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(71) Applicant *(for all designated States except US)*: **THE BOARD OF TRUSTEES OF THE UNIVERSITY OF ILLINOIS** [US/US]; 506 South Wright Street, 352 Henry Administration Building, Urbana, IL 61801 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **HAMMANN, Ralph, E.** [US/US]; 309 W. University Avenue, Apt. 1, Champaign, IL 61820 (US).

(74) Agent: **HERMANSON, Christopher, S.**; Greer, Burns & Crain, Ltd., 300 South Wacker Drive, Suite 2500, Chicago, IL 60606 (US).

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(54) Title: INTEGRATED PORTABLE SHELTER

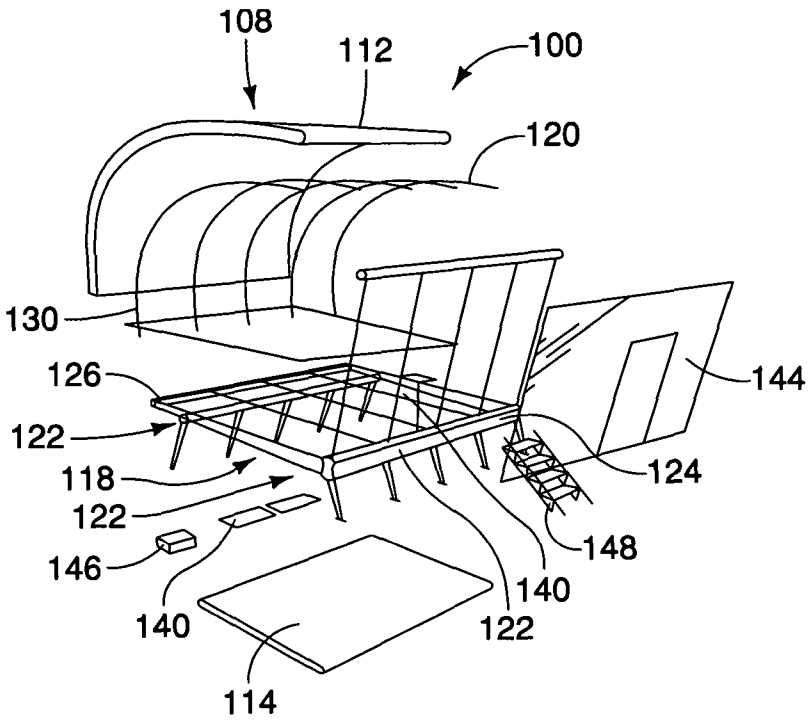

FIG. 3

(57) Abstract: An integrated, portable shelter including a frame and at least two supports hingedly connected to the frame. The supports being movable between a storage position and a support position, where in the support position, the frame is positioned above an underlying support surface. The shelter also includes a bottom wall supported by the frame, a peripheral wall structure connected to the frame, where the peripheral wall structure includes a front wall, a rear wall and at least two sidewalls and the front wall defines an opening, and a top wall connected to the peripheral wall structure. The peripheral wall structure and the top wall define an interior space. The shelter further includes a front panel hingedly connected to the front wall. The front panel is movable between an open position away from the front wall and a closed position adjacent to the front wall.

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INTEGRATED PORTABLE SHELTER

PRIORITY CLAIM

This Application claims priority to and the benefit of U.S. Provisional Patent Application No. 60/937,784, filed on June 29, 2007.

FIELD

A field of the invention is portable shelters. Example applications of the invention include disaster shelters, emergency aid shelters and military shelters.

BACKGROUND

Natural disasters and other emergency events cause major destruction to roads, buildings and homes. The vast destruction leaves many people without amenities such as food and water, and without shelter. Poor economic conditions also cause many people to be homeless or live in slum conditions.

In 2006, approximately 1.4 billion people worldwide had to survive each night without adequate shelter. Whether due to natural disasters (such as earthquakes, hurricanes. typhoon or tsunami) or economic tragedy (slum villages, shanty towns, favelas or other kind of slum conditions), hundreds of millions of people throughout the world do not have housing or do not have adequate housing.

The present invention addresses the above problems and conditions.

SUMMARY

An embodiment of the invention is an integrated, portable shelter including a frame and at least two supports hingedly connected to the frame, the supports being movable between a storage position and a support position, where in the support position, the frame is positioned above an underlying support surface. The shelter also includes a bottom wall supported by the frame, a

peripheral wall structure connected to the frame, where the peripheral wall structure includes a front wall, a rear wall and at least two sidewalls and the front wall defines an opening, and a top wall connected to the peripheral wall structure, where the peripheral wall structure and the top wall define an interior space. The shelter further includes a front panel hingedly connected to the front wall, the front panel being movable between an open position away from the front wall and a closed position adjacent to the front wall.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a side view of an embodiment of an integrated shelter of the present invention with a portion of a side wall removed.

Fig. 2 is a front view of the integrated shelter of Fig. 1.

Fig. 3 is an exploded perspective view of the integrated shelter of Fig. 1.

Fig. 4 is a series of perspective views illustrating the assembly of the integrated shelter of Fig. 1.

Fig. 5 is an enlarged cross-section view of two connectors attached to supports of the integrated shelter of Fig. 1.

Fig. 6 is an enlarged cross-section view of one of the connectors shown in Fig. 5 showing two supports attached to the connector.

Fig. 7 is an enlarged cross-section view of the connector of Fig. 6 showing a leg extending from the connector and the two supports removed from the connector.

Fig. 8A is a side view of the integrated shelter of Fig. 1 the front panel in the closed position.

Fig. 8B is a side view of the integrated shelter of Fig. 1 the front panel in the open position.

Fig. 9 is a side view of two of the integrated shelters of Fig. 1 positioned so that the front panels open towards each other.

Fig. 10 is an exploded perspective view of an embodiment of a water system connected to the integrated shelter of Fig. 1.

Fig. 11 is a fragmentary, cross-section view of the integrated shelter of Fig. 1 showing the electrical system, the water system and the ventilation system.

Fig. 12 is an embodiment of a water storage tank for the water system of Fig. 10.

Fig. 13 is a top view of an arrangement of three of the integrated shelters of Fig. 1 with the roofs removed.

Fig. 14 is a schematic diagram of different arrangements of a plurality of the integrated shelters of Fig. 1.

DETAILED DESCRIPTION

Millions of people are left stranded and homeless by the devastating effects of natural disasters such as tsunamis, typhoons, earthquakes and tornadoes. The present integrated portable shelter is a short-term or semi-permanent shelter to be used by people affected by such natural disasters with a particular focus on utilization in hot-humid climates such as the climates of Southeast Asia which are prone to natural disasters.

Referring now to Figs. 1-11, the present invention provides an integrated portable shelter 100 that provides modularity, ease of transportation and assembly, complete autonomous generation and supply of electric energy, and harvesting of water to aid people that are stranded and homeless after natural disasters and other types of disasters.

The integrated shelter 100 is designed to act as temporary housing placed in the direct vicinity of homes affected by a disaster. In order to be assembled and placed as close as possible to peoples familiar living quarters,

social settings and infrastructure, the shelter is constructed to be a highly flexible, multi-purpose system that is easy to handle and transport.

The structure of the integrated shelter 100 includes a structural fiberglass tube bundle with integrated steel-cable-reinforced framing support elements, wall and roof enclosure materials, a bladder water tank for rainwater harvesting, water purification, and a thin-film photovoltaic or solar element for off-grid power generation, which is transportable in required quantities to areas affected by disasters.

