June 2, 1942. R. L. SPEED 2,284,927

UNITARY STRUCTURAL SYSTEM

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Fig. 2.

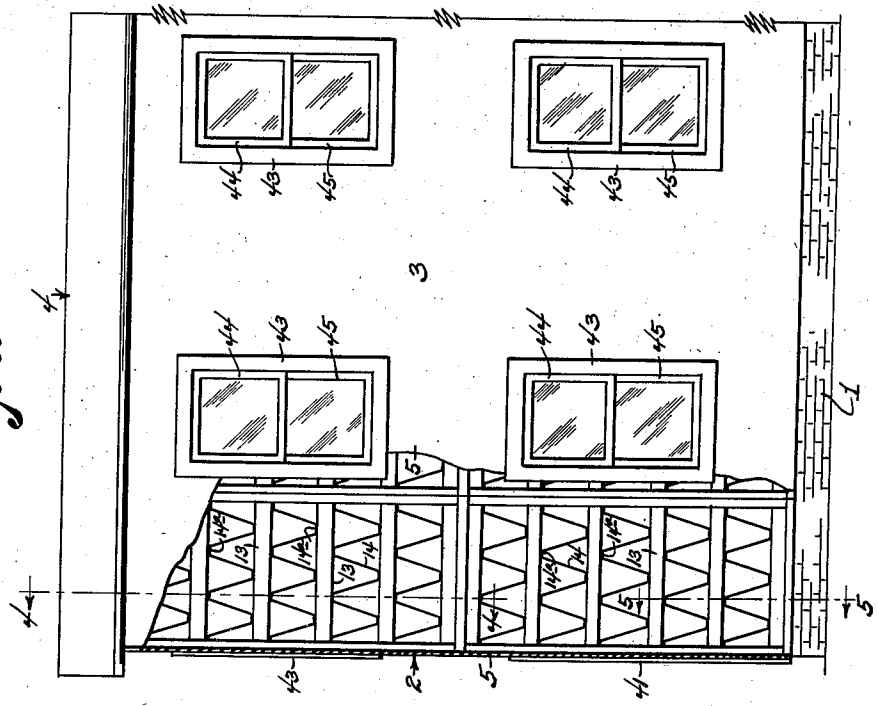
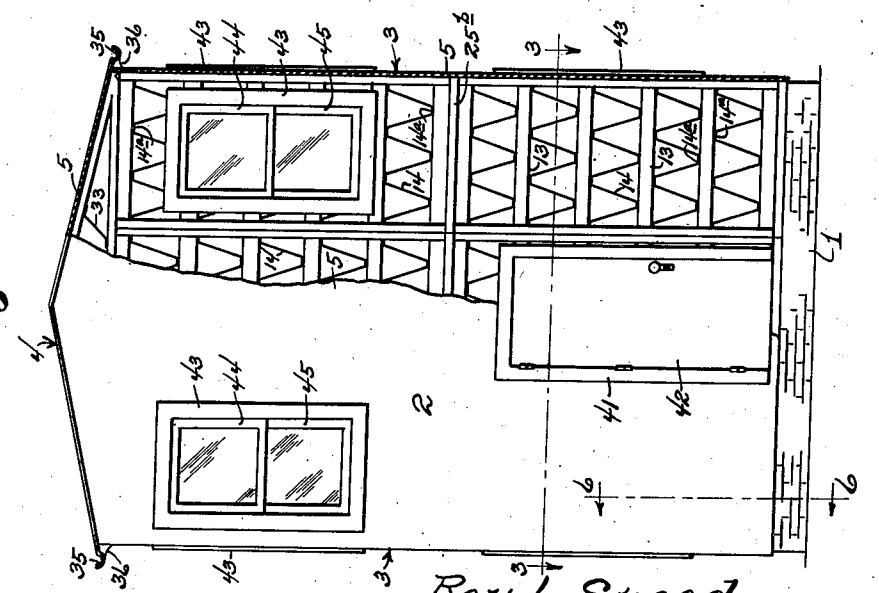


Fig. 1.



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June 2, 1942. R. L. SPEED 2,284,927

