June 27, 1967 G. A. GIMBER ETAL 3,328,750

ENTRAPPED AIR FLOTATION DEVICE

Filed Aug. 31 1965

Fig. 2

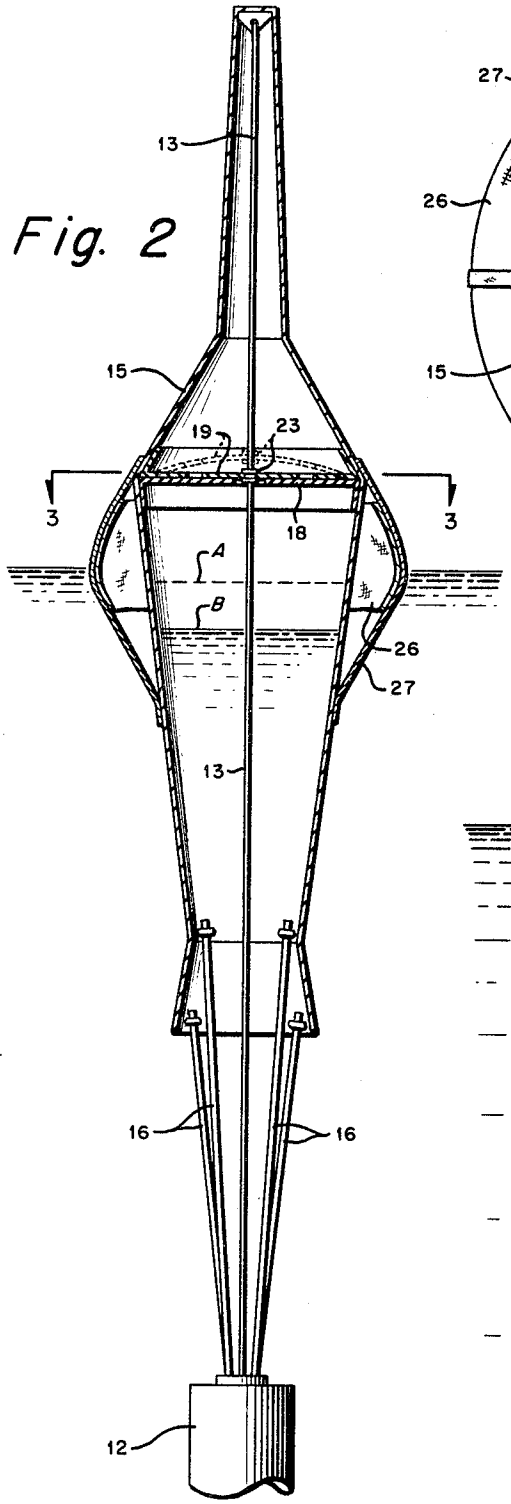


Fig. 3

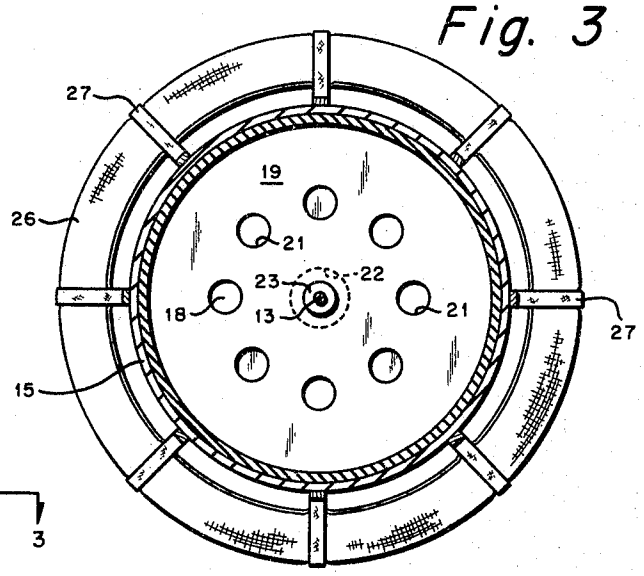
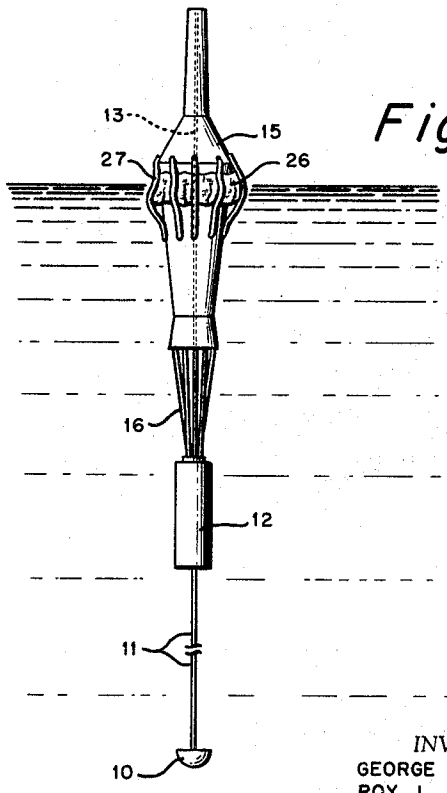


