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 [45] Patented **Aug. 3, 1971**

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 Primary Examiner—Trygve M. Blix

[54] **LIGHT-WEIGHT WRECK-RESISTANT VEHICLE**
35 Claims, 21 Drawing Figs.

[52] U.S. Cl. **114/69,**
114/0.5
 [51] Int. Cl. **B63b 43/10,**
B63b 35/00
 [50] Field of Search **114/0.5, 0.5**
F, 68, 69, 66.5

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ABSTRACT: A vehicle, especially adapted for marine use, having strong, lightweight walls, comprising gas-containing thin-metal, cylindrical or corrugated cans, between skins, and surrounded by foamed plastic. These receptacles are: sealed pipes or tubes; or rows of aligned short cans, end-to-end glued together. The skins may be: metal sheets, epoxy-glued or brazed to the cans; or metallic mesh attached to the cans by brazing or glue and/or bolts, coated with stucco. Optionally the rows comprise short cans of slightly different diameters, with the smaller cans nested and glued within rims of the larger cans; and skin-holding bolts are between opposite smaller cans in adjacent pairs of the rows. Sheet rubber is glued to the outer skin of stucco or metal.

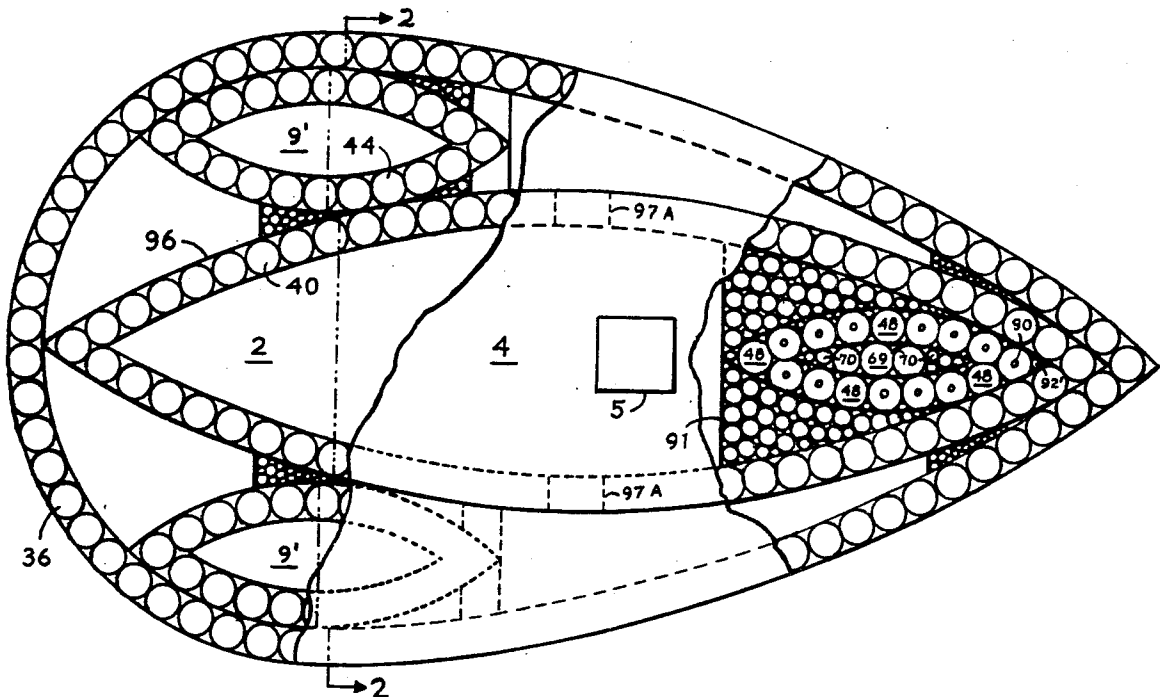


FIG. 1

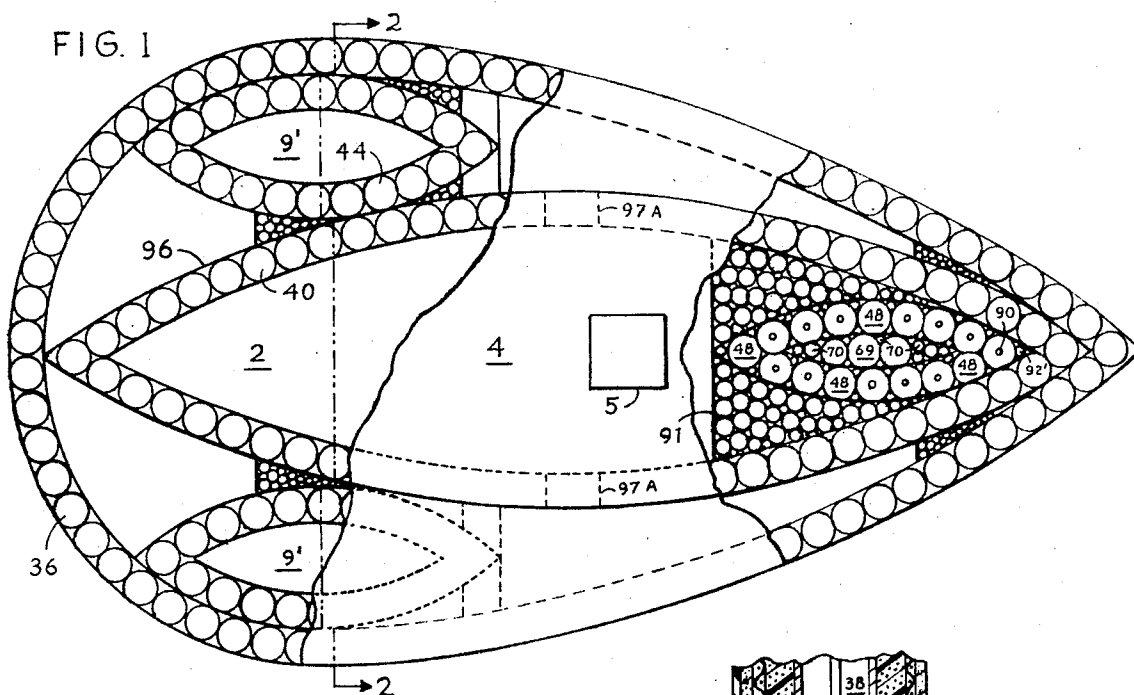


FIG. 2

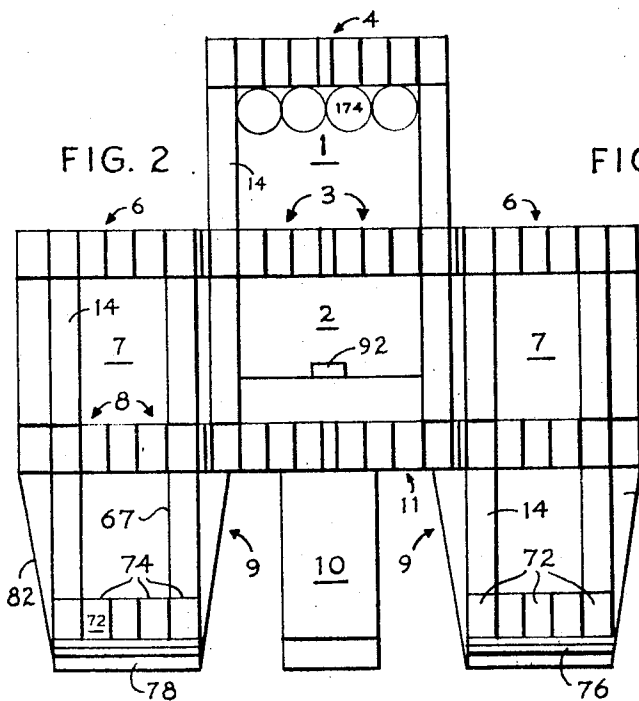


FIG. 3

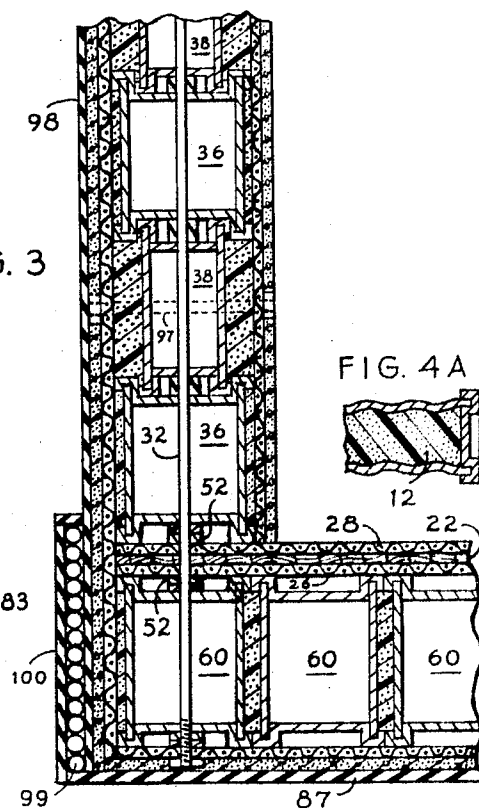


FIG. 4A

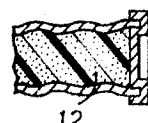
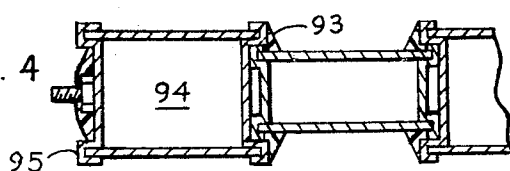


