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Loebsack

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[54] BUILDING CONSTRUCTION SYSTEM

[76] Inventor: **Victor H. Loebsack,** R.F.D. 7, Topeka, Kans. 66204

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[52] **U.S. Cl.** **52/265,** 52/270, 52/268, 52/285, 52/586, 52/234, 52/309

[51] **Int. Cl.** **E04b 2/08**

[58] **Field of Search**.....52/309, 586, 268–270, 52/238, 285, 286, 92

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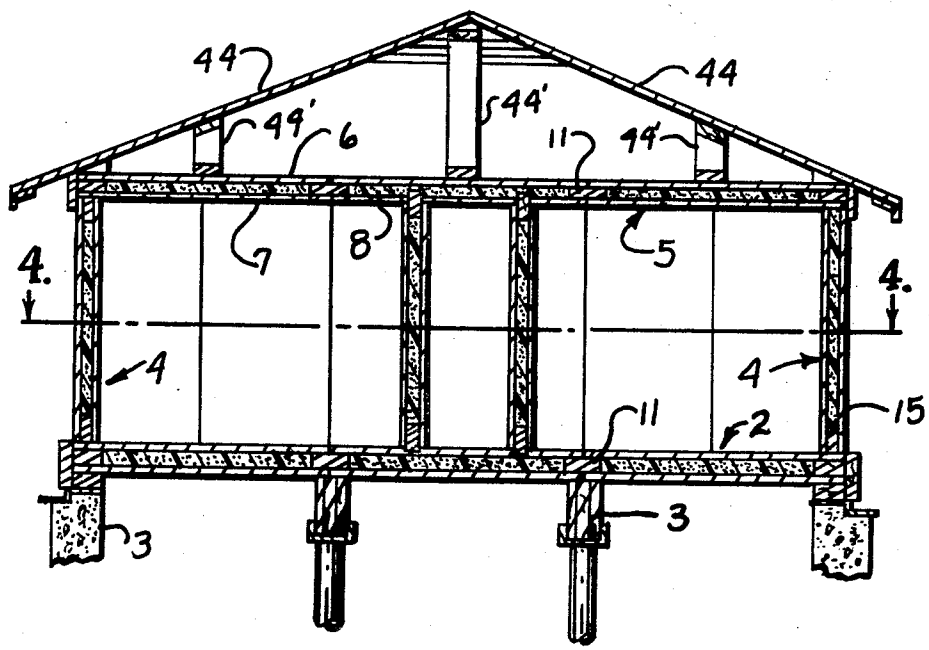
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Primary Examiner—Frank L. Abbott
Assistant Examiner—Henry E. Raduazo
Attorney—Fishburn, Gold & Litman

[57] **ABSTRACT**

A building construction system provides a building wherein the entire building acts as a structural unit and the system comprises a plurality of connected floor panels each having edge portions thereof supported on spaced support members and a plurality of connected wall panels each having one edge thereof supported on the floor panels and extending upwardly therefrom with a plurality of connected ceiling panels supported on the wall panels. The floor, wall, and ceiling panels each are of laminated or sandwich construction and include a pair of generally parallel face members separated by an insulating core member. Adjacent edges of the floor, wall, and ceiling panels are secured together by a spline member placed between the face members of each of the adjacent panels to be secured together and fastening members extending through the face members of each panel and the spline member.