UNITARY STRUCTURAL SYSTEM

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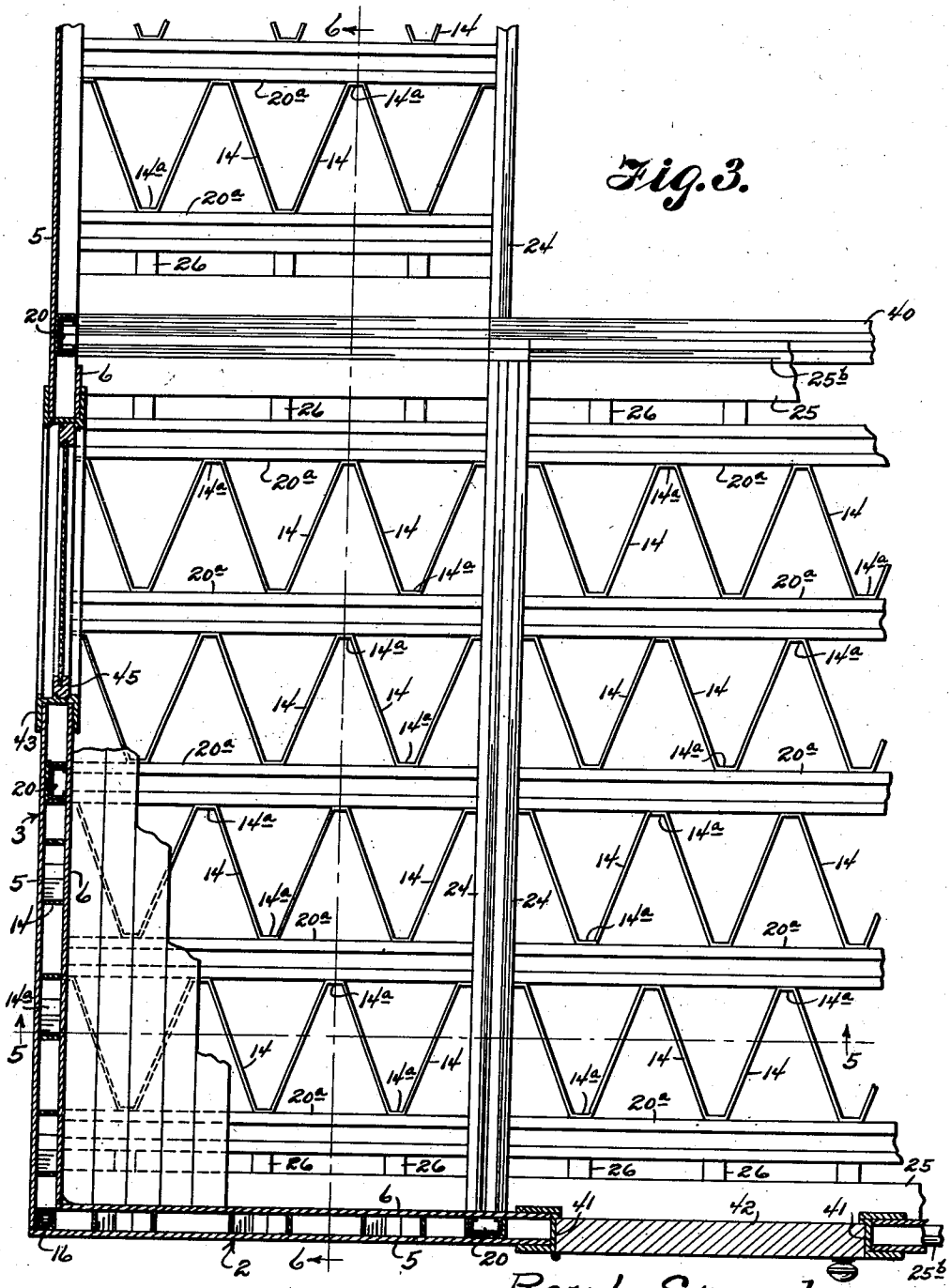
Fig. 3.



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UNITARY STRUCTURAL SYSTEM

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Fig. 4.

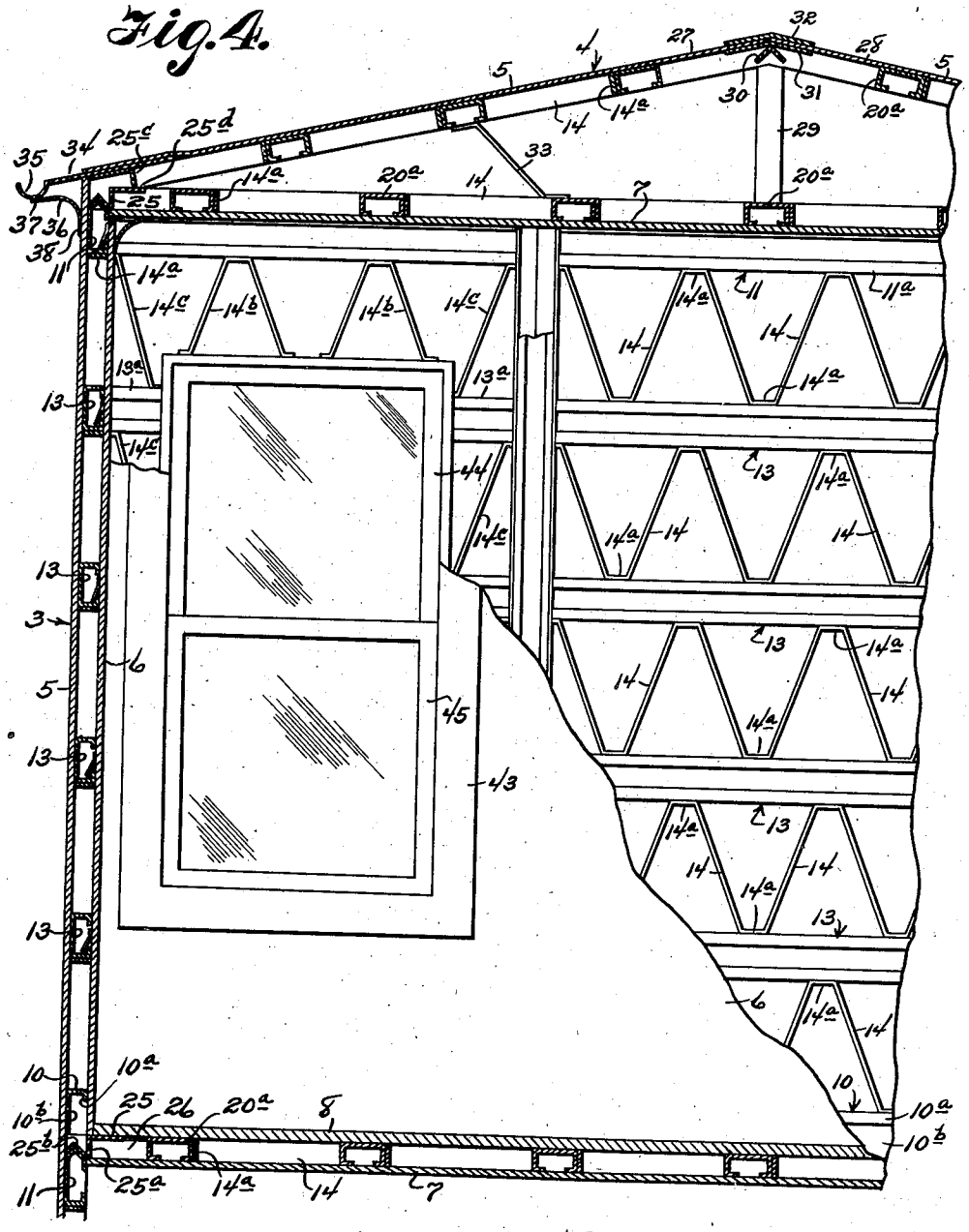
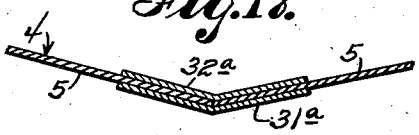


