

Sept. 8, 1953

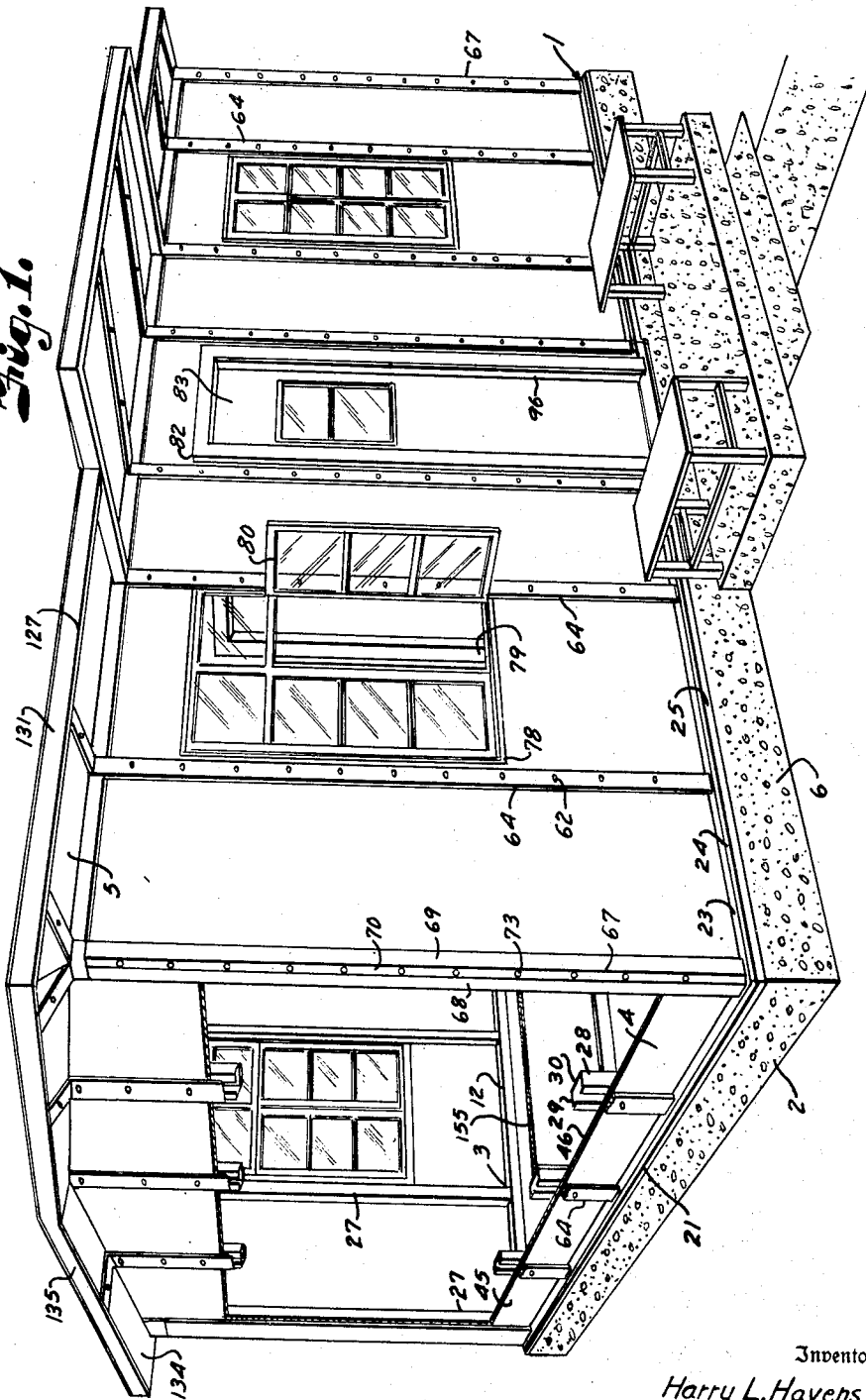
H. L. HAVENS
BUILDING STRUCTURE

2,651,391

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4 Sheets-Sheet 1

Fig. 1.