FIG. 4



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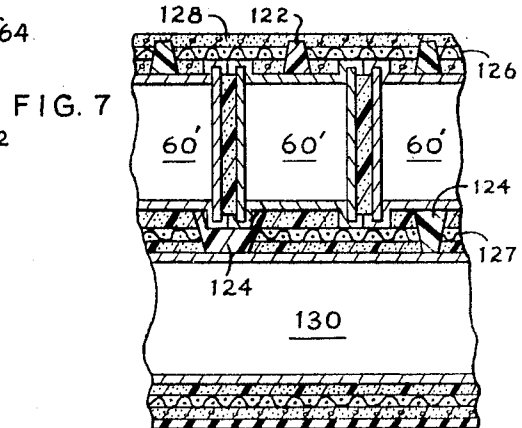
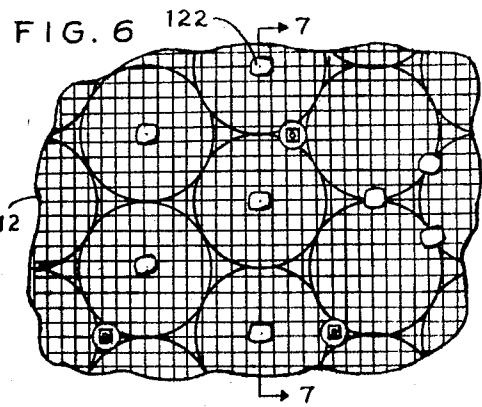
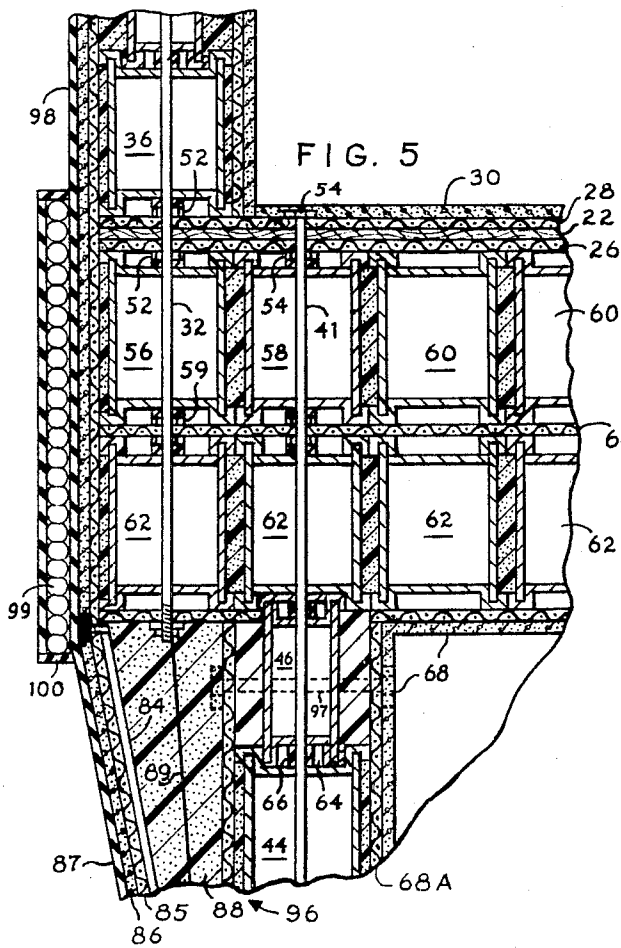


FIG. 10

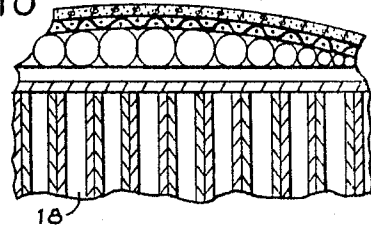


FIG. 11

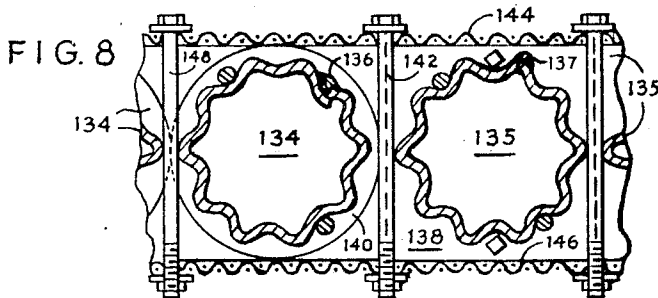
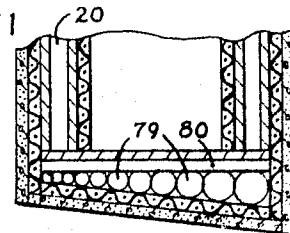
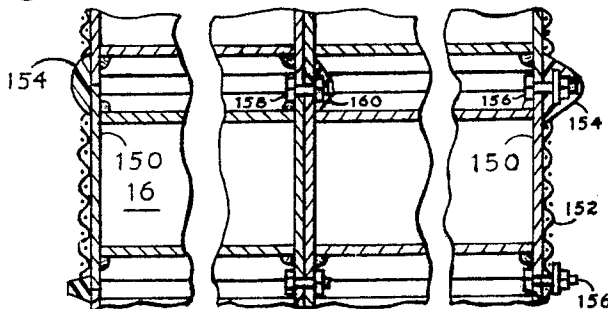


FIG. 9



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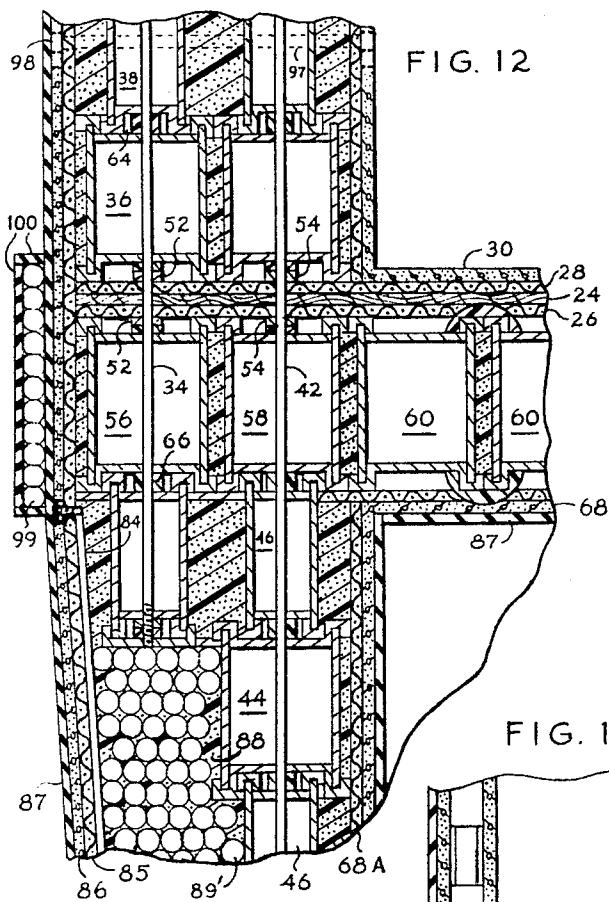