Fig. 18.



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UNITARY STRUCTURAL SYSTEM

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Fig. 5.

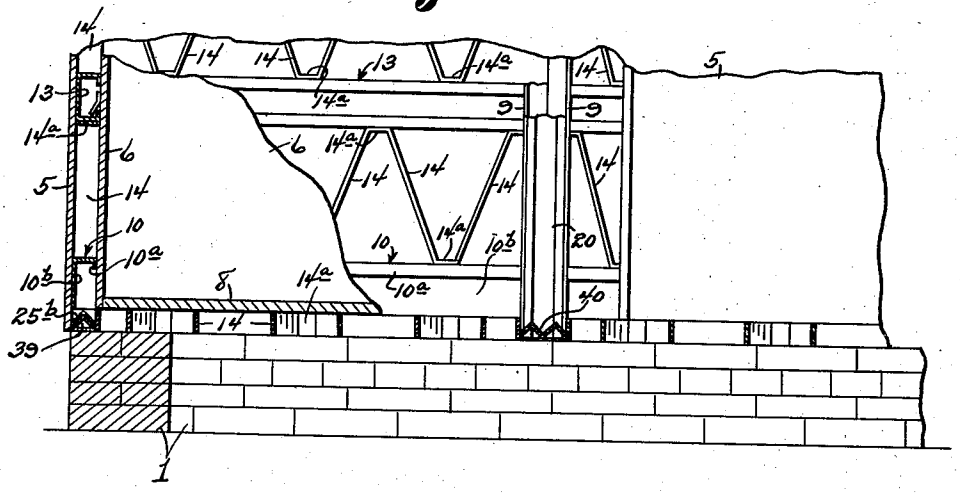

Fig. 6.

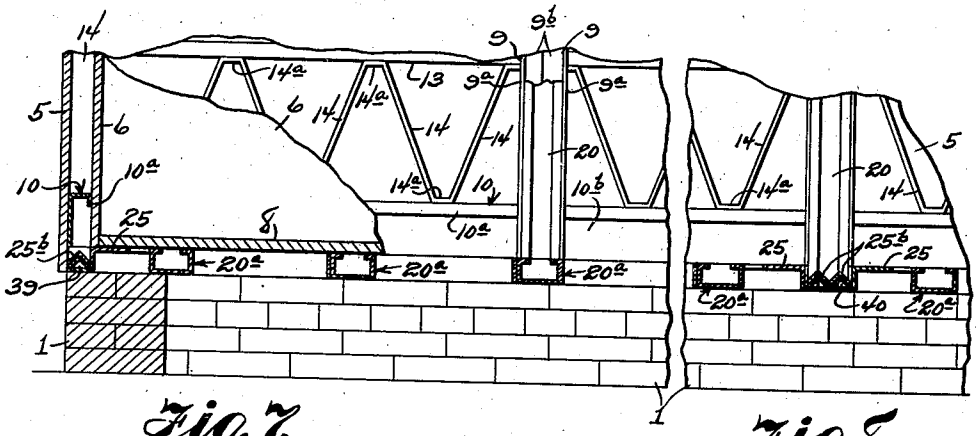

Fig. 7.

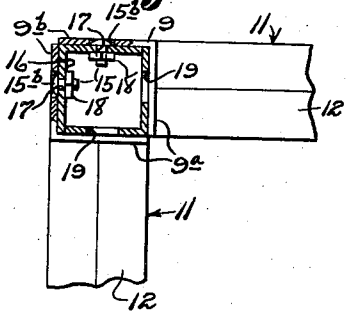

Fig. 8.

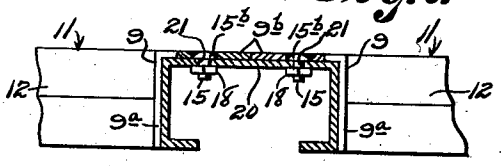

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Fig. 9.

