

Feb. 16, 1971

C. W. MOSS

3,562,975

PREFABRICATED SHELTER AND METHOD OF ERECTING SAME

Filed Jan. 14, 1969

4 Sheets-Sheet 1

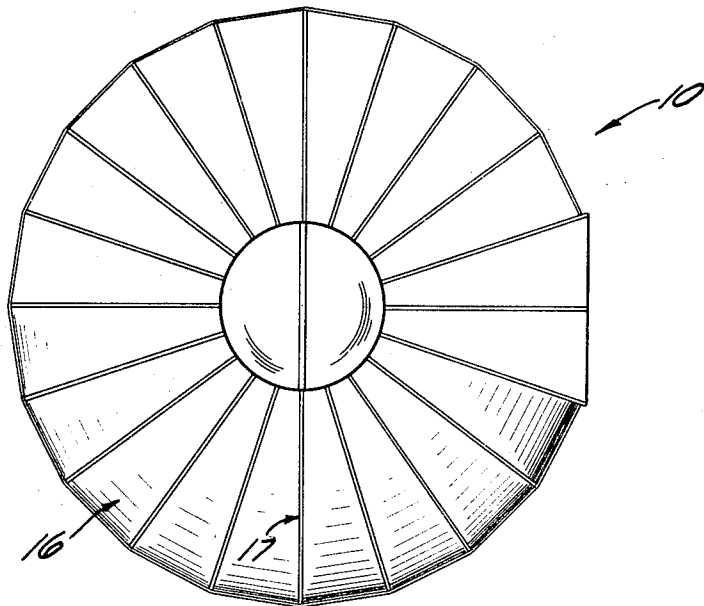


FIG. 1

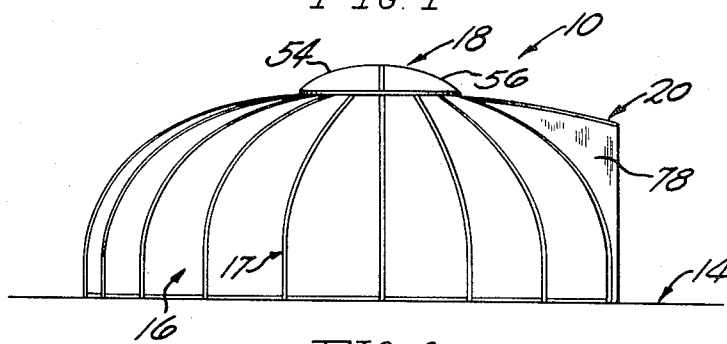


FIG. 2

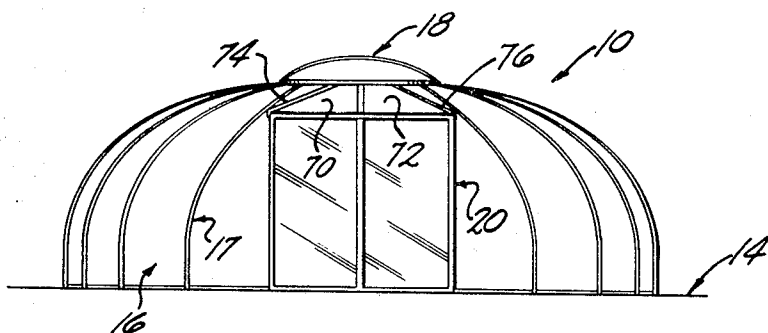


FIG. 3

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4 Sheets-Sheet 2

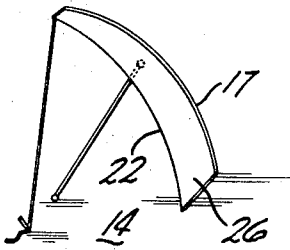


