

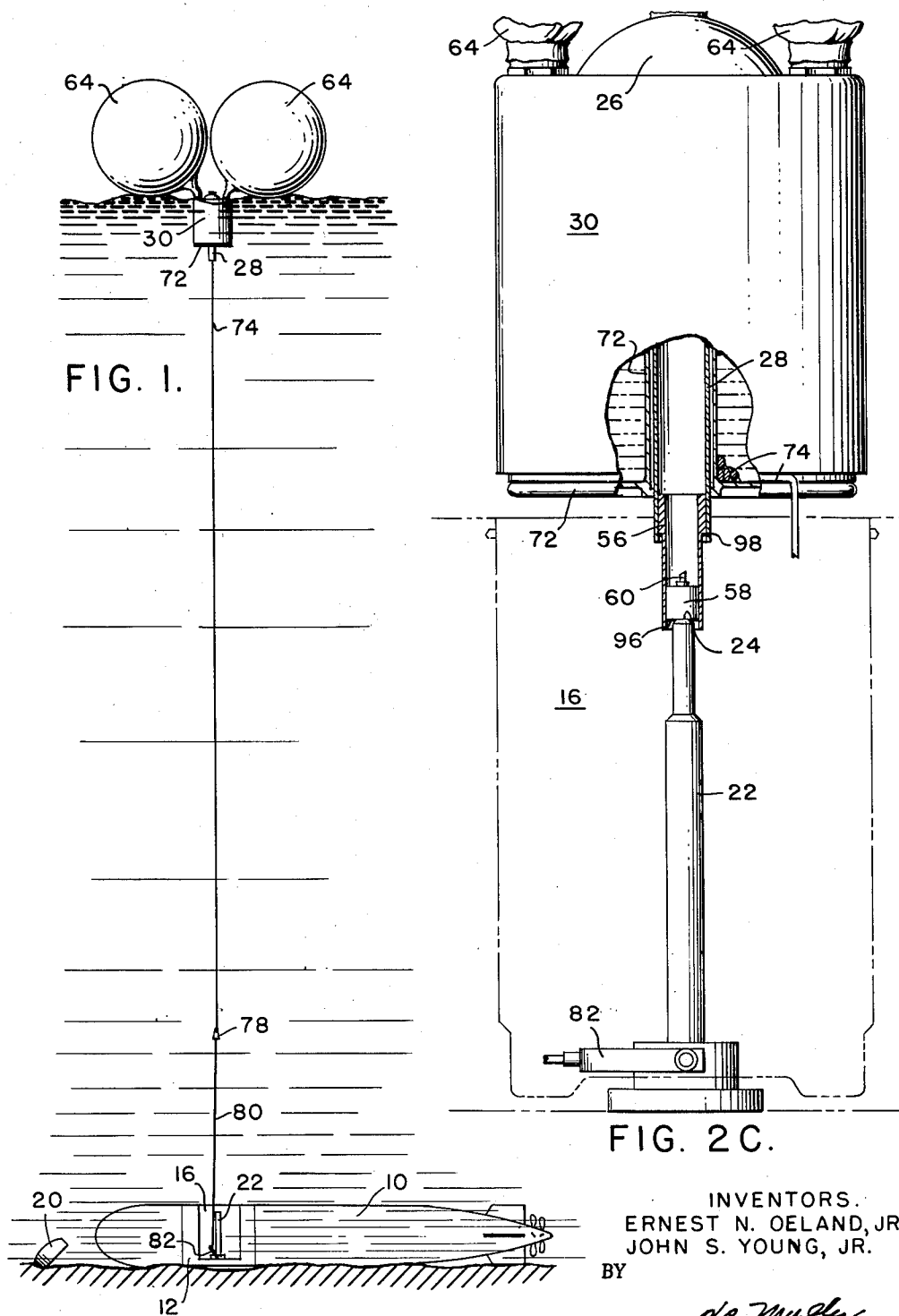
March 10, 1964

E. N. OELAND, JR., ETAL  
GAS EJECTED APPARATUS FOR LOCATING  
AND RECOVERING SUNKEN OBJECTS

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3 Sheets-Sheet 1



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3 Sheets-Sheet 2



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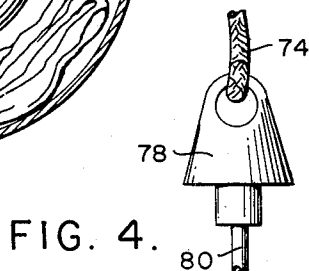
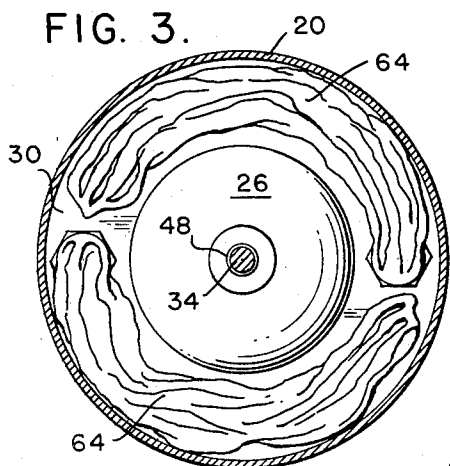
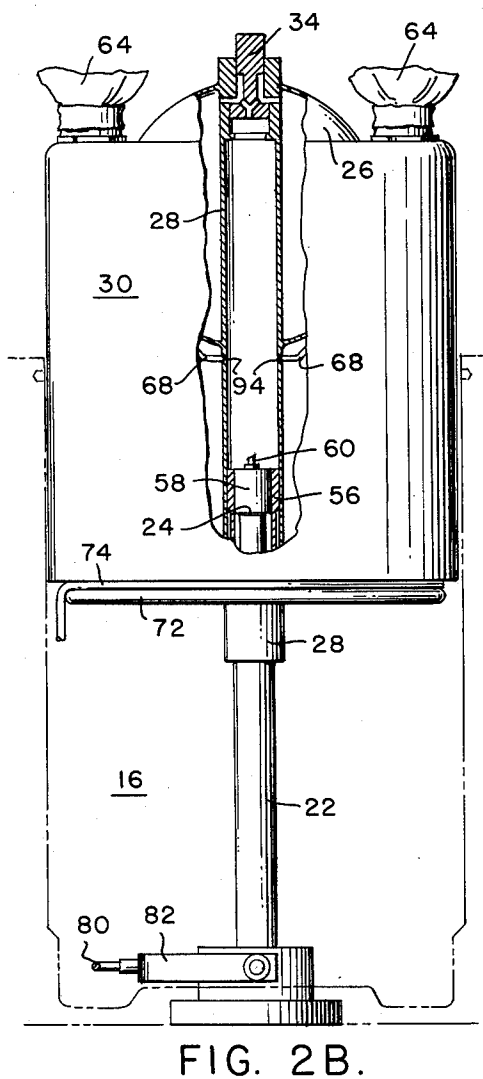
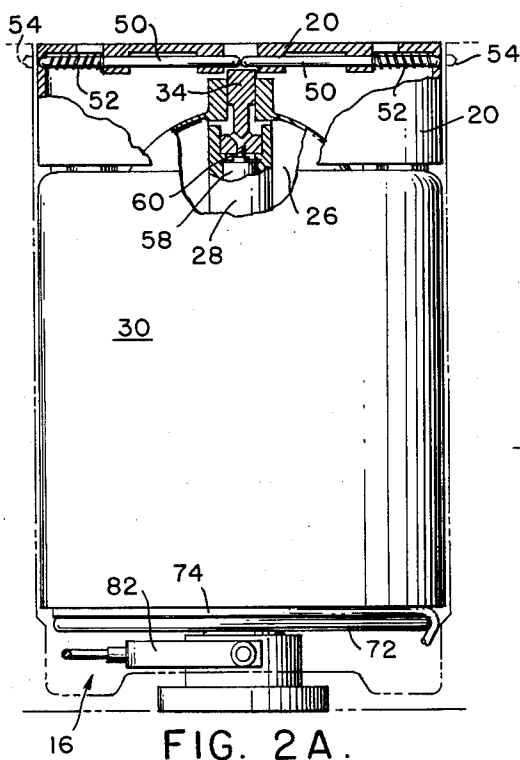
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## GAS EJECTED APPARATUS FOR LOCATING AND RECOVERING SUNKEN OBJECTS

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9 Claims. (Cl. 9—9)

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The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to apparatus for locating and retrieving negatively buoyant objects, such as torpedoes, submarines, instrumentation packages, and others which have sunken to the floor of a body of water, such as the sea.