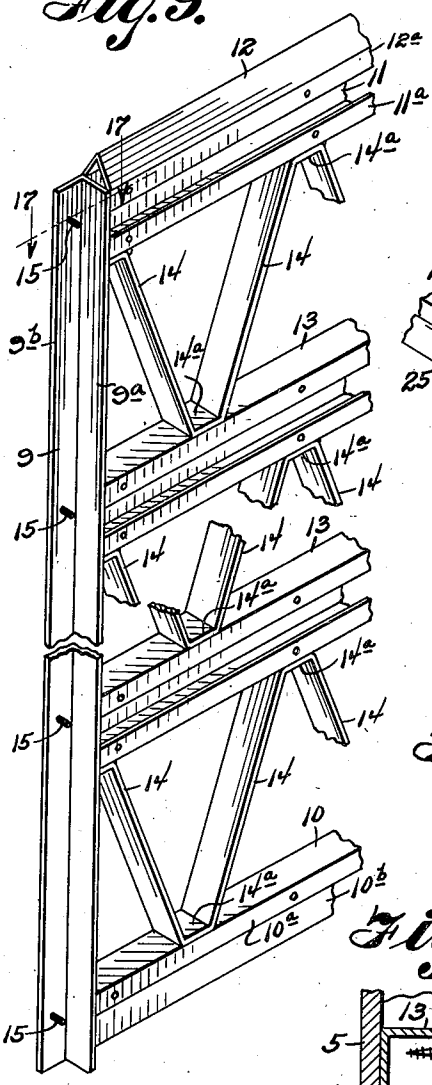


Fig. 17.

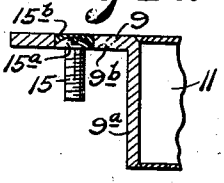


Fig. 10.

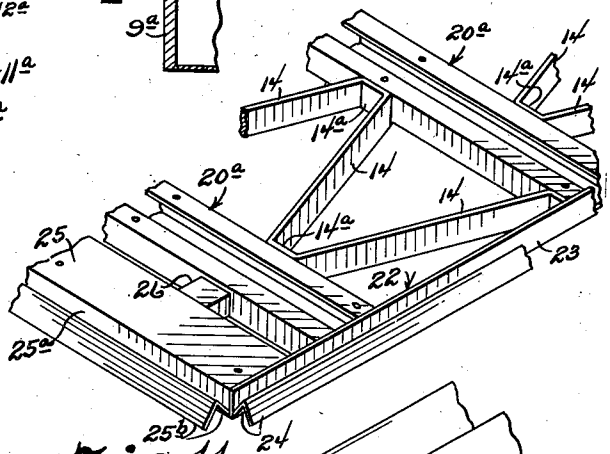


Fig. 11.

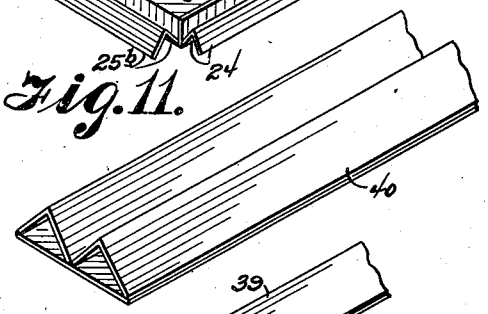


Fig. 12.

Fig. 14.

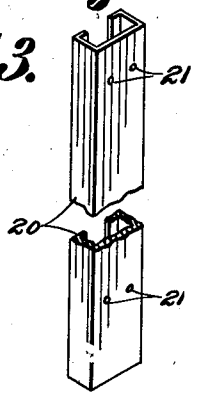


Fig. 13.

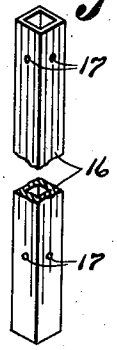


Fig. 16.

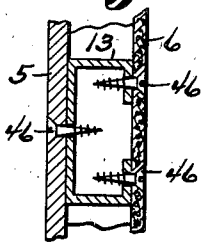
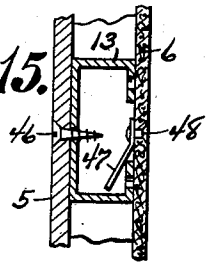


Fig. 15.



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Patented June 2, 1942

2,284,927

UNITED STATES PATENT OFFICE

2,284,927

UNITARY STRUCTURAL SYSTEM

Roy L. Speed, San Francisco, Calif.

Application November 4, 1940, Serial No. 364,310

4 Claims. (Cl. 189—34)

This invention relates to unitary, metal panel, building structure systems and has for its prime object to improve generally upon such structural systems and more particularly in the simplification of the several units in the respective structural fabrications thereof whereby to minimize weight without detracting from the rigidity, strength and durability of the several units.

A particular object is to produce a system of interfitting and interchangeable panel units and cooperative supporting frame and connector elements for ready assemblage in side wall, floor, ceiling and roof construction, not only in buildings in general to be used as dwellings, or for public use, commercial or other purposes, but also for the construction of many other utilities of various constructions and arrangements too numerous to here describe in detail.

Other objects and advantages to be attained will hereinafter more fully appear.