7 Claims, 11 Drawing Figures



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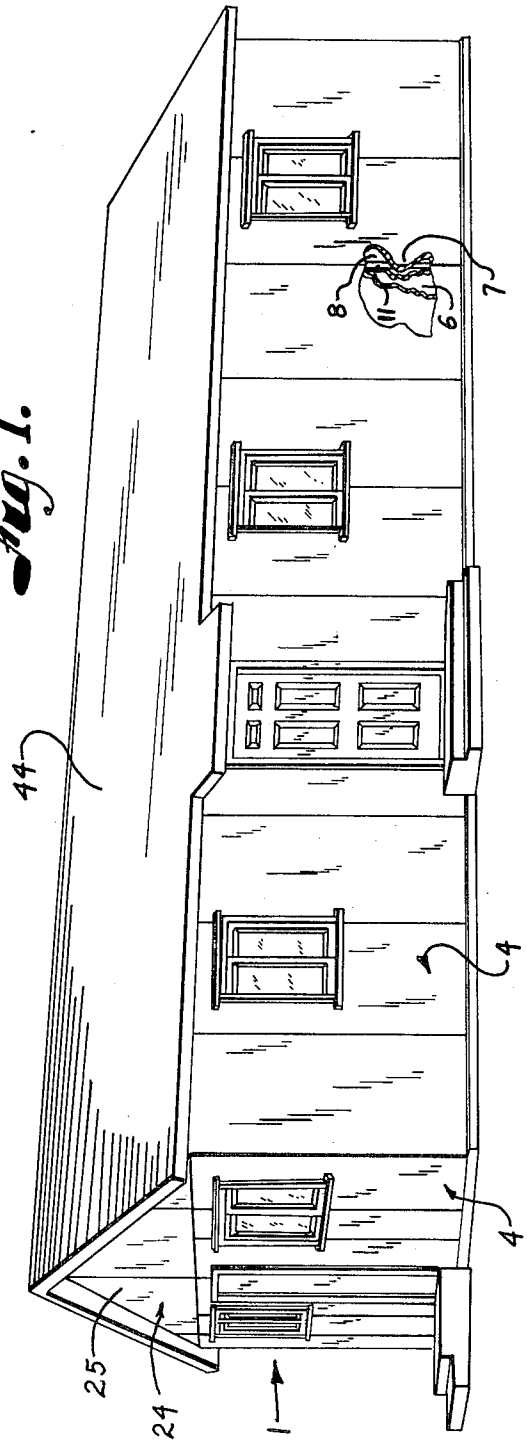


Fig. 1.