FIG. 4

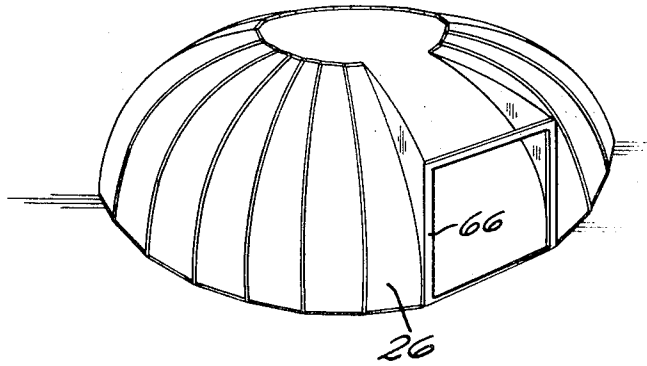


FIG. 7

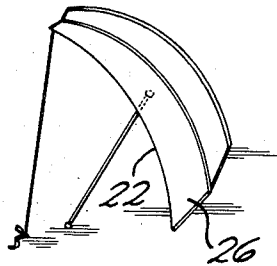


FIG. 5

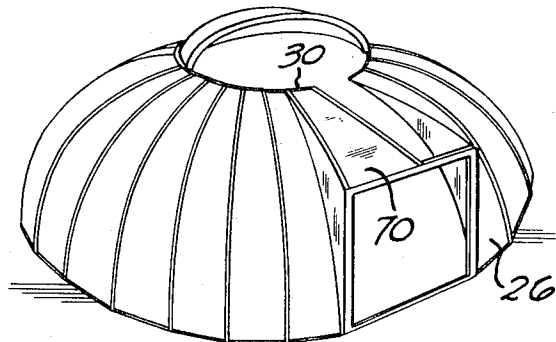


FIG. 8

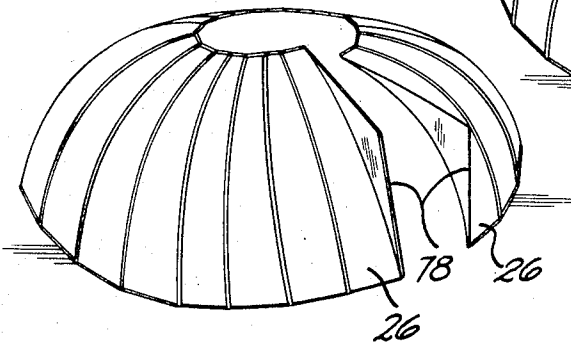


FIG. 6

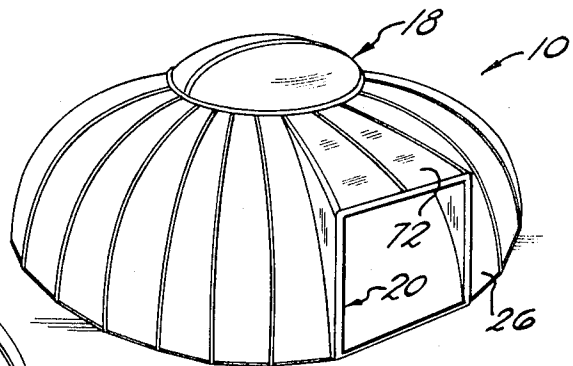


FIG. 9

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4 Sheets-Sheet 3

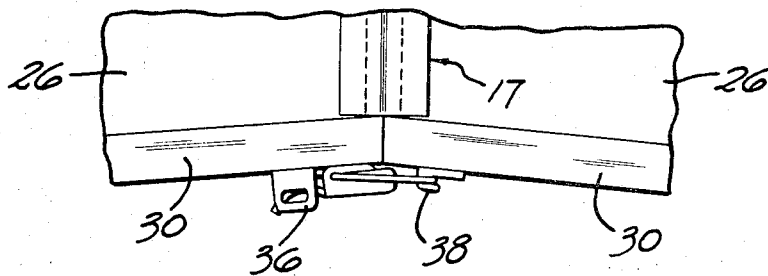


FIG. 10