FIG. 12

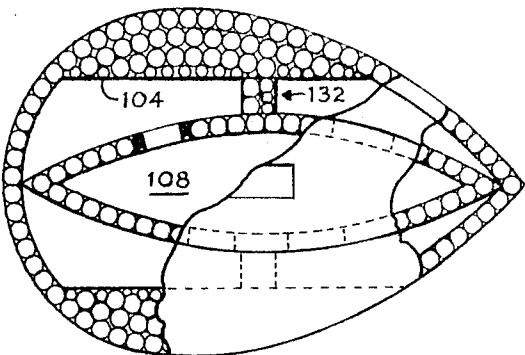


FIG. 13

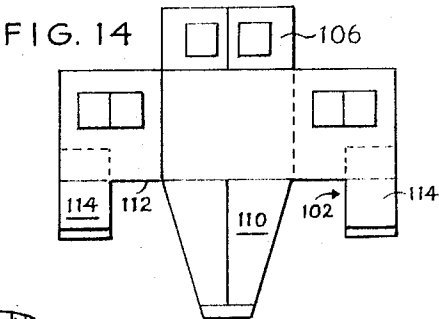


FIG. 14

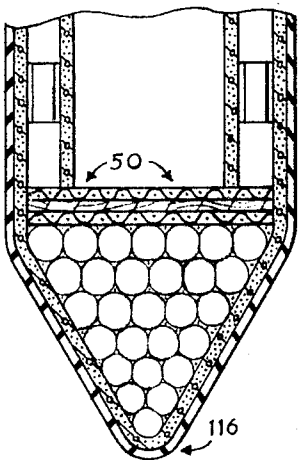


FIG. 16

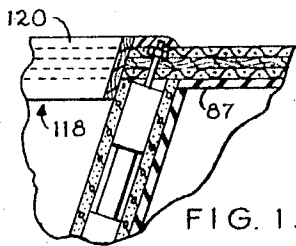


FIG. 15

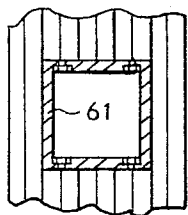


FIG. 17

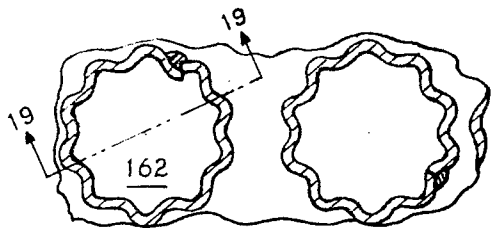


FIG. 18

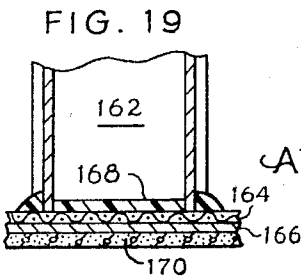


FIG. 19

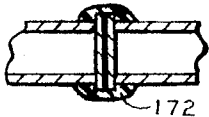


FIG. 20

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LIGHT-WEIGHT WRECK-RESISTANT VEHICLE

This invention pertains to lightweight and strong vehicles. Although its basic structure may be utilized in land vehicles, space vehicles and aircraft or hovercraft that takeoff from land, it is preferably incorporated in a water-traversing vessel, such as a motorboat, cabin cruiser, houseboat, small yacht, barge, lifeboat, raft, hovercraft, or flying boat.

Such vehicles of currently standard construction are hard to control or dangerously fragile in rough water; or else—as in known concrete or steel boats—they are extremely heavy, very expensive, cumbersome, and require much power in their propulsion. In view of these facts, this invention has, among other objects, the following objectives: (1) a relatively lightweight but extremely strong vehicle, preferably adapted to float at least part of the time in water; (2) such a vehicle having substantially rigid, inner, load-carrying structure and outer resilient structure that protects its walls against fracture in crashes or storms; (3) a water-traversing vehicle having walls comprising strength-providing, buoyant, tubular receptacles of rigid material; (4) a vehicle having walls comprising strength-providing, buoyant, sealed cans; (5) a vehicle having walls comprising strength-providing, sealed, corrugated tubes of substantially rigid material; (6) a vehicular float, comprising cans or corrugated tubes, adapted to be located below a load-carrying cabin and to support the cabin and its bottom deck above water level when the vehicle is moving at cruising speed thru water; and (7) a vehicular float of this type having a lower surface that is inclined downward from its forward portion to its after edge.

Other objects and the specific structure of the invention will become apparent from the following specification, and from the accompanying drawings, in which:

FIG. 1 is a plan view of the invented vehicle, having forward and after portions broken away and in section along a horizontal plane between the upper and lower decks of the main load-carrying space.

FIG. 2 is a view in vertical section along the planes indicated by lines 2-2 of FIG. 1.

FIG. 3 is a detail view, in section from a vertical plane that is transverse to the longitudinal axis of the vehicle and located at a portion of the tubular outer wall which is not above one of the floats.

FIG. 4 is a detail view of a portion of one of the tubular wall elements (of a row of joined cans) before it is assembled with other elements in a wall, in section along a plane thru the longitudinal axis of the row.

FIG. 4A is a detail view of one of the cans of the preferred corrugated type, shown in longitudinal section and partly broken away, the can being filled with foam plastic as an optional feature in lieu of gas.

FIG. 5 is a detail view, in section from a vertical plane that is transverse to the longitudinal axis of the vehicle, showing a variation of the main cabin deck that is adapted to provide extraordinary strength and buoyancy under shocks of extremely rough conditions, and further showing a junction between the main deck and a wall of one of the floats.

FIG. 6 is a detail view, partly broken away, indicating, when considered as in top plan view, the frame of a horizontal deck (and, when considered as in elevational view, of a vertical vehicle wall that is optionally different from that of FIGS. 3 and 5), the frame being shown before stucco or like material is applied to the metallic mesh.

FIG. 7 is a view in section from the plane 7-7 of FIG. 6.

FIG. 8 is a detail, sectional, plan view, partly broken away, of an alternative, corrugated form of the tubular receptacles, shown as fixed between sheets of mesh that are parallel to the longitudinal axes of the receptacles.

FIG. 9 is a detail, sectional view of corrugated tubular receptacles, shown as broken away in their middle parts and as fixed between sheets of mesh that are perpendicular to the longitudinal axes of the receptacles. These receptacles may be of the elongated or short type of the cans.

FIG. 10 is a detail, vertical view in fore-and-aft section along an exterior wall of FIG. 1, showing the upper side decks of the vehicle as optionally shaped in winglike fashion— aerodynamically curved to exert a lifting force on the craft.

FIG. 11 is a detail, sectional view from a vertical plane along and thru the longitudinal axis of the preferred, skilike form of float.

FIG. 12 is a detail view, in section from a vertical plane that is transverse to the longitudinal axis of the vehicle showing a preferred form of the main deck, and further showing a junction between the main deck and a wall of one of the floats.

FIG. 13 is a plan view (on a scale reduced from that of FIG. 1) of an optional form of the invented vehicle, shown as partly in section along a horizontal plane.

FIG. 14 is a front elevational view of one form of the vehicle of FIG. 13.

FIG. 15 is a detail view, in section from a vertical plane thru a junction between one form of the main deck and the central, larger float of FIG. 14, this plane being normal to the longitudinal axis of the craft and at the middle of the float.

FIG. 16 is a detail view, on an enlarged scale, of the bottom part of an optional form of either the central float or one of the side floats of FIG. 14; this view is in section from a plane normal to the longitudinal axis of the craft and at the middle of a float; in this float the concrete parts of the float walls are coated with rubber or other waterproofing applied in liquid or paste form.

FIG. 17 is a detail, sectional, reduced-scale view of a port or door.

FIG. 18 is a detail view of part of an alternative type of deck or wall frame, in section along a plane that is transverse to the tubular receptacles.

FIG. 19 is a detail, sectional view from the plane 19-19 of FIG. 18.

FIG. 20 is a detail view in section from a plane along the axes of two cans, joined together in an alternative of the rows of cans.

The vehicle, as shown in FIGS. 1 and 2, comprises: a central cabin structure which provides upper and lower load-carrying spaces 1 and 2 that are separated by a deck, 3; a top deck, 4, of this central structure, having a hatch 5 leading from the top deck to the inside of the top cabin; lower top decks 6, one on each side of the cabin inner deck 3; cabin structures beneath decks 6 that provide load-containing spaces 7; lateral inner decks 8, beneath spaces 7; side, forward floats 9, below and fixed to decks 8; and central, after float 10, below and fixed to the main deck 11 of the cabin structure. Each of these above-numbered members of the craft comprises tubular receptacles of the general type indicated in FIGS. 3 to 12 and 15 to 20. Any of the specific forms of the cans shown in these last-named figures may be used in building the strong, lightweight boat or aircraft frame of FIG. 1.

The vehicle's sidewall, as shown in FIG. 3, comprises a plurality of adjacent rows of cans, with each row having a number of the cans held together in end-to-end relation. These cans may be made of rubber or synthetic plastic (for example of substantially rigid plastic, reinforced with asbestos or fiberglass); but preferably and as shown in FIG. 3 they are of sheet metal (for example, thin sheet iron, tinned iron or aluminum alloy), and may be made by known methods of manufacture of tin cans.

