United States Patent [19]

Moore

[11] **3,883,911**

[45] **May 20, 1975**

[54] **INSULATED, TUBE-FRAMED BOAT OR THE LIKE**

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[21] Appl. No.: **462,735**

[52] **U.S. Cl.** **9/6**; 114/69

[51] **Int. Cl.** **B63b 3/00**

[58] **Field of Search** ..... 114/.5 F, 65, 68, 69, 83, 114/26; 9/6, 6.5

[56] **References Cited**

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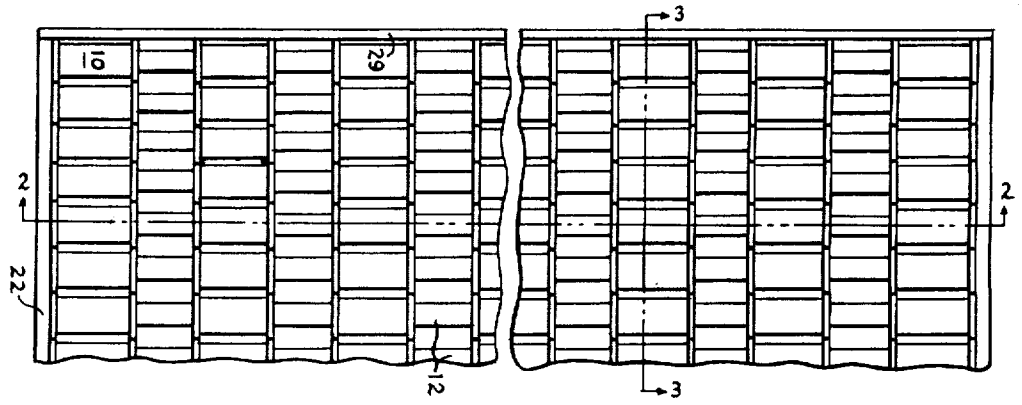
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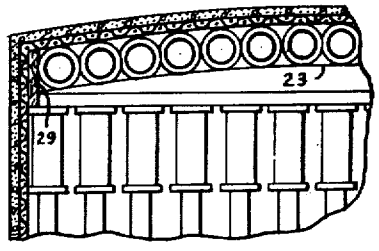
Primary Examiner—Trygve M. Blix
Assistant Examiner—Stuart M. Goldstein
Attorney, Agent, or Firm—Cmdr. Alvin E. Moore

[57] **ABSTRACT**

A boat or other load-holding structure that has: upper and lower four-sided members, each formed of end-joined cans (or optionally of thin-metal or plastic pipes) and having strong joints, optionally of double thickness of the can or pipe material; exterior skin means, preferably of mesh, and stucco on the mesh of portland cement, epoxy putty or other cement and light-weight aggregate, but optionally of plywood, plastic or other siding; interior skin means that optionally may be of plywood, stiff, strong plastic sheet or stucco on mesh or panels of plywood, plastic or the like; and insulation adjacent to tubular members. This insulation preferably includes light-weight, economical insulating material inside the cans or pipes, which for example may be cinders, ashes, sand, light-weight top-soil, cotton linter, bits of spent tan-bark, modules or other bits of pine or other bark, shredded bark, sawdust, shells of peanuts or other nuts, rice or other seed hulls, or the like. Optional other insulation, also adjacent to the tubular elements, may include applied-in-place foamed plastic or strips of foam rubber placed in V-shaped spaces between sidewalls of the tubular members. The boat or the like may have a flat or nearly flat bottom; or, when of the catamaran or trimaran type of craft, it may have floats extending below a generally flat bottom deck. The invented light-weight structure may be a houseboat or other boat, a trailer or other wheeled vehicle, or a portable house or other building. Optionally it may be made in sections, bolted and glued together in fianl assembly.

25 Claims, 24 Drawing Figures





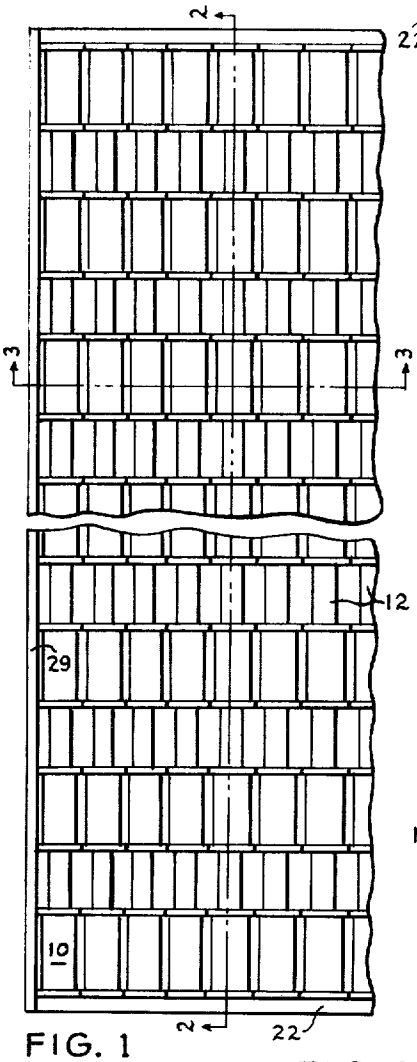


FIG. 1

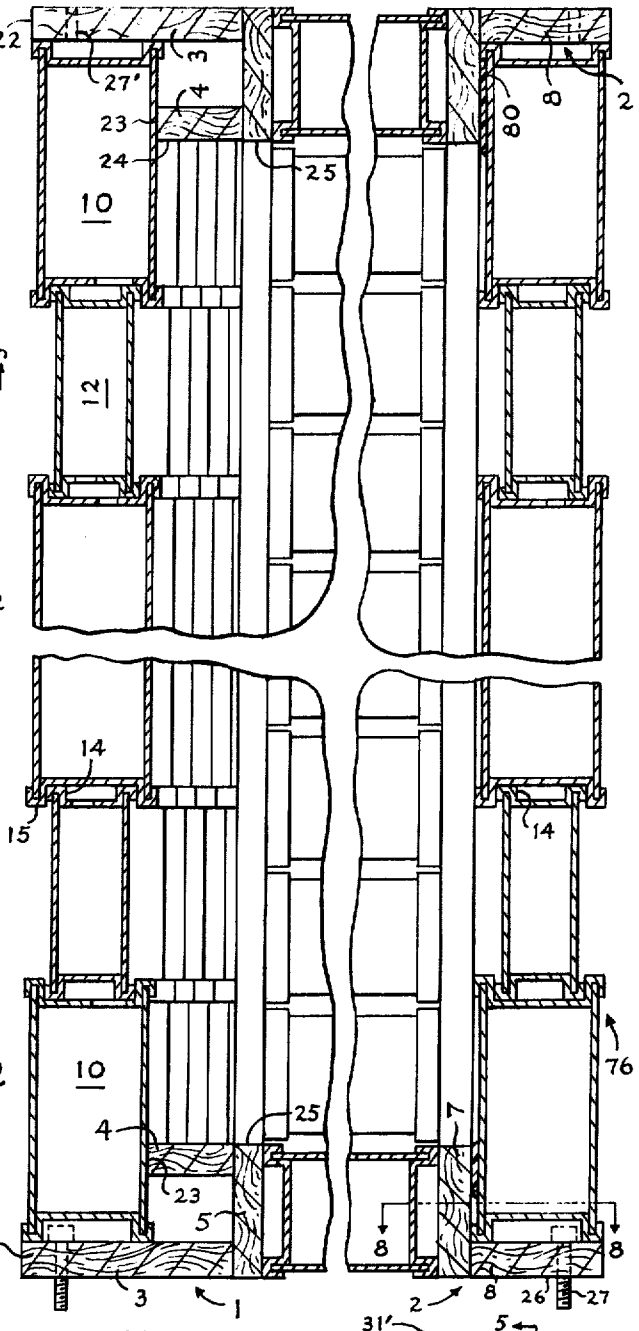


FIG. 2

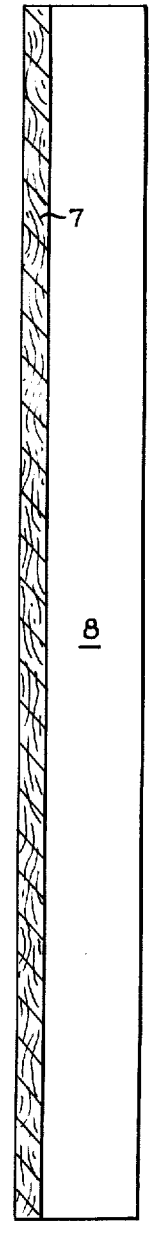
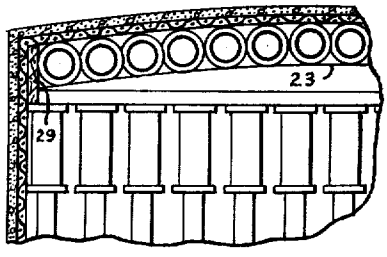


