Nov. 10, 1936. J. H. HAMMOND, JR 2,060,199

PHOTOELECTRIC DETONATOR CONTROLLED BY INTENSITY CHANGE

Filed Jan. 5, 1934 3 Sheets-Sheet 1

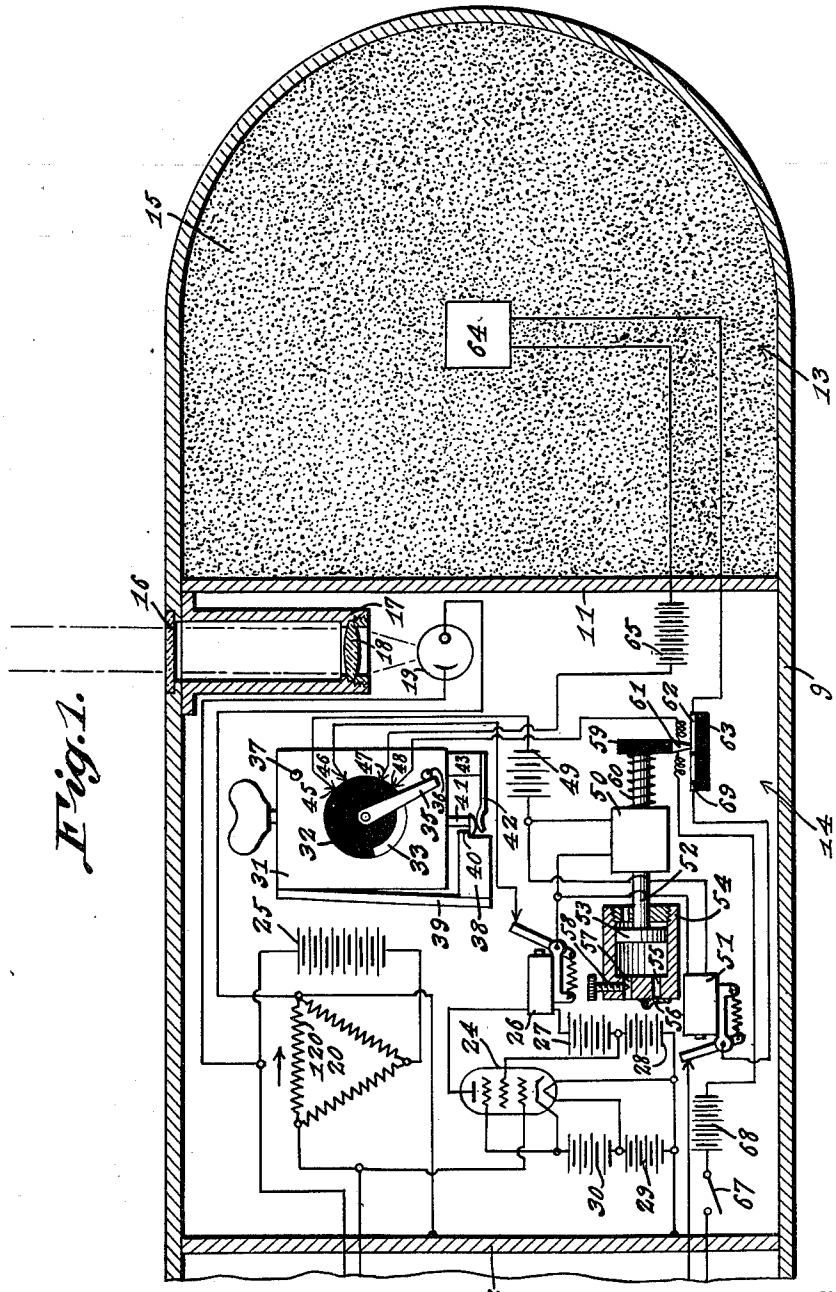


Fig. 1.

