Our invention relates to mooring devices and more particularly to devices for mooring detonators.

The use of moored detonators is a regular procedure of modern warfare but it is not often an easy matter to lay magnetic mines and contact mines in enemy waters without being detected by the enemy. Submarines while submerged are not subject to detection by radar equipment. The use of torpedoes as detonators in enemy waters has therefore been proposed.

A torpedo is an excellent detonator and has the advantage that it has considerable freedom of motion and can be designed to seek its target once the target comes within a given range of the location of the torpedo, namely, the moored position of the torpedo.

One broad object of our invention is the provision for automatically mooring a torpedo after the torpedo is launched in some manner, as from a submarine firing tube.

A more specific object of our invention is the provision for automatically mooring a torpedo at a predetermined depth in the water at the position the torpedo is launched and from which moored position it later releases itself under specified conditions.

Another object of our invention is to provide for so mooring a detonator that its position is not altered by tidal currents or other currents in the sea.

Another more specific object of our invention is to moor a torpedo at a given depth in the water, prevent its shifting from the moored position, and release the torpedo from its mooring when the target detecting equipment "sees" a target within a given range of the moored torpedo.

Other objects and advantages will become more apparent from a study of the following specification and the drawings accompanying the specification. In the drawings, FIGURE 1 is a somewhat schematic showing of our mooring device; FIG. 2 is a longitudinal sectional view of a portion of a torpedo showing a side view of our mooring device with parts broken away to improve the showing; FIG. 3 is a plan view of the main anchor and auxiliary anchor in position in the main anchor; FIG. 4 is a transverse sectional view to a larger scale of the anchor cavity—anchor not in place—looking forward; FIG. 5 is a transverse sectional view to a larger scale of the anchor cavity—anchor not in place—looking aft; FIG. 6 is a plan view of the housing for the mooring equipment with parts broken away to show some details; FIG. 7 is a side view of the auxiliary anchor; FIG. 8 is a view of the auxiliary anchor taken along section lines VIII—VIII of FIG. 7; and FIG. 9 is an enlarged sectional view of the combined cable-guide and shear construction taken along section lines IX—IX of FIG. 6.

In FIG. 1, which is a showing to a large extent schematic and where 1 designates the torpedo body, the cavity or housing 31 for storing the anchors 2 and 3 is not shown in proper contour, to facilitate a discussion of the general theory of operation. To better understand the details of construction and functions of our device, a general discussion will first be given.

To moor the torpedo, the anchors 2 and 3 are provided. The torpedo itself, minus the weight of the two anchors, is quite buoyant, that is, has positive buoyance, but the weight relation between anchors and torpedo is such that with the anchors in the torpedo it has a considerable negative buoyance. The anchors once resting on the sea bottom will, with the aid of our control, hold the torpedo at a given depth in the water.

In practice, the torpedo is launched from a submarine at a lesser depth than it will occupy during its moored period. As the torpedo is launched, a trigger switch 4 is operated. This trigger switch through intermediate control device C including time limit means sets up a circuit for the latch release solenoid 5. Energization of this solenoid 5 releases the anchors 2 and 3 as shown, as a unit, drop out of the torpedo.

The main anchor 2 is secured to the outer end of the cable 6, which is wound over the payout reel 7, and the inner end of the cable is securely attached to the payout reel 7. The initial drop of the anchors is substantially restrained and as they descend a restraining force is gradually built up as will be described hereafter. The anchors have dropped some twenty-five feet, namely, a distance equal to, but preferably somewhat greater than the length of the torpedo, the braking mechanisms 8 restrains further descent of the anchors provided the torpedo is above its set depth. The main anchor 2, if not already in the position shown in FIG. 1, will thus positively take the position shown in FIG. 1 so that the auxiliary, or fluke, anchor 3 will drop out of its cavity in the main anchor. The auxiliary anchor will thus, on the descent of the torpedo and anchors, hang below the anchor a distance dependent upon the length of chain 9. The end of the flexible armature cable 10 in the stored position of the anchors in the torpedo engages the depth-actuated armature device 11–A in locking relation. As the anchors drop out of the torpedo, the pull on this armature cable unlocks the depth actuated armature device 11–A. Electric switch means in and actuated by armature device 11–A when the torpedo is at or below a predetermined depth, in combination with closure of trigger switch 4, places control system 11 in operation. Control system 11 includes timing means, target detecting devices, circuit interrupting devices and circuits for the later energization of solenoids 12 and 13 at appropriate times. These components in themselves form no part of our invention and will not be described in detail. As soon as these devices have thus been set in operation by the withdrawal of the bayonet end of cable 10, said cable hangs from the anchor in the water and thereafter has no further utility.

