

Aug. 29, 1967

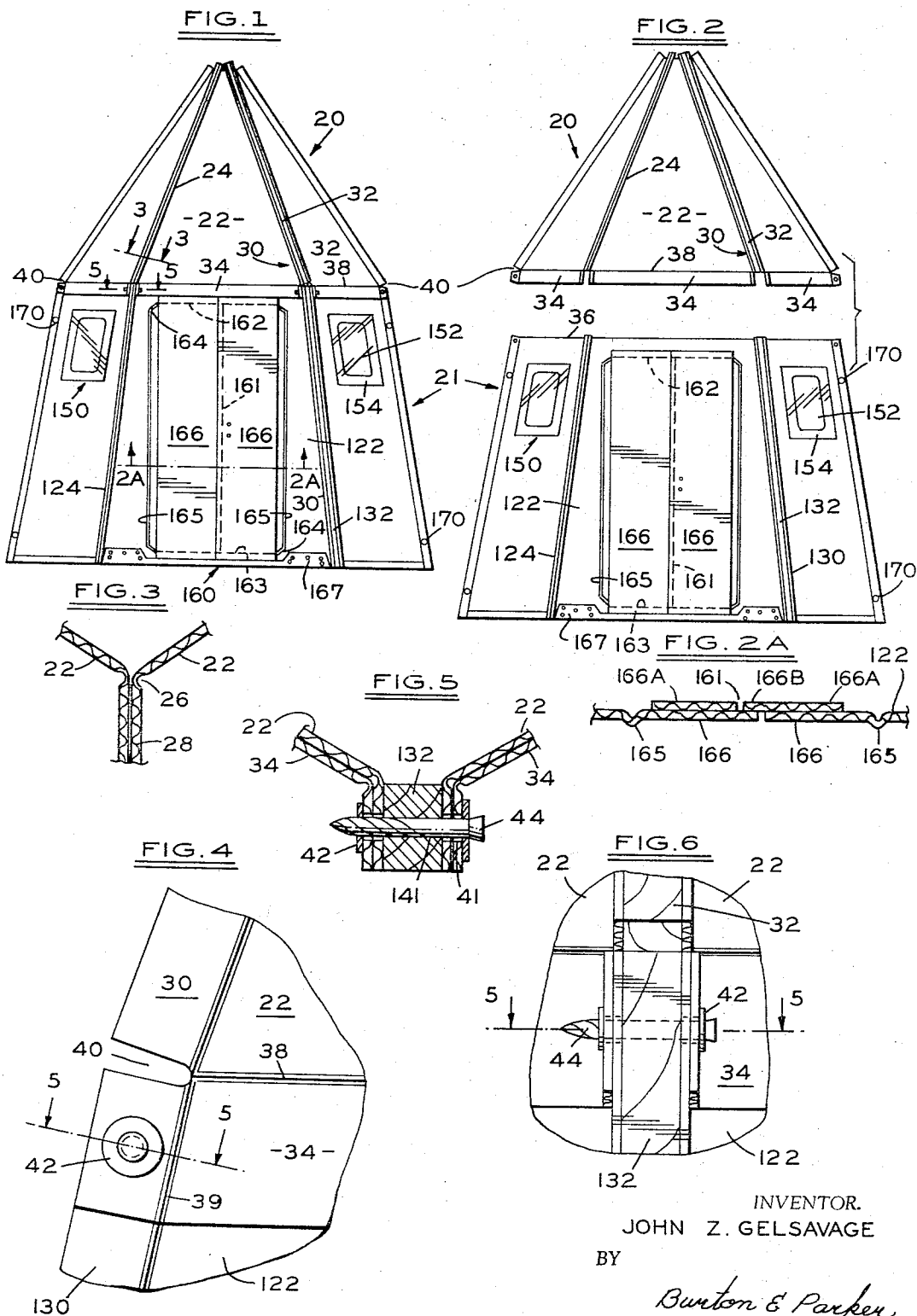
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3,338,005

