Jan. 3, 1967 V. J. LUNDELL 3,295,267

BUILDING HAVING TENSIONED COVERING BETWEEN FRAMES

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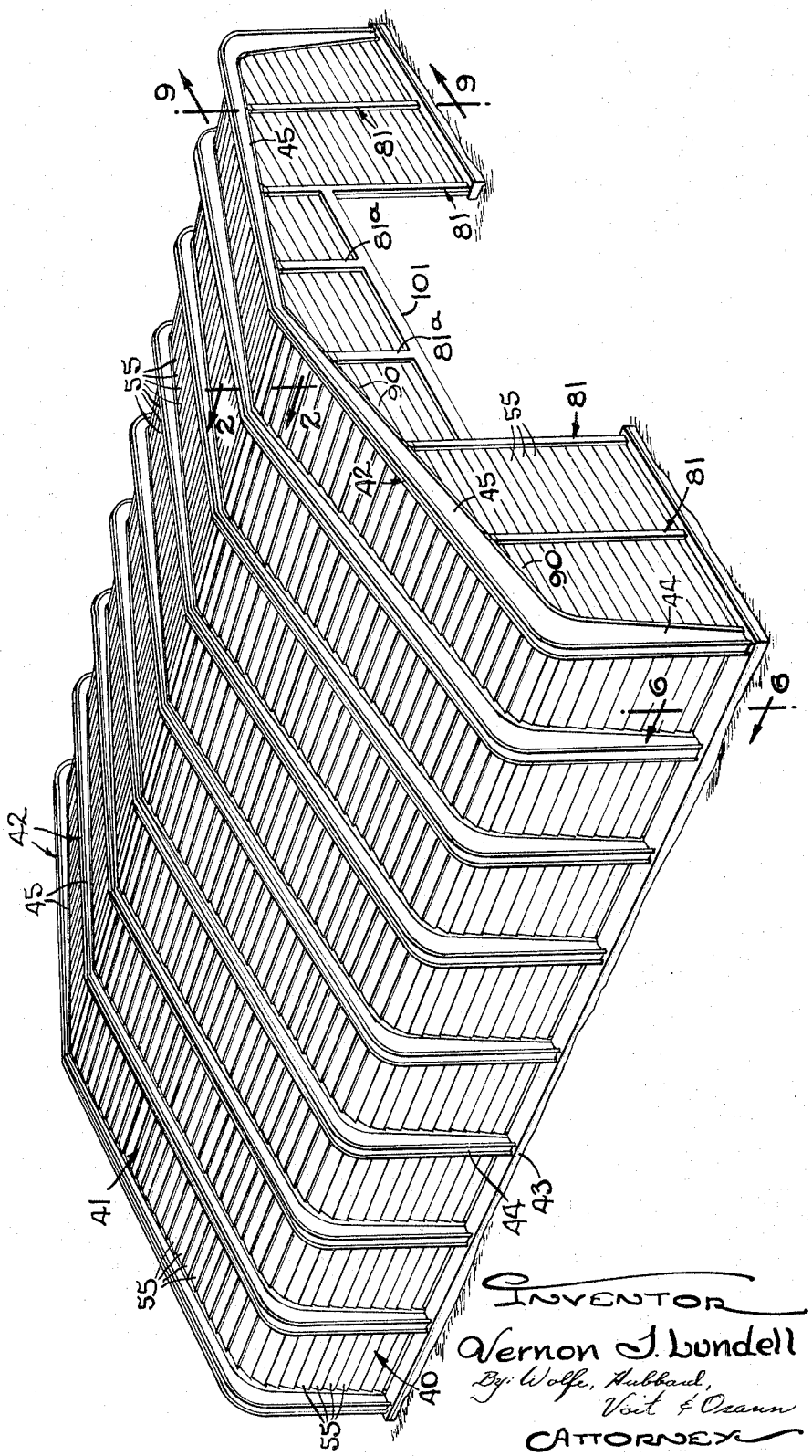


Fig. 1

INVENTOR
Vernon J. Lundell
By: Wolfe, Hubbard, Voit & Osann
ATTORNEYS

Jan. 3, 1967 V. J. LUNDELL 3,295,267

BUILDING HAVING TENSIONED COVERING BETWEEN FRAMES

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Fig. 2

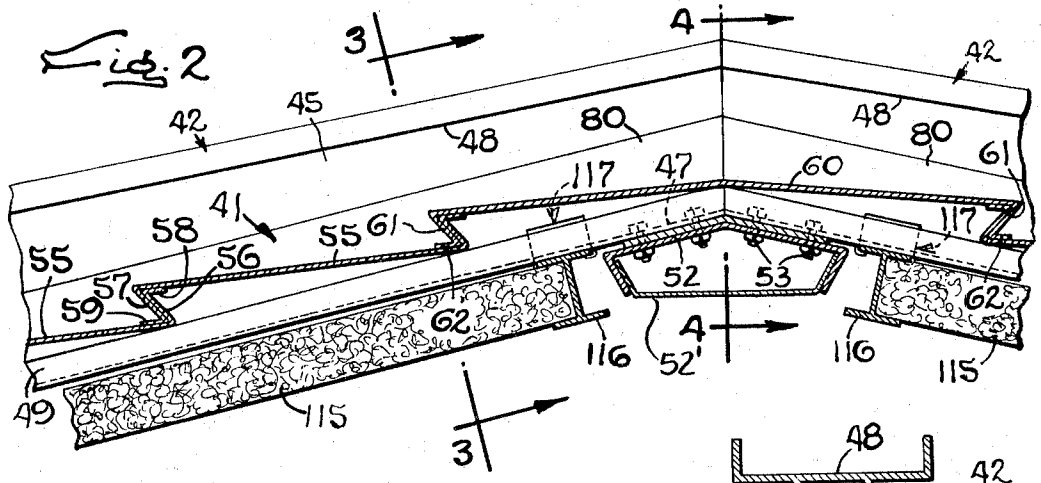


Fig. 3

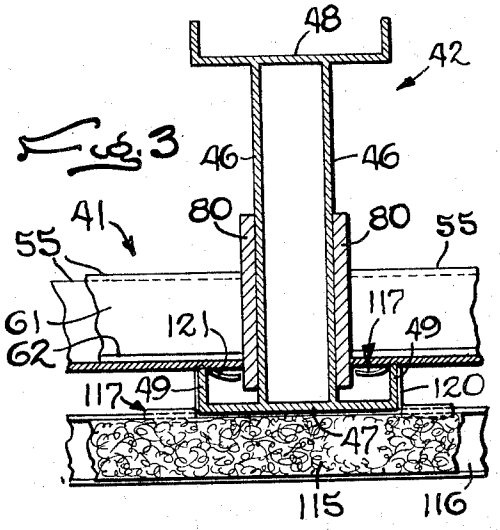


Fig. 4

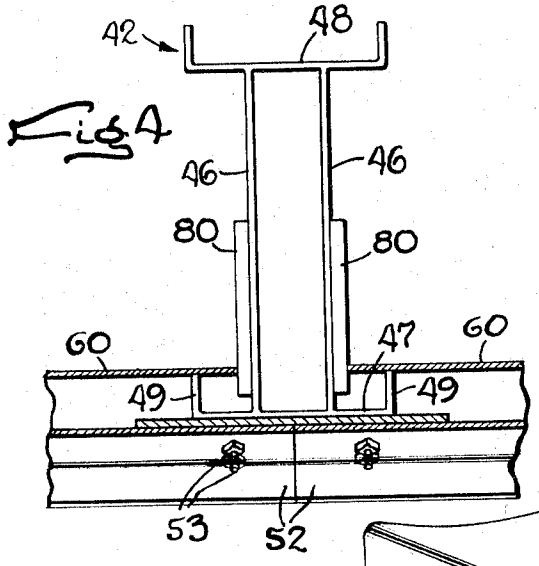
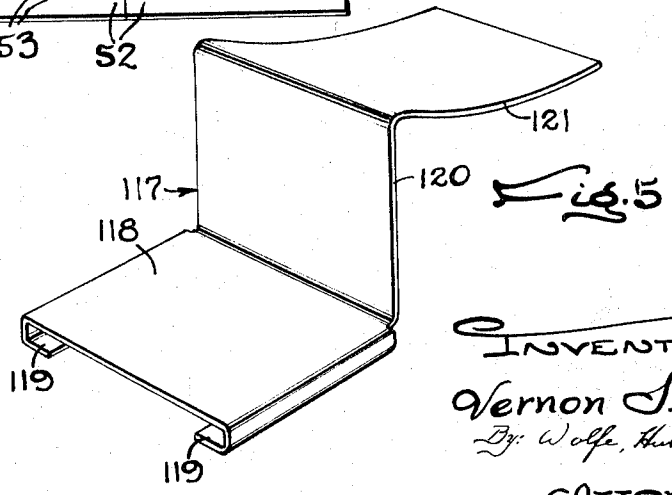