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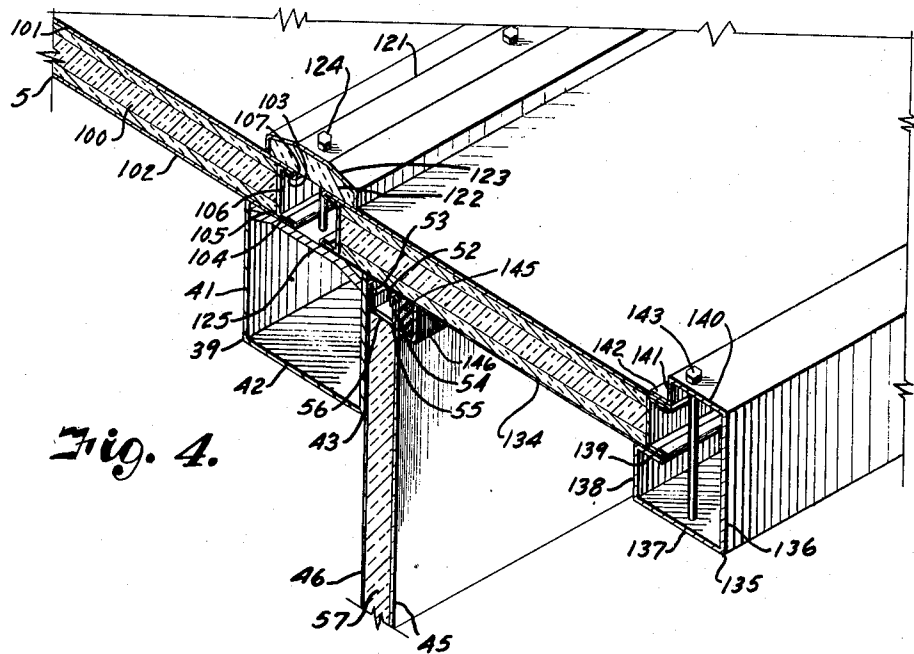


Fig. 4.

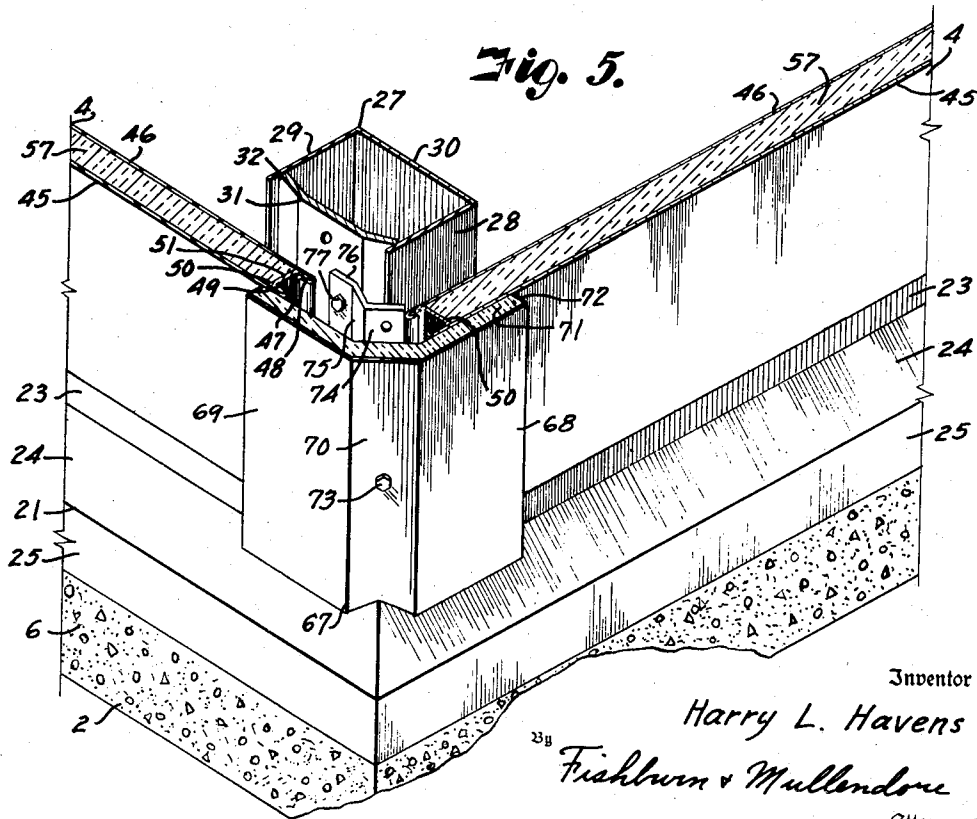


Fig. 5.