FIG. 8

FIG. 3



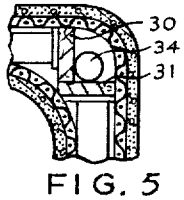
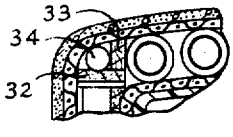


FIG. 5

FIG. 6



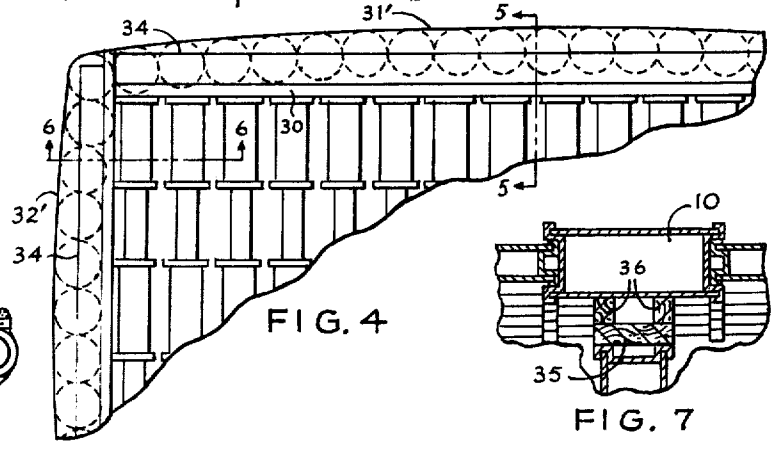


FIG. 4

FIG. 7

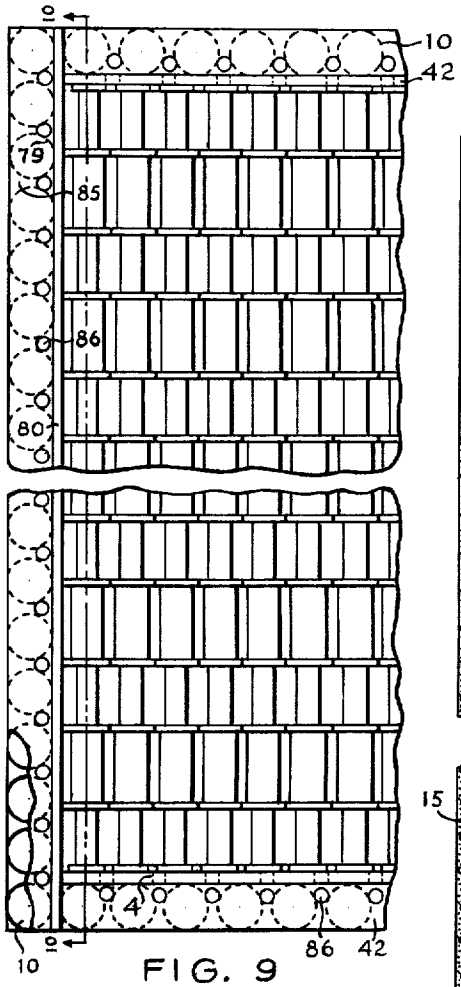


FIG. 9

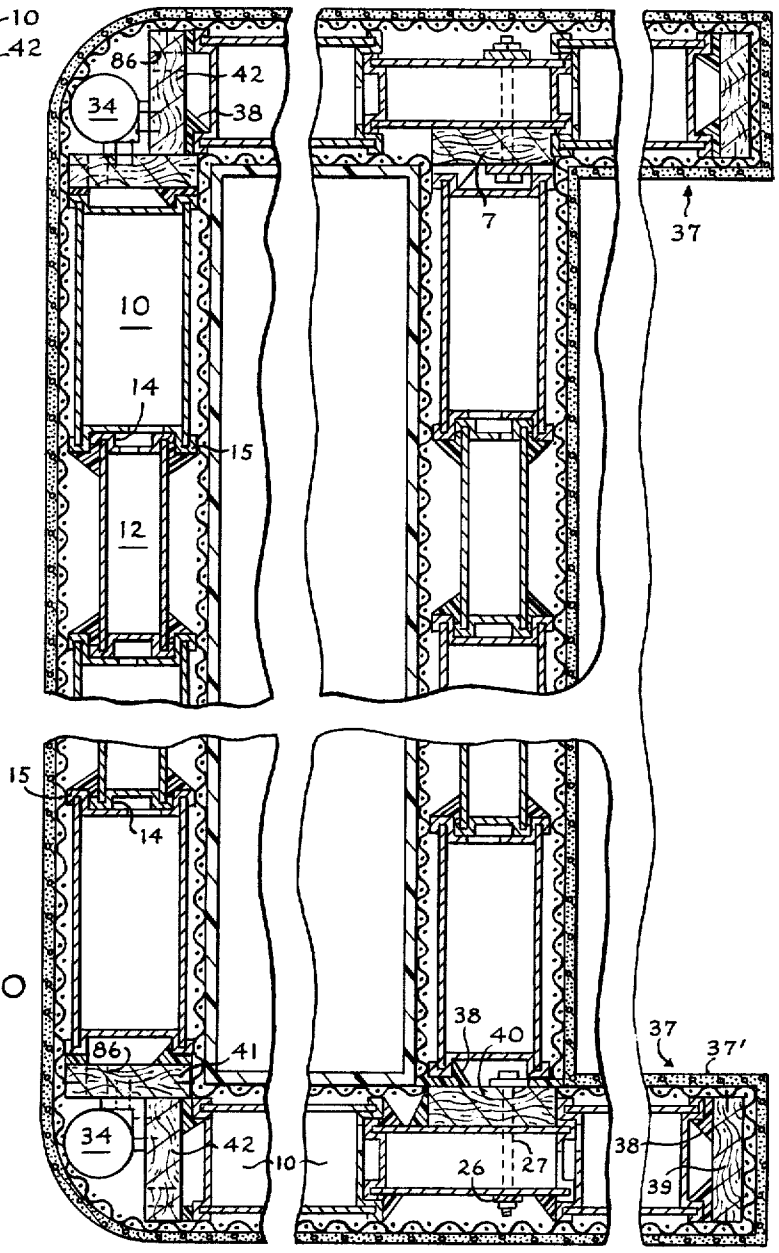


FIG. 10

FIG. 11

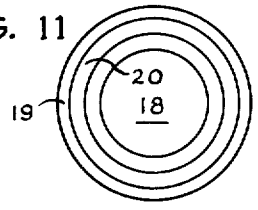


FIG. 12

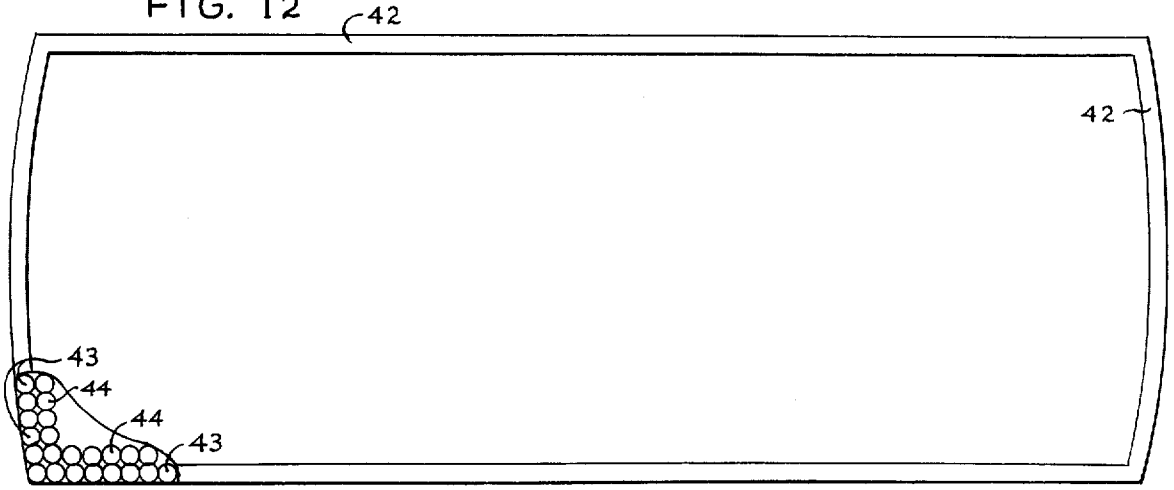


FIG. 13

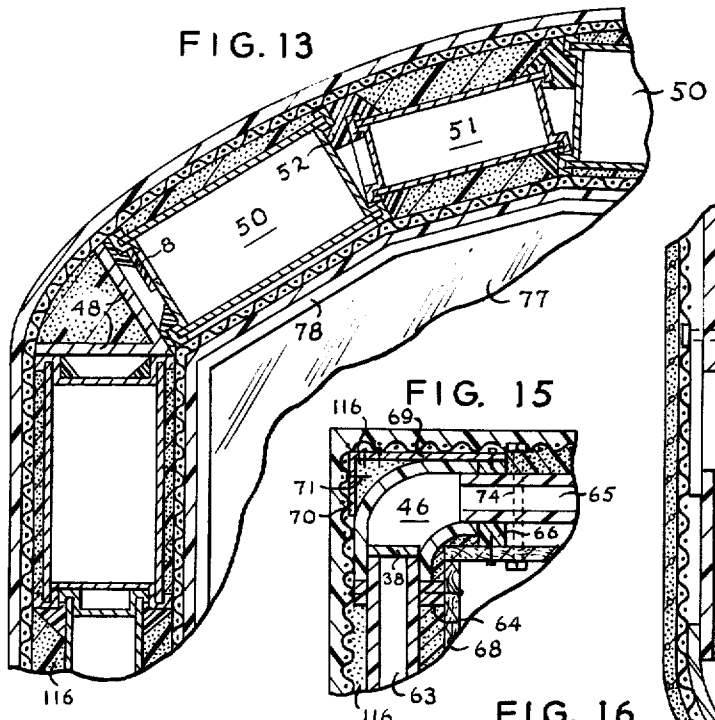


FIG. 14

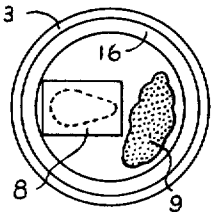


FIG. 15

FIG. 16

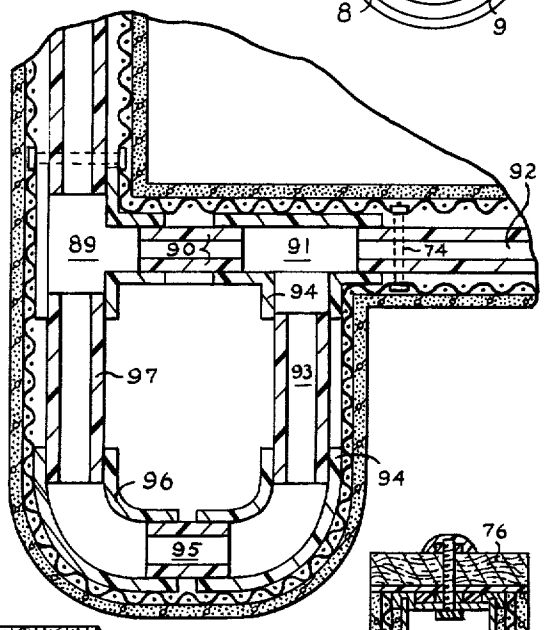


FIG. 17

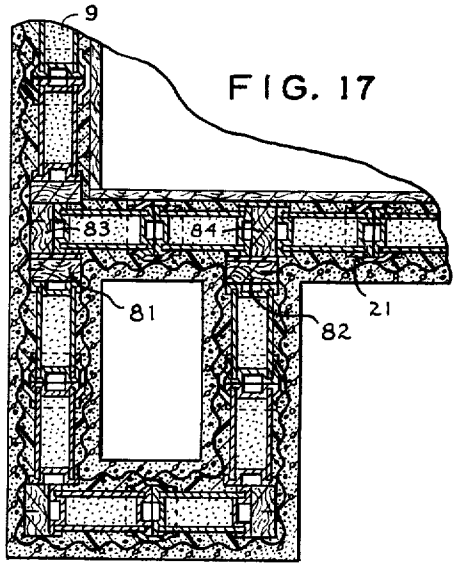


FIG. 19

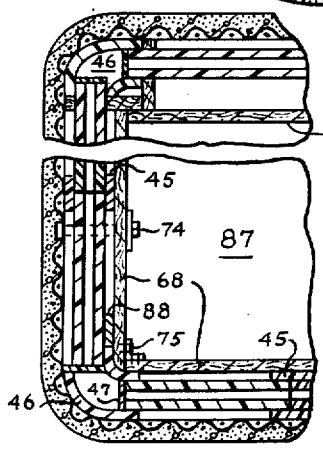


FIG. 20

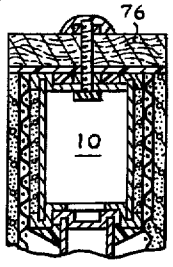


FIG. 21

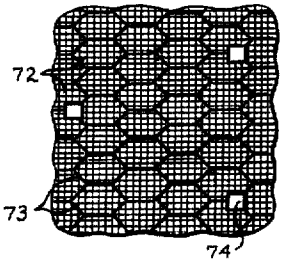


FIG. 18

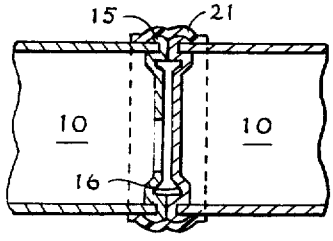


FIG. 22

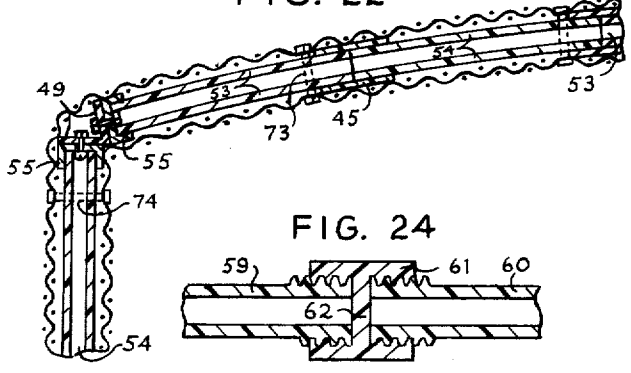


FIG. 23

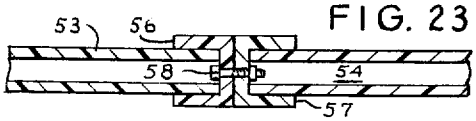


FIG. 24

INSULATED, TUBE-FRAMED BOAT OR THE LIKE

This invention pertains to a light-weight, well-insulated, simply and economically built houseboat, portable house, house trailer, or similar structure, capable of lessening damage in crashes, and easily repairable. In some aspects it comprises improvements of the inventor's prior U.S. Pat. No. 3,596,622 of Aug. 3, 1971.

Some of the objects of this invention are: (1) a strong load-holding structure having a frame that is as light in weight as possible, consistent with strength; (2) a houseboat or other portable house or similar structure having excellent insulation; (323) a structure of this type having insulated upright walls, top and floor which include buoyant tubular members having jointed, light-weight strength, each member comprising a plurality of tubular elements, fastened together at pairs of adjacent tubular-element ends by extra-strength-providing junction elements that are spaced from each other by thin-walled tubes, this structure also preferably including economical insulation in the tubular elements, strong skin means, optional foamed plastic within the skin means, and elongated, structure-bracing, angled beams, fastened to tubular-member ends and to portions of the skin means; (4) structure as in (3) above, in which the tubular elements are new or used cans having fastened-together end-closure elements, and the skin means includes mesh, fastened to the beams and cans and stucco on the mesh; (5) structure as in (4) above, in which the junction elements between cans comprise adhesive tape, wrapped around abutting ends of the cans; (6) structure as in (3) above, in which the tubular elements are lengths of plastic pipe and the junction elements are plastic couplings, comprising sleeves over abutting ends of the pipe; (7) structure as in (3) above, in which adjacent pairs of the tubular elements are fastened together at screwthreaded joints; (8) structure as in (3) above, in sub-assembled sections, bolted and glued together in final assembly; a boat having the structure of (3) above, including floats comprising tubular members that are joined to members of the bottom deck. Other objects and specific details of the invention will be apparent from the following specification and accompanying drawings.