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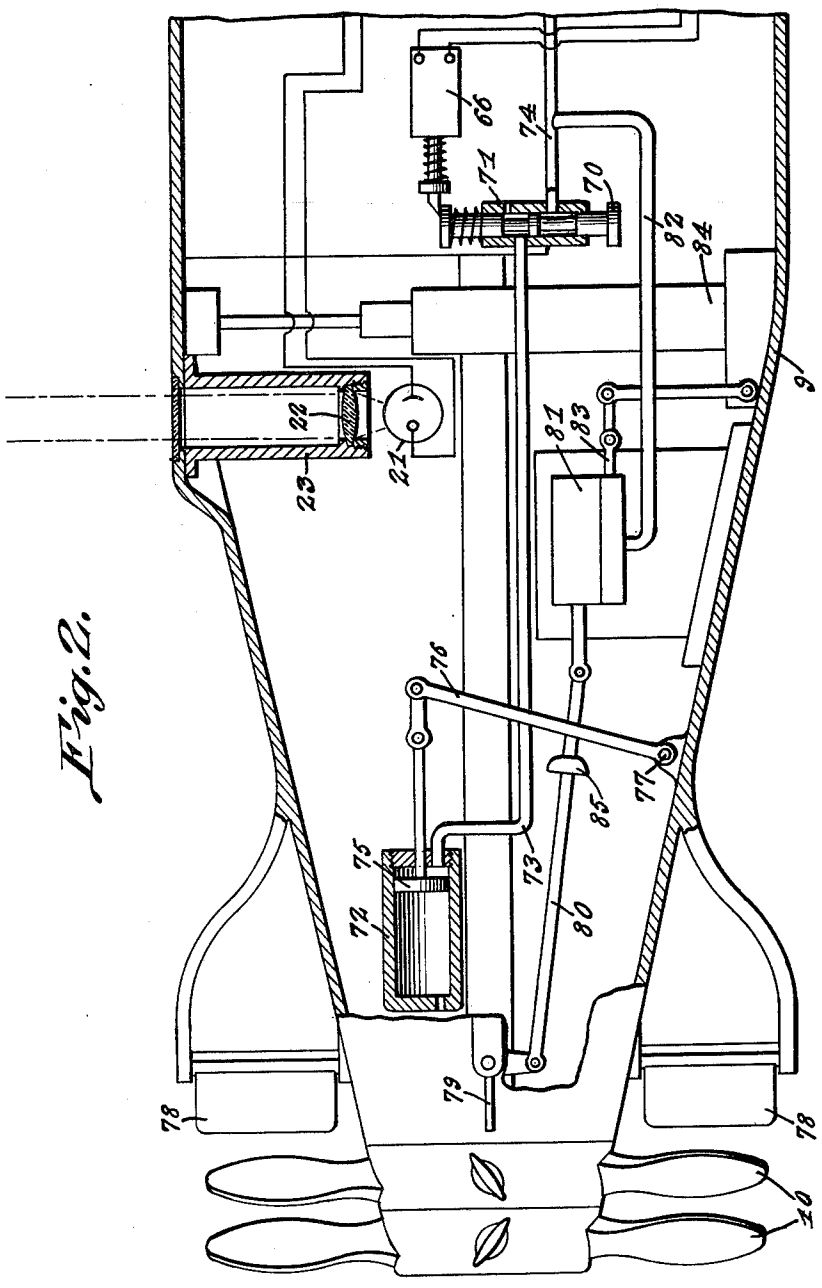


Fig. 2.