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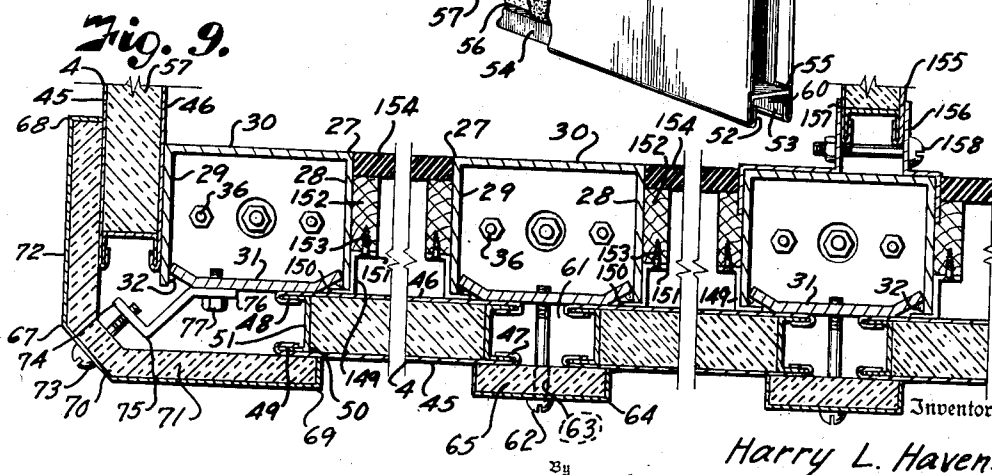
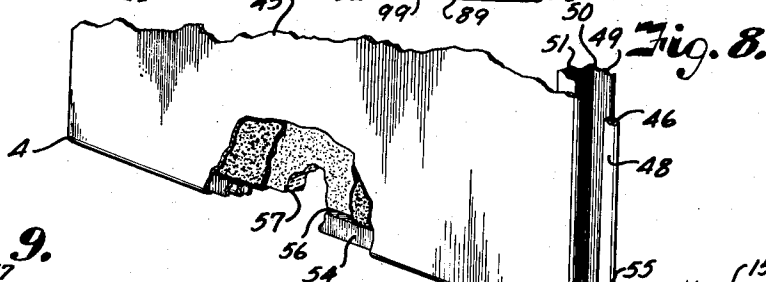
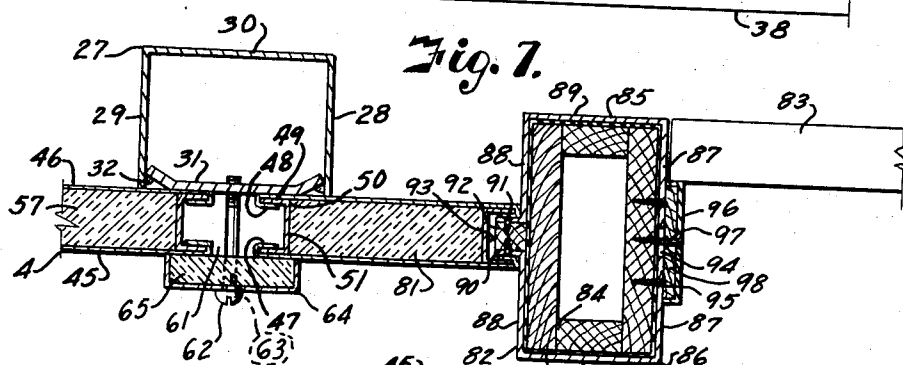
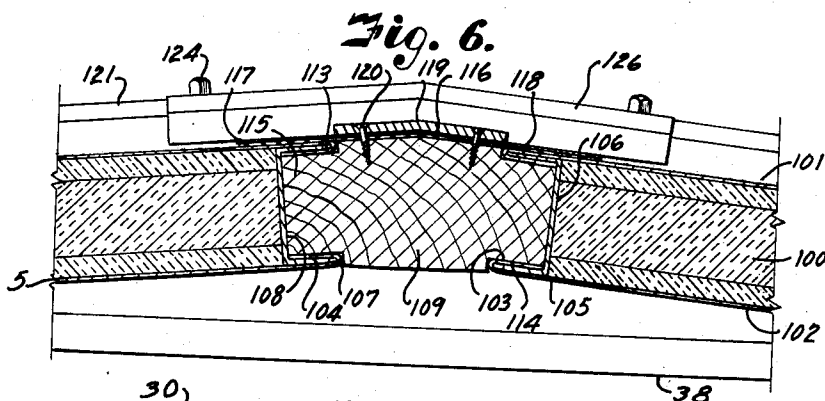
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UNITED STATES PATENT OFFICE

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BUILDING STRUCTURE

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1 Claim. (Cl. 189—1)

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This invention relates to a building structure and more particularly to an arrangement of insulated panels and structural members, prefabricated and assembled on the structure site to form a metal building.

