

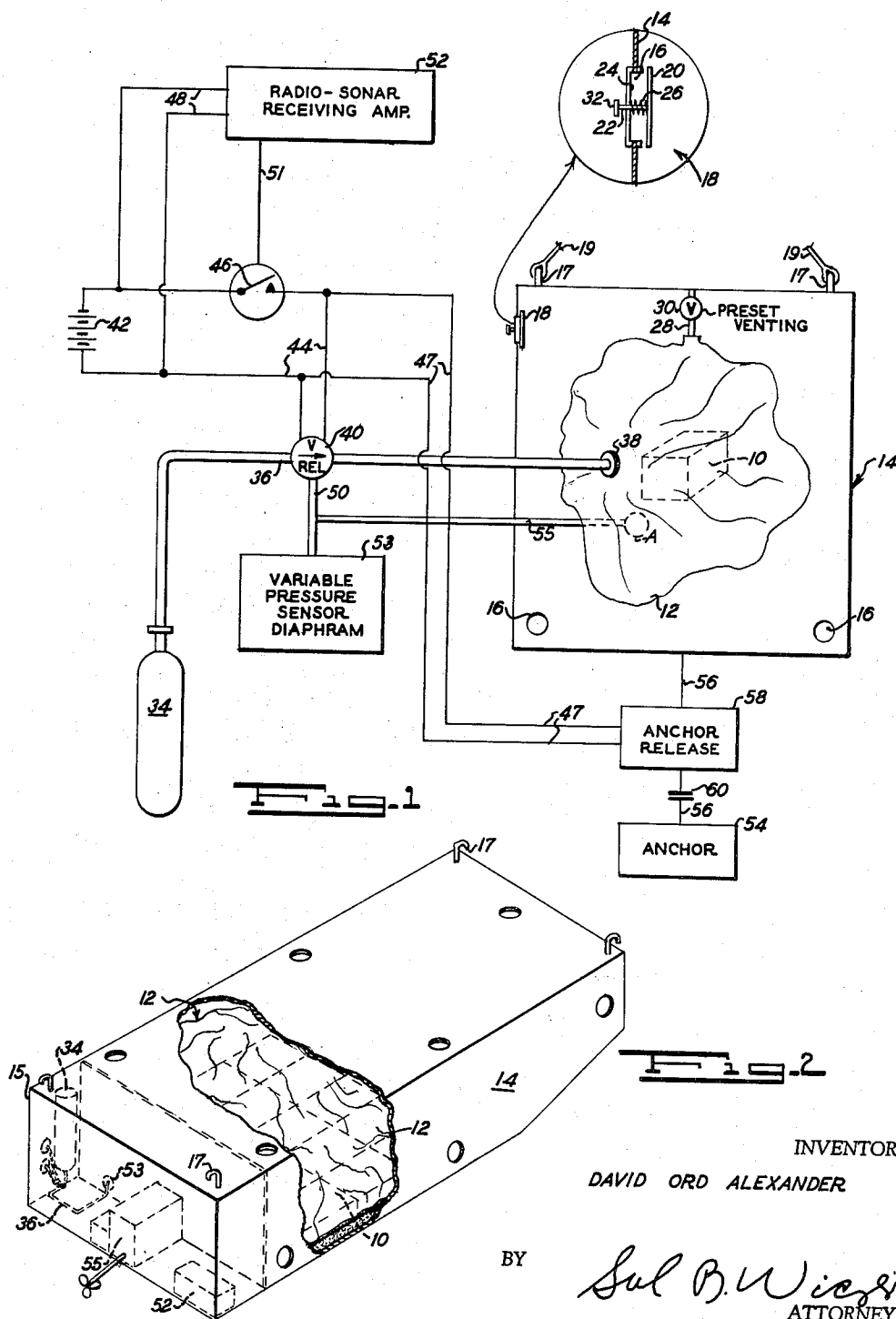
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UNDERWATER CONTAINER ASSEMBLY

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UNDERWATER CONTAINER ASSEMBLY

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My invention relates to a method of submersibly packaging various products—solid, liquid, or gaseous—for ready submersion and buoyant recovery from intermediate level underwater storage of the packaged product; to the submersible container recovery system; and to the container and apparatus units combined therewith for varying its density and for operation of such packaging method.

