Oct. 12, 1971 L. W. HORVATH 3,611,650

PREFABRICATED STRUCTURE FOR SHELTER OR STORAGE

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FIG. 1

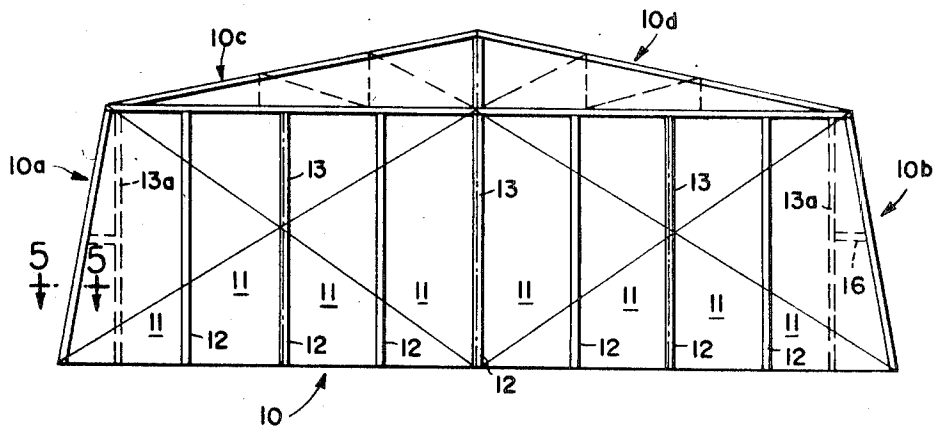


FIG. 2

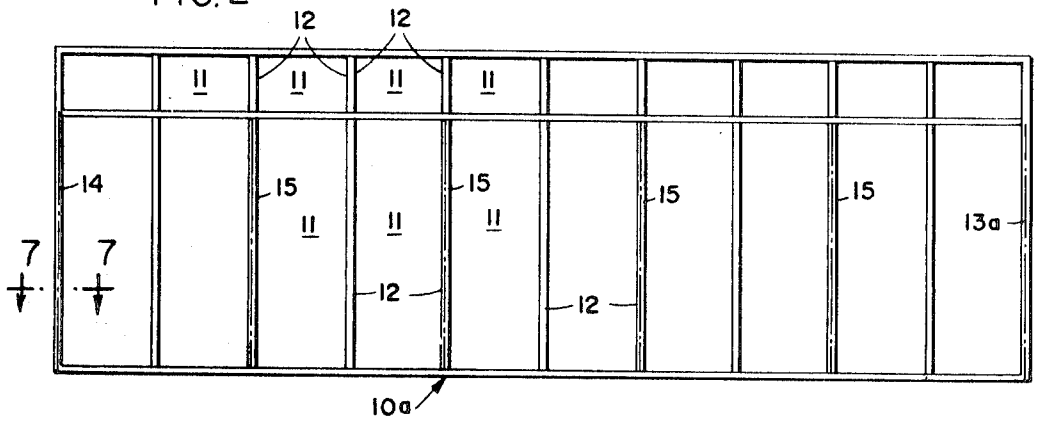
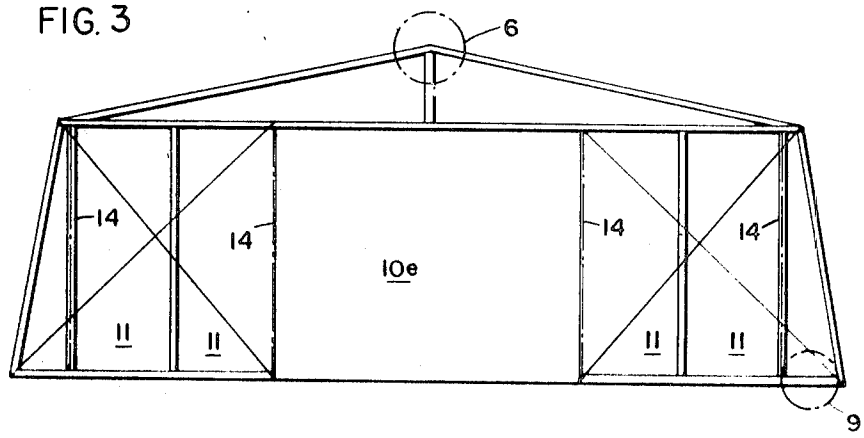


