Feb. 23, 1954 J. N. LAYCOCK 2,669,960

APPLIANCE FOR AMPHIBIOUS WARFARE

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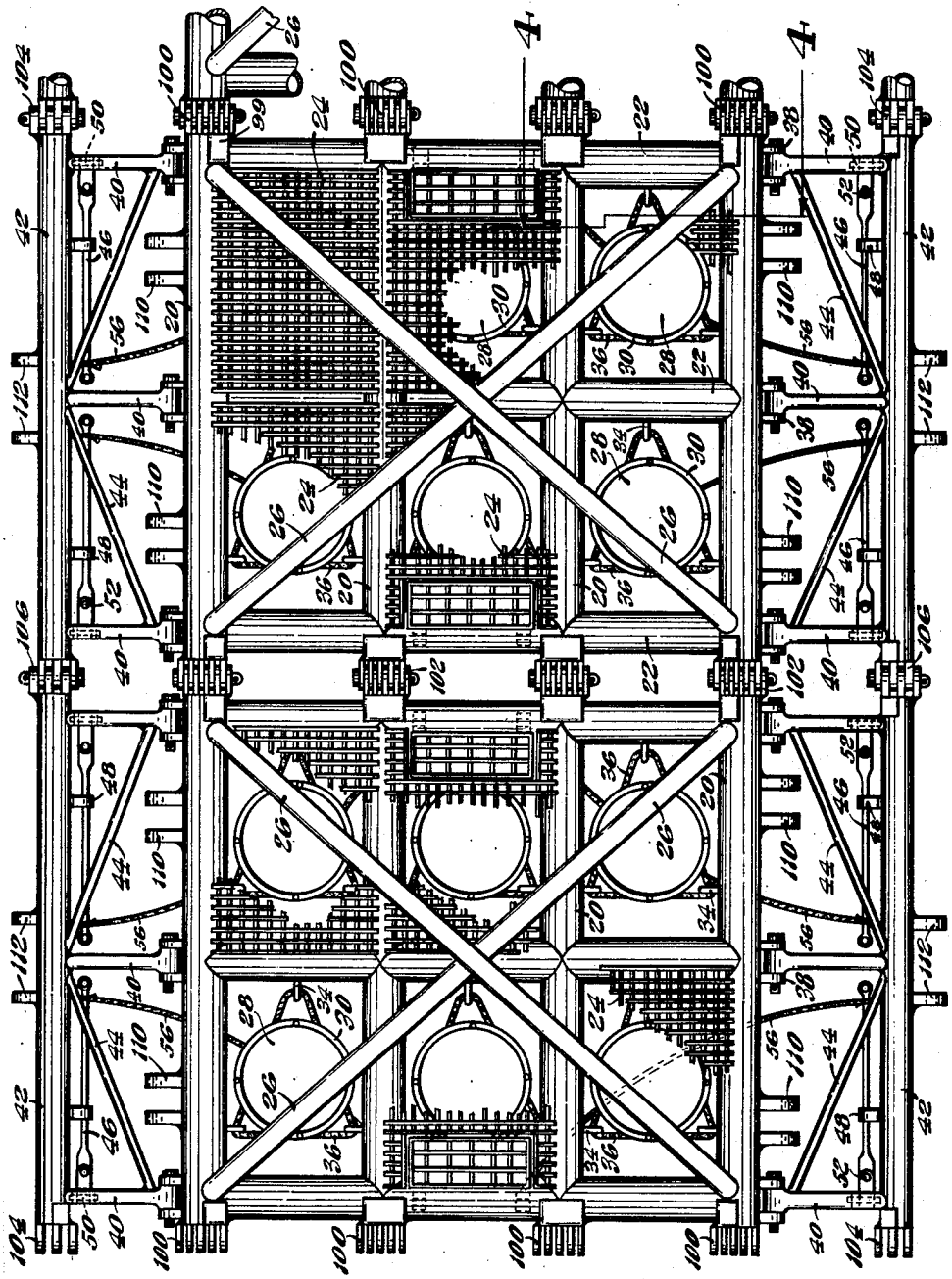


Fig. 1

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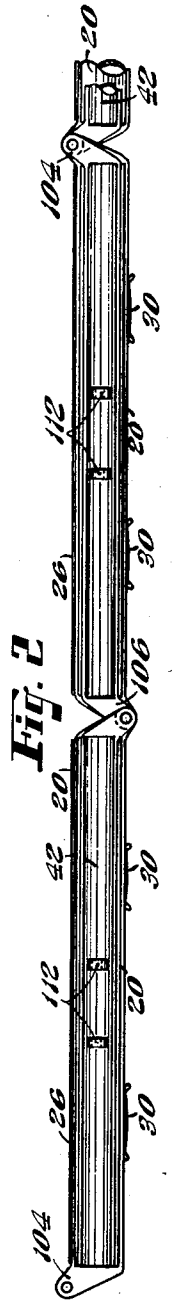