The invention consists in the general structure and in the particular parts and combinations and arrangements of parts as hereinafter described and finally defined in the appended claims, reference being had to the accompanying drawings illustrating a practical adaptation of the invention, in which,

Figure 1 is a view, partly in front elevation partly in transverse vertical section, illustrating a two story building erected in accordance with the invention;

Figure 2 is a view, partly in side elevation and partly in longitudinal vertical section, of the same building shown in Figure 1;

Figure 3 is a horizontal section, on an enlarged scale, and somewhat fragmentary in character, the section being taken on or about the line 3—3 of Figure 1;

Figure 4 is a fragmentary vertical section of the upper story portion of the building illustrated in Figures 1 and 2, on an enlarged scale, and the section being taken on or about the line 4—4 of Figure 2;

Figure 5 is a fragmentary section, on an enlarged scale, taken on or about the lines 5—5 of Figures 2 and 3;

Figure 6 is a view similar to that in Figure 5, but the section being taken at right angles thereto, on or about the lines 6—6 of Figures 1 and 3;

Figure 7 is a fragmentary, detailed view, partly in top plan and partly in horizontal section, illustrating a tubular corner post element of square cross section and illustrating the manner of attaching side wall panel units thereto;

Figure 8 is a view similar in character to that of Figure 7, but showing a channeled intermediate side wall post or studding element and the manner of attaching the meeting rightangular end portions of two adjoining side wall panels thereto;

Figure 9 is a fragmentary perspective view illustrating a side wall panel frame structure;

Figure 10 is a fragmentary perspective view illustrating the structural details of a floor or ceiling panel frame;

Figure 11 is a fragmentary perspective view illustrating a double spar or joist or girder element;

Figure 12 is a view similar to Figure 11, but showing a single spar, joist or girder element;

Figure 13 is a foreshortened perspective view of a square corner post element;

Figure 14 is a view similar to Figure 13, but showing a channeled intermediate side wall post, or studding element, the form of which is the same as that of the intermediate horizontal elements of the respective panel frames;

Figure 15 is a fragmentary sectional view illustrating one method of attaching the side wall, floor and ceiling plates or sheets to the channeled intermediate panel frame elements or the similarly formed side wall uprights, as the case may be;

Figure 16 is a view similar to Figure 15, but showing a different method of attaching the plates or sheets to the channeled element;

Figure 17 is a fragmentary section, on an enlarged scale, taken on or about the line 17—17 of Figure 9; and

Figure 18 is a fragmentary sectional view illustrating a seam formation where two downwardly sloping roofing plates or sheets meet at the bottom of the valley between two adjoining hipped roof sections in a multiple hip roof structure.

Referring now to the drawings in detail, and first more particularly to Figures 1 to 6, inclusive, the numeral 1 designates a conventional building foundation of brick or other masonry, and the numeral 2 designates, generally, the finished front wall, as a whole, of the building, and the numeral 3 likewise designates the finished side wall of the building, while the numeral 4 similarly designates the roof.

The front wall 2, side walls 3 and roof 4 each includes an outer covering of plates or sheets 5 of any suitable material, either metallic, wooden, compressed fibre or other conventional, approved and well known composition, said covering being applied over and suitably fastened to special unitary, metal, open frame, panel units to be later

more fully described in detail. The front and side wall panels, as shown more clearly in Figures 3 to 6, inclusive, are also covered with interior lining or facing plates or sheets 6, and the roofing panels and upper floor panels of the structure are covered on their under sides with ceiling plates or sheets 7. So, too, in this connection, it is here also noted that both the bottom and the upper floor panel units are covered on their top sides with any suitable flooring material 8. The manner of fastening the wall, ceiling and flooring plates or sheets to the several panel frames will be later more fully described.

The front and side wall panel unit frame structure will be now described. In this connection, it is first pointed out that the several panels are made in different standard unitary sizes and each unit separately fabricated at the factory in many different sizes to suit the requirements in the construction of buildings and other utilities of different characters, sizes and uses. It is here further pointed out that there are obviously plain panel units and certain other units which are provided with either door or window frames, and associated adjuncts, but as to marginal structure and general framing the several panels are identical, this for the interfitting changeability of the several panels the one with the other in whatever part of the building structure they are placed in the assembly.

As shown more clearly in Figure 9, each wall panel unit is of general rectangular form and comprises vertical longitudinal side margin frame members 9 which are of plain rightangular cross section, that is to say, said members 9 are of ordinary commercialized L-shape. The vertical frame members 9 are rigidly connected by bottom cross members 10, also of L-shape, but the horizontal leg of the member 10 being at the top thereof and extended inwardly and having its inner margin reflanged, as at 10a, and the other leg 10b of said member 10 being of greater width than the horizontal leg thereof and disposed at the outer side of the panel.

The upper end portions of the vertical frame members 9 are rigidly cross-connected by a channel member 11, the opening of which is at the inner side of the frame, the bottom flange of the channel member 11 being marginally reflanged, as at 11a, and the upper flange of said member 11 being formed in inverted V-shape, as at 12, to provide a sharp ridge extending lengthwise at the top of the panel frame, and said ridge portion being marginally reflanged, as at 12a, in the same vertical plane as the underlying reflanged portion 11a of said member 11.

At places intermediate the bottom and top cross members 10 and 11, the vertical members 9 of the wall panel frame are rigidly cross-connected by plain rectangular channel members 13 whose openings are at the inner side of the panel like the member 11, and it is here noted that the fastening together of the frame members 9, 10, 11 and 13 may be obviously effected by a welding process or any other known and approved means.