Upon deployment to the particular areas or sites, the individual integrated shelters 100 can be transported and erected by two people without the use of tools. Also, the integrated shelter 100 has an autonomous electrical system 102, which provides electrical energy for lighting of the shelter and other equipment, and a water system 104 for harvesting and storing water for human consumption in areas which have lost the ability to provide power and water due to destroyed or damaged utility grids.

A single integrated shelter, unit or module 100 provides rapid shelter for approximately four adult people for short term or semi-permanent use. The number of people that can live in a shelter unit varies based on the size of the unit and the size of the people staying in the unit (i.e., adults, adults and children, etc.). The integrated shelters 100 can be arranged in flexible setups to accommodate larger space needs, to respond to local conditions or to reflect local cultural habits.

Each integrated shelter 100 is provided as a light-weight, compact shelter system kit. The materials and shape of the shelter are capable of effectively harvesting rainwater for purification and human consumption. Also, the generation of electrical energy for lighting purposes is provided through the use of one or more integrated thin-film photovoltaic panels. For warmer climates, the shelter allows for climatically responsive natural cross-ventilation without mechanical means or mechanical devices. To further minimize heat gain during the day, the integrated shelters are designed to be compact having a surface-to-

volume ratio of 1.2. The compact design also helps to minimize heat loss at lower ambient air temperatures that typically occur at night.

To facilitate effective under-floor natural ventilation, each integrated shelter has an elevated or raised dwelling platform 106. The elevated platforms 106 also provide a safe area of inhabitation by protecting against animals, adverse soil conditions, moisture and uneven ground conditions. Further, the elevated design reflects various global dwelling customs. Another feature of the integrated shelter 100 is that it is integrated as a compact, easily transportable fiberglass tube bundle, which provides the structural framework, autonomous water supply system, photovoltaic energy generation, and space for storage of all necessary elements of its canopy structure.

Besides the main fiberglass tube bundle, the secondary structural elements of the integrated shelter include bamboo, wood and other similar materials that can be readily replaced by local materials.

Furthermore, the roof 108 and side walls 110 of the integrated shelter 100 consist of double-skin, inflatable double chamber cushions 112, which reduce solar energy heat gain, and prevent energy loss. The roof 108 also includes funnels (not shown) that collect rainwater into a shelter-integrated water storage tank or bladder tank 114 typically mounted underneath the shelter. The water storage tanks 114 may also be mounted on any other suitable part of the shelter or outside of the shelter if needed.

Since lightness and transportability is one of the primary design features of the integrated shelters 100, the shelters are secured to the ground using retrievable, reusable earth anchors (not shown). A steel driving rod for the placement of the anchors is integrated into the fiberglass support structure.

Once the integrated shelter 100 is transported to a site it can be unfolded and put to use without using heavy equipment or tools. The tent-like structure is easy to set up and can be transported, unfolded, erected, joined together, and manually inflated by as little as two people.

Single shelters 100 can be either stand-alone structures, or joined together with other shelters to form larger, continuous bi-articulated dwelling units for special uses, such as for first aid, education, or community functions. With the help of a flexible intermediate connector 116 (accordion joint, bi-articulation connectors) shown in Figs. 5-7, a series of connected shelters are able to be adapted to the local conditions of a site, such as trees, rocks, and other obstacles and obstructions. As shown in Figs. 1 and 14, the flexible connector defines a pair of recesses 119 and allows for the arrangement of the integrated shelters 100 to form circular arrangements, semi-circular arrangements, courtyards, and other customary dwelling patterns warranted by the local cultural tradition. At least one connector 116 is included in each of the shelter kits. A ground support or leg 117 is rotatably connected to each connector 116 and rotate from a storage position to a support position as shown in Fig. 7. The legs 117 allow the shelter 100 to stand securely on the ground so that the platform 106 is raised above the ground. It is also contemplated that the legs 117 may be non-rotatably connected to the connectors 116 by friction fit or other suitable connection method.

Each integrated shelter 100 includes a structure formed by a primary support system 118 forming the base or support frame, a secondary support system 120 including platform 106, and a roof 108 supported by the secondary support system.

The primary support system 118 includes a tubular base frame or support frame made of lightweight, high-strength tri-modular group of fiberglass tubes 122 that are resin reinforced at major bearing intersections. The fiberglass tubes 122 include a front support beam 124, a rear support beam 126, and a vertical photovoltaic mast 128. Fiberglass is utilized since it is stronger than aluminum, which is commonly used for such shelters. Also, fiberglass is lighter than aluminum and can be repaired when needed. The fiberglass tubes are formed in standardized molds and provide a space-saving bundle for easy transport of the shelter.

The secondary support system 120 includes flexible, hollow fiberglass poles or rods 130 that form the frame or support for the roof 108 and front wall 111. The rods 130 are connected to the base tubes 122 using connectors 116, where the rods and base tubes are inserted in the recesses 119 by using a friction-fit. The hollow rods 130 contain a stainless steel leader wire (now shown) to allow for easy assembly.

The roof or canopy 108 is positioned on and secured to the secondary support system 120 and is made of a double-skin, flame retardant, neoprene-coated nylon, such as DuPont™Tedlar® Architectural Colored Film or a polyvinyl chloride (PVC) coating (specific weight 0.2-1.0 kg\m^2) having at least two inflatable chambers 112 (Figs. 3 and 10). The double-chamber construction provides a safe roof structure in the event that one of the inflatable chambers should fail. The roof material is also resistant to ultraviolet light to help reduce the effects of the sun on the temperature in the shelter. The roof 108 and more specifically, the inflatable chambers 112 of the roof include pressure compensating units 132 to account for any air pressure changes during use, and one or more safety valves to prevent over inflation. The maximum pressure of each of the inflatable chambers is approximately three psi (0.2 bar), although the chambers can be made to accommodate other suitable pressures.

The roof 108 is mainly used as a cover for the shelter and also acts as a system for water collection into one or more water storage bladder tank(s) 114 as described in more detail below.

One or more side wall panels or side walls 110 and a front wall 111 are secured to at least one of the primary and secondary support systems 118, 120 to define a living space inside the shelter. The front wall and side walls 110 include buttons, zippers or other suitable attachment devices that allow the side walls to be easily secured to and removed from the primary and secondary support systems. One or more of the side walls 110 also include one or a plurality of

adjustable zipped or buttoned openings 134 so that shelters can be combined to form multiple units (i.e., a first-aid-shelter, a meeting area, or classrooms).

To provide comfortable conditions inside of the shelters 100, especially in hot-humid climates, each of the shelters is equipped with adjustable ventilation panels 135 at the lower bottom of the rear inflatable roof section for cooler (denser, heavier) air supply, and at the upper front enclosure for exhaust of warmer (less dense, lighter) air. The concept of opposing air ventilation panels 136 provides for effective cross-ventilation, even when the shelter enclosures are closed.

Furthermore, vernacular structures, such as bamboo and wood, provide a great degree of cross-ventilation due to their loose wall and floor construction. The shelter can be opened with zipped and buttoned down panels at the lower back and full front of the shelter to allow for cross-ventilation. These apertures consist of a double-layer construction. The outer layer provides water-tightness and full enclosure during times of rain and the inner plastic screen allows for ventilation yet protects against insects.

A floor or underlying support surface 136 is placed on the primary support system 118 and is made of a heavy duty PVC-coated, inflatable, flame retardant nylon that is supported by fiberglass floor rods. Bamboo, wood or other suitable materials may also be used to from the floor of the integrated shelter.

The integrated shelter kits/packages also includes accessories such as guy-lines with adjusters (not shown), suspension hooks (drips, etc)(not shown), a rain water collector system 104 including a rain water collector tank or bladder tank 114 with integrated carbon filter purification 138, a ceramic filter cartridge 137 and a manual pump 140 (shown in Fig. 1) that is integrated into the support frame.