Metal buildings, generally, are adapted for prefabrication and are considered portable in that they can be knocked down and assembled on other sites but modification of the floor plan usually requires replacement of some of the units because holes in the panels or framing destroy its use except for exact replacement in the same relative position of the building. There are many disadvantages in the conventional metal buildings. There is a tendency for the interior or portions thereof to sweat due to difference of temperature and transmission thereof from the exterior to interior surfaces and condensation of moisture thereon. Changes in surrounding temperatures effect expansion and contraction resulting in weakening the joints and the buckling of members forming the panels. Holes also are required in the building parts for accommodating fastening devices used in the erection of the building. Such holes prevent complete salvage of all the members and also make modification or alteration of the building difficult requiring replacement of some members instead of merely an addition of parts needed for extension or enlargement of the building or insertion of partitions therein.

The objects of the present invention are therefore to provide a metal building comprised of a plurality of standardized units easily and accurately assembled with all roof and wall panels held in place by friction; to provide a metal building assembled of prefabricated units, the panels of said building being free to expand and contract whereby the building may be said to be characterized by full floating walls and roof; to provide a metal building structure in which all joints are waterproof and transmission of cold or heat through the metal members from the exterior to the interior is retarded; to provide a metal building structure adapted for easy modification to partition or change the size of the building by mere addition or removal of the panels and frame involved without alteration of any unit; to provide standardized columns functioning in any portion of the building including the corners thereof; to provide a novel roof ridge member and joining of the roof panels therewith whereby the usual ridge cap is eliminated; to provide a novel structural mounting of both gutters and gable facia on the roof; to provide a building structure in which all units are re-

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usable; to provide a modular insulated metal building construction formed of prefabricated units that can be easily manufactured, transported and installed or moved and used in various building arrangements to easily erect a structure adapted for strong, efficient service under severe conditions such as varying temperatures and moisture.

In accomplishing these and other objects of the present invention I have provided improved details of construction, the preferred forms of which are illustrated in the accompanying drawings wherein:

Fig. 1 is a perspective view of the building constructed in accordance with the present invention, portions of the walls being broken away to show the arrangements of the parts therein.

Fig. 2 is a detail perspective of the wall and roof structure illustrating the mounting from the gutter thereon.

Fig. 3 is a detail perspective view of the lower portion of the building wall.

Fig. 4 is a detail perspective view of the end wall and roof structure illustrating the structure of the units and the mounting of the gable facia thereon.

Fig. 5 is a detail perspective of the lower portion of the walls showing the corner structure.

Fig. 6 is a transverse section through the ridge portion of the roof.

Fig. 7 is a horizontal sectional view through the door jamb and adjacent wall.

Fig. 8 is a partial perspective of a typical wall panel, portions being broken away to illustrate the structure thereof.

Fig. 9 is a horizontal sectional view through the walls illustrating the mounting of an inner wall.

Referring more in detail to the drawings:

1 designates a building erected with prefabricated units and generally consisting of a suitable foundation 2 and framing 3 for supporting prefabricated wall panel units 4 and roof panel units 5. The foundation 2 is preferably of suitable material such as concrete to form the floor of the building and is of a shape to conform substantially to the floor plan thereof, said foundation having suitable footings or other supports as in conventional practice. Located in the foundation and spaced inwardly from the edges 6 thereof are anchor bolts 7 having a threaded portion 8 extending upwardly from the upper surface of said foundation, the anchor bolts being arranged in alignment whereby they extend through openings in the bottom wall 11 of a column base 12. The column base is

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formed of sections arranged parallel to the outer edge 6 of the foundation and substantially on the inner side of the outer wall of the building. Suitable nuts 13 are applied to the threaded ends 8 of the anchor bolts to rigidly secure the column base to said foundation.

The column base 12 continues around the perimeter of the building except at door openings and is preferably of channel shape, formed of relatively heavy sheet metal and consists of a bottom wall 11 having an upwardly extending web 14 on the inner edge thereof, said web terminating in an outwardly directed flange 15, the outer edge of which is bent upwardly as at 16 to form a lip 17. The outer face of the lip 17 is preferably in alignment with an upwardly directed flange 18 on the outer edge of the bottom wall 11 and engages the inner face of a board or the like 19 arranged with the lower edge 20 resting on the foundation, said board being of suitable width whereby the upper edge is substantially in alignment with the upper edge of the lip 17 and of suitable thickness to cooperate with said lip in supporting a wall panel unit as later described.

