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Herzer et al.

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[45] **Sept. 4, 1973**

[54] **PRE-FABRICATED SHELL STRUCTURE**

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[52] **U.S. Cl.** **52/90,** 52/86

[51] **Int. Cl.** **E04b 1/32**

[58] **Field of Search** ..... 52/86, 90, 631, 80, 52/81, DIG. 6

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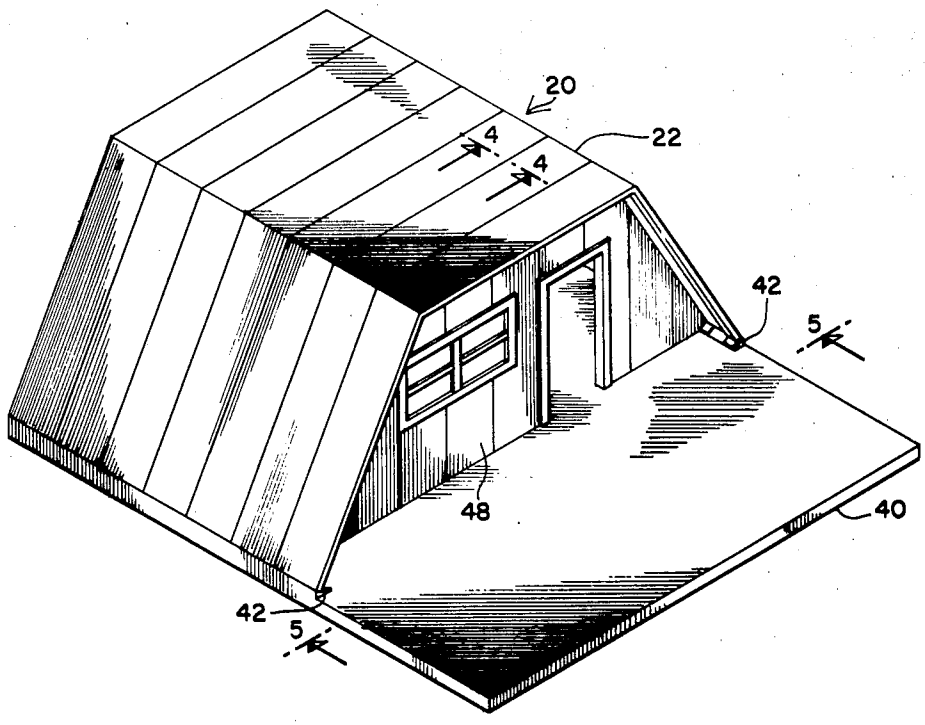
[57] **ABSTRACT**

A pre-fabricated shell structure made from modular structural roof and wall panels or units, said units being fabricated from chemically treated pressed organic fiberous material. The panels are folded along transverse and/or longitudinal score lines to form a preferred design. The ends of the roof panels are anchored to a foundation; front and rear wall panels are added and spanned between the roof panels and foundation to complete the shell. The individual panels are fastened to each other by means of friction clips or holding brackets. A fiber reinforced waterproof film is applied to and coats the outer surface of the panels. Weather proofing is completed by the addition of insulating material placed adjacent the interior of the panels.

10 Claims, 13 Drawing Figures



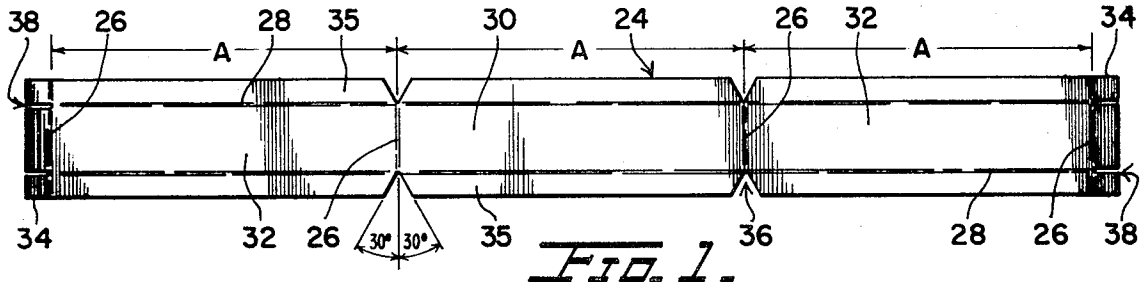


Fig. 1.