Fig. 5



INVENTOR
Vernon J. Lundell
By: Wolfe, Hubbard, Voit & Osann
ATTORNEYS

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BUILDING HAVING TENSIONED COVERING BETWEEN FRAMES

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Fig. 6

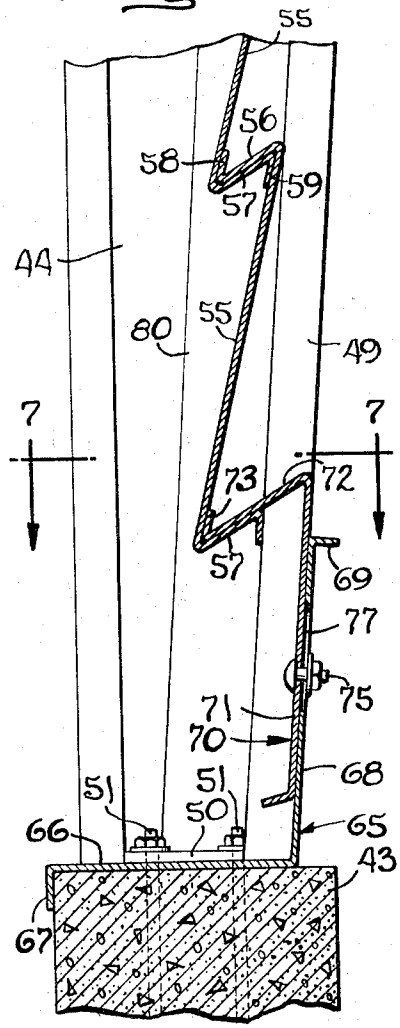


Fig. 7

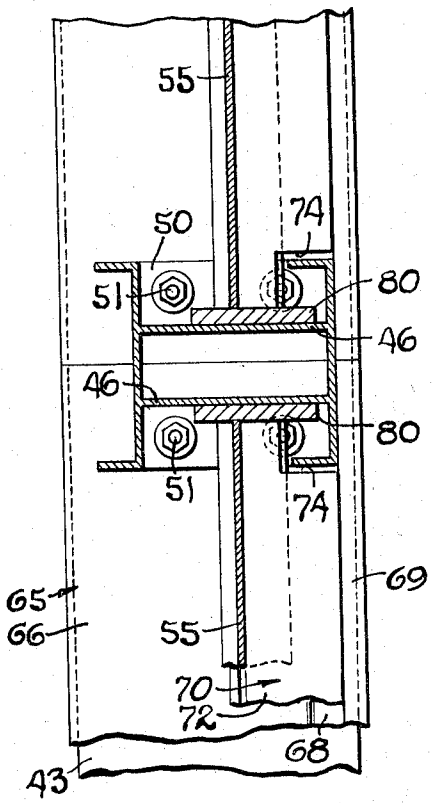
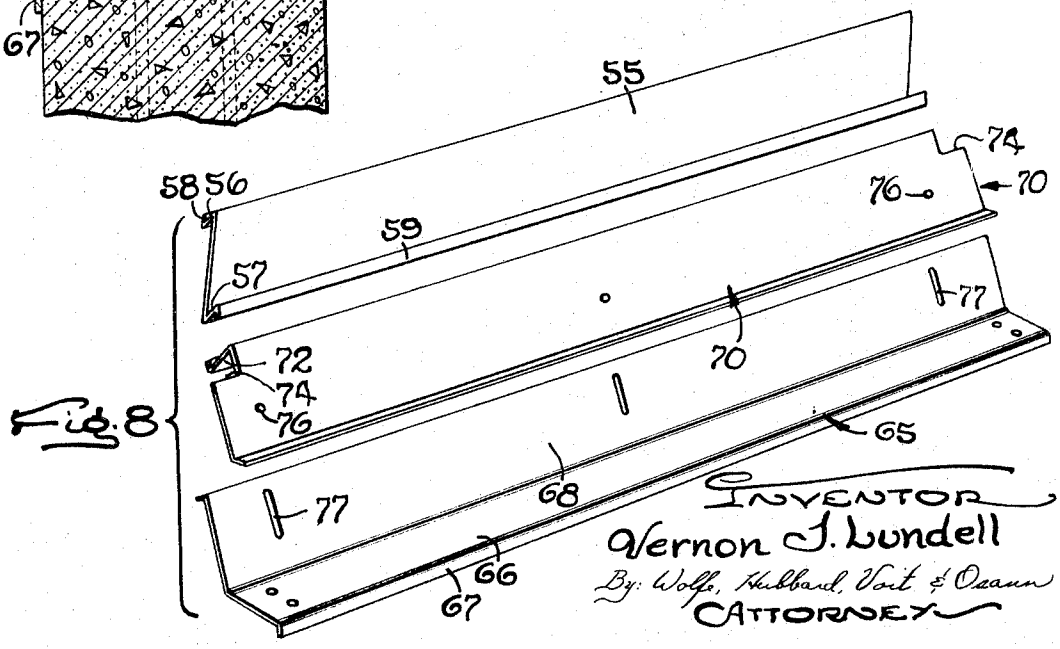