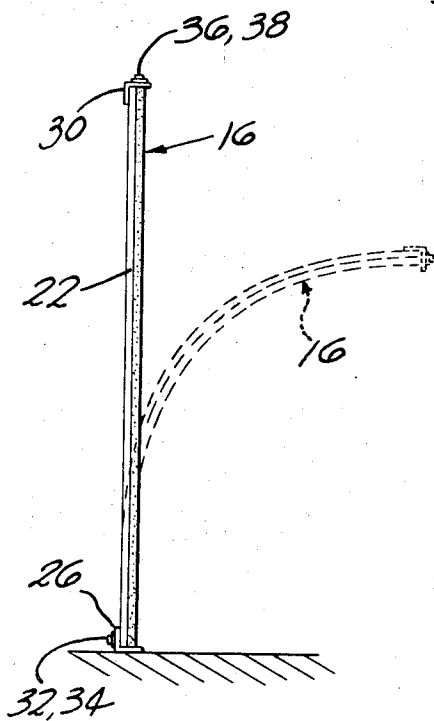


FIG. 11

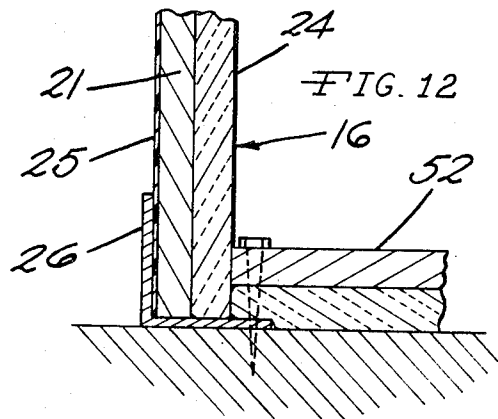


FIG. 12

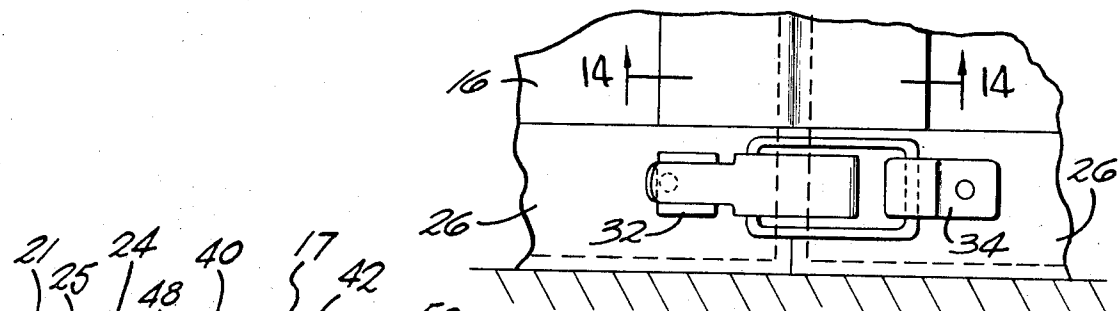


FIG. 13

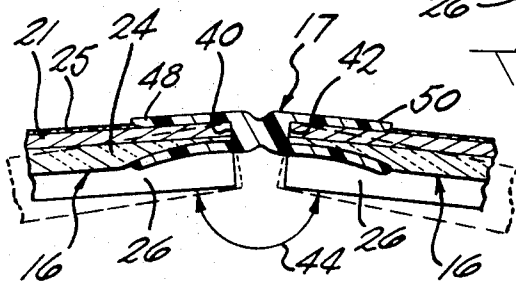


FIG. 14

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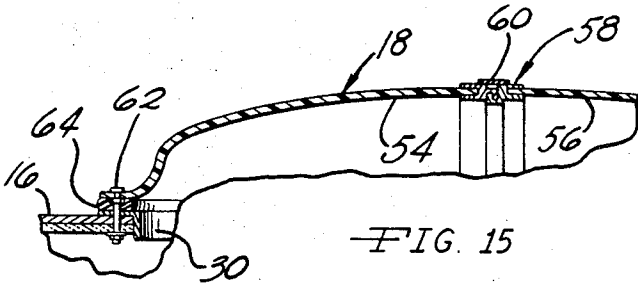


FIG. 15

FIG. 16

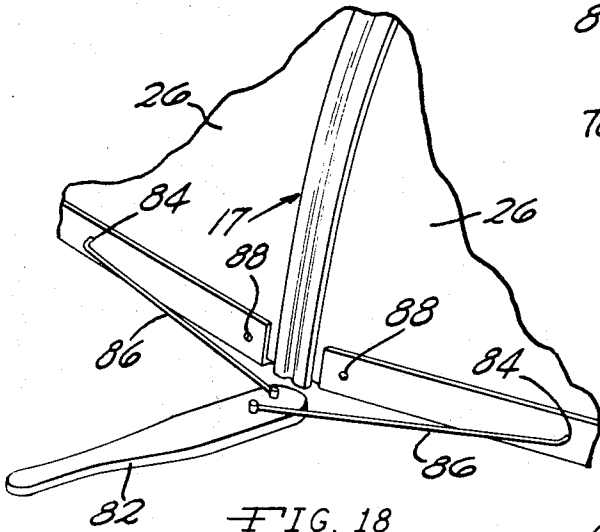
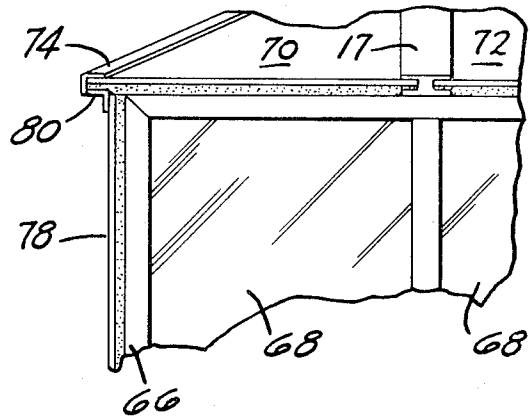


