United States Patent

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a part interest

[54] **VALVE MEANS FOR APPARATUS FOR RAISING SUBMERGED VESSELS**
5 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **114/52**
[51] **Int. Cl.** **B63c 7/12**
[50] **Field of Search** 114/52, 53

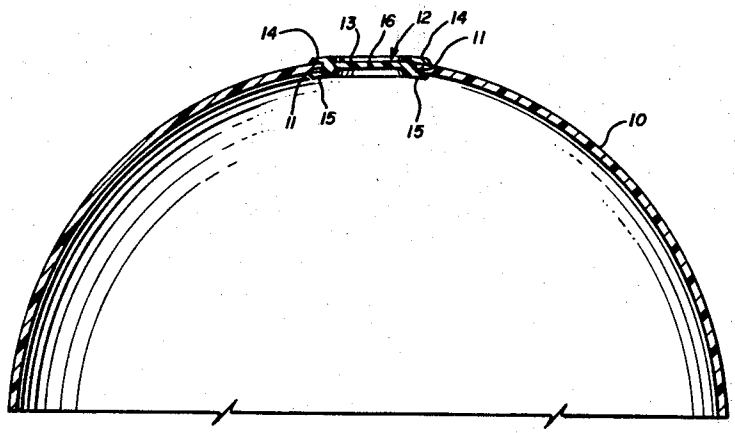
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ABSTRACT: Valve means for buoyant hollow elements used in apparatus for raising submerged vessels constructed to require a predetermined pressure differential internally and externally of the buoyant elements to permit passage of either air or water into or out of the elements, and which will not allow passage of air or water in either direction until a predetermined pressure differential has been reached. The valve means may embody a flexible apertured diaphragm or a pair of ball valves which function to permit passage of air or water only when the aforementioned pressure differential exists.