A suitable water table 21 is preferably arranged around the foundation, said water table consisting of sheet metal formed to provide a flange 22 extending over the upper edge of the board 19, the outer edge of said flange being turned downwardly to form a vertical web 23 substantially engaging the outer face of the board 19. Approximately midway the height of the board 19 the lower end of the web is turned outwardly and downwardly to provide an inclined portion 24, the outer end of which terminates in a downwardly directed portion 25 which engages the outer edge 6 of the foundation and extends below the surface thereof. Suitable blocks or strips 26 of wood or other suitable material may be located on the foundation between the water table and the board 19 to support the inclined portion of said water table. Also suitable waterproof plastic or adhesive is preferably provided between the contacting faces of the column base, board 19 and water table 21. The sections of the column base and water table adjacent the corners of the building are suitably joined to provide a substantially waterproof construction. This arrangement makes a hollow column base adapted for enclosing pipes, wires, or the like, where arranging utility service in the portions of the building is desired.

Mounted on the column base 12 are a plurality of columns 27, said columns being spaced slightly more than the width of the wall panels later to be described. Said columns are arranged vertically and preferably are formed in a channel shape to provide flanges 28 and 29 connected by a web 30. The columns are mounted on the column base in such a manner that the web 30 forms the inner face and the flanges are directed outwardly, terminating in slightly spaced relation with the inner face of the lip 17, the spacing being such that a flange on the wall panels may be received therebetween as later described. The open portion of the channel is preferably closed by a plate 31 of such width that the sides edges of said plate substantially engage the inner faces of the flanges 28 and 29, the plate 31 being welded or otherwise suitably secured to the flanges of the column as to 32. The lower ends of the columns 27 are closed as by a bottom wall 33 welded to said column, said wall 33 having apertures therein aligned with apertures in the flange 15 of the

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column base whereby the column may be rigidly secured to the base by suitable fastening devices such as bolts 36. The wall 33 and flange 15 also have aligned apertures through which wires, pipes or other utility connections may extend.

The upper ends of the columns are suitably shaped for connection with rafters 38 and spandrels, the ends of which are aligned with and supported by the columns. The rafters slope upwardly toward the center of the building and are adapted for supporting a roof as later described. The rafters and spandrels are substantially the same in cross section as the column members. Extending between the columns and rafters aligned therewith are header members 39, the ends of said header members being suitably connected to the columns by bolts 40. The header members consist of an inner panel 41, extending downwardly from the upper edge of the rafters and terminate in horizontal portions 42 which extend to the outer edges of the columns. The outer edges of said portions 42 are turned upwardly as at 43, in coplanar relation with the outer edge of the column to form a wall 44 adapted to be engaged by the upper portion of the wall panels 4. This arrangement of the column bases, columns, rafters and connecting members suitably secured together form the framework of the building for supporting the wall panel units 4 and roof panel units 5.

Each of the wall panel units consists of spaced sheets 45 and 46 having a width slightly less than the spacing of the centers of the columns, the side edges being turned inwardly to form flanges 47 and 48 spaced from the respective inner faces of the panels sufficiently to form U-shaped seats adapted for insertion of flanges 49 of the side channel members 50 whereby the web 51 of said channels forms the connecting member enclosing the side edges of the panels. The end edges of the sheets 45 and 46 are turned to form flanges 52 and 53 spaced from the sheets to form U-shaped seats adapted to receive the flanges 54 of channels 55 whereby the webs 56 of said channels close the ends of the panel, the length of the sheets being such that when folded over the panel will be of sufficient length whereby the lower edge of the inner sheet engages the upper wall 13 of the column base and the upper edge is coplanar with the upper edge of the wall 44 on the header member 39. Located between the sheets 45 and 46 and substantially filling the space therein is a sheet of insulating material 57, the contacting surfaces of said insulating material sheets and channels being covered with a waterproof adhesive which preferably has some resiliency to provide adherency between the insulating material and the sheet during expansion and contraction thereof.

The wall panel units are placed in the building structure by inserting the lower edge of the inner sheet in the spacing between the lip 17 of the column base, at the outer edge of the flanges 28 and 29 of the columns, whereby the upwardly extending portion of the insulating board 19, lip 15 and upper portion of the water table are received in the groove 60 at the lower end of the panels, the side edges of said panels overlying the columns being arranged in spaced relation as at 61 to permit the passage of bolts 62 which extend through apertures 63 in astragals 64, the inner portion of said bolts being threaded into the plate member 31 whereby tightening of the bolts clamps the side edges of the panels 4 between the astragal and the outer edges of the

flanges 28 and 29 of the columns. The astragals consist of sheet metal formed in a channel shape with insulating material 65 being located inside of the channel portion of the astragal, the astragal being of such length as to extend from the inclined portion of the water table to the upper edge of the outer sheet of the wall panel.

