United States Patent

Axelson et al.

[15] **3,701,319**

[45] **Oct. 31, 1972**

[54] **UNDERWATER SOUND SIGNAL FOR EXPLOSIVE ECHO RANGING**

[72] Inventors: **Carl A. Axelson,** 190 McKay Street, Beverly, Mass. 01915; **John R. Hinves,** 249 Caroline Avenue, Somerset, Mass. 02725; **Elton Y. McGann,** 214 Kingswood Drive, Williamsburg, Va. 23185; **Robert M. Johnson,** 110 Green Briar Drive, Clarks Green, Pa. 18411

[22] Filed: **Dec. 1, 1970**

[21] Appl. No.: **93,977**

[52] **U.S. Cl.**............................**102/7,** 102/10, 102/22

[51] **Int. Cl.**..**F42b 21/00**

[58] **Field of Search**.................102/2, 4, 7, 10, 13, 22

[56] **References Cited**

UNITED STATES PATENTS

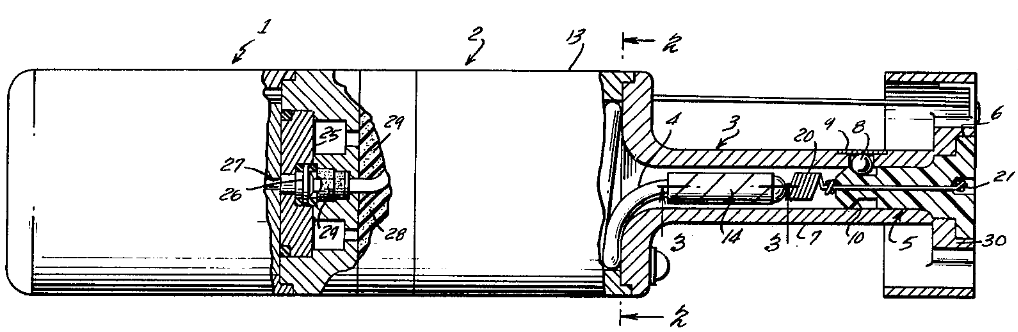
3,276,366	10/1966	Johnson et al.	102/7
2,820,971	1/1958	Welsh et al.	102/13 X
3,351,010	11/1967	Ainslie et al.	102/4
3,354,826	11/1967	Axelson et al.	102/10
3,408,935	11/1968	Biggs, Jr.	102/4

Primary Examiner—Samuel W. Engle
Attorney—R. S. Sciacia and L. I. Shrago

[57] **ABSTRACT**

A bomb-type underwater sound signal source is disclosed wherein the explosive charge is in the form of an explosive cord which is normally coiled within the bomb casing and automatically deployed upon impact with the sea surface. The extended cord trails behind the bomb until it is detonated at a preset depth to produce an acoustic signal substantially confined to a horizontal plane.