More particularly, my invention is a combination of a vented container and an intermediate flexibly inflatable protective membrane or sheath encasing the product which is being stored and having one or more of several functions to: (a) protectively surround the product to be stored, (b) exclude water, (c) enclose with the product some air or other gas and serve to cushion the membrane against full collapse under pressure and possible rupture against edges of the product encased, (d) to vary the cushioning resistance with increasing hydrostatic pressure, and (e) to expand the membrane upon increase of internal gas pressure enclosed therein against vented walls of an outer container sufficient to provide buoyancy to the assembly, and (f) to vary the bulk density of the submerged container.

My invention further includes with the vented container and membrane combination, a source of inflation gas having duct means communicating with the protective sheath for transfer of a controlled supply of gas thereto, such as for its inflation to provide buoyancy as desired.

My invention further includes means for remotely actuating a means to release the stored gas for inflation of the membrane and to the incidental venting and valving which controls the passage of gas and expulsion of ballast water to and from the encased and packaged product.

My invention may include pressure sensitive control elements such as safety devices to prevent excessive or disruptive pressures from developing, and timing devices for ultimately imparting buoyancy to any extent after a selected storage period.

My invention may also include means to continually adjust or control gas pressure within the membrane or sheath containing the packaged items or cargo so as to continuously regulate internal pressure within the membrane to substantially balance external hydrostatic pressure so as to maintain a selected, usually low, pressure differential as may be desired or required.

These and other objects will be apparent from the description which follows, made in conjunction with the drawings wherein:

FIG. 1 illustrates diagrammatically the several elements of a packaging system, and

FIG. 2 illustrates a typical packaged assembly detail with parts broken away to show internal construction.

Referring first to FIG. 1, a product or article to be submersibly packaged and stored may first be encased within a box 10 which may be of any size or shape shown here as an ordinary rectangular paperboard box.

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The box 10 is then encased in a larger loosely folded gas-tight bag 12, whose dimensions in inflated or expanded condition approximate at least the total interior volume of an outer casing 14, here also shown as a rectangular container. However, as will appear, the container may be of any size or shape large enough to enclose the stored package or article 10, and it could be spherical, cylindrical, frusto conical, or barrel shaped. The sheath 12 may be of any gas-proof and preferably waterproof material, such as a plastic sheath of sufficient strength to withstand a substantial amount of pressure, sufficient to function as described below, although not necessarily excessively large pressures.

Such materials as polyethylene, rubber (natural or synthetic), saran, Pliofilm, Thiokol, waterproofed cellophanes, polyacrylonitriles, Hypalon, metal foils, or laminates thereof, or laminated combinations of such film materials, are useful examples of inflatable protective diaphragm or membrane materials for use in forming the protective bag 12. The outer container 14 may be of any pressure-resistant material sufficient to withstand the pressures probably to be encountered in the use to which the container may be put. That is, the container 14 and sheath film materials 12 are selected to reasonably withstand the underwater storage hydrostatic pressures and temperatures for which the particular packaging is designed. The container 14 may be of plastic, wood, plywood, ceramics, metal, or combinations thereof, having such requisite strength. The container 14 may also have been treated, or the material of which it is formed, selected, to be resistant to water or sea water that might tend to warp, dissolve, or corrode the container if stored submerged for substantially long periods. That is, the container will be selected to be suitable for the service intended.

The walls of the container 14 are vented and may be made so by cutting several small holes or perforations 16 distributed about the surface of the container for ready passage of water into and out of the container 14. The vents may be protected by fine screens (not shown) to exclude fish, etc. If desired, each of the vents may be regulated by closures, such as each by spring biased venting valve 18, each of which comprises a vent opening 16 in the wall of the container 14 over which is supported for closure a valve plate 20. The plate 20 is supported on a valve stem 22 slidably fitted in a yoke 24. A coil spring 26 is mounted about the valve stem 22 and bears at one end against the yoke 24 and at the other against the underside of the plate 20, biasing the plate to open position for normal passage of water into and out of the vent opening 16. The plate 20 is pressed to closed position by the pressure of the gas expanding the flexible bag 12, bearing in its expanded position against the wall 14 and thus closing the plate 20, whereby the plate 20 merely serves as a seal, restraining the bag 12 from being pushed through a vent opening when large vents are used. The closable vent valve structure described is optional and may be replaced by use of numerous small perforations 16 which can operate for venting purposes, as will appear.