FIG. 18

FIG. 17

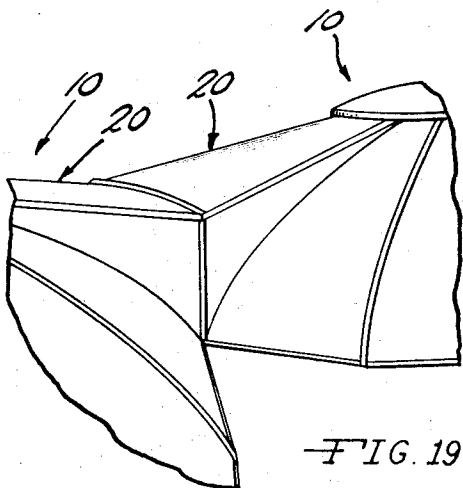
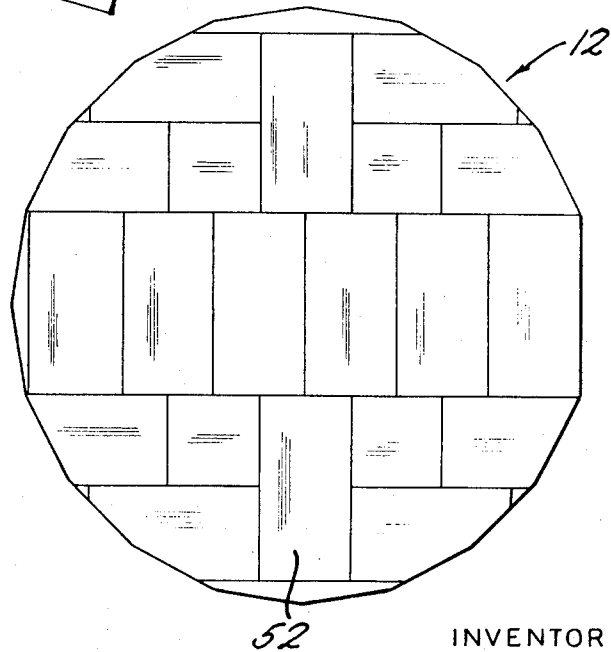


FIG. 19



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**PREFABRICATED SHELTER AND METHOD OF  
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Int. Cl. E04b 1/32; E04h 1/02

U.S. Cl. 52-80

7 Claims

**ABSTRACT OF THE DISCLOSURE**

A shelter which has panels bowed and secured together in a stressed condition to define a dome-like building. The panels are retained in the stressed condition by supporting structure, and the stressed condition of the panels cooperates in locking the assembled parts together. A flexible joint is provided between the panels to aid in erecting and in retaining the structure together and to provide a weather seal. A method whereby the shelter can be erected by stressing the panels in sequence is provided.

**BACKGROUND OF THE INVENTION**

One of the early shelters which is constructed by bowing and securing together a plurality of prestressed panels so as to define a dome-like structure which is free of internal supporting structure is disclosed in French Patent No. 899,373. As there shown, the panels are secured together by overlapping the panels and then bolting them together, or by bolting bands to adjoining panels.

Another prior art shelter of this general character is disclosed in the United States Patent No. 2,820,990, granted Jan. 28, 1958 to Johnson. As there shown, the panels are joined by clips and a cable is connected to the upper most clip between each adjoining panel for retaining the upper ends of the stressed panels together.

The shelters disclosed in the two cited references create many significant problems when an effort is made to erect them, and also, when such shelters are erected, problems exist with respect to providing proper weather seals at the joints between the panels.

**SUMMARY OF THE INVENTION**

The present invention relates to an improved prefabricated dome-like shelter and the method of erecting the same.

The problems that exist with respect to the prior art structures have been solved in a unique and unobvious manner by the present invention. Initially, a new and improved upper and lower edge construction of the panels has been provided, and in addition, an improved flexible joint has been provided for interconnecting the abutting lateral edges of the panels so as to provide an effective weather seal, and also to facilitate erecting the shelter quickly and with a minimum of help. In carrying out this operation, a first panel can be assembled in place, and thereafter, each succeeding panel can be attached to the preceding panel partly by means of the flexible joint which then functions to aid in maintaining the panels in position during the erection of the succeeding panels. When the shelter is completely erected, the construction and arrangement of the flexible joints is such that portions thereof are constantly urged tightly against the exterior surfaces of the associated panels to provide a tight weather seal.

