Feb. 22, 1949. C. T. MINKLER 2,462,118

TORPEDO EXPLODING MECHANISM

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Fig. 1

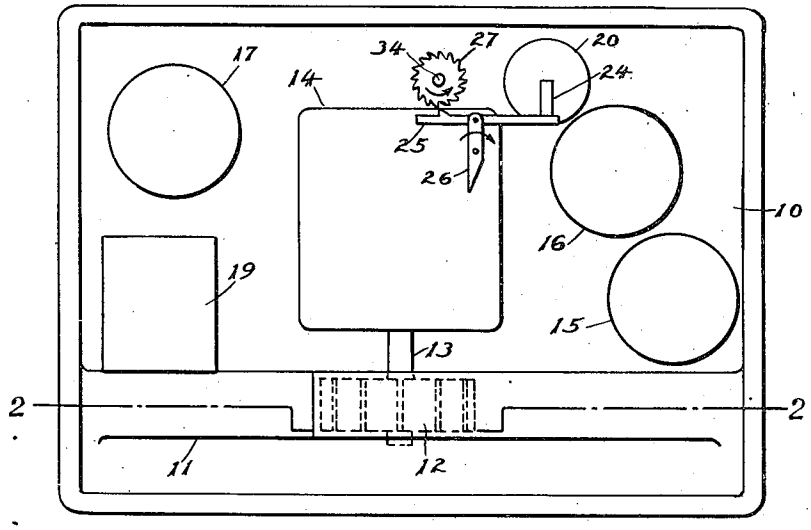
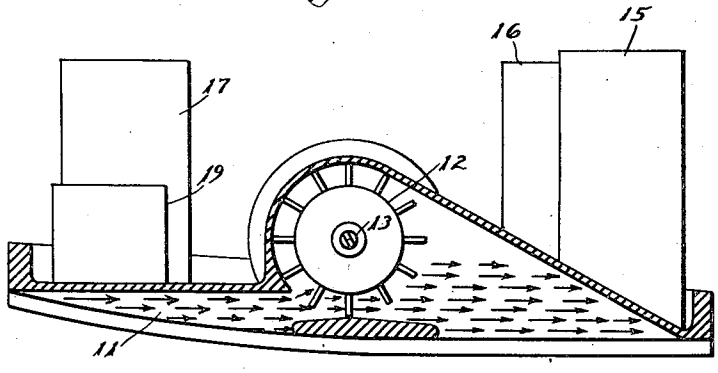