The braking device 8 is responsive to the hydrostatic head of the water above the torpedo. The braking device restrains the payout reel against further rotation, after the initial free fall of the anchors, and the payout reel remains thus locked in position until the anchors have pulled the torpedo to the depth at which it is desired to moor the torpedo. The hydrostatic elements 14 of brake means 8 then sufficiently releases the brake so that the anchor cable 6 is paid out while the torpedo remains at substantially the desired mooring depth.

After a predetermined time, which is selected to be ample to permit the anchors to reach sea bottom for the mooring position selected, the solenoid 12 is automatically energized to release the spring actuated latch 15. The lug 16 on this latch 15 engages one of the notches 17 in the flange 18 on the payout reel. The length of the anchor cable paid out is maintained at a fixed length determined by the distance, at the time of locking the
payout reel, between the anchors at the sea bottom and the selected mooring depth of the torpedo. At this point, the torpedo is moored to the selected mooring depth of the 3199870 reel, between the anchors at the sea bottom and the selected mooring depth of the torpedo. After the... the anchor itself deeper and deeper in the soft or hard sea bottom. The main anchor 2 which thus serves mainly to oppose the buoyancy of the torpedo, is by the anchor 3 caused to stay within a given radius of the anchor 3. Shifting of the torpedo from its moored position is thus prevented.

After the target detecting device detects a target, the control devices are set and caused to operate so that the torpedo when released may proceed toward the target. At this time, the solenoid 31 is energized so as to release the latch for the spring actuated shear. The anchor cable is sheared at a point immediately adjacent to the body surface, and the propulsion equipment is started and the torpedo speeds on its way toward the target.

For the details of the construction of our device, reference may be had to FIGS. 2, 3, 4, 5, 6, 7, 8 and 9. In FIG. 1 the torpedo shell 1 is shown provided with a water-tight anchor housing, or compartment, 31. This compartment houses the main and auxiliary anchors, the payout reel 7 and the depth control devices 19 and some other devices hereinafter discussed. The housing 31 is provided with a door 32 hinged on the bearing pin 33 and biased to its closed position, as shown in FIGS. 1 and 2, by a heavy spring 34 which is at one end secured to the wall of the housing and at its other end secured to the door. The stress of the spring is so selected as to firmly hold the door against suitable stops, not shown, to be flush with the body of the torpedo. The upper portion of the housing is provided with an air discharge opening or tube 35 so as to permit the ready discharge of the air from the housing after the torpedo is launched and the sea-water begins to enter at the peripheral edges of the door.

The main anchor is generally sector shape and is welded about a steel frame, not shown, to which the steel inserts 36, 37 and 38 are secured. The anchor is provided with a suitable recess 39 shaped to receive the auxiliary anchor 3. This auxiliary anchor has a stem portion 20 and two anchor flukes 21 and 22 which are welded to a pivot pin or shaft secured to the stem portion 20 mounted for rotation on the stem portion 20. The arrangement of the anchor flukes on the bearing shaft 23 such that the anchor flukes can take a 60° position with reference to the stem portion 26. The stem portion 26 is secured to the main anchor 2 by the chain 9 having a suitable length, as from three to six feet.

At the forward lower edge of the sector shaped anchor, it is provided with steel bearing shoes 46 and 47 which engage the bearing pin 33 of the door. These steel inserts prevent the anchor, which is made of lead and is comparatively soft, from being deformed during storage or transport so that its operation might not be impaired. The arcuate portion of the anchor is provided with steel rails 48 and 49 having rolling engagement with rollers 50 and 51 during pivotal movement of the anchor out of the anchor chamber after the torpedo is launched.