The walls or decks of the form of the invented vehicle shown in the drawings optionally may comprise sealed tubular receptacles of any of several different types. As indicated in FIGS. 2 to 5, 7, 10 to 12, 15, 16 and 17, the receptacles may have cylindrical walls that are straight in cross section. Or they may have corrugated walls of the type indicated in FIG. 4A (each having walls that are circular in cross sections along planes normal to the can's axis) or of the type shown in FIGS. 8, 9 and 18 (each having walls that are corrugated in cross sections that are normal to its axis). They may be filled with gas at atmospheric pressure or, optionally, under pressure above that of the atmosphere—for instance, in the range of 5 to 15

pounds per square inch; this gas, for example, may be air, helium, hydrogen, or hydrogen mixed with a combustion-inhibiting gas. Or, as indicated in FIG. 4A, they may be filled and reinforced with insulating foamed plastic 12—for example, with polyurethane plastic foam, which may be flexible but preferably is substantially rigid.

Such reinforcing, gaseous foam plastic is preferably under a small above-atmospheric pressure. One way of accomplishing this pressurized plastic filling is to insert thru a temporary end opening of the can sufficient amounts of the two liquids which form such gaseous foam to insure that the cellular gas of the plastic is under the desired small pressure and then to tightly close the opening against the pressure of the formed foam. This end opening may be a hole in the end cap or in a tube fixed to the cap which is quickly and tightly plugged after the two foaming liquids are poured thru it. Or the can may have a separable lid of the type used in common paint cans, in which event the liquids may be poured into the large opening in the can and the lid then quickly clamped into place.

The foam plastic 12 of FIG. 4A is there shown as an optional feature which also may be optionally used as a reinforcing and insulating material in any of the other disclosed tubular receptacles. But when the cans are corrugated, as shown in FIGS. 4A, 8 and 9, and as optional in the other figures, the corrugations present so much strength against shock that ordinarily the plastic filling is not needed as reinforcement, although in some installations it is desirable as insulation, as well as providing extra strength.

The inventor's currently preferred lightweight, strength-providing receptacle has corrugated walls. The corrugations may be either of the type shown in FIG. 4A or that shown in FIGS. 8 and 9. Preferably, therefore, the tubular containers shown in each of the figures have such corrugated walls and are filled with gas. In boats that do not fly, air is currently preferred as this gas, and it is preferably under atmospheric pressure. But in flying boats or hovercraft the gas used is preferably helium, optionally under pressure above that of the atmosphere.

An assembled, glued row of the shorter cans, such as is shown in FIGS. 3 to 5, 12, 15 and the upper part of FIG. 16, have some advantages over elongated cans of the type shown at 14 in FIG. 2, optionally indicated at 16 in FIG. 9, 18 in FIG. 10, and 20 in FIG. 11. The glue that is between the end caps of the short cans is very strong, and preferably is epoxy-resin cement or putty, comprising plastic and a hardener, which sets into a firm solid that has strength comparable to that of steel. With such glue firmly bonding each juxtaposed pair of the end caps, the two caps together with the cement between them form a very strong joint; and the thus-formed lightweight and buoyant wall or deck row strongly resists lateral shock and bending of the row at each junction of its cans.

The vehicle illustrated in FIGS. 1 and 2, utilizing structural details indicated in FIGS. 3 to 12 and 15 to 20, is preferably built in accordance with the following steps of manufacture (here described with particular reference to FIGS. 1, 3, 5 and 12):

1. Pieces of plywood are laid flatwise on a level floor with their edges coated with epoxy resin or other strong cement or putty and abutting each other. Preferably a strip of paper is put on the floor beneath each pair of the contacting edges and the glue is then troweled and forced into the small space between the edges and leveled. When the glue sets a flat, unitary plywood piece of greater area than the desired size of the main-deck plywood has been formed.

2. This unitary piece is then curvingly sawed in the desired general deck form or deck-piece, which in FIG. 1 is illustrated as in streamline form, in FIGS. 3 and 5 is indicated by the numeral 22, and in FIG. 12 and 24. Holes are now sawed in the plywood for the hatchways thru the main cabin-deck structure to the interior of the lower floats which are to hold useful loads.

3. The plywood is covered entirely with a layer, 26, of reinforcing metallic mesh, which may be of aluminum alloy, but

preferably (and especially in a nonflying vehicle) is steel network in the form of expanded metal (metal lath) or hardware cloth. This mesh is forced down into continuous level contact with the plywood by large-headed nails or screws thru washers, and then glue (preferably epoxy-resin putty) is troweled into the apertures of the mesh and on the plywood.

4. After the glue sets the laminated member of plywood and mesh is turned over and another layer of metallic mesh (28) is similarly fastened and glued over the plywood. If the main deck of the cabin space is to comprise stuccoed, waterproofed concrete (of Portland cement and fine lightweight aggregate), indicated at 30 in FIGS. 5 and 12, this application of glue or putty does not completely cover over the expanded metal, but instead merely glues it to the plywood, so that the stucco (comprising fine aggregate—for example, cinders or granules of expanded clay or shale or pellets of foamed plastic)—will enter into the mesh, and the two will reinforce each other. But preferably waterproof putty (which may be epoxy putty, or the more economical plastic putty that contains aluminum powder and requires no hardener) is troweled over the mesh and slightly covers the whole of it, as indicated in FIG. 3 at 28. This then forms the load-carrying surfaces of the lateral decks 8, in the compartments 7, and the similar upper surface of the deck 11, in space 2.

5. The resulting laminated deck structure of plywood and mesh is raised and laid on sawhorses or benches; and holes for the rods 32 (or 34) are drilled thru it. Many of these holes are along the streamline curve thru the centers of the outer cabin-wall cans or can rows 36 and 38 and the distance along the curve between the centers of the holes is equal to the outer diameter of the end caps of the larger cans 36 in the upright can rows. Similarly spaced holes are also drilled for the optional rods of the rows of cans 40 that form the major part of the walls of central cabins 1 and 2, for the optional rods 41 (or 42) on which are threaded the cans 44 and 46 of the side floats 9, and for the optional rods of the cans 48 of the central after float 10. These optional float rods are not all shown in FIG. 1 for the cans 44 and 48, as shown in this figure, may be either of the short type (joined in rows on rods) or of the elongated type (for example, those of FIG. 2, 10 or 11) which preferably have no central rods thru them, but are epoxy-resin-glued to the main deck 11 and to the lower, float deck (50 in FIG. 16).

6. The laminated deck structure is turned over and laid on benches that are high enough and spaced apart enough to allow a workman to work under the deck structure and between floats 9 and 10. The laminated structure is now upside down, with its puttied bottom mesh 26 now uppermost.

7. The rodlike elements 32 and 41 (or 34 and 42) are now vertically placed thru the holes along the outer periphery of the craft and thru the holes outlining the walls of the floats and central cabin space 2. These elements may be elongated stove bolts (threaded at each end), but preferably they are threaded rods. Such rods of three-sixteenth inch and one-quarter inch have been utilized by the inventor. After each rod is in place pairs of the nuts 52 and 54 are screwed on them, toward each other and against the laminated structure, tightly clamping the rods to the flat deck structure and in upright positions. These nuts are sufficiently deep that the top one of each pair of the nuts holds only a small portion of the upper end of the rod, so that about half of the screw-threaded bore of the nut is temporarily vacant, ready to be filled in later screw-threaded and glued union with the lower end of a cabin-wall rod.

8. Next, there are threaded and glued on the rods the rod-braced ones of the main-deck cans: the cans 58 (to which the side-float cans are to be attached); and those cans 48 to which the sidewall cans of after float 10 are to be attached. (This assembly is possible because the end caps of these cans have been previously, centrally drilled, to provide holes that fit over the rods.) These rod-braced cans, forming part of the buoyant, insulating, strength-providing portion of the cabin main deck are now strongly fastened to the laminated deck structure, either by nuts 59, covered with glue in short cylinders as shown in FIG. 5, or only by glue 66 in short cylinders (as shown in FIG. 12).

9. The remaining ones of the tier (or tiers) of the main-deck cans are now glued to the flat main cabin-deck structure, and so to each other. Where the hatchways to float interiors are located these cans outline the openings and border on hatch frames of wood—or of metal as indicated in FIGS. 17 at 61. Preferably, and as shown in FIGS. 2, 3, 7 and 12, only one tier of these main-deck cans 56, 58 and 60 is utilized. But in building a boat, hovercraft or aircraft that will be used under extremely rough conditions—for example in rescue work during storms—two tiers of such cans, as indicated in FIG. 5 at 56, 58, 60 and 62, may be made, preferably with a sheet of metallic mesh, 64, between them, with the cans epoxy-resin glued to the mesh and to each other.