Each integrated shelter 100 has a width of 3.30 meters, a length of 4.00 meters and a useful interior height of 2.75 meters. It is contemplated that the

integrated shelter 100 may be any suitable size or shape and is not limited to a specific width, length and interior height.

The sizing of the shelter kit/package including the tripartite tubular support structure and the inflatable roof and side walls is compliant with ISO container dimensions and payloads. Three shelter kits in line, each 4.00 meters in length, fit the most common standard international container with a length of 12.20 m, equal to two Twenty-Foot Equivalent Units (TEU), or 12.20 m x 2.44 m x 2.59 m.

A single carrier includes sixty complete shelter kits fit into one container. The most effective mode of rapid deployment of a large number of integrated shelter kits is by helicopter such as an Erickson Sikorsky Skycrane Helicopter S-64. One flight carries one container with sixty complete shelter kits. Upon arrival at the site, the kits are unloaded. As shown in Fig. 4, the two front and rear support beams 124,126 are made of lightweight fiberglass and are assembled to the full shelter length of 4.00 meters. The secondary fiberglass rods 130 for the inflatable roof structure which are contained in the hollow support frames are assembled and the two upper and rear support frames are put together, and the water storage tanks 114, the roof inflatable chambers 112, side walls 110, front wall 111 and PV panels 144 are installed in a last step. It should be appreciated that any method or series of steps may be used to assemble the shelter 100.

Other modes of transportation, such as train or flatbed truck, are also contemplated and are determined based on the availability of a particular mode of transportation and what type of transportation is permitted by the local infrastructure.

When natural disasters or other disasters occur, fresh water is typically in short supply. Thus, each integrated shelter 100 has an autonomous water supply system 104 that is particularly needed in hot-humid climates. Rainwater is collected on the curved or sloped, inflatable roof 108, passed through

a ceramic filter 137, and collected in at least one flexible, ultraviolet (UV) light inhibited vinyl bladder tank 114. The integrated shelter 100 may also have a plurality of bladder tanks 114. During periods of rain, the bladder tank 114, which is initially rolled up and stored underneath the platform of the integrated shelter, uncoils automatically due to the increasing water pressure from the water entering the tank. The bladder tank 114 uncoils to a length of 0.60 meters (which is identical to the height of the raised dwelling platform) as it is filled with water.

As an example, the size of each shelter's roof 108 is approximately (3.00 m [L] x 4.00 m [W]) resulting in a collection surface having an area of 12 m^2. The minimum rain fall in Southeast Asia in the months of January and February is $0.025m^3/m^2$ surface area = $25liters/m^2$ x 12 m^2 = 300 liters/month. The maximum amount of rainfall in the months of September to November and March to April is approximately 2,500 liter/month. The average consumption per shelter unit (four occupants) is: 4 x 10 liters/day or 1,240 l/month. The size of the bladder tanks is coordinated with the size of the shelter support platform and its clearance from the ground. The shelter design is able to accommodate a maximum number of four (4) interconnected bladder tanks each having dimensions of 3.00 m (L) x 0.35 (H) x 1.00 (W) for a volume of 4.20 m^3, or 4,200 liters. This tank size compensates for periods of insufficient precipitation during dry periods.

A first flush device, i.e., ceramic filter 137, ensures that runoff from the first spell of rain is flushed out and does not enter the system. This is necessary since the first spell of rain carries a relatively larger amount of pollutants from the air and the roof surface. The water is purified by activated carbon cartridges 138 along with ultra membrane filtration or micro-membrane filtration modules incorporated in the bladder tank assembly. The purification components of the water supply system 104 has the capacity to deal with E-coli and is designed to meet the World Health Organization's (WHO) water regulation standards.

Other methods of simple purification, such as adding chlorine tablets, can be used if warranted by local conditions. From the bladder tank, the stored water is pumped through flexible conduit, such as PVC tubing, to the inside of the shelter using a hand-operated or manual pump 140 mounted on an internal sink.

During dry periods, the bladder tank(s) 114 recoil back under the integrated shelter 100 using integrated stainless steel coils, and is also stored automatically beneath the platform 106, which protects it against damage and soiling. Using the water supply system 104 makes it is necessary to calculate the tank volume as a function of daily/monthly rain water availability at the site and the water consumption of four persons per shelter so that adequate water is available. An example calculation follows:

1 shelter = 4 person @ ll0 liter/Person/Day consumption
Shelter catch surface area: 3 x 4 m=12 m^2
Assuming that the min. rainfall (such as in January/February) =
0.025m3/m2 surface = 25 liter/m2 x 12 m2= 300 liter/month
4 persons x 10 liter/day x 31 days =1240 liter/ month

Each integrated shelter 100 also has an electrical system 102 that generates and supplies electricity for lights, such as light emitting diodes (LEDs) 142 mounted in the shelters to illuminate the interior living space of the shelters, for small cooking equipment and for other electrical devices. The electrical system 102 includes an array of flexible, thin-film photovoltaic modules or cells (PVs) 144 with an efficiency of approximately η = 12%, that generate electricity using solar radiation. The shelters 100 each have a size of approximately 1429.39 mm x 424.4O mm and are rated for a power of 32 watts and an operating voltage of 16.5 volts. At night the plastic photovoltaic film serves as the front enclosure of the shelter and provides privacy for the dwellers. The generation of electrical energy begins at the beginning of the day when the front shelter enclosure is

opened to a vertical canopy and supported by fiberglass rods or local materials, such as bamboo sticks.

During the day-time the photovoltaic plastic sheets or panels 144 also may serve as a cover against rain, and as a semi-private, intermediate space between two shelter modules facing each other (see Fig. 9). In this space, school can be held, community meetings find a protected space and supplies for first aid shelters can be stored.

Because of the flexible patterns of the shelter layout (in semi-circles, circles etc.) shown in Fig. 14, the radiation exposure of the shelter walls to the cardinal directions of the sun causes the photo voltaic panels 144 to be only oriented as a horizontal roof surface facing the zenith.

To embed one or more of the thin-film photovoltaic panels 144 in the canopy structure, the canopy structures are oriented independently of the orientation of the individual articulated shelters.

The maintenance-free clean energy of each photovoltaic panel 144 is delivered as Direct Current power (DC). It is assumed that the dwellers in the shelter units 100 use electricity for cooking for a period of 2 hours/day. An electrical storage device or storage battery 146, such as a car battery, of 13.5 kWh is therefore necessary, especially for overcast and night time conditions.

The following calculation determines the optimum number of square meter PV cells that are needed for a shelter at a given global radiation level:

$$\begin{aligned} \text{Per } m^2\text{PV} &= 83.7\text{kWh/m/12\%} \\ &= 6987.500 \text{ kWh (Global Radiation)}/100 \text{ kWh/m}^2 \text{ PV} \\ &\approx 7.00 \text{ m}^2 \text{ PV cells} \end{aligned}$$

Since the lowest amount of global radiation amounts to 100 kWh/month / 31 days = 3.22 kWh/day or 3.220 Wh/day, battery storage is required for each shelter. Therefore, a minimum battery storage capacity of 2,700-3,000 Wh such as that of larger car batteries is recommended. Therefore, using

electrical power over the course of five days results in 5 x 2,700 W = 13,500 Wh or a PV net surface area (m^2) of 13,500/2,700 W = 5.1 m^2 PV cells.