IN THE DRAWINGS

FIG. **1** is a top plan view, partly broken away, of the tubular frame of one form of the invented structure, shown before installation of the skin means and the foamed plastic, the jointed tubular members being shown as cans of a commercially obtainable type;

FIG. **2** is a view of the structure on a scale enlarged from that of FIG. **1**, in vertical section from the plane **2—2** of FIG. **1**, partly broken away, the body being shown as having a curved top;

FIG. **3** is a view in vertical section from the plane **3—3** of FIG. **1**;

FIG. **4** is a top plan view, partly broken away, of the tubular frame of another form of the invention, comprising cans, shown before installation of the skin means and the foamed plastic;

FIG. **5** is a fragmentary sectional view from the plane **5—5** of FIG. **4**;

FIG. **6** is a fragmentary sectional view from the plane **6—6** of FIG. **4**;

FIG. **7** is a fragmentary sectional view from a plane comparable to that indicated at **2—2** in FIG. **1**, illustrating an optional middle partition of the structure;

FIG. **8** is a sectional detail view of a lower beam, from the plane **8—8** of FIG. **2**;

FIG. **9** is a top plan view of a straight-sided variation of the structure of FIG. **4**;

FIG. **10** is a view on a scale enlarged from that of FIG. **9**, in section from the plane **10—10** of FIG. **9**;

FIG. **11** is a plan view of an optional type of the new or used cans of the invention;

FIG. **12** is a top plan view of the structure of FIG. **10**, showing its front and rear walls as optionally curved, a portion being broken away in section just above the deck or floor level to indicate bumper rows of tubular elements;

FIG. **13** is a fragmentary view in vertical section from a plane comparable to that indicated at **2—2** of FIG. **1**, or at **5—5** of FIG. **4**, or **10—10** of FIG. **9**, showing an optional curved top and an optional one-piece body-bracing angled beam;

FIG. **14** is a top plan view of another optionally used common type of used can, in which insulation has been placed;

FIG. **15** is a fragmentary view in vertical section from a sectional plane comparable to that of FIG. **3** or FIG. **10**, showing a one-piece angled beam as arranged in a square corner of the body;

FIG. **16** is a fragmentary view in section from a vertical plane comparable to that indicated at **5—5** in FIG. **4**, showing one of a pair of lateral floats, comprising pipe elements, before optional application of foam-plastic liquids;

FIG. **17** is a fragmentary view from a plane comparable to that of FIG. **16**, showing one of a pair of lateral floats, comprising cans, after application of foam-plastic liquids;

FIG. **18** is a fragmentary, sectional view on a scale enlarged from that of FIG. **17**, indicating a pair of aligned cans as joined by adhesive tape;

FIG. **19** is a fragmental sectional view from a plane comparable to that at **10—10** in FIG. **9**, showing a forward (or rear) portion of a flat-bottomed body having pipe elements, before optional installation of foamed plastic;

FIG. **20** is a fragmentary view in section indicating an optional fastening of a door or window frame to ends of cans;

FIG. **21** is a detail view of an optional and currently preferred composite mesh, adapted to be stuccoed in forming the skin means;

FIG. **22** is a fragmentary sectional view, illustrating a pipe-framed body having an arched top;

FIG. **23** is a fragmentary sectional view of an optional type of joint between adjacent pairs of tubular-element ends; and

FIG. **24** is a fragmentary sectional view of another optional type of tubular-member joint.

This invention comprises angled beams fixed at body corners to ends of angularly-related tubular members which preferably have joints or nodes intermediate of their lengths, skin means fastened to the angled beams and tubular members, preferable insulation inside the tubular members, and optional other insulation, preferably foamed plastic between sidewalls of the tubular members, applied in mixed liquids via spaces subtended by angled sides of apertured beams or else from

a side or upper end of each wall while it is being made in subassembly. Some of the angled beams are indicated in FIG. 2 at 1 and 2. The beam 1, at each side of the body, has three angularly arranged parts, 3, 4 and 5. Although these may be of metal, and thinner than illustrated, they are shown as made of material that is capable of frictionally holding nails or other rod-like elements. The beam (1 or 2) may be of integrally molded plastic, reinforced or mixed with porous material (for example fibers, fabric excelsior or the like) which provides strength and capability of being efficiently nailed; but preferably the parts 3, 4 and 5 (or 7 and 8 in the beam 2) are of wood and nailed and/or glued together. Each of the beams in the other disclosed forms of the invention also optionally may comprise metal, plastic or porous material capable of frictionally holding nails or other rod-like elements. This porous material is illustrated as wood; and the beam elements 3, 4, and 5 (or 7 and 8 of the lower beams) are nailed and epoxy-glued together. Optionally these beams 1 and 2 and each of the other beams of FIGS. 4 to 20 may be of: wood; metal plate (preferably aluminum alloy or thin steel); strong, expanded metal; molded plastic or portland cement, reinforced by fibers, fabric, excelsior, cinders, metal mesh, or other strengthening material.

The ends of numerous tubular members are fastened by epoxy putty, plastic rubber or other bonding material and optional bolts, screws or other fastening means to sides of the angled beams. Although these tubular members optionally may be elongated plastic or thin-metal pipes, each extending over the full span between opposite beam elements, each preferably has at least one strengthening joint between its ends and comprises a plurality of end-joined tubular elements. In each of FIGS. 1 to 7, 9, 10, 12, 13 and 15 to 20 these tubular elements optionally may be cans or lengths of plastic or of thin-metal pipes.

As illustrated in FIGS. 1 to 7, 13, 14, 17, 18 and 20 they are cans - shown as of metal, but optionally they may be of plastic. Cans of the common kind that contain beer or soft drinks are shown in these figures. Optionally, they are of two diameters and of the used type. When they are used cans they optionally may be resealed by bits of masking tape or other adhesive tape (8, FIG. 14). Optionally and preferably the cans may be filled with a light-weight, low-priced insulation, 9. This insulating material may be cinders, ashes, sand, soil, bits of spent tanbark, nodules, shreds or other bits of pine bark or cedar or cypress or other bark, sawdust, shells or peanuts or other nuts, rice or cotton-seed hulls, or the like. When it is organic it optionally may be dipped in or otherwise treated with low-cost preservative, or slightly charred. In addition to this insulation inside the tubular elements of the upright walls, top and floor, other insulation between the sidewalls of the tubular elements preferably is used. This optionally may be: slender strips of resilient foam rubber (for example, cut from scrap foam-rubber pieces), forced by a putty knife or the like into V-shaped spaces between the tubular-element side walls, adjacent to the exterior skin, the interior skin, or to both of these skins; or applied-in-place foamed plastic, sheathing the sidewalls of the tubular members. The cans of FIGS. 1 to 7, 13, 14, 17, 18 and 20 are illustrated as of the beverage-containing type, but any known type of metal, plastic or glass cans may be substituted for them. The illustrated tubular elements 10 preferably are 14-ounce beer or soft-drink cans, having a diameter of approximately 2⅝ inches and a length of 5½ inches; and the elements 12 are 10-ounce beverage cans, having a length of 4¾ inches and a diameter of 2⅜ inches. Each of these cans has an annular groove, just inside the rim 13, 14 or 15, that is shown at 16 in FIGS. 14 and 18, but for convenience of drafting not shown in other figures. With reference to FIGS. 2 and 10, the rim 14 of each of the smaller-diameter cans (here shown as enlarged for clear illustration) fits in the groove of a larger can and has a small clearance between it and the rim 15. Into this clearance, when the tubular member is sub-assembled, epoxy putty, plastic rubber, welding, solder or other bonding material is placed, to securely hold the adjacent can-end covers together. Each of the tubular members thus comprises a light-weight row of cans, having thin-material tubes of short length between relatively thick and strong bonded joints. In forming each of the rows illustrated in FIGS. 1, 2, 3, 4 and 10, numerous pairs of the larger and smaller cans may be bonded together, and two end sets of three cans each (two large cans and a small can between them) are also initially bonded together. Then, at the bottom of an elongated, preferably upright fixture an end set of three cans is placed. Into the upper groove of the large upper can of this trio epoxy putty, other cement or other bonding material is placed, and the rim 14 of a smaller can is moved down into position within the rim 15. Other pairs of the cans are similarly glued (or soldered) until the tubular member is complete.