At the upper end or edge of the anchor, a suitable roller 52 is shown connected to the steel insert 36. This roller engages the hook portion 53 of the latch 54 biased to rotate in a clockwise direction by the spring 55. This latch member 54 is pivoted on a pin 56 and has an upwardly directed projection 57 engaging the cross arm 58 of the solenoid 59. At this point, this link 59 is also pivoted on bearing pin 56. At its upper end, link 59 is secured to the armature 60 for the solenoid 5. In operation, the solenoid 5 is energized a relatively short predetermined interval of time after the torpedo is launched, whereupon the armature 60 and the hook 53 which is spin clockwise to thus release the roller 52. The weight of the anchor will immediately cause the entire anchor, including the roller 52, to move clockwise on the bearing pin 33 by an amount determined by the angle between the lower arcuate surface 62 of the anchor and the door 32. This angular space between the door 32 and the lower surface 62 is so chosen that in the event the door is prevented from immediate opening by possible momentary contact with the sea bottom in case of shallow launching, the anchor will, nevertheless, have moved a sufficient amount in a clockwise direction so that the roller 52 will pass under the surface 63 of the hook 53. It is thus apparent that even if the solenoid 5 is immediately thereafter deenergized, the anchor will not again be relatched to its upper firm position in the housing for the anchor.

As soon as the torpedo clears the bottom, the anchor will move on bearing pin 33 as a pivot to open the door 32 and thus slip out of the housing. At the lower aft edge, the anchor is secured to the mooring cable 6 by means of a suitably designed swivel joint 65 of electric insulation to prevent electrolytic corrosion of the cable by the sea water. As the anchors move out of their housing, the cable is pulled out and the payout reel 7 is immediately caused to rotate to pay out the amount of cable needed for a free drop of the anchor equal to about the length of the torpedo. Before the anchor is released, there is substantially no frictional engagement between the flange 67 of the payout reel 7 and the flange 68 of the brake drum. The payout reel will thus rotate quite freely, even though the brake mechanism 8 is set, thereby permitting the anchor to drop freely out of its housing.

As best apparent from FIGS. 4 and 5, the payout reel 7 consists of a hollow drum having suitable side flanges 18 and 67. The flange 67 is designed to have frictional engagement with the flange 68 of the brake drum 70.

Disposed within the hollow drum is a helical spring 71 surrounding the reel shaft 72. The shaft 72 at the extreme right, as seen in FIG. 5, is journaled in a suitable bearing 73. To the left of the bearing, the shaft 72 is grooved with threads 74 upon which the nut 75 is threaded. This nut is threaded on the arcuate member 82 disposed on the internal surface of the hollow drum. At the brake drum end, the shaft 72 is rigidly secured to the brake drum 70 and disposed in a suitable outer bearing 80. During the initial stages of the descent of the anchor, the brake band 81 firmly grips the brake drum with the result that the shaft 72 is prevented from rotating. The payout reel 7 rotates freely, however, and in so doing, the nut 75 is caused to move toward the middle of the drum to compress the spring 71.

Since the spring 71 is disposed between the nut 75 and the inwardly directed flange 67, the payout reel is forced toward the brake drum. The spring compression and initial position of nut 75 is so chosen that locking engagement takes place between flanges 67 and 68 as soon as the anchor has cleared its free drop of from twenty-one to twenty-five feet. Thereafter, the entire assembly sinks together until the hydrostatic devices release the brake mechanism.

The brake mechanism comprises an arcuate member 82 pivoted at one end on bearing pin 83 and at its other end secured to the upper end of the arcuate member 84 and to the lower end of the hydrostatic element or pressure-responsive bellows 14.

The left end (as seen in FIG. 2) of the arcuate member 82 is secured to the right bearing pin 83 to the
upper end of the brake band 81. The lower end of the brake band is adjustably secured to the arm 86 also pivoted on bearing 87. Counterclockwise rotation of arcuate member 82 will thus release the brake band and thus permit rotation of the payout reel. This operation is accomplished by the combined action of the bellows and the spring 84.

The lower end of spring 84 is secured to the link 87. This link is adjustable in length as shown, and may be pulled vertically to adjust the tension of the spring 84 by the mooring depth adjustor 88. This mooring depth adjustor comprises a worm and worm wheel transmission 89, or any other type of transmission, graduated in fathoms or feet depth for vertically moving the link 87 to adjust the pull of spring 84 on the hydrostatic bellows 14.