It is conventional practice to locate a sunken body by a buoy which is released from the body and rises to the surface of the water, a suitable line connecting the two, which serves to guide a diver to the body, or to guide a retriever device or "go-getter" to the body, if in water beyond diving depth. The patent to Dayer 2,818,586 is exemplary of such devices.

One of the objects of this invention is to provide improvements in recovery apparatus of the general type referred to which is particularly adaptable for use in recovering objects which are sunken in water beyond diving depth.

Another object is to provide apparatus in which the buoy is forcibly ejected from the sunken body even though the body may be in inverted position on the floor of the sea.

Another object is to provide a buoy which may be inflated to relatively large size to more readily locate same on the surface of the sea.

A further object is to eliminate water drag on the buoy line as the buoy rises to the surface and thus increase the rate of ascent of the buoy and effect earlier recovery of the sunken body.

Further objects, advantages and salient features will become more apparent from a consideration of the description to follow, the appended claims, and the accompanying drawing, in which:

FIG. 1 is a vertical section of a body of water illustrating a sunken body and apparatus for recovering same,

FIG. 2 is a longitudinal vertical section through a portion of the sunken body and in a position of parts prior to actuation,

FIGS. 2A, 2B and 2C illustrate successive stages of actuation subsequent to FIG. 2.

FIG. 3 is a section taken on line 3—3, FIG. 2, and

FIG. 4 is a detail as viewed in the direction of arrow 4, FIG. 2.

Referring now to the drawing, and particularly FIGS. 1 and 2, an exemplary environment of the invention comprises a negatively buoyant body, such as a torpedo 10, provided with an exercise section 12, which is employed in lieu of the torpedo warhead and which houses the recovery apparatus. The exercise section is a cylindrical portion of the torpedo hull which may be attached to an adjacent hull section in any manner conventional in the art. A circular tube 14 extends diametrically across the exercise section, forming a cylindrical cavity 16, closed at one end by an integral wall 18 and at the opposite end by a removable closure or lid 20, the outer surface of which conforms to the cylindrical outer surface of the exercise section. A guide post 22, affixed at one end to the exercise section in any suitable manner, extends axially within the cylindrical cavity, its free end 24 forming

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an abutment for ejecting the apparatus to be subsequently described.

The ejectable apparatus comprises a spherical gas pressure vessel 26, having a diametrically extending cylinder 28, which surrounds post 22. A cylindrical container 30 surrounds the major portion of the gas container and the space between the two is filled with a foam material 32 having a density of about one-half of water. This structure adds to the buoyancy of the pressure vessel and provides a cylindrical guide which conforms to the shape of cavity 16.

The upper end of the ejection cylinder is provided with an actuator piston 34, one end 36 of which is of larger diameter than its other end 38, the latter being slideable within the bore of a threaded member 40. A threaded stud 42, part of the smaller end of the actuator piston, carries a pair of circular nuts 44, 46, a magnesium washer 48 being disposed between nut 44 and the outer end surface of member 40 which normally prevents gas pressure in vessel 26 and sea pressure from moving the actuator piston radially inwardly. Nut 46 is disposed between the inner ends of a pair of locking pins or rods 50, slideably carried by lid 20, which are urged inwardly by springs 52, 52, the outer ends of which engage in apertures 54, 54. In the position shown in FIG. 2, nut 46 blocks inward radial movement of the locking pins, but when moved radially inwardly out of blocking position, permits the springs to move the locking pins out of locking position thus freeing the lid for bodily release from the exercise section.

A hollow cylinder extension piston 56 is slideably disposed within ejection cylinder 28, its bore receiving an ejector piston 58, one end of which abuts end 24 of post 22. A diaphragm piercing pin 60 projects from its other end and pierces a diaphragm 62, disposed on actuator piston 34, when the latter moves radially inwardly, as will subsequently be described.

The space between the cover and pressure vessel contains a pair of resilient deflated bags 64, the mouth of each being secured to a fitting 66 which communicates with ejection cylinder 28 through a conduit 68. A pressurizing fitting 70, containing a check valve (not shown), communicates with the pressure vessel.