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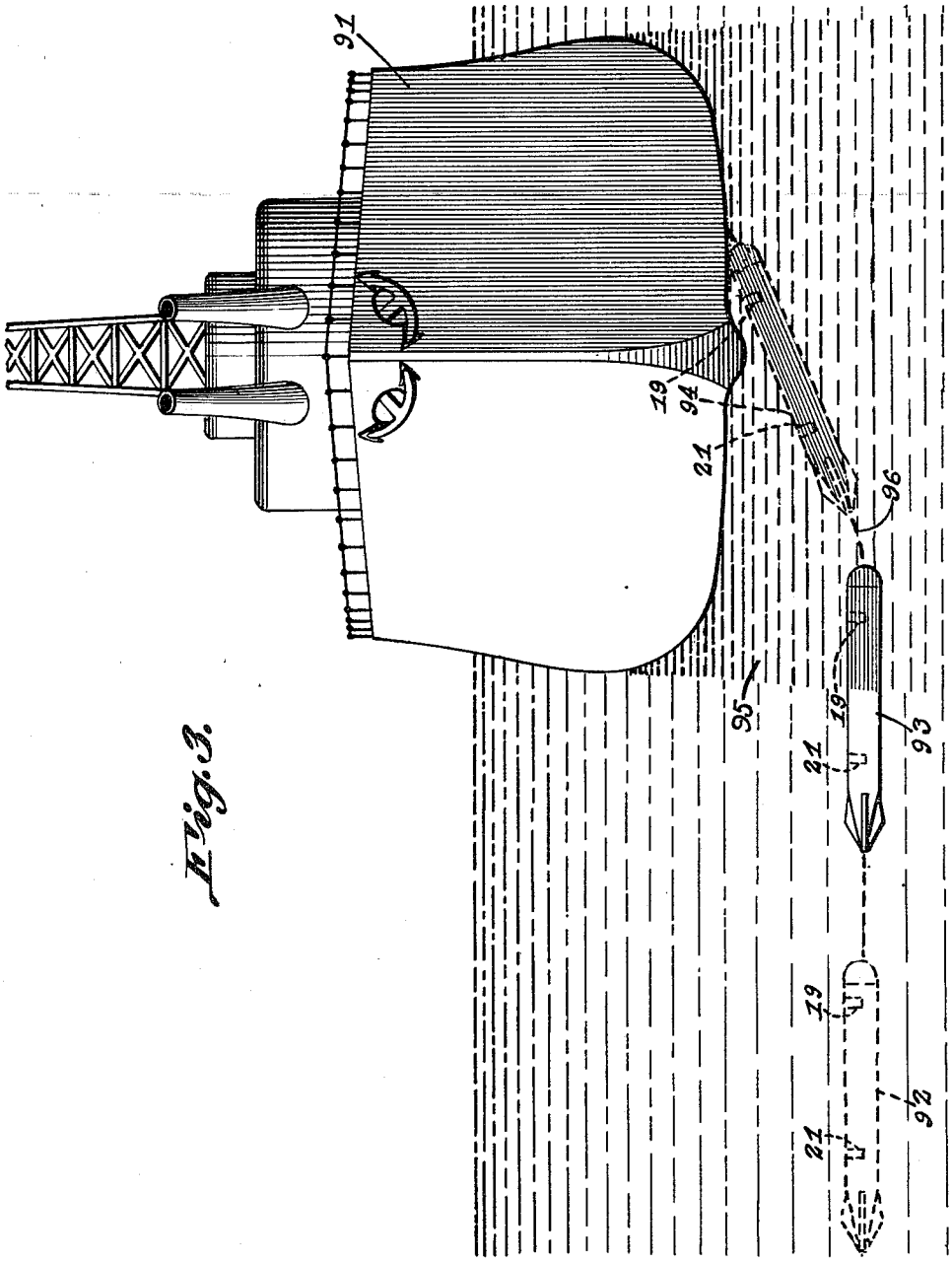


Fig. 3.

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2,060,199

PHOTOELECTRIC DETONATOR CONTROLLED BY INTENSITY CHANGE

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Application January 5, 1934, Serial No. 705,354

13 Claims. (Cl. 114—21)

This invention relates to ordnance devices and more particularly to torpedoes.

According to one form of the invention, a torpedo may be provided with light sensitive devices which control the detonation of the explosive charge thereof when it passes beneath a ship. The torpedo mechanism may include photoelectric cells which are energized by the light of day transmitted through the water above the torpedo. These cells may be balanced to maintain the control mechanism inoperative as long as the cells receive the same intensity of illumination. As soon as the illumination of some of the cells is different from that of the other cells the mechanism may operate to produce the desired results. Thus the apparatus may be independent of weather conditions and may function equally well on bright or dull days.

The invention may also provide means whereby the detonation of the war head of the torpedo is delayed a predetermined time after the photosensitive means has passed into the shadow of the ship in order to allow the explosion to occur near the central portion of the vessel, where it would be most effective, rather than at the so called "blister" where it would be comparatively ineffective.

The invention also consists in certain new and original features of construction and combinations of parts hereinafter set forth and claimed.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, the mode of its operation and the manner of its organization may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part thereof, in which

Figure 1 represents diagrammatically the forward portion of a torpedo provided with this invention.

Figure 2 represents diagrammatically the afterbody of the same torpedo, and

Figure 3 diagrammatically illustrates the course of a torpedo attacking an enemy vessel.

Like reference characters denote like parts in the several figures of the drawings.

In the following description and in the claims, parts will be identified by specific names for convenience, but they are intended to be as generic in their application to similar parts as the art will permit.