Plastic material is preferably placed between the astragal and sheet whereby said astragal not only closes the space between the wall panels, but also forms a waterproof seal therebetween, the insulating material in the astragal insulating the gap between the wall panels whereby the entire wall is of insulated structure. It is to be noted that the bolts are arranged between the wall panels whereby the only apertures are in the astragal and plate 31 and no bolts extend through the wall panels.

At the corners of the building the wall panels 4 overlie portions of the columns 27 which are identical with the intermediate columns above described. As illustrated in Fig. 5 the wall panels 4 of one side of the building overlie the flange 28 and the wall panels 4 of the adjacent side forming the corner overlie the plate 31. The joint at the corner is covered by a corner astragal 67 having angularly arranged flanges 68 and 69 preferably arranged at right angles to each other and adapted to extend from the water table member 21 to the upper edges of the wall panel 4. The flanges 68 and 69 are of such width as to overlap the side edges of the wall panels 4, the adjacent ends of the flanges being connected by a web portion 70 to provide an attractive corner appearance to the building. The corner astragals preferably consist of insulated material 71 and sheet metal 72 bent in such a manner as to close all of the outer surfaces of the insulating material, said astragals being held in place and in clamping relationship with the wall panels 4 to hold same against the members of the columns by means of screws or other suitable fastening devices 73 extending through the web 70 and threaded into a flange 74 of an angular bracket 75 which has a flange 76 secured to the plate member 31 by a suitable fastening device 77.

In forming the walls of a building, combinations of short wall panels and suitable window framing 78 may be used to provide window openings 79 adapted to receive suitable window panes 80, for example casement windows. Also as illustrated in Fig. 7, wall panels 81 of reduced width may be used in combination with suitable door framing 82 to provide for mounting of doors 83. The door frame preferably consists of a wood liner 84, of hollow rectangular cross section, the inner and outer ends thereof being covered with sheet metal members 85 and 86 bent in channel shapes to provide flanges 87 on the door opening side thereof and flanges 88 on the wall side, said flanges being connected by a web 89. The adjacent ends of the flanges 88 are provided with outwardly struck portions 90 secured by fastening devices 91 to a block 92 located therebetween and of such size that the portions 90 form a rib adapted to be snugly received in the groove 93 between the side flanges of the wall panel 81. Adjacent edges of the flanges 87 are spaced as at 94 to break the conduction of heat and cold from the outside to the inside members, the flanges 87 being secured to the wood member 84 and suitable fastening devices 95. The joint is covered by a door stop 96 overlapping the adjacent edges of the flanges 87 and secured to the wood frame member 84 by a suitable fastening device 97, said door stop preferably being of sheet

metal formed in a channel shape and enclosing a suitable filler member 98. The filler member has contact with the flanges 87 of the metal members 85 and 86 but the edges of the metal portion of the door stop 96 do not contact said flanges, therefore direct heat flow from the inner member 85 to the outer member 86 is prevented. A plastic material 99 is preferably interposed between the wood member 84 and the sheet metal portions 85 and 86 of said door frame.

The roof panel units 5 preferably consist of a plurality of layers of insulating material 100 or combinations of insulating material and plywood, each being formed in panels of conventional thickness whereby the plurality of layers will make up the proper thickness of roof. The roof panel units are made similarly to the wall panel units being provided with outer and inner metal sheets 101 and 102 of such size that the edges extend beyond the edges of the insulating material 100, each of the edges being provided with in-turned portions 103 whereby said portions are spaced from the sheet to snugly receive flanges 104 of channel shaped members 105. The webs 106 of the channels engage the edges of the insulating material 100 when the ends of the flanges 104 engage the bends 107 at the edges of the sheets 101 and 102. Rubber or other elastic waterproof adhesive is preferably provided between the metal members and the insulating material forming the roof panel. This arrangement provides grooves 108 on each side and end of the roof panel and said panels are of such length as to extend from the roof ridge 109 to a point beyond the wall panels to provide an eave structure 110. Said panels also preferably have transverse reinforcing members 111 spaced from the outer ends of said panels whereby said reinforcing members substantially overlie the header member 39 at the upper end of the wall panels to support the roof load and span between the roof supporting members. The inner sheet 102 is preferably provided with a break or separation 112 adapted to overlie the upper edge of the wall panel 4 to prevent loss of heat from the inside of the building to the panel portion located outside of the building. The roof panel units are of substantially the same width as the wall panel units whereby the side edges overlie the rafters, said side edges of adjacent roof panels being spaced substantially the same distance as the wall panels.