INVENTOR
Victor H. Loebsack
BY
Fishburn, Holland & Letman
ATTORNEYS

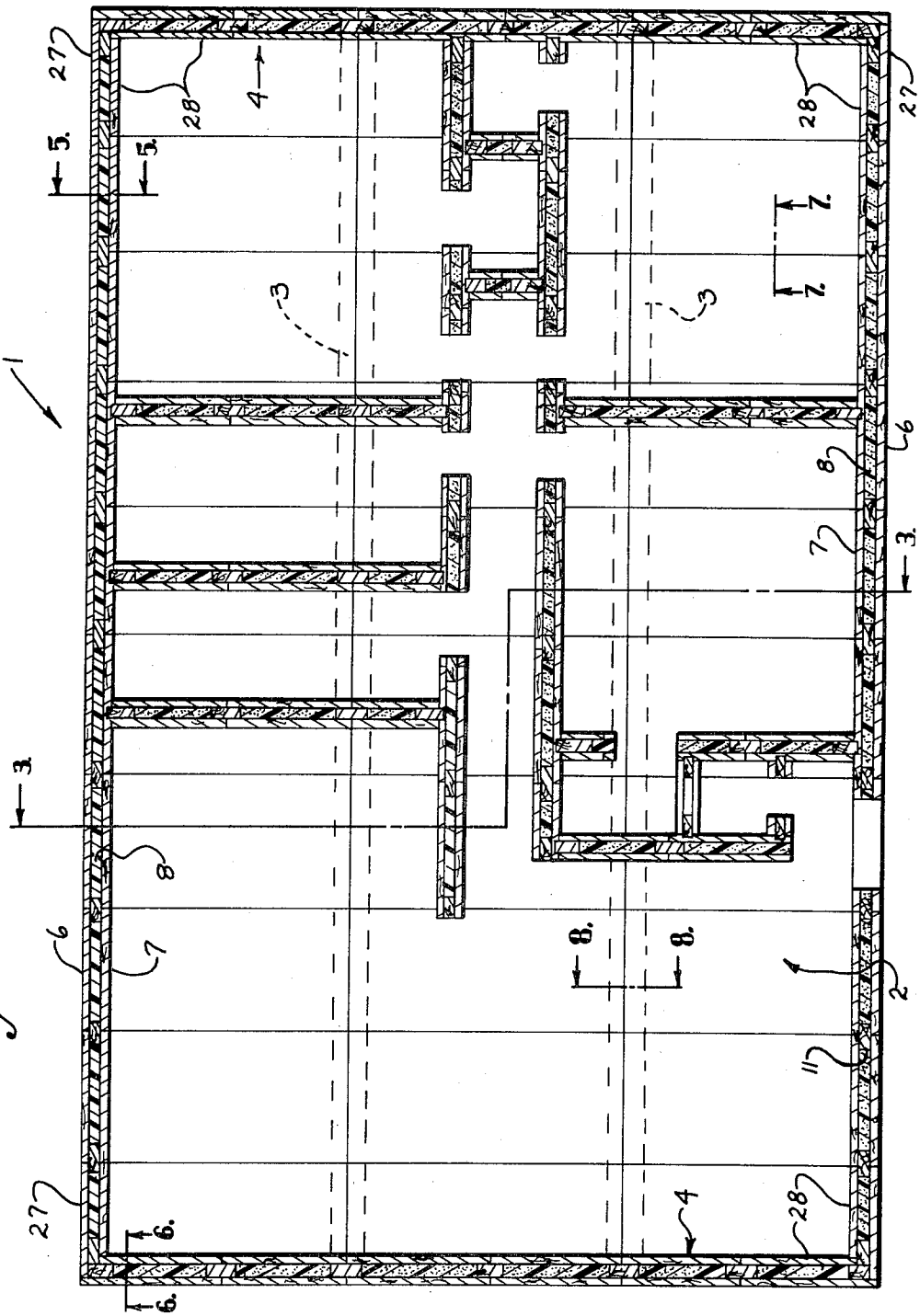


Fig. 2.

INVENTOR.
Victor H. Loebsack
BY
Fishburn, Gold and Litman
ATTORNEYS

Fig. 3.

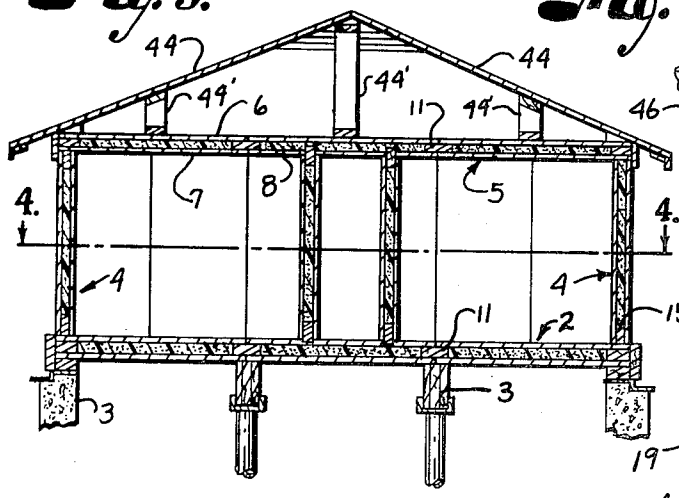


Fig. 5.

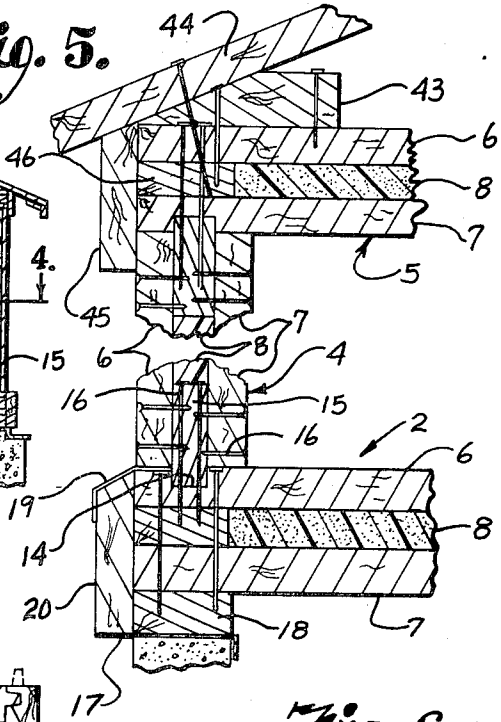


Fig. 4.