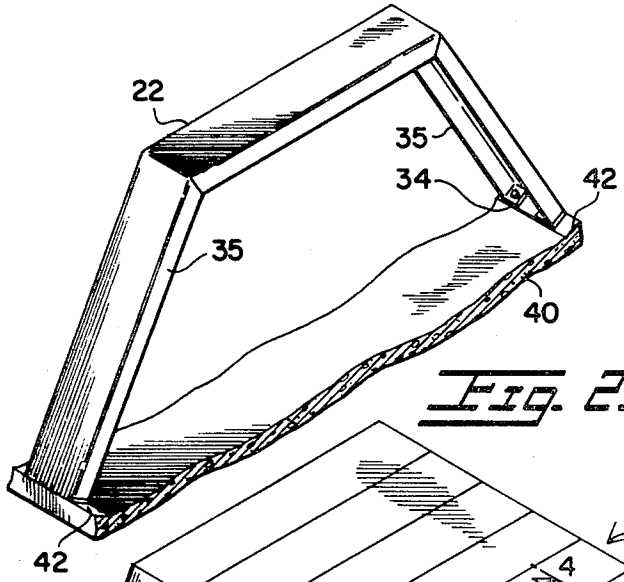


Fig. 2.

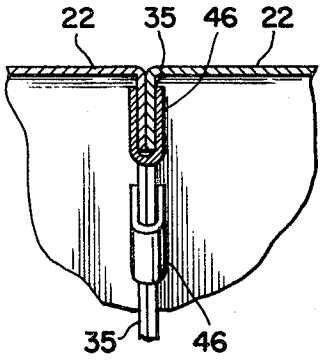


Fig. 4.

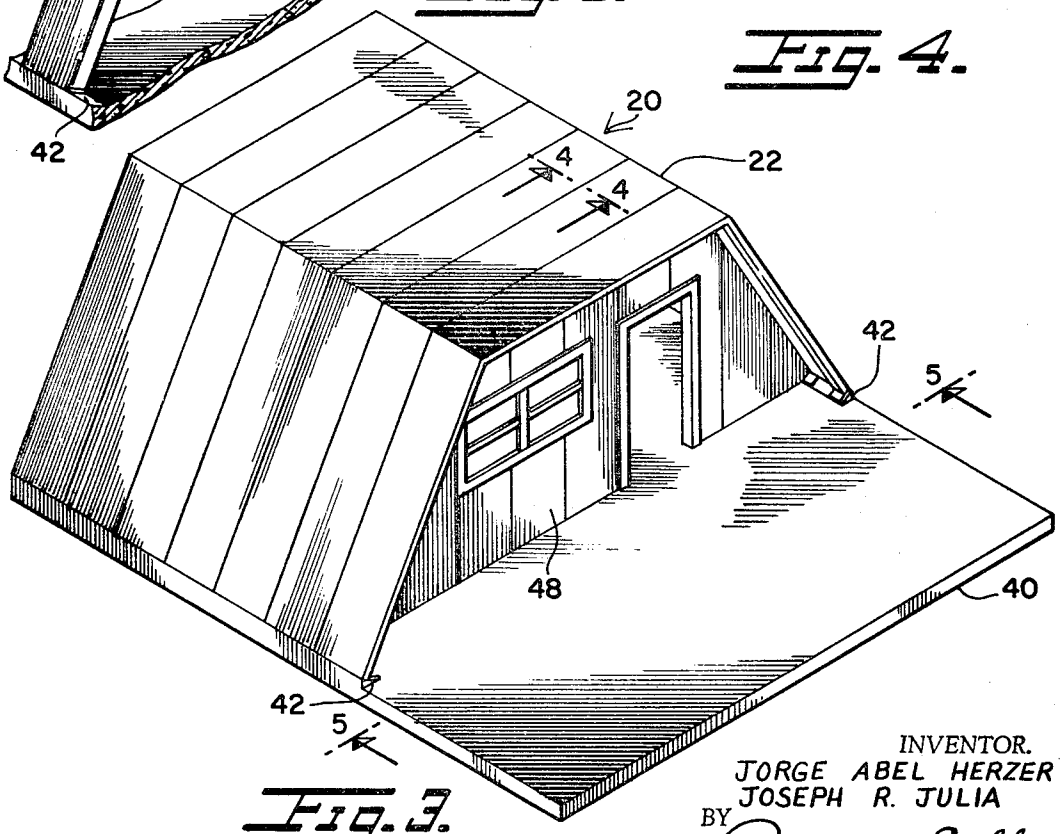


Fig. 3.

