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HYDROSTAT-ACTUATED PARACHUTE RELEASE MECHANISM

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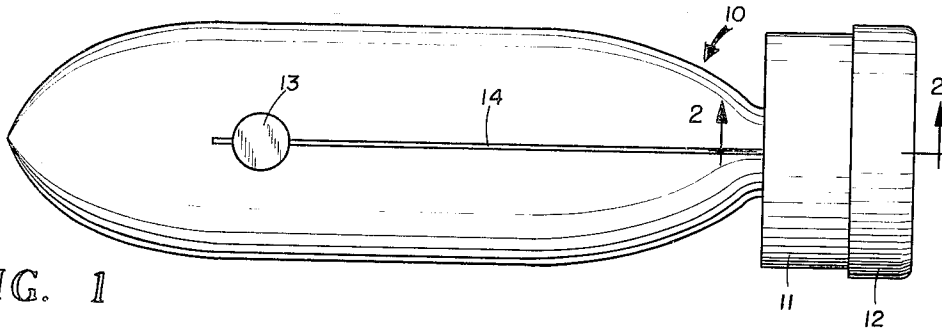


FIG. 1

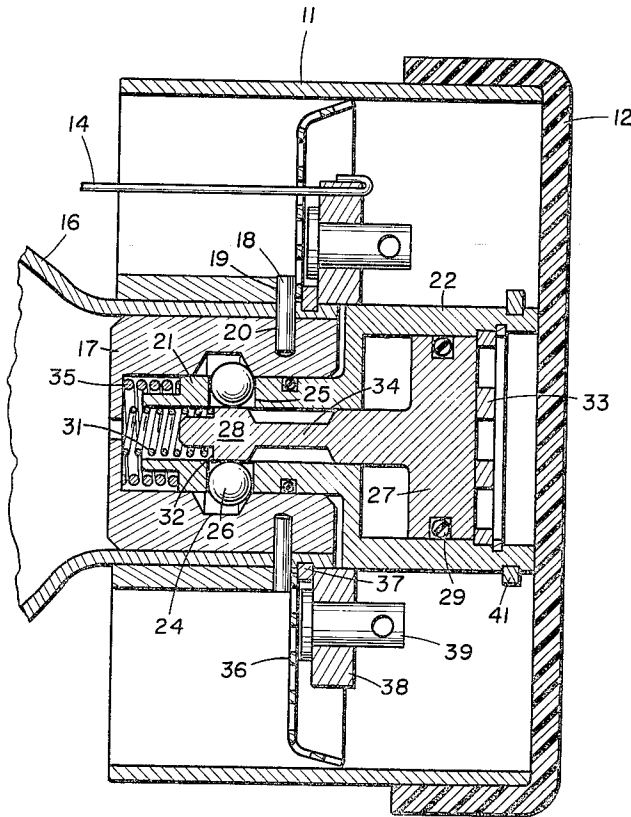


FIG. 2

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HYDROSTAT-ACTUATED PARACHUTE RELEASE MECHANISM

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10 Claims. (Cl. 102-7)

The invention described herein may be manufactured and used by and 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 aerial launched underwater ordnance items and more particularly to an explosive charge adapted to be detonated at a predetermined depth below the surface of the water and having a first means responsive to the opening of the parachute for arming the charge and a second means responsive to a predetermined hydrostatic pressure for separating the parachute from the charge at a predetermined depth below the surface of the water.

In the past, various separation mechanisms have been employed to release a parachute from an ordnance item at the moment of impact of the item with the surface of the water in response to the movement of an inertial weight, while various other separation mechanisms have been employed for releasing a parachute from an ordnance item after the item has descended to the floor of the body of water, these devices being actuated by any one or combination of time delay devices, sea batteries or hydrostatic switches in cooperation with time delays. Those separation mechanisms responsive to the movement of an inertial weight are not entirely reliable because of their inability to function properly if the load strikes the surface of the water with a low velocity or at an oblique angle, and are unsuited for modification for operation in a manner to cause the separation at a predetermined depth below the surface of the water. Those separation mechanisms employing sea batteries or time delay mechanisms are likewise unreliable for separating the parachute from the load at a predetermined depth below the surface by virtue of the fact that in one case the time of response of the sea battery is not readily controlled nor predicted, and in the other case a change in the altitude from which the load is dropped would vary the period of time during which the charge would descend through the water before detonation.