Fig. 2

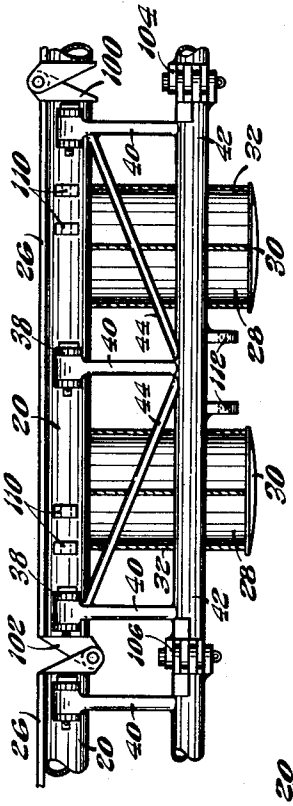


Fig. 3

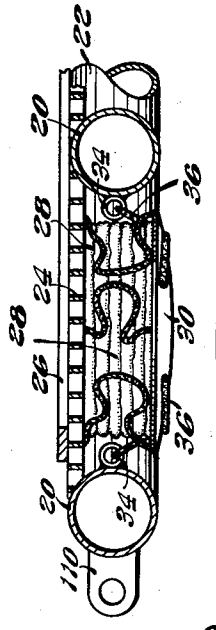


Fig. 4

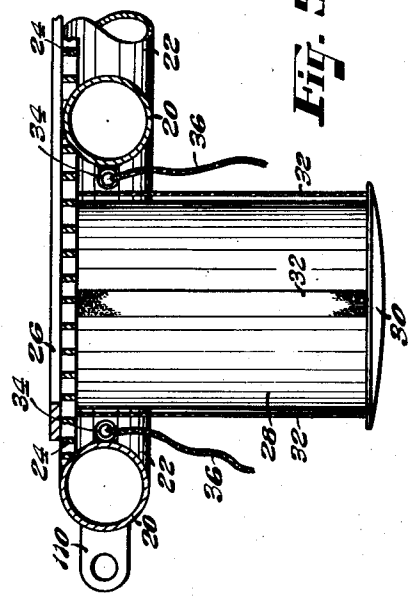


Fig. 5

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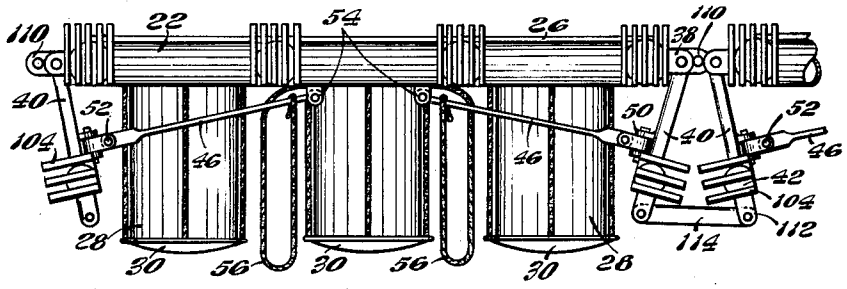
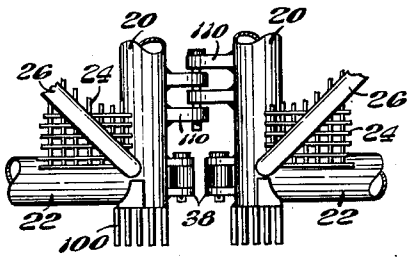


