EXPLOSIVE SWAGING DEVICE FOR MOORING A SUBMERGED MINE

Charles F. Bowersett, Laurel, Md., assignor to the United States of America as represented by the Secretary of the Navy

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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.

This invention relates to a submersed moored mine and more particularly to an explosive swaging device for gripping the mooring cable thereof in such a manner as to prevent further paying out of the cable when a predetermined amount thereof has been payed out corresponding to the number of magnetic signals received from the cable by a magnetic measuring device in accordance with a preselected setting thereof.

Furthermore, the invention relates to a moored mine which comprises a floatation chamber releasably connected to an anchor device and adapted to be released therefrom at the expiration of a predetermined period of time by a suitable explosive actuated release device whereupon the floatation chamber will ascend toward the surface of the body of water and upon rising to a preselected depth of submergence the swaging mechanism of the present invention is functioned to grip or clutch the cable and prevent further paying out thereof and thus moor the mine at the desired depth of submergence within the body of water in which the mine has been planted. Such action is controlled by a suitable magnetic induction metering device and pick-up coil operatively connected thereto and adapted to function to initiate the explosive actuated device when a predetermined amount of the cable has been payed out and a predetermined number of magnetic signals are picked up by the coil as the cable upon which the magnetic signature is impressed passes therethrough during the ascent of the floatation chamber after the chamber has been released from the anchor.

Hereinafter, moored mine employed mechanical linkages and hydrostatic devices for measuring and controlling the paying out of the mooring cable as the mine is planted on the bed of a body of water, wherein the cable is stowed on a normally locked reel or drum rotatably supported within the mine anchor and adapted to be released as the mechanical or hydrostatic devices are functioned, as the case may be whereupon the cable is payed out when the floatation chamber and anchor separate and the floatation chamber ascends toward the surface of the body of water. The aforesaid devices are adapted to lock the drum or reel and prevent further paying out of the cable when the floatation chamber ascends to a preselected depth after release thereof from the anchor. Such devices have not proven entirely satisfactory for the reason that all the moving components thereof are exposed to the sea water when the mine is planted in the body of water and thus subjecting the mechanical release and pawling devices to failure due to corrosion after the anchor has been submersed for a comparatively short period of time. Furthermore, such devices are bulky, costly, and occasionally inaccurate due to the defects in the mechanical releasing and pawling arrangement thereof.

Accordingly, an object of the present invention is the provision of a new and improved mine anchoring arrangement which is devoid of cable reels and mechanical controlled releasing and pawling devices and which is small in size, economical to manufacture and possesses all the qualities of ruggedness and durability during handling and transportation and in which an explosive swaging device is employed to stop the paying out of the mooring cable when the swaging device is actuated in response to an explosive force received thereby.

Another object is to provide a novel and effective explosive device for anchoring a floatation chamber at a preselected depth of submergence after the floatation chamber is released from an anchor member.

A further object is to provide a new and improved mine anchoring system wherein an explosive swaging device is functioned to grip the mooring cable in such a manner as to prevent further paying out thereof when a predetermined amount of cable has been payed out and a predetermined period of time has elapsed after the mine has been planted on a bed of a body of water.

Still another object is to provide a new and improved mooring system for a mine in which a magnetic induction controlled metering device functions to initiate an explosive type cable gripping device when a predetermined number of magnetic signals have been received thereby.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is an elevation view of a mine partially broken away and having several units assembled in accordance with the present invention;

FIG. 2 is an enlarged top plan view of the swaging device in accordance with the present invention;

FIG. 3 is an enlarged bottom plan view of the device of FIG. 2;

FIG. 4 is a sectional view taken on the line 4—4 of FIG. 2;

FIG. 5 is a sectional view taken on the line 5—5 of FIG. 2; and

FIG. 6 is a detail sectional view of the gripping sleeve in a deformed condition and illustrating the manner in which the mooring cable is gripped thereby.

Referring now to the drawings and more particularly to FIG. 1 there is shown a submarine mine generally indicated by the reference character 10 and comprising an anchor 11 and a floatation member or mine casing 12 releasably secured to the anchor and adapted to be released therefrom a predetermined period of time after the mine has been planted on a bed of a body of water.