A reel 72, containing small but strong flexible cord 74, such as braided nylon, is rotatably carried by a portion of the ejection cylinder, a retainer ring 76 preventing the reel from disengaging from the cylinder. The end of the outermost coil of cord is secured to a spearhead 78 disposed on one end of a steel cable 80, the other end of the cable being secured to a yoke 82 pivotally attached to the post 22.

In the operation of the apparatus it will first be assumed that the torpedo is being prepared for an exercise run with lid 20 and the flotation apparatus removed. Cable 80 is coiled in the lower portion of cavity 16 and the flotation apparatus, with a fully wound reel, is inserted into the position shown in FIG. 2. The pressure vessel is then pressurized with air, nitrogen or other inert gas to a desired pressure through fitting 70, the check valve in the fitting preventing release of the gas after the pressurizing hose is detached from the fitting. Nut 46, previously removed, permits the lid to be applied since the outer ends of locking rods 50 are now urged inwardly to a position within the periphery of the lid (as shown in FIG. 2A). Suitable tools are now inserted through access holes 84, engaging snap rings 86, and urging the rods to the outward locking position shown in FIG. 2. Nut 46 is next applied to stud 42, blocking inward movement of the locking rods. Upon removal of the tools the torpedo is then otherwise activated for its test run and at the end of the run it sinks to the floor of the sea. After a predetermined time from launching, the outer annular edge

of magnesium washer 48 will disintegrate due to electrolytic action between magnesium and steel in salt water. The pressure of sea water on the small end 38 of the actuator piston, aided by gas pressure applied through apertures 38 to the differential area of its two ends now moves it toward the ejector piston 58, diaphragm 62 being pierced by piercing pin 60. The movement of the actuator piston has now moved nut 46 out of blocking position and locking rods 50 have moved inwardly under urge of springs 52, thus conditioning the lid for release. Gas now passes through aperture 90 in the actuator piston and into chamber 92.

As pressure increases in chamber 92 the flotation apparatus begins to emerge from cavity 16 until it reaches the position shown in FIG. 2B wherein cylinder extension piston 56 has uncovered ports 94, permitting gas to pass through conduits 63 and beginning inflation of the bags. As ejection continues the extension piston moves relative to cylinder 28 to a final position abutting retainer ring 98 (FIG. 2C) and the ejector piston moves to a final position abutting retainer ring 96. At this point, the forcible ejection by gas pressure ceases and the remaining upward movement of the apparatus is effected by only the buoyancy of the pressure vessel and the bags. While the bags are not essential for the apparatus to reach the surface, their added buoyancy increases the rate of ascent, and when they reach the surface, due to their large size, materially aid in visually locating same on the surface of the sea. In the event that the negative buoyancy of the torpedo is less than the breaking strength of the cord, the latter may be winched in by a surface winch, raising the torpedo to the surface. If, however, the negative buoyancy is greater than the breaking strength of the cord, a retriever, attached to a strong winching cable, is lowered along the line and when it reaches the spearhead it automatically latches to same and the torpedo is then raised by the retriever cable.

In prior art devices in which the supply of cord remains with the sunken object, the entire length of payed out cord is in motion in the water during ascent of the buoy, producing drag, which must be overcome by the buoyancy of the buoy. As will be apparent, if a large length of cord is being pulled through the water the rate of ascent of the buoy will be relatively slow. In the present invention, the cord is payed out from the buoy, rather than from the sunken object, and hence is not in motion through the water, thus eliminating the cord drag and permitting the buoy to ascend unimpeded by cord drag. Further, the buoyancy is constantly increasing with ascent due to loss of weight of cord carried by the buoy, and more particularly, by expansion of gas in the bags which results from decreasing sea pressure.

Another distinction from prior art devices resides in the forcible ejection of the buoy from the sunken object. This is of particular advantage if the sunken object comes to rest in an inverted position. When used with a torpedo, the forces produced by the piston-cylinder apparatus is sufficient to raise the torpedo from the floor of the sea sufficient to permit the buoy to eject in a downward direction and thence ascend to the surface of the sea. Also, as will be apparent from FIG. 1, even though the opening of cavity 16 may be facing downward in the direction opposite to that shown, spearhead 78 will be disposed in an accessible position away from the torpedo where the retriever may latch on to same.