COLLAPSIBLE BUILDING STRUCTURE

Filed March 4, 1965

2 Sheets-Sheet 1



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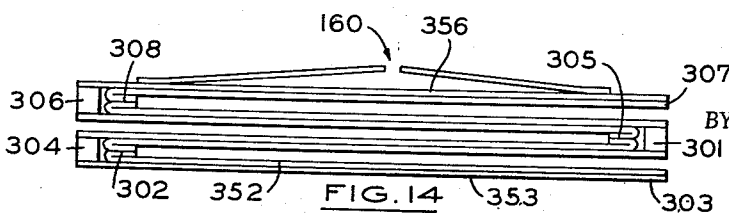
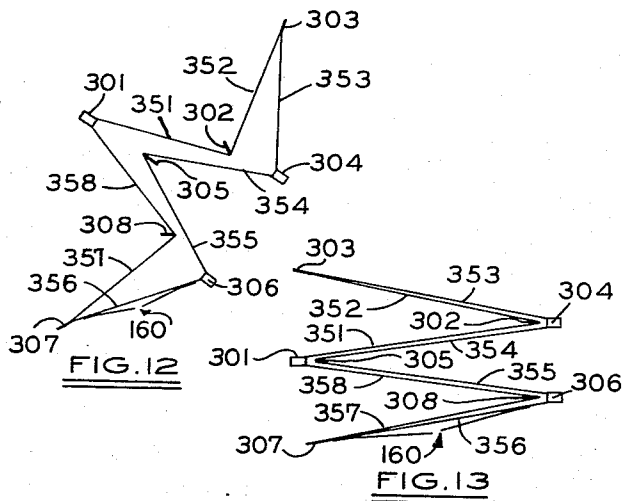
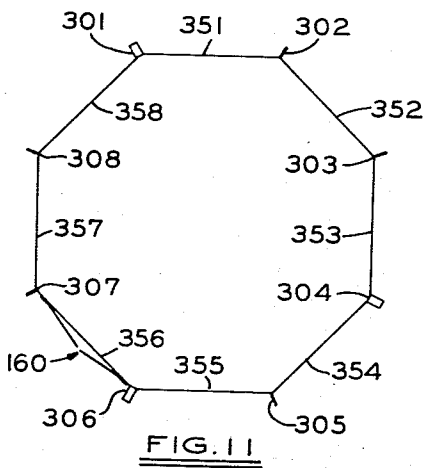
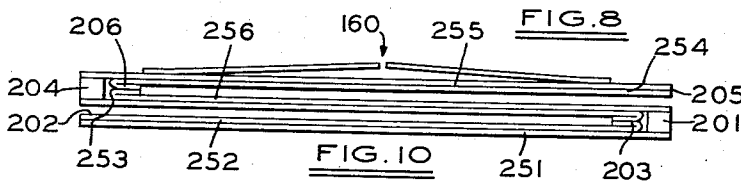
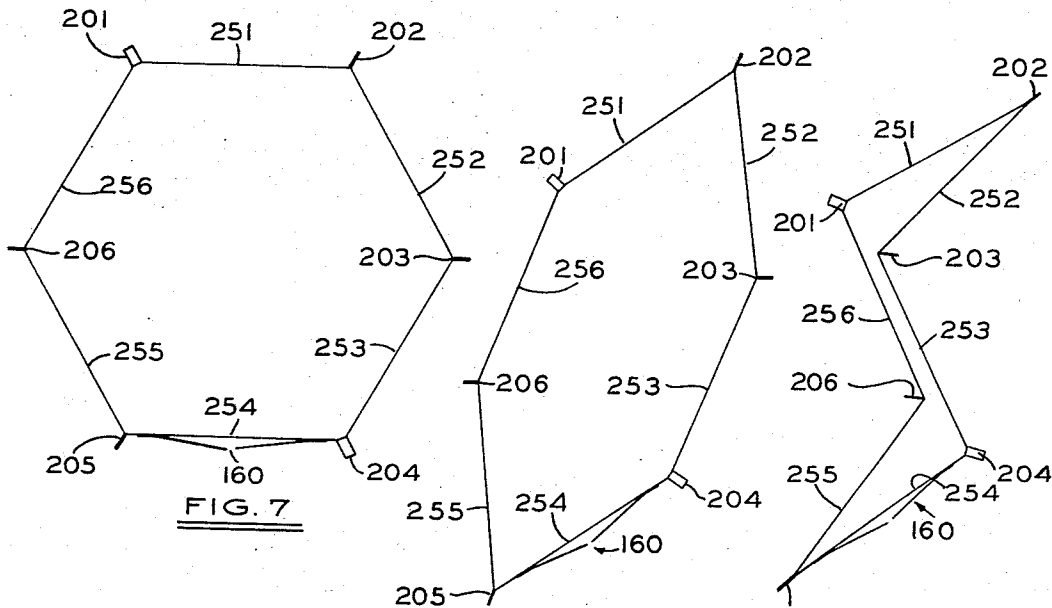
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Filed Mar. 4, 1965, Ser. No. 437,141

11 Claims. (Cl. 52-70)

ABSTRACT OF THE DISCLOSURE

In general, this disclosure relates to a collapsible building structure or shelter which has a continuous wall of panels, spacer members and hinges, but which may be folded flat without detaching adjacent wall panels.