The anchor comprises a casing 13 having secured thereto a suitable magnetic metering device 14 such, for example, as a type similar to that disclosed and claimed in the co-pending application of Leon J. Loftus, titled "Magnetic Cable Measuring Device," Serial No. 285,039, and filed April 29, 1952.

Secured to the measuring device 14 by bolts 15 is an explosive clutching or gripping device generally indicated by the numeral 16 comprising a casing 17 consisting of a substantially U-shaped member 18 and a support or end wall 19 arranged in the open end of the U-shaped member and secured thereto by a plurality of bolts 21. The end wall 19 is provided with a threaded nipple 22 and a bore 23 which extends therethrough, the nipple having threaded engagement with a magazine generally indicated by the numeral 24.

The magazine comprises a casing 25 having a threaded bore 26 formed therein in threaded engagement with the nipple 19 and thus by this arrangement the magazine is supported on the end wall 19 in alignment with the bore 25. FIG. 4. The casing 25 is provided with a counterbore or explosive chamber 27 bordering on the bore 26 and having an explosive charge 28 arranged therein, the charge being maintained within the chamber 27 by a frangible diaphragm 29. As shown on FIG. 4 the diaphragm comprises a cup-shaped member 31 in
abutting engagement with the charge 28 and a flange 32 in abutting engagement with a shoulder 33 formed on the casing, the flange being maintained in abutting relation with the shoulder 33 by a retaining nut 34. By this arrangement the charge 28 is maintained sealed and confined within the bore 27.

As more clearly shown on FIG. 5 a threaded bore 35 is formed in the magazine 24 at a right angle with respect to the hole 27 and in communication therewith. Threaded into the bore 35 is a detonator holder 36 comprising a casing 37 having a bore 38 extending substantially therethrough in which is arranged an electrorponsive detonator 39, the detonator being provided with a pair of leads 41 extending through an aperture 42 formed in the casing 37 thereby to provide an external electrical connection to the detonator.

The gripping device 16 is provided with an end wall or fixed jaw 43 having a substantially semicircular recess 44 formed therein and extending the full length thereof, the wall defining the recess having a plurality of grooves 45 formed therein thereby to provide a plurality of anvils 46 therebetween, the purpose of which will be hereinafter more fully described.

As more clearly shown on FIG. 4 a clamp or jaw 47 is shabbily arranged within the member 19 by reason of a plunger 48 formed therein and movably disposed within the bore 23 arranged in the member 19, the plunger being in alignment with the explosive charge 28 and adapted to be moved in response to the force of the explosion as the charge is fired by the detonator. The jaw 47 is provided with a substantially semicircular recess 49 extending the full length thereof, the wall defining the recess having a plurality of grooves 51 formed therein wherein a plurality of anvils or ridges 52 are formed therewithin, the jaw 47 being adapted to coact with the anvils 46 on the stationary jaw 43 when the movable jaw 47 is moved toward the stationary jaw.

As shown more clearly on FIG. 4 a crushable sleeve generally indicated by the numeral 53 and comprising an elongated tubular member 54 and a flange 55 is disposed between the jaws 43 and 47, the tubular member 54 being in alignment with the recesses 44 and 49 and the flange 55 resting on the jaws 43 and 47. Secured to the upper end portion of the jaw 47 as by bolts or screws 56 is a yoke 57 having an elongated opening formed therein in which is arranged the flange 55 and secured to the lower end portion thereof as by bolts or screws 58 is a yoke 59 having an elongated slot formed therein in which is arranged the end portion of the tubular member 54. The crushable sleeve 53 is maintained between the jaws 43 and 49 and locked in alignment with the recesses 44 and 49 by a pair of set screws 61 threaded into the yoke 57 and into clamping engagement with the flange 55 and a pair of set screws 62 threaded into the yoke 59 and into clamping engagement with the tubular member 54.