The present invention relates to an explosive charge adapted to be detonated at a fixed distance below the surface of the water subsequent to being dropped by an aircraft and particularly to charges adapted to be detonated at shallow depths. The charge has a parachute attached to the tail section by means of a ball-lock connection, which ball-lock connection is released by a hydrostat at a predetermined depth below the surface to separate the parachute from the charge. The device also includes an arming wire connected at one end to the parachute mounting means and at its other end to the detonating means of the charge, whereby the detonator is held in a safe position by the arming wire until the charge is dropped and the parachute opens to withdraw the arming wire from the detonator and thereby arm the charge for actuation upon reaching its predetermined depth for detonation. The arming wire enables safe handling of the charge and prevents accidental detonation thereof by holding the detonator in an inactive position until the parachute has been opened when the charge has been released. The parachute release mechanism is not uncoupled by the hydrostat until the charge has descended to a predetermined depth below the surface and therefore the parachute is used to not only retard

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the falling charge to a safe water entry velocity but also to retard the descent of the charge through the water and assure that the charge is properly orientated in its firing position when the parachute is released and later when the charge is detonated.

One of the objects of the present invention is to provide a new and improved device for releasing a parachute from an aerial launched marine ordnance item.

Another object of the invention is to provide an inexpensive device for releasing a parachute from an aerial launched marine ordnance item at a predetermined depth below the surface of the water.

A further object is to provide an underwater explosive charge adapted to be launched from an aircraft and detonated at a predetermined depth below the surface having means for arming the charge upon opening of the parachute and having a parachute release mechanism for uncoupling the parachute from the charge at a predetermined depth below the surface prior to detonation of the charge.

Other objects, advantages, and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings wherein:

FIG. 1 is a side view of the underwater explosive charge having the parachute packed in the tail fin assembly and the arming wire connected to the detonator;

FIG. 2 is a somewhat enlarged sectional view of the parachute release mechanism taken on lines 2-2 of FIG. 1.

Referring now to the drawings, there is shown in FIG. 1 an explosive charge 10 of the type adapted to be launched from an aircraft and to descend to a predetermined depth below the surface before detonation of the charge. The charge is provided with a cylindrical tail fin assembly 11 within which is packed a parachute, not shown, which is employed to decrease the velocity of the descending charge as it falls from the aircraft to a safe water entry velocity so that the impact upon water entry does not damage the charge. A closure cap 12 is provided on the cylindrical fin assembly to retain the packed parachute therein before the charge is dropped and to protect the parachute during storage. The closure cap is mounted upon the cylindrical fin assembly by means of a loose friction fitting so that the cap may be easily unseated by the parachute as it deploys. The explosive charge is provided with a hydrostatic detonator 13 for detonating the charge upon descent to a predetermined depth below the surface of the water, and accidental actuation of the hydrostatic detonator is prevented by means of a safety and arming wire 14 which extends through a transverse aperture formed in the piston of the hydrostatic detonator to hold the piston in a safety position. The opposite end of the safety and arming wire is connected to the parachute mounting means so that, after the charge has been launched by the aircraft and the parachute deploys, the safety and arming wire is withdrawn from the transverse aperture in the position of the hydrostatic detonator to arm the charge, in a manner which will become more apparent from the following description.

The after end of the explosive charge casing, as seen in the enlarged view of FIG. 2, decreases in diameter and terminates in a short small diameter cylindrical tail section 16 having an aperture formed therein to receive a cup-shaped base member 17 of the parachute release mechanism. The base member is rigidly secured within the aperture in the cylindrical tail section 16 by means of a pair of oppositely disposed anchor pins 18 which extend through apertures 19 formed in the wall of cylindrical section 16 and fit within recesses 20 formed in the

base member. When mounting the base member within the cylindrical end section 16, the outer peripheral surface of the base member is coated with a liquid plastic sealant prior to insertion of the base into the aperture and the recesses 20 are aligned with the pin apertures 19 and the pair of pins 18 are inserted therein to lock the base to the cylindrical section 16. The liquid plastic sealant enables the air trapped within the charge casing to escape while the base is being inserted and after the plastic hardens, it forms a watertight seal to prevent water or moisture from entering the interior of the charge casing.