10. The cans of the sidewalls of the floats are now assembled and glued to each other and to the rods. Although all the longitudinally aligned cans of each row of the float and cabin walls optionally may be of the same diameter, preferably they are of slightly different diameters, and the smaller cans 46 are nested in the recesses 64 of the larger cans 44. Between the adjacent end caps of each pair of the nested cans there is an element 66 which seals each of the adjacent rod holes and fastens the cans to each other and to the rod. This element comprises: a short cylinder, which may be of molded plastic, or a cut piece of plastic or other pipe, or waterproofed cardboard; and strong glue. The cylinder is of slightly less length than the distance between the end caps, and the epoxy putty or other strong glue is mounded above the top of each cylinder so that it penetrates the hole of the next upper can, and seals around the rod there when this next can is threaded on the rod and pressed downward.

11. The next step is the construction of the inner skin means of the hollow floats that are to house useful loads. This skin means, indicated in FIG. 2 at 67, may comprise an imperforate, curved sheet or sheetlike piece of metal or plywood, glued to the cans; or, as shown in FIGS. 5, 11, 12, 15 and 16, it may comprise stucco, 68, of cement and fine, lightweight aggregate, impregnating and coating fabric, 68A, which may be of fiberglass but preferably is metallic mesh (for example, expanded metal, aluminum mesh or steel hardware cloth). The cement used is of a type that makes a hard stucco. It may be epoxy or other plastic glue, and the fine aggregate mixed with it may be aluminum powder or filings in adhesive putty. In this step (11) the inner skins of the float deck (of the general type indicated at 50 in FIG. 16) is also made of the hard stucco on fabric—preferably on metallic mesh.

12. When the craft of FIG. 1 is a boat and its propulsion is not of the aerodynamic type (such as preferably would be used in airboats, hovercraft or flying boats), the space within the sidewall cans 48 of float 10 may house an engine or an hydraulic or electric motor, which drives a propeller that is abaft the bottom part of the float. But the boat as illustrated in FIG. 1 preferably is propelled by means of engines or motors in floats 9; and so the central float 10 may comprise float-strengthening, buoyant filler elements. In this event, this optional step (12) comprises the placing and strongly gluing together of the filler elements. As shown, these comprise cans 69 and smaller-diameter, gas-containing elements 70, which may be end-sealed lengths of thin-walled metallic or plastic pipe, but preferably are pieces of bamboo. The cans used may be of the elongated type indicated in FIGS. 9 to 11, but for extra strength preferably are of the short, strong-jointed form indicated in FIGS. 4, 4A, 5, 16, 19 and 20. In the spaces between these annular unitary or composite tubular members of the larger diameter the smaller pieces of bamboo or pipe are placed after being coated with strong glue or putty, at least at their ends which engage the main deck so that they become strongly glued to it. Preferably the smaller elements 70 are of slightly different diameters, and where feasible are forcibly jammed tightly between the cans. Optionally, the entire surfaces of these elements may be coated with epoxy-resin or other strong cement or putty either before or after they are in position between the cans.

13. While the float walls are still upside down, the major portions of the bottoms of the floats are now constructed. The

bottom part of each of the pair of side floats 9, or of the central float 10, optionally may be V-shaped in cross section, or flat and horizontal, or inclined for ski-type lift, and flat as shown (or curved in hydrodynamic fashion). When V-shaped, its sides may be curved, but preferably and as shown in FIG. 16, they are straight. When the bottom of the central float or of each of the side floats operates as a lifting water ski it may be constructed as shown in FIG. 2 or in FIG. 11. In cross-sectional FIG. 2, the cans 72 are similar to cans 60 of FIG. 12 and, like cans 60, they are strongly glued to the bottom flat deck structure 74 of the interior of the float. This structure optionally may be a metal sheet or plate; or it may be of the type shown in FIG. 12 at 24–26–28. To the bottoms of the cans 72 numerous pieces 76 of bamboo or of sealed metallic or plastic pipe are glued or puttied. These pieces may be of approximately the same small diameter and piled higher at the after part of the float than at its bow, to build up and solidly strengthen the inclined ski surface 78; or they may have selected diameters of considerably different sizes as indicated at 79 in FIG. 11. This figure shows optional substitution for the cans 72 of FIG. 2 of a tier of the gas-containing pieces 80 of metal or plastic pipe or of bamboo.

Optionally: the bottom parts of the three floats of FIGS. 1 and 2 are ski-surfaced; the bottoms of the side floats 9 are considerably higher than the bottoms of the central float 10; the floats 9 contain some of the heavier loads of the craft—for example, batteries, gasoline engine and generator, air-conditioning equipment and/or tools; and the deeper float 10 is hollow (as in FIG. 16) and houses propulsion means, which preferably comprises an hydraulic or electric motor, receiving its power from a source that is driven by a gasoline or diesel engine and is located either in one of the side floats or on the deck 11. Thus, when underway the inclined surfaces of the side floats rise to a level not far below the surface of the water (but sufficiently below that surface to aid in achieving directional stability); and the after float rises about the same amount but its bottom stays well below the water's surface, for efficient propulsion and directional stability. Alternatively and as shown in FIG. 2, the bottoms of the three floats may be at the same level and in practice they are so narrow in beam and deep that the ski-surfaced bottoms of all three floats stay well below the water surface, thus achieving efficient directional stability and propulsion. In each instance, the criterion of the optional arrangement of the floats is: their volumes, depths, and usual loads (with respect to the other loads of the craft) are so calculated and related that the ski bottoms rise until the main deck is well clear of the water, but at least one of them remains well below the water's surface.

In summary, and in connection with any of the optional float structures and arrangements, this step (13) comprises the following substeps: (A) placing and fastening on the bottoms of the float-deck gas-containing elements of step (11) (that is, on the upright rows of cans and/or filler elements) a flat float-deck structure (metallic and/or laminated); (B) gluing to this structure upright cans and/or horizontal gas-containing elements 80; and (C) building up an inclined ski-bottom frame by gluing to the members of substep (B) gas-containing elements (pieces of bamboo or pipe).

14. The outer skins of the floats are now made. Those of the float sidewalls may be substantially vertical like the outer sidewall skins of the float 10 as it is shown in FIG. 2, or inclined upward from the float's bottom, like those of the side floats shown in FIG. 2, FIG. 5 or FIG. 12. In FIG. 2, element 82 comprises a rubber-coated piece of metal which is preferably of spring steel. This piece optionally may be a metallic sheet, or fibrous or metallic fabric (network) with its apertures filled with impregnating flexible cement, for example, liquid rubber cement which sets in the air. The sidewall's outer surface preferably is sheet rubber that is glued to it; but optionally it may be rubber that is molded in place on the sheet or fabric or is applied to it in liquid form and allowed to set in the air.

Between element 82 and the sidewall cans there is a space 83 which is filled with air or other gas, or with resilient foamed plastic. In FIGS. 5 and 12 the composite sidewall skin means comprises: metal rods 84, angled and screw-threaded at their upper and lower ends, and spaced along the float's sidewall; a layer or ply of metallic mesh 85 (preferably of expanded metal), fastened to rods 84; concrete stucco 86 (or epoxy-resin putty or cement or rubber), impregnating and coating the mesh 85; and an outer sheet of rubber, 87, glued to the stucco or rubber-impregnated mesh of the float sidewalls and bottoms, and to the under side of the cabin main deck 11. Between the rods and sidewall cans (in FIG. 5 or FIG. 12) there are filler elements, which comprise foamed plastic 88 and plastic-reinforcing elements which may be wires, metallic mesh or fabric as shown at 89 in FIG. 5, or bowed, elongated, gas-containing elements 89, as shown in FIG. 12. The lightweight, float-strength-providing elements 89' may be bent, curved, plastic or metal pipes (preferably of resilient material); or of steamed or hot-water-soaked and bent bamboo. The inventor currently prefers for these elements 89' bamboo of small diameter, which is easily bent into the desired curve, is stiffly resilient, strong and economical; and prefers that the plastic 88 be resilient (of liquid materials poured in situ between the outer and inner float skins), and that the outer skins and rods be resilient. Thus stiffly resilient buffers for the floats are provided.

Broadly, this method step (14) comprises: (A) strongly connecting to the main cabin-deck structure and to the float-deck structures upright rods 84, well spaced apart in lines that generally conform with the desired outer shape of the float; (B) fixing waterproof dense sheet material (metal sheet or elements 85-86) on the outside of the rods 84; and (C) gluing with epoxy or rubber cement an outer skin of flexible rubber sheet 87 to the rod-attached dense sheet material, to the under surfaces of the floats, and to the lower surface of the cabin main deck 11.

15. The two liquids which make the desired, known type of foamed plastic are now briefly mixed; the foaming mixture is poured or injected between the inner and outer skin means of the floats; and after this pouring the hole is forcibly closed. Passage of the pressurized foam outside the skins and the tiers of cans and bamboo (or pipe) fillers is prevented by this hole closure and by the imperforate structures of the skin means and of the flat structures of the cabin decks; but the foam penetrates into the spaces between the cans and filler elements. The resulting foamed plastic quickly sets. Its chosen type is resilient if the outer skin means is resilient, and preferably is substantially rigid if the skin means lacks resiliency.