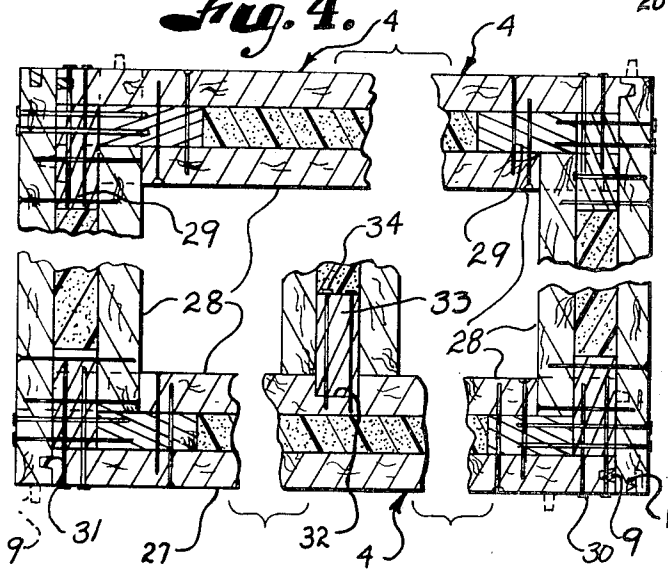
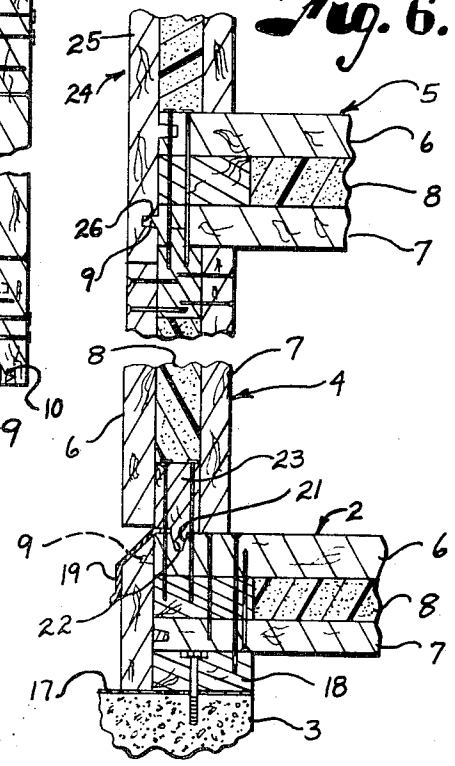


Fig. 6.



INVENTOR.
Victor H. Loebsack
BY
Frishkorn, Gold & Litman
ATTORNEYS

Fig. 7.

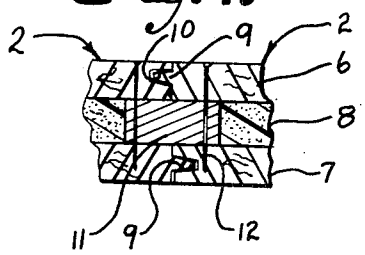


Fig. 8.

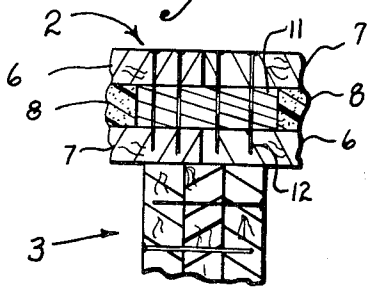


Fig. 9.

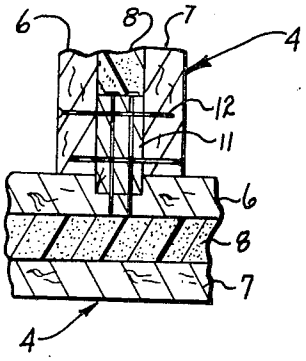


Fig. 10.

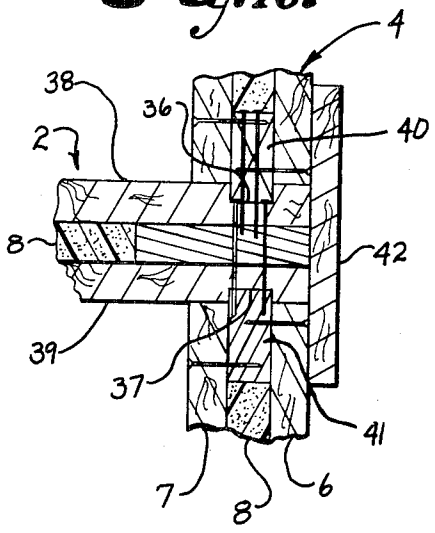
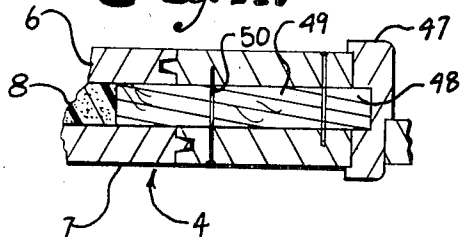


Fig. 11.



INVENTOR.
Victor H. Loebsack
BY
Friedman, Gold & Litman
ATTORNEYS

BUILDING CONSTRUCTION SYSTEM

The present invention relates to building construction and more particularly to a building construction system having laminated or sandwich floor, wall, and ceiling panels joined together in a manner to cause the entire building to act as a rigid structural unit.