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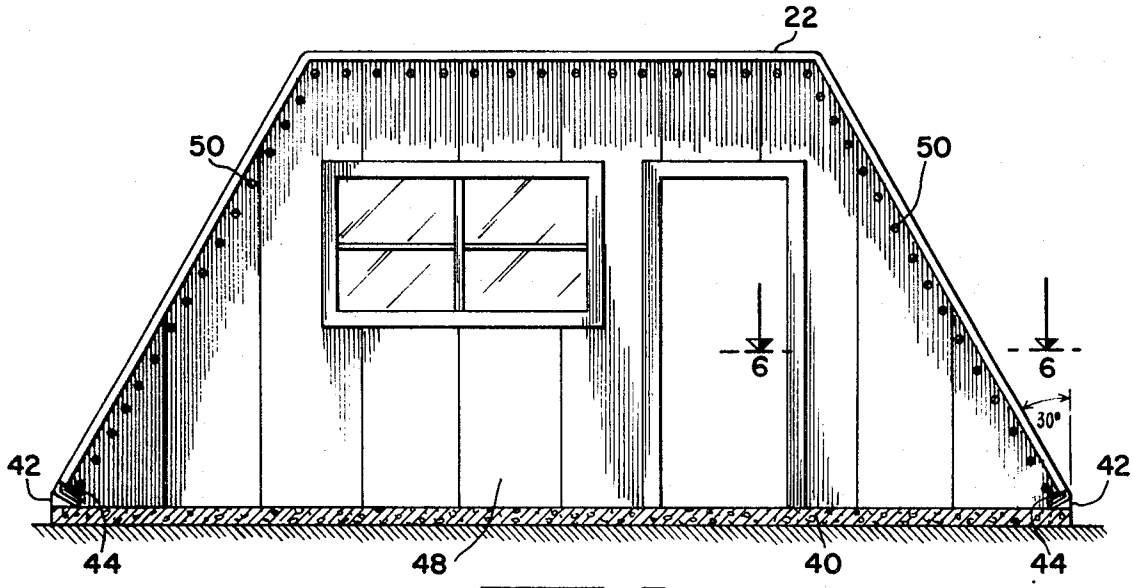
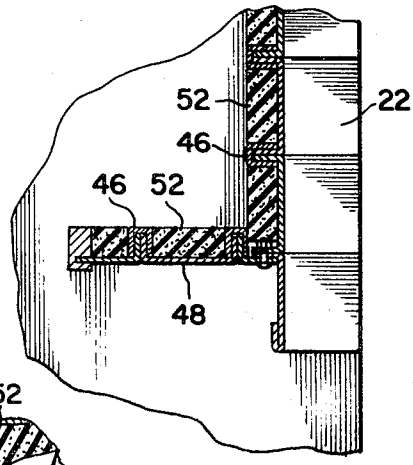


Fig. 5.



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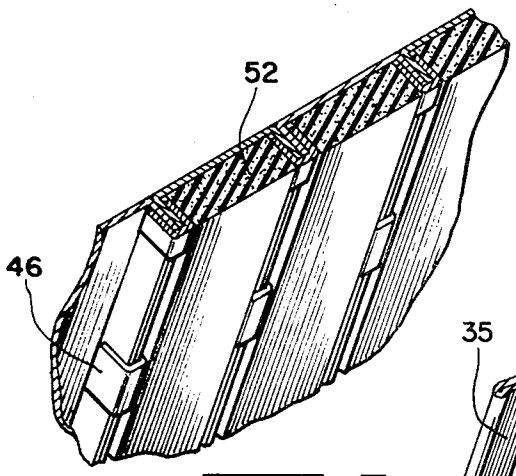