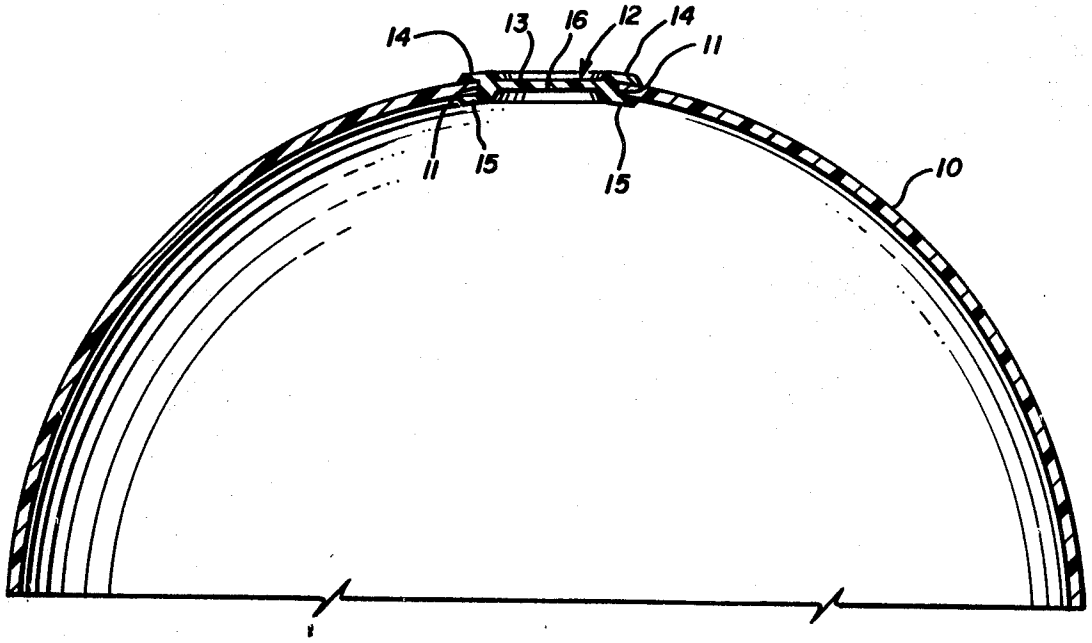


FIG. 1

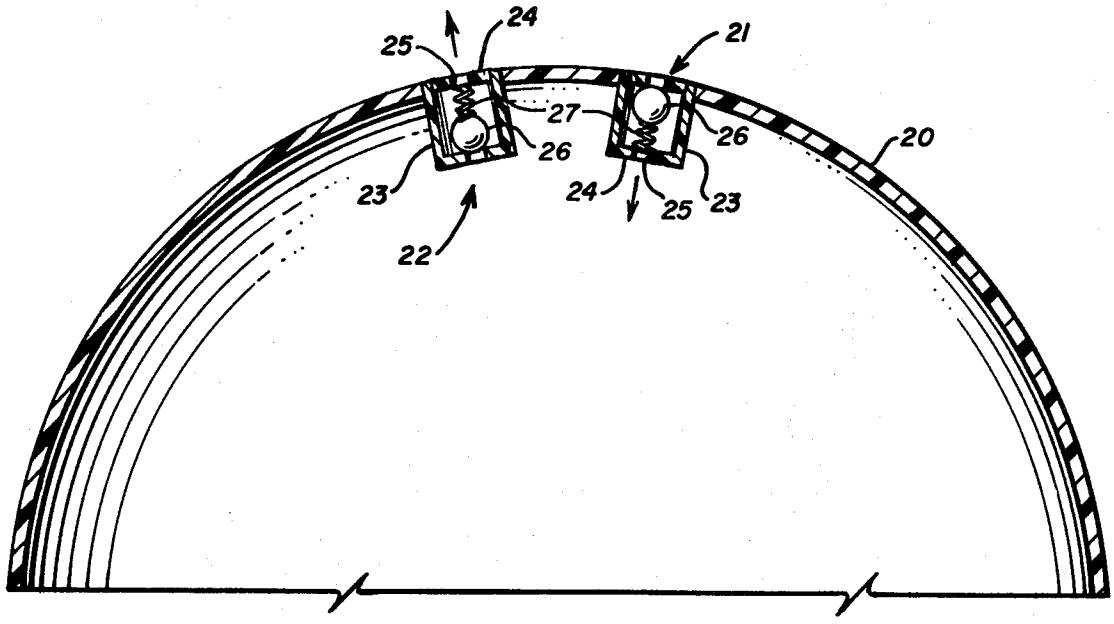


FIG. 2

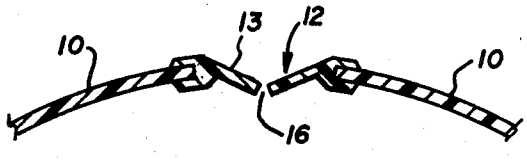


FIG. 3

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VALVE MEANS FOR APPARATUS FOR RAISING SUBMERGED VESSELS

This invention relates to apparatus for raising submerged vessels, and more particularly to valve means for buoyant elements which are part of such apparatus.

In the apparatus for raising submerged vessels described in my U.S. Pat. No. 3,308,808, valveless buoyant elements were employed for the purpose stated. The patented apparatus includes a plurality of buoyant hollow elements in the form of spheres, having walls impervious to air and water, each provided with a very small aperture through which air passes automatically into the element when the air pressure is greater externally than internally of the elements, and passes automatically out of the elements when the pressure is greater internally than externally of the elements, but through which water cannot pass when pressures internal and external of the elements are substantially equal. The patented apparatus also comprises a walled pressure chamber containing said hollow elements and air pressurized to a predetermined pressure at least equal to the water pressure at the depth of the submerged vessel to be raised for automatically causing said pressurized air to pass into the buoyant elements through said apertures until their internal and external pressures are approximately equal.

This treatment of the hollow elements is preparatory to conveying them into the vessel to be raised and prevents destruction of the hollow elements due to increased external pressure resulting from lowering of the elements into a sunken vessel.

Although not limited as to size, the valveless spheres or balls heretofore used were relatively small, of the size such as ping-pong balls, for example, consisting of hollow casings of plastic or other suitable material provided with one or more very small apertures designed to permit passage of air into and out of the ball and to prevent water from entering as described in said patent.

Under some conditions it is desirable to utilize larger balls than those heretofore employed for this purpose, and to provide valve means designed for the varying pressure conditions to which the apparatus may be subjected. Such conditions depend on the depth of the submerged vessel and on the varying water depths and pressures resulting from tide and other variable factors.

The main object of the invention is to provide valve means constructed to require a predetermined pressure differential internally and externally of the buoyant elements in order to permit passage of either air or water into or out of the elements, and which will not allow passage of air or water in either direction until a predetermined pressure differential has been reached. Valves constructed in accordance with this invention, which function automatically to permit passage of air or water into or out of the buoyant elements only when the aforementioned predetermined pressure differential exists, overcome the objections encountered when tides or waves temporarily alter the pressures to which the buoyant elements are subjected (with resultant passage of air or water) after they have been discharged into the submerged vessel to be raised. For example, the buoyant elements may have been pretreated in a pressure chamber or conduit to have internal pressure of 100 pounds, equal to the air pressure in the chamber or conduit, and equal to the pressure the elements are expected to encounter at the water depth of the submerged vessel into which they are to be discharged. Tides or waves may temporarily alter this external pressure, for example, by increasing it to 105 pounds. This differential of 5 pounds between internal and external pressures affecting the buoyant elements is not sufficient to destroy the elements but heretofore has been sufficient to cause air or water to pass through the apertures provided in the spheres employed for raising submerged vessels. It is an object of this invention, therefore, to provide valve means which prevent passage of air or water into or out of the buoyant elements until a predetermined differential exists.

Another object is to provide valve means which may be detachably mounted on the buoyant elements and which may be used and reused, and are interchangeable for use on different sized elements or under varying conditions, such as in apparatus for raising submerged vessels located at different depths in the water or subjected to varying pressures due to tides and other factors.