Preferably, as shown, the wall panel frame is trussed and stiffened by zigzag latticework 14, the flattened portions 14a thereof, between the inclined transverse portions, being welded or otherwise secured to the horizontal frame members 10, 11 and 13. It is here further noted that the respective vertical frame members 9 have one of their flanged or leg portions 9a fastened to the ends of the horizontal frame members 10, 11 and 13, and the other flanged or leg portion 9b thereof being extended perpendicularly in the plane of the outer side of the panel frame, this for the attachment of the panel frame to either a corner post of the building frame or to an intermediate post or studding element in the front or side wall structure. So, too, in the same connection, the outer flanges or leg portions 9b of said vertical panel frame members 9 are preferably provided with integral, inwardly projecting, screw-threaded studs 15 which are respectively positioned so as to enter apertures provided therefor in the vertical corner or intermediate posts or studding elements which will be next described.

As shown more clearly in Figures 7 and 13, the corner posts or studding elements, designated by the numeral 16, are of square cross section, and the same are made in standard unitary lengths, some of which are long enough to extend from the building foundation to the roof framing unit or units to be later more fully described, or, in some structures of more than one story, other posts or studding elements will be of a length to extend only approximately the height of each story and being superimposed in vertical alinement one upon another.

As shown in Figure 7, but more clearly in Figure 17, the respective above described screw-threaded studs 15 are provided with heads 15a which are received and welded securely, as at 15b, in apertures provided therefor in said frame member flanged portion 9b. Obviously, however, the studs 15 may be otherwise fixedly attached to the flange 9b in any approved conventional manner.

The apertures in the corner post 16 for the reception of the screw-threaded studs 15 are designated by the numeral 17 (see Figures 7 and 13) and, as shown in Figure 7, nuts 18 are tightened on the studs 15 against the adjacent inner face portions of the walls of the post 16, thereby clamping the flange portion 9b of the panel frame member 9 to the opposed wall of the post and also holding the other flange 9a of the frame member 9 against the adjacent rightangular wall of the post. For convenient access to the interior of the corner post 16, for the placing and tightening of the nuts 18 on the screw-threaded studs 15, the opposite wall portions of the post are provided with openings 19 of ample size for the placing of the nuts 18 and the application thereto of a wrench or manipulating tool.

In Figures 8 and 14, intermediate vertical wall posts or studding elements 20 are illustrated, said elements being of plain, rectangular, channeled cross section, and the opening of the channel being inwardly as with the channeled panel frame members 11 and 13, these intermediate channeled posts or studding elements 20 being apertured, as at 21, for the reception of the screw-threaded studs 15 of the meeting flange portions 9b of the vertical panel frame members 9 which are joined to the posts or studding elements 20 as shown in Figure 8 and in substantially the same manner as in the corner post attachment of the panels 11 in Figure 7. In this connection, it is here noted that the longitudinal opening of the channeled post or studding element 20 affords ready access to the studs 15 for the placing and tightening of the nuts 18 thereon.

The frame structure of the floor and ceiling panels will now be described. As shown, and more clearly in Figure 10, these frames are of general rectangular form and of substantially the same body structure as the hereinbefore de-

scribed wall panel frames, except as to the marginal portions of the structure. That is to say, the several floor and ceiling panel frames each includes a plurality of intermediate transverse channel members 20a which are identical in cross-sectional form as the hereinbefore described intermediate wall posts or studding elements 20, said transverse elements 20a being rigidly attached at their ends to longitudinal side members 22 having flat strip portions 23 and integral, inverted V-grooved, laterally projecting, flange portions 24 extending along the lower margins thereof.

The channeled transverse members 20a of the floor and ceiling panel frames are braced by zigzag lattice-work 14 the same as in the wall panel units hereinbefore described. However, the floor and ceiling panel frames differ in end structure from the wall panel frames, in that, in the floor and ceiling panel frames, the end members 25 thereof are of an L-shape in cross section, that is to say, as to the main body portion thereof (see Figures 4, 6 and 10) wherein one flange thereof (the wider) is uppermost and horizontal, while the other flange 25a (the narrower) is vertically disposed and is provided at its lower margin with an integral, inverted V-grooved, laterally projecting, flange portion extending the length thereof, as at 25b. These end members 25 are welded or otherwise rigidly attached at their ends to the adjacent end portions of the frame side members 22. So, too, in addition to the latticed bracing 14 of the frame structure, short longitudinal strut pieces 26 are interposed between the vertical flange portions 25a of the end member 25 and the next adjacent channeled cross members 20a of the frame, said members 26 being welded or otherwise rigidly secured to said frame member 20a and to both flanges of the end member 25 whereby to further reinforce and stiffen the structure.

The panel units for floors and ceilings are identical in structure except as to a minor feature which is not always carried out, and in some structures the panels used may be precisely identical, that is to say, for ceilings and upper floors the channeled cross members 20a of the panel frames may be inverted as shown in Figure 4, or, in other words, with the opening of the channel at the bottom of the frame, whereas, as shown in Figure 6, the transverse channel members 20a of the panel frames which rest on the foundation and carry the lower floor have their openings at the tops of the frames.

For a flat-roofed structure the roofing plates or sheets 5 thereof may be obviously laid directly on top of the topmost ceiling panel frames. However, for a hip roof as shown in Figures 1, 2 and 4 a special roof unit is provided. As shown more clearly in Figure 4, the roof unit includes a base panel frame such as that hereinbefore described and as illustrated in Figure 10, with a superstructure comprising a hipped frame sloping downwardly, as at 27 and 28, on opposite sides of its middle which is supported by vertical struts 29 (see Figure 4) whose lower ends rest upon and are rigidly secured to the underlying transverse channel member 20a of the ceiling frame proper.