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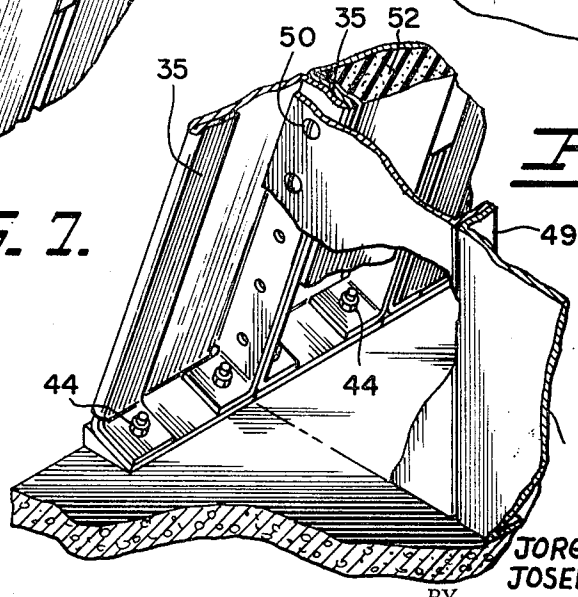

Fig. 8.

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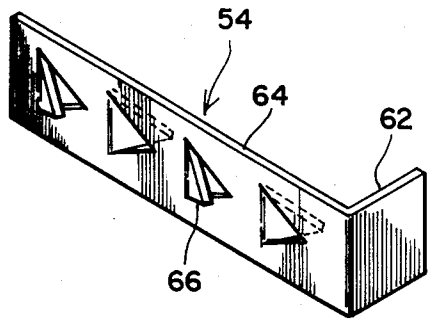


Fig. 9

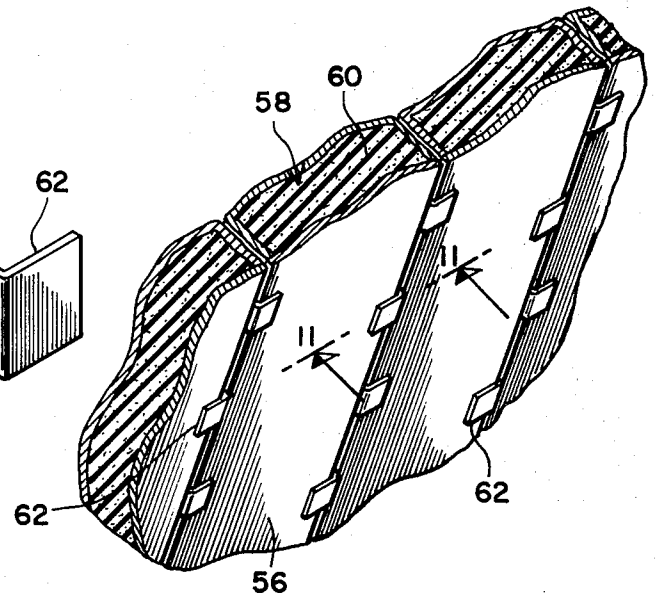
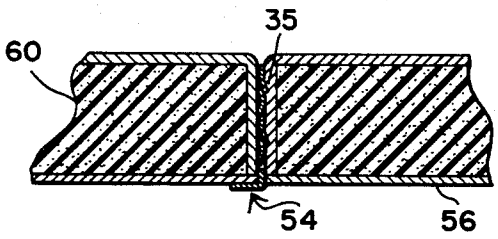


Fig. 10.



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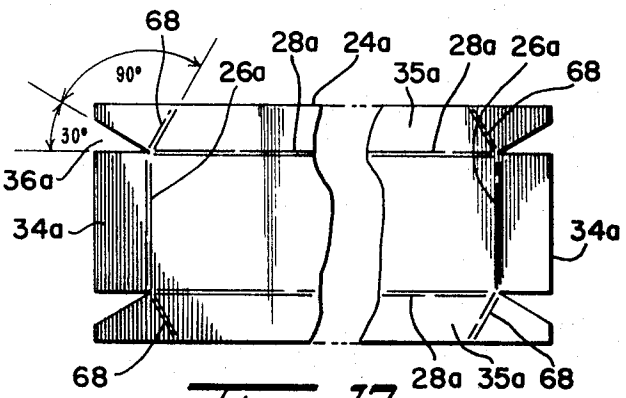

Fig. 12.