The lighting for the integrated shelters 100 is integrated into the fiberglass support tubing and consists of a series of shock and vibration resistant high-brightness lighting devices such as LEDs 142 that are each inserted into a UV resistant polycarbonate housing to eliminate dust and dirt buildup. It is assumed that a maximum power of 100 W/shelter unit x 7 hrs/day = 700 Wh/day will be needed for lighting. Thus, utilizing lighting with a small cooking station, or hot water boiler, of a maximum of 1,000W x 2 hrs/day = 2,000 Wh/day. The resulting total power demand is 2,700 Wh/day for each integrated shelter. The monthly power use for each integrated shelter is 2,700 Wh/day x 31 days = 83.7 kWh/month. The lighting devices may be connected to the battery 146 or to at least one of the photovoltaic panels 144.

The above integrated shelter 100 provides transportable, convenient, safe and durable temporary housing to people that are stranded and homeless due to natural disasters and other disasters. As a result, the devastating effects of such disasters on those people are lessened as they try to rebuild their lives.

While various embodiments of the present invention have been shown and described, it should be understood that other modifications, substitutions, and alternatives are apparent to one of ordinary skill in the art. Such modifications, substitutions, and alternatives can be made without departing from the spirit and scope of the invention, which should be determined from the appended claims.

Various features of the invention are set forth in the appended claims.

CLAIMS

WHAT IS CLAIMED IS:

1. An integrated, portable shelter, comprising:

a frame;

at least two supports hingedly connected to said frame, said supports being movable between a storage position and a support position, wherein in the support position, said frame is positioned above an underlying support surface;

a floor supported by said frame;

a peripheral wall structure connected to said frame, said peripheral wall structure including a front wall and at least two side walls, the front wall defining an opening;

a roof connected to said peripheral wall structure, wherein said peripheral wall structure and said roof define an interior space; and

at least one front panel hingedly connected to said front wall, said front panel being movable between an open position away from said front wall and a closed position adjacent to said front wall.

2. The shelter of claim 1, further comprising at least one inflatable chamber removably attached to said roof.

3. The shelter of claim 1, further comprising at least one water storage tank secured to said frame.

4. The shelter of claim 3, further comprising a water filtration system attached to said at least one water storage tank to filter impurities out of the water being stored in said water storage tank.

5. The shelter of claim 3, further comprising at least one of a ceramic filter and a carbon filter attached to said at least one water storage tank to filter impurities out of the water being stored in said at least one water storage tank.

6. The shelter of claim 3, further comprising a manual pump positioned in said interior space and secured to said frame, wherein said pump allows a user to transfer water from said at least one water storage tank to said interior space for use.

7. The shelter of claim 1, further comprising a photovoltaic panel secured to said at least one front panel, wherein said photovoltaic panel receives solar energy.

8. The shelter of claim 7, further comprising a battery removably secured to said frame, said battery storing the solar energy received by said at least one photovoltaic panel.

9. The shelter of claim 1, further comprising a plurality of photovoltaic panels secured to said at least one front panel, wherein each of said photovoltaic panels receives solar energy.

10. The shelter of claim 1, further comprising at least one ventilation panel mounted to a lower portion and an upper portion of said peripheral wall structure to provide cross-ventilation for said interior space.

11. An integrated, portable shelter, comprising:

a frame including a plurality of supports, said supports position said frame above an underlying support surface;

a peripheral wall structure connected to said frame, said peripheral wall structure defining at least one opening;

a roof connected to said peripheral wall structure, wherein said peripheral wall structure and said roof define an interior space; and

at least one photovoltaic panel hingedly connected to said peripheral wall strucuture, said photovoltaic panel movable from a closed position adjacent to said peripheral wall structure and an open position away from said peripheral wall structure.

12. The shelter of claim 11, further comprising at least one electrical storage device connected to said photovoltaic panel.

13. The shelter of claim 12, further comprising at least one lighting device mounted at least one of said peripheral wall structure and said roof in said interior space, said lighting device being connected to said electrical storage device.

14. The shelter of claim 11, further comprising at least one lighting device mounted at least one of said peripheral wall structure and said roof in said interior space, said lighting device being connected to said photovoltaic panel.

15. An integrated, portable shelter, comprising:

a frame including a plurality of supports, said supports position said frame above an underlying support surface;

a peripheral wall structure connected to said frame, said peripheral wall structure defining at least one opening;

a sloped roof connected to said peripheral wall structure, wherein said peripheral wall structure and said sloped roof define an interior space; and

at least one water storage tank secured to said frame, wherein rainwater is collected by said sloped roof and moves downwardly on said roof due to gravity and is stored in said water storage tank.

16. The shelter of claim 15, further comprising a water filtration system attached to said at least one water storage tank to filter impurities out of the water being stored in said water storage tank.

17. The shelter of claim 15, further comprising at least one of a ceramic filter and a carbon filter attached to said at least one water storage tank to filter impurities out of the water being stored in said at least one water storage tank.

18. The shelter of claim 15, further comprising a manual pump positioned in said interior space and secured to said frame, wherein said pump allows a user to transfer water from said at least one water storage tank to said interior space for use.