In general respects the hipped frame structure is substantially identical with that of the ceiling frame proper, that is to say, it comprises a plurality of the transverse inverted channel members 20a, latticed bracing 14, and L-shaped end members 25c which are similar to the end members 25 of the ceiling frames proper except that they are not provided with the inverted V-grooved marginal portions 25b, the depending flange portion of the member 25c being welded or otherwise rigidly secured to said end member 25 of the ceiling frame proper, as at 25d.

At the middle of the hipped roof frame is a rigid transverse member 30 of inverted V-shape in cross section, above which is a supporting plate 31 which slopes on opposite sides of the ridge of the member 30, both of said members 30 and 31 being welded or otherwise rigidly secured at their ends to the side members of the hipped roof frame. The member 31 affords a support for the meeting ends of roof plates or sheets 5 which rest thereon and are firmly secured thereto, and over the seam is placed a water-shedding strip 32 which is suitably secured to the underlying portions of the roofing plates or sheets 5. In this connection, it is here noted that in cases where the roofing plates or sheets 5 and the supporting member 31 and covering member 32 are made of thin gauge sheet metal, or even certain fibrous materials or compositions, conventional sheet metal fastening screws or threaded nails may be driven through the assembled parts to provide the necessary fastening, or, obviously, the fastening may be effected by welding or any other approved conventional means. It is here further noted that diagonal bracing such as that indicated at 33 may be provided between the ceiling frame portion and the hipped roof framing of the structure, as shown in Figure 4, or, if desired, the hereinbefore described zigzag latticed bracing 14 may be employed.

As to the roof structure, it is preferable to provide a special integral eaves or cornice and gutter element 34 (see Figure 4) the same being formed of sheet metal with a portion thereof of sufficient width to underly the outer marginal portion of the roofing plate or sheet 5 and extending a considerable distance beyond the side wall of the structure and formed at its outer margin with a gutter 35. To brace the outer portion of the element 34 an arcuate bracket plate 36 is welded or otherwise secured at its upper margin to the under side of the gutter portion of the element 34, as at 37, and has its opposite marginal portion secured to the adjacent outer face of the wall plate or sheet 5. By this provision, the overlapped portion of the roof plate or sheet 5 makes for an effective shedding of the water at the eaves and at the same time the arcuate bracket plate 36 affords a stable support for the gutter and cornice or eaves extension.

Special spar, joist or girder elements are provided for a building structure in accordance with the invention, said elements being shown on a larger scale and in detail in Figures 11 and 12, there being two types of these elements, one hereinafter referred to as a "single spar" and designated by the numeral 39 and the other as a "double spar" and designated by the numeral 40, the double spar being shown in Figure 11 and the single spar in Figure 12. These elements are preferably made tubular, of sheet metal and of triangular cross-sectional form, that is to say, one side thereof constitutes a flat bottom so as to rest either flatwise and lengthwise of a brick or other foundation, or, by their triangular tubular form they possess ample rigidity to be self-supporting and load-supporting when placed with their opposite end portions on supporting

foundations and spanning the space therebetween. With the spars placed in either way mentioned, and their body ridges upward, the V-grooved marginal portions **24** or **25b** of the floor or ceiling panel frames are received over the ridged body portions of said spars **39** or **40**, as the case may be. It is here noted that the single spars **39** are utilized usually in lengthwise disposition on a foundation, and, thereby, receive and support only the outer marginal portion of each floor and celing panel frame having its V-grooved end or side portion seated thereon, it being understood that the double spars **40** are utilized to support the meeting V-grooved end or side portions of two adjoining panel sections in the assembly, and it being further understood that in use certain double spars are more generally employed as joists or girders supported at their ends on opposite foundation walls and spanning the space therebetween, rather than being disposed lengthwise on a foundation wall, although that is possible in some structures.

The peculiar form of the spars **39** and **40** and the counterpart marginal grooving of the floor and celing panel frames affords a substantial cross tie between the side walls of the building structure, and, in this connection, it is further noted that the same effect is attained in a building of two or more stories, inasmuch as the side walls of the upper story are substantially cross-tied because of the provision of the special cross members **11** of the wall panel frames which have the top ridges **12** to receive the marginal inverted V-grooves **24** and **25b** of the respective upper floor and ceiling panel frames. This last mentioned provision of the wall panel frames and the corresponding inverted marginal V-grooved portions of the roof unit, whether the same be for a plain flat roof or a hipped roof, also affording a stable and safe cross tie at the uppermost portion of the building.

As hereinbefore stated, the several wall panel frames are identical except as to such panels which are provided with door or window frames. This is illustrated in Figures 1 to 4, inclusive, wherein a door frame **41** with a door **42** provided therein is installed in the building structure and several window frames **43** provided with upper and lower sashes **44** and **45**, respectively, are also installed.

In the particular panel sections where the door or window frames are installed, certain of the transverse channeled frame members **13** are removed for the accommodation of the door frame or the window frame, as the case may be, and only short members **13a** are provided as struts between the vertical side members of the door and window frames and the adjacent vertical L-shaped side members of the panel frame. So, too, different latticed bracing elements **14b** and **14c** are substituted in place of the other hereinbefore described latticework **14**.