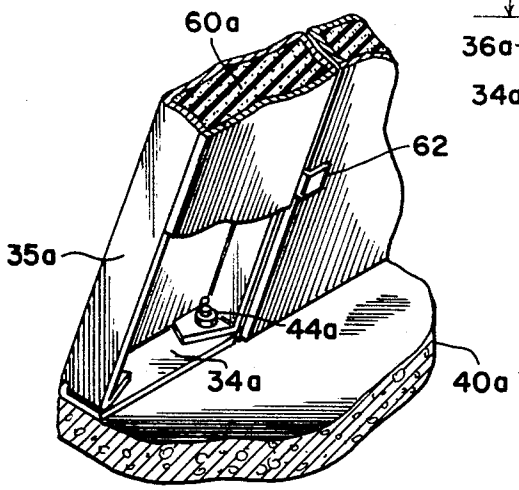

Fig. 13.

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PRE-FABRICATED SHELL STRUCTURE

This invention relates to pre-fabricated shell structures, particularly those utilizing modular structural units suitable in home construction.

The pre-fabricated shell structure of this invention encompasses the use of a modular structural roof and wall panels or unit comprised of a chemically treated pressed organic fibrous material. The panel is designed to sustain pre-determined structural loads and when used for the erection of a shell structure, with the addition of appropriate protection materials, will provide a waterproof, and fire-resistant structure.

The pre-fabricated panels are economical to produce, and the modular design facilitates site assembly by reducing excessive alteration or cutting of component parts. A shell structure can therefore be readily erected and a low cost home can easily be completed with the addition of necessary plumbing, electrical wiring, heating and cooking equipment. The shell structures can thus be used for a year-round home or for vacation home, country home, beach home, ski chalet, etc.

The conventional low-cost shell structures are usually constructed with a wood frame embodying plywood, wood siding, shingles, shakes, aluminum siding, etc., for the roof and wall covering. The cost of such building materials along with the expense of assembling same, due in part to the lack of modular structural units, makes the pre-fabricated shell structure of this invention a distinct improvement over prior home construction.

The shell structure of the present invention further incorporates score lines or incisions scribed in the roof panel forming weaken sections to permit folding said panel in a desired design shape. The ends of the roof panels are anchored to a foundation or base and front and rear end wall panels are positioned to span the opening between the roof panel and foundation, thus completing the shell enclosure.

The present invention also embraces the use of friction clips and/or holding brackets having penetrating protuberances, for affixing the roof and wall panels in abutting engagement. The outer surface of the roof panels and the front and rear end wall panels are coated with a fiberous reinforced water-proof film and appropriate insulating filler material is placed adjacent the interior of the roof panels.

It is an object therefore of the present invention to provide a pre-fabricated shell structure of the general character described which is economical to construct and will suitably supply the demand for low-cost homes.

Specifically it is an object of the present invention to provide a pre-fabricated shell structure utilizing modular structural units made from pressed organic fiberous material.

It is a further object of the present invention to provide a pre-fabricated shell structure wherein the modular structural units are mechanically and chemically treated to provide a waterproof, and fire-resistant building material.

Another object of this invention is to provide a pre-fabricated shell structure wherein the modular structural units may be joined together by means of friction clips or holding brackets.

The above and other objects, features and advantages of the present invention will be apparent from the following description of the preferred embodiments considered in connection with the accompanying drawings.

In the accompanying drawings in which is shown some of the various possible embodiments of the invention:

FIG. **1** illustrates in plan view a roof panel blank cut from the pressed organic fiberous material showing the score lines scribed therein and the cut out portions of removed material thus permitting the blank to be folded and to form a modular roof panel.

FIG. **2** is a perspective view of a single roof panel shown as assembled and anchored to the foundation.

FIG. **3** is a perspective view of a pre-fabricated shell structure shown as completed wherein a plurality of modular roof panels have been utilized and front end wall panels has been positioned between the roof panels and the foundation.