Fig. 6

Fig. 7



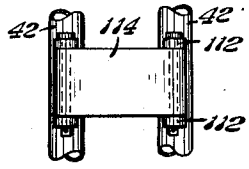


Fig. 7a

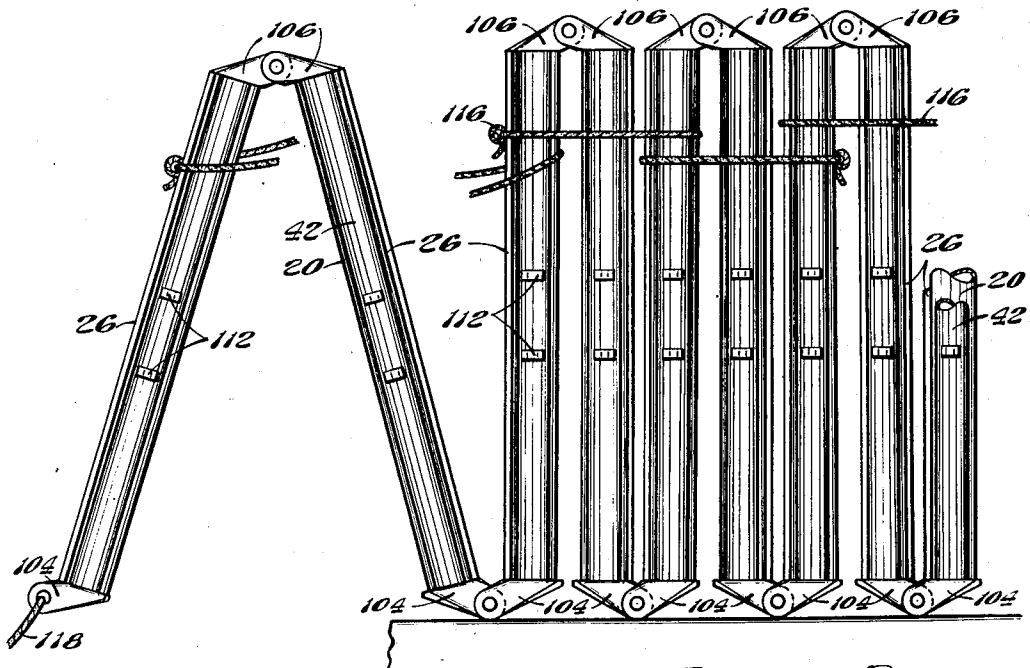


Fig. 8

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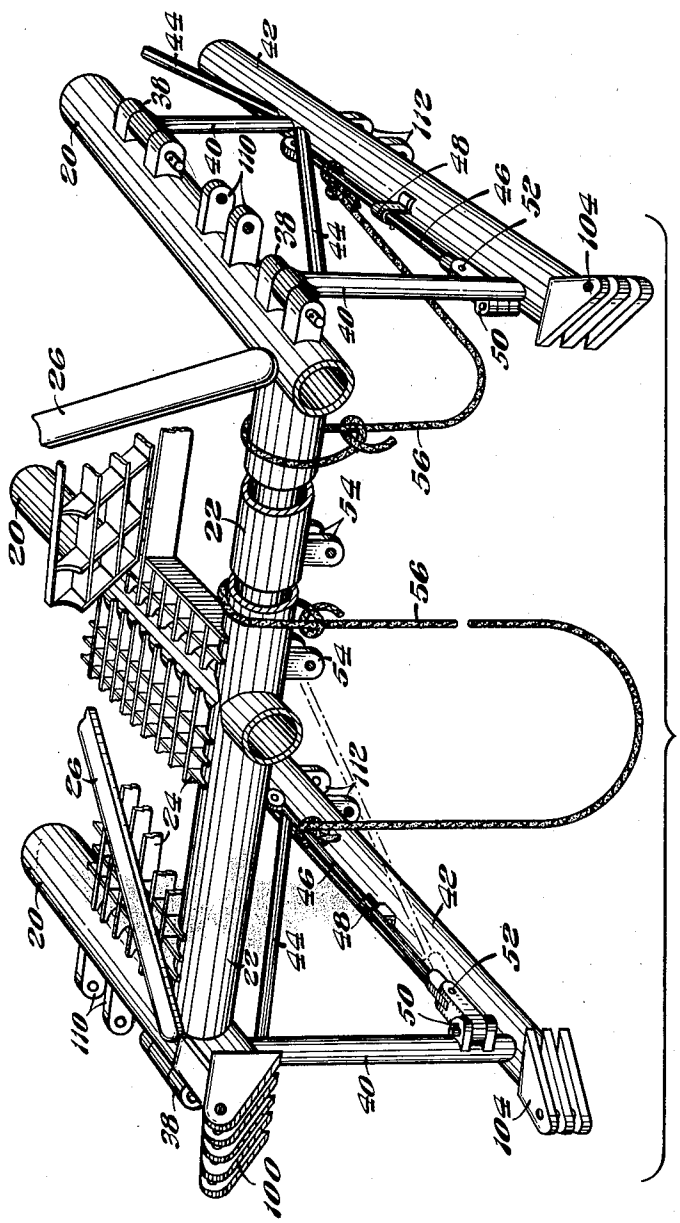


