

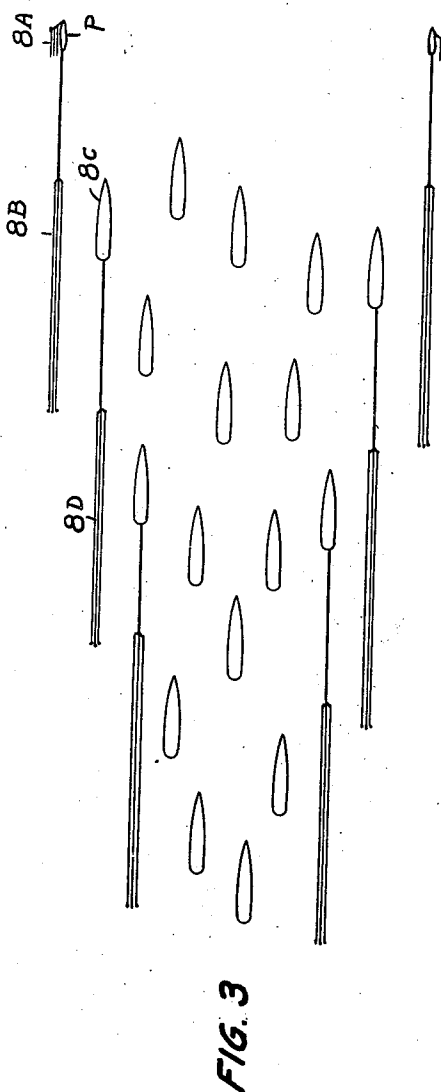
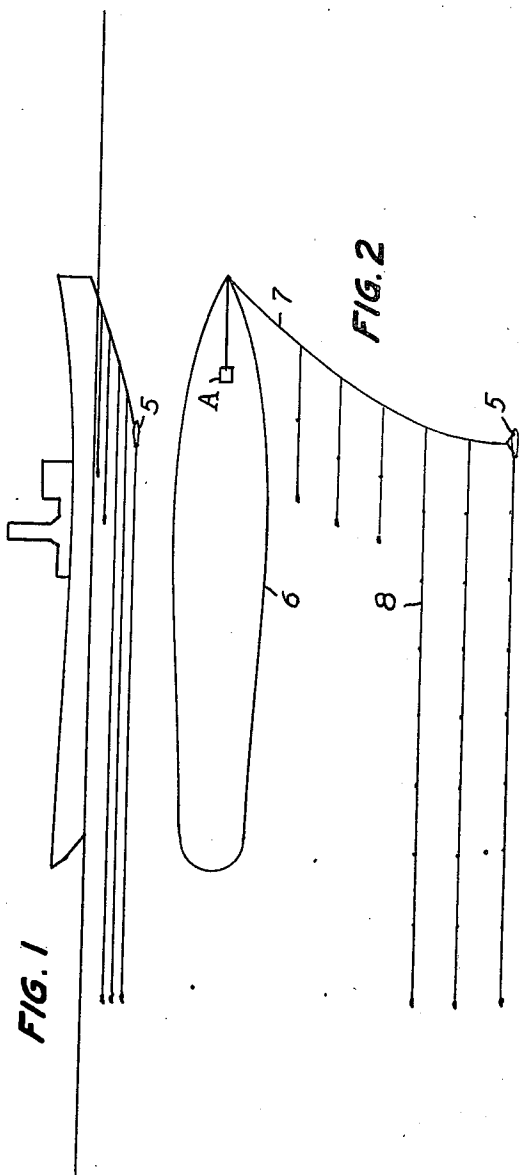
July 23, 1946.

