United States Patent [19]

Johnson

[11] **3,926,137**

[45] **Dec. 16, 1975**

[54] **DEEP OCEAN PARACHUTE RELEASE**

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[73] Assignee: **The United States of America as represented by the Secretary of the Navy,** Washington, D.C.

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[21] Appl. No.: **555,012**

[52] **U.S. Cl.** ..... **114/209;** 83/39; 114/235 B; 244/151 B; 307/252 N; 307/252 J; 340/3 T

[51] **Int. Cl.²** **B63B 21/48**

[58] **Field of Search** ..... 114/209, 221 A, 235 B; 244/150, 151 B; 83/39, 639; 307/252 N, 252 J, 236, 305; 340/3 T, 7 PC

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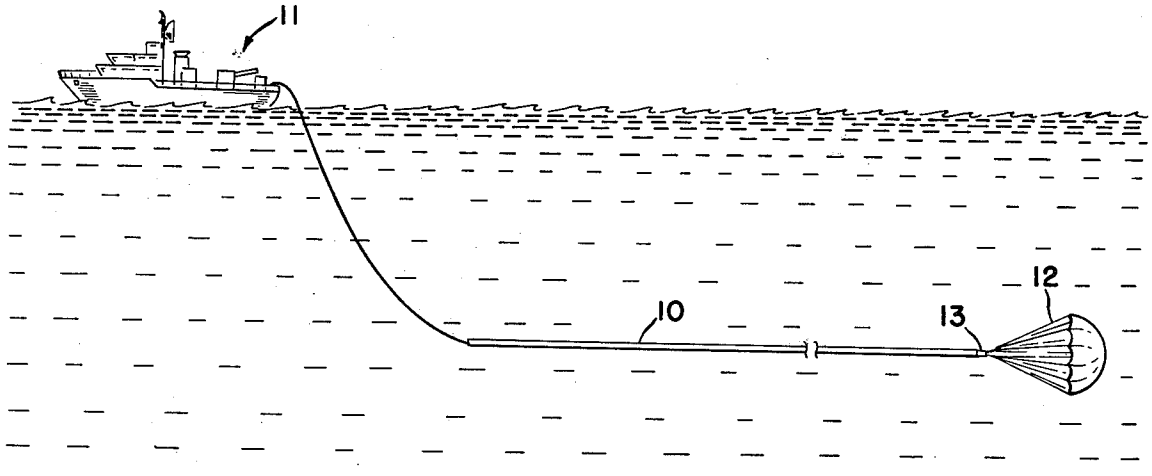
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Attorney, Agent, or Firm—Richard S. Sciascia; Ervin F. Johnston; William T. Skeer

[57] **ABSTRACT**

A drogue chute is used to extend a long line transducer array in the water as it is being towed in or played out in an ocean current. To avoid problems during a subsequent retrieval of the array, the drogue chute is disconnected. For this reason a release mechanism is interposed between the transducer array and the chute. This release mechanism provides for a nonabrupt separation of the array from the chute's riser straps. An electronic circuit in the mechanism initiates the separation of a first riser strap to dump the entrained water and next, the second riser to completely sever the chute from the array.