Fig. 8



INVENTOR
Vernon J. Lundell
By: Wolfe, Hubbard, Voit & Osann
ATTORNEY

Jan. 3, 1967 V. J. LUNDELL 3,295,267

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Fig. 9

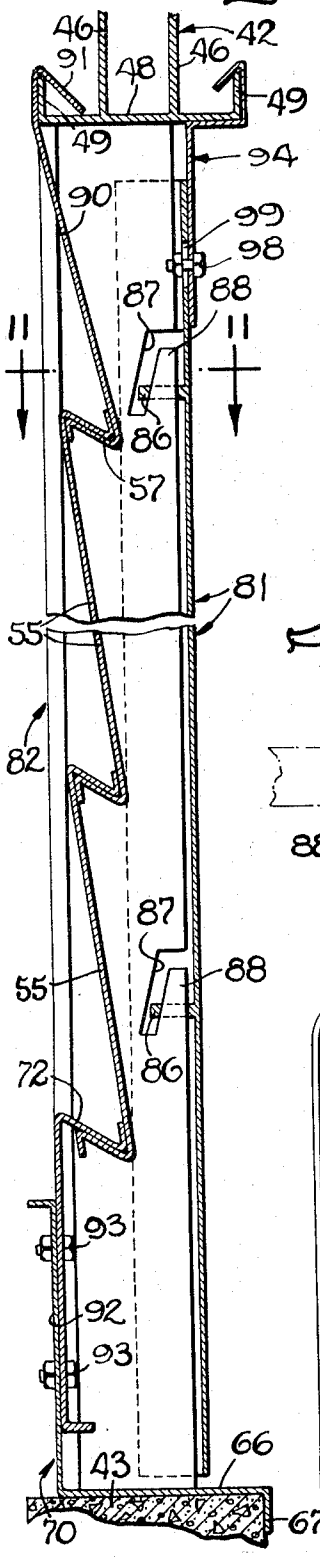


Fig. 10

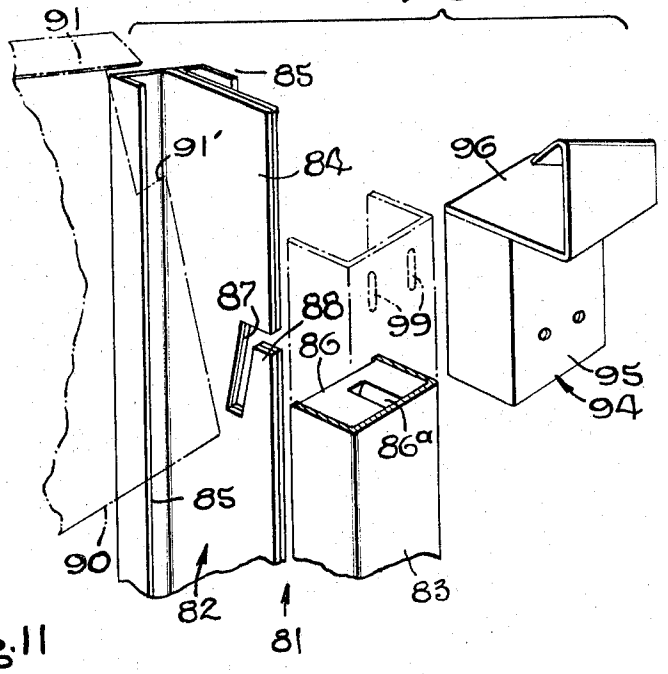


Fig. 11

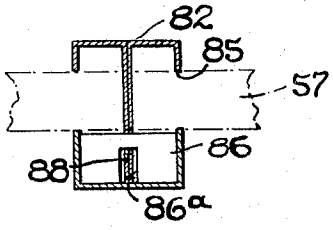


Fig. 12

Fig. 13

INVENTOR
Vernon J. Lundell
By: Wolfe, Hubbard, Voit & Osann
ATTORNEY

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BUILDING HAVING TENSIONED COVERING BETWEEN FRAMES

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Fig. 14

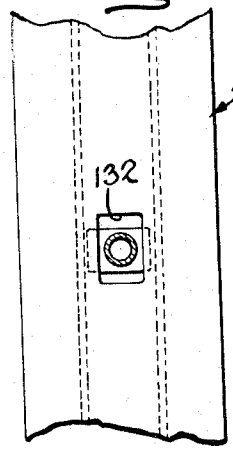


Fig. 15

Fig. 16

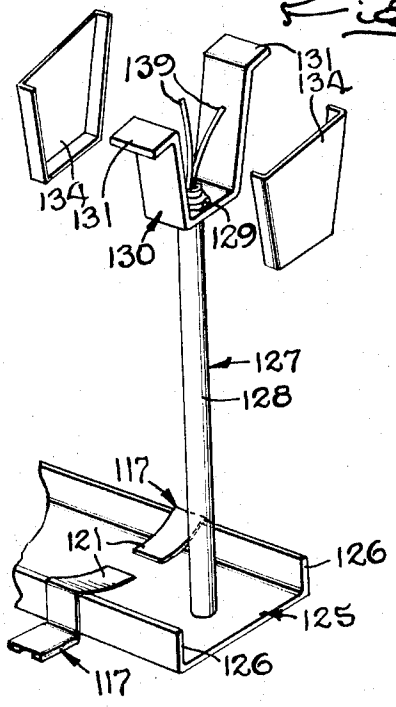
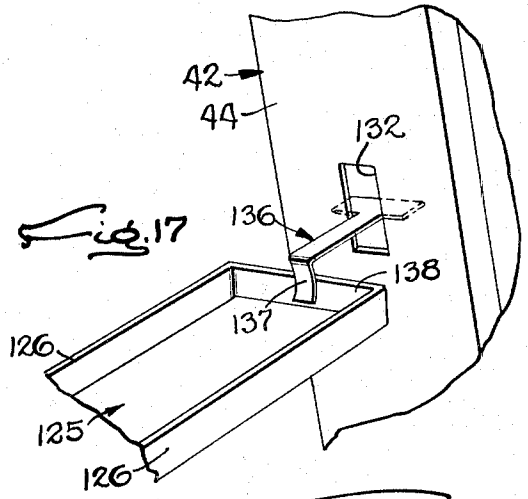


Fig. 17



INVENTOR

Vernon J. Lundell

By: Wolfe, Hubbard, Voit & Osann

ATTORNEY

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BUILDING HAVING TENSIONED COVERING BETWEEN FRAMES

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Fig. 18

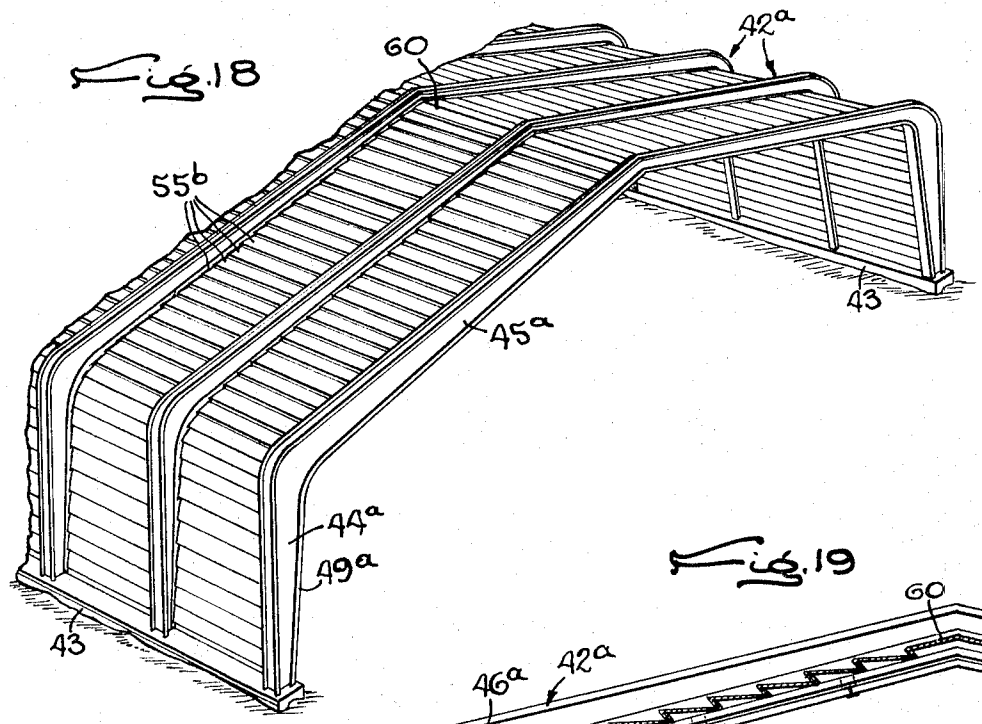


Fig. 19

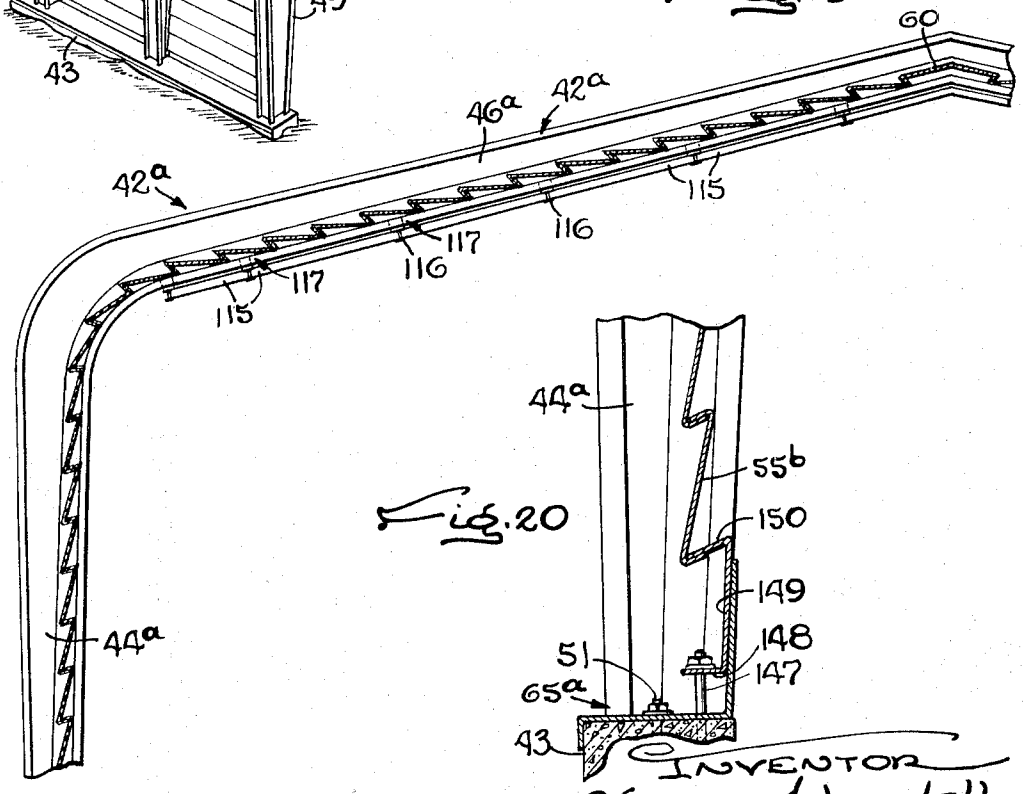


Fig. 20

INVENTOR
Vernon J. Lundell
By: Wolfe, Hubbard, Voit & Osann
ATTORNEY

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Fig. 21

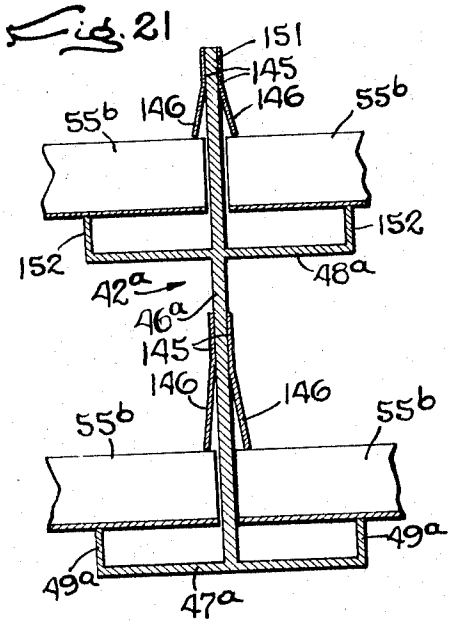
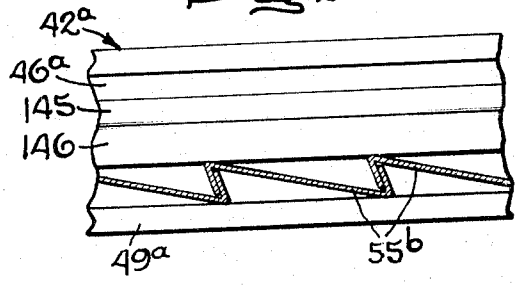