16. The sawhorses or benches are now removed from under the completed lower part of the craft, and it is turned over, and the float bottoms are rested on the floor.

17. The next step is the construction of the central wall or structure that braces the upper part of the float 10, shown in section in FIG. 1. This wall comprises, in effect, a continuation upward of the tubular articles of the float proper. Preferably the cans and fillers that are in line with the lower, similar, tubular articles of the after float 10 rise to the height of only one of the shorter cans; they are covered by a strong top, thus forming a seat and/or shelf for supporting articles. When the float 10 is hollow (housing, for instance, a propulsive motor), this top comprises a hinged hatch; but when, as shown in FIG. 1, the float is solidly built its top is permanently attached to the upper cans and fillers. In either event, the top may be of wood or metal or of stuccoed metal mesh. Each of the outer, upper cans 48 preferably is threaded on and glued to a screw-threaded rod, 90, the bottom of which may be screwed and glued into the top half of a deck-contacting nut on the aligned lower rod of a float can. Alternatively, the rods in the upper cans may be integral continuations of the lower rods, projected from the flat deck structure in step (7), above. The upper cans 69 and pieces of bamboo or pipe 70 are now positioned and glued to the flat deck structure; and the cans and

fillers are tightly surrounded by and glued to a curved sheet of metal, plywood, or stuccoed mesh. Then, outside this sheet, the filler cans and pieces of bamboo pipe shown in FIG. 1 are glued to the deck, and bordered by the upstanding sheet 91 of plywood, metal or stuccoed mesh. The cover is now made; and preferably foam-plastic liquids are poured thru closable small holes in the top into the spaces between the cans and fillers. On the after part of the bench or shelf thus formed a rudder—operating device 92 (a motor, wheel, lever or gears) is mounted; it moves the rudder by means of a rudder-post shaft that is pivoted in a stern-pipe, 92', of the float and float-bracing shelf.

18. This step is the construction of the side and upper walls of the central cabins 1 and 2. (If a craft of less height is desired, the upper cabin may be eliminated). The cans 40 are shown as glued to the deck, preferably with epoxy putty; but as pointed out above they may be threaded and glued on rods that are screwed down and cemented in the upper halves of the bores of nuts 52. These cans are preferably corrugated; they may be elongated, end-sealed tubes as indicated in FIG. 5, 9 or 10, or optionally in FIG. 19; or they may be short and glued together as indicated in FIG. 3, 4, 5, 12, or optionally in FIG. 19. Preferably they are stacked as shown in FIG. 4, cemented by epoxy putty 93; and to the end cap of the can 94 a short bolt is attached, by epoxy glue, soldering or brazing—or by extending the bolt thru the end cap before it is soldered in place, housing the bolt head inside the can. When used at the bottom of a can row 40 the total length of the bolt between the two end caps is less than indicated in FIG. 4, and is such that when its threaded end is screwed and cemented in the top half of a nut 52 the rim 95 is tightly jammed (and glued) on the deck. The opposite end can of each row 40 preferably has a similar bolt, similarly attached to its end cap, but this bolt is preferably longer than the relative length that is indicated in FIG. 4. After all the can rows of the sidewall of compartment 2 are in place, they are tightly surrounded by a skin or sheet 96, of metal, or cement-stuccoed fabric (for example, Portland cement and fine aggregate on metallic mesh). The cans also are tightly bordered on their inside by such sheet material; and thru apertures in the two skins bolts 97 are extended, strongly clamping them to the larger cans when nuts are tightened on the bolts. These extend between some of the cans of the smaller diameter and are glue-puttied over at their nuts and heads. When the curved sheets comprise expanded metal or steel hardware cloth these bolts are extended thru the mesh before the stucco is applied; when the sheets are of solid metal (for example corrugated aluminum roll roofing) they are drilled for reception of the bolts. The decks 3 and 4 are similar to the main cabin deck shown in FIG. 3. The upper sidewall can rows and skins are preferably made like the walls of compartment 2. Before the top surface of the deck 4 is stuccoed the bolts at the upper ends of the can rows, of the general type shown in FIG. 4, are projected thru holes in the top-deck structure, and nuts are screwed on the bolt ends, tightly clamping the can rows to the deck structure. The projecting ends of the bolt, if necessary, are clipped off, and the nuts are glued and stuccoed over. In this step framed gaps are left in the walls in which doors are preferably hinged, for passage between each pair of the partition-separated cabins shown in FIGS. 1 and 2. Preferably the can rows that are above and below the door frames are fastened to the frames by glue and by bolts of the type shown in FIG. 4. Two of the doors are indicated at 97A.

19. Next the sidewalls of compartments 9', constituting an upper continuation and bracing means for the side floats 9 and vehicle-strengthening partitions in the cabin space, are built. These may comprise elongated cans, but preferably the can rows 44 are made as indicated in FIG. 4. These rows are sheathed with skin means and bolt-clamped between the two skins as indicated in step (18). If the craft is very narrow in beam these sidewalls preferably extend upward only a short distance above the main deck 11.

20. Next the outer sidewalls of the cabin structure are formed. Although the can rows 36 may comprise elongated cans, preferably they are of the stacked, glued and bolt-ended shorter cans of the general type shown in FIG. 4; and they are preferably bolt-clamped to inner and outer skins of the type referred to in step (18). This outer wall structure is contiguous to, and is mutually braced by, substantial portions of the sidewalls of compartments 9'; and preferably these portions are clamped to the outer walls by bolts or wires that extend between pairs of the small-diameter cans in both walls.

21. The upper side decks 6 are now formed in the manner of construction of the deck 4. They are clamped to the can rows by means of bolts of the general type shown in FIG. 4.

22. Rubber sheeting, 98, is now glued by epoxy or rubber cement to the tops of decks 4 and 6, and preferably also to the outer cabin sidewalls, as indicated in FIG. 3, 5 or 12.

23. This step is the construction of a resilient bumper around the middle of the craft. Lengths of gas-containing, resilient, rubber or plastic hose, 99, are glued with epoxy or rubber cement to the outer sidewalls, with each length preferably encompassing the whole craft and having ends that are sealing glued together at the pointed stern. When the desired number of such lengths are in place the set is covered at top, sides and bottom with rubber sheeting, 100, that is glued with epoxy or rubber cement to the hose. The gas in the hose lengths may be helium, but preferably is air; it may be pressurized, but preferably is at atmospheric pressure.

FIGS. 13 and 14 illustrate another, optional form of the vehicle that may be made by the general method that is described above. In this species of the invention the side floats 102 have flat upright sides 104, and although the floats optionally may be hollow and house propulsion motors, they are preferably solidly constructed of cans and filler elements in accordance with the general method of building the floats as set forth above. Since horizontal planes thru the float intersect the sides 104 in straight lines that are parallel to the longitudinal axis of the craft little or no wave action is caused by these sides. The skins, bolts, rods, tubular receptacles and small-diameter lengths of filler pipes or bamboo used in building the boat of FIGS. 13 and 14 may be of any of the types and arrangements of these structures that are shown in the drawings and described above.

As illustrated in FIG. 14, the boat has a central superstructure 106 which constitutes a continuation upward of the can rows of the central cabin 108, and has a central float 110 in the form of a deep V, with a narrow, inclined-surface, ski-type bottom. Any type of hydrodynamic or aerodynamic propulsion may be used; but preferably an hydraulic motor mounted on the deck inside this central float, receiving driving fluid from a pump and engine located in an upper part of the boat, drives a propeller that is abaft the bottom of the float. When underway, pressure on the inclined bottom surfaces of the three floats lifts the boat part of the way out of the water. Preferably the floats are sufficiently narrow and have the proper volume to cause this lift to clear the main lower deck 112 above the water level, while the ski-shaped bottoms of the floats 114 are at or near the water's surface, and the bottom of float 110 is sufficiently below the surface to keep the propeller efficiently below the water level.

If desired, the bottom of the float 110 may be pointed as indicated at 116. Or this central float may be eliminated, making the boat a catamaran; in this event the side floats 114 preferably are deeper, and preferably support propulsion motors. When a boat of only about 8 feet in total height is desired: the superstructure 106 preferably is eliminated; the flat bottom deck of the float 110 is used as a walkway; the main lower deck has an opening 118 in it (shown in FIG. 15) so that there is sufficient headroom for walking on the float deck; and storage spaces, seats and/or bunks are provided in the side spaces, above 112. In FIG. 15, no cans are shown in the deck, but preferably the structure of this deck is like that illustrated in FIG. 12. The hole 118 is framed by lumber (or metal), 120, glued with epoxy putty or cement to the deck structure.