FIG. 1

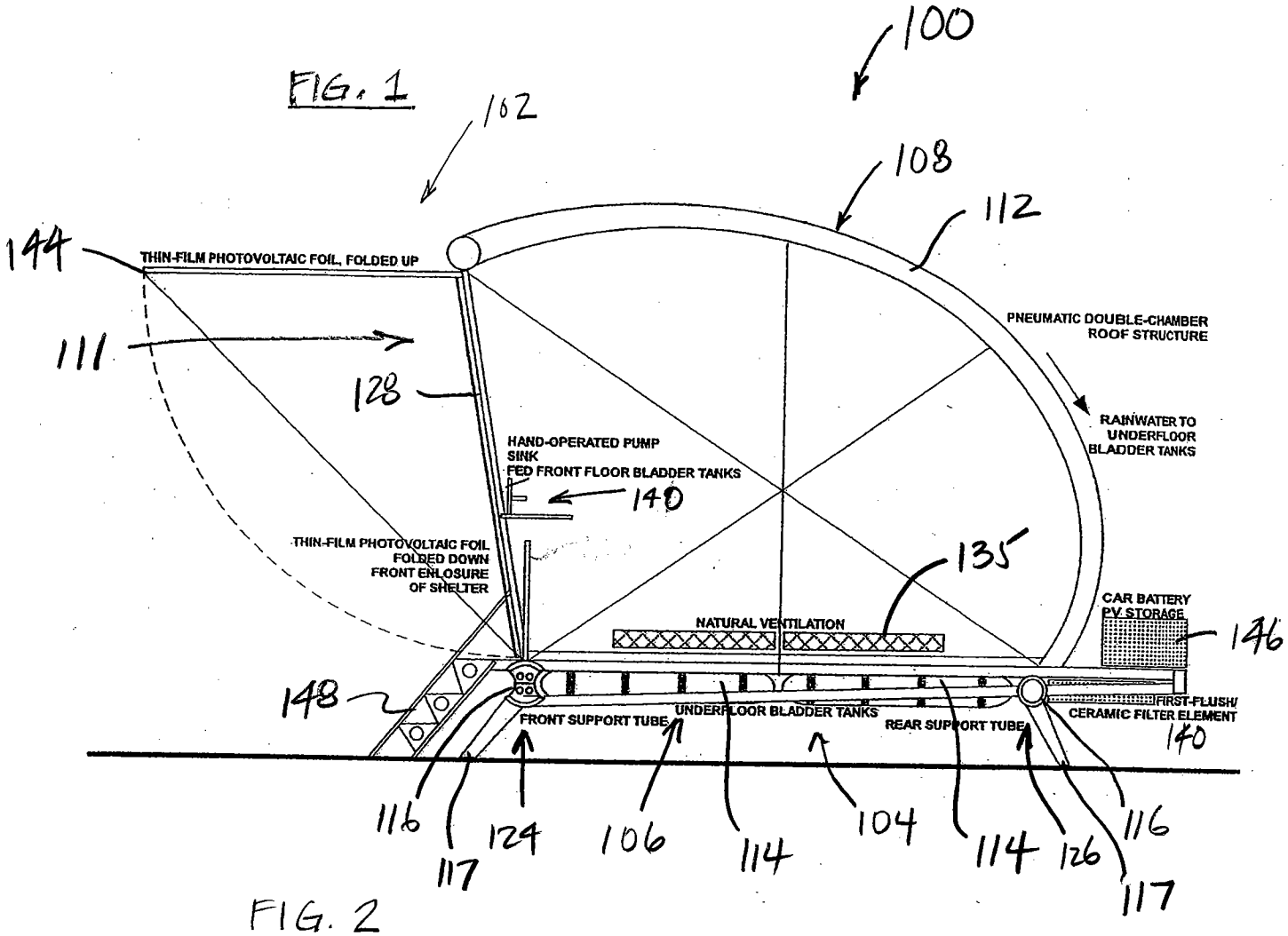

100
102
108
112
144
THIN-FILM PHOTOVOLTAIC FOIL, FOLDED UP
111
128
PNEUMATIC DOUBLE-CHAMBER ROOF STRUCTURE
RAINWATER TO UNDERFLOOR BLADDER TANKS
HAND-OPERATED PUMP SINK FED FRONT FLOOR BLADDER TANKS
140
THIN-FILM PHOTOVOLTAIC FOIL FOLDED DOWN FRONT ENCLOSURE OF SHELTER
135
CAR BATTERY PV STORAGE
146
NATURAL VENTILATION
148
FRONT SUPPORT TUBE
UNDERFLOOR BLADDER TANKS
REAR SUPPORT TUBE
FIRST-FLUSH/ CERAMIC FILTER ELEMENT
140
116
117
124
106
114
104
114
126
116
117

FIG. 2

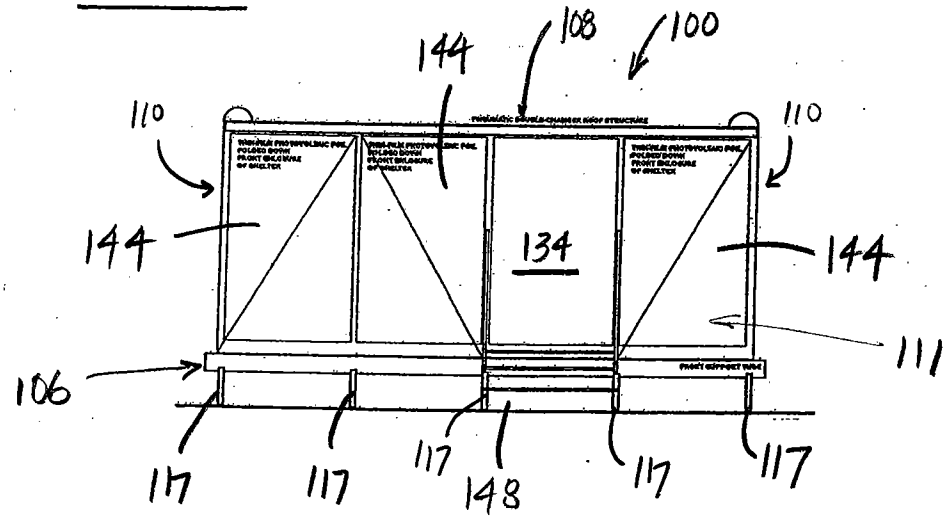

144
108
100
110
110
144
134
144
111
106
117
117
117
148
117
117

FIG. 3

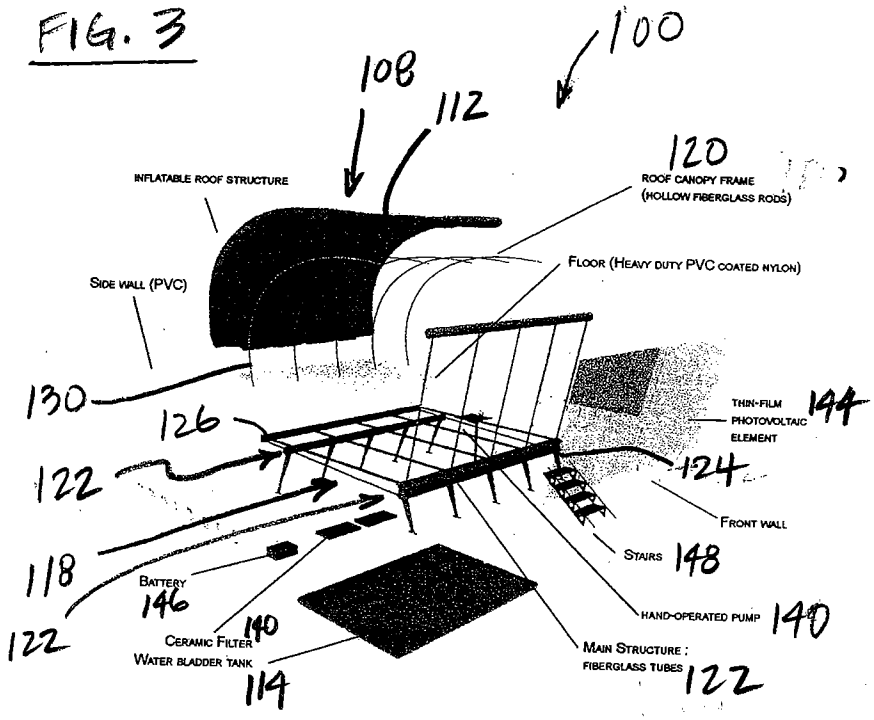

100
108
112
120
INFLATABLE ROOF STRUCTURE
ROOF CANOPY FRAME (HOLLOW FIBERGLASS RODS)
FLOOR (HEAVY DUTY PVC COATED NYLON)
SIDE WALL (PVC)
130
126
122
THIN-FILM PHOTOVOLTAIC ELEMENT
144
124
FRONT WALL
118
STAIRS 148
BATTERY 146
122
CERAMIC FILTER 140
WATER BLADDER TANK
114
HAND-OPERATED PUMP 140
MAIN STRUCTURE : FIBERGLASS TUBES
122