Fig. 9

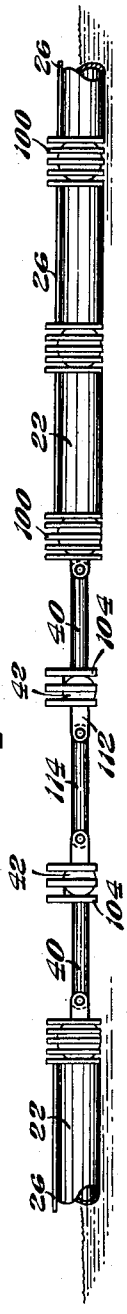


Fig. 10

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Fig. 11

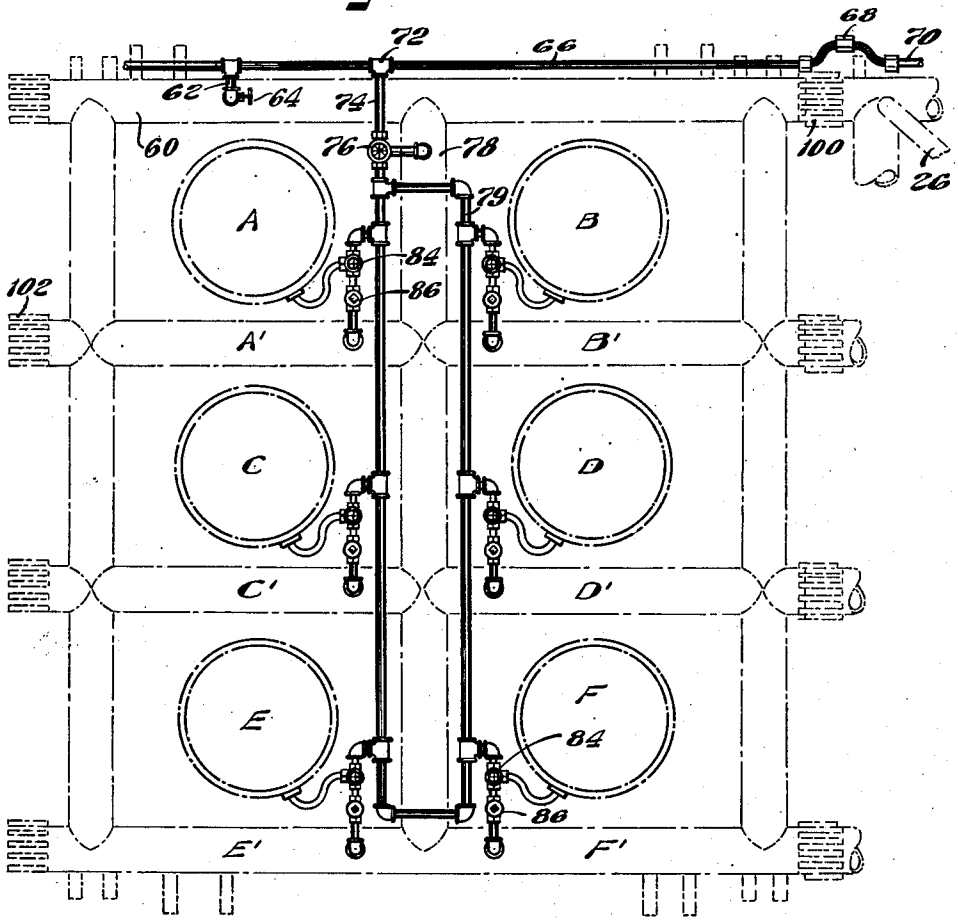
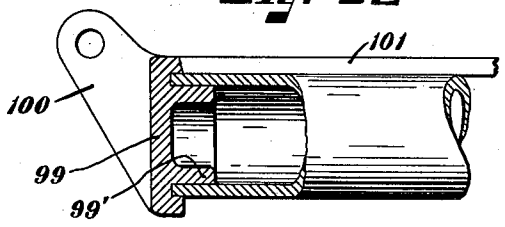


Fig. 12



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UNITED STATES PATENT OFFICE

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APPLIANCE FOR AMPHIBIOUS WARFARE

John N. Laycock, Derry, N. H.

Application May 17, 1951, Serial No. 226,822

12 Claims. (Cl. 114—0.5)

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This invention relates to portable folding buoyant units useful, particularly in military operations, for bridges, landing ramps, wharves, and the like.