6 Claims, 5 Drawing Figures



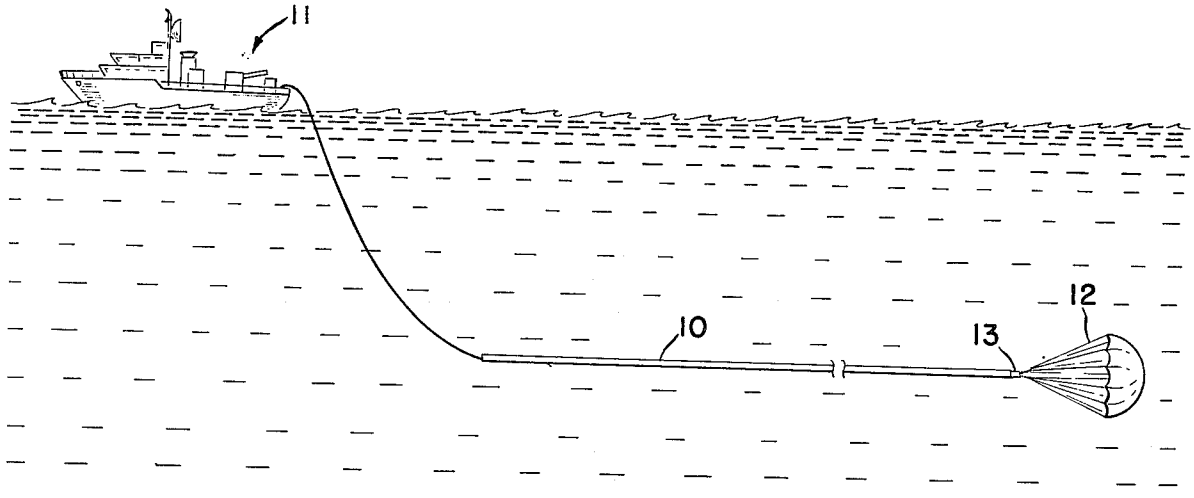


FIG. 1

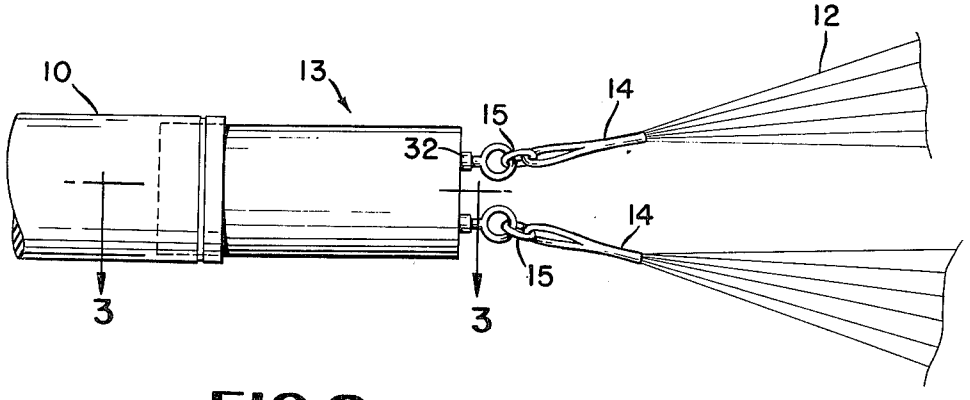


FIG. 2

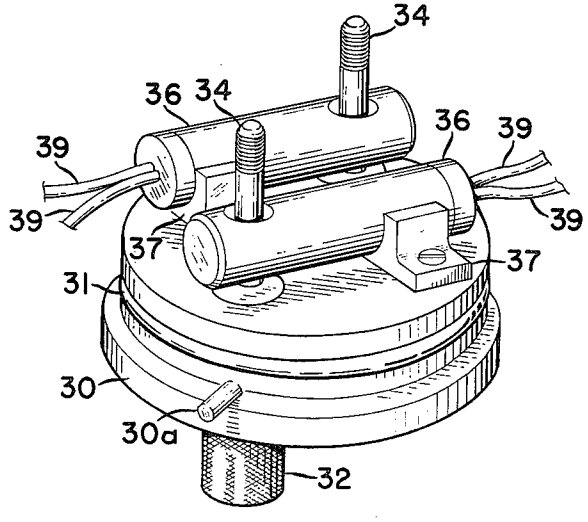


FIG. 4

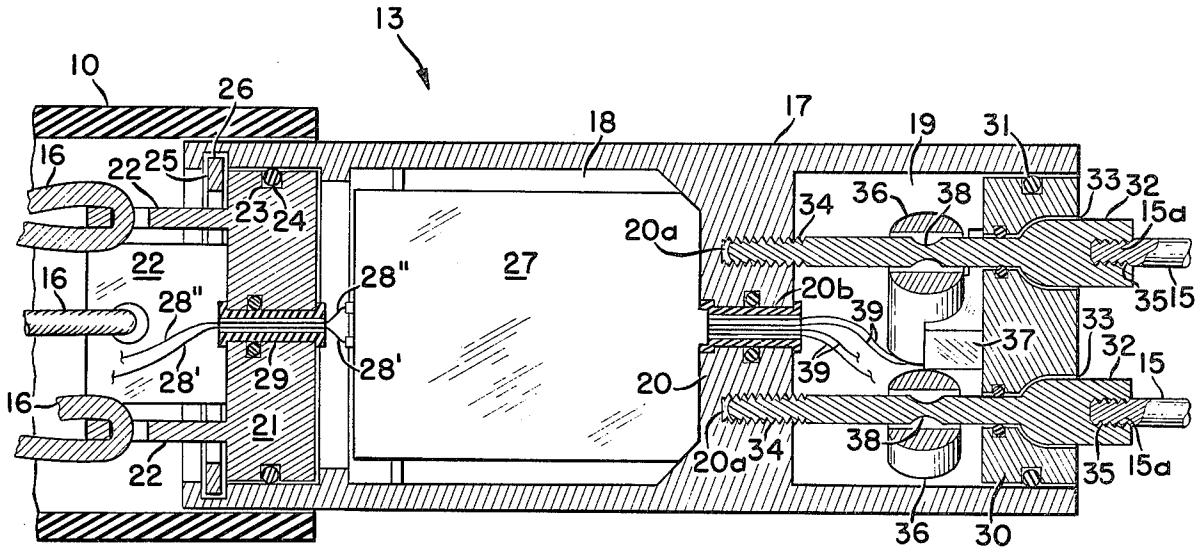

13
10
26
18
17
19
31