The illustrative embodiment of this invention is a collapsible shelter formed of rigid panels permanently hingedly connected at their lateral side edges to allow folding. The shelter may comprise two detachable sections: an upper section in the form of a regular pyramid, and a lower section in the form of a frustum of a regular pyramid. The use of two sections increases the floor area for a given height of structure, makes the shelter more resistant to the elements and further makes it more compact when folded. It is understood however, that the structure may be constructed of a single section, similar to the upper section in the form of a regular pyramid.

I have found that a multi-sided structure cannot be folded into a flat optimum package, which would be defined by the area of the largest side versus the total thicknesses of the sides, when the sides are permanently affixed and rigid, unless spacing is provided between certain of the adjacent side edges. Such spacing allows for the nesting of opposite hinged edges and the resultant folding of the structure into a flat optimum package.

The primary object of this invention is therefore to provide a permanently attached multi-sided building structure, constructed from rigid panels, that can be folded into a flat optimum package without damage.

A second important object of this invention is to provide a shelter that may be constructed of relatively inexpensive rigid panels such as treated cardboard, plastic, wood or metal sheet, yet be collapsed into a lightweight, compact package. Other collapsible structures employ heavy canvas which is relatively more expensive, and are relatively more difficult to erect and collapse into an optimum package for transport.

A further object of this invention is to provide a self-supporting structure that does not require center supports that restrict available space.

A still further object of this invention is to provide a shelter that can be erected easily by one person in minutes and fold easily into a small flat package that can be carried by one man or in the trunk of a car.

Other objects, advantages, and meritorious features of the structure will more fully appear from the following specification, claims, and accompanying drawings, wherein:

FIG. 1 is a front elevation of a six panel embodiment of the invention;

FIG. 2 is an exploded view of FIG. 1 showing the separability of the upper and lower sections;

FIG. 2-A is a section view of FIG. 1 along section line 2a-2a further showing the door structure;

FIG. 3 is a sectional view of FIG. 1 along section line 3-3 showing a close hinge;

FIG. 4 is an enlarged segment of FIG. 1 showing how the upper and lower sections may be detachably secured together;

FIG. 5 is a sectional view of FIG. 4 through section line 5-5;

FIG. 6 is an end view of FIG. 5;

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FIG. 7 is a schematic bottom view of a six panel shelter showing the relative location of the spacer means;

FIGS. 8, 9 and 10 show the folding procedure of a six panel shelter;

FIG. 11 is a schematic bottom view of an eight panel shelter showing the relative location of the spacer means; and

FIGS. 12, 13 and 14 show the folding procedure of an eight panel shelter.

Referring to FIGS. 1 and 2, the completely assembled shelter is comprised of two sections, an upper section generally referred to as 20, and a lower section generally referred to as 21. In the embodiment shown in FIGS. 1 and 2 the top section 20 is a six-sided regular pyramid constructed of six identical rigid panels 22 in the shape of isosceles triangles, made from treated corrugated cardboard. The cardboard is treated with any well known water-proofing agent, such as linseed oil, waxes or plastics. This treating may serve as both a waterproofing and as a reinforcement, and may be sprayed, painted, or dipped on.

The panels 22 are permanently pivotally attached by hinge means which will vary with the type of panel material employed. In the embodiment shown a hinge is made by merely weakening the cardboard at the desired location, as at 26 in FIG. 3. The weakening can be effected by scoring or collapsing the corrugation along the fold, or by using perforations.

Two types of hinge means are required in the structure to allow the structure to be folded flat into an optimum package without damage. The first type may be referred to as a close hinge, and is shown at 24 in FIGS. 1 and 2 and in cross section in FIG. 3. The close hinge is made by weakening and folding a lateral edge of adjacent panels, and then securing the interfaces at 28 as by bonding with adhesives, or stapling.