According to a preferred form of the present invention, a shelter is provided comprising a plurality of resilient panels each having the general shape of an isosceles trapezoid with curvilinear sides. Each panel is mounted in an upright position at its base and prestressed into a bowed position with its curvilinear edges substan-

tially in abutting relationship throughout their lengths to the curvilinear edges of the next adjacent panels. First means secure the bottoms of said panels together and second means secure the tops of the panels together. Flexible joints extend between the substantially abutting lateral edges the full lengths of the panels and overlap the inner and outer edges of such panels.

The flexible joints comprise resilient strips having a generally H-shaped cross section, the open channels of which are directed outwardly and define between them an included angle of a pre-established degree less than the intended included angle between two adjacent panels. Thus, when the shelter is erected, the adjacent panels will be in tight sealing relationship with the outer surfaces of the H-shaped cross sections to assure weather-tight seals at such joints.

In a preferred method of erecting the shelter, the first of said panels is erected in an upright position at a selected location with one of the flexible joints or strips fitted on the remote edge, and the panel is bowed radially inwardly from the upper end toward the intended axis of the shelter, a second panel is secured in an upright position to the lower edge of the first panel while at the same time fitting the lateral edge of the second panel into the other open channel of the first-panel flexible joint, and such second panel is then bowed inwardly from its upper end and the upper end is secured to the upper end of the first panel while at the same time fitting the lateral edge of the second panel into the aforesaid channel of the first-panel strip. These steps are repeated successively with respect to each of the panels while allowing the included angles between such panels to be approximately equal to the pre-established included angle defined by the openings of the channels in the flexible joint so that the lower edges of the joined panels are spiraled inwardly. When all of the panels have been secured together in this manner, they are moved outwardly against the resilient properties of the flexible joints to a desired position wherein a door frame is fitted between the free edges of the first and last of the panels. Thereafter the remainder of the door frame assembly can be inserted in place, and a suitable dome can be positioned over the joined upper ends of the panels. If desired, a suitable interior floor can also be inserted in place within the dome.

Accordingly, it is an object of the present invention to provide an improved dome-shaped shelter which can be assembled readily from prefabricated components, and it is a further object of the present invention to provide an improved method of erecting such a shelter.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

**BRIEF DESCRIPTION OF THE DRAWINGS**

FIG. 1 is a top elevational view of a dome-shaped shelter embodying one form of the present invention;

FIG. 2 is a side elevational view of the embodiment shown in FIG. 1;

FIG. 3 is a front elevational view of the embodiment shown in FIG. 1;

FIGS. 4 to 9, inclusive, illustrate a series of steps that may be employed in erecting the shelter illustrated in FIGS. 1 to 3, inclusive;

FIG. 10 is a fragmentary top plan view illustrating details of the structure for securing the upper ends of the panels together;

FIG. 11 illustrates one of the panels in an upright position, and in broken lines the panel is shown bowed to its final position after erection of the shelter;

FIG. 12 is a fragmentary section illustrating the arrangement whereby one of the panels is secured to the base structure;

FIG. 13 is a fragmentary side elevational view illustrating details of the structure for securing the lower ends of the panels together;

FIG. 14 is a fragmentary section taken on the lines 14—14 of FIG. 13 showing in solid lines the assembled positions of two of the panels and showing in broken lines the positions of the panels during one stage of the erection of the shelter;

FIG. 15 is a fragmentary section taken through the cap member of the shelter;

FIG. 16 is a fragmentary front elevational view illustrating details of the door frame assembly;

FIG. 17 is a top plan view of the floor or base member that may be utilized within the shelter as a floor;

FIG. 18 illustrates a modified arrangement that may be used for assembling and subsequently securing the bottom edges of two panels together; and

FIG. 19 is a fragmentary view illustrating two shelters of the type shown in FIG. 1 connected together by their common door frame assemblies.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Referring now to the drawings, the invention will be described in greater detail. A preferred embodiment of a single unit, dome-shaped shelter 10 constituting the present invention is shown in FIGS. 1, 2 and 3, in an assembled position. The complete assembly includes an annular polygonal base structure 12 (see FIG. 17) which is supported on a supporting surface 14 in a manner to be described, a plurality of prestressed bowed panels 16 which have been cut to have a desired shape generally consisting of an isosceles trapezoid with curvilinear sides or edges, a plurality of flexible joints 17 fitted between adjacent panels 16, a cap member 18 which is seated on the upper ends of the panels 16, and an entranceway or door frame assembly 20.