FIG. 3



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FIG. 4

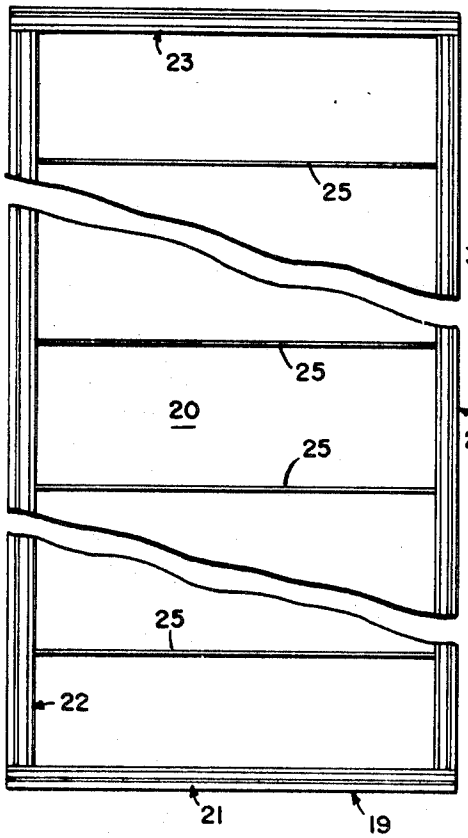


FIG. 5

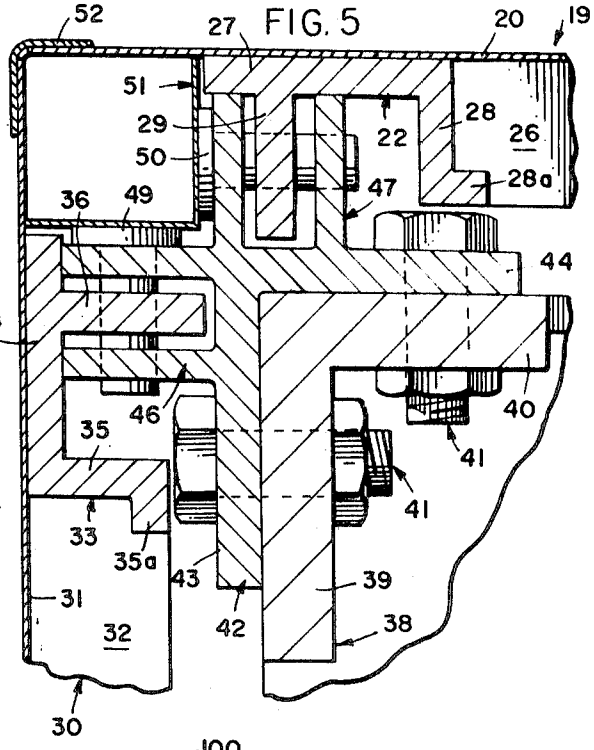


FIG. 6

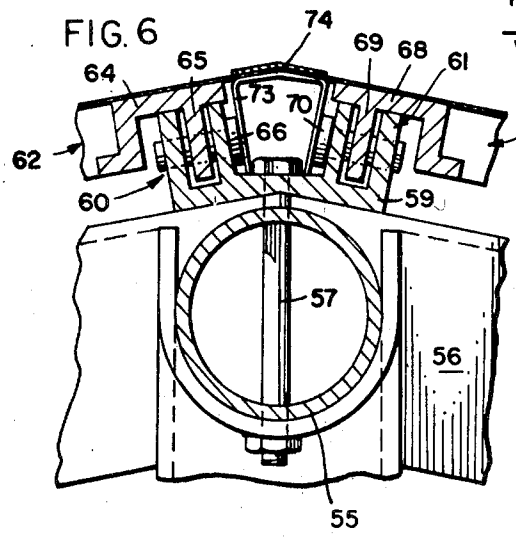


FIG. 10

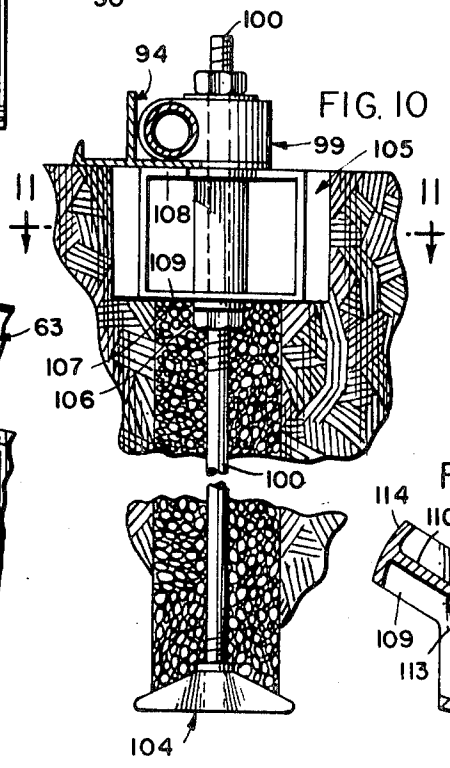
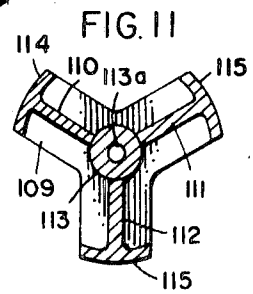