As shown on FIG. 1 a cable dispenser 63 is disposed within the anchor casing 13, the dispenser being secured thereto in any suitable manner such, for example, as by bolts or screws. Stowed within the dispenser is a suitable length of mooring cable 64, the cable having a magnetic signal impressed along the length thereof, the purpose of which will be more clearly apparent as the description proceeds. The cable is trained over a plurality of rollers 65, through the pick up coil 66 and the crushable sleeve 53 and thence through a conventional fairlead 67, the cable thereof being secured to the floatation chamber or mine casing 12 as at 68.

As shown on FIG. 1, the floatation chamber and anchor are initially locked together by the conventional link 71 and an explosive link device 72. It will be understood, however, that when the mine is launched and sinks to the bed of a body of water, the floatation chamber and anchor will remain locked together for a predetermined period of time, such time delay being controlled by a conventional clock mechanism or any other suitable time delay device. However, at the expiration of the time delay period the clock will initiate firing of the explosive link device 72. When this occurs the link 72 is blown from the anchor casing and releases the floatation chamber for movement to plumb or vertical such movement being sufficient to detach the link 71 from the floatation chamber and thus the floatation and floatation chamber are separated. Upon release of the floatation chamber it will ascend toward the surface of the body of water and thus in response to the upward movement thereof the magnetized mooring cable 64 is payed out from the dispenser 63 and pulled through the pick up coil 66 and the swaging sleeve 53. Paying out of the cable will continue until a predetermined number of signals have been received through the pick up coil 66 correspondingly to the preset mooring depth at which the metering device is set. When this occurs a firing circuit is completed to the detonator 39 by way of conductors or leads 41 in any suitable manner such, for example, as by the arrangement disclosed in the aforesaid copending application of Leon J. Loftus. The explosive charge 28 arranged within the explosive chamber 27 is thus fired by the detonator as the detonator is initiated. As the explosive charge 28 is fired within the explosive chamber 27 the explosive force therefrom forcibly drives the plunger 48 a sufficient amount to cause the anvils or ridges 46 and 52 on the movable and fixed jaws to forcibly engage and, and thus swage the sleeve onto the cable, FIG. 6. Such swaging of the sleeve to the cable prevents further paying out thereof, whereupon the mine or flotation chamber is moored at the desired depth of submergence corresponding to the preselected mooring depth at which the measuring device is set.

As shown on FIG. 1 a cartridge type cable dispenser 73 is disposed within and secured to the anchor 13. Stowed within the dispenser is a suitable length of plumbnet cable 74 having a magnetic signature along the length thereof, the cable being trained about the aforesaid rollers 65, through a pick up coil 75 similar to the coil 66 operatively connected to the measuring device 14 and having the free end thereof secured to a plumbnet 69 as at 77. The plumbnet is releasably maintained within the anchor 13 by a suitable mechanism 78, however, when the mine is launched the plumbnet is released as the mechanism 78 is actuated to a release position. Thus as the plumbnet sinks the plumbnet cable is pulled through the pick up coil 75. The magnetic signature impressed on the cable is pulled through the pick up coil 75 when the cable is pulled therethrough will function the measuring device and thus measure the depth of water during the sinking of the plumbnet to the bed of the body of water. The floatation chamber and anchor attached thereto will then sink to the bed of the body of water and at the expiration of a predetermined period of time controlled by a conventional clock mechanism included in the measuring circuit the clock will function and initiate firing of the explosive link 72. When this occurs the floatation chamber and anchor are separated and the floatation chamber ascends toward the surface of the body of water whereupon the mooring cable 64 having the magnetic signature thereon is pulled through the pick up coil 66. When the cable has been payed out a predetermined amount corresponding to the number of magnetic signals received in accordance with the preselected setting of the measuring device, the explosive swaging device 16 through which the mooring cable has also been paying out is actuated to swage the malleable sleeve 53 onto the cable as the explosive charge 28 is fired by the detonator 39 and thus locking the cable and preventing further paying out thereof, whereupon the floatation chamber is moored at a predetermined depth beneath the surface of the body of water.