When a rodlike element is used to go thru and clamp the cans of a row together, it may be a screw-threaded rod (three-sixteenth inch and one-quarter inch threaded rods have been thus utilized by the inventor); or it may be an elongated, headed bolt having one screw-threaded end—or a rod having only its ends threaded. In any event, a nut is screwed tightly on each screw-threaded end of the element, tightly clamping the nested ends of the cans together.

FIGS. 6 and 7 illustrate an optional type of main-deck structure that may be made in any of the forms of the invented boat. This comprises: upright cans 60'; adhesive putty 122 and 124 that glues their tops and bottoms to sheets of metal mesh, 126 and 127; stucco, 128, of any of the above described types, on at least the top piece of mesh, 126; a lower tier of elongated gas-containing tubular articles, 130, which may be rows of sealed pipes or jointed and sealed short cans; and, below 130, layers of mesh, stucco and optional rubber sheeting of the above-described types. If desired, this general form of wall structure may be used in making any of the decks of the invented craft or partitions of the general type indicated at 132 in FIG. 13. This wall as shown in FIG. 13 comprises two staggered upright tiers of tubular articles (rows of sealed pipes or jointed and sealed short cans).

The wall structures illustrated in FIGS. 8 and 9 also optionally may be used in either decks or walls. In FIG. 8, two similar types of corrugated, sealed, gas-containing cans, 134 and 135, are shown. These may be either pipes or the shorter cans that are glued and jointed in a tubular article (or row). They may be made by extrusion of dense plastic or metal; but as shown they comprise pieces of corrugated aluminum or galvanized iron, of the type that is commonly sold in sheets or rolls as roofing, that have been curvingly bent, with their joined edges brazed, soldered or epoxy-glued as indicated at 136 or 137. To each end of the resulting tube an end cap, comprising a tube-bordering flange, is brazed, soldered or epoxy-glued. The flange 138 of can 135 is rectangular; and the flange 140 of can 134 is in the form of a disk. Other shapes of flanges may be utilized. For example, where the cans are to be joined in an arcuate wall the contacting areas of each pair of the flanges are preferably a straight line (somewhat like the line of square-flange contact 142, but making an angle with the mesh 144 that is not a right angle), and the mesh and the bordering lines 146 of mesh and flange then are in the desired arc.

Preferably, the contacting edges of the pairs of flanges are epoxy-glued, with the cement or putty covering their lines of contact. Alternatively, the flanges may be overlapped and bolted (or riveted) and/or glued together. The bolts 148, extended thru the mesh before stucco is applied to it, tightly clamp it against the flanges.

After the mesh is stuccoed foamed-plastic liquids are poured thru a closable hole into the spaces around the cans and bolts. It is the inventor's intention to thus form insulating, wall-strengthening foamed plastic between imperforate skins in all the spaces around the cans and small-diameter filler elements that are indicated in the drawings. The gas in any of the disclosed cans (for example, air or helium) optionally may be pressurized.

In FIG. 9 (a view in section along a plane that is parallel to the axes of the tubular articles shown), the gas-containing cans 16, shown as partly broken away, may be elongated or short. The end caps and flanges 150 are shown as optionally attached to the two parallel sheets of mesh, 152, by epoxy putty 154 and/or bolts 156. And the flanges at the wall-interior or junction of pairs of the cans are epoxy-glued and/or bolted together. In the top part of this figure, the wall-interior end caps of four juxtaposed cans are shown as joined by a single bolt, 158. The end caps of one pair of coaxial cans have semicircular cutout or drilled-out recesses that fit around half of the bolt and join in a circle with like recesses of the other pair of coaxial cans. These end caps are further fastened together by epoxy or other strong putty, 160.

FIGS. 18 and 19 show another way of sealing the cans and attaching them to spaced skins, this method being of especial

use in connection with elongated cans in an upright wall, such as an outer or interior sidewall of the craft. The can 162 indicated in FIG. 19 is at first open at its top, and resting on deck wire-mesh 164, which is supported and glued on the imperforate plate 166 of metal or plywood. While the can is held in position and its top is open, epoxy or other strong, dense glue is poured thru it, and around it, forming the imperforate seal, 168, which strongly attaches the can to the mesh and plate and seals the bottom of the tube. After the desired number of upright tubes are placed in the wall in the general arrangement indicated in FIG. 18, the upper ends of these cans are sealed and attached to an imperforate sheet of plastic, plywood or metal. One way of achieving this upper seal is to heavily coat this sheet with epoxy or other strongly adhesive putty and press the sheet down on the open can top. Another way is to weld a metal plate over the open tops. If desired, a layer of wire-reinforced stucco 170 and/or an outer skin of sheet rubber may be added to either the top or the bottom of this wall.

FIG. 20 illustrates a method of strongly connecting the end caps of cans of the same diameter. Preferably the cans of a row (or of a pair) are held in aligned, horizontal position on a fixture that may be rotated on its horizontal axis. Their end caps may be slightly spaced apart as here indicated; or optionally they may be jammed together. In either event, while they are thus aligned they are strongly and permanently connected by brazing, soldering, welding or gluing them solidly together. Alternatively: the adjacent end caps of each pair of the aligned cans are slightly apart; they are supported in small teflon-lined molds that are horizontally and rigidly connected together, forming part of a stationary fixture, with a narrow mold sealingly looping around each can joint of the row; and epoxy or other strong cement is poured (by hand or machinery) into the tops of the molds and between the cans. After the mounds of glue, 172, have hardened, the row is taken from the fixture. If the cans are brazed, welded or soldered together the jig holding them horizontally aligned is preferably turned beneath the union-forming flame or electric heat by an automatically operated electric motor.

Each of the vehicles shown in FIGS. 1 and 2 and FIGS. 13 and 14 preferably comprises a plurality of balloons, 174, in the upper part of a load carrying space. In FIG. 2, such balloons optionally may also be located in the tops of spaces 7. Although they may be spherical, they preferably comprise round-ended cylindrical, lightweight envelopes of balloon cloth, plastic or the like, containing helium or hydrogen mixed with a small percentage of combustion-inhibiting gas. Preferably they are much shorter than the fore-and-aft length of the vehicle, with a plurality of the cylindrical envelopes arranged in end-to-end relation in a row extending from the bow to the stern. These vehicle-stabilizing balloons lessen the tendency of the craft to roll and pitch in waves or air turbulence.

For amphibious or ice-traversing use of the vehicle, a wheel or skid may be mounted in or on the lower part of each of the floats.

Within the scope of the subjoined claims, various changes may be made in the specific disclosed structure. For instance, the middle portions of the outer sidewalls of the vehicle may be parallel and straight, instead of curved as indicated in FIGS. 1 and 13; and in this event, the stern is preferably still pointed and streamlined. More room in the craft is obtained by this change.

In the claims: the word "can" is used to signify any sealed, elongated or short, tubular article of any cross-sectional shape or material; the word "stucco" to mean cement that is mixed or unmixed with aggregate, whether the cement that is Portland cement, epoxy or other resinous glue mixed with powder or other aggregate, epoxy or other putty, or the like; the word upright signifies substantially vertical or slanting; and unless qualified the word "gas" means pure gas or any mixture of gases, and the term "foamed plastic" signifies any synthetic or latex-containing foamed plastic.

I claim:

1. A vehicle adapted to traverse water comprising:

deck structure having an upper load-supporting surface; sidewalls, each of which comprises: a plurality of sealed, upright, vehicle-strength-providing, juxtaposed cans; means, comprising skin structure, holding said cans in vehicle-strength-providing relation to each other and to said deck structure; and gas-cell-containing foamed plastic in contact with said skin structure and with said cans; and

vehicle-floating means, fastened to lower portions of said deck structure, comprising: float-wall rows of sealed, upright end-to-end-joined, vehicle-strength-providing float cans; means holding said float cans in strength-providing, end-to-end relation; attaching means on said deck structure strongly connecting it with upper ends of said float-wall rows of cans; float-bottom means strongly connecting the lower ends of said float-wall rows of cans; outer, waterproof float-skin means, exterior of said float cans, forming outer surfaces of said floating means; and gas-cell-containing foamed plastic, in contact with said float-skin means and with float cans.

2. A vehicle as set forth in claim 1, in which:

each of said float cans has a curved tubular wall, and an end cap fixed to each end portion of said curved wall and indented toward the center of the can from one of its ends, thus forming an end recess;

each of said float-wall rows comprises float cans having juxtaposed end caps and recesses of different areas, with smaller-area caps fitting in larger-area recesses; and

said means holding said float cans in end-to-end relation comprises strong bonding material within larger-area recesses and between juxtaposed end caps of said different areas.