FIG. 4

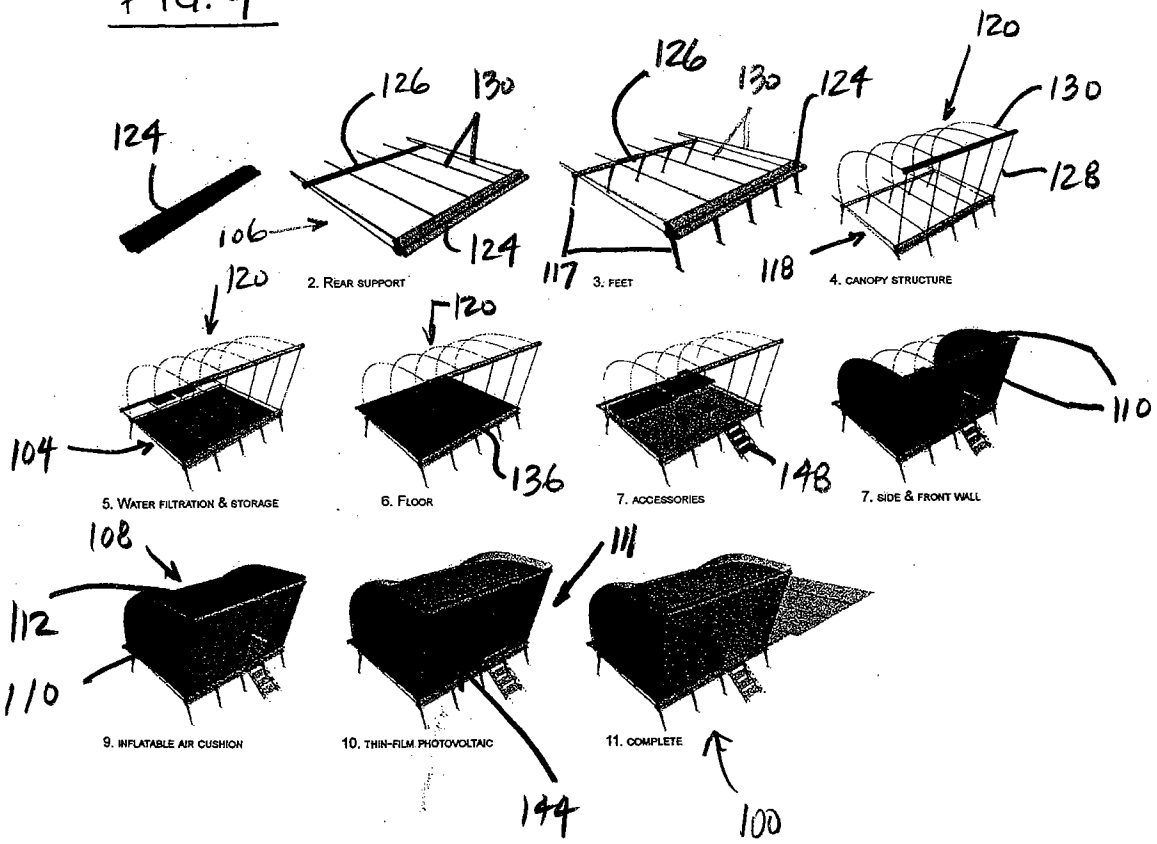

124
126
130
106
124
2. REAR SUPPORT
126
130
124
117
3. FEET
120
130
128
118
4. CANOPY STRUCTURE
120
104
5. WATER FILTRATION & STORAGE
120
136
6. FLOOR
148
7. ACCESSORIES
110
7. SIDE & FRONT WALL
108
112
110
9. INFLATABLE AIR CUSHION
111
144
10. THIN-FILM PHOTOVOLTAIC
11. COMPLETE
100