The cup-shaped base 17 receives a tubular extension 21 of a cylindrical housing 22, the outer diameter of the tubular extension being substantially equal to the inner diameter of the aperture formed within the cup-shaped base member. Formed within the inner peripheral surface of the cup-shaped base is a pair of oppositely disposed bevelled detents 24 which cooperate with a pair of oppositely disposed through apertures 25 formed in the wall of the tubular extension 21 to receive a pair of steel balls 26 and thus form a ball-lock mechanism for releasably coupling the cylindrical housing 22 and its tubular extension 21 to the base 17. Positioned within the cylindrical housing 22 is a piston 27 having a piston rod 28 formed thereon and partially extending into the tubular extension 21, the outer peripheral surface of the piston having an annular groove formed therein to receive an O-ring 29 to provide a sliding sealing engagement with the inner peripheral surface of the cylinder 22. A helical compression spring 31 is seated upon the bottom of the cup-shaped base and engages an annular shoulder 32 on the piston rod to resiliently bias the piston outwardly against a perforated plate 33 which is seated upon an annular shoulder formed in the inner peripheral surface of the cylindrical housing 22 and held in position by means of a retaining ring 35 positioned within an annular groove in the inner peripheral surface of the housing 22. In this, the normal position of the hydrostat piston 27, the piston rod 28 confines the locking balls 26 to their positions illustrated in FIG. 2 to lock the housing 22 to the base 17. However, when the piston 27 is exposed to a hydrostatic pressure sufficient to overcome the force of the resilient bias spring 31, the piston moves to the left as illustrated in the drawing and a reduced diameter section 34 of the piston rod comes into alignment with the ball-receiving through apertures to permit the locking balls 26 to be cammed radially inwardly into the space around the reduced diameter section 34. The balls are forcibly cammed into the space around the reduced diameter portion by means of a second helical compression spring 35 seated upon the bottom of the cup-shaped base and engaging an annular shoulder formed on the tubular extension 21 to force the balls against the bevelled edges of the detents 24 and cam the balls inwardly. The drag force of the parachute is transmitted to the cylindrical housing 22 and tubular extension 21 to further assist in the camming of balls 26 and ejection of the cylindrical housing.

An annular perforated dish-shaped plate 36 is mounted upon the tail section 16 of the charge casing and is held thereon by abutment on one side against anchor pins 18 and on the other side against a retaining ring 37 seated within an annular groove formed in the outer peripheral surface of said tail section. The perforated dish-shaped plate is of sufficient diameter to extend radially into contact with the inner peripheral surface of the cylindrical tail fin and thereby form a base for packing of the parachute.

A parachute attachment assembly is mounted upon the outer peripheral surface of the cylindrical housing 22 and comprises an annular collar 38 having a pair of oppositely disposed anchor pins 39 extending through apertures formed in said annular collar, said pins having eye hooks formed in the ends thereof for attachment of the shroud lines of the parachute. The collar 38 is mounted upon

the cylindrical housing 22 for sliding movement longitudinally of the housing between the retaining ring 37 and a second retaining ring 41 which is seated within an annular groove formed in the outer peripheral surface of the cylindrical housing 22 near the open end thereof. The arming wire 14 is attached at one end to the collar 38 and at its other end to the hydrostatic detonator 13 and consequently, when the parachute opens, the drag of the parachute pulls the collar away from ring 37 toward the stop ring 41 and hence withdraws the arming wire 14 from the through aperture within the hydrostatic detonator to arm the detonator.