Fig. 22



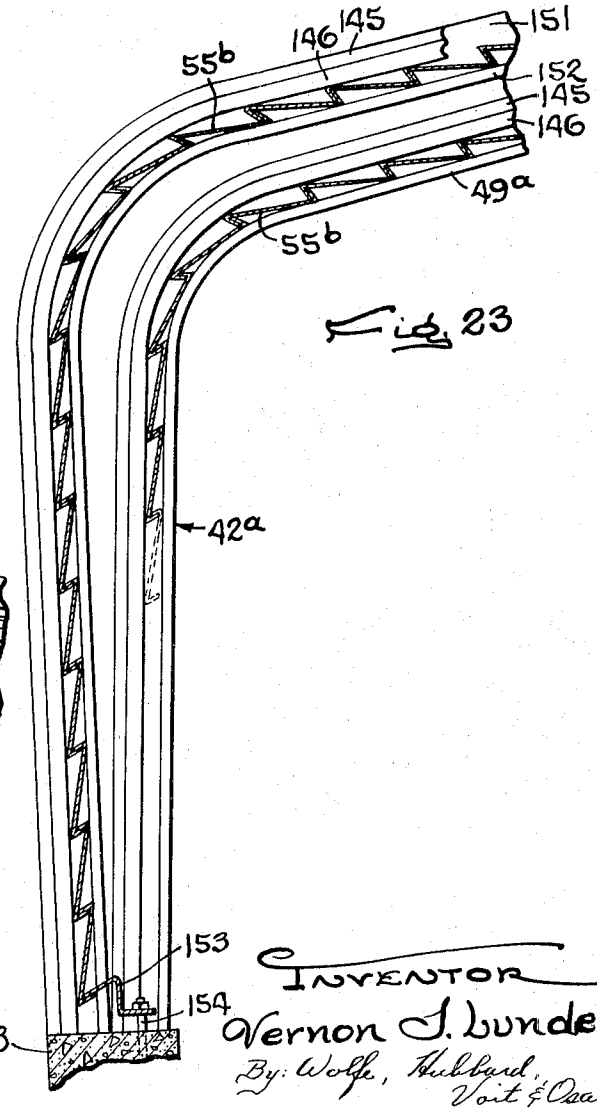
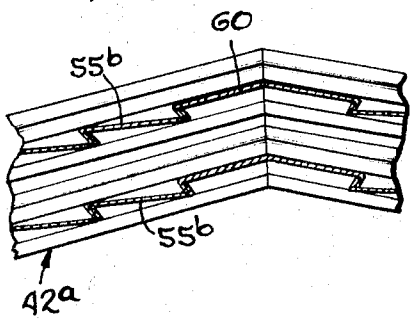


Fig. 23

Fig. 24



INVENTOR
Vernon J. Lundell
By: Wolfe, Hubbard, Voit & Osann
ATTORNEYS

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Fig. 25

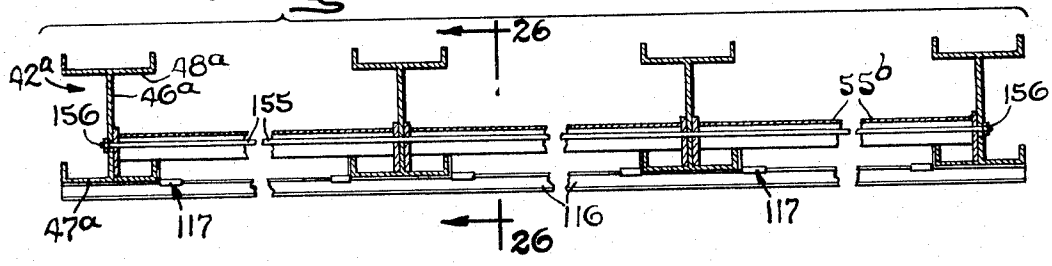
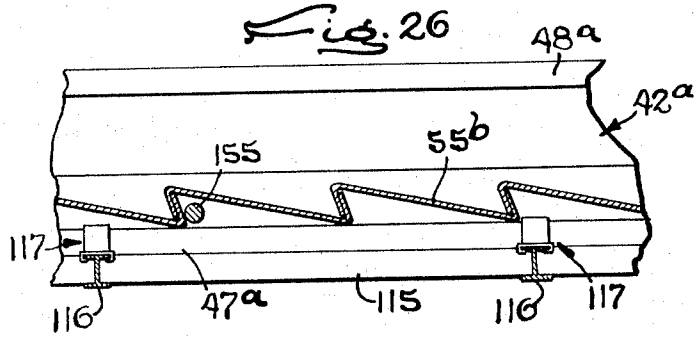


Fig. 26



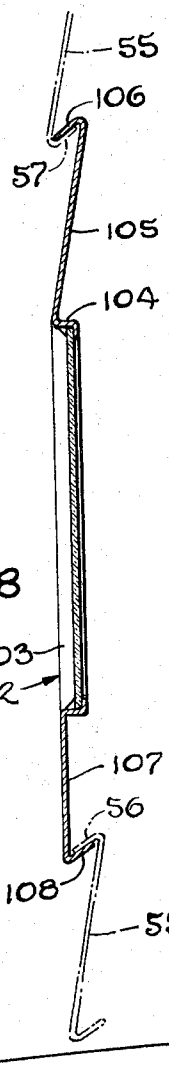


Fig. 27

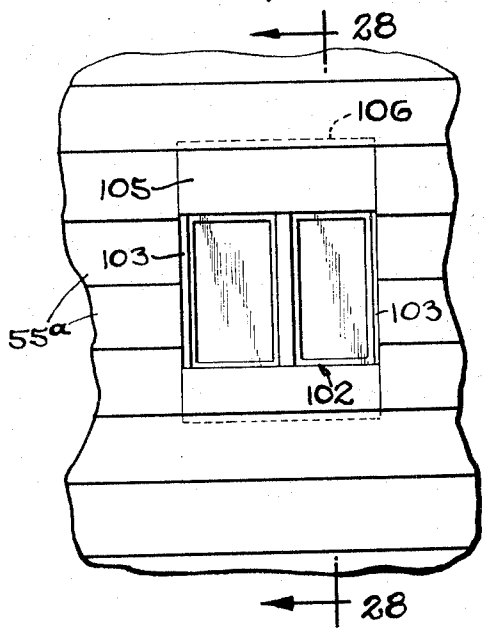


Fig. 28

INVENTOR
Vernon J. Lundell
By: Wolfe, Hubbard, Voit & Osann
ATTORNEY

Jan. 3, 1967 V. J. LUNDELL 3,295,267

BUILDING HAVING TENSIONED COVERING BETWEEN FRAMES

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Fig. 29

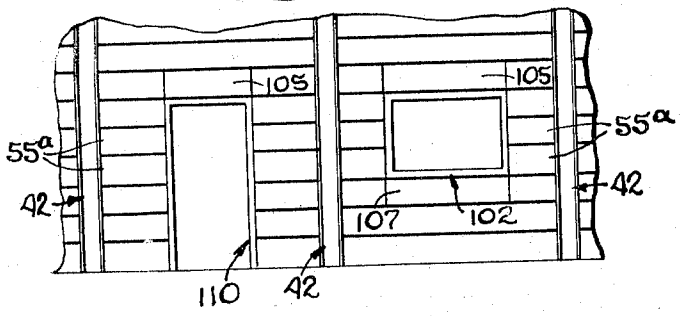


Fig. 30

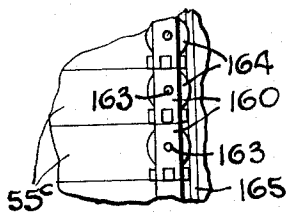
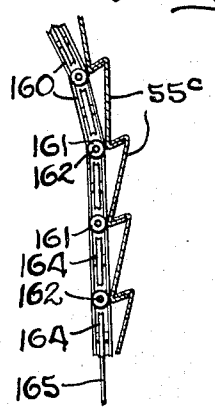


Fig. 31



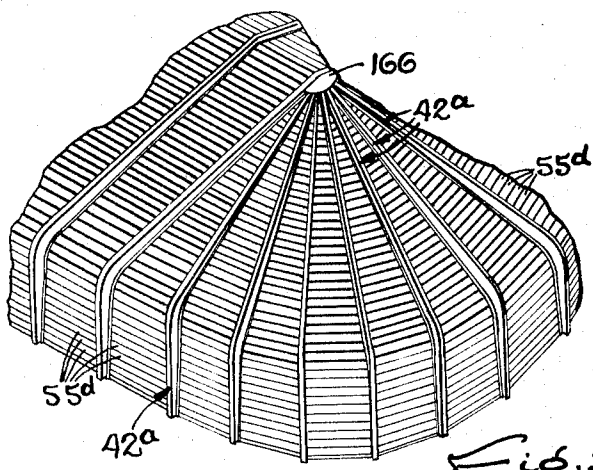
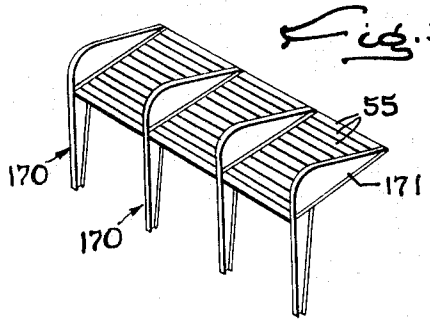


Fig. 32

Fig. 33



INVENTOR

Vernon J. Lundell

By: Wolfe, Hubbard, Voit & Osann

ATTORNEY

United States Patent Office

3,295,267
Patented Jan. 3, 1967

3,295,267

BUILDING HAVING TENSIONED COVERING BETWEEN FRAMES

Vernon J. Lundell, Cherokee, Iowa 51012

Filed June 13, 1963, Ser. No. 287,612
15 Claims. (Cl. 52—90)

This invention relates to building structures generally and more particularly to buildings of the industrial or commercial type. This application is a continuation-in-part of my previously filed applications Serial No. 205,428, now abandoned, filed June 26, 1962, and Serial No. 219,667, now abandoned, filed August 27, 1962.