FIG. 5

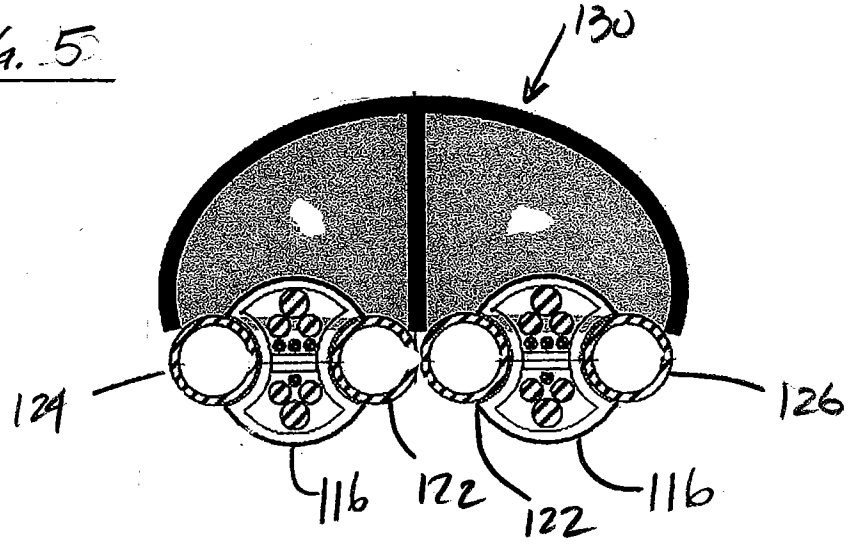


FIG. 6

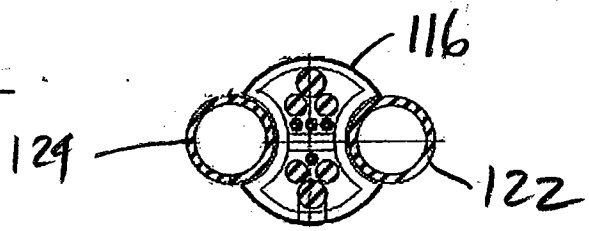


FIG. 7

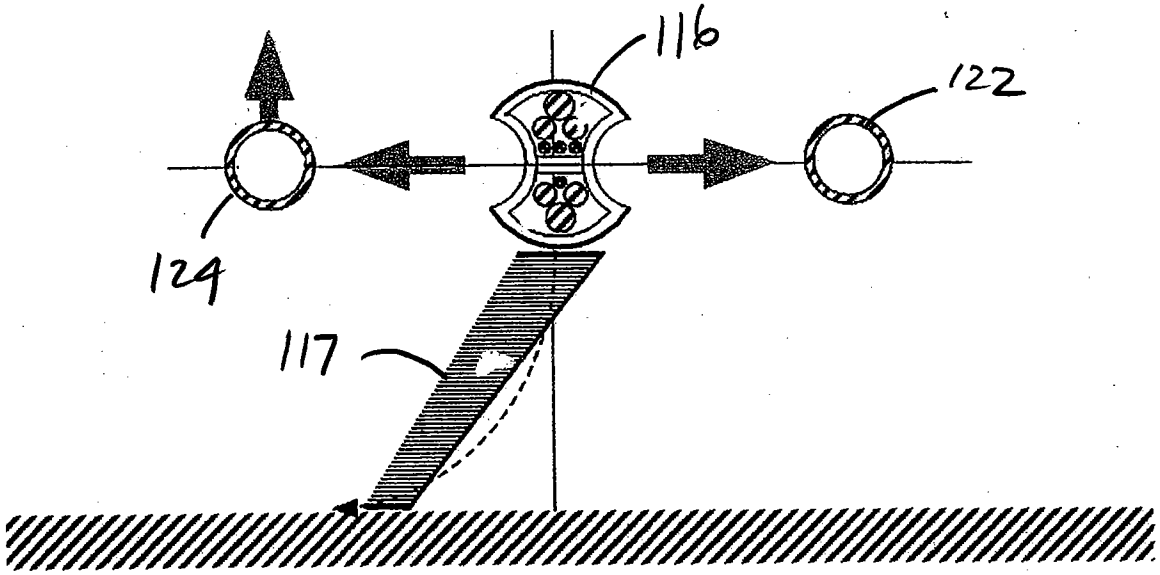


FIG. 8A

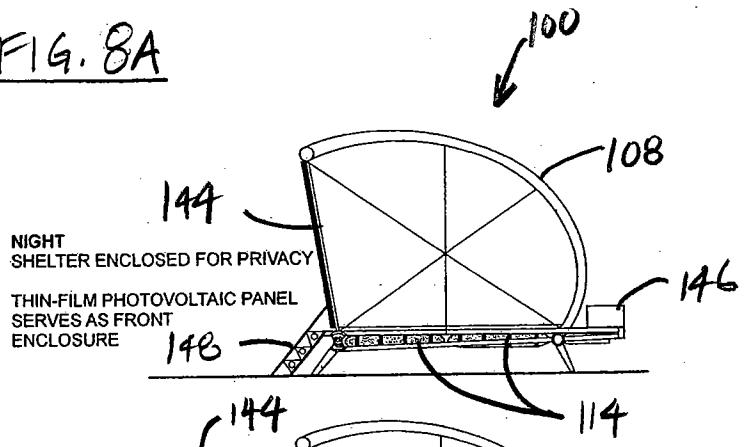


FIG. 8B

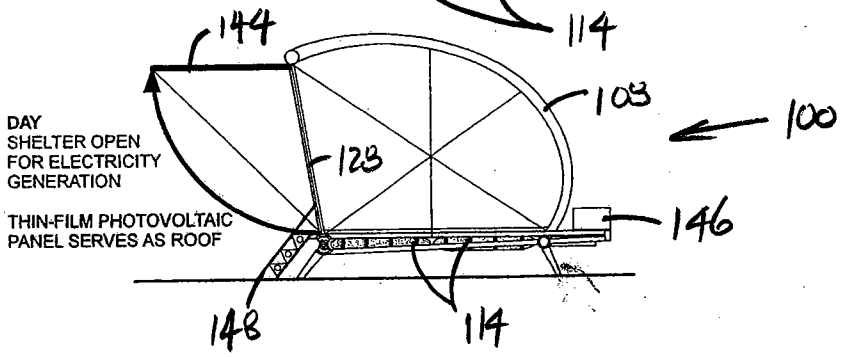


FIG. 9

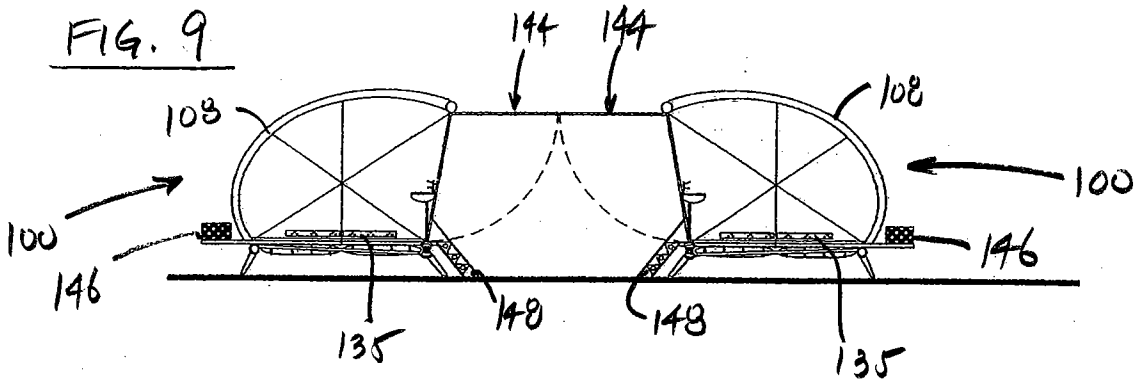


FIG. 10

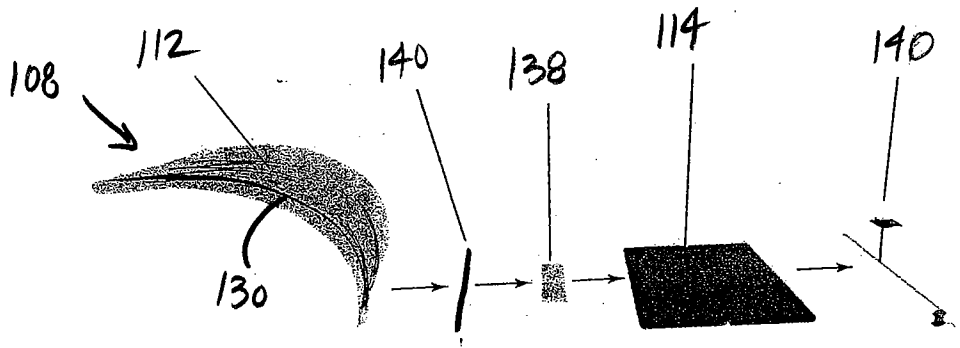


FIG. 11

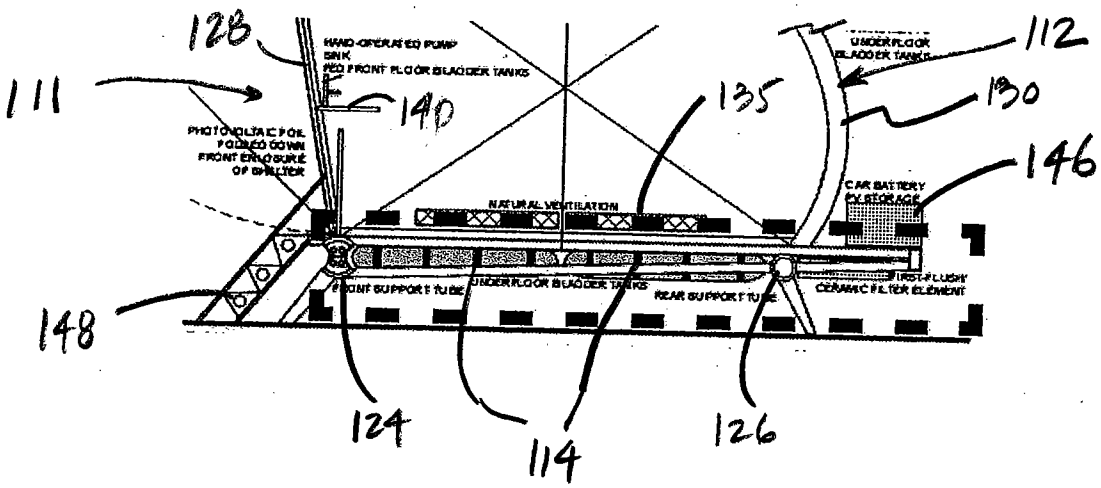

128
111
140
135
112
130
146
148
124
114
126
NATURAL VENTILATION
UNDER FLOOR BLADDER TANKS
REAR SUPPORT TUBE
CERAMIC FILTER ELEMENT

