranged at the top of and supported by said hollow members, and a floor supported by said hollow members at a desired height above the foundation.

2. A prefabricated building construction according to claim 1, in which said plate members are arranged in opposed pairs with respect to each of said hollow members.

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References Cited by the Examiner

UNITED STATES PATENTS

2,137,767	11/1938	Betcone .....	52—274
2,363,164	11/1944	Waller .....	52—732 X
2,924,638	2/1960	Feketics .....	52—282 X
2,963,121	12/1960	Felver .....	52—90 X
3,203,145	8/1965	Raynes .....	52—90 X

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