Metering orifices 94 prevent rapid filling of the bags and maintain gas pressure for ejecting the ejectable apparatus. As will be apparent from FIG. 2B, piston 56 has uncovered orifices 94 but ejection is not yet completed. If the orifices were not provided, bags 64 would now be rapidly inflating thus reducing gas pressure for ejection. In FIG. 2B only a small amount of gas has

been delivered to the bags and the pressure within cylinder 28 is only slightly less than the original pressure in vessel 26. Thus, the pressure in vessel 26 is utilized, first for ejecting the ejectable apparatus, and thereafter for inflating the bags. The metering orifices also serve a second function of preventing loss of inflation of one bag in event the other should be ruptured. In the event of rupture of one bag the remaining bag will remain inflated since the size of the orifices is so chosen to prevent rapid loss of gas pressure within the bags.

During normal ascent with the bags equally inflated the ejected apparatus will rise in an erect position as illustrated in FIG. 1. When so rising, the cord will feed off the lower flange of spool 72 around its periphery, with the spool remaining stationary with respect to cylinder 28. In the event of unequal inflation of the bags, or rupture of one bag, the ejected apparatus will rise in a canted position with the plane of the lower flange in non-horizontal position. In this case the line will not feed off the lower flange around its periphery. To obviate this possible malfunction the reel is mounted so that it may rotate on cylinder 28. Thus, if the ejected apparatus rises in a canted position, the reel will rotate around extension 28 and line will be payed out over some point on the lower flange rather than around its periphery.

The disintegration of magnesium washer 48, previously referred to briefly, will now be described in greater detail. As will be apparent from FIG. 2, the washer is disposed between the upper face of threaded member 40 and the lower face of nut 44. Member 40 and nut 44 may be of any metal which will provide electrolytic action in salt water with the magnesium washer. Steel, stainless steel and copper are preferred examples. As the electrolytic action proceeds the exposed portions of the annulus of the washer disintegrates until insufficient magnesium remains to withstand the shear force on the annulus, resulting from pressure tending to move piston 34 inwardly, whereafter the piston moves and initiates the sequence of events previously described. As will be apparent, the time required to cause disintegration of the magnesium annulus may be chosen by selection of its mass or choice of metals employed for member 40 and nut 44.

In some instances it may be desirable to raise a non-buoyant body without the use of a retrieving device which latches onto spearhead 78. In such instances the amount of cable 80 is increased so that its free end may be raised to the surface of the water by the nylon line. In one embodiment (not shown) this has been accomplished by employing the same structure shown but with the addition of a separate rotating reel of cable disposed adjacent the lower end of cavity 16. In operation, cable is fed from the reel, through a wall, such as 14 or 18, and thence to the surface by the nylon line. The other end of the cable is, of course, secured to the reel so that when all of the cable has been unreeling further lifting of the cable will raise the object to which it is attached.

If the apparatus is to be employed in fresh water which would not provide electrolytic action on the magnesium disk, a water soluble disk, such as a compressed salt or soluble plastic may be employed. If it is to be employed with a sunken object containing personnel, such as a sunken and disabled submarine, initiation of the apparatus would not be desirable until a command is given. In such instance, a suitable latching pin, engaging piston 38, or a U-shaped latch, slidably disposed beneath nut 44, may be employed, which, upon disengagement from piston 34 will initiate operation of the apparatus.

Referring again to FIG. 2, it will be noted that the upper end 24 of post 22 terminates at a point below the mouth of cavity 16 and the effective ejection movement of the ejectable apparatus (not considering extension piston 56) is the distance between end 24 and retainer ring 98. This distance, alone, is insufficient to completely eject the device. As will be apparent, also, the post could be lengthened if the space occupied by the ejector piston had