The supporting surface 14 forms no part of the present invention and may comprise any suitable surface such as a wooden platform, a concrete or similar surface, or earth which has been made level for the purpose of erecting the shelter.

The panels 16 include a suitable resilient material, such as plywood 21, or the like, and have the general shape when in an un-stressed position of an isosceles trapezoid with curvilinear lateral or side edges 22. However, it will be recognized that other suitable panel structures of this character having resilient properties may also be employed. In the preferred embodiment of the invention, a sheet of foam plastic material 24 is secured to the inner surface of the plywood 21 for heat and sound insulation purposes. A suitable foam plastic material that may be used for this purpose is manufactured by Uniroyal, under the trademark Ensolite which comprises closed-cell plastic sheets from a group of flexible, expanded, modified polyvinyl chloride materials. This material is fire retardant, will provide a moisture and sound barrier and heat insulation, and will not wrinkle when the panels are bowed. Other materials having these same properties may also be used.

The outer surface of the plywood 21 preferably has a plastic film 25 thereon of the type manufactured by Du Pont under the trademark Tedlar, which is a PVF film.

This film can be obtained in a variety of colors to provide a desired and attractive appearance for the finished dome-like structure. Not only does this film provide an attractive appearance, but it eliminates the need for painting the plywood surface while providing an excellent protective covering for the wood.

Attached to the plywood 21 to provide a bottom edge for the panel 16 is the aluminum L channel 26 which can be attached in any suitable manner, as by rivets, not shown. A similar L channel 30 is secured to the top of the plywood panel 21 to provide the upper edge of the panel 16, and the L channel 30 is also attached to the plywood by suitable means, such as rivets or the like, not shown. Riveted to one end of the L channel 26 of each panel 16 is one portion of a toggle clamp 32, and similarly riveted to the end of the flange 26 of an adjacent panel 16 is the other portion 34 of the toggle clamp, for a purpose to be described hereinafter. Similar toggle clamp portions 36 and 38 are mounted on the upper surfaces of the L channels 30 of adjacent panels 26. It is to be noted that the toggle clamp portions 32 and 34 are mounted on the outside or outer surfaces of the L channels 26, whereas the toggle portions 36 and 38 are mounted on the upper surfaces of the L channels 30. The manner in which these toggle clamp portions function will be described hereinafter.

The flexible joints 17 are extruded strips of suitable organic plastic material, such as polyvinyl chloride or the like, which has resilient properties. The extruded strips have generally H-shaped cross sections, as can be seen best in FIG. 14. When in an unstressed condition, the included angle between the outwardly opening channels 40 and 42 is less than 180 angular degrees and less than the included angle 44 between adjacent panels 26 when such panels are in their final, erected positions shown in solid lines in FIG. 14. Thus, during erection of the shelter 10, the panels 16 can be joined together by the flexible joints 17 while in the broken line positions, FIG. 14, and thereafter when the panels 16 are urged outwardly to their final positions represented by the solid line positions, FIG. 14, the outer legs 48, 50 of the flexible joints 17 will oppose such enlarging of the included angle to that of angle 44 resulting in legs 48, 50 being urged tightly against the outer surfaces of the panels 16, thereby providing a weather-tight seal and also cooperating to provide a rigidly formed structure.

The floor or polygonal base structure 12, FIGS. 12 and 17, is preferably formed of a plurality of panel structures 52 which have been cut and numbered to facilitate assembling them in place after the remainder of the shelter has been erected.

The cap member 18 is formed in two sections 54, 56 from a suitable clear plastic material, such as an acrylic plastic, and a retaining aluminum frame structure 58 is provided for joining the sections 54 and 56 together with an interlocked joint, as best seen in FIG. 15. A suitable weather strip 60 is bonded to one of the interlocked portions of the interlocked joint.

The cap member 18 is connected to the panels 16 at their upper ends by means of a plurality of bolts 62, FIG. 15, which extend through the periphery of the sections 54, 56 and pass through the L channels 30 on the upper ends of such panels 16. For the purpose of providing suitable insulation, a sealing ring 64 is fitted between the outer periphery of the sections 54, 56 and the L channels 30.