The ridge 109 is preferably formed of non-metallic structural material and extends the length of the building. The upper edges slope to correspond to the slope of the roof, the sides of said roof ridge member being provided with undercut portions 113 and 114 to provide ribs 115 adapted to be received in aligned grooves 108 in the upper ends of the roof panels, to provide a frictional connection therebetween. In order to cover the joints of the roof panel and the ridge member a thin sheet of metal 116 is preferably arranged over the ridge member having side edges 117 overlying the upper ends of the roof panels. The under surface of the sheet 116 is preferably integrally coated with waterproof flexible gasket material 118. In order to secure the sheet on the ridge member a ridge cap 119 is arranged longitudinally of the ridge member conforming to a slope thereof whereby the side edges extend substantially to the adjacent portions of the undercut 113, said cap member being secured to the ridge member by suitable fastening devices such as screws 120.

Roof astragals 121 consisting of strips of insulating material 122 having the outer portions thereof covered with sheet metal 123 are arranged over the adjacent side edges of the roof panels whereby the astragals secure the roof panels in place by a frictional contact obtained from clamping action provided by screws 124 extending through the astragals and threaded into plate members 125 of the rafters, the ends of said astragals adjacent the roof ridge member being suitably covered by sheet metal caps 126 to close the joints thereof. Waterproof flexible material is adhered to the roof astragals and becomes an integral part thereof to form a water seal between said astragal and roof panels. The lower ends of the astragals project beyond the edge of the roof as shown in Fig. 2 for supporting gutters 127 on said roof. The gutter preferably consists of sheet metal bent in a channel shape whereby the web 128 forms the bottom of the gutter, the inner flange 129 extending upwardly and terminating in a lip 130 adapted to underlie the projecting edge of the sheet 101 of said roof panels. The outer flange 131 extends upwardly from the web 128 and overlies the end of the astragal 121, the upper end being turned inwardly and downwardly to provide a finished edge on said gutter. The flange 131 is secured to the ends of the astragals by a suitable fastening device 132. The flange 129 may also be secured by being attached to the astragals or under side of the roof panels by suitable fastening devices 133.

The eaves at the gable ends of the building are formed by a roof panel of the same structure as the other panels but of reduced width to provide a projecting portion 134. The outer edges of said eave panels are finished by a fascia 135 having an outer wall 136 of substantially the same vertical height and width at the bottom as the gutter 131, the lower edges of said wall terminating in an inwardly directed portion 137 extending toward the wall and terminating in an upwardly directed portion 138, the upper ends of which are provided with an outwardly directed flange 139 adapted to underlie the roof panel 134. The upper edge of the wall 136 is provided with an inwardly directed portion 140 terminating substantially in alignment with the outer edge of the eave panel and having a downwardly directed portion 141 terminating in an inwardly directed flange 142, adapted to engage the upper surface of the panel 134. Suitable bolts or the like 143 extend through suitable openings in the portions 140 and 137 to draw the respective members together to provide clamping engagement between the flanges 139 and 142 and the eave panel 134. The gable fascia 135 and the gutter 127 are preferably provided with mitered ends to form a finished joint at the corners of the building.

In order to seal the line of engagement between the roof panels and the wall panels a strip of waterproof flexible material or the like 145 is clamped into the angle formed by the inner-sheet 102 of the roof panel and the outer-sheet 45 of the wall panel by an angular member 146, the flanges of which are spaced slightly from the sheets of the roof and wall panels. The angular member is held in place by flanges 147 secured by suitable fastening devices 148 to the side edges of the astragals 64.

Fig. 9 illustrates a structure for frictionally supporting wall boards, plaster boards and the like for finishing the inside of the building. Z bars 149 are arranged with one flange 150 located

between a wall panel 4 and a flange of a column, the other flange 151 of said Z bar extending outwardly from said column to mount a strip of wood or the like 152 preferably secured to the flange 151 by suitable fastenings 153. The strips of wood 152 form nailing strips, the faces of which are preferably in spaced relation to the inner-surface of the columns for mounting wall boards 154 or the like by nailing or otherwise securing same to the nailing strips 152. The wall panels 154 may be arranged whereby the inner-surface thereof is flush with the inner-surface of the columns or said panels may be inset whereby the columns will project slightly into the room to give a panel strip effect.