been utilized. To provide complete ejection and yet provide a compact apparatus the extension piston has been provided, however, which, in effect increases the effective length of cylinder 28 (see FIG. 2C) so that complete ejection is possible. It will be apparent, therefore, that according to the particular design of the apparatus or whether or not complete ejection is required the extension piston may or may not be required.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. Apparatus for locating and recovering an object disposed on the bed of a body of water, comprising:
  - (a) a cylindrical cavity in the object having an open end communicating with the water,
  - (b) a removable closure closing the open end of the cavity,
  - (c) locking means for locking the closure to the object and unlocking means for unlocking it from the object,
  - (d) a post secured at one end to the object and disposed centrally in the cavity having an abutment end disposed between ends of the cavity,
  - (e) an ejectable floatation device disposed within the cavity, and retained therein by the closure when the latter is locked to the object,
  - (f) the device having an ejection cylinder disposed around the post,
  - (g) a gas pressurized vessel for supplying gas to the cylinder,
  - (h) an ejector piston within the cylinder having one end abutting the abutment end of the post,
  - (i) an actuator piston within the ejector cylinder adapted to initiate operation of the device,
  - (j) the actuator piston having means carried thereby for preventing operation of the unlocking means when disposed in an initial position,
  - (k) means for permitting the actuator piston to move to an actuating position, when desired, under urge of ambient water pressure and gas pressure within the vessel,
  - (l) means for preventing flow of gas from the pressure vessel to the ejector piston until the actuator piston has moved to its actuating position,
  - (m) resilient bag means adapted to be inflated after the pressure in the pressure vessel has been utilized for at least substantial ejection of the device from the cavity,
  - (n) and a reel of cord having one end connected to the object,
  - (o) the construction and arrangement being such that when the actuator piston moves to its actuating position the cover becomes unlocked, permitting the device to be ejected from the cavity, gas pressure in the vessel then commences forcible ejection of the device, and after complete ejection of the device, pressure in the pressure vessel is utilized to inflate the bag means to ambient water pressure.
2. Apparatus in accordance with claim 1 wherein the removable closure (b) is disposed within the open end of the cavity, the locking means (c) comprising at least two radially slideable locking pins carried by the closure having outer ends engageable within apertures in the object, the unlocking means comprising springs for urging the locking pins radially inward, the means for preventing operation of the unlocking means (j) comprising a blocking member disposed between the inner ends of the locking pins preventing their radial inward movement.

3. Apparatus in accordance with claim 1 wherein the pressurized vessel (g) is substantially spherical in shape and the ejector cylinder extends diametrically across the pressure vessel with a portion extending therebeyond, to provide a cylinder length approaching the depth of the cavity.

4. Apparatus in accordance with claim 3 wherein the ejector piston (h) is disposed within an extension piston adapted to operatively cooperate with the ejector piston and ejector cylinder to provide an effective ejector cylinder length sufficient to eject the device to a position outwardly beyond the open end of the cavity.

5. Apparatus in accordance with the claim 1 wherein the means for permitting the actuator piston to move to actuating position (k) comprises a magnesium abutment cooperating therewith and adapted to be disintegrated by electrolysis.

6. Apparatus in accordance with claim 1 wherein the means for preventing flow of gas from the pressure vessel to the ejector piston (l) comprises a puncturable diaphragm carried by the ejector piston adapted to be punctured when the ejector piston moves to its actuating position.

7. Apparatus in accordance with claim 1 wherein the resilient bag means (m) comprises a plurality of identical bags having mouths secured to the device at equal distances from the axis of the cavity to thereby cause the device to ascend in the water with the axis of the cylinder disposed vertically, said reel of cord (n) being mounted on cylinder and having a lower circular flange, the cord adapted to pay out from the reel around the periphery of the flange when the device is ascending with the axis of the cylinder disposed vertically.

8. Apparatus in accordance with claim 7 wherein the reel is rotatably mounted on the cylinder to permit it to rotate when the device is ascending with the axis of the cylinder disposed non-vertically.

9. Apparatus for locating and recovering an object disposed on the bed of a body of water, comprising:

- (a) an ejectable floatation device adapted to be ejected from the body and ascend to the surface of the body of water,
- (b) said device comprising a gas pressurized vessel,
- (c) an ejector cylinder having an ejector piston therein engageable with an abutment on the object disposed within the cylinder,
- (d) means for delivering gas from the vessel to the cylinder during ejection of the device from the object,
- (e) an inflatable resilient bag,
- (f) means for delivering gas from the vessel to the bag for inflation of the latter to ambient water pressure after the device has been ejected from the object, and
- (g) a reel of cord adapted to pay out cord from the device as it ascends in the water and without water drag on the cord,
- (h) the construction and arrangement being such that the pressure in the vessel is first utilized solely for ejection of the device and thereafter for inflation of the bag, the bag expanding under decreasing ambient water pressure as the device ascends, constantly increasing its buoyancy and rate of ascent.

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