From the foregoing description it will be apparent that
a new and improved explosive swaging device has been devised wherein means responsive to an explosive force applied thereto grips and licks the mooring cable of a submarine mine and prevents further paying out thereof when a predetermined amount of the cable has been paid out corresponding to the number of magnetic signals received from the cable by a magnetic measuring device in accordance with a preselected setting thereof. 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 as new and desired to be secured by Letters Patent of the United States is:

1. An explosive swaging device for a submerged mine having a flotation chamber separable from an anchor and secured thereto by a mooring cable comprising a casing, an elongated deformable sleeve supported on said casing through which said cable is paid out as the flotation chamber is separated from said anchor and ascends toward the surface of a body of water, means including a movable jaw formed thereon for swaging said deformable sleeve onto said cable and mooring said flotation chamber at a predetermined depth beneath the surface of said water as said anvil means are forcibly driven into engagement with said deformable sleeve in response to an explosive force applied thereto, and for causing said deformable sleeve to move in the casing in response to said explosive force means for applying said explosive force to said movable member as the explosive means is fired.

2. An explosive swaging device for a submerged mine having a flotation chamber separable from an anchor and secured thereto by a mooring cable comprising a casing, an elongated deformable sleeve supported on said casing through which said cable is paid out as the flotation chamber is separated from said anchor and ascends toward the surface of a body of water, means movable arranged within said casing and having a plurality of anvil means formed thereon for swaging said deformable sleeve onto said cable and mooring said flotation chamber at a predetermined depth beneath the surface of said water as said anvil means are forcibly driven into engagement with said deformable sleeve in response to an explosive force applied thereto, and for causing said deformable sleeve to move in the casing in response to said explosive force means for applying said explosive force to said movable member as the explosive means is fired.

3. An explosive swaging device for a submerged mine having a flotation chamber separable from an anchor and secured thereto by a mooring cable comprising a casing, a fixed jaw arranged on said casing, a movable jaw supported within the casing and moved a predetermined amount in response to an explosive force applied thereto, the device having means disposed within the casing in proximate spaced relation with respect to said movable jaw for applying said force thereto as the explosive means is fired, a deformable sleeve supported between said jaws through which said cable is paid out as the flotation chamber is separated from said anchor and ascends toward the surface of a body of water in which the mine is planted, and means on said jaws for swaging said sleeve onto said cable as the movable jaw is moved said predetermined amount thereby to moor said flotation chamber at a predetermined depth beneath the surface of said water.

4. An explosive swaging device for a submerged mine having a flotation chamber separable from an anchor and secured thereto by a mooring cable comprising a casing, a movable jaw supported within the casing and adapted to be moved a predetermined amount in response to an explosive force applied thereto, explosive means disposed within the casing in proximate spaced relation with respect to said movable jaw for applying said force thereto as the explosive means is fired, means responsive to an electrical impulse for firing said explosive means, a deformable sleeve supported between said jaws through which said cable is paid out as the flotation chamber is separated from said anchor and ascends toward the surface of a body of water in which the mine is planted, and anvil means on said jaws adapted to be forcibly driven into engagement with said deformable sleeve as the movable jaw is moved said predetermined amount for swaging the sleeve onto the cable thereby to moor said flotation chamber at a predetermined depth beneath the surface of said water.

5. An explosive swaging device for a submerged mine having a flotation chamber separable from an anchor and secured thereto by a mooring cable comprising a casing, a stationary jaw forming a part of said casing, a movable jaw supported within the casing and movable a predetermined amount in response to an explosive force applied thereto, a magazine secured to said casing in alignment with said movable jaw, an explosive charge disposed within said magazine in proximate space relation with respect to said movable jaw for applying said explosive charge to the explosive means is fired, an electro-responsive firing device secured to said magazine and fired in response to an electrical impulse received from said magazine for firing said explosive charge, a deformable sleeve supported between said jaws through which said cable is paid out as the flotation chamber is separated from said anchor and ascends toward the surface of a body of water in which the mine is planted, and means on said stationary jaw, complementary anvil means on said movable jaw and adapted to connect with said anvil means on said stationary jaw for swaging the sleeve onto the cable as said movable jaw is moved said predetermined amount thereby to moor the flotation chamber at a predetermined depth beneath the surface of said body of water.