FIG. **4** is a fragmentary enlarged auxiliary view taken along line **4—4** of FIG. **3** and shows friction clips holding the side flaps of two adjacent roof panels in abutting engagement.

FIG. **5** is a front elevation view to a slightly enlarged scale of the pre-fabricated shell structure showing the front wall panels and apertures provided therein.

FIG. **6** is a fragmentary auxiliary view taken along line **6—6** of FIG. **5** and shows the insulating filler material placed between the side flaps of the roof and wall panels.

FIG. **7** is a fragmentary perspective view of attached panel units showing the friction clips around the side flaps and the insulating material press fit between the respective side flaps of each panel.

FIG. **8** is a fragmentary perspective view showing the details of the foundation and anchorage of the roof panel, also included is a cut-away section through the wall panel and a showing of the attachment of the wall panel to the roof panel.

FIG. **9** is an enlarged perspective view of an L-shaped holding bracket, having protuberances projecting alternately from either side of a leg portion thereof.

FIG. **10** is a fragmentary perspective view of several panels shown fastened together in this modified form, by use of the "L" shaped holding brackets; said bracket additionally securing an interior panel member.

FIG. **11** is a fragmentary auxiliary view in a taken along line **11—11** of FIG. **10** and shows the protuberances of the "L" shaped holding bracket and the manner in which they engage the side flaps of the panel members and brace the interior panels.

FIG. **12** is a plan view of a roof panel blank for an alternate embodiment wherein the score lines scribed therein and cut out portions of material have been modified so as to permit the end flaps of the panel to fit flush against the base or foundation.

FIG. **13** is a fragmentary perspective view showing the anchorage of the modified roof panel to the foundation.

Referring now in detail to the drawings, the reference numeral **20** denotes generally the pre-fabricated shell structure of this invention. The basic structural units of the pre-fabricated shell structure **20** is a roof panel **22** and a wall panel **48.** A plurality of roof panels **22** and wall panels **48** are cut from a structural material to form roof panel blanks **24** (FIG. **1**) and similar wall

panel blanks (not shown). The blanks **24** are formed into modular roof panels **22** by means of folding same along prescribed transverse score lines **26** and longitudinal score lines **28**. The transverse score lines **26** are preferably placed at equal distances "A" along the blank **24**, thus defining a tripartite roof panel **22** having an intermediate panel portion **30**, two end panel portions **32** and two end flaps **34**. The longitudinal score lines **28** similarly provide a weakened section along which the blank **24** may be folded to define two side flaps **35**. A portion of the side flap **35** positioned at opposite ends of the transverse score line **28** forming the junction between the intermediate panel portion **30** and end panel portion **32** has been removed forming cut-out portion **36**, to thus permit the tripartite blank **24** to be folded along said transverse score line **26** and longitudinal score lines **28** without having segments of the side flap **35** overlap at the transverse fold. The cut out portion **36** in this embodiment, assumes the shape of an equilateral triangle having its apex at the intersection of the transverse score line **26** and the longitudinal score line **28**. The angular configuration of cut-out portion **36** can be varied and will depend on the manner in which the roof panel blank **24** is to be folded and the desired resultant roof shape. Additionally, the end flaps **34** contain slits or cuts **38** coinciding with the longitudinal score line **28** to facilitate the bending and overlapping of said end flaps **34** for anchoring same to a foundation.

The structural material from which the roof panel blanks **24** are fabricated is preferably a pressed organic fiberous material having a composition of wood fiber, such as cardboard, however, cotton fiber, cane fiber or similar organic fiber which has been specially processed and surfaced may be equally as effective. This structural material is economical to manufacture and additionally may be chemically treated to make it fire resistant. Furthermore, the material may be coated with a film of thermo-plastic resin such as polyethylene, or with a fiber reinforced waterproofing material such as fiberglass to make the roof panel **22** and wall panel **48** waterproof. The panel **22** and **24** may also be impregnated with appropriate chemicals to make same resistant to parasites, termites or other household insects and pests. It has been found that when a fiberglass waterproof coating combined with a pigmented polyester resin, has been applied to the panels **22** and **24**, they have been structurally capable of withstanding tensional forces of approximately 2,000 lbs. per square inch.

