Oct. 25, 1966 R. H. TAPLIN 3,281,765

MINIATURE SONOBUOY AND CABLE

Filed Jan. 25, 1965

Fig. 3

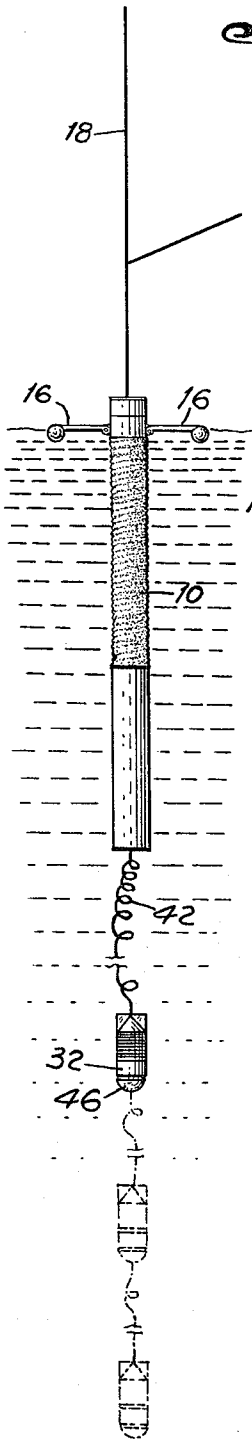


Fig. 1

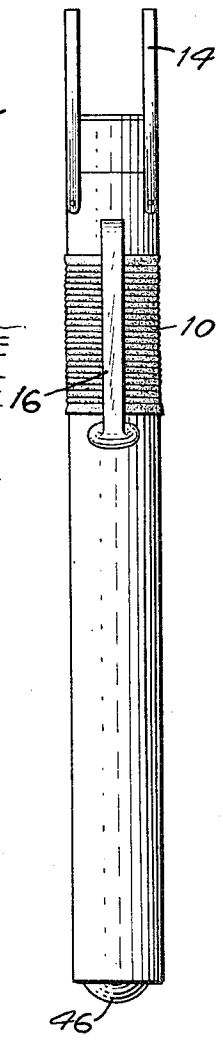


Fig. 2

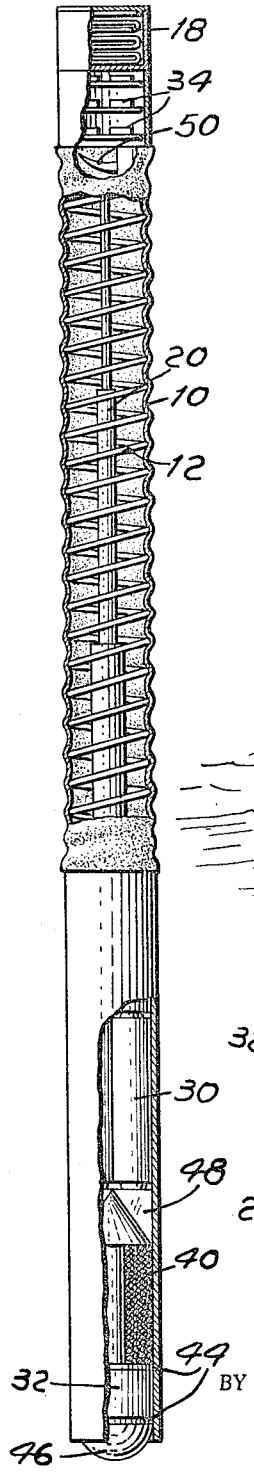


Fig. 4a

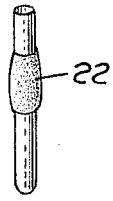


Fig. 4b

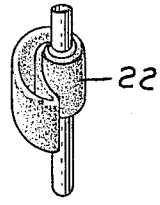


Fig. 4c

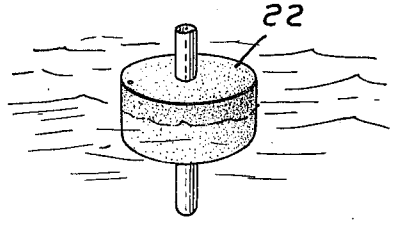
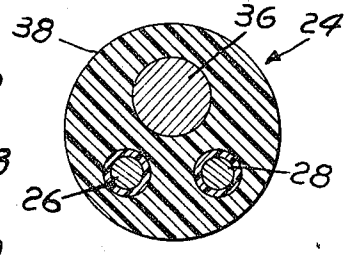


Fig. 5



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MINIATURE SONOBUOY AND CABLE

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12 Claims. (Cl. 340—2)

This invention relates to radio sonobuoys and particularly to a novel miniaturized expendable sonobuoy which has improved reliability, greater stability in water and rapidly attains extended operating depths.

Previous radio sonobuoys have generally been bulky due to the use of large air space enclosures and large electronic components, and had difficulty in maintaining a relatively stable position in a body of water. In addition, the hydrophone cable package was unwieldy and the cables attained only limited depths at low rates of speed and often acquired a set during storage which caused a hang-up and unreliable payout. Some examples of known forms of sonobuoys may be found in U.S. Patent Nos. 2,422,337, issued June 17, 1947; 2,641,751, issued June 9, 1953; and 3,093,808, issued June 11, 1963.