Normally the parachute is packed within the cylindrical tail fin assembly 11 between the perforated dish-shaped plate 36 and a closure cap 12, shown in FIG. 1, which fits over the after end of the tail fin assembly to seal the parachute and confine the parachute within said tail fin assembly. When the charge is dropped from the aircraft, air rushing through the perforated plate 36 forces the parachute out of the tail fin assembly, unseating the closure cap. When the parachute is deployed, the tension in the shroud lines pulls the annular collar 38 from the position shown in FIG. 2 axially along the cylindrical housing 22 to abutment with the stop ring 41, thus withdrawing the arming wire 14 from the through aperture in the hydrostatic detonator 13 to thereby arm the detonator. In this position, the charge descends until impact with the surface of the water at which time the parachute momentarily deflates until the charge and the parachute are submerged in the water, when the parachute re-inflates. As the charge descends in the water, hydrostatic pressure is exerted on the rear face of piston 27 but movement of the piston is opposed by the helical compression spring 31. When the charge has descended to a depth at which the hydrostatic pressure overcomes the bias force of the compression spring 31, the piston moves to the left as viewed in FIG. 2 and the locking balls 26 are then permitted to be cammed radially inwardly into the space around the reduced diameter section 34 of the piston rod. When the balls have been cammed radially inwardly, the cylindrical housing 22, stop-ring 41 and parachute mounting collar 38 are released from the cup-shaped base 17 and positive separation of these members is aided by the pull of the water inflated parachute and by the force of the ejection spring 35. The base and the perforated dish-shaped plate remain with the charge as the charge continues to descend in the water until the charge reaches its critical depth at which the hydrostatic detonator 13 ignites the charge.

From the foregoing, it is apparent that the present invention provides a device for decelerating an aircraft launched underwater explosive charge to a safe water entry velocity and for further retarding the descending charge through its initial depth as well as insuring proper orientation of the charge for firing and then separating the parachute from the charge to permit the charge to descend to its critical depth of detonation. The present invention provides a reliable, accurate, and inexpensive device for arming an underwater explosive charge upon opening of the parachute and for performing a second function of separating the parachute from the charge at a predetermined depth below the surface of the water before the charge is detonated. The present invention provides a device for generating an explosive signal at shallow depths below the surface of the water by retarding the descent of the charge through the water with its parachute and uncoupling the parachute below the surface of the water prior to detonating the charge.

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. A release mechanism responsive to hydrostatic pres-

sure for uncoupling a parachute from an aerial launched marine bomb comprising,

- a cup-shaped base to be fixedly secured to the after end of a marine bomb,
 - said base having at least a pair of oppositely disposed detents formed in the inner peripheral wall thereof,
 - a hydraulic cylinder having a portion thereof extending into the cup-shaped member and having a pair of oppositely disposed ball-receiving through apertures formed therein for alignment with said detents,
 - a piston slidably received within said cylinder and having a piston rod formed thereon extending partially into said base for alignment with the detents and the ball-receiving apertures,
 - a pair of balls received within said apertures and extending into said detents and being normally held in this position by the end portion of the piston rod, said piston rod having a reduced diameter section thereon to enable the balls to move radially inwardly and out of contact with the detents when said reduced diameter portion is moved into alignment with the ball-receiving apertures,
 - piston retaining means rigidly secured within said cylinder to hold the piston within the cylinder for limited movement therein,
 - means received within said base and contacting said piston rod for resiliently biasing the piston outwardly into contact with the piston retaining means, and means mounted upon said cylinder for connection to the shroud lines of a parachute,
 - whereby the parachute is rigidly coupled to the bomb until the bomb reaches a predetermined depth below the surface of the water at which the hydrostatic pressure is sufficient to overcome the force of the biasing means to move the piston a distance sufficient to bring the reduced diameter portion of the piston rod into alignment with the ball-receiving apertures to permit the balls to move out of contact with the detents to uncouple the cylinder from the base and thereby release the parachute from the bomb.
2. The release mechanism of claim 1 wherein the piston retaining means comprises a perforated plate.
 3. The release mechanism of claim 2 further comprising a helical compression spring received within said base and contacting said cylinder to resiliently bias the cylinder outwardly of the base and eject the cylinder from the base when the balls move radially inwardly out of contact with the detents.
 4. The release mechanism of claim 3 wherein said means for biasing the piston outwardly of the cylinder comprises a second helical compression spring.
 5. The release mechanism of claim 4 wherein the means mounted on the cylinder for attachment of the parachute shroud lines comprises an annular collar slidably mounted on the cylinder for longitudinal sliding movement thereon between first and second spaced apart positions,
 - whereby a bomb arming mechanism may be connected to the collar for actuation when the collar moves from the first position to the second position in response to the opening of the parachute.
 6. An underwater explosive charge adapted to be dropped by an aircraft, retarded by a parachute, and separated from the parachute at a predetermined depth below the surface of the water prior to detonation of the charge comprising,
 - an elongated cylindrical charge casing having a nose portion and the tail portion, said casing containing a body of explosive material,
 - a hydrostatic detonator mounted within the casing and connected to the explosive material for detonation of said material upon reaching a predetermined depth.
 - a base member fixedly secured to the tail section of the charge casing,