The individual roof panels **22** are each anchored to a base or foundation **40** which may typically be a poured concrete slab. The extreme edges of the foundation **40** are cantered to form a wedge shaped abutment **42** for receiving and anchoring the end flaps **34** of the roof panel **22**. The end flaps **34** are folded in an overlapping arrangement and affixed to a wedge shaped abutment **42** by appropriate bolted fasteners **44** (see FIG. **8**). It should also be apparent that the end flaps **34** may be nailed, clamped, stapled or adhesively bonded to the wedge shaped abutment **42**. The several roof panels **22** are held in abutting relationship to each other by means of resilient friction clips **46** which are placed over respective side flaps **35** of two adjoining roof panels **22** as illustrated in FIG. **4**.

The resultant roof structure formed by the roof panel blanks **24**, which in this particular embodiment are folded to form a tripartite roof panel **22**, will when fabricated become a "mansard" roof wherein the intermediate panel portion **30** forms a horizontal or flat surface and the end panel portions **32** approach a vertical. It should be noted that this particular roof construction wherein the end panel portions **32** slope gradually from the vertical will provide an enclosed area within the shell has relatively no loss of head room nor wasted space forming a heat trap near the top of the shell.

The wall panels **48** can be fabricated from blanks in a manner similar to the roof panels **22**, and can additionally be provided with apertures for the placement of a door and windows. The several wall panels **48** comprising a front wall for the shell structure are secured together along respective side flaps **49** by means of resilient friction clips **46** as detailed with regard to the roof panels **22**. The panels **48** so formed can be secured between the roof panels **22** and foundation **40** by a bolted fastener **50** passing through the side flaps **35** (see FIG. **8**). The side flap **35** of the roof panel **22** projecting outwardly over the front wall panel **48** is folded back against the underside of the roof panel **22** to present a neat and pleasing appearance.

Several rear wall panels **48** (not shown) are positioned at the opposite end of the pre-fabricated shell structure **20** in a manner similar to that described with respect to the several front wall panels **48**.

A suitable insulating material **52** is placed between respective side flaps **35** of the roof panel **22** and side flaps **49** of the wall panels **48**. The insulating material may be typically of fiberglass, mineral wool, slag wool, glass wool composition or a vermiculite or perlite substance and may have a waterproof backing. The insulating material **52** is cut in strips and frictionally held in place such that it may be press fit between the corresponding side flaps **35** and **49**.

In a modified embodiment of the pre-fabricated shell structure **20** shown in FIGS. **9, 10** and **11**, an "L" shaped holding bracket **54** is employed in place of the friction clips **46**. The bracket **54**, besides holding the side flaps **35** and **49** in abutting engagement, will also secure an interior panel **56** between two adjoining side flaps **35** and **49** to form a hollow elongated chamber **58** which may be pneumatically filled with an insulating filler material **60**.

The L-shaped holding bracket **54** is comprised of a head portion **62** and a leg portion **64** depending at right angles from the head **62**. The leg portion **64** contains protuberances **66** which project alternately from opposite sides of leg portions **64**. When the leg portion **64** is placed adjacent the side flaps **35** and **49**, the head **62** will brace or support the interior panel **66**. The pressure exerted by the pneumatic filling of the hollow elongated chamber **58** with the insulating filler material **60** along with the weight of the material **60** will press the protuberances **66** into the side flaps **35** and **49** to thereby grip same, and will thus lockingly engage the holding bracket in a fixed position.

Alternate construction for the roof panel **24** is shown in FIGS. **12** and **13** wherein like numerals have been used to represent like parts in the various embodiments and the suffix letter "a" is used to designate like parts in this particular embodiment. The roof panel blank **24*a*** has longitudinal score lines **28*a*** to form side flaps **35*a***. The roof panel blank **24*a*** may also be divided into a tripartite roof panel by means of transverse score lines **26*a***. However, the transverse score lines **26*a*** do

not extend into the side flap **35***a* at the end flaps **34***a* and is canted at an angle of 120° from the longitudinal score line **28***a*, thus forming an oblique score line **68.** A portion of the end flap **34***a* has been removed, leaving a cut out portion **36***a*. The cut out portion **36***a* as shown in FIG. **12** assumes the shape of a 30°–60° right triangle with the 30° angle placed at the intersection of the transverse score line **26***a* and longitudinal score line **28***a*. This modified roof panel blank **24***a* provides a means for folding and anchoring the end flap **34***a*, as shown in FIG. **13**, to the foundation **40***a* without the need for the wedge shaped abutment **42** (see FIG. **2**). This modified construction in all other aspects is similar to those embodiments shown and described herebefore.