The spring 84 and hydrostatic device 14 act in opposition to each other and both together determine the angular movement of arcuate member 82. As long as the spring force predominates, as will be the case as long as the torpedo is at a lesser depth than selected by the adjustment of the mooring depth adjustor, the brake band will lock the brake drum against rotation. As soon as the torpedo is at the desired depth, the bellows 14 will be compressed and thus effect the release of the payout reel. The anchor cable is thus paid out until the anchor is secured to the ocean floor. Short of that, solenoid 12 is energized to withdraw the pin 90 from the spring biased latch 15. This arm moves clockwise, as seen in FIG. 2, and the lug 16 engages one of the notches 17 on the flange 18. Thereafter, no more rotation of the payout reel can take place and the torpedo remains moored at the desired depth.

The torpedo remains in the moored position until a target is sighted by the acoustic or other type devices on the torpedo whereupon the cable shear is operated, the motor started, and the torpedo automatically sets its course on the target.

The shear comprises a structure 93 of two plates rigidly mounted in the housing at the bottom near the door 32, and a movable cable shearing element 94 disposed between them. This element 94 is pivoted at 95 on member 93 and has an opening at 96 designed to firmly hold a sharp circular cutting die 97 of suitable metal for cutting the steel cable 6. The lower plate of the structure 93 is provided with an adjustable nut 98, also including a circular cable cutting edge. This nut is adjusted to be firmly against the die, as shown in FIG. 9. Above and below the die 97 and nut 98 are a pair of cable guiding nuts 99 and 100. These nuts not only guide the cable through the shears to prevent rubbing of the cutting edges by the cable but also hold the die 97 and nut 98 in firmer relation to each other.

All the operating mechanism in the housing 31 are amply supplied with a grease non-reactive with sea water.

To prevent grease from being lost during the mooring operation, the shears are provided with the wipers 101 and 102 as shown. To prevent the shears from operating except when desired, a link 103 having the roller 104 is pivoted on structure 93 at 105. The disposition of the roller 104 is such that it is in the path of element 94 at the right as seen in FIG. 6. A heavy spring under some considerable tension is hooked on the projecting hooks 106 and 107 on elements 94 and 93, respectively. The upper end of link 103 is operatively connected to the armature 108 of the solenoid 13.

When the anchor cable is to be sheared, the solenoid 13 is energized to operate the link, or lever 103 in a clock-wise direction to thereby move the roller 104 out of the path of the element 94. The full loading of the spring is then applied to the projection 106 with the result that die 97 moves relative the nut 98 to cut the anchor cable 6 with a snap action.

The tube 110 through which arming cable 10 is threaded also serves to transmit hydrostatic pressure to the target detecting device. The device 111 is merely a detonating device for blowing an opening into the torpedo proper at the housing 31, when under certain desired conditions, the torpedo should be self-destructive.

We claim as our invention:

1. In a device for mooring a normally buoyant detonator at a predetermined depth in the sea after the detonator is placed in the sea, in combination, a housing in the detonator, an anchor in the housing, said anchor having a weight sufficient in magnitude to cause the normally buoyant detonator to sink to the sea bottom as long as the anchor is in the housing, latching means for normally latching the anchor in the housing, said latching means being operable a short time after the detonator is placed in the sea to release the anchor, a payout reel, a cable wound on the reel and having one end connected to the anchor, means responsive to a selected hydrostatic pressure for controlling the operation of the payout reel so that the descent of the anchor from the detonator to sea bottom is controlled as a function of the hydrostatic head of the sea water above the detonator, and a fluke anchor, having anchor hooks, flexibly connected to the first anchor to prevent shifting of the detonator from its moored position.

2. In a device for mooring a normally buoyant detonator at a selected depth in the sea after the detonator is placed in the sea, in combination, a cable payout reel rotatably mounted on the detonator, a cable one end secured to the payout reel and wound on the payout reel, an anchor secured to the outer end of the cable, and means responsive to the hydrostatic pressure of the sea at a given depth for controlling the rotation of the payout reel so as to maintain the detonator at a given depth in the sea while the anchor sinks to the sea bottom, a fluke anchor, a relatively short flexible connection between the fluke anchor and the first mentioned anchor.