C. H. HOLM
TORPEDO COUNTER MINING DEVICE

2,404,440

Filed April 19, 1941

3 Sheets-Sheet 1



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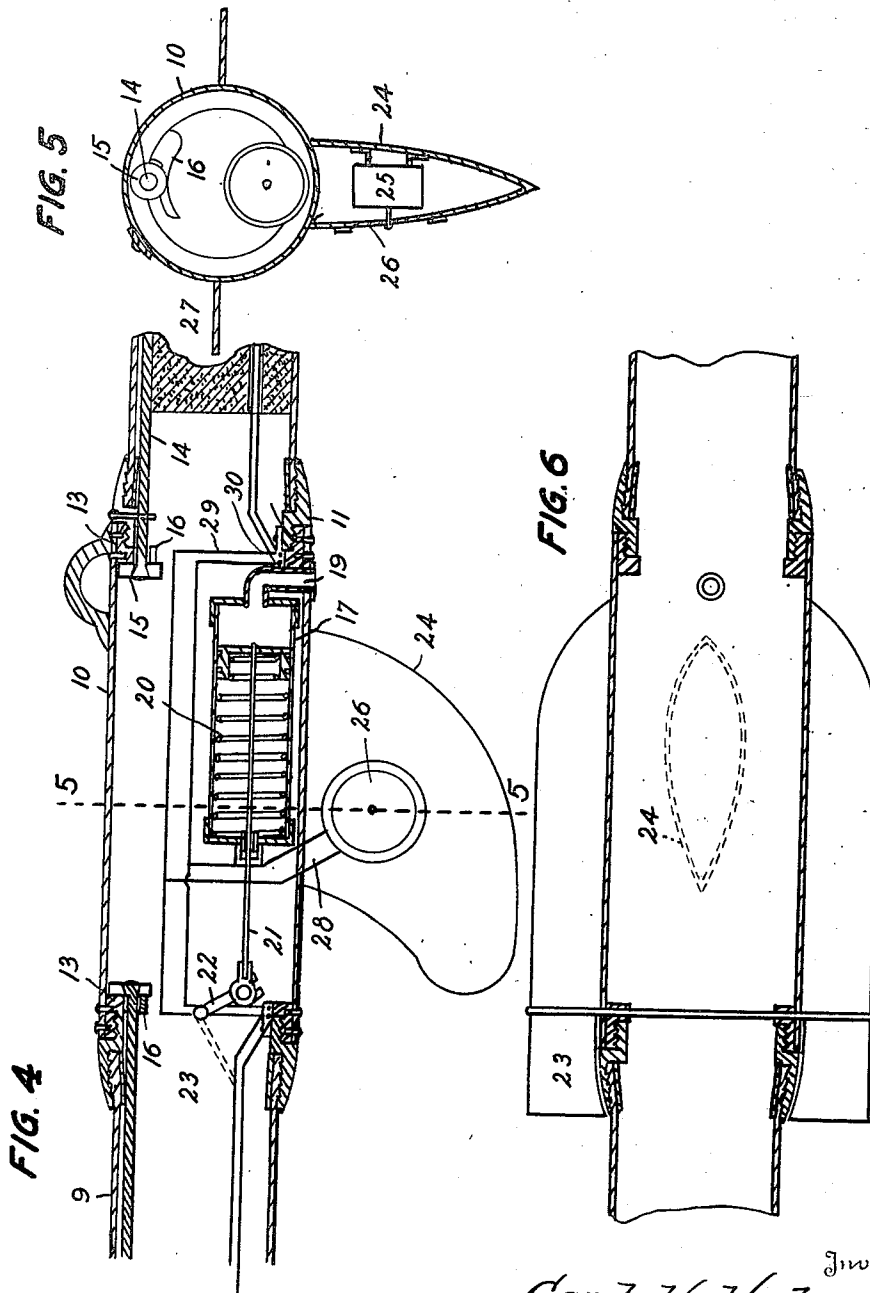
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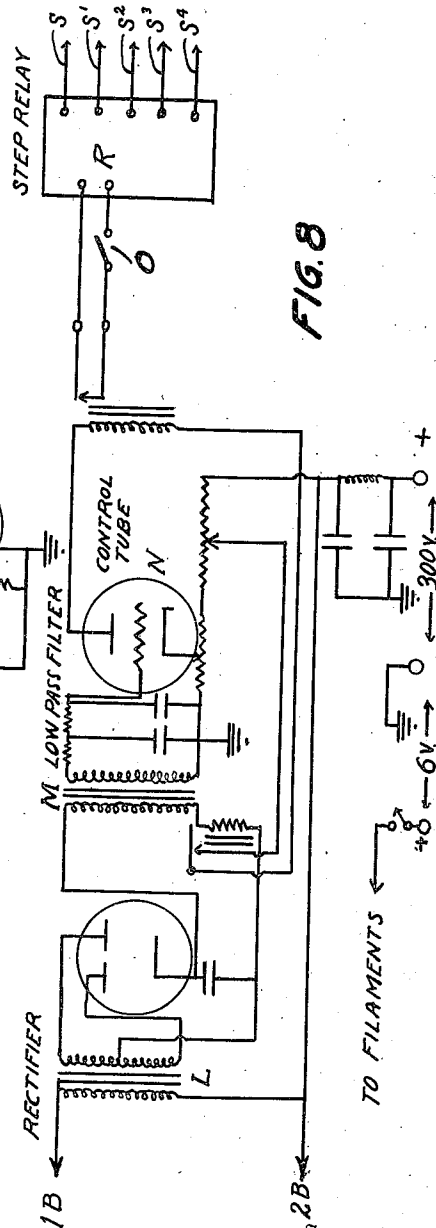
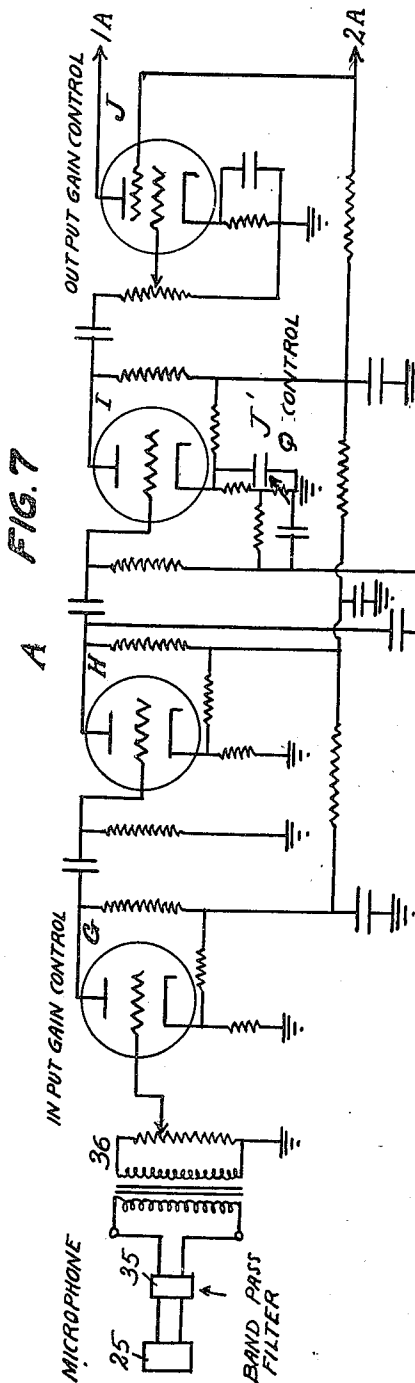
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,404,440