Partitions 155 may be mounted on the various columns as desired by suitable clamping devices 156 having portions extending across the inner-face of the columns and engaging the side flanges thereof, said clamping members being provided with flanges 157 extending into the interior of the building and suitably spaced to receive the partition 155 therebetween, suitable fastening devices 158 extending through the flanges 157 to draw same together and clamp the partition in place.

In assembling a building constructed as described, the respective members are prefabricated and shipped to the site of the building. The foundation 2 is poured of concrete, steel floor framing or other suitable material, anchored bolts being provided for mounting the column base 12 thereon. The columns are erected on the column base and secured thereto by fastening devices 36 and the rafters and the like secured to the upper ends of said columns, the upper ends of said columns being connected by the header members 39. The ridge member 109 is secured to the rafters to provide a rigid frame structure. The members 19, 21 and 26 which preferably are prefabricated with waterproof adhesive coating are then placed on the outer edge of the foundation, the adhesive between the respective members supporting same and the member 19 in engagement with the outer portion of the column base, the ends of the water table being mitered to provide a finished structure at the corners to the building. The wall panels are then arranged in engagement with the columns with the channeled lower edge of said wall panels engaging over the upwardly projecting edges of the lip 17, member 19 and water table 21 to provide a snug fit therebetween. The wall astragals are then located to close the space between the wall panels and secured to the columns by fastening devices 62, waterproof gasket material prefabricated on said astragals sealing the contacting face of said astragals and wall panels. Tightening of the fastening devices draws the astragals into clamping engagement with the wall panels to frictionally hold same in place. The upper ends of the roof panels are then engaged with the ridge member 109 whereby the grooves 108 in the end engages rib 115, and the side edges of said roof panels are spaced with each edge overlying the rafters. The strip 116 is then placed along the ridge member overlapping the joint of the roof panels and ridge members. The cap 119 is placed over the strip and anchored to the ridge member by suitable fastening devices 120, waterproof adhesive being located between contacting faces of said members. The roof astragals are then located over the open spaces between the roof panels with suitable waterproof adhesive previously applied to the astragal during prefabrica-

tion between the contacting faces, said roof astragals being secured in place by suitable fastening devices 124 to clamp the roof panels in place and provide frictional engagement between the astragals, panels and the rafters. Strips of waterproof gasket material are then placed in angular members 146 and applied at the joint between the roof panels and wall panels and secured in place by suitable fastening devices 148. The gable fascia is applied to the eave panels 134 and clamped thereon by fastening devices 143. The gutters 127 are then placed on the projecting ends of the roof panels and secured thereto by fastening devices 133, the outer flange 131 being secured to the projecting ends of the astragals by fastening devices 132. If a finished wall is desired on the inside of the building the Z bars 149 are inserted between wall panels 4 and the flanges of the column. Nailing strips are applied to the Z bars and the wall panels 154 suitably secured to the nailing strips. Also any partition desired in the interior of the building may be clamped to the columns as desired.

In a building structure such as described all of the panel units are held in place by friction, no bolts passing through said panel units. Therefore, the building is characterized as consisting of a rigid steel frame to which is applied metal, insulated wall and roof closure units held in place by friction, thus permitting expansion and contraction of closure unit panels. Also the complete floating assembly eliminates any requirement for new or replacement panels where re-erection or enlargement of the building is required.

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

In a metal building, a base, spaced vertical columns mounted on said base, rafters secured to said columns and spanning the building, a plurality of roof panel units, said roof panel units having side edges overlying said rafters, said side edges of adjacent roof panel units being spaced apart, roof astragals overlying the side edges of

adjacent roof panel units, means securing the roof astragals to the rafters for clamping the roof panel units therebetween whereby said roof panel units are held in place by friction and are free to expand and contract individually, a plurality of wall panel units the upper edges of which substantially engage the bottom surfaces of the roof panel units, said wall panel units having side edges overlapping the columns, said edges of adjacent wall panel units being spaced apart, wall astragals overlying the side edges of adjacent wall panel units, means securing the wall astragals to the columns for frictionally clamping the wall panel units therebetween whereby said wall panel units are free to expand and contract individually, waterproof flexible strips exteriorly of and at the upper edges of the wall panel units, and angle members supported by and extending between the wall astragals in engagement with the flexible strips for retaining said strips in sealing engagement with the adjacent portions of the wall and roof panel units for providing a waterproof joint therebetween which permits relative movement of the wall and roof panel units.

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