3. In a device for mooring a normally buoyant detonator at a selected depth in the sea after the detonator is placed in the sea, in combination, a cable payout reel rotatably mounted on the detonator, a cable one end secured to the payout reel and wound on the payout reel, an anchor secured to the outer end of the cable, means responsive to the hydrostatic pressure of the sea at a given depth for controlling the rotation of the payout reel so as to maintain the detonator as a given depth in the sea while the anchor sinks to the sea bottom, and means for locking the payout reel against rotation after the anchor is on the bottom of the sea to thereby maintain a given cable length between the anchor and detonator.

4. In a device for mooring a normally buoyant detonator at a selected depth in the sea after the detonator is placed in the sea, in combination, a cable payout reel rotatably mounted on the detonator, a cable one end secured to the payout reel and wound on the payout reel, an anchor secured to the outer end of the cable, means responsive to the hydrostatic pressure of the sea at a given depth for controlling the rotation of the payout reel so as to maintain the detonator as a given depth in the sea while the anchor sinks to the sea bottom, a fluke anchor, a relatively short flexible connection between the fluke anchor and the first mentioned anchor, and means for locking the payout reel against rotation after the anchor is on the bottom of the sea to thereby maintain a given cable length between the anchor and detonator.

5. In a device for mooring a normally buoyant detonator at a selected depth in the sea after the detonator is placed in the sea, in combination, a cable payout reel rotatably mounted on the detonator, a cable one end secured to the payout reel and wound on the payout reel, an anchor secured to the outer end of the cable, means responsive to the hydrostatic pressure of the sea at a given depth for controlling the rotation of the payout reel
so as to maintain the detonator at a given depth in the sea while the anchor sinks to the sea bottom, and means for severing the cable connection between anchor and detonator when a target for the detonator is within the detection range of the detonator.

6. In a device for mooring a normally buoyant detonator at a selected depth in the sea after the detonator is placed in the sea, in combination, a cable payout reel rotatably mounted on the detonator, a cable one end secured to the payout reel and wound on the payout reel, and an anchor secured to the outer end of the cable, means responsive to the hydrostatic pressure of the sea at a given depth for controlling the rotation of the payout reel so as to maintain the detonator at a given depth in the sea while the anchor sinks to the sea bottom, a fluke anchor, a relatively short flexible connection between the fluke anchor and the first mentioned anchor, and means for severing the cable connection between anchor and detonator when a target for the detonator is within the detection range of the detonator.

7. In a device for mooring a normally buoyant detonator at a selected depth in the sea after the detonator is placed in the sea, in combination, a cable payout reel rotatably mounted on the detonator, a cable one end secured to the payout reel and wound on the payout reel, an anchor secured to the outer end of the cable, means responsive to the hydrostatic pressure of the sea at a given depth for controlling the rotation of the payout reel so as to maintain the detonator at a given depth in the sea while the anchor sinks to the sea bottom, a fluke anchor, a relatively short flexible connection between the fluke anchor and the first mentioned anchor, and means for severing the cable connection between anchor and detonator when a target for the detonator is within the detection range of the detonator.

8. In a device for mooring a normally buoyant detonator at a selected depth in the sea after the detonator is placed in the sea, in combination, a cable payout reel rotatably mounted on the detonator, a cable one end secured to the payout reel and wound on the payout reel, an anchor secured to the outer end of the cable, means responsive to the hydrostatic pressure of the sea at a given depth for controlling the rotation of the payout reel so as to maintain the detonator at a given depth in the sea while the anchor sinks to the sea bottom, a fluke anchor, a relatively short flexible connection between the fluke anchor and the first mentioned anchor, means for locking the payout reel against rotation after the anchor is on the bottom of the sea to thus thereafter maintain a given cable length between the anchor and detonator, and means for severing the cable connection between anchor and detonator when a target for the detonator is within the detection range of the detonator.