FIG. 11



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FIG. 7

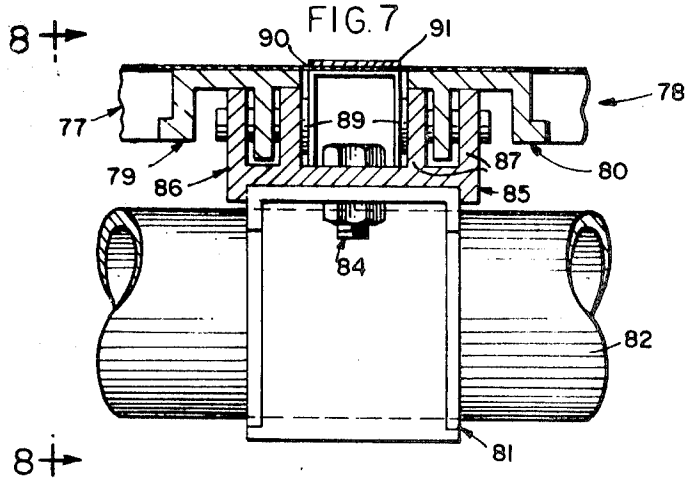


FIG. 8

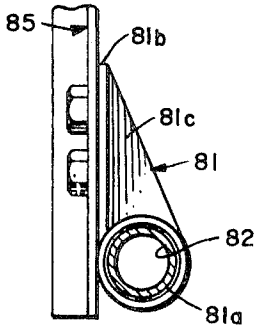
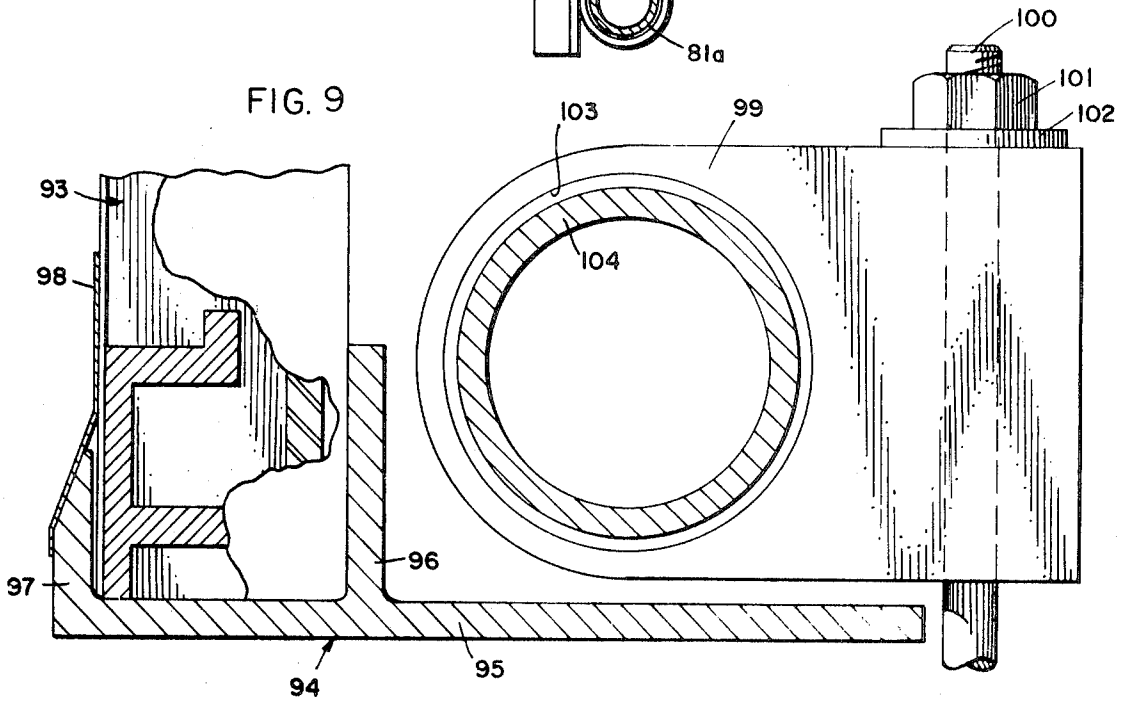