Fig. 2




Inventor:
Chester T. Minkler

by Robert A. Saunders
Attorney

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TORPEDO EXPLODING MECHANISM

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Fig. 3

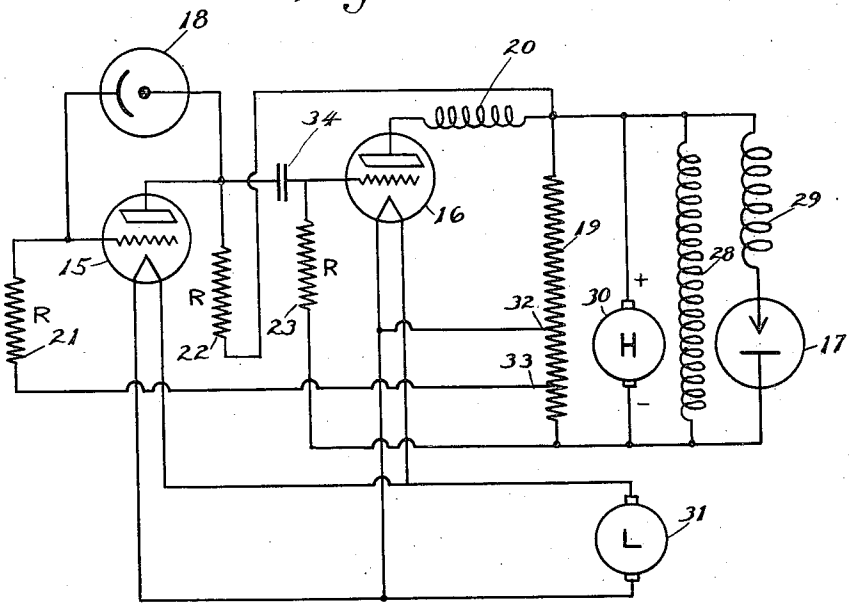



Fig. 4

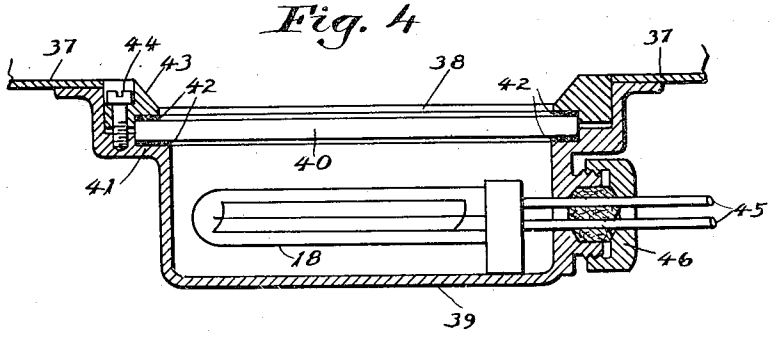
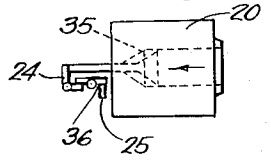



Fig. 5.




Inventor:
Chester T. Minkler
by Robert A Townsend
Attorney

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2,462,118

## TORPEDO EXPLODING MECHANISM

Chester T. Minkler, Newport, R. I.

Application December 6, 1932, Serial No. 646,019

22 Claims. (Cl. 114—21)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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This invention relates to torpedo exploding mechanism and more particularly to an exploding mechanism which, upon passing under a ship is, by the shadow thus created, caused to function to explode the torpedo.

Torpedoes now in general use are adapted to explode on impact with the outer surface of a target. Capital ships are at these surfaces protected against such attacks. If the torpedo could be caused to explode directly under the ship, greater damage would be done than otherwise as at this point it is not as well protected. Furthermore, there would be the additional advantage of bringing into effect both the detonating and pressure waves and make it practically impossible to shield the ship from such an explosion. Also, if a torpedo could be caused to explode by passing in the vicinity of a ship, the size of the target would be increased both as to depth and width and correspondingly increase the chances of making hits.

This invention is based upon the utilization of energy from a source of light such as the sun, and the device is caused to function by a reduction in the amount of light energy reaching said device due to the presence of a foreign body large enough to cast a distinct shadow. This reduction in energy causes a reduction in the current flowing through a photo-electric cell which in turn causes a variation of the bias on a vacuum tube to such an extent as to cause a considerable variation in the current flowing in its plate circuit. This variation in current is applied to the grid of a high capacity triode, thereby causing a much greater current to flow through a solenoid which, through appropriate mechanism, causes the torpedo to be exploded.

The principal object of this invention is to provide a torpedo firing mechanism that will function without the torpedo coming into direct contact with a target.

Another object is to provide a torpedo firing device of such character as will be safe to handle and which will not assume an armed position until a predetermined distance from the firing point has been reached.

A further object is to provide a torpedo firing device which will cause the torpedo to fire at the most vulnerable part of the target.

A further object is to provide a torpedo firing device which can be used in conjunction with impact firing apparatus, used on torpedoes at the present time, without impairing the efficiency of the same.

A further object is to provide a torpedo firing device which is self-contained and can be given independent periodical tests to assure its workable condition.

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With the above and other objects in view, this invention consists in the construction, combination and arrangement of parts as will be more fully described hereinafter, in connection with the accompanying drawings, in which:

Fig. 1 is a diagrammatic view of the arrangement of the apparatus of this invention as assembled in the body of a torpedo;

Fig. 2 shows a method of acquiring power for the apparatus of this invention;

Fig. 3 is a wiring diagram showing the electrical circuits employed in this invention;

Fig. 4 shows a photo-electric cell mounted near a window in the body of a torpedo.

Fig. 5 is a detail side elevational view of the elements immediately associated with the firing mechanism.

Referring now to Fig. 1, 10 denotes the base that forms an integral part of the torpedo in addition to carrying the completely assembled torpedo firing device. Its outer surface is made to conform to the contour of the torpedo so that it will not increase the normal resistance to the travel of the torpedo through the water. Cast in the under side of the base plate 10 is a channel 11 that permits the water flowing through it to act on the impeller or water wheel 12 housed therein. Impeller 12, through shaft 13, drives generator 14 which supplies the electrical energy for the circuits comprising an amplifying triode 15, a high current capacity triode 16, a voltage control tube 17, photo-electric cell 18, potential divider 19, solenoid 20 and resistances 21, 22 and 23, as will be more fully described hereinafter. The solenoid 20, when energized, operates the exploder (not shown) through latch 24, pawl 25, lever 26 and ratchet wheel 27.