In applying the outer wall plates or sheets **5** and the inner wall plates or sheets **6** to the respective wall panel frame members **10**, **11** and **13**, conventional sheet metal screws **46** may be used, as shown in Figure 16, or, obviously, special or conventional nails may be used, which means of fastening may be also utilized throughout other parts of the structure in applying the plates or sheets **5** and **6**, as well as in fastening panel frames and other parts in the building structure assembly as a whole. However, as shown in Figure 15, the inner wall plates or sheets **6** may be provided with inclined clips or tongues **47** of relatively stiff material yet possessing a certain amount of inherent resiliency whereby said clips may be sprung slightly away from the plate or sheet **6** from the place of attachment **48** when the plate or sheet is placed against the channel member **13** and moved forcibly downward to catch the tongue **47** over the lower reflanged portion of said member **13**, thereby wedging said reflanged portion between adjacent portion of the plate or sheet **6** and the overhanging tongue **47**.

As to a roof construction in accordance with the present invention, it is here pointed out that the general hereinbefore described special hipped framing may be utilized in a multiple hipped roof by joining two or more of the unitary frames, in which case, obviously, an under plate **31a** may be provided at the bottom of the valley where the lower marginal portions of the downwardly sloping cover plates or sheets **5** meet, which under plate will be applied similarly as the hereinbefore described supporting ridge plate **31** except that this valley seam under plate **31a** will be obviously bent the reverse of said ridge supporting plate **31**, or, in other words, in the form of a gutter of angular cross section. So, too, if desired, a cover plate **32a** may be applied over the roof valley seam like the hereinbefore described plate **32** is provided in the structure shown in Figure 4, but, of course, in reversed bent form and corresponding to the aforesaid underlying gutter plate **31a**, this feature of the invention being illustrated in Figure 18 of the drawings.

In the general adaptations of the present invention, particularly in building structures of the character illustrated in the accompanying drawings, the several wall, floor and ceiling panel frames will be covered with either outside or inside plates or sheets, or both outside and inside coverings, in which latter cases the space between the outside and inside covering may be left vacant for ventilation if provision is made for air circulation therein, or, for insulation against heat transfer, that is to say of exceedingly high or exceedingly low temperature, all openings for air circulation will be shut off so that the spaces between the outer and inner covering will be dead air spaces. So, too, in some uses of the present invention, the space between the outer and inner wall plates or sheets and also the space between the flooring material and the underlying ceiling material may be filled with conventional or any approved commercial fibrous or other insulation materials. Furthermore, in some uses of the invention, the wall, floor and ceiling panel frames may be filled in with a suitable cementitious or plastic material which sets and hardens, while in other uses where an open frame structure is built, such as a sun shelter, arbor or trellis and the like, no inner or outer wall panel coverings will be provided. Also, as herein first described, the several panel frames and cooperative adjuncts are adaptable in the construction of many devices or utilities other than the specific building structures herein described and illustrated in the drawings.

While the structure as illustrated and herein described embodies a practical adaptation of the invention, it is understood that considerable modification and alteration is permissible within the spirit and scope of the invention as defined in the appended claims. The invention, therefore,

is not limited to the specific construction and arrangement shown.

What is claimed is:

1. In a unitary structural system for buildings and other utilities, a panel unit comprising an open, generally rectangular, frame including L-shape longitudinal side members; an L-shape transverse member rigidly connecting said side members of the frame at one end thereof; a channeled transverse member rigidly connecting said side members of the frame at the opposite end thereof, said channeled transverse member having its outermost flange portion formed V-shape in cross section to provide a sharp ridge extending the width of the frame between the side members thereof and projecting beyond the ends of said side members; channeled transverse members rigidly cross connecting said longitudinal side members of the frame at intervals between the said transverse end members of the frame; and trussing elements disposed between and rigidly connecting the respective next adjacent transverse end and intermediate members of the frame.

2. A panel unit for building construction, comprising a rectangular frame composed of L-shaped longitudinal side members, an L-shaped transverse member rigidly connecting said side members of the frame at one end thereof, a channeled transverse member rigidly connecting said side members of the frame at the opposite ends thereof, said channeled transverse member having its outermost flange portion formed V-shaped in cross section to provide a sharp ridge extending the width of the frame between the side members and projecting beyond the ends of the side members, transverse members rigidly cross connecting said side members between the said transverse end members, and trussing elements disposed between and rigidly connecting the respective next adjacent transverse end and intermediate members of the frame.

3. A panel unit for building construction, comprising a rectangular frame composed of L-shaped longitudinal side members, a transverse member rigidly connecting said side members of the frame at one end, a channeled transverse member rigidly connecting said side members of the frame at the opposite ends thereof, said channeled transverse member having its outermost flange portion formed V-shaped in cross section to provide a sharp ridge extending the width of the frame between the side members, transverse members rigidly cross connecting side members between the transverse end members, and trussing elements disposed between and rigidly connecting the next adjacent transverse end and intermediate members of the frame.

4. A panel unit for building construction, comprising a rectangular frame composed of L-shaped longitudinal side members, an L-shaped transverse member rigidly connecting said side members of the frame at one end, a channeled transverse member rigidly connecting said side members of the frame at the opposite ends thereof, said channeled transverse member having its outermost flange portion formed V-shaped in cross section to provide a sharp ridge extending the width of the frame between the side members and projecting beyond the ends thereof, transverse members rigidly cross connecting said side members between the transverse end members, and diagonal trussing elements disposed between and rigidly connecting the respective next adjacent transverse ends and intermediate members of the frame.

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