9. In a device for mooring a normally buoyant torpedo at a selected depth in the sea after the torpedo is launched, in combination, a housing in the torpedo, a cable payout reel rotatably mounted in the housing, a cable at one end connected to the payout reel and wound on the reel, a sector shaped relatively heavy anchor weight pivotally mounted in the housing, the other, or outer, end of the cable being connected to the weight, a latch for holding the weight in position on its pivot in the housing, a fluke anchor mounted within the weight, a relatively short flexible connection between the weight and fluke anchor, braking means for the payout reel for holding the payout reel against rotation, means for releasing the latch for the anchor weight operable a relatively short time interval after the torpedo is launched whereby the anchor weight and fluke anchor, by rotary action on its pivot, drops out of the housing, and hydrostatic means operable when the torpedo has sunk to a given depth to control said braking means to permit the payout reel to pay out cable, while the torpedo remains at a given depth, till the weight and fluke anchor are at sea bottom.

10. In a device for mooring a normally buoyant torpedo at a selected depth in the sea after the torpedo is launched, in combination, a housing in the torpedo, a cable payout reel rotatably mounted in the housing, a cable at one end connected to the payout reel and wound on the reel, a sector shaped relatively heavy anchor weight pivotally mounted in the housing, the other, or outer, end of the cable being connected to the weight, a latch for holding the weight in position on its pivot in the housing, a fluke anchor mounted within the weight, a relatively short flexible connection between the weight and fluke anchor, braking means for the payout reel for holding the payout reel against rotation, means for releasing the latch for the anchor weight operable a relatively short time interval after the torpedo is launched whereby the anchor weight and fluke anchor, by rotary action on its pivot, drops out of the housing, and hydrostatic means operable when the torpedo has sunk to a given depth to control said braking means to permit the payout reel to pay out cable, while the torpedo remains at a given depth, till the weight and fluke anchor are at sea bottom.
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13. In a device for mooring a normally buoyant torpedo at a selected depth in the sea after the torpedo is launched, in combination, a housing in the torpedo, a cable payout reel rotatably mounted in the housing, a cable at one end connected to the payout reel and wound on the reel, a sector shaped relatively heavy anchor weight pivotally mounted in the housing, the other, or outer, end of the cable being connected to the weight, a latch for holding the weight in position on its pivot in the housing, means for severing the cable between the weight and the torpedo when a target ship for the torpedo is within detection range of the torpedo.

14. In a device for mooring a normally buoyant torpedo at a selected depth in the sea after the torpedo is launched, in combination, a housing in the torpedo, a cable payout reel rotatably mounted in the housing, a cable at one end connected to the payout reel and wound on the reel, a sector shaped relatively heavy anchor weight pivotally mounted in the housing, the other, or outer, end of the cable being connected to the weight, a latch for holding the weight in position on its pivot in the housing, a fluke anchor mounted within the weight, a relatively short flexible connection between the weight and fluke anchor, braking means for holding the payout reel against rotation, means for releasing the latch for the anchor weight operable a relatively short time interval after the torpedo is launched whereby the anchor weight and fluke anchor rotate on their pivot, drops out of the housing, and hydrostatic means operable when the torpedo has sunk to a given depth to control braking means to permit the payout reel to pay out cable, while the torpedo remains at a given depth, the weight and fluke anchor are at sea bottom, means for locking the payout reel against rotation after the weight and fluke anchor are at sea bottom to thus maintain a given cable length between the weight and the torpedo, and means for severing the cable between the weight and torpedo when a target ship for the torpedo is within detection range of the torpedo.

15. In a device for mooring a normally buoyant torpedo at a selected depth in the sea after the torpedo is launched, in combination, a housing in the torpedo, a cable payout reel rotatably mounted in the housing, a cable at one end connected to the payout reel and wound on the reel, a sector shaped relatively heavy anchor weight pivotally mounted in the housing, the other, or outer, end of the cable being connected to the weight, a latch for holding the weight in position on its pivot in the housing, a fluke anchor mounted within the weight, a relatively short flexible connection between the weight and fluke anchor, braking means for holding the payout reel against rotation, means for releasing the latch for the anchor weight operable a relatively short time interval after the torpedo is launched whereby the anchor weight and fluke anchor rotate on their pivot, drops out of the housing, and hydrostatic means operable when the torpedo has sunk to a given depth to control braking means to permit the payout reel to pay out cable, while the torpedo remains at a given depth, the weight and fluke anchor are at sea bottom, means for locking the payout reel against rotation after the weight and fluke anchor are at sea bottom to thus maintain a given cable length between the weight and the torpedo, and means for severing the cable between the weight and the torpedo when a target ship for the torpedo is within detection range of the torpedo.