The bag 12 may have fitted a venting tube 28 controlled by a venting valve 30 which may be preset to allow passage of gas from within the bag 12 outwardly through the tube 28 at any pre-set venting pressure. The valve 30 may be any conventional spring-loaded valve

pre-set to open at a given pressure. Such vent valve as shown, comprising the vent valve 18, may be used as the venting valve 30 with the modification that the spring 26 will be selected for a desired pre-set venting pressure and it will be mounted between a cap 32 and the yoke 24 about the valve stem 22, the spring under pressure now biasing the plate closure 20 to closed position, rather than, as shown for vent 18, to open position. The vent tube 28 and its controlling valve 30 serves the purpose of preventing overloading of the bag 12 by a disrupting pressure. That overloading of the bag 12 to disrupting pressures may be caused either by release of too much inflating gas into and filling the bag 12 from a stored gas supply or by the rise of the container in the water from great depths by the buoyancy of the inflated bag where there is considerable pressure exerted hydrostatically upon the bag 12, to a position of lesser depth where the hydrostatic pressure upon it has decreased up to and including atmospheric pressure. At the raised position of the container to a level where there is no substantial external pressure on the bag 12, excessive internal pressure within the bag is desirably vented through the tube 28 by opening of the valve 30, thus reducing the great unbalanced internal pressure within the bag to prevent its bursting from excessive internal pressure.

The bag communicates with a source of compressed gas 34 which is connected by a tube or duct 36 to the bag 12 at 38. The tube passes to an intermediate pressure flow and control valve 40 which serves to release gas from the tank 34 for inflation of the bag 12 passing thereto by way of tube 36. The control valve 40 can merely be a servo control reciprocating stem valve operated by a solenoid. It may be fully or partially open or closed, responsive to the current supplied by a battery 42 connected thereto through lines 44 when the circuit is closed by a switch 46. The switch 46 may be manually or locally operated by a time mechanism (not shown) which makes or breaks the circuit at a pre-set time interval; or remotely operated by a radio or sonar signal control unit 52 of conventional construction, connected through lines 48 and 51. Thus, the inflating valve 40 may be controlled manually, mechanically by timer, or remotely by radio or sonar signal.

As a further control, a variable pressure sensor diaphragm unit 53 responsive to the hydrostatic pressure may be placed in circuit with the valve 40 through lines 50, and serves to control the flow of the gas and inflation of the bag 12 responsive to the hydrostatic pressure sensed by diaphragm unit 53 in the system, thus to maintain a selected buoyancy in the container 14. It may also be controlled by a similar pressure sensor device 55 mounted within the diaphragm and present to maintain a slight pressure within the bag sufficient to offset the surrounding hydrostatic pressure whereby complete collapse of the bag upon the stored items therein is prevented. The sensor 55 operates to increase the pressure within the bag by control of valve 40 through lines 50 and 57 in the same manner as diaphragm unit 53, but is situated to be responsive to the air pressure within the bag.

The container 14 may be weighted by an anchor 54 connected thereto by a cable 56 fastened to an intermediate anchor release mechanism 58. The anchor release device may operate an electromagnet 60 which electrically holds it secure or the actuating current may be cut off to release the anchor 54 and part of the cable 56. The actuating current is connected to the circuit through lines 47 and may be made equally responsive to the timer mechanism or radio or direct electrical control means or sonar signal.

In use of the system thus described, a commodity 10 suitably packaged for ordinary handling is enclosed in the ample folds of an inflatable bag membrane, bladder, or the like, 12 as described and the protectively sheathed package is then enclosed in a vented container 14. The

bag 12 is connected with a high pressure container as a source of gas 34 through tubes 36 and to a venting valve 30 through tube 28. The container 14 may be attached to an anchoring means 54. The bag 12 protectively encloses the commodity 10. It may contain just enough air under pressure, controlled by sensor 55, to prevent the hydrostatic pressure of water surrounding it from crushing the commodity 10, or from pressing the bag 12 so tightly against sharp corners of the commodity 10 that the bag could be punctured or the cargo itself damaged by hydrostatic pressure. Thus, the bag 12 may enclose within it the commodity 10 together with a protective air or an inert gas bubble which is maintained as needed. The entire container 14 and sheathed commodity 10 therein may then be submerged in an underwater storage area at or intermediate the bottom. Water will enter the vents 16 or through the vent valves 18 of the container, filling all of the void space and pressing about the outside of the bladder or bag 12 which, however, protectively encases the commodity 10 maintaining it dry. The container 14, however, substantially filled with water and with very little, if any, air in the bag 12 together with commodity 10, having insufficient buoyancy, may sink even without the anchoring means 54. In that case the anchor could be omitted. However, if that assembly, even slightly inflated, is too light to sink, then the anchor will serve to submerge it in the underwater storage site.