Referring to the accompanying drawings, and more particularly to Figures 1 and 2, there is shown a water-borne body such as a carrier of explosives having a water tight torpedo hull 9, and arranged to be propelled in the usual manner by propellers 10 located at the after end. The hull 9 is provided with two transverse bulkheads 11 and 12, thus providing two compartments 13 and 14, the former being filled with an explosive charge 15, such for example as TNT.

A hole is provided in the hull 9 at the top of the compartment 14. This hole is covered by a sheet of glass or other transparent material 16. Mounted in a tube 17 is a lens 18 which is positioned directly below the hole in the hull. The interior of the tube 17 is painted a flat black so as not to reflect any light. Positioned at the focus of the lens 18 is a photoelectric cell 19 one side of which is connected to a resistance bridge 20 and the other side to a second photoelectric cell 21 located in the afterbody, as shown in Fig. 2. The cell 21 is situated at the focus of a lens 22 mounted at the end of a tube 23 which tube is secured to the hull 9. A hole in hull 9, covered by a sheet of glass or other transparent material, is located at the end of the tube 23 and directly above the lens 22. The tube 23 is painted a flat black on the interior surface, so as not to reflect any light.

The other side of the photoelectric cell 21 is connected to the resistance bridge 20 and to the grid of a pentode tube 24. A battery 25 is connected from one point of the bridge 20 to the two cells 19 and 21. The plate of the tube 24 is connected through the winding of a relay 26 to a battery 27, the other side of which is connected to the screen of the tube 24. This screen is connected thru a battery 28 to ground. A filament battery 29 and a biasing battery 30 are also provided.

A clock-work mechanism 31 is provided which drives a commutator 32. This commutator is provided with a conducting segment 33. To the shaft of the commutator is secured an arm 35 which normally engages a pin 36. A second pin 37 is provided for limiting the motion of the arm 35 and the commutator 32.

For automatically starting the clock-work mechanism 31 a heavy weight 38 is secured to the end of a flat spring 39 the upper end of which is fastened to the casing of the clock-work mechanism 31. The weight 38 is provided with a projection 40 which normally engages a finger 41 which controls the starting of the clock-work mechanism. Engaging the end of the finger 41 is a spring 42 which is supported on a bracket 43.

Engaging the commutator 32 are four brushes

45, 46, 47 and 48. The brush 45 is connected through a battery 49 to one side of the winding of a solenoid 50 and to one side of the winding of a relay 51. The other sides of these windings are connected to the armature of the relay 26.

The solenoid 50 is provided with a core 52 which is adapted to be moved to the left as shown in Fig. 1 when this solenoid is energized. Secured to one end of this core is a piston 53 which reciprocates in a cylinder 54. This cylinder is provided with a port 55 covered by a flap valve 56 which is adapted to allow the air to escape rapidly from this cylinder. The cylinder is also provided with a port 57 the opening in which is controlled by a needle valve 58 for restricting the flow of air through this port.

To the other end of the core 52 is secured an insulating member 59 between which and the solenoid 50 is mounted a compression spring 60. Mounted on the insulating member 59 is a contact 61 which is connected to the contact 48 and at suitable times engages a conducting segment 62 mounted on an insulating base 63. The segment 62 is connected to one side of a detonator 64, the other side of which is connected to the contact 47 through a battery 65.

The back contact of the relay 51 is connected to one side of a solenoid 66 located in the afterbody of the torpedo as shown in Fig. 2. The other side of the winding of this solenoid is connected through a switch 67 and a battery 68 to the contact 61. A conducting segment 69 is provided in the insulating block 63 and is connected to the armature of the relay 51.

The core of the solenoid 66 normally engages a valve 70 which is mounted for reciprocation in a valve casing 71. The interior of this valve communicates with the interior of a cylinder 72 by means of a pipe 73. Also communicating with the interior of the valve 71 is a pipe 74 which is supplied with fluid under pressure from any suitable source not shown. Slidably mounted in the cylinder 72 is a piston 75 which is operatively connected to an arm 76 which is pivoted for rotation about an axis 77 supported by the shell of the torpedo.

The torpedo is provided with the usual vertical and horizontal rudders 78 and 79. The latter are operated by means of a link 80 from the horizontal steering engine 81 which is supplied with fluid under pressure from a pipe 82 and is controlled by a valve 83 operated in a well-known manner from the depth control mechanism 84. Secured to the link 80 is a collar 85 which is located in the path of travel of the arm 76.