In the drawings:

FIG. 1 is a sectional view of part of a hollow sphere provided with a valve embodying my invention.

FIG. 2 is a sectional view similar to FIG. 1 showing another type of valve means.

FIG. 3 is a fragmentary view showing the valve of FIG. 1 as it appears when the external pressure is greater than the pressure in the buoyant element.

In the embodiment of the invention shown in FIG. 1, 10 indicates a hollow ball or sphere made of plastic or other suitable material which is light enough to be buoyant in water and capable of withstanding the pressures imposed on the buoyant spheres through physical contact with each other and with the walls of the submerged vessel, as well as capable of withstanding limited differential in pressures, internal and external of the buoyant elements, due to varying pressure conditions resulting from tides and waves. The sphere 10 is provided with an opening defined by the edge 11. The opening may be circular or other shape. The valve means 12 comprises a diaphragm of flexible resilient material having a relatively flat central portion 13 and a peripheral portion which is thicker than the central portion and terminates in radially extending flanges. The external flange 14 overlies the outer surface of the sphere 10 adjacent the opening, and the internal flange 15 engages the inner surface of he sphere 10 adjacent the opening defined by the edge 11. The edge 11 of the sphere around the opening fits within the annular recess formed between the flanges 14 and 15 of the diaphragm 12.

The central portion 13 of the resilient diaphragm is provided with an aperture or slit 16 which extends through the diaphragm but does not permit passage of air or water when the internal and external pressures affecting the element 10 are equal. When the external pressure is greater than the internal pressure, as is the case when the buoyant elements are subjected to pressurized air in the walled pressure chamber described in my said U.S. Pat. No. 3,303,808, preparatory to being conveyed into a sunken vessel, the relatively thin resilient and flexible central portion 13 is forced inwardly as shown in FIG. 3 and the slit 16 is thereby opened sufficiently to admit pressurized air into the sphere 10. When the internal pressure of the sphere is greater than the external pressure, as is the case when a sunken vessel is raised and approaches the water surface, the central portion 13 of the diaphragm 12 is forced outwardly and the slit 16 is thereby opened sufficiently to permit internal air, and water if any, to pass out of the sphere 10 until the external and internal pressures are substantially equal.

The construction is such that the valve member 12 can be placed into position to close the opening in the sphere 10 without separate fastening means, and can be removed and replaced with other similar valve means in which the size of the slit 16 or thickness of the diaphragm differs to accommodate the valve means to different pressures.

In FIG. 2, a buoyant sphere 20, similar to the sphere 10 is provided with two openings, one closed by valve means 21 for passage of air into the sphere and the other closed by valve means 22 for passage of air out of the sphere for the purpose of equalizing internal and external pressures. The end-apertured, cup-shaped casings 23 which encase each of the valve mechanisms 21, 22 may be formed integrally with the sphere 20 or may be insertable in the openings in said sphere. The valve means 21 and 22 may be removable from the casings 23, or the casings 23 and contents may be removable from the sphere 20, for replacement by similar parts adapted for use under varying pressure conditions.

Each of the valves 21, 22, comprises an end wall 24 provided with an opening 25. In FIG. 2, the valve 22 illustrates the

position of the ball **26** and spring **27** when the internal pressure in the sphere **20** is greater than the external pressure. The valve **21** illustrates the position of the ball **26** and spring **27** when the external pressure is greater than the internal pressure in the sphere **20**. It will be understood of course that only one of the two valves will function at one time, depending on the pressure conditions affecting the sphere **20**.

I claim:

1. Valve means for apparatus for raising submerged vessels, comprising

a. a hollow buoyant element having an opening extending through the element wall,

b. a diaphragm covering the opening in the element and having a flexible resilient portion provided with an aperture which does not permit passage of air therethrough when pressures inside and outside of the hollow element are substantially equal, said apertured portion of the diaphragm automatically becoming flexed in response to predetermined unequal pressures against opposite sides whereby the aperture is altered and permits passage of air through the aperture, and

c. means mounting the diaphragm on the hollow element to cover the opening in the element.

2. The valve means defined by claim **1**, in which the diaphragm includes peripheral flange means which overlie the outer and inner surfaces of the hollow element surrounding the opening in the element and form a recess for reception of the edge of the element adjacent the opening.

3. The valve means defined by claim **1**, in which the aperture in the diaphragm is a slit extending at a right angle to the major surfaces of the diaphragm, the angles of the surfaces defining the slit being altered when the diaphragm is flexed in response to predetermined unequal pressures against opposite sides of the diaphragm.

4. The valve means defined by claim **1**, in which the diaphragm is flexed to move inwardly or outwardly of the hollow element in response to predetermined unequal pressures on opposite sides of the diaphragm, and the aperture in the diaphragm is enlarged when the diaphragm is flexed.

5. The valve means defined by claim **2**, in which the peripheral flange means are flexible and manually disengageable to remove the diaphragm from the hollow element.