One object of the invention is to provide a building structure of the above general character utilizing components which can be manufactured economically, which can be assembled and erected quickly with simple tools and with a minimum of labor, and which, when completed presents an unusually attractive appearance. It is also an object of the invention to provide a building structure in which the interior is completely free of supporting pillars or other obstructions.

Another object is to provide a building structure utilizing as its major components similarly shaped and dimensioned parts which can be produced economically in large quantities. An ancillary object is to provide a building structure employing standardized parts which can be assembled to produce buildings of widely varying sizes and styles.

Another object is to provide structural elements for buildings of the above type which interfit and cooperate in a manner that substantially eliminates cutting and fitting on the job as well as costly joining procedures such as drilling, riveting, welding, etc. in the assembly and erection of the building.

Another object is to provide a building structure in which the component elements coact in a novel manner to impart maximum strength and rigidity to the finished building and particularly to resist end sway or comparable movements of the same.

Another object is to provide a type of building construction in which the same standardized closure panels can be used for buildings of any size. An ancillary object is to provide a construction which permits additions to be made to a previously erected building with a minimum of change or modification of the existing structure.

Another object is to provide closure panels which coact with other elements of the building structure in a manner which eliminates the need for openings of any kind in the panels thereby enhancing the weather tightness of the building structure and materially increasing the resistance of the panels to deterioration.

Another object is to provide a building structure of the above general type which affords a wide choice of the location of doors and windows. It is also an object of the invention to provide a building structure which affords wide latitude in the treatment of the end walls of the building.

Another object is to provide a type of construction which greatly simplifies and facilitates the installation and wiring of electrical fixtures in the building.

Another object is to provide a building structure in which the entrance of water from rain or melting snow to the interior of the building and the accompanying dripping from the roof or ceiling portion of the building

is effectively prevented. A related object is to provide for effectively draining away the water deposited on the roof of the building.

It is also an object of the invention to provide a type of building construction in which the main supporting elements of the frame structure are related to the closure elements in a manner which effectively shields the frame elements from heat and minimizes damage thereto in the event of fire within the building.

Other objects and advantages of the invention will become apparent from the following detailed description of the preferred embodiment of the invention and the modifications shown in the accompanying drawings in which:

FIGURE 1 is a perspective view of a building constructed in accordance with the present invention.

FIG. 2 is a fragmentary section through the ridge portion of the building taken in a plane substantially on the line of 2—2 of FIG. 1.

FIG. 3 is a fragmentary sectional view taken in a plane substantially on the line 3—3 of FIG. 2.

FIG. 4 is a fragmentary sectional view taken in a plane substantially on the line 4—4 of FIG. 2.

FIG. 5 is a perspective view of a snap-on connector for assembling lining elements with the building framework.

FIG. 6 is a fragmentary sectional view through the side wall of the building structure taken in a vertical plane substantially on the line 6—6 of FIG. 1.

FIG. 7 is a fragmentary sectional view taken in a horizontal plane substantially on the line 7—7 of FIG. 6.

FIG. 8 is an exploded view showing a typical closure panel and the associated panel-like elements for anchoring the same to the building foundation.

FIG. 9 is a sectional view through the end wall of the building taken in the vertical plane substantially on the line 9—9 of FIG. 1.

FIG. 10 is an exploded perspective showing details of the upright and associated elements forming the frame structure at the end of the building.

FIG. 11 is a transverse sectional view taken in the plane substantially on the line 11—11 of FIG. 9.

FIG. 12 is a perspective view of a preferred form of frame member or beam.

FIG. 13 is a transverse sectional view through the beam shown in FIG. 12 taken in the plane on the line 13—13 of that figure, a portion of a lighting fixture conduit support being shown assembled with the beam.

FIG. 14 is a fragmentary view of the underside of the generally horizontal portion of the beam showing the arrangement for mounting suspended electrical fixtures or ceiling supports.

FIG. 15 is a fragmentary vertical section through the building structure showing details of the combined support for electrical fixtures and the ceiling structure.

FIG. 16 is an exploded perspective view showing further details of the fixture and ceiling supporting elements.

FIG. 17 is a detailed perspective showing the manner of anchoring a ceiling support member to the framework of the building.

FIG. 18 is a fragmentary perspective view of a modified form of the improved building structure.

FIG. 19 is a fragmentary transverse sectional view through the building structure shown in FIG. 18.

FIG. 20 is a fragmentary vertical sectional view through

the building structure shown in FIG. 18 taken adjacent the base of the same.

FIG. 21 is a transverse sectional view through a modified form of frame member or beam.

FIG. 22 is an enlarged fragmentary sectional view of the building shown in FIG. 1 taken transversely of a series of the closure panels.

FIG. 23 is a transverse sectional view through a building of the type shown in FIG. 18 modified to employ a double wall construction.

FIG. 24 is a fragmentary sectional view through the ridge portion of a building employing the construction shown in FIG. 23.

FIG. 25 is a longitudinal sectional view through the building shown in FIG. 18 illustrating details of the installation of lining panels.

FIG. 26 is an enlarged fragmentary sectional view taken in a plane substantially on the line 26—26 of FIG. 25.

FIG. 27 is a fragmentary elevational view showing the manner of installing windows in a wall of a building structure of the type shown in FIGS. 1 and 18.

FIG. 28 is a fragmentary sectional view taken in a vertical plane substantially on the line 28—28 of FIG. 27.

FIG. 29 is a fragmentary elevational view showing the installation of door and window elements in a wall of the building structure.

FIG. 30 is a fragmentary front view, partially sectioned, showing details of a segmented movable door structure.

FIG. 31 is a fragmentary sectional view showing details of the segmental door structure illustrated in FIG. 30.

FIG. 32 is a fragmentary perspective view showing a modified form of end closure adapted for use with building structures of the type herein disclosed.

FIG. 33 is a perspective view of a deck or roofing structure adapted for use with the improved building structure.

While a preferred embodiment to the invention and various modifications have been shown in the drawings and will be described herein, these are merely illustrative, and it is to be understood that various changes in the form, construction and arrangement of parts may be made without departing from the spirit and scope of the invention as more broadly defined in the appended claims.

A typical building erected from parts constructed in accordance with the present invention as shown in FIG. 1, has upright side walls **40** and a centrally peaked roof **41**. The building includes a rigid frame structure made up of a series of generally arch-shaped frame units **42** each having its legs suitably anchored to a foundation structure **43** which may be in the form of a concrete slab or may comprise a pair of spaced parallel footings as desired.

In accordance with one aspect of the invention, the frame units **42** are all alike in construction and they are intended to be erected so that they are uniformly spaced apart laterally. The space between the adjacent pairs of the frame units is closed by wall units or panels constructed and arranged to coact with the frame units and with each other to provide a weatherproof closure over the sides and roof of the building.

The uniform spacing of the frame units is important in that it permits the use of wall units of standardized length regardless of the dimensions of the building. Since the frame units are also made up of similar parts, the number of components or different shapes or dimensions required for buildings of any size is thus reduced to a minimum so that parts can be manufactured economically in large quantities instead of being produced individually for each job.

Further in accordance with the invention, the frame units **42** embody novel structural features which facilitate assembly and erection of the building and which insure its weather tightness. In general, each frame unit is made up of two beams secured together at their ends at the peak of the roof. Each beam comprises two angularly related sections, namely an upright wall section **44** and an inclined roof section **45**. The angular relationship between the two sections is determined by the roof pitch desired. The length of the sections is determined by the minimum roof height and by the desired building width respectively. In particular, the beams are usually dimensioned to provide building widths in multiples of 10 feet, for example, such as 20, 30, 40, 50, feet, etc. As to the building length, no limits whatever are imposed by structural considerations and of course, additions can be made to existing buildings by simply installing more frame and wall units.