The door frame assembly 20 can be constructed in a variety of ways, and preferably it includes a conventional aluminum door frame 66 which can have sliding panels therein closed by glass panes 68. The door frame 66 normally is constructed to have a width substantially equal to the width at their bases of two of the panels 26. The door frame assembly 20 has a top wall portion which comprises two panels 70 and 72 which are joined by a flexible joint 17. Each of the panels 70 and 72 also will

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have an L channel 74 and 76 at the outer edges for joining with the two side wall panels 78. As shown in FIGS. 2 and 16, the side wall panels are cut to a suitable shape for fitting between one of the panels 26 and the corresponding top wall panel 70 or 72. The side wall panel 78 is formed of the same material as panels 26, and also has an L channel 80 at its upper end for use in bolting the side wall panel 78 to the top panel 70. Each of the side wall panels has an L channel shaped and fitted to its lower edge which can be inserted under the adjacent panel 26 and bolted to this panel by means of bolts, not shown, which pass through the L channel.

It is to be observed that the top panels 70 and 72 have L channels at their upper ends which correspond to and are joined to the plurality of channels 30 forming the upper ring on which the cap member 18 is seated.

In the erection of the shelter 10, a suitable surface 14 is initially selected or provided, after which the site of the door frame assembly 20 is chosen.

Referring now to FIGS. 4-9, inclusive, the sequence of steps employed in erecting the shelter will be described. Initially, a first panel 26 is placed on the surface 14, as is shown in FIG. 4, adjacent to the side selected for door frame assembly 20. For this purpose the bottom edge can be secured to the surface 14 if desired, or any suitable structure, such as a concrete block or the like may be placed adjacent to the bottom edge of the panel to assure that it will remain in the bowed position illustrated in this figure. Normally, a flexible joint 17 will have been bonded to one edge of each of the panels 26 as shown in this figure prior to beginning erection of the shelter.

After the first panel 26 has been placed in the position shown in FIG. 4, a second panel is fitted to the first panel, as shown in FIG. 5. This is accomplished by initially placing the second panel in alignment with the open channel of the first joint 17, and then by means of a suitable draw-pull means, such as a toggle mechanism, or the like, the second panel is pulled into the open channel of the flexible joint bonded to the first panel. The lower edge of the panels are then secured together by the toggle mechanism or clamp, and the second panel is then bowed to the position shown in FIG. 5 and the upper ends of the two panels are secured together.

In a preferred form of the present invention, the two panels can be pulled together by means of the draw-pull mechanism shown at the bottom of the two panels 26 illustrated in FIG. 13, and by the draw-pull or toggle mechanism at the top of the panels shown in FIG. 10. These are conventional buckles of the over-center type which can readily be manipulated to pull or draw the two panels together while locking the buckle in its closed position. Other suitable means may be used for pulling the two panels together, as is shown by the mechanism illustrated in FIG. 18. As there shown, the two panels 26 can be pulled together by means of the toggle mechanism or draw-pull tool 82 which has been made for this purpose. For the purpose of carrying out this operation, apertures are provided at 84 in each of the panels in which the ends of the arms 86 can be temporarily inserted for pulling the two panels 26 together. Pivoting of the lever arm of the tool 82 will carry out this object. Once these two panels are pulled together, U-bolt holes are provided at 88 through which a U-bolt (not shown) can be inserted and bolted on the interior side of the shelter.

After the first two panels have been joined together in the described manner, the remaining panels will be successively joined, and when so doing, the panels will assume a spiral which is inwardly directed so that the group of panels when assembled will be in essentially the position shown in FIG. 6, with the last panel 26 to be put in place being positioned inwardly of the first panel that was erected. Thereafter, the panels will be urged outwardly to assure that a tight joint is provided by means of the outer legs 48, 50 of the flexible joints 17 acting against the outer surfaces of the panels 26, as was previously

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described. The side wall panels 78 can then be bolted in place to the free ends of the first and last of the panels 26 to be assembled together.

Thereafter, when the panels 26 have all been urged outwardly to their intended final positions, the door frame 66 can be inserted in place, as shown in FIG. 7. The first roof panel 70 is next inserted in place, after which the second panel 72 is fitted thereto to close the top of the entranceway. During these operations, the L channels 30 at the inner ends thereof are secured together with the L channels of the various panels 26 in the same manner as previously described.

By virtue of the described arrangement for assembling the panels and door assembly, a ring is provided at the base of the shelter and a similar ring is provided at the upper ends of the panels 26 and roof panels 70, 72. Both of these rings are in tension and the midportion of what may be termed the hip-portion of the panels 26, which is an area between the upper and lower ends of the panels, will be in a state of compression. Thus, once the panels have all been joined together in the prescribed manner, they will be a rigid structure wherein internal forces will act to hold all of the parts rigidly together.