Although capable of a wide variety of uses, the buoyant unit of my invention affords a satisfactory solution to some of the most crucial problems encountered in amphibious warfare, where there is involved the movement of masses of men and equipment from vessels to landing places ordinarily extremely inconveniently arranged by nature for the purpose.

For example I contemplate a combination of buoyant frame units capable of assembly in a few hours to provide a water-borne landing field larger than the flight deck of an aircraft carrier, whereby fighter protection may be provided to cover a landing in the minimum time and without exposing carriers to enemy attack.

Furthermore buoyant units constructed in accordance with my invention may quickly be arranged to provide landing ramps, wharves, or barge lighters with the added advantage of rapid conversion from one such use to another.

Alternatively the units may readily be transported by land for use as pontoon bridges or as trussed bridge spans without pontoon support.

An important feature of my invention resides in the combination of a deck supported by a tubular skeleton frame which also serves to store compressed air for use in servicing collapsible inflatable pontoons secured beneath the deck.

Another important feature of the invention consists in an arrangement of valves and conduits by means of which all the pontoons associated with a string of units may quickly be inflated, each pontoon and each unit being isolated from all the others so that a failure of one pontoon or unit will not affect the others.

Another feature of the invention resides in the provision of hinged connections permitting any desired number of units to be serially connected and folded into a compact upright stack for transportation in a suitable vessel, ready for quick release.

Still another feature of the invention consists in trussed panels hinged to the sides of each buoyant unit, adapted to be stored in the stack in flat condition but easily swung down and locked in substantially vertical position to provide the unit with truss support of great rigidity and stiffness, thereby imparting sufficient stability to withstand stresses imposed by massive deck loads or heavy seas.

These and other features and advantages of the

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invention will be more readily understood and appreciated from the following detailed description of a preferred embodiment thereof, selected for purposes of illustration and shown in the accompanying drawings, in which:

Fig. 1 is a plan view of two complete buoyant units constructed and coupled together in accordance with my invention,

Fig. 2 is a view in side elevation of the units shown in Fig. 1,

Fig. 3 is a view in side elevation of one unit with the side panel in dropped position,

Fig. 4 is a view in cross-section along the line 4—4 of Fig. 1,

Fig. 5 is a view in cross-section similar to Fig. 4 but showing a typical pontoon in inflated condition,

Fig. 6 is a view in end elevation,

Fig. 7 is a fragmentary plan view illustrating the lateral connection of two units,

Fig. 7*a* is a fragmentary view of a link connection,

Fig. 8 is a view in side elevation of a partially unfolded stack of serially connected units,

Fig. 9 is a view in perspective of the corners of a unit illustrating the operation of the locking strut,

Fig. 10 is a diagrammatic view in elevation showing the manner of laterally connecting several craft units, and

Fig. 11 is a diagrammatic plan view of a buoyant unit illustrating the inflation piping and valve system.

By reference particularly to Figs. 1, 3 and 4 it may be seen that each unit is organized about a skeleton frame of rectangular outline and composed of hollow metal tubes of relatively large diameter fitted and welded at their ends to form four parallel longitudinal stringers 20 and three lateral frame members 22, thus providing six rectangular interstitial compartments. A steel grating 24, similar to that conventionally used in engine rooms, is placed on the frame and spot welded to the tubes 20 and 22 in order to anchor it firmly in place. In order to provide a stiffened structure, I supply a pair of flat bars 26 laid diagonally over the deck grating 24 and welded to the side frame tubes 20 as well as united at their central meeting point.

A cylindrical collapsible rubber bag, or pontoon, 28 is placed under the deck 24 in each of the six compartments. Each pontoon is bottomed by a dished metal plate 30 and reinforced by four stout ropes or canvas straps 32 as shown in Fig. 5. At its upper end the bag is suitably secured to

the deck grating 24 in any convenient manner. A length of weak rope or "rotten cord" 36 is roven through pad eyes 34 mounted on the sides of the tubes 20 and 22 adjacent each pontoon and serves, by bearing on the bottom plate 30, to maintain the pontoon in collapsed storage position snug against the deck. The number and placement of the bags is a matter of choice.

When the pontoon 28 is inflated, the line 36 breaks, and the bag distends to the condition shown in Figs. 5 and 6. It is contemplated that the tubes 20 and 22 will be made of aluminum or light gauge steel and so dimensioned that the unit will be fairly buoyant prior to the inflation of the pontoons 28, but upon their inflation the buoyancy greatly increases and the craft rides high in the water.