2 Claims, 3 Drawing Figures



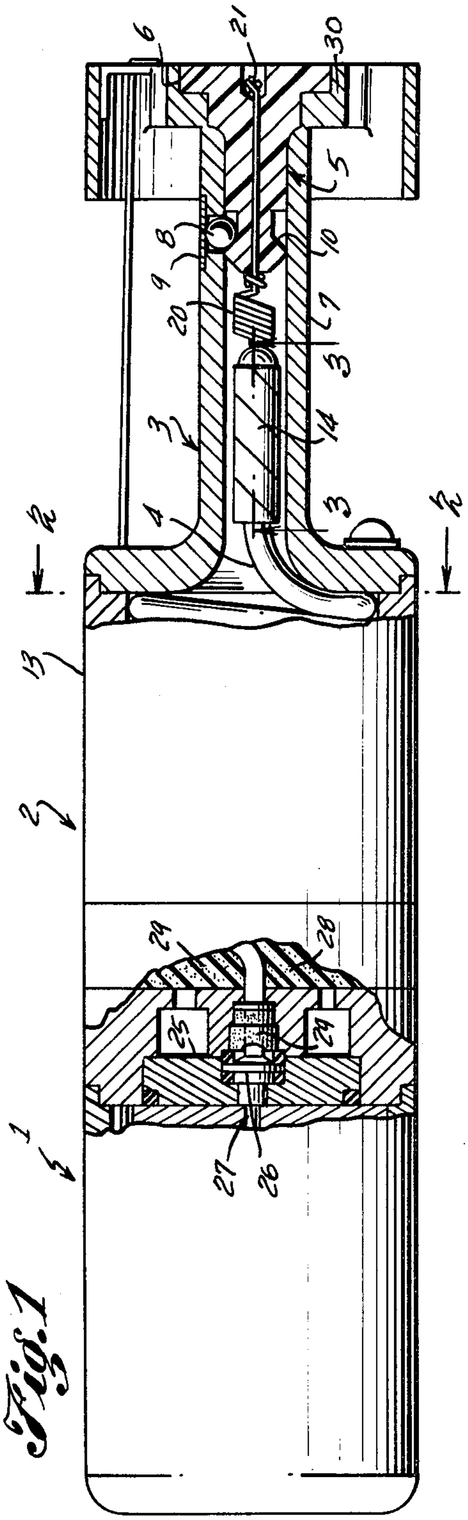


Fig. 1

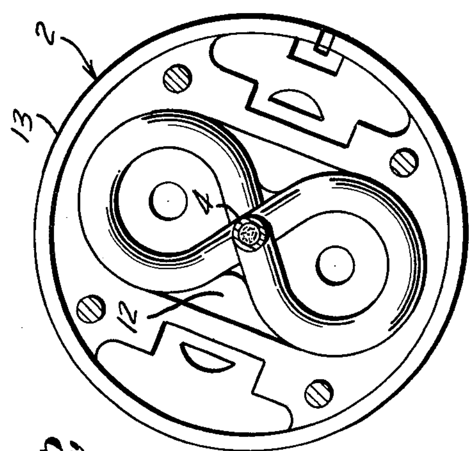


Fig. 2

Carl A. Axelson
John R. Hinves
Elton Y. McGann
Robert M. Johnson
INVENTORS

By [signature]
Attorney

Fig. 4

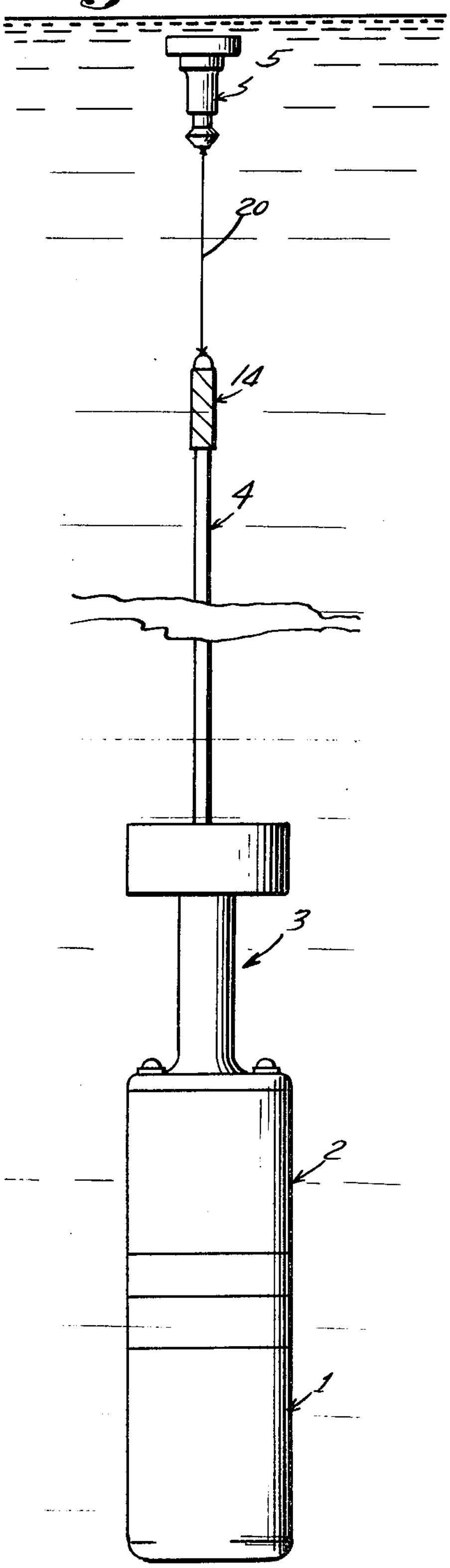
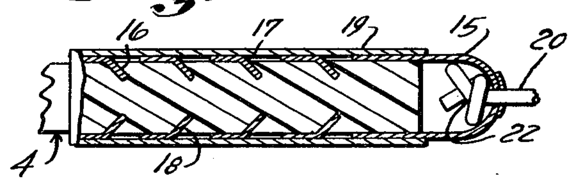


Fig. 3



Carl A. Axelson
John R. Hinves
Elton Y. McGann
Robert M. Johnson
INVENTORS

By

Attorney

UNDERWATER SOUND SIGNAL FOR EXPLOSIVE ECHO RANGING

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 a line charge bomb which may be detonated at various depths to generate an acoustic signal which is concentrated in a horizontal plane.