In the operation of this system when the torpedo is fired the inertia of the weight 38 causes it to be moved backward relative to the torpedo, thus disengaging the projection 40 from the finger 41 which is moved upwardly under the action of the spring 42 thus causing the clock-work mechanism to start turning the commutator 32 at a predetermined speed. Switch 67 is closed before firing. The circuit through the solenoid 66 will be open however, as the brush 61 does not make contact with the segment 69.

The photoelectric cells 19 and 21, which are chosen to have uniform characteristics are in a bridge arrangement comprising the resistance bridge 20. When the illumination of the two cells 19 and 21 is equal no current will pass through the resistance 120 irrespective of the intensity of the illumination of the cells 19 and 21. The pentode tube 24 is biased to near cut-off value by the positive potential produced on the cathode of this tube by the biasing battery 30, thus preventing any flow of current through the tube 24 and keeping the relay 26 deenergized.

After a predetermined interval of time the segment 33 of the commutator 32 will engage the brushes 45 and 46, thus connecting the contacts of high resistance relay 26 in the circuit including the solenoid 50 and the relay 51 which devices will be energized by the battery 49. This will cause the core 52 of the solenoid 50 to be moved rapidly to the left as the air in the cylinder 54 is freely exhausted through the port 55. The contact 61 will be moved off the segment 62, thus keeping the circuit to the detonator 64 open as the segment 33 comes into engagement with brushes 47 and 48. The solenoid 66 will still remain deenergized due to the opening of its circuit by the relay 51.

This condition continues as long as the two photoelectric cells 19 and 21 receive light of the same intensity no matter whether this intensity is high as in bright day-light or low as at dusk or on cloudy days. When the torpedo passes beneath an enemy ship, however, the light will first be decreased on the photoelectric cell 19. This relative decrease of light on cell 19 will cause an unbalancing of the bridge arrangement thus causing current to flow through the resistance 120 in the direction shown by the arrow, thus putting a positive potential on the grid of the tube 24. This will permit the passage of current through this tube and through the high resistance relay 26, thereby causing the operation of this relay which will open the circuits to release solenoid 50 and relay 51. The release of relay 51 closes the circuit through the solenoid 66 as the contact 61 is then in engagement with the segment 69. This causes the core of the solenoid 66 to be moved to the right, thus releasing the valve 70 which is moved upwardly under the action of a spring surrounding this valve. This allows fluid under pressure to pass from the pipe 74 through the interior of the valve casing 71 and pipe 73 to the interior of the cylinder 72. This causes the piston 75 to be moved to the left, thus rotating the arm 76 in a counterclock-wise direction. This arm engages the collar 85 and forces it together with the link 80 to the left against the action of the steering engine 81, thus throwing the horizontal rudders 79 into the hard-up position, which causes the torpedo to be steered sharply upward.

The deenergization of the solenoid 50 allows the core 52 to be moved slowly to the right under the action of the spring 60, the speed of this motion being determined by the setting of the needle valve 58. After a predetermined interval of time the contact 61 will engage the segment 62, thus closing a circuit from the battery 65 through the segment 33 and contact 61 to the detonator 64, which is detonated thereby exploding the charge of explosive 15 in the war head of the torpedo.

This explosion will take place directly under the center of the ship and in contact with the hull as the mechanism has been so timed that it will give the torpedo a sufficient time to reach a position under the center of the ship and the horizontal rudders will have directed the torpedo upwardly so that it is in contact with the hull of the ship.

If it is desired to operate the system without the use of the horizontal rudders, the switch 67 may be opened, thereby causing the solenoid 66

to remain inoperative so that the horizontal rudders will not be affected.

Fig. 3 shows a torpedo of this construction attacking the enemy's ship. In this figure the enemy vessel is pictured at 91 and 3 positions of the torpedo at 92, 93 and 94 respectively. In the position shown at 92 the torpedo is running submerged at the required depth and the photoelectric cells are energized equally by light received through the water. At 93 the torpedo is shown entering the shadow 95 of the hull of the vessel 91. At this instant the illumination of the photoelectric cell 19 has been decreased relatively to the illumination of the cell 21 and the operation of the horizontal rudders 79 just described has been initiated causing the torpedo to follow the course indicated by the dotted line 96 until it reaches the position shown at 94 where the explosive charge will be detonated directly under the center of the ship and in contact with the hull thereof, thus insuring the destruction of the enemy vessel.