Instead of the can of FIG. 14, the common can shown in FIG. 11 may be utilized. This container, easily filled with the low-priced insulation, is of the paint-can type, having the lid 18 which snaps within and is frictionally held by the rim 19. The lid has a groove 20; and the can's bottom has a rim which is similar to the rim 19. The similar bottom rim of a smaller-diameter can fits within the groove 20; and each adjacent pair of the cans are bonded together in the above-described manner, or optionally wrapped in a joint by adhesive tape. Optionally all the tubular elements in a row, of the type of either FIG. 11 or FIG. 14, may be of the same diameter, and the cans may be welded, epoxy-glued, or otherwise bonded together. This bonding may be economically and quickly effected in the manner indicated in FIGS. 17 and 18 by use of slightly resilient, resistantly stretchable adhesive tape. This tape, 21, may be commercially obtainable masking, rubber or friction tape. It is tautly wrapped around the abutting rims with some overlap of the tape end that is initially stuck on the rims. The slight yielding of side portions of the tape due to its taut application causes it to very snugly and strongly envelop both the summit of the rims and portions of the two sidewall tubes. For extra strength two wrappings of the tape may be made. Some cans that are presently manufactured do not have covers which outwardly project beyond the tubes of the sidewalls. In forming taped joints between ends of cans of this kind any type of adhesive tape may be used - for example, non-stretchable tapes of strong fiberglass fabric or aluminum foil and adhesive.

The top of the body is preferably curved between its forward and rear ends. With reference to FIGS. 2, 3, and 5: The uppermost portions of the contours of the end cans 10 of the top tubular members conform to the parallel curves of the upper outer edge 22 of the beam elements 3 of the body's sides; and lowermost portions

of these end cans rest on and conform to the parallel, curved, upper surfaces **23** of the beam elements **4.** The lateral surfaces **24** of the beam elements **4** thus are flush with the inner edges **25** of the beam elements **5,** providing continuously planar surfaces upward from lower lines of these edges **25** and the outer outlines of the upright tubular members to the curved top; and the inner skin means, which is nailed or otherwise affixed to the edges **25** and surfaces **24** is smoothly continuous from the floor along each sidewall to and along the curved ceiling of the water-shedding top.

Each pair of the lower beam elements **7** and **8** form a right angle between them. The outer surface **26** of the element **8** is flush with the outer edge of the element **7,** thus providing a continuously planar surface on which the exterior skin is nailed or otherwise affixed, this skin being also smoothly arranged over outermost outlines of the tubular members.

The forms of the invention shown in FIGS. **1, 9** and **10,** having straight upright sides, optionally may comprise subassembled sections, easily movable to the site of final assembly, where they are bolted and/or glued together. Bolts for this final-assembly purpose are illustrated at **27** in FIG. **2.** These bolts fit in holes like those at **27'** in the inward sidewall of an outer section of the composite body. Nuts may be screwed on the bolt ends because they are applied before installation of the skin means and foamed plastic recesses are provided for manipulation of the nuts, and the bolts project into spaces between curved sidewalls of the cans. When the body has three sections the third one is attached by extending its bolts thru the holes indicated at **27'**.

As illustrated in FIGS. **1** and **3,** the front beam **29** (similar to the rearward beam which is not shown) consists of only one beam element, and the front end of the body is square. But in the form of the invention shown in FIGS. **4** to **6,** all four sides of the body, as well as its top, are curved. In this form there are four top, outwardlycurved, angularly-joined beams and four somewhat similar, outwardlycurved deck beams. Of these, each of the two parallel side beams consists of two right-angularly-joined beam elements **30** and **31.** The outer edge **31'** of the element **30** is curved to conform to the desired curvature of the side of the body; and the outer, upper edge of element **30** is curved to conform to the curved top. Each of the front and rear beams of these four consists of a beam element **32** which has an outer surface, **32'**, conforming with the front body curvature, and an element **33** which has two straight edges. The four angularly joined lower-deck beams are oppositely arranged from the top beams, having their angles opening downward instead of upward. Preferably, an elongated body-bracing element is placed within the angle of each of these top and lower-deck beams. As illustrated in FIGS. **4** to **6,** this element comprises a strong tubular member, which may be an end-joined row of cans of the type shown in FIG. **2** or FIG. **17,** but which as shown is a pipe **34** of thin steel, plastic or aluminum alloy. Foamed plastic, preferably within these angles, further strengthens the corners of the body.

An optional interior partition is indicated in FIG. **7.** It comprises a row of tubular members (preferably of end-joined cans) topped and bottomed by fore-and-aft beams, attached to the tubular members by epoxy putty, bolts or the like. The upper one of these beams comprises: a straight, horizontally-flat beam element, **35**; and two side elements **36,** each of which has a curved upper surface, conforming to the curved top. The beam at the bottom of this partition may be a single horizontally-flat board or bar of metal or strong metallic network.

The bottom of the boat or other body shown in FIG. **2** is flat, but optional catamaran floats are indicated in FIGS. **10, 16** and **17.** Each of the floats **37** of FIG. **10,** preferably extending from the bow to the stern, includes a downward extension of the cans of sidewall tubular members, the lowest can of each tubular member being fastened by epoxy putty or other bonding material and/or bolted to a bottom keel piece, **39.** This beam of wood, bar metal or strong metallic network, may be similar to the lower-deck beams **40.** Optionally, these beams **40** may be like the angled deck beams of FIG. **4.**

The body of FIGS. **9** and **10** has straight, approximately planar bow, stern and lateral sides, and preferably has a curved, water-shedding top of the type indicated in FIGS. **3** and **6.** When curvature of the bow, stern and sides also is desired, the beam elements **41** and **42** may be curved in the manner of the elements **30** to **33** of FIGS. **4** to **6** and the beams **40** and **39** outwardly bowed, while the stuccoed inner surfaces **37'** of the floats are straight and planar, mostly spaced from the illustrated float tubular members.

Optional bumper rows of tubular members are shown in FIG. **12.** In this figure only one thickness (**42**) of tubular members and skin is illustrated, comprising one row of tubular members **43** outside the cabin-wall tubular member **44** at the bow, each side and the stern, but optionally there may be a plurality of such rows - a second row or several rows being outside the tubular members **43,** between the flexible bumper skin and the members **43.** The members **43** may be single elongated cans of resilient, shape-retaining plastic or a vertically stacked tier of end-joined cans. In any event, the four angularly related rows of these tubular elements or stacked cans preferably extends a little above the inside deck level, may be nearly encompassed by a lifeline; and preferably the top, horizonal portion of the skin at **42** serves as a narrow outer deck, leading to a door or doors, the frame of each being fixed within a gap in the body walls. These bumper tubular members preferably are filled with frangible elements - for example, glass fibers, tufts of rock wool, shredded rigid foam plastic, preservative-treated bark, or the like.

In FIG. **19** the tubular elements are illustrated as optionally being end-joined lengths of pipe, shown as of plastic, but optionally of thin steel or aluminum alloy (preferably of extruded plastic or metal) or glass. The currently preferred type of these tubular members comprises cut lengths of extruded, commercially obtainable plastic plumbing pipes. They are cut to the desired length and end-joined within the plastic-pipe couplings **45.** When the pipes are of polyvinyl chloride or chlorinated polyvinyl plastic a coat of solvent is applied to the end of a pipe and the socket of the coupling or other fitting, and the pipe is immediately inserted and rotated into final position. These couplings, as well as the elbow fittings **46** form strengthening joints or nodes in the tubular members and also serve the useful purpose of positioning and holding the exterior and interior body skins in even arrangement. This arrangement reduces the thickness of stucco required when the skin means comprises stucco on mesh. For such extra strength and evenness of arrangement two or more of

these joints are provided between the ends of each tubular member of the walls, top and floor. Optionally, the pipe lengths may be sealed by pieces **47** of masking tape or other adhesive tape.

The upper elbows **46**, preferably of the commercially obtainable plastic type, are shown in FIG. **19** as within the angles of the angular beams. When, as is optional, the adjacent pairs of these elbows are spaced from each other the optionally used, injected or poured foam-plastic liquids may be more efficiently transmitted to the spaces between the tubular members.

Preferably the top of the structure of FIG. **19** is arched; and such curvature may be achieved in the manner described above in connection with FIGS. **2** to **6** or optionally as indicated in FIGS. **13** and **22**. Here, the angular beams (**48, 49**) are not orthogonal, but each has an acute angle opening outward, toward the skin. Each of these angular beams may comprise: molded, reinforced plastic; metal bars, optionally apertured, welded together at abutting edges; angularly bent, strong expanded metal (steel or aluminum alloy); apertured and concrete-sheathed sheet-metal angles of the plaster-cornerbead type, or wood or other porous nail-holding material. The acute angle of each angular member is such as to permit the adjacent ends of the tubular members, which conform to the desired curvature of the top, to lie closely against and be glued and/or bolted to surfaces of its sides.

