

Nov. 10, 1936.

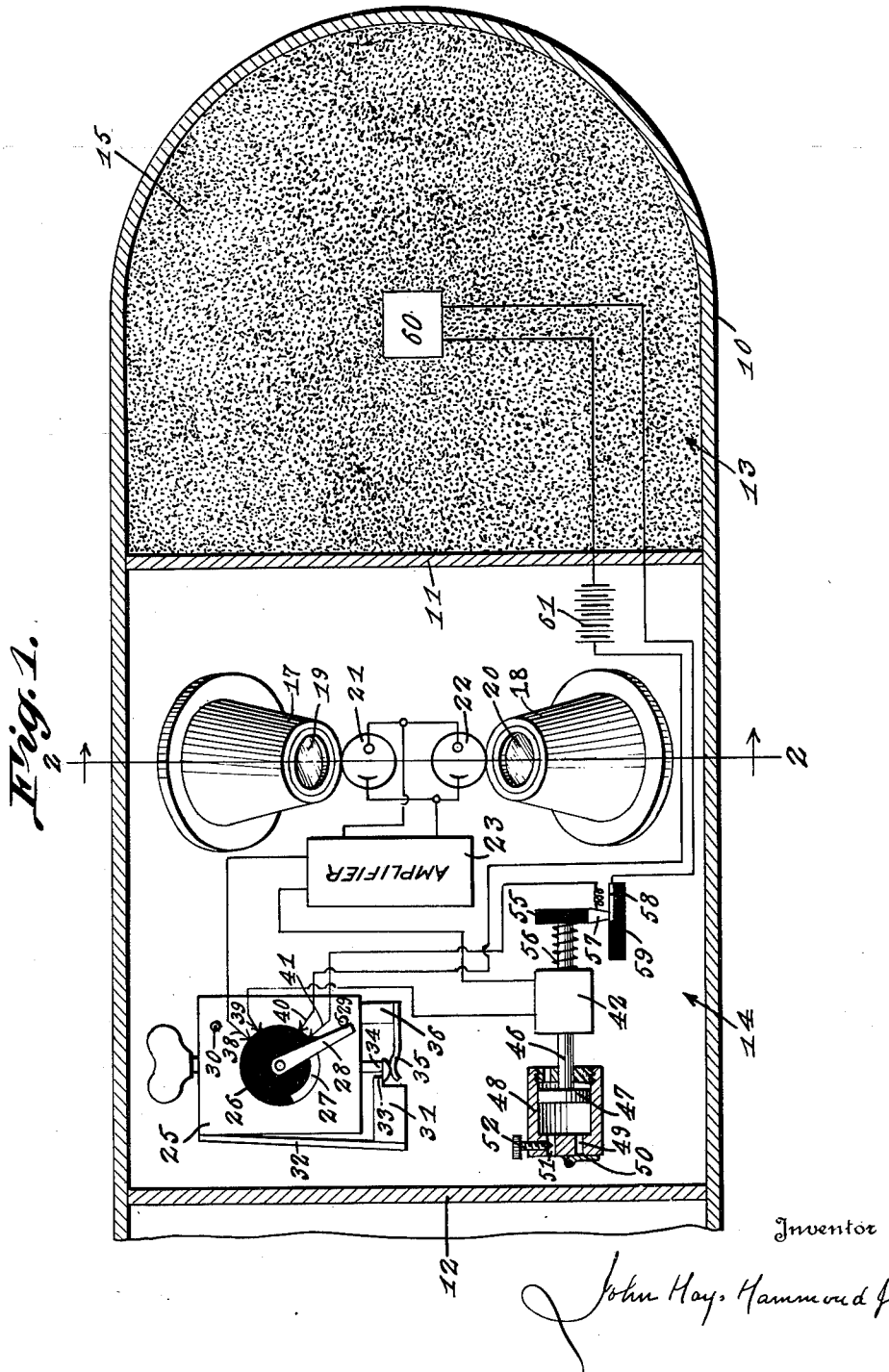
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2,060,201