16
22
25
23
24
33
32
15a
34
36
38
20a
22
27
28"
20b
35
15
16
28"
39
37
33
32
28'
29
28'
15
20
16
21
39
38
20a
34
35
15a
22
36
30

FIG. 3

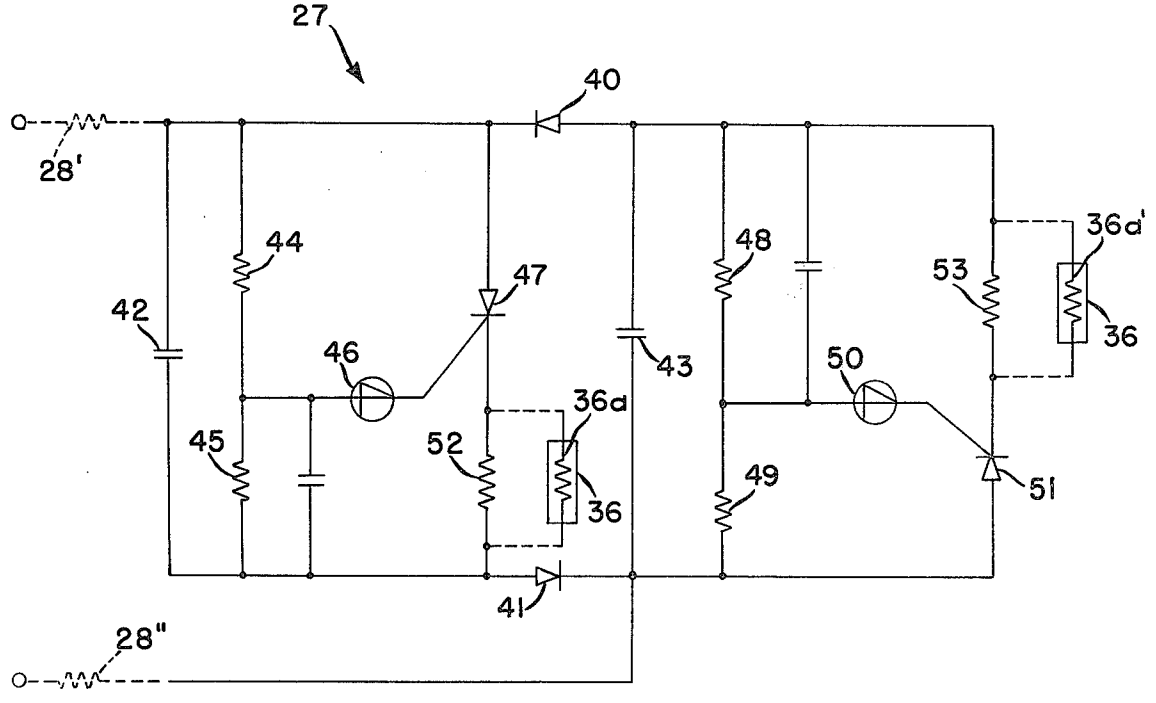

27
40
28'
44
48
36a'
53
47
42
46
43
50
36
36a
45
52
49
51
36
41
28"