The above cited embodiments are intended as exemplary and while they have described the invention with a specific implementation thereof other modifications and changes might be made in the embodiments as so set forth and will be apparent to those skilled in the art.

It should therefore be understood that all material herein described or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A pre-fabricated shell structure utilizing modular structural units suitable for home construction, said structure comprising a foundation serving as a supporting base for the structure, a plurality of waterproof coated panels each shaped to define a self-supporting modular roof means including a non-metallic roof section and non-metallic contigous modular-wall sections one extending downwardly from each of opposite side end-portions of the non-metallic roof section, said shaped panels each being rigidly formed of press-shaped organic fibers with a water-proofing coating on at least a part of the outer surface of the pressed fibers forming each panel, for each panel each of opposite downwardly extending wall sections including securing means for securing each respective wall section to said foundation, means for fastening the contigous wall sections of each of two adjacent panels to each other, a rear wall panel securable between the opposing downwardly extending wall sections and the roof section of an end one of said panels, the rear wall panel being securable to the foundation, a front wall panel spaced from the rear wall panel and securable between opposite downwardly extending wall sections and the roof section of a panel of said plurality of panels and securable to the foundation, the front wall panel having means defining openings therein providing access into and out of the shell structure, said waterproof coating being a film coating at least the outer-shell surface of each panel's roof and downwardly extending wall sections, each panel being a blank of pressed organic fiberous material scored in a transverse direction permitting folding of the blank into a tripartite panel having the two non-metallic contigous modular-wall sections and the non-metallic roof section.

2. A pre-fabricated shell structure as claimed in claim **1**, wherein the blank is further scored in a longitudinal direction along two opposed sides of said blank to permit folding same to form side flaps adapted to extend into the interior of the shell structure.

3. A pre-fabricated shell structure as claimed in claim **1**, and the securing means comprising an end flap one on each of the terminal lower ends of the wall sections, and the blank being cut from a larger section.

4. A prefabricated shell structure as claimed in claim **2**, wherein said longitudinally scored material comprises scored parallel opposite edge-portions of the modular roof means permitting folding thereat to define side flaps adapted to extend into the interior of the shell when bent at said scored edge-portions.

5. A pre-fabricated shell structure as claimed in claim **2**, wherein the means for fastening the contiguous sides of each of two adjacent respective panels includes resilient clip means frictionally engaging a side flap of each of two contiguous panels to hold said panels in abutting relationship.

6. A pre-fabricated shell structure as claimed in claim **5**, further including insulating filler material frictionally positioned between the side flaps of the roof and wall panels.

7. A pre-fabricated shell structure as claimed in claim **2**, further including an interior panel section adapted to fit between the side flaps of the respective roof and wall sections for rigidly holding said interior panel between the side flaps to thereby form a hollow elongated chamber and insulating fill material pneumatically placed within the hollow elongated chamber.

8. A pre-fabricated shell structure as claimed in claim **7**, wherein the means for rigidly holding the interior panel sections comprises a holding bracket, said bracket having a head portion for bracing the interior panel section, said bracket further having a leg portion containing protuberances projecting alternately from either side thereof, said leg portion being positioned between the side flaps of two adjacent roof and wall sections so that the protuberances will penetrate and grip the respective abutting side flaps of said adjacent roof and wall sections.

9. A pre-fabricated shell structure as claimed in claim **8**, wherein the blank defines cut out portions therein to facilitate folding of the blank along the prescribed score lines.

10. A pre-fabricated shell structure as claimed in claim **9**, wherein the pressed organic fiberous material is a chemically treated, fire-resistant cardboard and a fiberglass reinforced waterproof film is applied to the outer surface of the roof and wall panels.

* * * * *