PHOTOELECTRIC DETONATOR USING TWO-PHOTOELECTRIC CELLS

Filed Jan. 5, 1934

2 Sheets-Sheet 1



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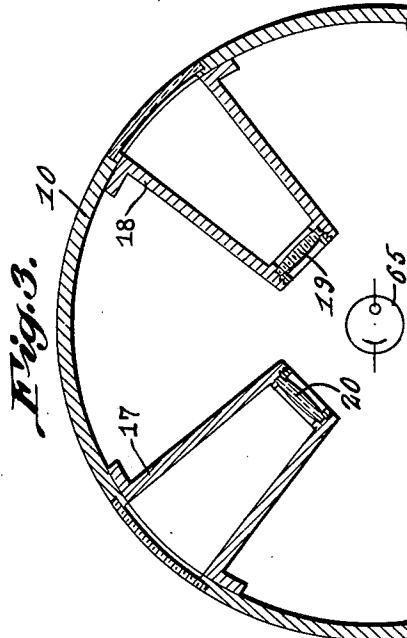
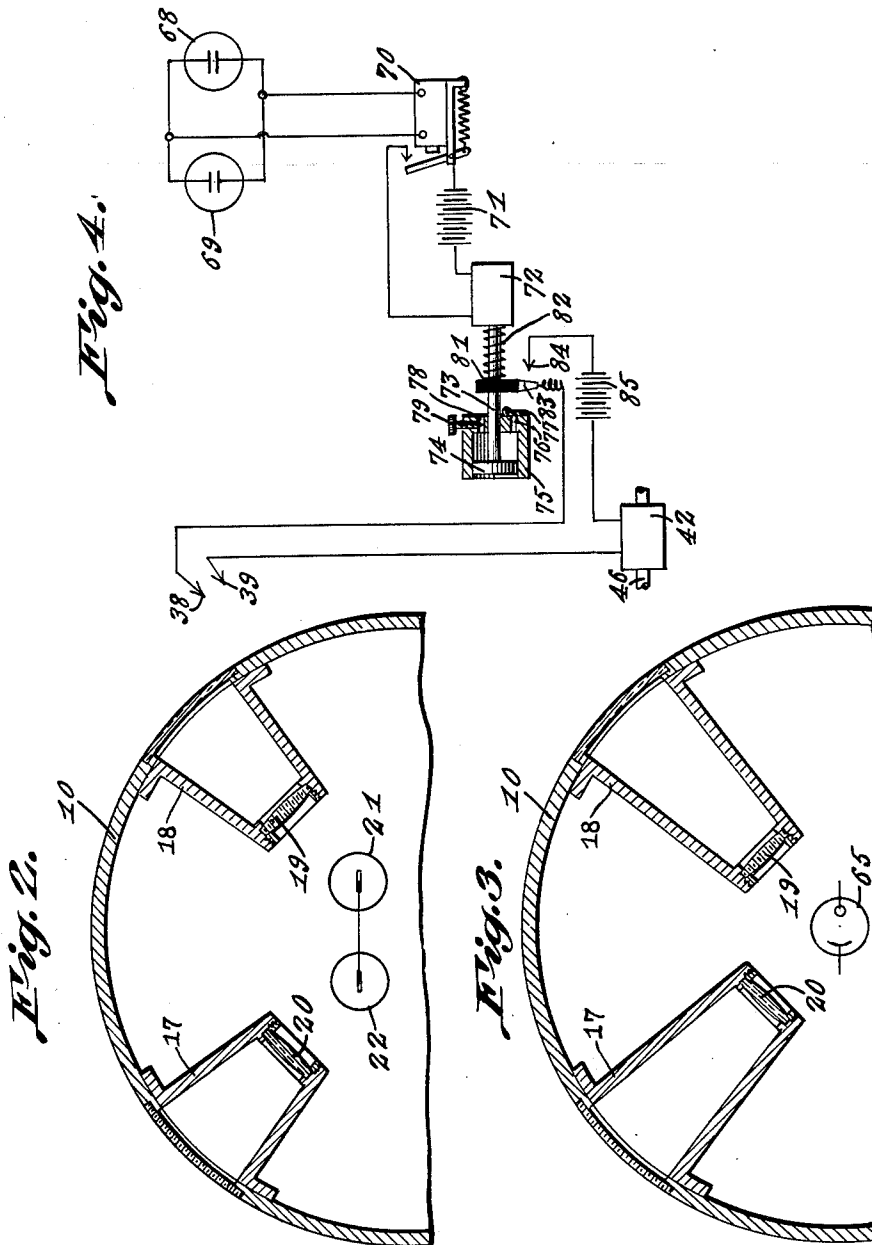
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2,060,201