FIG. 9



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3,611,650

PREFABRICATED STRUCTURE FOR SHELTER OR STORAGE

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Filed May 12, 1969, Ser. No. 823,621
Int. Cl. E04c 1/30
U.S. Cl. 52—90 8 Claims

ABSTRACT OF THE DISCLOSURE

Shelter or storage space is provided by a prefabricated structure which is easily erected without the need for field fabrication and simply dismantled; yet the structure is strong and highly resistant to wind forces, etc. The roof and side walls are formed from individual panels of aluminum sheet material which are provided about their periphery with extruded male connecting strips having a connection flange extending longitudinally of each strip. The superstructure is formed by means of interconnected tubular members which carry extruded female strips with elongated U-shaped channels for receiving the connection flange of the male extruded strips substantially along their respective lengths. The U-shaped receptacles are provided with apertures which align with corresponding apertures in the connection flanges of the male connecting strips. Lock pins are inserted through each set of aligned apertures; and the pins are held in place by removable retainer members for easy disassembly. The structure is secured to the ground by re-useable footings resembling a paddle-wheel in horizontal cross section.

BACKGROUND AND SUMMARY

The present invention relates to an easily-erected, prefabricated, all-aluminum shelter which may be insulated, if desired.

A portable hangar for aircraft which has structural stability when erected, yet is easily disassembled for storage or movement is disclosed in my Pat. No. 3,270,755 entitled Portable Hangar. When erected, the enclosure is stabilized against wind forces by means of guy wires secured to tie-down castings. My Pat. No. 3,389,514 for Tubular Frame Shelter, issued June 25, 1968, discloses a tubular frame superstructure consisting of a number of tubular members, adjacent ones of which are connected at their ends to define side wall supports and roof trusses. Four tubular members are connected at each truss corner by integral fittings having four separate receptacles—one for each of the tubes. A similar connection is provided for the four tubular members which define the truss ridge. The tubular members are secured in their respective fittings by pins which extend through aligned openings in the tubular members and the fittings.

The present invention represents an improved easily-erected, prefabicated shelter which requires no fabrication in the field and is more easily disassembled for storage or movement, yet which will more readily withstand higher forces produced by incident winds and rough weather.

As is known, a building may be designed to withstand the loading caused by a wind in a number of different ways. In one structure the load-bearing members are vertical columns spaced-apart about the periphery of the building, cross braces may be provided between adjacent columns so that incident wind forces are transmitted either directly to the vertical columns or to the cross braces, to the columns and then to the footing.

A second known type of wind-loaded structure uses an integral side walls so that each wall member (which may be a sheet of material) acts as a diaphragm. An incident

wind causes the diaphragm to flex thereby transmitting a stress force to the periphery of the sheet material. Along the ground periphery, the force is transmitted to the foundation or other footing. The stress forces which are transmitted to the other peripheries of the wall panel (namely, the vertical edges and the upper horizontal edges if the panel is rectangular) are transmitted to adjacent panels which have a perpendicular orientation and thence to the footings. Thus, the forces transmitted through the perpendicularly-oriented panels are transmitted to the ground eventually. This provides a very rigid box parallel to the wind direction (or a component of the wind vector). Obviously, any given wind can be broken up into orthogonal components and the same result would be effected for each of the two orthogonal components by perpendicular building wall sections.

It is desirable from the standpoint of rigidity and stability to have a shelter or other storage structure exhibit the above-described diaphragm effect—namely, that of having sufficiently rigid wall panels to transmit the force of incident wind via stresses of the wall panel to its periphery and from there, either directly into the footings or to perpendicularly-oriented panels from which the force is ultimately coupled to the footings. This effect may be combined with the other design wherein vertical column members are also employed; and in a preferred embodiment of the present invention, there is such a combination.

The provision of a true diaphragm is easy if one employs a solid continuous material for covering—such as a heavy corrugated metal sheet material. But this complicates site fabrication of the shelter in some cases. That is to say, fabrication and dismantling is facilitated with panels, but the use of panels heretofore has made it difficult to form a wall structure that acts like a rigid diaphragm in resisting winds.

The present invention provides for a portable, easily-erected prefabricated structure for shelter or storage wherein the wall and roof panels are formed in modular sections which are easily assembled or disassembled. When in an assembled state, the walls form a rigid structure so as to act as a diaphragm in the transmission of incident wind forces. Each of the modular panels is essentially rectangular in form (some panels are aligned to conform to the roof and or side walls pitch contour) and it is provided about its periphery with a male panel connector which is a strip of extruded metal having a first flat, elongated piece to which a face panel of aluminum sheet metal is secured, an elongated flange member extending perpendicularly of the panel-receiving strip, and a second strip parallel to the flange and located at the interior edge of the panel-receiving strip for containing insulation foamed onto the panel, if such is used.