When the stored container with its packaged commodity therein is to be raised to the surface from the underwater storage site, then the closure of the switch 46, either manually, by operation of a timer, or by a radio or sonar signal passed to the unit 52, will open valve 40 interconnecting the bag through tube 36 with an inflating supply of compressed gas. The inflation of the bag 12 will displace all, or as much of the water in the container 14 as needed through vents 16 or venting valve 18, as the bag 12 is expanded, thereby making the container 14 buoyant, and it will rise in the water to the surface and float. If the packaged unit 14 has an anchor 54, the anchor can be released by the same radio or sonar signal actuating the anchor release means 58. If the stored container is at considerable depth and under great hydrostatic pressure, after it has expelled the water through vent 16 and the container begins to rise, excessive internal gas pressures within the membrane may be reduced through the venting valve 30 pre-set to a selected intermediate pressure at which the gas within the bag begins to be expelled as the external hydrostatic pressure becomes reduced upon the rising container. This prevents overloading of the bag and consequent strains on the bag and/or contents due to excessive internal pressure generated by the reduction of the external hydrostatic pressure upon the bag and container as it rises in the water.

The system can also operate under control of the sensor diaphragm unit 53 which can be preset to a selected hydrostatic pressure. When the hydrostatic pressure tends to be increased, it causes the diaphragm to actuate the valve 40, partially inflating the bag 12 with gas only sufficient to expel enough water to impart a slight buoyancy; that is, enough buoyancy to prevent the hydrostatic pressure from increasing above the value set for the diaphragm unit 53. With that control, the container, even combined with the anchoring weight, can be set to sink in water to only a pre-set or preselected depth below which the unit, the bag, will be self inflating to a point sufficient to prevent further sinking. In other words, containers can be stored under water which has great indefinite depths, possibly hundreds of fathoms, but with a pre-set diaphragm controlling unit 53 the container can be regulated to sink to only 5 or 10 fathoms as desired and will sink no deeper.

Numerous practical applications are available for this packaging system. As illustrated in FIG. 2, the single package unit 14 may be compartmented within a watertight section 15 which can house all of the control units,

a gas bottle 34 and mechanical and electrical controls and sensing units 52 and 53 illustrated above in approximate diagram.

The container 14 can have fastened thereto various handling links 17 to which lines 19 of a hoisting derrick may be fastened for lifting the container out of the water. The container 14 of FIG. 2 may be in the form of a boat which can carry a small motor 55 for propulsion and it may be in the form of a sled which can be drawn upon the shore on self-contained tracks, wheels or skids. Moreover, it will be appreciated with control element 53 regulating the depth, the boat as shown or faired to the shape of submarine can be towed under water, maintaining a selected depth as described.

Certain modifications will occur to those skilled in the art. For example, the containers may be of any size and shape as indicated. They may have skids, rollers, propelling motors and rudders for imparting improved mobility when brought to shore or to the deck of a ship or for steering upon or under water. The entire assembly may be in the form of a boat landing craft. The diaphragm or sheath may be constructed for ready opening and filling to enclose or remove the products or they may be constructed as dispensable diaphragms which are thrown away with each use.

Accordingly, it is intended that the description given herein be regarded as exemplary and not limiting except as defined in the claims appended hereto.

I claim:

1. In combination, a relatively rigid container for underwater storage of a commodity packaged therein, vents in the walls of said container allowing communication between the interior and exterior for free flow of water entering the container as the body sinks in underwater storage and leaving as the container is made buoyant, a commodity in said container having a protective membrane of water and gas-impermeable material loosely and expandibly enclosing the same, and means for inflating said membrane with gas under sufficiently high pressure to expel water through said vents and impart buoyancy to the combination.

2. The container combination defined in claim 1 wherein the pressure balancing and/or buoyancy imparting gas is stored in a small pressure-resistant gas supply container connected to said membrane by a duct including valve means controlled remotely from said container assembly, actuating said valve for inflating said membrane with a supply of gas to provide buoyancy.

3. The container combination defined in claim 2 wherein the valve means is controlled to be actuated by a radio and/or sonar or sonic signal broadcast from a point remote from the storage site of said container.