PHOTOELECTRIC DETONATOR USING
TWO PHOTOELECTRIC CELLS

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Application January 5, 1934, Serial No. 705,357

13 Claims. (Cl. 114—21)

The 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 a plurality of photoelectric cells which are energized by the light of day transmitted through the water above the torpedo. When the torpedo passes beneath a ship, the shadow causes the deenergization of the photoelectric cells which in turn may be arranged to cause the detonation of the war head of the torpedo. Some of the photoelectric cells may be arranged to receive light from directions different from others to compensate for variations due to the rolling of the torpedo.

The invention may also provide a 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

Fig. 1 represents diagrammatically the forward portion of a torpedo provided with this invention as seen from below,

Fig. 2 is a section taken on line 2—2 of Fig. 1,

Fig. 3 is a section similar to Figure 2 of a modified form of the invention, and

Fig. 4 diagrammatically illustrates a modified form of circuits used in connection with this invention.

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 10, and arranged to be propelled in the usual manner by propellers located at the after end. The hull 10 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.

Two holes are provided in the hull 10 in the upper part of the compartment 14. Each hole is covered by a sheet of glass or other transparent material. Mounted in two tubes 17 and 18 are two lenses 19 and 20 which are positioned in line with the corresponding holes in the hull. The interiors of the tubes are painted a flat black so as not to reflect any light. Positioned at the foci of the lenses 19 and 20 are two photoelectric cells 21 and 22 which are connected in parallel to the input circuit of an amplifier 23.

A clock-work mechanism 25 is provided which drives a commutator 26. This commutator is provided with a conducting segment 27. To the shaft of the commutator is secured an arm 28 which normally engages a pin 29. A second pin 30 is provided for limiting the motion of the arm 28 and the commutator 26.

For automatically starting the clock-work mechanism 25, a heavy weight 31 is secured to the end of a flat spring 32, the upper end of which is fastened to the casing of the clock-work mechanism 25. The weight 31 is provided with a projection 33 which normally engages a finger 34 which controls the starting of the clock-work mechanism. Engaging the end of the finger 34 is a spring 35 which is supported on a bracket 36.

Engaging the commutator 26 are four brushes 38, 39, 40 and 41. The brush 38 is connected to one side of the output circuit of the amplifier 23. The brush 39 is connected to one side of a solenoid 42, the other side of which is connected to the amplifier 23.

The solenoid 42 is provided with a core 46 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 47 which reciprocates in a cylinder 48. This cylinder is provided with a port 49 covered by a flap valve 50 which is adapted to allow air to escape rapidly from this cylinder. The cylinder is also provided with a port 51 the opening in which is controlled by a needle valve 52 for restricting the flow of air through this port.

To the other end of the core 46 is secured an insulating member 55 between which and the

solenoid 42 is mounted a compression spring 56. Mounted on the insulating member 55 is a contact 57 which is connected to the contact 41 and at suitable times engages a conducting segment 58 mounted on an insulating base 59. The segment 58 is connected to one side of a detonator 60, the other side of which is connected to the contact 40 through a battery 61.

In the operation of this system when the torpedo is fired the inertia of the weight 31 causes it to be moved backwardly relative to the torpedo, thus disengaging the projection 33 from the figure 34 which is moved upwardly under the action of the spring 35, thus causing the clockwork mechanism to start turning the commutator 26 at a predetermined speed. After a predetermined interval of time the segment 27 of the commutator 26 will engage the brushes 38 and 39, thus connecting the amplifier 23 to the solenoid 42 which will be energized as the photoelectric cells 21 and 22 will by this time be receiving the light of day focused upon them by means of the lenses 19 and 20.