The two outer tubes 20 are each provided with three pairs of relatively massive hinge plates 38 extending horizontally outward to provide pivot connections for three stout rods 40 each of which is welded at its outer end to a long tube 42 equal in length to that of the tubes 20 and braced by a pair of diagonal rods 44 running from the tube 42 to the rods 40. There is thus provided a trussed panel hinged to the side of the unit, normally stored in flat position but easily swung downwardly to approximately vertical position or at right angles to the frame as a whole.

In order to lock the side panel in depending position, I provide a pair of struts 46 each held in inactive position by a spring clip 48 secured to the tube 42. Each strut is pivotally connected at its base to one of the end rods 40 by a hinge 50. The other end of each strut 46 has a clevis to match a ring 54 secured to the bottom of the end tube 22. A line 56 is secured adjacent the free end of each strut 46 and connected to the deck 24, there being a hole in the deck by means of which a crew member may reach down, pull the line 56 to free the strut 46 from the spring clip 48 and then draw the strut vertically about a pivot joint 52 until the clevis on the strut engages the ring 54, whereupon a locking pin is thrust through the clevis and ring. The side panel is then held in the position shown in Fig. 6 and greatly stiffens the buoyant unit against vertical stresses imposed by heaving seas or massive deck loads.

I shall now proceed to describe the system by means of which the pontoons are simultaneously inflated from a single control valve.

In Fig. 11 there appears a longitudinal pipe or conduit 66 connected by a conduit 62 to the side tube 60, there being a manual valve 64 controlling the flow of compressed air from the side tube 60 through a conduit 62. The side tube 60 is one of the skeleton frame tubes 20, but a different reference character has been employed to emphasize that the tube as here considered is a storage tank for compressed air and is a separate air-tight compartment.

A flexible connection 68 is provided at the end of the pipe 66 and leads to a similar pipe 70 running down the side of the next adjacent unit at the right. From a T union 72 a branch pipe 74 leads to a pressure operated valve 76 controlling the supply of compressed air from a tube compartment 78 through a conduit into a pipe loop 79. The loop 79 has branch connections to six pressure operated valves 84 to supply the six pontoons A, B, C, D, E, and F from six storage compartments A', B', C', D', E', and F' respectively. Associated in the line with each valve 84 is a pressure regulating valve 86.

When the valve 64 is manually opened, the tube compartment 60 at once supplies air under pressure to the pipe 66. The pressure in the pipe 66 then acts to open the valve 76 so that the loop 79 is supplied with air under pressure from the tube 78. The pressure in the loop then opens each of the valves 84 to permit compressed air to fill the pontoons A—F from the compartments A'—F' respectively. The valves 76 and 84 may be of the type shown in the United States patent to Bliss No. 1,566,814. The pressure regulating valves 86 shut down automatically and independently as each pontoon reaches a predetermined pressure. The valve 86 may be of the type shown in the United States patent to Deisbrock No. 158,768. It will be remembered that the lashings 36 are broken as the pontoons expand (see Figs. 4 and 5).

Similarly the pressure in the line 66 is transmitted through the connection 68 to the line 70 and so on through the series of craft units which may have been coupled to form a string of desired dimensions. The inflating system is the same for all the units.

Inasmuch as the inflation of each pontoon is from a separate compartment and the valve system is arranged to isolate each valve 84, the presence of a leak in one pontoon or one compartment has no effect on the others. Furthermore the valve 76 may be operated by hand so that a failure or leak in the compartment 60, the valve 64, or the line 66 does not mean that the pontoons of each craft unit cannot be inflated.

The inflating system as above described is particularly valuable where time is of primary importance since the frames may be filled at leisure prior to a given military operation, the inflation of the pontoons there taking place in the minimum time during the progress of the operation. Alternatively, however, the units may be inflated by a conventional compressor of moderate size with simpler piping and controls.

I come now to a consideration of the manner in which the units previously described may be connected in series or parallel or both in order to provide floating decks of desired length and width.

To afford serial connection I provide relatively massive hinge plates welded to the ends of the longitudinal frame members 20. At one end of each unit there are upwardly inclined hinge plates 100, while at the other end hinge plates 102 are inclined downwardly. This is clearly shown in Fig. 3. The hinge plates are preferably in the form of castings each comprising (as shown in Fig. 12) a U-shaped end plate 99 having an integral inwardly extending annular flange portion 99' adapted to fit snugly within the end of the pipe of the frame and be welded thereto. Adjacent the upwardly or downwardly extending hinge plates of the casting is a long reinforcing plate or strap 101, the strap of each casting extending approximately one half the length of the frame to reinforce the tubular frame members against stresses imposed on the hinge plates. Integral with the plate 99 is a plurality of vertical hinge plates 100 disposed in parallel arrangement perpendicular to the reinforcing strap 101. All of the hinges are identical; the reference characters 100 and 102 being used to differentiate between those hinges disposed to extend upwardly and those which are inverted to extend downwardly.