The second type of hinge means includes a spacer, and therefore may be referred to as a spacer hinge. The spacer hinge is similar to the close hinge, except that a spacer means is provided between the panel interfaces to be joined. A spacer hinge is shown at 30 in FIGS. 1 and 2 and can be seen in cross section in FIG. 5 in combination with the securing means between the top and bottom sections. The spacer used in this embodiment is a wood member 132 which has a dual function of reinforcing the structure and spacing the hinge.

Two types of hinge means are required because the close hinges must nest within the spacer hinges to allow the structure to be folded into a flat optimum package. The operation and relative location of these hinge means will be fully described below in the description of FIGS. 7 to 14.

It is understood that other types of hinges may be required if the panels are constructed from materials not capable of forming an integral hinge, as wood or sheet metal. Any well known hinge could be employed, as for example a leather strap, or a piano hinge.

The lower section 21 is constructed the same as the upper section, except the panels are in the shape of isosceles trapezoids, and the assembled section is in the shape of a frustum of a regular pyramid. Elements of the lower section corresponding to equivalent elements of the upper section have the same number in the 100 series, therefore the spacer hinge in the upper section is 30, and 130 in the lower section.

The upper and lower sections can be detachably secured by any well known means, as for example friction plugs shown in the embodiment, clips, ties or threaded bolts. The embodiment, best shown in FIGS. 4, 5 and 6, employs friction plugs 44 which are easily assembled. The upper section panels 22 are provided with integral flaps 34, which overlie the upper marginal edge of the lower section 34, shown in FIG. 2. The integral flaps 34 are hinged

by scoring at 38 and 39, see FIG. 4, and cut-outs 40 are made to give the flaps a needed freedom of movement for attachment. The flaps have an aperture 41 at an outer end, and the lower section hinge means has a corresponding aperture 141. The flap apertures 41 are also provided with grommets 42 to reinforce the flap apertures 41, and to provide a friction surface for the plugs 44. The upper and lower sections are detachably secured by placing the upper section 20 on top of the lower section 21, allowing the flaps 34 to overlay the lower section, matching the wood spacer channels 32 of the upper section with the corresponding spacers 132 of the lower section, aligning the apertures 41 and 141 and pushing the plugs 44 through these apertures with sufficient force to obtain a friction fit.

FIGS. 4, 5 and 6 illustrate the joint at a spacer hinge means, however it is understood that the joint at a close hinge is identical, except that no spacer is present.

FIGS. 1 and 2 illustrate some of the improvements that can be made in the structure, such as windows 150, a center-opening door 160, and tie-down grommets 170. These will be described only generally, as it is anticipated that these improvements can take many forms.

The windows 150 are constructed by cutting an aperture 152 in a panel wall, and securing an overlay of clear sheet material 154, such as plastic. The overlay can be molded in place, or bonded on by a suitable adhesive or tape.

The center-opening door 160 is made by first cutting an offset center line 161 in a lower section side panel 122. Then the top 162 and bottom 163 of the door are cut from the panel, including fillets 164 at the corners to allow the two door panels 161 to swing freely. Folds are scored at 165 to act as hinges. Finally two panels 166a are overlaid and secured in any convenient fashion to the inside of the door panels to provide reinforcement, make the door relatively more rigid and provide a weather seal by the overlap 166b, as shown in FIG. 2a. An additional reinforcement in the form of metal channels can be provided, as required, around the door frame, as at the sill 167.

An alternative structure may include hinge means, similar to the close hinges 124 used to secure the adjacent rigid panels, in place of the score lines 165. This would provide additional support for the door, and reduce sagging.

A final improvement shown are the tie-down grommets 170. These grommets can be used in foul weather to stake the shelter down.

FIGS. 1 and 2 illustrate the construction details of a six-sided building structure or shelter, but the description is not limited to a six-sided structure, and it is equally appropriate for any structural embodiment of the invention having an even number of sides of four or more. The number of sides of the structure determines the quantity and location of the spacer hinges. This relationship is described below.

FIGS. 7 to 10 are a schematic illustration of a six-sided shelter, and show the function and location of the spacer hinges in the folding operation. The figs. illustrate a schematic bottom end view of the lower section to show a possible location for the door 160, however, except for the door, the figs. could represent a schematic end view of a six-sided structure along any horizontal cross section of either section.