This will cause the core 46 of the solenoid 42 to be moved rapidly to the left as the air in the cylinder 48 is freely exhausted through the port 49. This condition continues as long as the photoelectric cells 21 and 22 receive light through the lenses 19 and 20.

When the torpedo passes beneath an enemy ship, the light will be cut off from the photoelectric cells 21 and 22 thus causing the deenergization of the solenoid 42, which allows the core 46 to be moved slowly to the right under the action of the spring 56, the speed of this motion being determined by the setting of the needle valve 52. After a predetermined interval of time the contact 57 will engage the segment 58, thus closing the circuit from the battery 61 through the segment 27 and contact 57 to the detonator 60 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 as the mechanism has been so timed that it will give the torpedo a sufficient length of time to reach this position.

By the use of two photoelectric cells connected in parallel and located with their optical axes at 45° on either side of the vertical, it is possible to compensate for any rolling of the torpedo which otherwise would affect the light received by a single photoelectric cell.

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 circuit may be incorporated in the amplifier 23, so as to make it necessary for the photoelectric cells 21 and 22 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.

In the modified form of the invention shown in Fig. 3, a single photoelectric cell 65 is used in place

of the two cells 21 and 22 and is located at the focus of the lenses 19 and 20. This photoelectric cell is connected to the input circuit of the amplifier 23. The system functions substantially the same as that shown and described in connection with Figures 1 and 2. In this case if the torpedo should roll the light received by the cell 65 will remain practically constant due to the fact that the light transmitted through one lens will increase in proportion as the light in the other lens decreases.

In the modified form of the invention shown in Fig. 4 two photoelectric cells 68 and 69 take the place of the photoelectric cells 21 and 22. These cells are of the new type similar to those developed by the Weston Instrument Company and by the Westinghouse Electric Manufacturing Company. These cells do not require the use of the amplifier but generate sufficient current so that they will operate a sensitive relay directly and are shown in this figure as connected to the winding of a sensitive relay 70. This relay controls the circuit through a battery 71 and a solenoid 72. The core 73 of this solenoid is provided at its distal end with a piston 74 which reciprocates in a cylinder 75. This cylinder is provided with a port 76 covered by a flap valve 77 which is adapted to allow air to escape freely from this cylinder. The cylinder is also provided with a port 78 the opening in which is controlled by a needle valve 79 for restricting the flow of air through this port.

To the central portion of the core 73 is secured an insulating member 81 between which and the solenoid 72 is a compression spring 82. Carried by the insulating member 81 is a contact 83 which is connected to the brush 38 of the clock-work mechanism 25 shown in Fig. 1. At suitable times the contact 83 engages a stationary contact 84 which is connected through a battery 85 to the winding of the solenoid 42, the other side of the winding of which is connected to the brush 39 of the clock-work mechanism 25.

In the operation of the modified form of the invention shown in Fig. 4, the photoelectric cells 68 and 69 are energized by light focused upon them by the lenses 19 and 20 causing the operation of relay 70 which closes the energizing circuit of solenoid 72, thus causing its core 73 to be moved to the right against the action of the spring 82. This will cause the movable contact 83 to engage the stationary contact 84, thus preparing an energizing circuit for the solenoid 42 through commutator brushes 38 and 39 as already described in connection with Fig. 1. Solenoid 42 will be energized and its core moved to the left when brushes 38 and 39 are engaged by commutator segment 27, as previously described.

In case the torpedo should pass under floating debris or other material which would momentarily cut off the supply of light, the relay 70 will be opened, thus deenergizing the solenoid 72 which will allow the core 73 to move slowly to the left under the action of the spring 82, the speed being determined by the setting of the needle valve 79. This motion is so slow, however, that the contacts 83 and 84 will not be separated unless it continues for an appreciable length of time so that the passing of the torpedo beneath a quantity of floating debris will not be sufficient to open the circuit through the solenoid 42. When the torpedo passes beneath a ship the photoelectric cells 68 and 69 will be deenergized, thereby opening the relay 70 which will deenergize the solenoid 72. Due to the size of the ship the torpedo will be

under it a sufficient length of time for the contacts 83 and 84 to open thereby deenergizing the solenoid 42 which as already described in connection with Fig. 1 will allow the core 46 to move slowly to the right. This will continue until the contact 57 engages the contact 58 which will close the circuit through the detonator 60 thereby exploding the charge in the war head of the torpedo.