These male panel extruded connecting strips on opposing sides of a panel form mirror images; and adjacent panel connecting extrusions are joined and locked together by means of an elongated, female panel connecting strips which define a channel receptacle for receiving the flange of the male panel connecting extrusion. Each female panel connecting extrusion is joined to two adjacent male panel connector strips by means of removable lock pins to form an integral, rigid structure of the two adjacent panels along the joint between them.

Roof panels are joined to adjacent roof panels and to side wall panels in a similar fashion; and roof panels on one side of the A-shaped roof are connected along the ridge to roof panels on the other side of the structure by the same method.

In a preferred embodiment, a unique, re-useable footing is used as a support for the structure and to anchor the same to the ground. Other features and advantages of

the present invention will be apparent to persons skilled in the art from the following detailed description of a preferred embodiment accompanied by the attached drawing wherein identical reference numerals will refer to like parts in the various views.

THE DRAWING

FIGS. 1–3 are respectively rear, side, and front elevation views of a completed structure incorporating features of the present invention;

FIG. 4 is an interior view of a wall or roof panel;

FIG. 5 is a horizontal cross section view of the connection of two corner panels;

FIG. 6 is a vertical cross section view of the interconnection between two panels forming the ridge of the roof;

FIG. 7 is a horizontal cross section view of the interconnection between two adjacent panels extending in the same plane;

FIG. 8 is a side view of the connection shown in FIG. 7;

FIG. 9 is a vertical cross section view of a side panel as it rests on the ground;

FIG. 10 is a partially broken away vertical elevational view of a preferred footing of the inventive structure; and

FIG. 11 is a horizontal cross section view of the footing of FIG. 10.

DETAILED DESCRIPTION

FIGS. 1–3 show the exterior of an assembled, prefabricated shelter or structure, generally designated **10**, incorporating the principles of the present invention. In FIG. 1, the panels forming the back wall are designated by reference numeral **11** with the joint between adjacent of the panels **11** covered by the strip of aluminum sealing tape designated **12**. The left side of the structure is generally designated **10***a* and the right side is generally designated **10***b*. The roof which has a broad A-shape; and it includes a first inclined side **10***c* and a second inclined side **10***d*. The left side **10***a* of the structure is shown in FIG. 2 as comprising additional panels **11** with the joints again covered by a strip of aluminum sealing tape **12**. The panels for the roof are identical and also identified by reference numeral **11**, the juncture between adjacent roof panels also being sealed with aluminum tape **12**.

The front of the structure, shown in FIG. 3, is similar in elevation view to the rear as shown in FIG. 1 except that a door opening generally designated by reference numeral **10***e* is provided. However, aluminum panels **11** form the nonmovable wall portions of the front of the structure.

In a preferred embodiment, the basic framing plan includes an end-connected frame of tubular members as is disclosed in the above-described Pat. No. 3,389,514. Although in plan view, the structure there had a T-shape; nevertheless, the formation of the roof trusses and vertical framing columns may be the same as shown there. For example, with the illustrated embodiment wherein an end-to-end ground dimension for the rear elevation of FIG. 1 might be 33'8", there would be five approximately equally spaced apart tubes extending in a vertical direction and linked together to form a rigid frame at their top and bottom ends. The center tubes are shown schematically by indicating their vertical center lines as the chain lines **13**. The side tubular framing members are designated **13***a*. Four such vertical tubular columns form the basic framing for the front wall of the structure (center lines designated **14** in FIG. 3); and four tubular columns **15** form the basic framing for each of the side walls. The front and rear walls are preferably cross-braced as shown for additional support.

The four tubular columns bracing each side wall are intermediate the front and back ends of each side wall to form five separated spaces over which the panels are extended. There are no supporting tubular columns at the corners of the building; rather, the corners of the building are formed by 90° angle irons which are supported by weldments (see **16** in FIG. 1) to the vertical column at either edge of the front and side wall frames. Thus, for this structure there are a total of six roof trusses, the front and rear trusses being supported respectively by the front and rear vertical framing sections and the four intermediate trusses being supported by the four intermediate tubular columns in the side walls. Again, the trusses are preferably made of a tubular construction similar to the one shown in the latter of the above-described patents.

