Oct. 4, 1966 R. M. JOHNSON ETAL 3,276,366

DEEP DEPTH LINE CHARGE

Filed Dec. 29, 1964 2 Sheets-Sheet 1

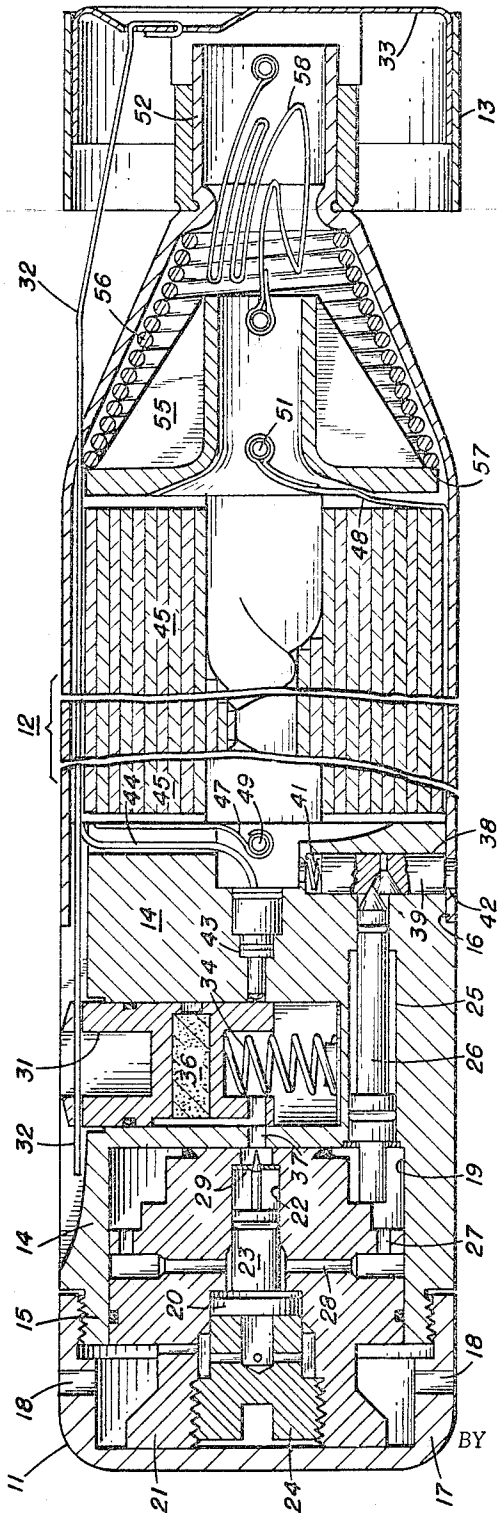

FIG. 1

INVENTORS
ROBERT M. JOHNSON
CARL A. AXELSON

BY Claude Funkhouser
ATTORNEY

Marshall Gould
AGENT

Oct. 4, 1966 R. M. JOHNSON ETAL 3,276,366

DEEP DEPTH LINE CHARGE

Filed Dec. 29, 1964 2 Sheets-Sheet 2

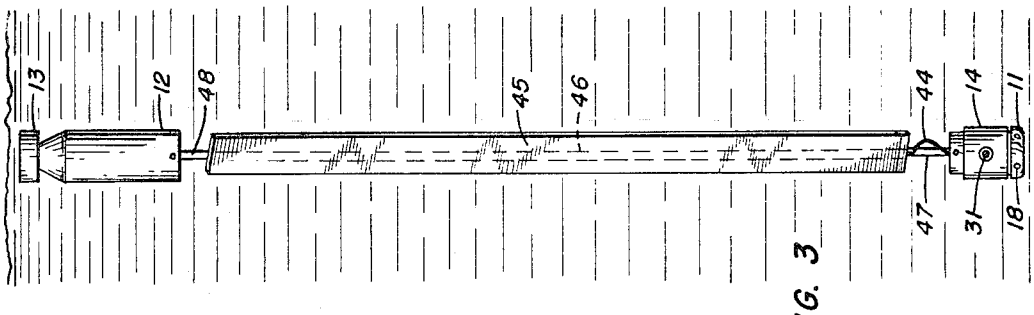

FIG. 3

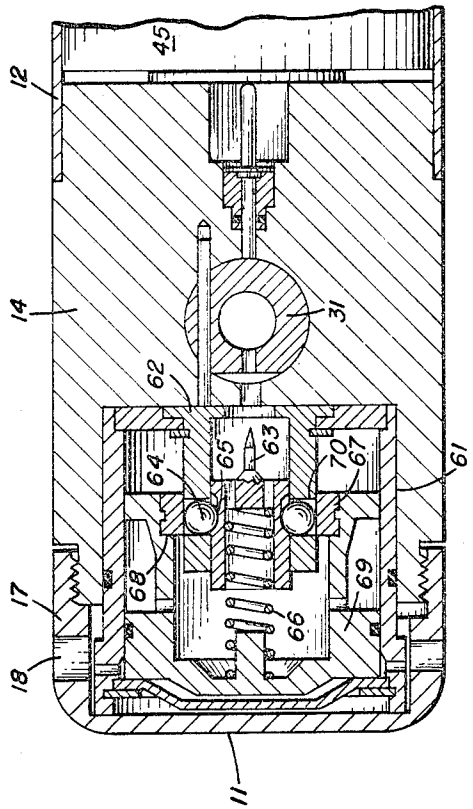

FIG. 2

United States Patent Office

3,276,366
Patented Oct. 4, 1966

3,276,366

DEEP DEPTH LINE CHARGE

Robert M. Johnson, Poughkeepsie, N.Y., and Carl A. Axelson, Middletown, R.I., assignors, by direct and mesne assignments, to the United States of America as represented by the Secretary of the Navy

Filed Dec. 29, 1964, Ser. No. 422,104
3 Claims. (Cl. 102—7)

This invention relates to a line charge bomb adapted to be exploded in the water at various depths to provide a source of underwater energy concentrated on a horizontal plane to detect submarines or to determine from sonar detection apparatus the contour of the ocean bottom.

The ignition of an explosive underwater at any one particular spot will send waves in all directions and result in a repetition of echoes from objects in the path of these waves. By controlling the explosion and concentrating the energy in the horizontal plane, the number of echoes is reduced and the results picked up by sonar equipment are much clearer. When the source of underwater energy is released in one spot, the waves radiate from that spot and are reflected by contact with the bottom and the surface to produce echoes which interfere with the obtaining of a clear picture of any underwater obstructions which would be in the path of a wave which was concentrated in a horizontal plane.

It is the object of the present invention to provide a bomb which will carry, in addition to an arming mechanism and a pressure actuated mechanism for initiating the firing mechanism and ignition of a detonator, a sheet of explosive approximately thirty to forty times as long as it is wide and to so suspend this explosive at a predetermined depth in an approximate vertical position that the resultant explosion will provide a source of underwater energy which will be concentrated in the horizontal plane.