- 10 The needle valves 79 and 52 are so adjusted that the time between the occulting of the photo-electric cells 68 and 69 and the detonation of the war head will be sufficient to allow the torpedo to travel to the central portion of the ship, thereby
15 exploding it in the most advantageous position.

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, means carried by
25 said body for receiving light from a plurality of directions external to said body and means operated by the change of the total intensity of said light for causing the detonation of said explosive
30 charge.

2. In combination with a moving body, an explosive charge carried thereby, a plurality of light receptive means mounted on said body for receiving light from a corresponding plurality of
35 directions and means operated by said light receptive means for detonating said explosive charge when the total intensity of said illumination is changed.

3. In a moving body, an explosive charge, means
40 for detonating said charge, a plurality of light sensitive devices for operating said detonating means so that when the total illumination on said devices is changed it will cause the detonation of said explosive charge and means for preventing
45 the detonating of said explosive charge for a predetermined time after the launching of said body.

4. In a moving body, an explosive charge, means for detonating said charge, a plurality of light
50 sensitive devices for operating said detonating means so that at a predetermined interval after the intensity of the total illumination on said light sensitive devices is changed it will cause the detonation of said explosive charge.

5. In a moving body, an explosive charge, means for detonating said charge, and two light
55 sensitive devices set at corresponding angles from the vertical for operating said detonating means so that when the total illumination on said devices is changed it will cause the detonation of said explosive charge.

6. In a moving body, an explosive charge, means for detonating said charge, and two light
60 sensitive devices set at 45° from the vertical for

operating said detonating means so that when the total illumination on said devices is changed it will cause the detonation of said explosive charge.

7. In a moving body, an explosive charge, 5 means for detonating said charge, a light sensitive device for operating said detonating means, and a plurality of lenses for focusing light on said device from a corresponding plurality of directions so that when the total illumination
10 from said plurality of directions on said device is changed it will cause the detonation of said explosive charge.

8. In a moving body, an explosive charge, means for detonating said charge, a light sensi- 15 tive device for operating said detonating means, and a pair of lenses for focusing light on said device from two directions so that when the total illumination received from said two directions on said device is changed it will cause the
20 detonation of said explosive charge.

9. In a moving body, an explosive charge, means for detonating said charge, and a light sensitive device for operating said detonating means, and means responsive to variations in
25 the total illumination received from two directions at right angles to each other to cause said device to detonate said explosive charge.

10. In a torpedo, an explosive charge, a pair of devices sensitive to light from two different di- 30 rections and means responsive to a change in the total intensity of light received by said pair of devices to detonate said charge.

11. In a torpedo, a utility carried thereby, light sensitive means also carried by said tor- 35 pedo, a plurality of devices for transmitting external light to said light sensitive means, said devices being arranged to transmit light received from different directions whereby variations in light due to the rolling of the torpedo are com-
40 pensated for, and means for operating said utility responsive to a variation in the light received by said light sensitive means.

12. In a torpedo, a utility carried thereby, a pair of light sensitive devices also carried by said 45 torpedo, means for receiving light from a plurality of different directions and for impressing said light on said light sensitive devices, and means for operating said utility responsive to a difference in the intensity of light received by
50 said devices.

13. In a torpedo, a utility carried thereby, radiation sensitive means carried by said torpedo, a plurality of devices for transmitting external radiations to said means, said devices being ar- 55 ranged to transmit radiations received from different directions whereby variations in said radiations due to the motion of the torpedo itself are compensated for and means for operating said utility responsive to variation in the total
60 amount of radiation received by both of said such radiation sensitive means.

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