In order to prevent the premature explosion of the torpedo in the event that it should pass under some floating debris and thereby momentarily occult the light sensitive means, any type of well-known delay action means may be provided, such as a condenser shunted across the relay 26, so as to make it necessary for the photoelectric cell 19 to be occulted for an appreciable length of time before the operation of the mechanism will be initiated.

An important advantage of this system of running torpedoes at considerably greater depths than are now used is the fact that at these depths the wakes are much farther behind the torpedoes when they come to the surface due to the longer time it takes the bubbles of air to rise to the surface and that the wakes are much less conspicuous due to the fact that the air has had a longer time to become diffused in the water. It is, therefore, much more difficult to observe and locate these torpedoes than those run at present day depths.

Although only a few of the various forms in which this invention may be embodied have been shown herein, it is to be understood that the invention is not limited to any specific construction, but might be embodied in various forms without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. In combination with a moving body, an explosive charge carried thereby, two light receptive means mounted on said body for receiving light from an external source, and means operated when the light received by these two means is of different intensity for causing the detonation of the explosive charge.

2. In combination with a moving body, an explosive charge carried thereby, two light receptive means mounted on said body for receiving light from an external source, means operated when the light received by these two means is of different intensity for causing the detonation of the explosive charge, and means for preventing the detonation of said explosive charge for a predetermined time after the launching of said body.

3. In combination with a moving body, an explosive charge, means for causing the detonation of said charge and two light sensitive means for controlling said detonating means so that when the intensity of illumination is different on the two light sensitive means it will cause the detonation of said explosive charge.

4. In combination with a moving body, an explosive charge carried thereby, a means for exploding said charge, a solenoid for controlling said means so that when said solenoid is deenergized it will cause the explosion of said charge and two light receptive devices which, when illuminated from an external source, with equal intensity, cause said solenoid to be energized and when illuminated with unequal intensity cause said solenoid to be deenergized.

5. In a moving body, an explosive charge, means for detonating said charge, two light sensitive devices for operating said detonating means so that when the illumination is different on said devices it will cause the detonation of said explosive charge and means for preventing the detonation of said explosive charge for a predetermined time after the illumination on the light sensitive device has been changed.

6. In combination with a moving body, an explosive charge, means for causing the detonation of said charge and a plurality of light sensitive means for controlling said detonating means, and means for causing detonation of the explosive charge at a predetermined interval after the relative intensity of illumination of said light sensitive means is changed.

7. In a moving body, an explosive charge, means for detonating said charge, and a plurality of light sensitive devices for operating said detonating means so that when equally illuminated with light of any intensity it will prevent the detonation of said explosive charge and when any of said light sensitive devices are illuminated with light of a different intensity from the rest of said devices it will cause the detonation of said explosive charge.

8. In combination with a body carrying an explosive charge of a means of detonating said charge and a plurality of light sensitive devices for operating said detonating means so that when equally illuminated with light of any intensity the detonation of said explosive charge will be prevented, and when illuminated with light of different intensities will cause the detonation of said explosive charge.

9. In a torpedo, an explosive charge, a pair of light sensitive devices and means responsive to a change in relative intensity of light received by said devices to detonate said charge.

10. In a torpedo, a utility carried thereby, a plurality of light receptive devices carried by said torpedo adapted to receive natural light transmitted directly through the water above said torpedo, and actuating mechanism controlled by said light receptive devices for operating said utility responsive to unequal reception of light by said devices.

11. In a torpedo, a utility carried thereby, a pair of light receptive devices carried by said torpedo and adapted to receive natural light transmitted directly through the water, the first of said devices being situated in the forward end of said torpedo and the second of said devices being situated in the rearward end thereof, means controlled by said devices and responsive to unequal reception of light thereby to operate said utility.

12. In a torpedo, a pair of light sensitive devices, steering means to control the depth of travel of said torpedo and means responsive to a change in relative intensity of light received

by said devices to cause said steering means to deflect said torpedo upwardly.

13. In a torpedo, a utility carried thereby, a pair of radiation receptive devices carried by said torpedo and adapted to receive radiations transmitted directly through the water, one of said devices being situated in the forward part of said torpedo and the other of said devices being situated in the rearward part thereof and means controlled by said devices and responsive to an unequal reception of radiations caused by the influence of an external object on one of said devices for operating said utility.

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