Referring in more detail to the frame construction, a preferred form of beam which can be fabricated economically from sheet or plate steel and which affords a high degree of strength and rigidity while retaining its light weight, is shown in FIGS. 1, 3, 4, 6 and 7. This beam has a box-like web or body comprising spaced parallel plates **46** (FIGS. 3 and 4) welded at their inner and outer edges to a pair of outwardly facing channel members **47** and **48**. The flanges **49** of the inner channel member **47** thus present two continuous abutments along the inner marginal edge of the beam spaced laterally from the beam web for cooperation with the wall members or panels as will appear presently.

At is lower end each vertical beam section **44** is fitted with a rigid horizontal footing plate **50** welded to the adjacent parts of the beam and adapted to rest on the foundation structure **43**. (See FIGS. 6 and 7.) The plates are formed with suitably spaced holes for the reception of anchor studs **51** set in the foundation structure in the conventional manner. Adjacent ends of the roof sections **45** of the beams comprising a frame unit are connected by an inverted, channel-shaped frame element **52** (FIG. 2) dimensioned to extend between two adjacent frame units **42** and constitute a ridge pole.

In the assembly of a building the beams are erected in pairs to form the frame units **42** and secured in place by screwing down the nuts on the anchor studs **51**. The beams of each frame unit are secured together and connected with the beams forming the adjacent frame unit by bolting them as indicated at **53** to the frame element **52**. A rigid self-sustaining frame structure is thus obtained. It is to be particularly noted that erection may be effected with simple tools such as wrenches, no drilling, riveting or welding being required on the job.

As indicated above, the frame units are uniformly spaced apart lengthwise of the building structure and the spaces between adjacent frame units are closed by the wall members which comprise elongated rectangular panels **55** adapted to rest on the continuous abutments or flanges of the adjacent units. While the wall panels **55** may be made of plastic impregnated fibre or other suitable building materials, structural strength and economic considerations presently make sheet metal the preferred material. The metal may be aluminum, steel or any other as preferred.

In accordance with the invention, the panels **55** are shaped to interengage with each other in a manner which produces an effective weathertight joint and which imparts strength and rigidity to the assembled series of panels installed between each of the pair of frame units. As shown in FIGS. 6 and 8, the panels have their side edges formed with oppositely directed flanges **56** and **57** inclined at an angle so as to overlie the front and rear faces of the panel. The tip portions **58** and **59** of the respective flanges are also bent back to extend substantially parallel to the faces of the panel. In assembling panels, the outwardly facing flange **56** of one panel is hooked over the inwardly facing flange **57** of the adjacent panel with the tip portions **58**, **59** fitting flush against the faces of the panels. The strong weathertight joint is thus produced.

The number of panels **55** required between each pair of beams is, of course, determined by the height and width

of the building structure. Provision is made for anchoring the first panel of each series adjacent the peak of the roof and for adjustably securing the last or lower panel of the series to the foundation structure. For anchoring at the roof peak, a cap member 60 is provided as shown in FIG. 2. This member comprises a slightly convex panel with its opposite side edges formed with inwardly turned inclined flanges 61 generally similar to the flanges 56 and 57 of the panels 55. The edges of the flanges 61 are turned outwardly as at 62 to lie flush against the face of the adjacent panel when the flange 56 is hooked under the flange 61 as shown.

For securing the series of panels to the foundation structure there is provided a base plate 65 (FIGS. 6 and 8) having a horizontal portion 66 adapted to fit flush against the foundation structure or footing. This horizontal portion is apertured to receive the beam anchor studs 51 which serve to hold it and the associated beam down securely on the foundation structure. The outer edge portion of the base plate is flanged downwardly as in 67 and the inner edge portion 68 is bent upwardly and has its edge 69 turned inwardly to stiffen the member.

Secured to the upright flange 68 of the base plate for adjustment vertically is a connecting element 70 having a flat rectangular body portion 71 adapted to lie flush against the flange 68. The upper edge of the element 70 is formed with an outwardly directed inclined flange 72 terminating in a short upwardly directed edge portion 73. Flange 72 is shaped complementally with respect to the flange 57, of the panel 55 and is adapted to hook over it as shown in FIG. 6 with the edge portion 73 abutting the inner face of the panel. The flange 72 however, is somewhat wider than the panel flange to enable it to extend from the inner face of the beam 42 adjacent which the element is mounted into tight engagement with the flange of the panel 55 which rests on the beam abutment 49. The ends of the flange 72 and the adjacent portions of the element 71 are notched as at 74 to clear the channel portion 47 of the beam.

Connecting element 70 may be secured to the base plate 65 in any suitable manner, a preferred means comprising bolts 75 inserted through holes 76 in the element alined with vertically disposed slots 77 in the flange 68 of the base plate. With the parts loosely assembled, the series of panels 75 may be placed under tension by application of pressure to the upper edge of the flange 72. When desired tension is obtained, the nuts are tightened on the bolt 75 to secure the parts against slippage.

To effectively seal the joint between the frame units and the wall panels against the entrance of moisture, resilient pads 80 (FIGS. 3 and 4) are interposed between the ends of the panels and the web plates 46 of the beams. The pads may conveniently take the form of relatively long strips dimensioned to extend the full length of each beam. The pads may be made of any desired material, asbestos impregnated with tar or an asphaltic compound being satisfactory as well as economical. To simplify installation the strips may have one side coated with a pressure sensitive adhesive effective to hold the strip in place during assembly of the wall panels. In such assembly the beams may be sprung apart sufficiently to permit entry of the panels. Upon release the beams return to normal position forcing the pads against the ends of the panels and thereby producing a weather tight seal.

The building structure above described has side walls and a roof but is open at both ends. While the ends may be finished with a conventional frame or brick structure if desired, the invention provides an assembly of simple, pre-shaped parts for that purpose. Referring to FIGS. 1, 9 and 10, a preferred form of end closure comprises a series of uprights 81 dimensioned to extend between the foundation structure and the lower face of the roof sections 45 of the end frame-unit 42. The uprights are preferably dimensioned to provide a lateral spacing similar to the spacing of the frame units for accommodation of the standardized wall panels 55. One of the wall units is shaped and dimensioned to fit snugly against the inner face of the wall section 44 of the beam and provides an abutment for cooperation with the wall panels. The uprights may be bolted to the foundation as previously described and may also be bolted to the channel portion 47 of the beam against which they abut. If bolting is desired the beam will be drilled at the factory to avoid the necessity of performing such operations on the job.

As shown in FIG. 10, the uprights 81 are made in two pieces, namely, an inner or abutment member 82 and an outer or locking member 83. The inner member 82 may be constructed of two J-shaped plates welded together back to back to present a vertical web 84 with laterally spaced outwardly facing continuous abutments 85 presented at opposite sides adjacent its inner edge.

The clamping member 83 is channel-shaped and adapted to fit over the web 84. Extending across the interior of the channel member 83 and welded thereto are a plurality of plates 86 each centrally slotted as at 86*a* adjacent the inner face of the channel to constitute a hook element. The web portion 84 of the clamping member is complementally slotted as at 87 to present tapering upright tongues 88 positioned to enter the slots 86 and lock the parts together. The taper of the tongues serves to draw the channel member inwardly to clamp the wall panels to the abutments of the inner member 82.

To accommodate the slope of the roof section at the beam forming the end frame unit, a special wall panel 90 is provided. This panel is suitably tapered and its upper edge is formed with an outwardly turned inclined flange 91 adapted to hook over the inner flange 49 of the beam as shown in FIG. 9. Notches 91' at the ends of the panels afford clearance for the projecting portions 85 of the member 82. The lower edge of the panel 90 is formed with an inwardly turned flange 57 precisely like that of the standardized wall panel strip 55 and adapted to interengage with the flange 56 of one of the latter panels. The lowermost panel of the series is connected to the foundation in substantially the same manner as the lower side wall panels previously described. For that purpose there is provided an anchor plate having the usual flat body 66 with its outer edge flanged outwardly as at 67. The inner edge of the plate is turned up to form the flange 92 which is slotted for receiving bolts 93 adjustably securing the connecting element 70 in place. This element as previously described has a flange 72 adapted to hook over the lower flange of the bottom panel 55 of the series and is pressed down to tension the series of panels. After tensioning the connecting element is locked in place by tightening the nut on the bolt 93.

The panel 90 and companion panels 55 are installed as above described with the locking members 83 removed from the assembly. When the panels are all in place, the locking members are secured in place by hooking the elements 85 over the tongues 88 and forcing the members downwardly until wedged tightly against the wall panels. The locking members are each secured against upward movement by a cap member 94 having a channel-shaped body 95 dimensioned to telescope over the upper end of the locking member as shown in FIGS. 9 and 10. A flat plate 96 welded to the top of the body 95 is adapted to abut the lower face of the beam 42. An upwardly turned flange 97 on the outer edge of the plate has its end portion turned downwardly to hook over the flange 49 of the beam thereby preventing rain or snow from entering the upright. The cap is firmly secured to the locking member as by bolts 98 as shown in FIG. 9, the bolts being accommodated in vertical slots 99 in the locking member to permit any adjustment

necessary to effect a tight fit for the uprights against the overhead portion of the beam 42.