Turning now to FIG. 4, there is shown a detailed construction for a typical individual panel section as viewed from the inside as it is intended to be placed on a structure. The panel contains a solid sheet of aluminum generally designated by reference numeral **20** which is rectangular in shape. It will be appreciated that the length and width of the sheet **20** is any convenient value. A male connecting strip of extruded aluminum is formed about the entire perimeter of the sheet **20** and secured thereto by means of a high strength modified epoxy adhesive widely used in the aircraft industry. The panels covering the superstructure have a normal width of 4 feet and a length, depending upon the intended use, of up to 13 feet. Preferably, the sheet material is an aluminum sheet having a thickness of 0.25 inch and may be stucco embossed on its exterior surface.

The male connecting strip or frame of extruded aluminum includes a lower section designated **21**, a left side **22**, an upper side **23**, and a right side **24** in FIG. 4. In cross section, each of the framing members **21–24** is similar except that the cross section view of a framing member on one side of the panel is a mirror image relative to the cross section of the framing member on the opposing side. That is, a horizontal cross section view of the frame member **22** is the mirror image of the cross section of the section **24**. The surface panel may extend slightly beyond the frames in order to make a better joint, as will be made clear herein. This cross sectional shape will presently be described in detail.

A plurality of horizontally oriented, vertically-spaced-apart aluminum bars **25** extend between the side framing members **22** and **24** to add support and rigidity to the aluminum sheet **20**. Preferably, the interior of the sheet **20** is sprayed with a one-inch thick layer of rigid, high strength, closed-cell urethane plastic foam having a density of about 2.2 lbs./ft.^{3} and a K factor of 0.11 to 0.14. The foam, in addition to adding supporting strength to the aluminum covering panel provides an excellent insulation for the structure.

Turning now to FIG. 5, the panel **19** is shown as the upper panel which extends across the width of the page; and the aluminum sheet is again designated **20**, the urethane foam is designated **26**, and the left-side extruded framing member is generally designated **22**. In this vertical cross section looking down, the extruded aluminum framing member **22** is seen to have the general cross sectional shape of an F, including a back strip **27** to which the panel **20** is bonded, a top strip **28** extending at right angles to the back strip **27** at its upper edge and confining the foam **26** and a second flange or strip **29** perpendicular to the strip **27** and spaced from the top strip **28**. The distal edge of the top strip **28** is formed at a right angle away from the flange strip **29** as at **28***a* for further confining the sprayed foam **26**.

FIG. 5 is, of course, a horizontal cross section of a corner of the structure of FIG. 1; and the rear panel which is perpendicular to the side panel **19** is generally designated by reference numeral **30**. It is similar to the panel illustrated in FIG. 4—thus including an exterior sheath of aluminum **31**, a layer of urethane foam **32** and a side extruded frame member generally designated **33**.

The cross sectional shape of the extruded framing member **33** shown in FIG. 5 would be the same shape as a horizontal cross section view of the framing member **24** in FIG. 4 looking in a downward direction, as previous-

ly explained. The extruded framing strip **33** includes: a back strip **34**, similar to the previously-described back strip **27**, for receiving the aluminum panel **33**; a top or inner strip **35** having a right-angle end portion **35***a* for confining the foam **32**; and an intermediate flange strip **36** similar to the flange strip **29** of the extruded framing member **32**.

An aluminum angle iron generally designated **38** and including first and second perpendicularly-oriented flanges **39** and **40** forms a corner brace for the structure; and it extends substantially the entire length of a corner. Secured to it by means of bolts **41** is a female extruded connecting strip **42** which includes first and second perpendicularly-disposed flange strips **43** and **44** for engaging respectively the outer surfaces of the flange strips **39** and **40** of the angle iron **38**. It is these flange strips **43** and **44** of the female connecting frame **42** that are secured to the angle iron by means of the bolts **41**. At the corner of the female connecting strip **42** are first and second elongated channels generally designated respectively **46** and **47** for receiving respectively the connector flange **36** of the male connector strip **33** and the connector flange **29** of the male connecting strip **22**.

The U-shaped channel **46** includes a number of transverse apertures in each of the channel sides which are aligned and which permit attachment to the panel **30** by means of similar aligned apertures in the connector flange **36** of the male connecting strip **33**. A smooth lock bolt or pin **49** fits through aligned apertures to secure the panel **30** to the female connecting strip **42** and, thus, to the angle iron **38**. A similar lock pin **50** secures the male extruded connecting strip **32** to the flange **40** of the angle iron **38**. The bolts **49** and **50** are held in place by means of a vertically-extending thin aluminum retaining member **51** having perpendicular flanges for engaging respectively the heads of the bolts **49** and **50** and holding the same in place. The distal edges of the angle iron **51** are prevented from being moved by means of the aprons of the panels **31** and **20** extending slightly beyond the framing members. Hence, the angle iron **50** may be removed only by vertically displacing it; and the retainer **50** functions as a light weight, removable retainer means for holding the lock pins securely in place. Weather sealing is accomplished by merely rolling over the joints a pressure-sensitive aluminum foil tape marketed under the name of Tedlar and manufactured by Minnesota Mining and Manufacturing Company of Minneapolis. The tape is designated **52** in FIG. 5.