After launching, and as the torpedo is propelled through the water, there is created a flow of water through channel 11, causing the rotation of impeller 12 that, through shaft 13, drives generator 14. The shunt field 28 is such that the generator quickly builds up to its operating potential, but in order to maintain this potential of the generator comparatively constant with varying torpedo speeds, an opposing field winding 29 is provided. This opposed field winding is in series with a gas tube 17 which, when the potential of the generator reaches a predetermined value, permits a flow of current through the opposed field winding, thereby reducing the field of the generator and tending to maintain its poten-

tial output constant, regardless of the speed of rotation of the impeller.

The generator 14 is provided with two armatures 30 and 31. Armature 30 supplies grid and plate potential for, and armature 31 lights the filaments of, tubes 15 and 16. The time required to heat the filament, together with the releasing of the exploder locking device (not shown), affords the necessary delay to prevent premature exploding. The potential divider 19 is across the terminals of armature 30, and the filament of tubes 15 and 16 are connected to the potential divider at 32. The grid of tube 15 is connected through resistance 21 to the potential divider 19 at 33 and the grid of tube 16 is connected through resistance 23 to the negative end of potential divider 19 and armature 30. It is clear that this causes the filaments of both tubes 15 and 16 to assume a higher potential than their respective grids, or, in other words, these tubes have a negative bias. The bias of tube 15 is so adjusted that it operates at the midpoint of its amplification curve. The drop in potential created by the flow of the plate current of tube 15 through resistance 22 reduces the potential of armature 30 to a value that is proper for the plate of tube 15. The plate current of tube 15 also flows through the lower end of potential divider 19 from connection 32. The photo-electric cell 18 is connected across the plate and grid of tube 15 and while it is exposed to the light permits a small amount of current to flow through resistance 22 and 21 and the lower part of potential divider 19 from connection 33. With the plate current flowing normally in tube 15, the bias on tube 16 is so adjusted that it is just sufficient to prevent flow of current in its plate circuit through solenoid 20. With this method of adjusting the bias of tube 16, a change in the potential of armature 30 which increases the plate potential on the tube will likewise increase the bias, and vice versa. It is evident that such an arrangement permits a bias adjustment very near the blocking point of the tube, so that a small change in the potential on the grid of tube 16 will cause current to flow in the plate circuit and at the same time without danger that such plate current will be caused to flow due to variations in the supply of plate potential. When the torpedo passes under a ship, the current flowing through photo-electric cell 18 is suddenly decreased causing a variation in the potential on the grid of tube 15. The change of potential is greatly amplified by tube 15 by a considerable reduction in plate current which reduces the drop in potential through resistance 22 or the potential on the plate of tube 15 is suddenly increased. This causes an increase in the potential of the left-hand plate of condenser 34 and a corresponding decrease in the potential of its right-hand plate which, in turn, results in an increase in the potential of the grid of tube 16 since resistance 23 serves to confine this change of potential to the grid. This increase in the potential of the grid of tube 16 causes current to flow in its plate circuit through solenoid 20 causing the torpedo to explode.

The method of operating the exploder is as follows: Shaft 34 is geared to the generator 14 and drives the ratchet wheel 27, as indicated by the arrow. When solenoid 20 is de-energized, the armature 35 rests against latch 24 and, when solenoid 20 is energized, moves in the direction shown by the arrow, and through latch 24 and pivoted piece 36 forces pawl 25 into engagement with ratchet wheel 27 that, by its rotation, causes lever 26 to rotate about its pivot as shown by the arrow, thereby tripping the exploder mechanism (not shown).

Fig. 4 shows how the photo-electric cell 18 is mounted near a window in the upper portion of the hull of a torpedo. In the drawing, numeral 37 represents a portion of the hull of a torpedo having an opening 38 over which a casing 39 is mounted. The glass 40 fits into a recess 41 of the casing 39 that is provided with gaskets 42 and is held in place by ring 43 that is secured to the casing by screws 44. The leads 45 from the photo-electric cell pass through the stuffing box 46.

The tests show that daylight without bright sunlight is sufficient to cause the apparatus to work satisfactorily.