After the entranceway or door assembly 20 has been erected, the cap member 18 can be inserted in place. In the preferred embodiment, the cap member 18 is shown in two sections 54, 56 to facilitate mounting the cap member from the interior of the shelter. By virtue of the two-piece structure, one of the sections can initially be passed through the hole at the top of the panels from the interior of the shelter, and secured in place, and thereafter, the second of the sections can similarly be passed upwardly from the interior of the shelter and similarly secured in place. In view of the fact that the cap member has a larger diameter than the opening defined by the L channels 30, the cap member 18 normally cannot be passed through the opening without being made in sections, as is illustrated.

After fitting the cap member 18 in place, the base structure 12 can be fitted into the shelter 10. The base structure 12 comprises a plurality of panels 52 which can be assembled much in the fashion of a jigsaw puzzle, but which has been shipped with numbers on them indicating their location so that they can be assembled readily within the shelter 10 once the various panels 26, 70, 72, 78 and the like have been assembled in place.

As shown in FIG. 19, the present shelter 10 can be used to provide a plurality of joined shelters merely by interconnecting the door frame assemblies 20 of two adjacent shelters 10. Thus, the present invention is not limited to a single unit, but it is contemplated that a plurality of such units may be joined together within the scope of the present invention.

It is claimed:

1. A shelter mounted on a base structure comprising a plurality of resilient panels each having the general shape of an isosceles trapezoid with curvilinear sides, each panel being mounted in an upright position at its base and pre-stressed into a bowed position with its curvilinear edges substantially in abutting relationship throughout their lengths to the curvilinear edges of the next adjacent panels, each pair of adjacent panels defining between them an included angle of a preselected degree, first means securing the bottoms of said panels together, second means securing the tops of said panels together, and flexible joints extending between the substantially abutting lateral edges the full lengths of the panels and being the only connection along said abutting lateral edges from the first means to the second means, said flexible joints overlapping the inner and outer surfaces of such panels, each of said flexible joints including a strip of generally H-shaped cross section so as to define longitudinal grooves between laterally projecting legs within which the edges of the adjacent panels are received in tongue-and-groove relationship, the legs defining each groove being essentially

parallel and the directions of outward opening of the channels of each strip when in an unstressed condition defining an included angle of a lesser degree than the afore-said included angle of a pre-established degree, said first and said second means providing a limited pivotal connection between adjacent panels so that during erection of the shelter such adjacent panels can be positioned so that they define an included angle corresponding essentially to said included angle of a lesser degree, said strips having resilient properties and the legs on the exterior sides of the bowed panels by virtue of their angular relation in unstressed condition being stressed against the exterior sides of the panels when the latter are in to their finally erected positions and also being stressed in tension in a longitudinal direction by virtue of the bowed configurations of the panels so that the interior surfaces of the exterior legs engage the outer surfaces of the panels in tight sealing relationship, said legs on the interior sides of the bowed panels being stressed in compression in a longitudinal direction by virtue of the bowed configurations of the panels so that the interior surfaces of the interior legs are flush with and engage the inner surfaces of the panels.

2. A shelter according to claim 1, wherein said first means and said second means are in a state of tension in parallel horizontal planes, and the curvilinear sides of said panels are curved so that when the panels are in their bowed positions the midportions of the panels will be in a state of compression in a plane parallel to said horizontal planes.

3. A shelter according to claim 1, wherein said means for securing the tops of said panels together include a plurality of separate mechanisms connected to adjacent ones of said panels for individually connecting adjacent panels together during erection of the shelter.

4. A shelter according to claim 1, wherein a cap mem-

ber is seated on and is secured to the upper edge portions of said panels.

5. A shelter according to claim 1, wherein a door frame is secured in an upright position between the bottom ends of the lateral edges of two panels, and other panels extend from the top of said frame to positions adjacent to and between the tops of said two panels, the tops of said two panels and said other panels being secured together.

6. A shelter according to claim 5, wherein panel segments are fitted between sides of the door frame, outer lateral edges of said other panels and lateral edges of said two panels to define with said two other panels and the door frame an entrance for said shelter.

7. A shelter according to claim 1, wherein a plurality of flat panels are fitted within the confines of the bottoms of said panels to define a floor.

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HENRY C. SUTHERLAND, Primary Examiner

U.S. Cl. X.R.

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