Heretofore, buildings constructed of wood, such as residential, apartments, shops and the like, employed floor and ceiling joists with cross-bracing members therebetween and walls were formed with spaced studs with spacing or bracing members therebetween. The erection operation for such a construction system was time-consuming and required considerable expensive labor for erection and after erection had been completed, it was necessary to provide finishing materials, such as plaster or wallboard, for interior surfaces of the walls and to enclose the floor and ceiling joints to provide a finished appearance to the structure. Exterior surfaces of the walls also required finishing materials, such as siding, masonry or the like, all of which required considerable expensive labor for erection.

The principal objects of the present invention are: to provide a novel building construction system having prefabricated components designed for rapid and efficient construction wherein floor, wall, and ceiling panels are standard size members and are laminated or sandwich members designed for modular construction; to provide such a building construction system having tight joints between connected floor, wall, and ceiling panels and tight joints between floor and wall panels and between wall and ceiling panels; to provide such a building construction system which provides floors having a comfortable resiliency and minimum deflection; to provide such a building construction system wherein the joints are nailed and glued and require no cover members, either for interior or exterior joints and the joints and panels present a smooth surface for receiving suitable standard or decorative finishes, such as paint, paper, suitable carpeting or floor tile, ceiling tile, and exterior siding where desired; to provide such a building construction system which has insulating qualities particularly for sound and heat and which is substantially fire resistant; to provide such a building construction system which is designed for rapid fabrication and erection with a minimum factory and field force per unit and which produces a rigid structure wherein walls, floors, and ceilings are interconnected whereby the entire building acts as a structural unit with the wall members acting as structural webs; to provide such a building construction system adapted for single and multiple story construction; and to provide such a building construction system which is simple and practical in construction, strong and durable in use, inexpensive and economical to manufacture and erect, and otherwise well adapted for the proposed use.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings wherein are set forth by way of illustration and example certain embodiments of this invention.

FIG. 1 is a perspective view of a building constructed according to the building construction system of the present invention.

FIG. 2 is a floor plan of the building.

FIG. 3 is a transverse sectional view through the building taken on line 3—3, FIG. 2.

FIG. 4 is an enlarged sectional view taken on line 4—4, FIG. 3, showing the construction of the exterior corners of the building and an interior wall normal to an exterior wall panel.

FIG. 5 is an enlarged sectional view taken on line 5—5, FIG. 2, showing the joint between wall panels and floor and ceiling panels for an exterior side wall of the building.

FIG. 6 is an enlarged fragmentary sectional view taken on line 6—6, FIG. 2, showing the joint between wall panels and the floor and ceiling panels at an end wall of the building.

FIG. 7 is an enlarged fragmentary sectional view taken on line 7—7, FIG. 2, showing the joint between adjacent edges of floor panels.

FIG. 8 is an enlarged fragmentary sectional view taken on line 8—8, FIG. 2, showing the joint between ends of floor panels over support members.

FIG. 9 is an enlarged fragmentary sectional view showing the joint between perpendicular interior wall panels.

FIG. 10 is an enlarged fragmentary sectional view showing the joint between an intermediate floor and a wall for multiple story construction.

FIG. 11 is an enlarged fragmentary sectional view showing a wall panel and a framing member defining an opening therein for a door, window, or the like.

Referring more in detail to the drawings:

The reference numeral 1 generally designates a building formed of prefabricated components which are secured together to form an integral structural unit formed of a plurality of connected walls, such as bottom walls or floors, top walls or ceilings, and upright side and interior walls. In the illustrated structure, the walls include floor panels 2 extending between and supported on spaced support members 3, such as foundation walls, beams, and the like with upright wall panels 4 each having one end edge portion thereof supported on the floor panels 2 and extending upwardly therefrom to support a plurality of ceiling panels 5 on the other end edge portion.

The floor panels 2, wall panels 4, and ceiling panels 5 are prefabricated of a standard size which is particularly adapted for modular construction, such as 4 feet wide by 8 feet long, and the support members 3 are spaced at 8 feet centers to thereby support adjacent ends of the floor panels 2, as later described. The floor, wall, and ceiling panels 2, 4, and 5 are similar in construction and each is of laminated or sandwich construction and includes a pair of spaced generally parallel outer layers or face members 6 and 7, with an insulating inner layer or core member 8 between and spacing apart the face members 6 and 7. It is preferable that the face members 6 and 7 be of a high quality material, such as exterior grade plywood, and it is desirable that the core member 8 provide sound and heat insulating qualities and that the core member 8 be of a fire resistant material, such as a rigid foamed plastic, for example, styrene or the like.