It will be understood that the above description and accompanying drawings comprehend only the general and preferred embodiment of my invention, and that various changes in the construction, proportion and arrangement of parts may be made within the scope of the appended claims without sacrificing any of the advantages of this invention.

The invention described herein may be manufactured and used by or for the Government of of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

1. A torpedo exploding device, comprising a first thermionic tube, a second thermionic tube, the output of said first tube being operatively connected to the control electrode of said second tube, means for maintaining the proper differences of potential between the cathodes and anodes of said tubes, means for maintaining the proper bias on said first tube and for normally maintaining the control electrode of said second tube at such a potential with respect to the potential of its cathode and anode that relatively little current flows from the anode of said second tube, light responsive means connected between the grid and anode of said first tube and responsive to a change of intensity of light energy striking it to cause a relatively large flow of current from the anode of said second tube, and current responsive means in the anode circuit of said second tube for exploding said torpedo.

2. A torpedo exploding device, comprising a first thermionic tube, a second thermionic tube, a generator consisting of a first and second armature, the first armature being adapted to heat the filaments of said first and second tubes, the second armature being adapted to supply potential to the grids and anodes of said first and second tubes, a potential divider across the terminals of said second armature, contact means connecting the cathodes of said first and second tubes to said potential divider at such a point that the respective grids of said tubes will have a proper biasing potential, a first resistance in series with said second armature and the anode of said first tube for reducing the potential of said second armature to a value proper for the anode of said first tube, light responsive means connected across the grid and anode of said first tube, a second and a third resistance in the grid circuits of said first and second tubes respectively for localizing the effect of variations in potential impressed upon these grids respectively, and current responsive means in the anode circuit of said second tube for exploding said torpedo.

3. A torpedo exploding device, comprising a

first thermionic tube, a second thermionic tube, a generator consisting of a first and second armature, the first armature being adapted to heat the filaments of said first and second tubes, a field winding connected across the terminals of said second armature and creating flux that threads both the first and second armature, a gas tube, a reversed field winding connected in series with said gas tube, said gas tube and reversed field being in parallel with the field winding and acting to maintain the output potential of said first and second armatures substantially constant, a potential divider across the terminals of said second armature, contact means connecting the cathodes of said first and second tubes to said potential divider at such a point that the respective grids of said tubes will have a proper biasing potential, a first resistance in series with said second armature and the anode of said first tube for reducing the potential of said second armature to a value proper for the anode of said first tube, a photo-electric cell connected across the grid and anode of said first tube, a second and a third resistance in the grid circuits of said first and second tubes respectively for localizing the effect of variations in potential impressed upon these grids respectively, and current responsive means in the anode circuit of said second tube for exploding said torpedo.

4. A torpedo exploding device, comprising a first thermionic tube, a second thermionic tube operatively connected to the grid of said first tube, a generator adapted to heat the cathodes and supply potential to the grids and anodes of said tubes, an impeller so installed as to be acted upon by the flow of liquid through a channel when the torpedo is moving through a medium of said liquid, an opposed field winding, a gas tube in series with said opposed field winding and cooperating with the same to maintain the potential of said generator approximately constant regardless of the speed at which the torpedo moves through said medium, light responsive means associated with the grid of said second tube, and current responsive means in the anode circuit of said first tube adapted to be energized by a variation in the energy flowing from said light responsive means resulting from a change in the amount of light energy striking same, thereby causing the torpedo to explode.

5. A torpedo exploding device, comprising a first thermionic tube, a second thermionic tube operatively connected to the grid of said first tube, a generator adapted to heat the cathodes and supply potential to the grids and anodes of said tubes, an impeller so installed as to be acted upon by the flow of liquid through a channel when the torpedo is moving through a medium of said liquid, light responsive means associated with the grid of said second tube, and current responsive means in the anode circuit of said first tube adapted to be energized by a variation in the energy flowing from said light responsive means resulting from a change in the amount of light energy striking same, thereby causing the torpedo to explode.

6. A torpedo exploding device, comprising a first thermionic tube, a second thermionic tube operatively connected to the grid of said first tube, a generator adapted to heat the cathode and supply potential to the grids and anodes of said tubes, light responsive means associated with the grid of said second tube, and a solenoid in the anode circuit of said first tube adapted to be energized by variations in energy flowing from said light responsive means, thereby causing the torpedo to explode.