It is a further object of the present invention to provide a bomb which may be assembled to be initiated by water pressure at varying depths, as a shallow depth bomb, at intervals of approximately 80 feet, and as a deep depth bomb, at intervals of 1000 feet from 1000 feet to 18,000 feet.

It is a still further object of the present invention to provide a sheet explosive which may be rolled into a compact package and with the actuation of the firing mechanism can be unrolled and projected from the bomb to an approximate vertical position where ignition of the bomb will result in a source of underwater energy which will be concentrated 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 front elevation of the bomb with a part of the bomb in section;

FIG. 2 is a sectional view of the nose section of the bomb showing a modified form to be used at shallow depths; and

FIG. 3 is a detailed view of the explosive sheet.

Referring to the drawings in which like parts are referred to by like numbers, the bomb is formed of a nose section **11**, a casing **12** and a tail section **13**.

The nose section **11** is made up of a body portion **14** formed at one end with a reduced threaded rim **15** and at the other end with a reduced annular portion **16** to receive the casing **12**. The body portion at the forward or threaded end receives a nose cap **17** threaded thereon and formed with holes **18** in the side wall to admit sea water. The threaded end of the body portion **14** is further formed with an annular recess **19** which houses an odd-shaped body portion **21**. This odd-shaped body portion is centrally bored with different diameters, the smaller bore **22** being toward the inner portion of the bomb and housing a

firing pin **23**. Outward of the firing pin the bore is slightly larger and carries a pressure disc assembly **20** which is selectively placed in position during assembly according to the depth at which it is desired to actuate the bomb.