FIG. 5

DEEP OCEAN PARACHUTE RELEASE

STATEMENT OF GOVERNMENT INTEREST

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.

BACKGROUND OF THE INVENTION

Usually, hose-like transducer arrays are connected to a drogue chute to extend the array to its full length. When the array is to be deployed, the supporting ship continues to proceed underway and the drogue chute is cast over the side. The drogue chute fills with water and tows the array from its spool and the array trails behind the ship. The chute also holds the array extended when the supporting craft is at anchor or on-station since the chute will exert a drag in the ocean's currents. Thus, it can be seen that a drogue chute can expedite the deployment and positioning of an elongate array. However, during retrieval of the array, the chute's drag becomes excessive. Usually, the chute is considered expendable and it is disconnected by some interposed mechanism. Unfortunately, when the disconnect would be initiated, a rubber-band-like snap would rebound along the array's length. The relatively fragile transducers and electronics will become damaged and impair the array's operability. Even with a static array, i.e., one not being towed, a certain amount of tension exists along the array between a drogue chute and the anchor point. Here again, severing the drogue chute snaps the array. There is a continuing need in the state of the art for a drogue chute release mechanism which avoids snapping the array and the consequent damage.

SUMMARY OF THE INVENTION

This invention is directed to providing an apparatus for releasing a drogue chute from an elongate array extended in tension. A cylindrical housing is connected to the array and a pair of frangible links couple the other end of the housing to the two riser straps of a drogue chute. A pair of guillotine cable cutters, each associated with a separate link, are sequentially initiated first to dump the entrained water mass and secondly to separate the drogue chute from the array in a two step operation.

It is an object of the invention to provide an improved release for a drogue chute.

Another object is to provide a releasing apparatus for initiating a two step release of a drogue chute.

Yet another object is to provide a drogue chute release which does not overly contribute to flow noise.

Yet another object is to provide a fail safe sequential chute release which requires a signal of a first polarity to separate one frangible link and a signal of the opposite polarity to separate the other frangible link.

These and other objects of the invention will become more readily apparent from the ensuing specification when taken with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an isometric depiction of the invention linking a drogue chute to an elongate array.

FIG. 2 is an enlarged isometric view of the invention.

FIG. 3 is a cross-sectional representation of the invention taken generally along lines 3—3 in FIG. 2.

FIG. 4 is an isometric view of a detail of the invention.

FIG. 5 is a schematic diagram of the initiation circuit.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, a representative embodiment of a hose-like transducer array **10** reaches from a surface craft **11** and is held extended by a drogue chute **12.** Although the array is shown being deployed from a surface craft, other modes of operation can dictate that the array be deployed by a submersible or be trailed from a buoy in the ocean's currents. In any event, a drogue chute is connected at the distal end to act as a drag to extend the array as it is pulled through the water or as it streams in a current. This type of an arrangement provides more satisfactory representations of transmitted and received acoustic energy. Arrays that are allowed to flutter or drift into contorted shape leave much to be desired when signals are to be analyzed.

Usually, the long line array is stored on a large spool. Unwinding the spool releases the array and an attached drogue chute is released. As the chute fills with water, it entrains a water mass and pulls the array in a straight line configuration.

However, a retrieval of the drogue chute does pose some problems. The chute resists being reeled in and the excessive tensile drag may damage the array. In addition, the chute does not lend itself to being pulled through sheaves nor to being wound on the spool.