7. A torpedo exploding device, comprising a first thermionic tube, a second thermionic tube operatively connected to the grid of said first tube, a generator to supply heating current to the cathodes and supply potential to the grids and anodes of said tubes, means operatively associated with the grid of the second tube to block said tubes, said means being responsive to a change in an energy field adjacent a target to unblock said tubes, and a solenoid in the anode circuit of said first tube energized by variations in energy flowing from said energy responsive means.

8. A torpedo exploding device, comprising a first thermionic tube, a second thermionic tube operatively connected to the grid of said first tube, means to heat the cathodes and supply potential to the grids and anodes of said tubes, means operatively associated with the grid of said second tube to block said tubes, said last mentioned means being responsive to a change in an energy field adjacent a target to unblock said tubes, and a solenoid in the anode circuit of said first tube to be energized by variations in energy flowing from said energy responsive means.

9. A torpedo exploding device, comprising a thermionic tube, light responsive means connected to bias the grid of said tube to keep the plate current below a predetermined minimum value under normal daylight conditions but to cause a large plate current to flow when daylight is cut off therefrom by proximity of a target, and means operable by said large plate current to fire the charge of the torpedo.

10. A torpedo exploding device, comprising a thermionic tube, means responsive to normal daylight to prevent the plate current from said tube from exceeding a predetermined minimum value but to cause a large plate current to flow when daylight is prevented from reaching said responsive means, and means operable by said large plate current to actuate the exploding mechanism of a torpedo but not operable by current from said plate under said normal daylight conditions.

11. A torpedo exploding device, comprising a thermionic tube, light responsive means subjected to natural light only and connected to affect the potential on the grid of said tube whereby the plate current of said tube is kept small during exposure to normal daylight but a large current flows when the light thereon is diminished, and exploding mechanism operable by the larger plate current flowing when the light is diminished as aforesaid.

12. A torpedo exploding device, comprising a thermionic tube, light responsive means subjected to natural light only associated with the grid of said tube to vary the potential of said grid, and current responsive means connected to be energized by the increased plate current of said tube when the potential on its grid is changed by variations in the energy flowing from said light responsive means due to diminution in the natural light received by said light responsive means.

13. The combination with a torpedo containing an explosive charge, of means carried by said torpedo for receiving natural light through the water above said torpedo, and means operated by the diminution of said light for causing the detonation of said explosive charge.

14. In a torpedo, an explosive charge, a light

sensitive device, adapted to respond to natural light transmitted from the surface directly through the intervening water, and a detonator controlled by said device, said detonator being operable in response to a change in intensity of light received by said device to detonate said charge.

15. In combination with a torpedo containing an explosive charge, means carried by said torpedo for receiving natural light transmitted directly through the water, and means operated by the change in intensity of said light caused by passing under a ship for causing the detonation of said explosive charge.

16. In a moving body, an explosive charge, means for detonating said charge, a light sensitive device for operating said detonating means so that when the illumination on said device is changed 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 launching of said body.

17. In combination with a moving under water body, an explosive charge carried thereby, light receptive means mounted on said body to receive natural light from the surface, transmitted directly through the intervening water and a detonator operated by said light receptive means for detonating said explosive charge when the intensity of illumination is diminished.

18. In combination with a moving under water body, an explosive charge, means for causing the detonation of said charge and light sensitive means adapted to respond to natural light transmitted from the surface directly through the intervening water for controlling said detonating means so that when the intensity of illumination of said light sensitive means is changed it will cause the detonation of said explosive charge.

19. In combination with a moving under water body, an explosive charge carried thereby, means carried by said body for receiving radiation from an external source transmitted directly through the intervening water, and means operated by the variation of said radiation caused by the shadow of an object for causing the detonation of said explosive charge.



20. In combination with a moving under water body, an explosive charge, means for causing the detonation of said charge, and radiation receptive means adapted to receive radiation from an external source transmitted directly through the intervening water for controlling said detonating means so that when the intensity of radiation is changed by the shadow of an object it will cause the detonation of said explosive charge.

21. In a submarine torpedo adapted to travel entirely submerged, control mechanism on said torpedo, and light receptive means on said torpedo for controlling said mechanism responsive to natural light transmitted directly through the water above said torpedo.

22. In a torpedo, an explosive charge, means to cause said torpedo to travel through the water at a depth below the draft of a target ship and means operable by the shadow of the ship when the torpedo passes thereunder for detonating said explosive charge.

CHESTER T. MINKLER.


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