It is therefore the primary object of the present invention to provide an improved, compact, reliable sonobuoy and sensing device which rapidly sinks into position and operates at relatively greater depths.

It is another object to provide a collapsible antenna and buoyancy chamber which forms an integral part of the sonobuoy and which expand to provide a stable floating radio transmitter platform.

A further object is to provide a novel cable of greatly reduced diameter which permits operation at greater depths and furnishes more rapid payout while also acting as a stabilizing mechanism for the sensing device.

These objects are achieved by use of a novel small diameter cable containing two conductive wires and a third high strength strain wire all molded integrally and enclosed within a plastic sheath. The entire cable is wound in a tubular form about a hollow cylindrical core at the lower end of the buoy and connects to the sensing device. The manner of winding provides a stored spring tension which upon release supplies a self-driven rapid reliable payout while retaining a partial twist in the fully extended position to form an expanded or stretched coil having a compliance action which maintains the attached sensing device at a relatively stable depth position despite vertical motion of the buoy caused by surface waves. This limitation of mechanical movement minimizes water noise and improves signal detection. In addition, a collapsible buoyancy chamber, folded antenna at the upper end and an inner telescoping tubular mechanical support provide a small package which expands upon impact with and submergence in the water. Use of integrated or monolithic low power microelectronic circuitry for the amplifier, oscillator and power output stages, with correspondingly smaller batteries, permits further miniaturization. The novel unit thus provides a lightweight, high strength device, which can withstand water impact when dropped from an aircraft. The details of the invention will be more fully understood and other objects and advantages will become apparent in the following description and accompanying drawings, wherein:

FIG. 1 shows the sonobuoy in a retracted position;

FIG. 2 shows a partial section of the device with the buoyancy chamber extended;

FIG. 3 shows the device floating in water with an extended antenna and hydrophone cable;

FIGS. 4*a*, *b*, and *c* show a variation of a collapsible float; and

FIG. 5 shows a cross section of the miniature cable.

As shown in FIGS. 1 and 2 the sonobuoy is formed of an integral tubular container, the upper portion of which includes a collapsible longitudinal buoyancy chamber **10** preferably formed of a flexible exterior skin of a suitable tough air-tight plastic material, such as a polyester film known as Mylar. The skin may be caused to unfold when the chamber is inflated with air or gas upon impact with the water and a compressed spring **12** or a plurality of spaced disks within the chamber are extended to maintain the wall in an elongated rigid position. A gas cartridge within the chamber may be broken by the impact or if so desired a barometric pressure actuator may puncture the cartridge and inflate the chamber during descent from an aircraft. Other variations include a catch to release the spring during ejection from the aircraft or upon impact with the water, or the use of the inertial force of the heavier lower portion of the buoy and the drag of the water on the upper container surface to expand the buoyancy chamber while drawing in air through a trailing tubulation. In a typical example, the outer diameter of the tubular container is in the order of one inch and the retracted length about 10 inches, increasing approximately to 17 inches when extended.

Vanes **14** are also caused to open to a predetermined angle during the fall through space to guide the buoy in a stable path and then bend back and drop off upon impact with the water. The same action may also be utilized to open horizontal buoyant flaps **16** which dampen vertical oscillations of the buoy and cable system with respect to the surface waves. These flaps along with the buoyant chamber and weight of the container, also maintain the device in a substantially vertical attitude in the water. In addition, the impact releases a cap over a folded antenna **18** enclosed in the upper end of the device. The antenna then springs out to a full vertical position as shown in FIG. 3 and a telescoping tubular support **20** expands to provide further rigidity to the collapsible buoyancy structure. The antenna may be a simple vertical conductor which folds into the container or a helical type with a collapsible ground plane at the lower end which opens to shield the antenna from washover from the surface of the water below. An alternative form may use polyurethane foam to expand and fill the chamber upon striking the water. In order to provide additional stability against horizontal movement, another buoyancy chamber in the form of a scroll, as shown in various stages of expansion in FIGS. 4*a*, *b*, and *c*, may be used. In this case, a larger float **22** is wrapped around the vertical container and unravels as it is filled with air or gas in a manner similar to that of chamber **10**. Flaps **16** would then be eliminated.

A very small diameter cable **24** which connects to the sensing device or hydrophone is shown in cross section in FIG. 5. This includes two conductive lines **26** and **28** for both the direct voltage connection from a battery power supply **30** and for signal transmission between the hydrophone **32**, which includes a solid state local preamplifier stage, the microelectronic transmitter circuitry **34** and the antenna **18**. Use of such minute circuit elements permits reduced power requirements and substantial economies in size and weight at the pressures involved in deep water. A third larger strain cable **36** of high tensile strength steel provides mechanical rigidity and a coating of a suitable resilient tough waterproof plastic material **38** such as polypropylene, encloses the wires to form a minute cable having an outer diameter of about 0.030 inch. The cable preferably extends to a depth of 1000 feet and is wound in the form of a hollow cylinder **40**. During winding, the cable is deliberately provided with a twist about the axis of the wire which when unwound exerts a positive driving force

to counteract any tendency of the cable to set during storage while producing a more rapid payout. In addition, as the hydrophone sinks, the cable is fed out from the top of the cylinder and the initial twist causes the retention of a coiled form 42 in the fully extended position as shown in FIG. 3, with the turns or loops being spaced more closely adjacent the body of the sonobuoy. The coil cable provides a spring action with a graded compliance which tends to counteract vertical wave motion at the buoy and maintain the hydrophone in a relatively constant position.