Turning now to FIG. 6 there is shown in vertical cross section, the interconnection between roof panels along the ridge of the structure. A tubular ridge member is designated **55**; and secured to it is a ridge casting **56** to which is secured by means of a bolt **57** a female ridge extruded connecting strip **59**. The ridge female connecting strip includes left and right side U-shaped channel receptacles generally designated **60** and **61** respectively which are angularly oriented relative to each other so that each channel extends generally perpendicular to the roof of the panels which are designated **62** and **63**. A male extruded connecting strip **64** associated with the panel **62** includes a connector flange **65** which fits into the U-shaped channel receptacle **60** for attachment thereto by means of a pin **66**, as previously described. Similarly, a male extruded connecting strip **68** includes a connector flange **69** which fits into the channel receptacle **61** and is secured thereto by means of pins **70**. An aluminum retainer strip **73** having a generally inverted U-shape holds the pins **66** and **70** in place; and the joint between the aprons of panels **62** and **63** is covered with tape **74**.

The juncture between a side panel and a roof panel (that is, along an eave) is similar to the connection shown in FIG. 6 except that, of course, the female extruded connector strip defines a greater angle between its two U-shaped channel receptacles because the angle between the side panel and the roof panel is greater than the angle formed by roof panels along the ridge.

In FIG. 7 there is shown a connector formation between adjacent panels wherein the panels extend in the same plane. The left and right hand panels are designated respectively by reference numerals **77** and **78**. The panel **77** is provided with a male extrusion connecting strip **79**; and the panel **78** is provided with a male connecting strip **80** which is the mirror image of the strip **79**, as illustrated. A base casting **81** is fitted around a tubular frame member **82** which extends in a horizontal direction as seen in FIG. 2, along the base of the structure. Secured to the base casting **81** by means of a bolt **84** is a straight panel extrusion connector **85** having left and right side U-shaped channel receptacles similar to the ones previously described and designated **86** and **87** respectively. The channel **86** receives the connector flange of the male connecting strip **79**; and the channel receptacle **87** receives the connector flange of the male connecting strip **80** of the panel **78**. The straight connector strip **85** is then secured to the panels **77** and **78** by means of pins **89**; and an inverted U-shaped retainer member **90** holds the pins **89** in place. A tape **91** covers the joint between the aluminum face sheets for the panels **77** and **78** as illustrated.

The base connector **81** is seen in side view in FIG. 8; and it comprises a hub **81***a* which is fitted about the tubular member **82**, a flange **81***b* for attachment to the vertically-extending straight strip connector **85**, and braces **81***c* (only one of which is seen) for supporting the flange **81***b* on the hub **81***a*.

Referring now to FIGS. 9, 10 and 11, a preferred method for securing the above-described shelter to the ground will be described. In FIG. 9, a vertical back panel is designated generally by reference numeral **93**; and it is received in a bottom extrusion generally designated **94** and adapted to be set on the grade about the periphery of the structure. The bottom extrusion **94** includes a generally horizontal plate member **95**, an intermediate, upstanding flange **96** and an outer flange **97**. The upstanding flanges **96** and **97** cooperate to define a horizontal channel for receiving the vertical back panel **93**; and a strip of sealing tape **98** covers the joint between the surface sheet of the panel **93** and the outer flange **97**. Inward of the flange **96**, a connector **99** is secured to a footing and anchorage by means of a vertically-extending anchor bolt **100**, nut **101** and washer **102**. The connector **99** defines a socket **103** for receiving a tubular frame member **104** which runs along the lower corner of the back wall above the inwardly-projecting flange portion of the base plate **95** of the ground extrusion **94**.

Turning particularly now to FIGS. 10 and 11, structure is shown for anchoring the shelter to the ground. As mentioned above, the base extrusion **94** is held down by means of a connector **99** through which a vertical anchor bolt **100** extends. The threaded anchor bolt **100** is secured at least five feet below ground level in an anchor **104**.