In U.S. Pat. No. 3,276,366, which has as inventors, coinventors of the present application, there is disclosed a line charge bomb which is detonated when a pressure disk included in the firing mechanism is ruptured at a predetermined hydrostatic pressure. When this rupture occurs, a tail portion of the bomb assembly is disconnected and ejected vertically by a coiled spring. Stored in the casing is a roll of sheet explosive and, as the tail portion travels upwardly, this sheet is unrolled and assumes a vertical position so that when it is subsequently fired it acts as a line charge. The radiated acoustic energy is consequently substantially confined to a horizontal plane. This type of radiation pattern is desirable since, for example, it minimizes surface and bottom reverberations which might otherwise obscure target echo signals.

One of the critical features of the above bomb is that deployment of the line charge must take place within a short time after the pressure disk assembly ruptures. Although a connector link of an ignition substance is included to provide a time delay, there is the possibility of premature ignition of the sheet explosive when it is only partially uncoiled. If this happens, the acoustic energy will be radiated omnidirectionally instead of in the preferred horizontal plane. It has also been determined that there is some tendency for the rolled sheet explosive to become jammed within the casing and not uncoil when a tension is applied thereto by the upward movement of the tail assembly.

It is accordingly a primary object of the present invention to provide a line charge bomb wherein the line charge is deployed in a vertical position shortly after the bomb impacts the sea surface.

Another object of the present invention is to provide a line charge bomb which utilizes a rolled explosive cord which is automatically deployed in response to the water splash and thereafter trails behind the bomb as it falls within the fluid medium to the preselected depth at which detonation occurs.

A still further object of the present invention is to provide a bomb for aircraft launch wherein a length of explosive cord stored within the tail assembly is streamed by the water splash and thereafter exploded from the bottom upwardly to produce a sound pattern wherein most of the acoustic energy is radiated in a horizontal plane.

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 partial section through the assembled line charge bomb showing the apparatus in its standby condition;

FIG. 2 is a sectional view taken along line A—A showing how the explosive cord is stored in the bomb casing;

FIG. 3 shows the details of a gripping device which is connected to the free end of the explosive cord and the strain cord; and

FIG. 4 shows the line charge bomb after the explosive cord has been deployed.

Referring now to FIG. 1 of the drawings, it will be seen that the bomb assembly consists of a nose section **1** containing the firing mechanism, a midsection **2** containing the main explosive charge, and a tail section **3**.

Nose section **1** is similar in all important aspects to the same section in the above-identified patent and, as described therein, includes an arming piston that is initially locked in place by a safety rod which is secured to a drag plate that fits into the tail fins **30**. As is well known, when the bomb assembly is dropped from an aircraft, the aerodynamic drag forces acting on the drag plate withdraw the safety rod from the piston so that after the bomb enters the ocean the hydrostatic pressures may act on the arming piston and move a spring-biased delay charge into alignment with a firing pin and an aperture which communicates with the midsection **2**. The precise manner in which the delay detonator is triggered is fully disclosed in the above patent and, consequently, no further description of this aspect of the present invention is deemed necessary. However, it would be pointed out that when the present bomb finally reaches a predetermined depth, the delay detonator is exploded and the explosive force is directed through the communicating aperture against one exposed end of an explosive cord **4** which, as will be seen hereinafter, has previously been deployed from the tail section **3** of the bomb and is fully extended in a substantially vertical direction.

Tail section **3** accommodates in a rear portion thereof a deployment member **5** which has a cylindrical body portion that effectively closes this end of the tail. This deployment member, which may be made of plastic, has a rear flared skirt portion **6** which extends outwardly beyond the narrow neck portion **7** of the tail section. This member is locked in place by an arcuated spring **9** that clips around a circumferential portion of the narrow neck section **7** and maintains a detent ball partially within an aperture cut through the wall portion of the tail section and a circular groove **10** formed in the body portion of the deployment member adjacent one end thereof. When clip spring **9** is in place, it will be appreciated, detent ball **8** latches deployment member **5** in the position shown and prevents its longitudinal movement out the open end of the tail section **3**.

Stored within the midsection **2** of the bomb assembly is the line charge explosive which consists of a suitable length of explosive cord **4**. This cord is in fact a plastic explosive covered by a nylon jacket. As best shown in FIG. 2, the cord is stored in a "figure eight" within an oval-shaped cavity **12** formed in the casing **13** of this section. By wrapping the explosive cord in this configuration, any possible kinks are eliminated and the subsequent payout of the cord is accomplished with little likelihood of entanglement.