The alternate use of upwardly and downwardly extending hinge plates makes possible the type of

serial or end to end connection shown in Fig. 3, and this in turn permits folding successive raft units into a stack as shown in Fig. 8.

It is contemplated that a folded stack of units in vertical formation as shown in Fig. 8 will be carried, properly blocked and shored, in a vessel having a section fitted similarly to the dry dock portion of an LSD. Such a section may be flooded and then opened to the sea. Subsequently a tow line 118 may be secured to the outboard unit, and a tug can tow the unfolding string of trussed craft units out of the ship. To prevent sudden uncontrollable unfolding of the stack, successive units may be lashed lightly together as shown at 116, so that the stack will remain intact until the pull on the tow line breaks successive lashings. Alternatively a crew member may be detailed to cut the lashings at proper intervals.

In loading a string of units with deflated pontoons into a vessel one end of the string is towed into the flooded well section of the ship until a crane, cargo hoist, or the like, can be connected to the junction of the first two units to enter the vessel. As the hoist operates the two units jackknife together. When vertical they are lashed in position, and the hoist then lifts the third and fourth units at their connection line, and so on until the entire string has been stacked.

The number of units in a string is purely a matter of choice. Hinge pins can be extracted easily to break the stack into sub-assemblies of any desired length.

It should be noted that the tubes 42 of the side panels are also provided at their ends with hinge plates 104 extending upwardly and hinge plates 106 extending downwardly. In stacking and unstacking the units the side panels behave exactly as the main frame.

While a simple string of units in series will prove useful for narrow bridges or landing ramps, it will quite often be desirable to assemble a number of strings in parallel to provide a floating wharf, an aircraft landing deck, or a barge lighter. For this purpose I provide the outboard frame members 20 with a pair of hinge plate members 110 so that lateral connections may be established between adjacent units. Also each of the tubes 42 is provided with two pad eyes or hinge plates 112 designed for interconnection through a rigid rectangular link member 114. The connections are shown completed in Fig. 6.

In assembling parallel strings of units they are first arranged as shown in Fig. 10, side by side with the side panels in horizontal position. Then the links 114 are pinned in place to connect the hinge members 112 and the struts 46 are disengaged from their clips. The next step is to swing the side panels down to the position shown in Fig. 6 at which time the locking struts 46 are pinned in the clevises 54. The hinge members 110 will then be in register and may be secured by hinge pins. This process may be facilitated if the pontoons are inflated after the links 114 have been secured in place, because the main deck portion of the units will rise relative to the side panels which can then be very easily swung down for locking.

It should be noted that the generally rectangular outline of the links 114 is important in restraining horizontal relative motion between adjacent links, although hinge action in the vertical plane is not impeded.

While I have described in detail the preferred

embodiments of the invention, it is to be understood that convenient variations to suit particular needs will suggest themselves to those skilled in the art.

I have not attempted to recite all the possible uses to which my invention may be put. Although I believe the term "buoyancy unit" is the most apt, I do not mean to exclude the use of the structure of my invention as elements of a suspension bridge, land ramp, or the like. On the other hand, I also contemplate the use of the individual units or groups thereof as life rafts mounted for launching in conventional fashion, whereby a vessel may carry enough rafts for abandon ship purposes as well as for combination into strings for wharves, barges, ramps, etc.

Having now described and illustrated a preferred embodiment of my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A buoyancy unit comprising a first group of parallel airtight tubes, a second group of parallel airtight tubes arranged transversely to said first group and secured thereto to form a rectangular skeletal frame having interstices, a deck secured to said frame, a collapsible inflatable pontoon disposed beneath said deck within each of said interstices of the frame, a conduit leading from each pontoon to one of said tubes, and a valve controlling said conduit.

2. A buoyancy unit comprising a plurality of tubular members united to form a skeletal frame and a plurality of airtight compartments, a plurality of collapsible inflatable pontoons disposed adjacent said frame, a conduit connecting each pontoon to one of said airtight compartments, a pressure operated valve controllably connected to each of said conduits, a loop conduit connecting all of said valves in series, a pressure operated master valve controllably connected to said loop conduit, a supply conduit connected to one of said compartments and to said master valve, and a manually operated valve in said supply conduit, whereby said manually operated valve may be actuated to open the supply conduit to said master valve and thereby cause the master valve to open the pressure operated valves controlling the conduits leading to the pontoons.