Secured to the anchor bolt **100** just beneath the surface level is a paddle-shaped footing **105**. Further details regarding the anchorage method may be found in the last-identified patent, but the paddle-wheel footing **105** represents an improvement over the method illustrated therein that this footing permits easy assembly, removal and reuse of the entire anchorage. The anchor bolt **100** is threaded over an extended area of its top portion so as to receive a second bolt **106** and washer **107** beneath the footing **105** to adjust its vertical location. In plan view, the paddle wheel **105** includes a Y-shaped upper plate **108** and a lower, similarly-shaped bottom plate **109**. Referring to FIG. 11, three radially-extending ribs **110**, **111**, and **112** extend from a central hub **113** outwardly of each of the three branches of the Y shape and provide a ribbing between the upper plate **108** and lower plate **109**. A second set of three ribs including members **114**, **115**, and **116** extend transverse respectively of the ribs **110**, **111**, and **112** at the distal ends of the branches of the Y. The hub

113 defines an aperture 113*a* for receiving the anchor bolt 100; and the connector 99 rests on the upper surface of the top plate 108 at grade level.

Having thus described in detail a preferred embodiment of the inventive prefabricated structure, it will be appreciated that the structure is easily assembled with a minimum of field fabrication; and that it comprises lightweight, rust proof elements which combine to provide a strong, durable shelter or storage place. Further, the side panels are easily separated from each other, yet, when connected together and forming part of the structure, these panels and their interconnection are rigid enough to form a unitary wall surface which acts like a diaphragm in resisting incident winds. Further, with the cross bracing, a combined effect of a diaphragm together with column bracing is achieved.

It will be apparent to persons skilled in the art that certain modifications may be made to the detailed embodiment shown while continuing to practice the inventive principle; and it is, therefore, intended that all such modifications or substitutions be covered as they are embraced within the spirit and scope of the appended claims.

What is claimed is:

1. In a prefabricated structure including a skeletal framework of column members, the improvement comprising: a plurality of panels for providing the walls and roof of said structure, each panel including a continuous surface sheet and a first extrusion member attached to the back of said surface sheet and having a first connector means extending along the edges thereof which are to be connected to said frame, a second extrusion member, adapted to be attached to said column members and having a pair of second connector means for receiving and interlacing with a pair of said first connector means of adjacent panels, one of said first or second connector means defining an elongated channel extending parallel to the edge of an assembled panel and the other having a flange for extending into a channel of said one connector means, both of said connector means providing a plurality of aligned holes, the axes of which extend parallel to an associated sheet; a plurality of pins with head flanges for slidably fitting through aligned apertures in both of said connector means with the head flanges of pins for adjacent panels in opposing relation; and elongated retainer members removeably received between the pair of second connector means on said second extrusion member for engaging the head flanges of opposing pins and preventing the dislodgement of said pins.

2. The structure of claim 1 wherein said first extrusion member on said surface sheet includes a male connector having a first elongated portion bonded to said sheet and a connector flange extending inwardly thereof and away from said sheet, and wherein said second extrusion member includes a pair of female connectors each comprising a channel receptacle for receiving the connecting flanges of the male connectors of adjacent panels, each of said connector flanges and receiving channels being provided with aligned holes for receiving pins, and said female connectors being spaced-apart to receive therebetween an elongated retainer member.

3. The structure of claim 2 characterized in that when said panels are interconnected to form walls and a roof, said walls and roof form a rigid structure and act as a diaphragm in transmitting incident wind forces to the ground and to perpendicularly-oriented skeletal column members.

4. The structure of claim 2 wherein each of said panels further comprises an insulating foam interior of said sheet and within the associated male connectors arranged about the periphery of said sheet, each sheet further including a plurality of spaced-apart aluminum ribs extending the width of said panel and between male connector members.

5. The structure of claim 2 wherein said skeletal frame means comprises an aluminum angle iron at each corner defining said structure, a female connector strip extending longitudinally of each angle iron and defining first and second channel receptacles for receiving connector flanges of perpendicularly-oriented side panel members, and means securing said receptacle means to said aluminum angle.

6. The structure of claim 5 further comprising lock pin means for securing said connector flanges to said channel receptacles by fitting through aligned apertures in each, and angle retainer means having first and second perpendicular flanges for engaging respectviely the pins associated with each of said connector flanges for holding the same in place, the face sheets of said panels extending beyond their associated framing strips for retaining said retainer means.

7. The structure of claim 2 further comprising a tubular ridge pole forming the ridge of said structure, a plurality of ridge castings secured to said ridge pole, a female connecting strip attached to said castings and providing first and second angularly oriented receptacle means for receiving respectively first and second connector flanges of roof panels on opposing sides of said ridge, and tape means covering the joint between said panels.

8. The structure of claim 7 further comprising a plurality of lock pins securing said connector flanges within their associated receptacles, an inverted U-shaped retainer means for retaining said pins in their assembled condition, whereby when said retainer means is removed, said pins may be slipped from their associated flanges.

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