The relation of the diameter of the steel cable member and inner winding diameter of the cylindrical cable pack and the weight and drag of the hydrophone determine the spring compliance and cable length necessary to reduce vertical movement to a minimum. This aids in elimination of unwanted water noise caused by relative movement in the water, which may be amplified at the hydrophone to mask the required signals. In addition, if so desired, the thickness of the cable may be varied to provide particular compliances at different depths. A monolithic integrated preamplifier stage which is unaffected by water pressure is used directly at the hydrophone to compensate for cable losses and thus permits the employment of a miniature wire having high resistance. Hard plastic shock absorbing rings 44 on either side of the hydrophone provide additional protection upon impact with the water, while a lead ballast nose 46 supplies added weight to pull the instrument into position. The hydrophone, cable and ballast fall freely as a streamlined unit guided by fins 48 with the wire trailing from above to minimize drag and provide a rapid descent.

Further variations include the use of nickel cadmium batteries which may be charged quickly at a high rate immediately before deployment, in place of normally used larger salt water activating types, and the use of a plurality of hydrophones in series to detect sounds at varying depths. The units at each position may be multiplexed to provide a scanning action in conjunction with suitable signal processors on an aircraft. Transducers responsive to other physical conditions of the water may similarly be employed in place of the hydrophone. For example, sound velocity meters, salinometers or bathythermographs may be adapted to sense parameters during the descent into the water to a particular depth and thus provide information on the vertical profile of the water. It is also useful to include an improved self-destruction element in the sonobuoy. This is illustrated in FIG. 2 as a controlled knife edge 50 which punctures the plastic envelope upon command to cause the device to sink rapidly. A destruction signal may be actuated by a preset timing device, a remote signal received at the antenna, or by a predetermined high sound level picked up at the hydrophone. A remote signal may also be used to switch off the main power of the buoy to provide an inoperative period and conserve battery life.

It may thus be seen that the present invention represents a novel compact sonobuoy configuration which provides a rapid attainment of the operating depth, reliable payout and inherent stability. While only a single embodiment has been illustrated, it is apparent that the invention is not limited to the exact form or use shown and that many other variations may be made in the particular design and configuration without departing from the scope of the invention as set forth in the appended claims.

What is claimed is:

1. A miniature radio sonobuoy comprising:
a tubular container,

an inflatable buoyancy member enclosing an integral portion of said container between the ends thereof and adapted to inflate to support said container in a vertical position when immersed in a body of water,

expandable supporting means within said container to maintain said member in a rigid position after inflation,

an expandable antenna folded within the upper end of said container and adapted to extend in a vertical position upon the immersion of said container,

sensing means positioned at the lower end of said container and adapted to be released upon immersion to sink into said water and supply signals responsive to conditions therein,

means for amplifying and transmitting said signals, and

cable means for supporting said sensing means at a predetermined depth in said water and connecting said sensing means to said amplifying and transmitting means, said cable means being wound in a tubular form for storage within said lower end and having a predetermined initial twist, said cable being released to unwind with said sensing means and retaining a coiled form having a graded compliance when fully extended to minimize the vertical movement of said immersed sensing means.

2. The device of claim 1 wherein said amplifying and transmitting means comprise solid state monolithic microcircuits and power supply means.

3. The device of claim 1 wherein said cable means comprises two conductive wires and a high strength strain wire, said wires being enclosed in a plastic sheath having an outer diameter of less than 0.100 inch.

4. The device of claim 1 wherein said sensing means comprises a hydrophone responsive to underwater sounds.

5. The device of claim 4 wherein said hydrophone includes a solid state monolithic preamplifier stage therein.

6. The device of claim 5 wherein said inflatable member comprises a collapsible plastic skin forming an external longitudinal portion of said tubular container.

7. A device of claim 5 wherein said inflatable member comprises a collapsible plastic material in the form of a scroll wrapped around said tubular container.

8. The device of claim 5 including vanes attached to said upper end and adapted to open upon falling through space to guide said container in a stable path and drop off upon impact with said body of water.

9. The device of claim 5 including shock-absorbing means secured to said hydrophone.

10. The device of claim 6 wherein said expandable supporting means comprises a coiled spring and telescoping tubular member.

11. The device of claim 6 including buoyant flaps extending horizontally from the upper portion of said container and adapted to open upon impact with said water to maintain said container in a substantially vertical attitude and dampen vertical oscillations.

12. The device of claim 6 including automatic self-destruction means adapted to puncture said plastic skin to sink said container upon occurrence of a predetermined signal.

No references cited.

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