In the event that an opening for a wide door in the end wall is desired, such opening is framed by a lintel beam 101 which is bridged between two of the uprights 81 and bolted or otherwise suitably secured to them at the desired height as shown in FIG. 1. The space above the door opening is fitted with short uprights 81*a* similar to the uprights 81. Panels 55 and 90 close the space between the uprights as previously described. The door opening may be fitted with any type of closure desired including an overhead type door such as that shown in FIGS. 30 and 31 and described in more detail hereinafter.

Windows may also be provided in the side and end walls of the building structure in a simple and expeditious manner by means of a frame 102 (FIGS. 27–29) provided by the invention. The frame is generally rectangular and is provided with channel-shaped side members 103 adapted to receive the ends of the wall panels as shown in FIG. 27. Preferably the window frames are dimensioned to fit between two of the frame units 42 or between two of the uprights 81 and the spaces between the side members 103 and the adjacent frame units or uprights are closed by short panels 55*a* which can be cut from standard panels at the factory (see FIG. 29).

Welded or otherwise attached to the upper rail 104 of the window frame is a connecting element 105 of thin sheet metal the same width as a wall panel. The element has along its upper edge portion an outwardly directed inclined flange 106 adapted to interengage with the lower flange 57 of a wall panel 55 as shown in FIG. 28. A similar connecting element 107 welded to the lower rail of the window frame has a flange 108 at its lower edge interengageable with the upper flange 56 of a wall panel 55. It will be appreciated that the joints between the panels 55*a* and the companion beams, uprights or window frame may be sealed with the resilient pads 80 as previously described.

A door opening may also be provided in the building wall at any desired location by a door frame 110 similar in construction to the frame 102 except for its longer vertical dimension and the omission of the bottom rail. The door frame is provided with the connecting element 105 similar to that of the window frame and the spaces at the sides of the door are closed by the short wall panels 55*a* as described. It will be evident that the frames 102 and 110 afford a high degree of flexibility with respect to the location of doors and windows in the building structure.

The invention also provides novel means for lining the interior of buildings constructed from parts and in the manner above described. The lining is preferably in the form of rectangular panels 115 which may be of wood, plastic, insulating compound or any other suitable material. Channels into which the insulating panels may be inserted are defined by I-bars 116 suspended from the inner channels of the frame units 42 and spaced apart the width of a lining panel as shown in FIGS. 2–4. The curvature of the beams permits continuous paneling from the roof peak to to building foundation.

In accordance with the invention the I-bars are secured to the beams by simple snap-on clips 117 which can be applied quickly and with a minimum of labor. The clip as shown in FIG. 5 comprises a flat section 118 adapted to fit flush against the top of a bar and having its side edges curled inwardly as at 119 to embrace the upper flange of the bar. An integral extension 120 at one end of the section 118 and having a width substantially equal to that of the beam flange 49 terminates in a resilient tip 121. To install an I-bar it is only necessary to slip the clips 117 on to the upper flange to the bar, a pair of clips being required for each beam to which the bar is to be secured. The clips of each pair are mounted so as to face the beam and are simply slid along the bar until their resilient tips engage and snap over the flanges 49 of the beam.

An inclined ceiling results when the I-bars are mounted directly on the beams 42 as above described. In case a horizontal or drop ceiling is desired, auxiliary horizontally disposed ceiling support bars 125 are installed. These bars may conveniently comprise channels having flanges 126 of the same width as the beam flanges 49. This is to accommodate the clips 117. The I-bars 116 may then be secured to the support bars by the clips in the manner previously described to form the channels in which the lining panels 115 may be fitted.

The bars 125 are preferably supported from the roof sections of the frame units 42 by means of hangers 127. Each hanger comprises a length of pipe or conventional electrical conduit 128 secured as by a nut 129 to a connecting element 130. The element 130 comprises a generally U-shaped sheet metal stamping having legs of slightly different lengths conforming to the slope of the roof section of the beam and terminating in outwardly directed flanges 131. By tilting the element relative to the beam, the flanges may be inserted into rectangular openings 132 in the lower face of the beam. For convenience the beam is formed in the factory with weakened sections or knockouts 133 spaced apart along the beam as shown in FIG. 12. These knockout openings not only serve as anchorage points for the hangers but can also serve as outlets for electrical conductors or the like run through the hollow portion of the beam. Upon release, the legs of the connecting element spring back so that the flanges 131 engage the beam and provide support for the hanger. Flange plates 134 adapted to telescope over the legs of the connecting element are frictionally held in place to close the sides of the element 130.

The conduits 127 project through suitable openings in the support bars 125. Support for the bars on the conduits may be provided in any preferred manner, as for example, by dished or convex clamp washers 135 of the type which firmly grip the conduit when weight is applied to their upper faces. Preferably the support bars are anchored to the wall sections 44 of the beams 42 to prevent endwise movement. Such anchoring may be effected by a clip 136 having a T-shaped end adapted to be inserted through one of the openings 132 and dimensioned to straddle the opening when turned to the position shown in FIG. 17. Its outer end is formed of a resilient, downwardly turned tip 137 adapted to hook over a flange 138 on the end of the support member.

The hangers 127 may also be used in supporting lighting fixtures 140 which may be of any desired type. Electrical conductors 139 for the fixture are carried back through the conduit 127 to the interior of the beam 42 which as explained heretofore provides an elongated closed passage for electrical conductors or cables. A closed conduit for carrying conductors from beam to beam is provided by the frame element 52 when closed by an unveiled, channel shaped closure panel 52. It will be understood of course that a suitable opening or openings will be provided in the outer face of the beam preferably in the upright wall section 44 through which connection with the exterior power source may be made.

FIGS. 18–22 show a modified form of the building structure which may be used to advantage for some types of buildings. Referring to FIG. 18, frame units 42*a* are made up of beams having the same general configuration as the beams forming the frame units 42. In this instance, however, the beam is formed with a rib 46*a* comprising a single vertically disposed plate welded to channel members 47*a* and 48*a* at opposite edges. As in the previously described beam construction the channel 47*a* has flanges 49*a* forming continuous outward facing abutments extending the full length of the beam for cooperation with the closure or wall panels forming the wall of the building.

The beams are assembled to form the frame units 42*a* in the same manner as the assembly of the frame units 42. The opening between the beams is closed by wall panels 55*b* which differ from the panels 55 only in that the bent tips 58 and 59 are omitted from the flanges 56 and 57. The method of assembly is the same and the flanges of the panels interlock in the same manner as the flanges of the panels 55 (note FIGS. 18 and 19). The building may be lined with panels 115 (FIG. 19) seated in channels formed by I-bars 116 secured to the frame by the snap-on clips 117 as before described.

While the joints between the panels 55*b* and the beam web 46*a* may be sealed by resilient pads as before explained, an alternate arrangement is shown in FIGS. 21 and 22. In this arrangement, elongated relatively thin metal strips 145 are welded to the web along their outer edges on opposite sides of the beam. Each strip has an outwardly extending resilient inner portion 146 adapted to project over and press on the outer face of the adjacent panels 55*b*. The strip 145 thus not only serves to hold the wall panels securely in place but also acts to deflect rain from the joint between the panels and the frame unit and thus minimize the entrance of water. However, any moisture leaking through the joint is collected in the channel 47*a* and carried off to the ground.

As in the previously described building structure, the topmost panel 55*a* of each series is interengaged with the flange of the cap member 60. The lowermost panel of the series is secured to the foundation rather than to the foundation plate 65*a* as by bolts, or studs 147, provided in the foundation structure as shown in FIG. 20. The studs extend through holes in the lower flange 148 of a connecting element 149 which has an outwardly turned and inclined flange 150 adapted to interengage with the lower flange of the panel 55*b*. The series of panels may accordingly be tensioned by turning down the nuts on the studs 147.

The beam construction contemplated by the invention is readily adaptable to provide double walls and roofs for building structures. When a double wall is required, an elongated metal plate 151 is welded or otherwise secured along its lower edge to the outer channel 48*a* of a beam as shown in FIG. 21. The plate is equipped with a hold down clip 145 having a flexible outwardly bent edge portion 146 as previously described. The plate 151 is located on the centerline of the channel 48*a* whose flanges 152 thus define outwardly facing abutments at opposite sides of the beam comparable to the abutments adjacent the inner edge of the beam. Interengaged panels 55*b* resting on the abutments close the space between the beams, the panels forming a complete wall and roof spaced outwardly from the wall and roof formed by the panels 55*b* carried on the abutments defined by the flanges 49*a*. The space between the walls may be filled with insulating material if desired. It will be understood that the same modification may be made in the case of the box-type beams 42.

In the particular building structure shown in FIGS. 21–23 the topmost panel of the outer series is interengaged with and anchored by the cap 60. The lowermost panel of the series has its bottom flange interengaged with the complemental flange of a connecting element 153 (FIG. 23). This connecting element is secured to the foundation 43 by anchor studs 154. The series of panels may be tensioned by screwing down the nuts on the studs. The resilient hold down strips 146 on the plate 151 project over the edge portions of the panels 55*b* and assist them in retaining them in tight engagement with the abutments.