The disc is adapted to rupture at a predetermined hydrostatic pressure and is selected to be ruptured at the depth desired. The rupture of the disc admits sea water to the outer end of the firing pin. Outward of the disc the bore is still further enlarged for the reception of a retaining plug **24**. This plug is formed with bore passages to admit sea water to one side of the disc, while retaining the disc tight against the shoulder of the bore to prevent leakage of the sea water past the disc and into contact with the firing pin previously to the rupturing of the disc.

The annular recess **19** is further formed with three comparatively deep recesses **25** extending inward of the body portion **14**, each of these recesses **25** housing a plunger **26**. Upon the rupturing of the disc **20**, sea water is admitted to the outer end of the plungers **26** through ports **27** formed in the odd-shaped body portion and passages **28** connecting these ports with the central bore adjacent to the firing pin. The firing pin has a cylindrical portion fitting the smaller section of the central bore and is provided with a sealing O-ring. Attached to the cylindrical portion a sharply pointed pin extends partially through a hole in a washer **29**. The washer **29** serves to hold the firing pin in position during shipment and storage and assures the initiation of the detonator upon movement of the firing pin.

Inwardly of the odd-shaped body portion and annular recess **19**, the body portion **14** is bored normally to its longitudinal axis and fitted with a piston **31**. The piston is sealed with an O-ring to prevent the entrance of sea water and at its outer edge is bored to receive a safety rod **32**. The safety rod extends the full length of the casing and terminates in a plate **33** which covers the tail section loosely. When the bomb is dropped from a plane, the aerodynamic drag forces acting on the plate withdraw the rod from the piston **31**. If the unit is dropped from a surface craft, the plate and rod are removed manually.

The piston **31** is formed with an annular recess **34** at its inward end in which a spring **35** is seated. The spring bears against the bottom of the recess and its strength plus the force exerted by compressing the entrapped air determines the movement of the piston. The piston further houses a delay detonator **36** which when the piston reaches the end of its travel is located in line with the pointed end of the firing pin which reaches the detonator through a small reduced portion **37** in the central bore of the odd-shaped body portion.

The body **14** is formed with three laterally bored recesses **38** equally spaced about its periphery and housing cylindrical catches **39**. These catches move longitudinally of the recesses **38** being normally thrust outwardly by spring **41**. They are engaged by the pointed ends of the plungers **26** and retracted to release their reduced ends from holes **42** in the casing. This retraction of the catches releases the casing from the nose portion.

The inward end of the body **14** is formed with a small central recess **43** housing a connector **44** which extends into initiating contact with the detonator. The connector extends from the detonator along the side of the casing and is connected to the sheet explosive **45** which is housed in the casing.

This sheet explosive is in the form of a long sheet substantially three inches wide and ten feet long. It has a reinforcing strip **46** extending the entire length and has retaining cords **47** and **48** connected to the strip. One of the cords **47** is connected to the body **14** at **49** and the other cord **48** is connected to a conical plug **55** at **51**. The explosive sheet is folded at its center and rolled on a spool to fit into the casing.

The casing 12 is a cylindrical tube tapered at the tail end and formed at that end with a comparatively small tubular section 52. The tail section 13 is cylindrical with an inner core which is attached to the tubular section 52 by crimping so that the casing and tail section are not separated after assembly. The tail end of the casing is fitted with a conical plug 55 having an inner cylindrical bore and supporting a conical-shaped coil spring 56. The spring bears against a shoulder 57 on the conical plug and against the crimped end of the casing. The plug bears against the end of the spool and is of a lesser diameter than the inside of the casing permitting the casing to slip easily over the plug under the action of the spring. The cord 48 is connected to the plug along its inner bore. A strain member 58 also connected to the plug along its inner bore is attached at its other end to the tubular portion of the casing so that although the plug will slip through the casing it will remain attached to it by the strain member 58.

The operation of the bomb is as follows.

The bomb may be dropped from an aircraft or from a surface vessel. Before assembly the disc 20 is selected for the depth at which the bomb is to be actuated. This may be done on board ship where the bomb may be assembled or it may be done at a factory and the bombs marked accordingly. After selecting the correct bomb for the depth desired it is dropped into the water. The resistance of the air or water against the plate 33 removes the plate from the tail section and its attached rod 32 thereby removing the safety from the arming piston 31. If the signal is launched from a surface vessel, the plate and rod are removed manually.