The floor, wall, and ceiling panels 2, 4, and 5 are equal in thickness to a 2 × 4 inches, namely 3 ¾ inches, and the face members 6 and 7 are 1 ⅛ inches thick plywood members and the core member is 1 ½ inches thick rigid synthetic resin foam having a density of 2 to 5 pounds per cubic foot.

The floor, wall, and ceiling panels 2, 4, and 5 are each designed to interfit with adjacent panels to form a continuous tight joint between adjacent panels which does not require a cover even for exterior surfaces. In the illustrated structure, one of the face members of each of the panels has a tongue member 9 extending outwardly from opposite side edges thereof and the side edges of the other face member of the respective panel has a groove 10 therein with the grooves 10 being shaped to receive a tongue member 9 extending from the side edge of an adjacent panel to thereby form a tight joint between the respective face members of the adjacent panels.

Additional structural continuity between respective adjacent floor, wall, and ceiling panels 2, 4, and 5 is provided by means for securing same together including a spline member 11 at each joint with the spline member 11 being positioned between the face members 6 and 7 of each of the adjacent panels and engageable with the core members 8 of each of the adjacent panels to be secured together. The spline member 11 and the edge portions of the core members 8 and face members 6 and 7 of the adjacent panels are coated with glue. Suitable fastening members, such as nails or screws 12, are installed in the joint to extend through one of the face members of each of the adjacent panels and through the spline member 11 and at least into the other face member of each of the adjacent panels to thereby provide a nailed and glued joint to secure the adjacent panels together in a tight joint having substantial structural continuity. Floor panels are normally subjected to greater loading than ceiling panels, therefore, the spline member 11 for the joint between adjacent floor panels 2 is wider than the spline member 11 for the adjacent ceiling panels 5. Spline members for floor joints are 1 ½ inches by 5 ½ inches members and for ceiling joints are 1 ½ inches by 3 ½ inches members. The loading for wall panels 4 is less than that on floors and ceilings, therefore, the joint between adjacent wall panels may have fewer fastening members 12 than the joint between adjacent floor and ceiling panels 2 and 5 and the spline members for wall joints are 1 ½ inches by 3 ½ inches members.

It is desirable to provide a rigid connection between the lower end edge portion of the wall panels 4 and the floor panels 2 to enable the wall panels 4 to function as structural webs thereby enabling the entire building 1 to function as an integrated structural unit, therefore, a groove or way 14 is provided in an upper face member of the respective floor panel 2 at the location of the respective wall. A spline member 15 is received in the groove or way 14 and is positioned between the face members 6 and 7 of the wall panels 2 forming the respective wall.

It is preferable that the spline member 15 be continuous over the length of several wall panels 4 thereby increasing the continuity between the wall panels and the floor panels supporting same. Suitable fastening members 16, such as nails or screws, are employed to secure the spline member 15 to the respective floor panel 2 and to the wall panels 4. In the illustrated structure, one group of the fastening members 16 extend through the spline member 15 and into at least the face member of the respective floor panel 2 having the groove or way 14 therein. A second group of the fastening members 16 also extend through each of the face members of the wall panels 4 and through the spline member 15 and into the other face member of the respective wall panel.

The rigidity of the joint and the structural continuity between the floor and wall panels is increased by coating with a suitable glue the groove or way 14, the spline member 15 and the end edge portions of the face members and core member of the respective wall panels 4 which engage the spline member 15 to thereby provide a nailed and glued joint having substantial structural continuity.

The above described joint between wall panels 4 and floor panels 2 is also employed for the joint between interior walls and ceiling panels and for the joint between the exterior side walls of the building 1, and the floor and ceiling panels.

Particularly for exterior side walls of the building 1, it is desirable to provide a suitable termite shield 17 between the support member 3 and a suitable plate 18 mounted thereon. It is also desirable to provide a metal flashing member 19 between the floor panel 2 and the wall panel 4 and extending over a facia 20 covering the end of the floor panels 2 and the plate 18 to thereby provide a finished appearance at the joint between the exterior side wall and the floor and supporting member.

The side edges of the floor panels 2 are parallel with the exterior end walls of the building 1, therefore, it is necessary to remove the tongue member 9 of the respective exterior side edge portion of the face member of the floor panel 2 and it is preferable to glue the removed tongue member 9 in the groove 10 of the other face member. A groove 21 is formed in the upper face member of the floor panels 2 adjacent the exterior edge thereof to receive a tongue 22 extending from a modified spline member 23 which is nailed and glued in the floor and wall panels, as previously described.