It can be seen that a six-sided building structure has six panels, 251 to 256, two spacer hinges, 201 and 204 at opposite corners of the hexagon, and four close hinges, 202, 203, 205 and 206. The hinges are permanently attached to the panels and are described above. Close hinge 203 folds and nests within spacer hinge 201, and close hinge 206 nests within spacer hinge 204. This is accomplished by pulling hinges 202 and 205 to the elongated form shown in FIG. 8, and collapsing the structure as shown in FIGS. 9 and 10.

The panels adjacent the spacer hinges will be termed hereinafter the adjacent panels, and the panels which nest within the adjacent panels will be termed the opposed panels. Thus, looking at the upper portion of FIG. 9, panels 251 and 256 are the adjacent panels with respect to the spacer hinge 201, and panels 252 and 253 are the opposed panels. Looking at the lower portion of FIG. 9, panels 253 and 254 are the adjacent panels with respect to the spacer hinge 204, and panels 255 and 256 are the opposed panels. It is apparent that some panels function as adjacent panels in one combination and opposed panels in another. This is true of any building structural embodiment of this invention having six sides or greater. A four-sided structure, the simplest form of the invention, has only one spacer hinge, two adjacent panels and two opposed panels.

It is further noted that two panels, 251 and 254, function as adjacent panels only. The door can be placed on either of these panels without adding bulk to the folded package, as can be seen in FIG. 10.

FIGS. 11 to 14 are a schematic illustration, similar to FIGS. 7 to 10, of an eight-sided building structure. It can be seen that an eight-sided structure has eight panels, 351 to 358, three spacer hinges, 301, 304 and 306, and five close hinges, 302, 303, 305, 307 and 308. A ten-sided structure would require four spacer hinges, and so on. The general relationship is:

$$\frac{n}{2} - 1 = \text{required number of spacer hinges}$$

where n is an even number greater than two, and represents the number of sides of the structure.

A detailed description of FIGS. 11 to 14 is not required because of the description of FIGS. 7 to 10.

What is claimed is:

1. A collapsible building structure comprising: an even number of rigid wall panels, hinge means permanently pivotally connecting the panels at opposite side edges of said wall panels, said wall panels and said hinge means defining a continuous surface about a common axis, said building structure having at least two adjacent panels and at least two opposite panels, said hinge means including

$$\left(\frac{n}{2}\right) - 1$$

spacer means wherein n is the number of wall panels, said spacer means pivotally connected to the adjacent wall panels along both marginal edges, said adjacent panels sufficiently spaced apart by said spacer means to allow said opposite panels to be reversely folded between and nested within the space defined by said adjacent panels and said spacer means, to allow said building structure to fold into a flat optimum package without damage.

2. The collapsible building structure of claim 1, wherein said continuous surface is defined by four wall panels, one of said hinge means including a spacer means separating the edges defined by a pair of said adjacent panels, and three close hinge means.

3. The collapsible building structure of claim 1, wherein said continuous surface is defined by six wall panels, two of said hinge means including a spacer means separating the panel edges adjacent two opposite edges of said continuous surface, and four close hinge means.

4. The collapsible building structure of claim 1, wherein said continuous surface is defined by eight wall panels, three of said hinge means including a spacer means separating the panel edges of said adjacent panels, and five close hinge means.

5. The building structure of claim 1, wherein said panels are constructed from metal.

6. The building structure of claim 1, wherein said panels are constructed from treated cardboard.

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7. The building structure of claim 1, wherein one of said adjacent panels has a door integrally cut from said adjacent panel.

8. The building structure of claim 1, wherein the structure is defined by upper and lower detachably secured 5 vertically placed sections.

9. The building structure of claim 8, wherein the upper of said sections defines a regular pyramid and the lower of said sections defines a frustum of a regular pyramid.

10. A collapsible building structure comprising: six 10 rigid panels pivotally connected at opposite side edges defining a six-sided regular pyramid, the panels adjacent two opposite edges of said six-sided regular pyramid spaced apart by a spacer member hingedly secured along both marginal edges to said adjacent panel members, whereby the pair of panels opposite said spacer members may reversibly fold and nest within the pair of panels adjacent

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said spacer members, thereby collapsing said regular pyramid to a substantially flat optimum package.

11. The structure of claim 10 in combination with a second structure defining the frustum of a regular pyramid, and detachably secured to the lower edges of said six-sided regular pyramid.

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