FIG. 12

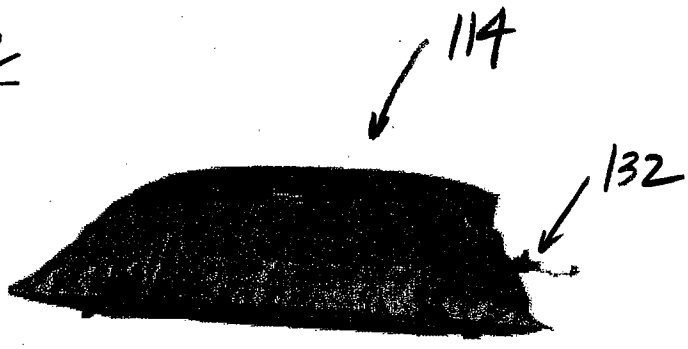

114
132

FIG. 13

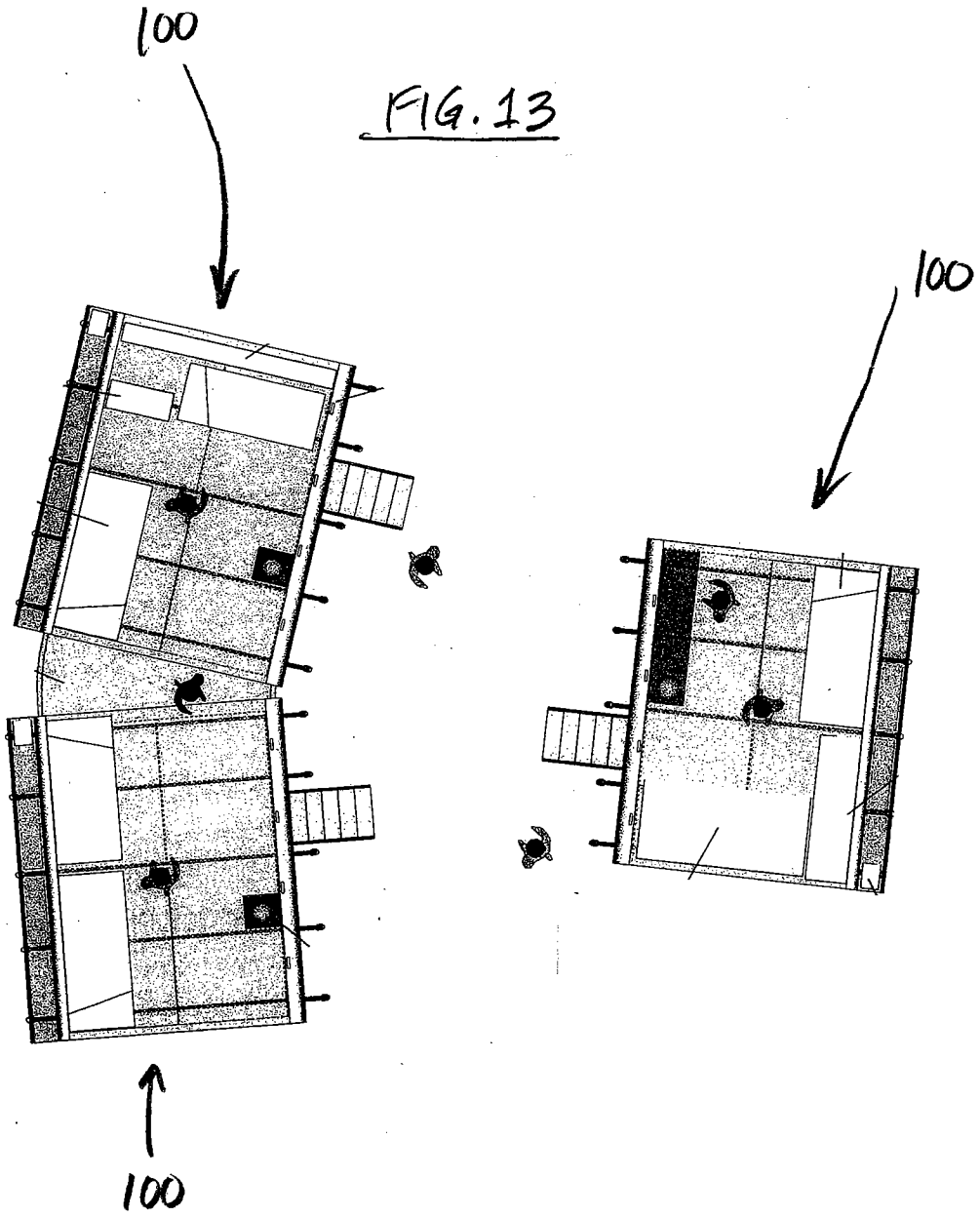
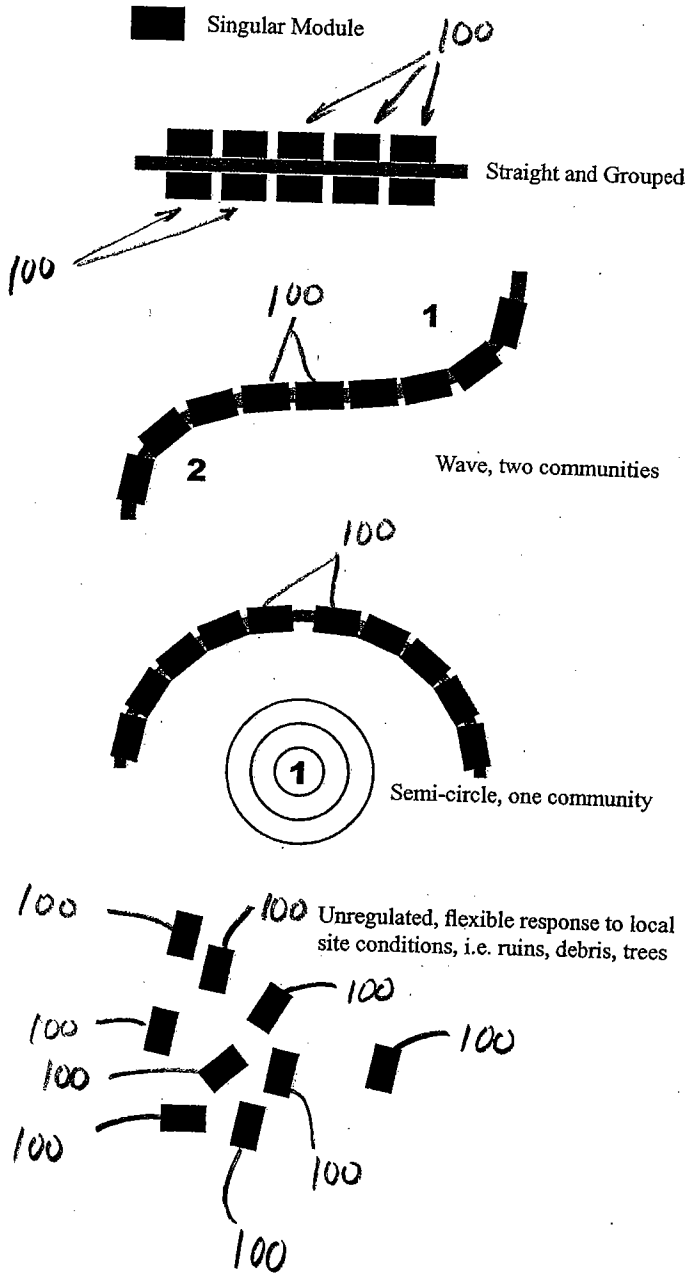


FIG. 14


Singular Module
100
Straight and Grouped
100
100
1
2
Wave, two communities
100
1
Semi-circle, one community
100
100
Unregulated, flexible response to local site conditions, i.e. ruins, debris, trees
100
100
100
100
100
100
100

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 08/68748

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - E04H 15/48 (2008.04)
USPC - 135/149
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8): E04H 15/48 (2008.04)
USPC: 135/149

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
IPC(8): E04H 15/48 (2008.04) (text search)
USPC: 135/87, 121, 124, 125, 126, 134, 137, 148, 149, 155, 117 (text search)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST(USPT,PGPB,EPAB,JPAB); Internet search via Google Web and Google Scholar search engines. Search Terms Used: portable emergency shelter water solar battery filter carbon ceramic frame framework air door roof inflatable float light lamp storage filtered desalination still osmosis collapsible transport PV photovoltaic

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 6,766,623 B1 (KALNAY) 27 July 2004 (27.07.2004), col. 8 ln. 63 to col. 36 ln. 51, Fig. 1-31	1-4, 6, 7, 9, 10, 15, 16 and 18 --- 5, 8 and 17
Y	US 2006/0175254 A1 (BAUER) 10 August 2006 (10.08.2006), para. [0047], Fig. 4	5 and 17
Y	US 6,085,475 A (PARKS et al.) 11 July 2000 (11.07.2000), col. 3 ln. 35 to col. 9 ln. 42, Fig. 1-13	8 and 11-14
Y	US 5,969,501 A (GLIDDEN et al.) 19 October 1999 (19.10.1999), col. 2 ln. 49 to col. 5 ln. 8, Fig. 1-10	11-14
A	US 7,152,614 B2 (KALNAY) 26 December 2006 (26.12.2006)	1-18

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 October 2008 (02.10.2008)	10 OCT 2008
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (April 2007)