4. The container combination defined in claim 1 wherein the buoyancy imparting gas is stored in a small pressure-resistant container connected to said membrane by a duct including a valve means and the valve means is controlled by a device responsive to hydrostatic pressure upon said container combination submersed in water, whereby to release sufficient gas inflating said membrane to maintain the container and contents submersed in water at a preselected depth and/or hydrostatic pressure level.

5. The container and diaphragm combination defined in claim 1 wherein the membrane has an outlet duct including a venting valve adapted to release the gas pressure inside of said membrane responsive to reduction of external hydrostatic pressure on said membrane, thereby maintaining a selected maximum pressure differential between the interior and exterior of said membrane, venting excessive gas pressures therein beyond the selected limit.

6. The combination defined in claim 1 wherein the external container vents include venting valves controlling the flow of water through said vents and adapted on the expulsion of water from said container by expansion of

said membrane to be held closed by the pressure of the gas therein.

7. The combination defined in claim 1 wherein the membrane material is a strong plastic film material selected from the group consisting of polyethylene, polypropylene, metal foil, saran, Pliofilm, natural and synthetic rubber, Thiokol, polyacrylonitrile, Hypalon and combinations thereof as a single film laminations including at least one of said film materials.

8. The combination as defined in claim 1 wherein the container includes elements providing portability on or under water as a boat or submarine, including mechanical propulsion means.

9. The combination defined in claim 1 wherein the container combination further includes an underwater anchoring means.

10. The combination as defined in claim 9 wherein the anchoring means is releasably controlled remotely.

11. The combination as defined in claim 1 wherein a pressure sensor device is mounted within the membrane in circuit with valve means controlling the flow of gas to said membrane whereby to maintain a gas pressure within said bag resistive to collapse under increasing hydrostatic pressure.

12. The combination as defined in claim 1 wherein the said membrane is adapted to enclose air in quantities sufficient to provide buoyancy to said container combination in water, and anchoring means weighting said combination sufficient to overcome said buoyancy for immersing the said combination under water.

13. The combination defined in claim 12 wherein said anchoring means and a supply of air connected to said membrane are both remotely actuated for control for release, thereby allowing the container and contents to buoyantly rise to the water surface.

14. The combination of a container, fluid transfer vents in said container providing communication through its walls of the interior with the exterior, a commodity fitted within said container, a gas and water tight membrane within the said container protectively enclosing said commodity, means for controllably inflating the membrane with a gas sufficient to provide buoyancy to the combination.

15. The combination of a container, fluid transfer vents in said container providing communication through its walls of the interior with the exterior, a commodity fitted within said container, a gas and water-tight membrane within the said container protectively enclosing said commodity, means for controllably supplying gas to said membrane, inflating it only sufficient to prevent collapse thereof under hydrostatic pressure upon the enclosed commodity within said sheath.

16. The combination of a container for underwater storage fluid transfer, vents in the walls thereof providing communication of the interior with the exterior, a commodity packaged within said container, a loosely folded inflatable gas and water-tight membrane protectively surrounding said commodity within the container, a source of inflating gas stored under pressure within said container, duct means providing communication between said gas storage means and the inflatable membrane, valve means in said duct controlling the flow of inflating gas passing through said duct and means for remotely actuating said valve means to provide buoyancy by controlled passage of the stored inflating gas into said membrane, expanding the same against the walls of the container and expelling water through the vents.

17. The combination as defined in claim 16 including anchoring means and means simultaneously operative with said remote valve control means for removing the anchoring means while providing buoyancy to the container combination.

18. The combination defined in claim 16 including means for actuating said valve responsive to a selected hydrostatic pressure, providing only sufficient buoyancy

to said combination to maintain submersion under water
at a selected level.

References Cited in the file of this patent

UNITED STATES PATENTS

59,228	Jarrett -----	Oct. 30, 1866
578,308	Anderson -----	Mar. 9, 1897
1,476,387	Atwell -----	Dec. 4, 1923
1,760,604	Paull -----	May 27, 1930

5

2,359,366
2,371,604
2,541,652
2,941,492
3,114,920

821,143

Katcher -----	Oct. 3, 1944
Mumford -----	Mar. 13, 1945
Howell -----	Feb. 13, 1951
Wilcoxon -----	June 21, 1960
Delarnelle -----	Dec. 24, 1963

FOREIGN PATENTS

Great Britain -----	Sept. 30, 1959
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