Fig. 1



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ENTRAPPED AIR FLOTATION DEVICE

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4 Claims. (Cl. 340—2)

ABSTRACT OF THE DISCLOSURE

An entrapped air inflated antenna erection and flotation device for a sonobuoy deployed in the sea. A pair of contiguous diaphragms are positioned intermediate the ends of the inflated device to maintain the maximum entrapped air pressure reached during water entry in the antenna erecting portion.

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.

The present invention relates to flotation devices and more particularly to an entrapped air flotation device for air-dropped stores.

In airborne ASW (antisubmarine warfare), stores of various kinds are dropped extensively from aircraft into the sea, and then floated for subsequent operation. Such a store could be a sonobuoy as disclosed in U.S. Patent 3,093,808, issued June 11, 1963 to Tatnall et al., for an "Air-dropped Miniature Sonobuoy." During its descent in the air, the store is usually retarded by a speed brake or parachute and is buoyed by a gas cartridge-inflated bag. For some applications where smooth deceleration and placement accuracy are not critical, a more simplified technique has been attempted wherein the retardation and inflation both utilize properties of the environment. That is, the flotation bag is modified to be inflated by ram air pressure during descent while concomitantly producing retardation. This technique is disclosed in U.S. Patent 3,161,896 to Holt et al., issued Dec. 22, 1964. However, where the bag is of an elongated configuration, as may be required for erecting an antenna therewithin, insufficient entrapped air pressure is maintained after the store and flotation bag reach their normal floating positions in the water. Incomplete antenna erection occurs resulting in poor radio reception and transmission. Complete antenna erection is essential especially in high sea-state conditions.

Accordingly, it is an object of the present invention to provide an entrapped air flotation device from air-to-sea launched stores in which retardation is provided during air descent, and in which a relatively high inflation pressure is maintained after reaching its normal floating position.

Another object of the invention is to provide an entrapped air flotation device which is capable of positively erecting an antenna therewithin for operation of radio apparatus associated therewith under various sea-state conditions.

Still another object of the invention is to provide an entrapped air flotation device which is relatively simple in construction and inexpensive to manufacture, which is compact and easy to package, and which is rugged and reliable in the most severe of operating environments.

Various other objects and advantages will appear from the following description of one embodiment of the invention, and the most novel features will be particularly pointed out hereinafter in connection with the appended claims.

Briefly, the invention to be described hereinbelow contemplates an inflatable bag connected by shroud lines at its open end to an air-to-sea launchable store such as a transducer and radio combination. After being launched from an aircraft, the bag pays out and scoops in air causing it to inflate and retard the store. An auxiliary parachute about the periphery of the bag assists in these functions, but may be omitted as conditions dictate. The bag is internally divided along its length into an upper compartment and lower compartment which communicate through a one-way valve that permits air to flow in one direction only from lower to the upper compartment. During water entry, where maximum entrapped air pressure occurs, the upper compartment becomes fully inflated and retains this pressure level irrespective of any subsequent reduction of pressure in the lower compartment as the store and bag assume their normal floating positions relative to each other in the water. The amount of entrapped air in the upper compartment is sufficient to maintain full inflation of the upper portion of the bag, and complete erection of any antenna supported therewithin.

In the drawings:

FIG. 1 is a pictorial representation in elevation of one embodiment of the invention as applied to an air-to-sea launched sonobuoy resting in water at its normal floating position;

FIG. 2 represents a longitudinal cross section of the upper portion of the inventive embodiment shown in FIG. 1; and

FIG. 3 represents a transverse cross section of the inventive embodiment taken along the line 3—3 of FIG. 2.

In the illustrated embodiment of the invention, FIG. 1 shows a sonobuoy floating in water in its normal operating position wherein a transducer or hydrophone **10** depends by a cable **11** from a housing **12**. The housing **12** contains radio equipment for electronically coupling the hydrophone **10** to an antenna **13**. As is explained hereinbelow, the antenna **13** is erected by means of an entrapped air flotation bag **15** which is attached to the housing **12** by a plurality of shroud lines **6**.