3. A trussed buoyancy unit comprising a plurality of tubular members united to form a skeletal frame and a plurality of airtight compartments, a plurality of collapsible inflatable pontoons disposed adjacent said frame, a conduit connecting each pontoon to one of said airtight compartments, a pressure operated valve controllably connected to each of said conduits, and means operatively associated with said pressure operated valves for simultaneously applying pressure to said pressure-operated valves to cause simultaneous inflation of said pontoons.

4. A buoyancy unit comprising a skeletal frame of airtight tubes, a plurality of collapsible inflatable pontoons disposed within said frame, valved conduits connecting each pontoon with one of said tubes, a plurality of rods each hinged at one end to one side of said frame, a tube secured to the other ends of said rods, braces connecting said rods and said tube, and means operatively associated with said rod and frame for locking said rods, braces and tube at a predetermined angle with respect to said frame.

5. A buoyancy unit comprising a skeletal frame of airtight tubes, a plurality of collapsible inflatable pontoons disposed within said frame, valved conduits connecting each pontoon with one of

said tubes, and a plurality of hinge plates secured to each end of said unit, the hinge plates at one end thereof extending upwardly above the frame and the hinge plates at the opposite end thereof extending downwardly beneath the frame.

6. A buoyancy unit comprising a skeletal frame of airtight tubes, a plurality of collapsible inflatable pontoons disposed within said frame, valved conduits connecting each pontoon with one of said tubes, a plurality of hinge plates secured to each end of said unit, the hinge plates at one end thereof extending upwardly above the frame and the hinge plates at the opposite end thereof extending downwardly beneath the frame, and a plurality of hinge plates secured to the sides of the frame, whereby a plurality of units may be secured serially in end to end relation, or in side-by-side relation, or both.

7. A buoyancy unit comprising a tubular rectangular frame divided into a plurality of airtight compartments, a deck secured to said frame, a plurality of collapsible inflatable pontoons disposed beneath said deck adjacent said frame, a valved conduit connecting each pontoon to one of said compartments, a trussed panel pivotally connected to each side of said frame, a plurality of hinge plates secured to the sides of the frame, and a link pivotally connected to the outer of each of said panels, whereby two frames may be brought in side by side relation, connected first by said links, the truss panels swung down, and then connected by said hinge plates.

8. A landing ramp comprising a series of rectangular buoyancy units hinged together at their ends in an articulated relation and folded on edge in stacked formation whereby the whole assembly may be pulled into extended horizontal position by traction applied to the endmost unit of the stack, a folding reinforcing truss panel member hinged to the side of each unit and movable from infolded inoperative position to a substantially right angular operative position, and rigid struts pivotally secured to said unit and detachably secured to said panel for locking the panel in operative position.

9. A folding buoyant deck or the like comprising a plurality of buoyancy units each including a plurality of hollow airtight members joined and constituting a buoyant frame, a plurality of collapsible inflatable pontoons secured to the bottom of each unit and connected to said frame, and valves controlling the connections to

permit inflation of the pontoons by compressed gas stored in said frame, said buoyancy units being hingedly interconnected to form an articulated structure capable of being folded into compact stack formation and of being extended to form a substantially continuous flat deck.

10. A portable folding buoyant deck comprising a plurality of buoyancy units hinged successively to one another to permit compact folding and stacking, each buoyancy unit comprising a plurality of hollow airtight strength members lying generally in the same plane and joined to constitute a buoyant frame, a plurality of collapsible inflatable pontoons secured to said frame, and valved connections from the frame to the pontoons, whereby compressed gas may be stored in said frame and released to inflate said pontoons.

11. A portable folding buoyant deck comprising a series of buoyancy units each including a plurality of hollow airtight strength members lying in the same general plane and joined to constitute a buoyant rectangular frame, a rigid truss pivotally secured to one side of said frame, and means operatively associated with said truss and frame for locking said truss in position at a predetermined angle with respect to said frame; and hinges pivotally connecting successive units in said series, said hinges projecting alternately in opposite directions from the planes of said units.

12. A portable folding buoyant deck comprising a series of units each including a plurality of rigid members lying generally in the same plane and joined to constitute a skeletal frame, means associated with said frame for storing compressed gas, a plurality of collapsible inflatable pontoons secured to said frame and connected to said storage means; and hinges interconnecting said units to permit the series of units to be folded into stack formation.

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