TORPEDO COUNTERMINING DEVICE

Carl H. Holm, Marion, Ky., assignor of twelve and one-half per cent to Clarence W. Lothrop, Riverside, Calif.; ten per cent to W. B. Pierce, Coral Gables, Fla.; twelve and one-half per cent to Norman Pierce, Chicago, Ill.; and sixty-five per cent to himself

Application April 19, 1941, Serial No. 339,441

17 Claims. (Cl. 114—240)

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This invention relates to torpedo counter-mining devices and it has for its object to provide a method and structure adaptable for use under all weather conditions and of such a nature as to destroy or disable a torpedo traveling toward the ship which the device is intended to protect.

Broadly stated, the invention contemplates the provision of one or more elongated, preferably flexible, stringers or streamers and means for towing the same in substantial parallelism with the ship's track and in considerably spaced relation to the ship. These stringers are relatively slender and, due to their flexibility, they conform readily to the forces imposed upon them by wave conditions so that the resistance which they present to towing is reduced to the minimum. These stringers carry explosive charges and also carry detectors of waves of audio-frequency. Means are provided, preferably upon the ship, but elsewhere if desired, for converting the waves of audio-frequency into an electric current capable of firing the explosive charges.

As this description proceeds, it will be seen that the apparatus provided for carrying out the invention is of such a nature that a torpedo traveling across the stringer will, by its presence, so affect the apparatus as to fire the explosive charge at such a time as to destroy the torpedo. Preferably, but not necessarily, the apparatus is so designed that the firing of the explosive charge will take place just as the torpedo has crossed the line of the stringer and begins to recede therefrom.

The tail portions of torpedoes are particularly vulnerable because the elevators, the propellers and the rudders are located at the tail. By causing the explosion to occur just as the torpedo starts to recede from the path of the stringer, the tail portion of the torpedo will usually be blown off or its appurtenant parts so damaged as to throw it entirely out of control.

The means by which the foregoing objects are attained, as well as other features of novelty and advantage, will be set forth in the detailed description which follows.