At the desired arming depth the water pressure acting on the arming piston 31 has moved the piston so that the delay detonator has moved opposite the firing pin. Upon reaching the desired depth, the disc 20 is ruptured by the pressure of the water entering through the holes 18 in the nose cap 17 and the holes in body 21 and retaining plug 24. The rupturing of the disc brings the water into contact with the firing pin and movement of the firing pin in the bore permits the water to enter the passage 28, pass the port 27 and engage the plungers 26 in the recesses 25. The plungers 26 have engaged the cylindrical catches 39 and moved these catches out of the holes 42 in the casing, thereby releasing the casing from the body 14. The detonator which is of the delay type and has sufficient delay for the plungers to release the casing from the body 14 now ignites the connector which in turn ignites the sheet explosive. During the delay period and upon release of the casing from the body, the spring 56 acting against the explosive sheet spool and the tubular part of the casing separates the casing from the rolled explosive sheet. The sheet is pulled out to full length by reason of the attached cords, one to the body 14 and the other to the casing by way of the plug and the strain member 58. The purpose of the strain member is to stop the conical plug 55 within the mouth of casing 12 so that cord 48 will pull centrally on the casing which acts as a parachute to unroll the explosive. As the explosive sheet is stretched to its full length, in a substantially vertical position, it is ignited and the resultant explosion together with its echoes is received on sonar equipment and evaluated. It may be used to detect any object of sufficient size within the limits of the wave explosion.

A modification of the above mechanism is shown in FIG. 2 and is a different type of regulator which may be actuated at shallow depths or at depths where the water pressure is insufficient to rupture the disc 20.

Instead of the disc 20, a cylindrical shell 61 is fitted into the annular recess in the body 14. The shell houses an inner cylinder 62 in which the firing pin 63 slides. This firing pin is different from the firing pin 23 in that the outer end is hollow and houses a coil spring 66. The firing pin is retained by balls 64 which engage an annular groove 65 in the wall of the firing pin. The inner cylinder 62 is formed with holes 70 which receive the balls 64 and retain the firing pin against the action of the coil spring. The balls are held in the holes 65 by a collar 67 seated in an annular shoulder 68 of a movable piston 69. The piston slides in the annular recess in cylindrical shell 61 under the pressure of the water at varying depths of 80 feet or more, dependent upon the strength of the coil spring 66, and moves the collar from engagement with the balls 64. The balls are then able to move from the groove in the firing pin and permit the firing pin to be pushed by the coil spring 66 into engagement with the delay detonator 36. On release of the balls, piston 69 follows the firing pin inward impacting plungers 26 releasing the cylindrical catches to release the casing and explosive sheet. Different caliber springs will regulate the depth at which the actuation takes place.

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. In a water pressure actuated bomb having a pressure actuated arming and firing mechanism, an explosive comprising:
   - a sheet of explosive material of elongated shape of approximately at length forty times the width,
   - means for extending the sheet of explosive material to a vertical position after the explosive material has been submerged in the water; and
   - means actuated by the water pressure at a predetermined depth for initiating the firing mechanism and igniting the explosive after the explosive has been extended in a substantially vertical position so that the ignition of said explosive provides a source of underwater energy concentrated in the horizontal plane.

2. In a water pressure actuated bomb comprising:
   - a firing pin actuated by a predetermined pressure,
   - an arming mechanism,
   - a delay detonator carried by said arming mechanism and initiated by movement of said firing pin,
   - a casing attached to the arming mechanism,
   - a sheet explosive approximately forty times as long as wide carried by said casing,
   - igniting means for said explosive connected to said explosive and to said detonator, and
   - means actuated by said firing mechanism for releasing the explosive from the casing in a substantially vertical position previous to actual ignition of said explosive, whereby ignition of said explosive will provide a source of underwater acoustic energy concentrated in the horizontal plane.

3. An underwater bomb having an arming mechanism and an initiating mechanism comprising:
   - a casing attached to the arming mechanism,
   - a substantially flat ribbon-like explosive charge carried in said casing,
   - means engaging the side of the casing and securing it to the arming mechanism,
   - means actuated by water pressure for releasing said casing engaging means,
   - resilient means actuated by the release of the casing to remove the casing from the explosive charge,
   - said means tending to stretch the explosive charge its full length in a substantially vertical position, and
   - means actuated indirectly by the water pressure for igniting the explosive charge,
   - said ignition occurring when said sheet is in a substantially vertical position to provide a source of underwater energy concentrated in a horizontal plane.

No references cited.

BENJAMIN A. BORCHELT, *Primary Examiner.*

S. W. ENGLE, *Assistant Examiner.*