- a hydrostatic piston and cylinder assembly releasably coupled to the base by means of a ball-lock connector,
 - said piston having a piston rod forming a part of the ball-lock connector for uncoupling the ball-lock connector when a predetermined hydrostatic pressure is exerted upon the piston to displace the piston from its normal position,
 - a parachute attachment collar mounted upon said cylinder for limited sliding movement thereon between first and second positions,
 - a parachute having its shroud lines attached to said collar,
 - said parachute being packed within an annular tail fin assembly mounted upon the tail portion of the charge casing, and
 - an arming wire having one end connected to said attachment collar and its other end attached to said detonator,
 - whereby the parachute is deployed when the charge is dropped by an aircraft and the opening of the parachute moves the said collar from its first position to its second position to operate the arming wire and actuate the charge detonator, and the piston releases the ball-lock connector at a predetermined depth below the surface of the water before the detonator ignites the explosive charge.
7. The explosive charge of claim 6 further comprising an annular perforated dish-shaped plate connected to the tail section of said casing and extending radially outwardly to contact the inner peripheral wall of the annular tail-fin assembly and thereby form a base for the packed parachute.
 8. A signal generating explosive charge adapted to be dropped from an aircraft and armed upon the opening of the parachute and separated from the parachute at a predetermined depth below the surface of the water prior to detonation of the charge comprising,
 - an elongated charge casing having a nose portion and a tail portion and being filled with a body of explosive material,
 - a hydrostatic detonator mounted in a hole formed in the wall of the casing for detonating the explosive at a predetermined depth,
 - an annular tail fin assembly connected to the tail portion of the charge casing,
 - a cup-shaped base fixedly secured to said tail portion, said cup-shaped base having a pair of oppositely disposed detents formed in the inner peripheral wall thereof,
 - a hydraulic cylinder having a reduced diameter tubular section extending partially into the cup-shaped base, said tubular portion having a pair of oppositely disposed through apertures formed therein,
 - a hydraulic piston disposed within said cylinder and having a piston rod formed thereon extending partially into said tubular extension,
 - a pair of balls positioned within said through apertures and extending into said detents and being held in these positions by the piston rod,
 - said piston rod having a reduced diameter formed thereon,
 - a perforated plate fixedly mounted in an open end of the cylinder to retain the piston within the cylinder,
 - a first helical compression spring seated upon the base of the cup-shaped member and abutting the end of the piston rod to resiliently bias the piston outwardly against said perforated plate,
 - a second helical compression spring seated upon the bottom of the cup-shaped base and abutting said tubular extension to resiliently bias the tubular extension outwardly of said cup-shaped base, said tubular extension being releasably locked within the base by means of the balls contacting the surfaces of

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the detents and the through apertures in the tubular extension,
 a parachute packed within the annular tail fin assembly and being connected to the cylinder, and
 means connected to said parachute and to said detonator for arming the detonator in response to the opening of the parachute,
 whereby the parachute opens when the charge is dropped by the aircraft to arm the detonator and remains attached to the charge until the charge and parachute have descended to a predetermined depth below the surface of the water at which depth the hydrostatic pressure is sufficient to move the piston against the bias of said first spring to move the balls out of the detents and thereby separate the parachute from the charge.

9. The device of claim 8 further comprising an annular dish-shaped perforated plate mounted upon the tail portion of the charge casing and extending radially outwardly to contact the inner peripheral wall of the annular tail fin assembly to form a base upon which the parachute may be packed within said tail fin assembly.

10. The device of claim 8 further comprising an annular collar mounted upon the outer peripheral surface of cylinder for limited longitudinal sliding movement

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thereon between said dish-shaped plate and a stop means mounted upon said outer peripheral surface of said cylinder,

said annular collar having anchor pins mounted thereon for attachment to the shroud lines of the parachute,

said arming wire being connected at one end to the detonator and at its other end to the annular collar,

whereby when the parachute opens the annular collar is moved from its position in contact with the perforated plate to a position in contact with said stop means to thereby pull the arming wire and arm the detonator.

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