6. An explosive swaging device for a submerged mine having a flotation chamber separable from an anchor and secured thereto by a mooring cable comprising a casing, a stationary jaw forming a part of said casing, a movable jaw supported within the casing, a plunger secured to said movable jaw and sidewise arranged within the casing in response to moving the movable jaw a predetermined amount in response to an explosive force applied thereto, and explosive means disposed within said casing in alignment with said plunger for applying said explosive charge to the explosive means is fired, a deformable sleeve supported between said jaws through which said cable is paid out as the flotation chamber is separated from said anchor and ascends toward the surface of a body of water in which the mine is planted, and means on said plunger for applying said explosive force thereto as the explosive means is fired, and means for firing said explosive means, a deformable sleeve supported between said jaws through which said cable is paid out as the flotation chamber is separated from said anchor and ascends toward the surface of a body of water in which the mine is planted, and means on said plunger for applying said explosive force thereto as the explosive means is fired.

7. In a locking device of the class described, in combination, an anchor, a floating chamber separable from said anchor after the mine has been planted and rests on the bed of a body of water for a predetermined period of time, a mooring cable having a magnetic signature impressed thereon and connecting said floating chamber to said anchor and adapted to be payed out as the flotation chamber is released from the anchor and ascends toward the surface of said water, releasing means for said floating chamber, means including a magnetic measuring device settable to different settings and responsive to the paying out of said cable for controlling the amount of cable to be payed out corresponding to the number of magnetic signals received thereby in accordance with a selected setting, and means including an explosive device operatively connected to said magnetic measuring device and actuated thereby when a predetermined number of said signals have been received by said
measuring device for locking the cable and preventing further paying out thereof thereby to moor the floatation chamber at a predetermined depth beneath the surface of the water.

8. In a locking device of the class described, in combination, an anchor, a floatation chamber separable from said anchor after the mine has been planted and rests on the bed of a body of water for a predetermined period of time, a mooring cable having a magnetic signature impressed thereon and connecting said floatation chamber to said anchor and adapted to be payed out as the floatation chamber is released from the anchor and ascends toward the surface of said water, releasing means for said floatation chamber, means including a magnetic measuring device settable at will to different settings and responsive to the paying out of said cable for controlling the amount of cable to be payed out corresponding to the number of magnetic signals received thereby in accordance with a selected setting of the measuring device, a casing, deformable means secured to said casing and through which the cable is payed out as the floatation chamber ascends, means including a movable member arranged within said casing for swaging said deformable means onto said cable as the movable member is forcibly driven into engagement with said deformable means in response to an explosive force applied thereto, said deformable means locking the cable and mooring the floatation chamber at a predetermined depth beneath the surface of the water in accordance with said selected setting, and means including an electroresponsive detonator operatively connected to said measuring device and fired in response to an electrical impulse received thereby as the measuring device is actuated to said selected setting for applying said force to said movable member.

9. In an explosive swaging device of the class described, in combination, an anchor, a floatation chamber separable from said anchor after the mine has been planted and rests on the bed of a body of water for a predetermined period of time, a mooring cable stowed within said anchor and having a magnetic signature impressed thereon, said cable connecting the floatation chamber to the anchor and adapted to be payed out therefrom as the floatation chamber is released from said anchor and ascends toward the surface of said water, releasing means for said floatation chamber, means including a magnetic measuring device settable at will to different settings and responsive to the paying out of said cable for controlling the amount of cable to be payed out corresponding to the number of magnetic signals received thereby in accordance with a selected setting, a casing, a fixed jaw forming a part of said casing, a movable jaw supported within the casing, a plunger secured to said movable jaw and slideably arranged within said casing for moving the movable jaw a predetermined amount in response to an explosive force applied thereto, explosive means arranged within said casing in alignment with said plunger for applying said force thereto as the explosive means is fired, an electroresponsive detonator arranged within the casing and operatively connected to said measuring device and fired in response to an electrical impulse received thereby as the measuring device is actuated to said selected setting for firing said explosive means, a malleable sleeve supported between said jaws through which said cable is payed out as the floatation chamber ascends, and means on said jaws adapted to be forcibly driven into engagement with said malleable sleeve as the movable jaw is moved said predetermined amount by said plunger for swaging the sleeve onto the cable thereby to prevent further paying out of the cable and moor the floatation chamber at a predetermined depth beneath the surface of the body of water.

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