The solution is to sever the drogue chute from the array by a suitable release mechanism and reel in the array. Yet, because the array is held in tension, severing the chute snaps the array. Particularly, when the array is hundreds or thousands of feet long, this shock can be quite severe. Previous trials have demonstrated that the transducer elements and the associated electronics are damaged during separation.

This invention, a deep ocean drogue release **13,** reduces the possibility of damaging the array during drogue chute disconnect. The drogue chute release mechanism is coupled to two risers **14** extending from drogue chute **12** by a pair of swivels **15.** The opposite end of the release mechanism is connected to the array by four cables **16,** only three of which are shown in FIG. **3.** These cables normally are contained within the array and serve as linking strength members among the transducer elements and the associated electronics.

The release mechanism includes a cylindrically shaped housing **17** which has substantially the same diameter as the array. Such dimensioning provides a cleaner hydrodynamic shape and reduces the problems associated with excessive flow noise.

The interior of the housing is divided into two cavities **18** and **19** by a separating wall **20.** The housing, separating wall and most of the other elements to be discussed are fabricated from a corrosion resistant material such as stainless steel, which possess the strength to bear tensile loads. Cavity **18** faces the trailing end of the transducer array and is closed by a disc-shaped plug **21.**

The outside surface of the plug is shaped with four projections **22** which receive the four cables **16** mentioned above, to join the drogue release to the array. The circumferential surface of the plug is provided with an annular groove **23** carrying an O-ring **24** to seal cavity **18** from the surroundings. A snap ring **25** fits into an

appropriately shaped groove **26** in the cylindrically shaped housing to hold the plug in place.

An electronic detonation-initiation circuit **27** is disposed inwardly of the plug and within the confines of cavity **18.** The details of the circuit will be discussed later, however it should be noted that only a single pair of leads **28'** and **28''** reach from the electronic circuit to the array via a packing member **29.**

At the opposite end of the housing a round mounting plate **30** carrying O-ring **31** seals shut a cavity **19.** Into the cavity a pair of frangible links **32** reach across from appropriately shaped holes **33** in the mounting plate. O-rings encircle the links' shanks to keep water out of the housing interior.

The links are shaped with threaded inner ends **34** for engaging correspondingly shaped threads provided in tapped holes **20a** in separating wall **20.** The opposite end of each of the frangible links is provided with a threaded recess **35** which mates with correspondingly threaded portions **15a** of a ring bolt-swivel combination **15.** Thus, the drogue chute is connected to the array via frangible links **32** and housing **17.**

Inside cavity **19** a pair of guillotine cutters **36** are supported by a pair of nylon clips **37** affixed to the inner surface of mounting plate **30.** The cutters are of the type manufactured by Holex, Incorporated, Hollister, California, under the code identification number 10640. These cutters are initiated to drive a blade against an anvil and to effect a cutting of a cable placed upon the anvil when a potential is applied to its pair of leads **39.**

The guillotine cutters are so arranged on their clips to align smaller diametered portions **38** of the frangible links with the blades of each of the cutters. The smaller diameter portions were machined down to have a tensile strength of about 2,500 pounds. The smaller diametered portions also serve as the weak link in the array and will separate first if some unforeseen excessive force is exerted on the array. The Holex 10640 cutter is sufficient to break the smaller diameter portion. Both pairs of leads **39** are fed through an opening **20*b*** in wall **20** and are coupled to output terminals on the electronic circuit **27.**

Part of the essence of this invention resides in the fact that the electronic circuit is initiated twice by signals of opposite polarities across input leads **28'** and **28''.** A signal of one polarity of the input signal actuates one of the guillotine cutters and its associated frangible link is severed. One of the risers **14** is released and the drogue chute slowly dumps its load of entrained water. After a predetermined time, a signal of opposite polarity is fed to electronic circuit **27** via leads **28'** and **28''** and the other cutter is actuated. The second actuation severs the other frangible link and the drogue chute is released. By this one-two sequence of cutter initiation there is a new two step release of the drogue chute. There is no sudden snapping of the array, but rather a smooth, two-step removal of the drogue's drag. The mechanics of this two-step initiation will become more apparent by a closer look at FIG. **5.**

Two identical circuits isolated by diodes **40** and **41** are used to fire the two cutters independently via only two input leads **28.** Apply one polarity across leads **28'** and **28''** fires one circuit while reversing the polarity of the signal fires the other circuit.