One end of cord **4**, which extends into the tail section **3**, has a cable gripping means **14** affixed thereto. This gripping means, as best shown in FIG. 3, comprises an arcuated metallic strap **15** that is formed with a plurality of depending projections, such as **16**, **17**, and **18**, that are pressed through the nylon jacket and into the plastic explosive. A suitable pressure-sensitive tape **19** is wrapped about this strap so as to keep it from spreading apart after it has once been bent in place. A length of nylon line **20** connects strap **15** to the deployment member **5**. More particularly, a central passageway is cut throughout the length of member **5**, and one end of the nylon **20** is led therethrough and knotted at **21**. The other end of the nylon line passes through a suitable aperture cut in the nose portion of strap **15** and is also knotted at **22**.

The other end of explosive cord **4** fits within an aperture formed in a central hub portion **23** of the midsection casing **2**. This aperture is enlarged with respect to the thickness of the explosive cord so that this end of the cord may be securely fastened to the midsection **2** by a potting compound **24** in a manner which leaves its end face exposed. Closing this end of the midsection **2** is a circular plate **25** which supports a pickup cup **26** containing an explosive charge, maintaining it in intimate contact with this exposed face of the explosive cord and in alignment with the communicating aperture **27** in the nose section **1** through which the explosive force of the delay detonator acts.

Midsection **2** also contains two pieces of sponge rubber **28** and **29** which rest against the inner face of the central hub **23** and an inner rim portion of casing **13**. These rubber pieces provide a spring force to keep the explosive cord **4** in its assembled condition and, additionally, they position the cable gripping means **14** in the front portion of the tail section so that the cord may be freely pulled out through this section at the appropriate time.

The operation of the line charge bomb is as follows: When the assembled apparatus, as shown in FIG. **1**, is launched from an aircraft, the air flow removes the drag plate from the tail fins and the safety wire is removed from the arming piston. The bomb is now armed and firing of the main explosive can occur when the proper water depth is reached. As the bomb continues its air flight, deployment member **5** remains held in place within the tail section **3** by the detent ball **8** and the cooperating, arcuated spring clip **9**. However, when it enters the water, the force of the water splash, because of the narrow neck design of the tail section, is directed against the flared skirt **6** of the deployment member and urges this member out the tail section. The sloping surface of groove **10** cams detent ball outwardly and forces spring clip **9** free. Deployment member **6** consequently is now unrestrained and the continuing forces acting on it pushes it completely out of the tail section **3**. As the bomb assembly continues to fall within the ocean, the drag experienced by member **5** gradually increases the separation between it and the bomb assembly, resulting in a tension stress being applied to nylon line **20** and a tightening of this line. Thereafter, continued descent of the bomb causes the explosive cord **4** to be gradually pulled through the tail section until all of it has been uncoiled. Finally, the cord is fully deployed and it continues, as shown in FIG. **4**, to trail behind the bomb until it reaches a depth where the firing mechanism actuates the delay detonator and the resultant explosion triggers the pickup cup and then the inboard end of the explosive cord.

It will be appreciated that while the apparatus of FIG. **1** is shown with a detonating assembly of the type utilizing an arming piston, other types of detonators may be used to detonate the explosive cup or the explosive cord at the preset depth. Likewise, different types of explosive trains may be used to detonate the explosive cord and, thus, the pickup cup may not be needed in the overall apparatus.

What is claimed is:

1. In a bomb-type underwater acoustic signal source having a casing that contains in its nose section a detonating mechanism that detonates a secondary explosive charge also accommodated therein at a preselected depth and having a hollow, narrow neck, open-ended tail section which communicates with the interior of said casing, the combination of

- a length of explosive cord coiled within the interior of said casing with one end thereof maintained in contact with said secondary explosive charge;
- a deployment member tied to the other end of said explosive cord,
  - said deployment member having a cylindrical body portion which slidably fits within said open-ended tail section and closes off this section when in place;
- means for latching said deployment member in place; said deployment member also having a rear skirt which extends radially outward beyond said narrow neck such that when said deployment member is in place and said signal source enters the ocean nose first, hydrodynamic forces act upwardly on said skirt,
  - said hydrodynamic forces, when sufficient, releasing said latching means and moving said deployment member out from said tail section, the drag forces subsequently acting on said deployment member uncoiling and extracting said length of explosive cord out from said hollow tail section and causing said explosive cord to be maintained in a vertical attitude as said casing falls to said preselected depth at which said explosive cord is exploded.

2. In an arrangement as defined in claim **1** wherein said deployment member has a circumferential groove formed in the cylindrical body portion thereof and said latching means includes

- an aperture formed through the wall of said tail section at a location adjacent that of said circumferential groove when said deployment member is in place;
- a detent ball; and
- an arcuate spring clip positioned on said tail section over said aperture and locking said detent ball partially within said aperture and said circumferential groove,
  - the hydrodynamic forces acting on the skirt of said deployment member, when sufficient, camming said detent ball outwardly and removing said spring clip.

* * * * *