In FIG. **13** the cans **50** and **51** are shown as having their end covers fastened together by epoxy putty or other bonding material, **52**. Rims of the smaller cans **51** fit within and at points lie against the larger cans **50**.

In FIG. **22**, ends of lengths of plastic pipe, **53** and **54**, are shown as end-joined by and within the couplings **45**. At the angular member **49** of each upper corner of the body, adjacent ends of the composite tubular members are sheathed and bonded in commercially obtainable end caps **55**; and these end caps are fastened to the angular member by polyvinyl chloride solvent or epoxy putty or other glue and bolts or rivets. In forming each of these curved tubular members, straight, extruded-pipe portions **53** and **54** are cut to the desired lengths and their ends are fastened in the couplings **45** and caps **55** by plastic solvent or glue. Then the tubular member is bent to the desired curvature. When the pipe lengths are of semi-rigid plastic the member may be bent without heating, but when, as is preferable, they are of rigid plastic they are sufficiently heated for bending into the curve.

FIGS. **23** and **24** illustrate two types of the intermediate joints of the tubular members, which optionally may be used instead of the coupling-formed nodes of FIGS. **19** and **22**. In FIG. **23**, two caps, **56** and **57** are bonded on ends of the tubes **53** and **54**, and these end caps are fastened together by plastic solvent or epoxy putty or the like and/or bolts (or rivets), **58**. Optionally, the composite element **56–57** may be integrally molded of plastic. In FIG. **24**, the lengths of pipe **59** and **60** are of plastic, molded to provide at each end of the tubular element a screwthreaded portion of larger outside diameter than the middle part of the pipe length; and on these screwthreaded pipe ends the coupling **61** is screwed. This coupling optionally may be continuously screwthreaded from end to end, but preferably and as shown it comprises an integral, tubular-member-strengthening middle element **62**. In a method of assembly of this tubular member the following steps may be taken: (1) coating the exterior threads of **59** and the internal threads of the left part of the coupling **61** with polyvinyl chloride solvent (or alternatively with epoxy putty or other glue); (2) screwing the left part of the coupling on the screwthreads of **59** until the element **62** is jammed tightly against the end of **59**; (3) placing plastic solvent or glue on the threads of pipe **60** and of the right-hand part of the coupling **61**; and (4) screwing the threaded end of **60** into the right socket of **61** until the end of **60** is jammed against the element **62**. Optionally, the tubular elements **59** and **60** may be lengths of standard extruded pipe, and the screwthreads on **59** and **60** may be formed by a screwthread-cutting device.

FIG. **15** illustrates an elongated angular type of body corner, which, as indicated, may be on each side of the top, or reversed and used as a lower body corner on each side. The upper-end portions of upright tubular elements, **63**, project thru openings in a non-angular beam **64**; and the left-hand end portions of horizontal tubular elements **65** project thru holes in a similar beam **66**. These beams are shown as of fiber-reinforced plastic or the like, but they may be of any of the above-described beam materials. They are fastened by nails, bolts or the like to the plywood or plastic panels **68** of the interior vehiclebody skin. (Optionally mesh and stucco may be substituted for this interior skin).

The elongated angle beam in this corner is turned upside down from the illustrated position of the angled beams of FIGS. **1** to **7**, **9**, **10**, **13** and **22**, and is exampled in FIG. **15** as having a right angle in cross section, which is adapted to conform to a curved or planar body top that is straight in transverse cross section. But when adapted to be used with an arched top of the type shown in FIGS. **13** and **22** its subtended angle is obtuse and the associated elbow **46** is of the 45° type. Its upper side **69** is preferably longer than its upright side **70** and is screwed, bolted and/or epoxy-bonded to the beam **66**. Its upright part **70** is fastened by bits of epoxy putty to the row of elbows **37**, and optionally also may be fastened by screws extending thru **70** and into and thru the outer curved walls of the elbows. Although this angled beam may be penetrated by these optional screws and is penetrated by the screws, bolts or the like, **71**, fastening the mesh to the angled member, and by the similar rod-like elements which fasten it to the beam **66**, it does not necessarily have relatively large holes. Its purposes are to form an angled, non-round, longitudinally-extending, body-bracing means and optionally, when applied-in-place foamed plastic is utilized, to provide an elongated space between the elbows **46** and the exterior skin, whence foaming plastic liquids may pass between the sides of the elbows to the spaces between tubular members. However, these beams **69–70**, as well as those of the other figures may have many apertures because of being optionally made of angled stiff network, for example, of expanded steel or aluminum alloy sheet, or of apertured, reinforced plastic.

THE SKIN MEANS.

Each of the exterior and interior skins, in each form of the invention, optionally may comprise: sheet metal or plastic sheets, plywood, mesonite, or stucco on mesh. The exterior skin may comprise commercially obtainable aluminum or plastic or cypress siding, but preferably it is stuccoed mesh. Although this mesh may be of a textile fabric or apertured sheet metal or ex-

panded metal or molded, apertured plastic, it is preferably wire network, and preferably of the lightweight, strong, composite type illustrated in FIG. **21.** This comprises layers of hardware cloth **72,** stretched around the tubular framework and fastened to it, having lap joints at their adjacent edges; and over this metallic-cloth mesh layers of larger-mesh fencing **73** (for example, diamond-mesh, poultry-fence material) are also stretched around and fastened to the tubular framework. This composite mesh is fixed to the framework by bits of epoxy putty extending thru the mesh to the tubular members and beams. Preferably, the hardware cloth and fencing are additionally fastened on the framework by extending the bolts **74** from the outside thru the exterior mesh, between spaced tubular elements, adjacent to joints or nodes of the composite tubular members, to and thru the interior skin. These bolts preferably fit in the parts of the diamond-shaped poultry-wire mesh where the wires are close together in a corner, so that the bolt heads clamp both layers of the exterior mesh to the framework, and when the interior skin is also stuccoed mesh the nuts of **74** are similarly positioned over corners of the interior diamond-shaped mesh. In stuccoing, the smaller mesh of the hardware cloth stops excessive penetration inward of the stucco, while the large-mesh, relatively large wire of the poultry-type fencing well reinforces the set stucco.

The stucco, sprayed or troweled on the mesh, comprises cement (portland cement, or portland cement and like, or epoxy, or other cement) mixed with lightweight aggregate (for example: crushed, expanded, baked clay; expanded shale, cinders, pumice, silica dust, bits of shredded cypress bark, or shredded or ground foamed plastic). The interior skin means optionally may comprise this stucco on mesh, or, as indicated in FIGS. **15** and **19,** panels of plywood, masonite or sheet metal. The outside and interior surfaces of the skins comprise coats of paint or enamel.

The doors and windows comprise transparent elements (of glass or plexiglass), within frames (for example like that shown at **76** in FIG. **20**) that are in gaps between tubular elements and epoxy-bonded and optionally bolted to and closures of these elements. Preferably there are only two doors. FIG. **13** illustrates a windshield having a transparent element **77,** within a metal of molded-plastic frame **78.** The upright part of the transparent element **77** stops at a level above the deck, and from this level short tubular members extend downward to the floor area. A window of this type also may be used inside the framework of FIG. **22.** Optionally, in both FIG. **13** and FIG. **22** the top part of the window frame may be horizontal and straight and at a lower location than the top part of the frame **78** of FIG. **13.** In this event, short upper tubular members, like **79** in FIG. **9,** extend downward from the arched or angled front element **78** to the straight top of the window frame. The top tubular part of each of these short upper tubular members is cut to fit beneath and against the bent or otherwise arched or angled tube-holding, metal plate, to which the reinforcing plate **80** (FIG. **9**) is fixed by welding or other bonding material. The tops and bottoms of these short upper tubular members are fastened by epoxy putty, welding or other bonding material to the upper arched member and the straight upper part of the windshield frame. Windows of this general type are also provided for the bodies of FIGS. **2, 4** to **6, 15** and **19,** but when, as here illustrated, the top is flat in transverse cross section the short tubular members between it and the window frame are of equal length.