3. A vehicle as set forth in claim 1, in which:

each of said float cans has a curved wall and an end cap fixed to each end portion of said curved wall;

in each of said float-wall rows, each pair of said end-to-end-joined float cans has closely juxtaposed end caps of substantially equal areas; and

said means holding said float cans in end-to-end relation comprises bonding material strongly uniting and holding together said closely juxtaposed end caps.

4. A vehicle as set forth in claim 1, in which:

each of said float cans comprises a tubular wall and an end cap fixed to each end portion of said wall; and

said attaching means comprises, in association with each of said float-wall rows, a tie element having a screw-threaded end;

means strongly connecting said tie element to a can-end cap at an end of the row;

apertured means in said deck member for reception of said screw-threaded end; and means tightly fitted on said screw-threaded end for drawing its associated float-wall row into tight, strength-providing contact with said deck structure.

5. A vehicle as set forth in claim 4, in which:

each of said float cans comprises a tubular wall and an end cap fixed to each end portion of said wall;

said vehicle comprises, in association with each of said float-wall rows, an elongated tie member that passes thru end caps of the cans of the row;

said tie element is the upper, screw-threaded end of said tie member; and

said float-bottom means comprises: a lower tie element, forming a lower, screw-threaded end of each of said tie members; and means strongly holding said tie member and its associated float-wall row in relation to said float-bottom means.

6. A vehicle as set forth in claim 1, in which said float cans have corrugated, tubular walls.

7. A vehicle as set forth in claim 1, in which at least some of said float cans comprise:

elongated, imperforate, corrugated tubes of dense, strength-providing material; and in which said vehicle comprises:

- bonding means, comprising material that is in flowing condition when put in place and is solid after it sets, strongly and sealingly uniting ends of said corrugated tubes with said deck structure; and
- closure means sealingly closing other ends of said tubes, spaced from said deck structure.
8. A vehicle as set forth in claim 7, in which at least some of said upright, vehicle-strength-providing cans comprise: elongated, imperforate, corrugated tubes of dense, strength-providing material; and in which said vehicle comprises: bonding means, comprising material that is in flowing condition when put in place and is solid after it sets, strongly and sealingly uniting ends of said corrugated tubes with said deck structure; and
- closure means sealingly closing other ends of said tubes, spaced from said deck structure.
9. A vehicle as set forth in claim 1, in which said float cans contain gas under pressure above that of the atmosphere.
10. A vehicle as set forth in claim 1, in which each of said cans contains gas under pressure above that of the atmosphere.
11. A vehicle as set forth in claim 1, comprising: forward, after and top structures, strongly connected to said sidewalls, providing inclosed, load-containing space; and inside said space, balloon means, comprising lighter-than-air gas, floating up against said top structure, exerting lifting force on it and on said vehicle.
12. A vehicle as set forth in claim 1, in which said float bottom means comprises a lower portion, having a bottom, fluid-contacting surface which in cross sections normal to the vehicle's longitudinal axis has lines that are athwart a vertical plane thru said axis, said surface having angles of attack on relatively moving fluid when the vehicle is underway and thus exerting lifting force on the float-bottom means and vehicle.
13. A vehicle as set forth in claim 1, comprising: vehicle-strength-providing top structure, having portions of considerable area that contact and make angles with relatively moving fluid when the vehicle is underway, thus exerting lifting force on the top structure and vehicle; and means strongly connecting said top structure to said sidewalls.
14. A vehicle as set forth in claim 1, in which said vehicle-floating means comprises three floats, each of which is strongly attached to said deck structure and comprises a group of said float-wall rows, attaching means, float-bottom means, float-skin means, and foamed plastic.
15. A vehicle as set forth in claim 14, in which two of said floats are in side parts of the vehicle, and the third float is in an after part of the vehicle and has a longitudinal axis substantially in an upright plane that contains the longitudinal axis of the vehicle.
16. A vehicle as set forth in claim 15, in which: said third float extends from the bow portion of the vehicle to its stern portion and has a bottom that is spaced from said deck structure by a distance that is greater than that between the deck structure and the bottommost surfaces of the floats in said side parts.
17. A vehicle as set forth in claim 16, in which said bottommost surfaces of the two side floats make angles of attack on fluid flowing over them when the vehicle is underway, thus exerting lifting force on the vehicle.
18. A vehicle as set forth in claim 17, in which said bottom of the said third float has a lower surface that is inclined to the direction of the fluid flowing over it when the vehicle is in forward motion, thus exerting lifting force on the vehicle.
19. A vehicle as set forth in claim 1, in which said vehicle-floating means comprises a float on each side of said vehicle, comprising a group of said float-wall rows, attaching means, float-bottom means, float-skin means and foamed plastic, constructed and arranged to provide a pointed float bow, a pointed float stern, a curved float sidewall on the side of the float that is farther from the longitudinal axis of the vehicle, and a flat, largely planar, upright sidewall on the side of the float that is nearer to said axis.
20. Vehicular structure comprising a vehicle-strength providing row of sealed, end-to-end-joined cans of different sizes, having different cross-sectional areas, said row comprising a plurality of pairs of end-joined cans of said different cross-sectional areas, each of these pairs having a smaller can-end cap of one of the cans of smaller size in juxtaposition with a larger can-end cap of one of the larger-size cans; gaseous material in said cans; and means holding said cans in strength-providing, end-to-end relation.
21. Vehicular structure as set forth in claim 20, in which: each of said cans has a curved tubular wall, and an end cap fixed to each end of said tubular wall and indented toward the center of the can from one of its ends, thus forming an end recess;
- said row comprises cans having juxtaposed end caps and recesses of different areas, with smaller-area caps fitting in larger-area recesses; and
- said means holding said cans in strength-providing relation comprises strong bonding material within larger-area recesses and between juxtaposed end caps of different areas.
22. Vehicular structure as set forth in claim 20, in which: each of said cans has a curved tubular wall and an end cap fixed to each end portion of said tubular wall;
- each adjoining pair of said cans has closely juxtaposed end caps of substantially equal areas; and
- said means holding said cans in strength-providing relation comprises bonding material, strongly joining and holding together said closely juxtaposed end caps.
23. Vehicular structure comprising a vehicle-strength providing row of sealed, end-to-end-joined cans, each of said cans comprising a tubular wall and an end cap fixed to each end portion of said wall;
- said structure comprising, in association with said row, a tie element having a screw-threaded end, and means strongly connecting said tie element to a can-end cap at an end of the row.
24. Structure as set forth in claim 23, in which said means connecting said tie element to a can-end cap comprises strong bonding material.
25. Structure as set forth in claim 24, in which said bonding material comprises glue.
26. Structure as set forth in claim 23, in which each of said end caps has a hole thru its middle portion, said structure comprising: a second tie element; means connecting it to a can-end cap at the end of said row opposite to the first-named row end; and an intermediate, slender, tension-resisting element, extending thru end-cap holes, joined to ends of said pair of tie elements.
27. Structure as set forth in claim 26, in which said tie elements and tension-resisting element are integral and form a screw-threaded rod extending thru said end-cap holes, and said means connecting said tie elements to can-end caps comprises a nut on said screw-threaded end.
28. Structure as set forth in claim 20, in which each of said cans comprises a curved tubular wall and end caps, and in which said means holding said cans in end-to-end relation comprises bonding material between and strongly uniting each adjoining pair of said can-end caps.
29. Structure as set forth in claim 28, in which said bonding material comprises strong glue.
30. Structure as set forth in claim 20, in which said gaseous material comprises lighter-than-air gas.
31. Structure as set forth in claim 20, in which said gaseous material comprises gas-cell-containing foamed plastic.
32. Structure as set forth in claim 20, further comprising: at least one other row of sealed, end-to-end-joined cans, placed alongside said first-named row, gaseous material in said last-named cans; means holding said last-named cans in strength-providing, end-to-end relation; a vehicle-strength-providing sheetlike, apertured element on each side of said side-by-side rows; and at least one tie member extending thru holes in said sheetlike elements and between said rows of cans, strongly holding said cans against said element.

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33 A vehicle, adapted to traverse water, comprising:
cabin structure having load-supporting means, and sidewall
members comprising a plurality of juxtaposed, vehicle-
strength-providing elements and means strongly holding
said elements together; and
vehicle floating means, connected to said sidewalls, com-
prising.
float-wall rows of upright, vehicle-strength-providing
float cans; gaseous material in said can; means connect-
ing said cans together and to said sidewall members; 10

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waterproof float-skin means, exterior of said float cans,
forming outer surfaces of said floating means; and
foamed plastic, in contact with said float-skin means
and with float cans.
34. Structure as set forth in claim 33, in which said float
cans comprise elongated tubes.
35. Structure as set forth in claim 33, in which said float
cans comprise tubes having corrugated walls.

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