Buildings constructed from the beams 42*a* and panels 55*b* may be lined in the same manner and with the same parts previously described. Thus the I-bars 116 may be secured to the beams by the snap-on clips 117 to form channels for the reception of the lining panels as shown in FIGS. 25 and 26. In some cases it may be desirable to draw some of the intermediate beams 42*a* together to insure a water tight joint with the panels 55*b*. This is readily done by means of tie rods 155 passed through alined holes in the beams and having nuts 156 threaded on their projecting ends as shown in FIGS. 25 and 26.

FIGS. 30 and 31 show details of a novel segmental overhead sliding door that may be used to advantage in building structures of the type above described. The door includes a pair of flexible carriers, one at each side of the door. Each carrier comprises a series of straps 160 attached at opposite ends to sleeves 161. Pins 162 passing through the alined sleeves associated with adjacent straps define a hinged joint between said straps each of which constitutes a door segment. Journaled at 163 on each of the straps 160 are rollers 164 adapted to engage tracks 165 which may be mounted on the door frame in any preferred manner. Closure or wall panels 55*c* may be utilized to close space between the two carriers.

An auxiliary structure for extending and closing one end of a building of the type above described is shown in FIG. 32. In this construction a plurality of beams 42*a* are assembled in a semi-circular group with their upper ends converging to a connection with a cap member 166 suitably secured to the end frame unit to the building structure. The lower ends of the beams are uniformly spaced apart and anchored in the usual manner to a foundation structure which in this instance is semi-circular. The spaces between the beams are closed by wall panels 55*d* which are cut from regular panels to the proper size and shape as dictated by the converging assembly of the beams.

A deck or roofing structure affording shelter for a door or other opening in the building wall is shown in FIG. 33. This structure comprises a series of beams 170 of the same general construction as the beams 42*a*. The beams have their lower ends anchored to a suitable foundation while their upper ends are bolted or otherwise suitably attached to frame members of the building with which they are alined. Preferably, the inclined section 171 of each beam 170 (corresponding to the roof section 45 of a regular beam) has extensions of the abutment defining flanges of the inner channel extended to the outer channel portion of the beam. This permits the spaces between the beams to be closed by standard wall panels 55 to form a flat, gently sloping roof extending from the side wall of the building.

Résumé

It will be apparent from the foregoing that the invention provides a building structure having many novel and advantageous characteristics. The major building components may be readily standardized as to shape and dimensions, thus enabling them to be manufactured in large quantities by economical production methods. Assembly of the parts is very simple and can be effected with a few simple tools such as wrenches. Complicated and expensive joining operations requiring use of power tools on the job are eliminated so that erection of a building may be carried out by relatively unskilled labor.

Buildings constructed in accordance with the invention are strong and rigid and, moreover, present an unusually attractive appearance. The graceful arching beams which form the framework of the building present the major portion of their width externally of the building structure which greatly enhances the appearance of the building. The tensioning of the skin or covering places the beams under compression and materially increases the strength and rigidity of the building structure. Additionally, this arrangement affords a substantial degree of protection for the beams in case of fire within the building. The major portions of the beams are effectively protected from the flames and exposed to the air so that the heat may be readily dissipated.

The improved building structure includes numerous accessories which permit the buildings to be finished at-

tractively without greatly increasing their cost. Thus the walls and roof of the building may be lined with insulating or decorative paneling applied in a very simple and expeditious manner by relatively unskilled labor. Continuous paneling from the roof peak to the foundation is made possible by the gentle curvature of the knee portions of the beams. The provision of box-type beams affords convenient protective channels for introducing electrical wiring into the building and simplifies the wiring of the fixtures which incidentally may be utilized for supporting a drop ceiling if desired.

The provision of standard door and window frames is advantageous in that it permits installation of such openings at any desired place in the side or end walls of the building. The invention also provides simple structural parts for closing the ends of the building which afford a wide choice in the treatment of the building end walls.

I claim as my invention:

1. A building structure, comprising in combination, a foundation, a plurality of beams mounted in laterally spaced relation on said foundation, each beam including a pair of angularly related sections respectively defining a generally upright wall section and an inclined roof section terminating in a peak end, each beam presenting upwardly outwardly facing continuous abutments at opposite sides along its inner marginal edge, a series of elongated sheet-like panels extending between pairs of said beams and resting on said abutments to completely close the intervening space between said pairs of said beams, each panel having its upper and lower edges respectively formed to define outwardly and inwardly facing flanges engaging the cooperating flanges of adjacent panels to form a weathertight closure, an upper end panel extending between one pair of said beams and resting on said abutments adjacent said peak ends, said upper end panel having a lower edge formed to define an inwardly directed flange engaging the outwardly directed flange formed on the upper edge of the uppermost one of said series of panels, and a lower end panel extending between said one pair of beams, said lower end panel having an upper edge formed to define an outwardly directed flange engaging the inwardly directed flange formed on the lower edge of the lowermost one of said series of panels, and adjustable means interposed between said foundation and said lower panel for applying tension thereto to maintain said series of panels in rigid assembled relation between said one pair of beams.

2. A building structure according to claim 1 wherein means are provided for securing oppositely directed ones of said beams together adjacent said peak ends to define a generally gable-shaped building structure, and said upper end panel is formed to define a cap member having an inwardly directed flange formed on each edge thereof for respectively engaging the outwardly directed flange formed on the uppermost one of said series of panels on either side of said building.

3. A building structure according to claim 1 wherein said beams are provided with spring biased strips secured to opposite sides thereof, said strips extending parallel to and in opposed relation to said abutments for resiliently engaging said panels to hold them against said abutments.

4. A building structure according to claim 1 wherein said beams are formed with a body portion having a rectangular box-like cross section and said outwardly facing abutments are formed to define a moisture collecting and conveying channel adjacent each side of said beams.

5. A building structure according to claim 4 wherein said box-like cross section of said beams forms a continuous duct for the reception of electrical conductors, and said beams are provided with removable, prestruck knockouts at spaced intervals along the length thereof for affording access to conductors disposed within said duct.

6. A building structure according to claim 1 wherein resilient pads are interposed between the ends of said panels and juxtaposed portions of said beams to provide a weathertight seal therebetween.

7. A building structure according to claim 1 including a plurality of snap-on clips engageable with the abutment portions of said beams for supporting I-bars adjacent the inner faces of the beams in spaced relation to each other so that said I-bars define oppositely facing grooves extending transversely of the beams, and lining panels with edges engageable in the grooves defined by spaced pairs of said I-bars.

8. A building structure according to claim 1 including means forming a drop ceiling within the building including a series of channel members supported in a horizontal plane by hangers depending from said beams, a plurality of I-beams, snap-on clips engageable with said bars and said channel members securing the bars to the members in uniformly spaced relation, and lining panels engaged in the channels defined by the spaced I-bars.

9. A building structure according to claim 8 in which said hangers also support lighting fixtures below the lining channels and serve as conduits for electrical conductors leading from the beams to the lighting fixtures.

10. A building structure according to claim 1 including a transverse wall defined by a series of uprights extending from the building foundation to one of the beams, each of said uprights comprising an inner section and an outer clamping section, said inner section including a flange portion defining outwardly facing abutments at each side of the upright, series of panels interposed between and closing the openings between adjacent uprights, the upper panel of each series having means engageable with said beam for securing the panel in place, all of said panels having their edge portions formed for interlocking engagement, means for connecting the lower panel of the series to the building foundation, and means on said clamping section cooperating with means on the inner section for drawing the two sections together to clamp the ends of said panels to the abutment on the inner section.

11. A building structure according to claim 10 in which the cooperating means on the inner and outer sections of the uprights comprise hook elements on one of the sections positioned to engage tapered tongues on the other section upon relative endwise movement of the sections.

12. A building structure according to claim 11 in which the uprights of the transverse wall are spaced apart the same distance as the beams of the building to accommodate wall panels of the same length for closing the sides, ends and top of the building.

13. A building structure according to claim 1 including a window frame dimensioned for reception between a pair of said beams, a panel-like element secured to the upper edge of said frame having an outwardly directed flange along its upper edge for interengaging the inwardly directed flange of one of said wall panels above said frame to support the frame, and a panel-like element secured to the lower edge of said frame having an inwardly directed flange along its lower edge for interengaging the outwardly directed flange of one of said wall panels installed below the window frame.

14. A building structure according to claim 13 wherein the window frame is dimensioned to fit between said pair of beams with clearance space at both sides, and means on the sides of said frame for cooperating with the beams to support short wall panels for closing the clearance spaces between the frame and the beams, said short wall panels having their upper and lower edges respectively formed outwardly and inwardly directed flanges to interengage with each other and with those wall panels above and below the window frame.

15. A building structure according to claim 1 wherein said outwardly and inwardly facing flanges are generally Z-shaped and are dimensioned for substantially continu-

ous face-to-face engagement with a cooperating flange on another of said panels.

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FRANK L. ABBOTT, *Primary Examiner.*

R. A. STENZEL, *Assistant Examiner.*