The joint between the wall panels 4 and the ceiling panels 5 is a mirror image of the corresponding joint between the wall panels 4 and the floor panels 2, except at the end walls of the building 1 having gable panels 24 extending upwardly above the ceiling panels 5 and in the illustrated structure, an exterior face member 25 of the gable panel 24 extends over the edge portion of the respective ceiling panel. The exterior face member 25 has a way or groove 26 therein to receive the tongue member 9 extending from the respective face member of the ceiling panel 5.

The wall panels 4 at the exterior corners of the building 1 are rigidly joined together to provide substantial residence against twisting due to wind forces and the like. Exterior face members 27 of the wall panels forming the exterior corners are moved into engagement and the interior face members 28 of said wall panels each have an edge portion thereof removed and the interior face members 28 are also moved into engagement. Spline members 29 are positioned between the interior and exterior face members 27 and 28 of each of the wall panels and the spline members 29 are in engagement. One group of suitable fastening members, such as nails or screws 30, secure each of the spline members 29 in the respective wall panel and an other group of the fastening members 30 secure the wall panels to the spline member 29 in the other wall panel.

Opposite corners of the building **1** form similar pairs and in one of the pairs, the tongue member **9** extends from the exterior face members **27** and the groove **10** is in the interior face members **28**. The exposed tongue member **9** is cut away from one exterior face member **27** and a groove or way **31** is formed in the exterior face member **27** to receive the tongue member **9** of the other exterior face member **27**.

In the other of the pairs of similar exterior corners, the exterior face members **27** have the grooves **10** in the exposed edge thereof. The tongue members **9** are cut away from each of the removed portions of the interior face members **28** and are secured in the grooves **10** of the exterior face members **27**, preferably by gluing same in place.

T-shaped vertical joints between interior and exterior wall panels and between normal or perpendicular interior wall panels are similar and each have a way or groove **32** formed in the face member to receive a spline member **33** between the face members of the wall panel abutting the wall panel having the groove therein. The spline member **33** is secured to the face member of the wall panel having the groove or way **32** therein and the spline member **33** may be secured to the face members of the other or normal wall panel by suitable fastening members **34** and by gluing.

The building construction system is particularly adapted for multiple story construction and FIG. **10** illustrates a joint between upper and lower exterior wall panels at an intermediate floor panel. Grooves or ways **36** and **37** are formed in upper and lower face members, **38** and **39** respectively, of the intermediate floor panel to receive spline members **40** and **41** respectively. The spline members **40** and **41** are each secured in the ways **36** and **37** and between the face members of the upper and lower wall panels, as by nailing and gluing, as previously described. A facia member **42** is secured in covering relation to the upper and lower wall panels and to the end of the respective intermediate floor panel.

When a sloping roof is desired for the building **1**, such as along side walls thereof, a nailer **43** is secured on an upper side of the ceiling panels along the side edges of the building **1**. The nailer **43** is cut to the desired slope and a suitable roof panel, such as a plywood panel **44** is secured to the nailer **43** in a conventional manner and suitable support members **44'** provide support for the panels **44** and a facia **45** is secured in position covering the edge of the ceiling panel and a spline member **46** therein. The panels **44** are covered with a suitable roofing material (not shown) to provide a finished structure.

Window and door framing is particularly easily installed at the factory wherein each framing member **47** has a way or groove **48** formed therein to receive a spline member **49** which is glued in the way or groove **48** and suitable fastening members, such as nails or screws **50**, secure the spline member **49** to the face members of the respective wall panel.

The building construction system is particularly designed to permit plumbing and electrical conduits to be installed at the factory wherein the plumbing and electrical conduits are positioned between the face members **6** and **7** of the respective panels. Suitable holes may be pre-cut or pre-drilled at selected positions in respective floor, wall, and ceiling panels and in respective face members of the panels for various fixtures, switches and the like.

The face members of the respective panels are particularly easy to finish in any selected manner, such as painting or decorative paper for exposed interior surfaces of walls and ceilings. Exposed interior floor surfaces are particularly adapted to be painted, receive suitable floor covering, such as asbestos or vinyl tile or carpeting. Exterior wall surfaces may be painted or have a suitable siding applied thereto and a masonry veneer may also be applied over exterior wall surfaces. However, it is noted that the tight joints formed at exterior corners and at floor and ceiling panels, as previously described, do not require covers, such as battens, siding, masonry veneers, or the like.