In assembly of the structure of FIGS. **1** to **3,** utilizing applied-in-place foamed plastic as the additional insulation outside the tubular members, the following steps may be taken: (1) Tubular members of the desired length, comprising cans which preferably are of the same diameter, are filled with low-priced insulating material and end-joined by means of adhesive tape (21, FIG. **18**). (2) An open-top load container or box, rectangular in cross sections, is made. This may comprise sheets of one-half-inch plywood like **68** of FIG. **19,** epoxy bonded at their abutting edges and reinforced by screw-fastened brackets **75** at their angled junctions. (3) The box of step (2) is turned upside down so that its bottom wall is uppermost, elevated enough for a worker to get inside it, and four angled beams **2** are arranged along the edges of its four lateral walls and fastened to the box bottom by epoxy putty or other bonding material and/or screws or bolts. The inner edges of the beam elements **7** are fastened to bottom portions of the box by epoxy putty or other bonding material and by screw or nails applied from inside the box thru the bottom portions and into the elements **7**; and the adjacent ends of the angled beams are fastened together by epoxy putty, short, metallic apertured bars and screws. (4) The box is lowered; and the deck tubular members **76** are placed between the beam elements **8** and fastened to them by epoxy putty or other bonding material and/or screws extending thru the elements **8** and into can ends, and also preferably fastened to the box bottom by epoxy putty or the like. These tubular members preferably are either in contact at their can ends or only slightly spaced apart. (5) The top framework is subassembled (it comprises the two side beams and two end beams similar to the beams **7–8,** the top rows of end-joined cans and an inner top skin comprising mesh nailed and otherwise fastened to inside surfaces of the elements **4** and the upper beam elements similar to **8**). (6) The subassembly of step (5) is fastened around the upper edge portions of the box in a manner similar to step (3). (7) Successively turning the box onto each of its four sides, the door and window frames are fastened to the plywood of the box and the upright tubular members are placed between the upper and lower beams, and fastened to them and to the box in the manner of step (4). (8) Again successively turning the box on its sides, mixed foam-plastic liquids are poured in proper amounts into the spaces between the cans and down against the plywood of the box. Any excess of the plastic, causing it to be too bumpy above the can-and-beam level on each side is sanded or cut away. (9) The layers of mesh **72** and **73** are placed over the beams and tubular members and fastened to them by nails extending into the beams and the bolts **74** (FIGS. **19** and **21**). (10) Stucco of one of the above-described types is troweled or sprayed on the mesh. After it sets it is sanded into smooth condition. (11) Two or more coats of paint are applied to the set stucco.

Instead of the above-described method of assembly the body may be constructed by separately subassembling each of its four upright walls and its top and bottom deck in completed condition excepting the skin means, and then attaching the panels together at their adjacent edges by appropriate fastening means - for example, elongated, angled plates, screws and epoxy

putty, fastening the mesh in the outside of the beams and cans, and stuccoing the mesh.

The subassembly of the bottom deck for instance may comprise the following steps: (1) Sheets of plywood are placed flatwise on the plant floor (over floor-protecting plastic sheet or newspaper pages) and epoxy-glued and pipestrap-reinforced at their contiguous edges. (2) The plywood, cut to the desired bottom shape, is placed on a fixture, the maximum height of which is approximately equal to the thickness of the beam elements **7**. (3) Epoxy or other strong adhesive material is placed on the normally lower surfaces of the elements **7**, indicated at **80** in FIG. **2**, and they are placed under and in contact with the four edge portions of the plywood. (4) The subassembled tubular members (preferably rows of cans of the same diameter, of the type shown in FIGS. **17** and **18**) are placed between opposite pairs of the inner surfaces of the beam elements **8** (the width of each of these surfaces that extends above the plywood maybe slightly greater than that shown in FIG. **2**; but preferably it is approximately equal to the maximum diameter of the cans). (5) The end cans of each tubular member are affixed by epoxy putty or other fastening means to the inner surfaces of the elements **8**. (6) Mixed foam-plastic liquids in proper amounts are poured between the sidewalls of the cans and onto the plywood.

When a catamaran boat of the type indicated in FIG. **17** is desired, the floats, mostly rectangular in horizontal section but comprising rounded or pointed bow and stern portions, are subassembled and then each is fastened to a side portion of the bottom of the main body by epoxy-puttying and metal-strap-fastening the float beams **81** and **82** to the base elements **83** and **84**. This is done before application of the exterior mesh.

An alternate method of applying the foam-plastic liquids is indicated in FIGS. **9** and **10**. Here, the beam elements **41** and **42**, of the body's sides, the forward beam element **85** and the similar element at the stern have numerous holes, **86** - one of the holes being opposite each space between adjacent pairs of the sidewalls of the tubular members. After the stuccoed exterior skin is formed it is drilled thru and mixed foam-plastic liquids are poured or injected thru the skin and into the space between the angled beams, whence the foaming liquids pass into the spaces between the tubular members via the holes **86**.

In assembly of the structures of FIG. **19** (or of FIG. **22** with the type of inner skin shown in FIG. **19**), the following steps may be taken: (1) The box-like inner skin or load-holder **87**, comprising the interior panels **68** and **68'** of plywood or the like (preferably braced slightly above each lower corner at each side of the body by an elongated metal beam **88**, of the type shown at **40** in FIG. **10**) is constructed. (2) The angular members of the upper corner shown in FIG. **19**, including the angled beams and the upper elbows **46** (or the beams **49** of FIG. **22**) are fixed by epoxy putty and nails or bolts to upper corners of the load-holder **87**. (3) The subassembled composite tubular members of the top (straight as in FIG. **19**, or arched as in FIG. **22**) are fixed to and between upright sides of the angular beams. (4) The composite tubular members of the upright walls are fixed at their upper ends to the angled beams - with their lower ends glued to the optionally apertured beams (or bars of metal plate or of strong expanded metal), **88**, by bits of epoxy putty and temporarily resting on fixture bars; and the frames of the windows and doors are installed in gaps between shorter upright tubular members. (5) The incomplete framework is jacked up (or turned onto its side or top) and the subassembled deck tubular members and lower elbows **46** are fitted on the in-use-lower ends of the upright tubular members. (6) Exterior-skin mesh is fastened by epoxy putty and bolts, looped wires or the like to the tubular members and the skin or walls of the inner load-holder **87**. (7) Stucco of one of the above-described types is sprayed or troweled on the mesh. (8) The exterior is smoothed by use of sandpaper or the like; (9) Optionally, additional insulation is provided (the above-described strips of foam rubber or the like placed in the V-shaped spaces between exterior surfaces of the tubular elements, or foamed plastic applied-in-place; if this additional insulation is provided by foamed-plastic liquids, holes may be drilled thru the stucco and mesh, into the spaces between sides of at least two of the corner angular members, and mixed cement and hardener of foamed-plastic liquids are injected or poured thru these holes, and they are closed against pressure from the gas of the foaming liquids. (10) Outer and inner coats of paint are applied; and (11) the doors and windows are installed in their frames.

When a catamaran boat of the type indicated in FIG. **16** is desired, the above method of assembly of the body of FIG. **19** may be generally followed, but the lower elbows **46** are now replaced by the tees **89**, and the tubular framework of each of the pair of floats further includes: the short deck tubes **90**; the tees **91**; fastened to the tubes **90** and to main deck tubular members **92**; the short upright pipes **93**; the elbows **94**, bonded to lower portions of **93**; the short tubes **95**, each bonded at one end in **94**; the elbows **96**, bonded to **95**; and the upright short pipes **97**, bonded to the elbows **95** and the tees **89**.

Various changes may be made within the scope of the following claims. For instances: instead of having larger cans (**10** of FIG. **2**) contiguous to the angled beams, smaller cans (**12** of FIG. **2**) may be placed next to the angular members; the tubular members optionally may be filled with compressed gas, optionally mixed with the above-described tube-contained insulating material; and when the body is adpated for use as an aircraft, as well as a land-traversing craft, wings may be provided, having spars extending across the top of the inner space and jutting out thru gaps in the sidewalls, and/or balloons may be attached to the top.

In the claims, unless otherwise specified: the word "plastic" means: synthetic or natural plastic; the term "bonding material" signifies: adhesive, or plastic material united due to plastic solvent, or welding, brazing, solder or the like; "insulating material" means fibers, insulating particles or pellets, foamed plastic, or other thermally insulating material; "stucco" signifies: aggregate of fibers, cinders, pellets, silica flour, pumice, sand, short shreds of cypress bark, or the like mixed with cement (portland cement or portland cement mixed with lime, lime, epoxy or other cement); the term "rod-like elements" means: nails, screws, rivets or the like; and the term "tubular member" means a single tube or a plurality of tubular elements that are joined together along a straight or curved line.