When a positive potential is applied to lead **28'** a firing capacitor **42** begins to charge exponentially through diode **41** at a rate determined by the line resistances of leads **28''** and **28'** and the value of firing capacitor **42.** Diode **40** now isolates firing capacitor **43** and its associated circuitry. When the potential on firing capacitor **42** reaches a magnitude as determined by a voltage divider network formed by resistor **44** and **45,** silicone unilateral switch **46** triggers a silicon controlled rectifier **47.** This dumps the firing charge stored on firing capacitor **42** to squib **36*a*** of guillotine cutter **36** to fire it.

Applying a positive potential to lead **28''** causes the detonation of the other squib **36*a'*** in exactly the same manner. A charge begins to exponentially accumulate on firing capacitor **43** at a rate determined by the line resistances of line **28'** and **28''** and the value of firing capacitor **43.** Diode **41** isolates firing capacitor **42** and its associated circuitry. As the potential on firing capacitor **43** reaches a magnitude as determined by a voltage divider network made up of resistors **48** and **49,** silicone unilateral switch **50** triggers a silicone controlled rectifier **51.** This dumps the charge stored on firing capacitor **43** through squib **36*a'*** to effect its detonation.

The line resistance of the array used in conjunction with this release mechanism is such that the firing signal need be applied to one of the associated firing capacitors **42** or **43** for approximately 4 seconds. During this period the accumulated charge reaches a potential on either firing capacitor which is of a sufficient magnitude to actuate its associated transistor **46** or **50.** This time delay provides an added safety feature to prevent accidental firing since it is necessary to apply the firing signal continuously for 4 seconds before either squib is detonated.

A pair of resistors **52** and **53** are protective devices for firing capacitors **42** and **43,** respectively. Since the cavity **18** inside of cylindrically shaped housing **17** is small, the size of the components must be kept down. To help accomplish this all the capacitors chosen are of low voltage ratings. If, for some reason the firing signal were applied across terminals **28'** and **28''** when the connections to the cutters were inadvertently open, the corresponding charge built on either of the firing capacitors **42** and **43** would not reach high enough levels to damage them. Thus, the resistors **52** and **53** are included to provide a path to discharge the firing capacitors.

As a final step to ensuring the efficient operation of the aforedescribed electronic circuit, it was fabricated on a printed circuit board and potted in an epoxy-like block sized to fit within cavity **18.**

Obviously, many modifications and variations are possible in the light of the above teachings, and it is therefore understood that the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. An apparatus for releasing a drogue chute from an elongate array extended in tension comprising:

a housing connected to the array;

means for frangibly coupling the housing to more than one riser of the drogue chute;

means for breaking the frangible coupling means being mounted adjacent thereto; and

means for sequentially initiating the breaking means to effect releasing of the drogue chute in stages thereby preventing the snapping of the elongate array.

2. An apparatus according to claim **1** in which the frangible coupling means are a pair of alloy links each

secured to a separate riser and the breaking means are a pair of guillotine cutters each provided with an opening for receiving a separate alloy link therethrough.

3. An apparatus according to claim **2** in which the sequentially initiating means is an electronic circuit formed of components which initiate the detonation of one of the guillotine cutters when an actuation signal of one polarity is fed to it and which initiate the detonation of the other guillotine cutter when an actuation signal of the reverse polarity is fed to it.

4. An apparatus according to claim **3** in which the electronic circuit includes a charging and firing capacitor coupled to each guillotine cutter to provide a delay between the time the actuation signal is fed to the electronic circuit and a guillotine cutter is detonated.

5. An apparatus according to claim **4** in which both guillotine cutters are orthogonally disposed with respect to their associated alloy link to assure the releasing of the drogue chute.

6. An apparatus according to claim **5** in which the housing is cylindrically shaped having an outer diameter the same as the array to reduce the problems associated with excessive low noise.

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