Referring now to FIGS. 2 and 3 the inflation bag **15** comprises a generally elongated cylindrical configuration of air-impermeable, flexible material closed at the so-called upper or free end and open at the so-called lower or shroud-connected end. The diameter of the bag **15** varies along its length: beginning at its open end, the bag tapers inward slightly, then tapers outward to a diameter greater than at the open end, and finally tapers inward again at any convenient angle or angles until it reaches the closed end. The precise taper profile of the bag for achieving optimum retardation and air entrapment is a matter of design and is not critical except to the extent that the bag functions in the manner contemplated by the invention as described and claimed herein.

At the point of maximum diameter along the length of the bag **15**, there is a check valve comprised of two adjacent circular diaphragms **18** and **19** each sealingly secured at their circumference to the inner surface of the bag **15** forming thereby two compartments: a lower compartment between the bag opening and the diaphragm **18**, and an upper compartment between the closed end of the bag and the diaphragm **19**. The diaphragm **19** includes a plurality of through holes **21** arranged in a circular array about its center, and the diaphragm **18** includes a single through hole **22** at its center. Thus, when the two diaphragms are contiguous to each other, there is no communication between the upper and lower compartments of the bag due to the offset between holes **21** and **22**. However, when the diaphragms are non-contiguous, such as shown by the dotted outline of diaphragm **19** in FIG.

2, communication is established. The diaphragm **19** is constructed in a manner and material so that it can deflect away from the diaphragm **18** into the dotted outline position whenever the pressure in the lower compartment is greater than in the upper compartment. Under this pressure differential condition, communication is established to permit air to flow upward through the openings **22** and **21**, respectively. No air is permitted to flow from the upper compartment to the lower compartment whenever the pressure in the upper compartment exceeds the pressure in the lower compartment by virtue of the contiguous relationship established by the diaphragms **18** and **19**. The antenna **13** is also flexible and passes from the lower to the upper compartment through a seal **23**. It is secured by any convenient means to the closed end of the bag **15**. Of course, the antenna length in the upper compartment must be sufficient to permit the diaphragm **19** to move to its contiguous position while the upper compartment remains fully inflated.

Depending upon conditions, it may be necessary to provide auxiliary retardation and inflation augmentation of the bag. It is, therefore, contemplated that an annular parachute **26** be placed about the bag **15** near the point of maximum diameter, such as by a plurality of straps **27** each secured at its ends to the bag in any convenient manner. When the bag **15** is initially deployed during descent, the parachute **26** will assist inflation by tending to pull the bag **15** radially outward near the point of maximum diameter. Concomitantly, the parachute **26** will augment the retardation produced by the open end of the bag in the same way as an ordinary parachute.

To appreciate the invention's operation it should be understood that the time of maximum entrapped air pressure in the bag **15** occurs during entry into the water. The level of the water within the bag is, at this instant, illustrated by the dotted line A in FIG. 2. As the bag comes to rest in its normal floating position, the water level within the bag "drops" to the level shown at line B. Since there is an increase in volume in the lower compartment, the pressure drops but the diaphragms **18** and **19** prevent the high pressure entrapped air in the upper compartment from escaping, thereby sustaining complete inflation of the upper portion of the bag **15** and full erection of the antenna **13**.

It will be understood that various changes in the details, materials, steps and arrangement of parts, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.

What is claimed is:

1. An entrapped air flotation device for air-to-sea launched stores, comprising:

an elongated inflatable bag open at one end for admitting air therein, said bag generally tapering toward the ends from an annular surface of the bag lying in the plane normal to and intermediate of the ends;

a pair of normally contiguous circular diaphragms sealingly secured at their circumferences to said bag in said plane forming thereby an open end compartment and a closed end compartment for permitting air flow only from said open end compartment to said closed end compartment, each diaphragm having a hole offset from the other for establishing communication between the compartments when said diaphragms are noncontiguous, and the diaphragm nearest said closed compartment being constructed to deflect away from the other diaphragm whenever the pressure in the open end compartment is greater than in the closed end compartment;

whereby the maximum air pressure attained in said closed end compartment is maintained irrespective of any reduction in the maximum pressure in the open end compartment.

2. An entrapped air flotation device as set forth in claim 1 further comprising shroud lines secured at the open end of said bag and adapted to be connected to the store.

3. An entrapped air flotation device as set forth in claim 2 further comprising:

a flexible antenna secured at one end to the closed end of said bag and adapted to be connected at the other end to the store.

4. An entrapped air flotation device as set forth in claim 3 further comprising:

an annular parachute secured about the periphery of said bag at said plane.

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