It is to be understood that while I have illustrated and described one form of my invention, it is not to be limited to this specific form or arrangement of parts herein described and shown.

What I claim and desire to secure by Letters Patent is:

1. A building structure comprising:

a. a plurality of connected walls;

b. a plurality of generally rectangular panels in each of said walls;

c. each of said panels being of laminated construction and having outer layers of plywood in parallel relation and spaced laterally of each other;

d. an inner layer of rigid synthetic resin foam between said outer layers with the adjacent surfaces of the inner layer and outer layers bonded together, the thickness of the laminated panel being the wall thickness;

e. said panel having a thickness in the nature of 3 ¾ inches with the total thickness of plywood being greater than the thickness of the inner layer with each of said panels being of a load bearing structure;

f. a panel in one wall having a groove in a portion of an outer layer, said outer layer being engaged on each side of said groove by edges of outer layers of an adjacent panel in a second wall connected thereto;

g. said inner layer of each panel having side and end edges spaced inwardly of the respective side and end edges of the outer layers;

h. wood members filling the space between the outer layers of one panel at adjacent edges of panels of a wall and having a projecting portion engaged between outer layers of a next panel with said wood member bonded to the panels by adhesive;

i. fastening means extending through certain outer layers and into the wood member to further secure the panels together in a keyed, bonded relation whereby the entire building acts as a structural unit;

j. a wood member filling the space between the outer layers of said adjacent panel of the second wall at the edges engaging the panel of said one wall and having a projecting portion engaged in said groove with said wood member bonded to the panels by adhesive.

2. A building structure as set forth in claim **1** wherein:

a. said panels have a thickness in the nature of 3 ¾ inches;
b. said outer layers of plywood have a thickness in the nature of 1 ⅛ inches; and
c. said inner layer has a thickness in the nature of 1 ½ inches.

3. A building structure as set forth in claim 1 wherein:
a. said panels of a wall are in edge to edge relation;
b. said wood member is a spline member between edge portions of said outer layers of each of said panels to be keyed together in a wall; and
c. said fastening means extend through one of the outer layers of each panel and through said spline member and at least into the other outer layer of each of said panels to thereby key and secure the adjacent panels together.

4. A building structure as set forth in claim 1 wherein said walls include floors and upright walls and ceilings formed of said laminated panels and including:
a. a groove in an upper outer layer of the panels of the floor;
b. a lower edge of the upright walls having a recess defined by the spacing of a lower edge portion of said inner layer upwardly of edge portions of said outer layers thereof;
c. a wood member being received in said groove of the floor panel and positioned in said recess between edge portions of said outer layers of the panels of the respective upright wall and forming a spline member;
d. fastening members extending through said spline member and into at least the outer layer of the panels of the floor having said groove therein; and
e. elongate support members under the panels of the floor and having supporting engagement therewith only at ends of said floor panels.

5. A building structure as set forth in claim 1 wherein said walls include floors and upright walls and ceilings formed of said laminated panels and including:
a. a groove in an outer layer of the panels of the ceiling;
b. an upper edge of said upright walls having a recess defined by the spacing of an upper edge portion of said inner layer downwardly of edge portions of said outer layers thereof;
c. said wood member being received in said groove of the ceiling panel and positioned in said recess between edge portions of said outer layers of the panels of the respective upright wall and forming a spline member; and
d. fastening members extending through said spline member and into at least the outer layer of the panels of the ceiling having said groove therein.

6. A building structure as set forth in claim 1 wherein said walls include floors and upright walls and ceilings formed of said laminated panels and including:
a. said panels of each of the upright walls at exterior corners of the building structure having a recess defined by the spacing of an upright edge portion of said inner layer of said corner panels inwardly of edge portions of said outer layers thereof;
b. a wood member in each of said recesses between edge portions of said outer layers of the corner panels of each of the upright walls at exterior corners of the building structure, an edge of one wood member engaging a side of the other wood member;
c. one outer layer of each corner panel forming an exterior building member and extending beyond the respective wood member to engage the said one outer layer of the other corner panel;
d. fastening members securing each wood member in the respective panels and securing the panels to the wood member in the other wall;
e. the engaging portions of the wood members and the engaging portions of the outer layers of the panels being secured together with adhesive.

7. A building structure as set forth in claim 1 wherein said panels are adapted for tongue-and-groove joining with adjacent panels and a certain edge of one of said outer layers has a tongue extending therefrom for substantially the length thereof and the same edge of the other outer layer of said panels having a tongue receiving groove.

* * * * *