I claim:

1. A device of the character described, including:

strength-providing framework of a load-holding body, comprising: a plurality of upright, body-wall tubular members, each of which has a pair of end elements and, between said end elements, a plurality of tubes and joints that connect pairs of said tubes together in a line and project beyond their outlines less than an inch; at least one body-bracing frame of four elongated, end-joined, angled beams, forming the general outlines of corners of the body, having spaces between angled sides; means fastening one group of said end elements to portions of one of said angled beams and means fastening a second group of said end elements to portions of an opposite one of said beams; a set of tubular members, having axes at angles to the axes of said upright tubular members, each of which has a pair of end portions that are fixed to and between an opposite pair of said angled beams and between said end portions a plurality of tubes and tubular-member-strengthening joints that connect said last-named tubes together in a line and project transversely to said first-named axes beyond the outlines of said tubes and means fastening said end portions to opposite portions of said angled beams; a second set of tubular members having axes at angles to the axes of said upright tubular members, each of which has a pair of end portions, the said last named end portions being adjacent to and connected to parts of said upright tubular members; an elongated, tubular-member-bracing means, fixed to tubular members at a level in the vicinity of the level of said parts;

exterior, waterproofed, body-skin means, adjacent to said tubular members and tubes;

interior skin means on the inside of said tubular members; and

thermal insulation, adjacent to said tubular members.

2. Structure as set forth in claim **1,** in which said device is a boat and comprises floats, each of said floats including: a plurality of float tubular members below and connected to said body framework, each of said last-named tubular members comprising a plurality of tubes and joints that connect pairs of these tubes together in a line and project beyond their outlines; and waterproof exterior float-skin means comprising mesh and stucco on said mesh.

3. A boat as set forth in claim **2,** in which each of said floats comprises foamed plastic in spaces between portions of said float tubular members.

4. A device as set forth in claim **1,** in which said insulation comprises insulating material within said tubular members.

5. A device as set forth in claim **1,** in which said insulation comprises applied-in-place foamed plastic in spaces between sidewall surfaces of said tubular members.

6. A device as set forth in claim **1,** in which: the said frame is at the top part of said body framework; the said second set of tubular members is at a lower part of said body framework; and the said tubular-member-bracing means comprises a pair of substantially horizontal beams at opposite walls of the body and means securely connecting said beams to elements of said walls.

7. A device as set forth in claim **1,** in which: said angled beams comprise material capable of being penetrated by and frictional holding of rod-like-elements; the said exterior body-skin means comprises mesh and stucco, coating and impregnating the mesh; and the said device further includes rod-like elements fastening said mesh to said angular members.

8. A device as set forth in claim **1,** in which: the said spaces between angled-beam sides are open toward the outside of said body and are in foamed-plastic communication with spaces adjacent to tubular elements via holes in said angled sides; and the said exterior body-skin means is contiguous with and fastened to outer surfaces of said sides.

9. A device as set forth in claim **1,** in which: the said spaces between angled-beam sides are open toward the outside of said body; the said framework includes, in each of said spaces between beam sides, an elongated framework-strengthening tubular member; and the said exterior body-skin means is contiguous with and fastened to outer surfaces of said sides.

10. A device as set forth in claim **1,** in which: the said frame is at a top part of said body framework; each of the said opposite pair of angled beams comprises a flat substantially horizontal beam element, a relatively wide upright beam element that is joined to an outer edge portion of said horizontal element and has lower end portions and a summit that it higher than said lower portions, and a second upright beam element that is joined to an inner edge portion of said horizontal element and has lower end portions and a summit that is higher than said last-named lower portions but is lower than said first-named summit; the said end portions of said first-named set of tubular members are fastened to inner faces of said relatively wide upright elements; lower portions of said last-named tubular members are contiguous with upper edges of said second upright beam elements; and the portion of said exterior body-skin means which is above said last-named tubular members and the said upright beam elements are constructed and arranged to provide shedding of water from said top part.

11. A device as set forth in claim **10,** in which the upper edges of said upright beam elements are arcuately curved.

12. A device as set forth in claim **1,** in which at least some of the said spaces between angled-beam sides are occupied by end portions of said tubular members.

13. A device as set forth in claim **1,** in which at least some of said spaces between angled-beam sides are open toward the interior of said body.

14. A device as set forth in claim **1,** in which: each of said tubular members comprises a plurality of end-joined cans; and each of the said joints comprises a pair of adjacent can-end caps on can tubes and bonding material between said adjacent caps.

15. A device as set forth in claim **1,** in which the tubular members comprises end-joined cans of the same diameter and the said joints comprise lengths of adhesive tape tightly surrounding abutting ends of adjacent pairs of cans.

16. A device as set forth in claim **15,** in which said adhesive tape is slightly, resistantly yieldable.

17. A device set forth in claim **14,** in which: said cans are of the used, liquid-containing type; and each pair of adjoined cans are of different diameters, the end cap of a smaller-diameter can fitting within rims of a larger-diameter can.

18. A device as set forth in claim **14,** in which: said cans are of the used, liquid-containing type and at least

one of each pair of end-joined cans comprises a piece of adhesive tape closing a previoulsy-made opening.

19. A device as set forth in claim **1,** in which: each of said tubular members comprises a plurality of lengths of pipe; and each of the said joints comprises a pipe coupling around adjacent pipe ends and bonding material between the pipe ends and coupling.

20. A device as set forth in claim **19,** in which at least some of said end elements comprise pipe-end caps and bonding material between said pipe-end caps and end portions of said pipe lengths.

21. A device as set forth in claim **19,** in which at least some of said end elements comprise pipe elbows and ends of pipe lengths that are at angles to each other.

22. A device as set forth in claim **2,** in which: each of said tubular members comprises a plurality of end-joined pipes; the said joints comprise pipe couplings around adjacent pipe ends and bonding material between the said pipe ends and couplings; the said float tubular members include upright lengths of pipe; and each of the said floats further comprises pipe fittings in which ends of said upright pipes are fastened and ends of other, horizontal pipes are also fastened.

23. A device of the character described, comprising a load-holding body, including:

an upper, quadrilateral, body-bracing frame comprising: a pair of oppositely placed beams, each of which includes a flat, elongated, substantially horizontal beam element, a relatively wide upright beam element that is joined to an outer edge portion of said horizontal element and has lower end portions and a summit that is higher than said lower portions, and a second upright beam element that is joined to an inner edge portion of said horizontal element and has lower end portions and a summit that is higher than said last-named lower portions but is lower than said first-named sumit; and a second pair of oppositely placed beams, each of which extends between and is connected to opposite end portions of said first-named pair of beams and comprises two elongated upper beam elements that are joined in angles to each other;

a top group of tubular members, each of which extends between said relatively wide upright beam elements and has lower portions that are contiguous with upper edges of said second upright beam elements; and means joining opposite ends of said tubular members to inner faces of said relatively wide upright beam elements;

a lower, quadrilateral, body-bracing frame comprising: four end-joined beams, each of which includes a lower, planar, substantially horizontal beam element, and an opposite pair of which include upright lower beam elements, angularly joined to said planar elements;

a pair of opposite groups of upright body-wall members, each of which has an upper end portion connected to the lower surface of one of said first-named substantially horizontal beam elements and a lower end portion connected to the upper surface of one of said planar beam elements;

a second pair of opposite groups or upright body-wall tubular members, each of which has an upper end portion connected to the lower surface of one of said upper beam elements and a lower end portion connected to the upper surface of one of said planar beam elements;

a lower group of tubular members, each of which is substantially horizontal and extends between an opposite pair of said lower, upright beam elements and has end portions that are connected to inner surfaces of said lower, upright elements;

waterproof exterior skin means and means fastening it to outer portions of said beams and said tubular elements;

interior skin means and means fastening it to inner portions of said beams and tubular elements;

the top portion of said exterior skin means, above said top group of tubular members, and the said upper body-bracing frame being constructed and arranged to provide shedding of water from the top of said body.

24. A device as set forth in claim **23,** comprising a boat, in which the upper edges of said upright beam elements and said top skinmeans portion are arcuate and conform to a boat-top curve.

25. A device as set forth in claim **24,** in which said body is a section of a composite body and further includes bolts, fastened to and jutting outside of a pair of said upper and lower upright beam elements, adapted in final assembly of said composite body to fit in and be secured in holes of upper and lower elements of another section.

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