In the accompanying drawings:

Figure 1 is a side elevation of a vessel having the protecting apparatus of the invention applied thereto;

Fig. 2 is a diagrammatic plan view of the structure of Fig. 1;

Fig. 3 is a diagrammatic plan view showing a number of vessels arranged in convoy and a manner of protecting the same;

Fig. 4 is a vertical sectional view through one of the detector units and the adjacent portions of the flexible stringers;

Fig. 5 is a transverse sectional view upon line 5—5 of Fig. 4;

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Fig. 6 is a horizontal sectional view through the structure of Fig. 4;

Fig. 7 is a diagrammatic view of one form of amplifying mechanism which may be employed, and,

Fig. 8 is a diagrammatic view of a form of control unit, which may be employed.

Like numerals designate corresponding parts throughout the several figures of the drawings:

As the means for towing the detecting and explosive carrying stringers, I prefer to employ a submarine kite of the nature of those employed in conjunction with paravanes. Structures of this nature are adapted to ride away from the vessel by which they are towed and to keep the cable by which they are attached to the vessel relatively taut. Since these structures are designed to travel along with the ship while being submerged, they may be used even in relatively rough water. A structure of this nature is indicated at 5 in the accompanying drawings and is attached to the ship 6, by a cable 7.

The detector and explosive carrying streamers are indicated at 8. They are attached to cable 7 and trail rearwardly therefrom. They may be of any suitable number and of any suitable length. However, it will be seen by reference to Fig. 2 that I contemplate the employment of a plurality of relatively short streamers nearer the ship than the outer streamers to protect that portion of the bow of the boat which would otherwise be left unprotected because of the fact that there is of necessity some rearward sag of the cable 7.

Many ways may be resorted to of constructing the stringers 8. One proposed method of construction is illustrated in Fig. 4 where sections 9, 9^a of a conventional fire hose are connected by a coupling 10. The ring-like threaded flanges 11 are like the corresponding elements of fire hose and while they comprise threaded portions 12, these threads are not continuous. In other words, the connection is of the bayonet slot type with the companion members 13 carried by the tubular body 10 of the coupling.

To relieve the flexible walls 9, 9^a of the towing strain, steel cables 14 may be extended through the flexible hose sections. These cables carry head blocks 15 upon their ends and in the partial turning movement which makes the connection between the elements 11 and 13, the cable is caused to ride circumferentially and into hook-like projections 16 of the members 13. At this time, the head blocks 15 are disposed inwardly of the hooks and thus the pull on the cables is imposed upon the couplings while the flexible walls of the fire hose are relieved of the strain. The hose sections and the couplings complementally constitute the stringers or streamers hereinbefore referred to.

If desired, hydrostatic devices may be mounted

in the coupling by which the depth at which the stringers will be towed may be determined. Such a hydrostatic device may comprise a cylinder 17 in which a piston 18 is disposed. Water entering at 19 acts to move the piston against the action of spring 20. The piston is connected by piston rod 21 with crank 22, said crank, in turn, moving external vanes 23 in a usual and known way. A fixed and hollow vane or wing 24 depends from the underside of the coupling 10 and houses a microphone 25. The diaphragm 26 of this microphone is exposed at the exterior of the wing 24 and acts in a manner hereinafter described to pick up the waves of audio-frequency peculiar to torpedoes and particularly to the propellers thereof.

The hose sections 9 or other portions of the stringers carry explosive charges indicated at 27. This explosive material may be substantially continuous throughout the hose sections or it may be disposed at any suitably spaced intervals therealong. The wires from the microphone are indicated at 28 and are connected to the audio-frequency circuit 29. The wires of this circuit extend throughout the length of the streamer, each of the microphones being connected thereto in the manner shown. These circuits lead to the amplifying unit illustrated in Fig. 7, this amplifying unit being indicated as a whole by the reference character A. This amplifying unit may be located on the ship being protected or elsewhere.

When the hose sections are connected through the medium of the couplings 10, the electric connections are made through suitable connector blocks indicated at 30.

As before stated, the first link in the process of detecting the torpedo is a microphone. Its function is to convert into audio-frequency currents water-borne sound waves originating in the vicinity, particularly those coming toward the vessel. Although the microphone can be made somewhat selective as to frequency, it will be at least partially responsive to all sounds striking it. Therefore, I contemplate placing an audio-frequency band pass filter between the microphone and the amplifying apparatus to select that band of frequencies characteristic of the torpedo.

The amplifier of Fig. 7, with a few exceptions, is quite similar to those commonly used in public address work. It differs in that a circuit has been added which prevents any signal from passing until its amplitude has reached some given level. Its purpose is to make the amplifier insensitive to incidental noises of the same frequency but of lesser amplitude than those of the torpedo. It also gives a measure of protection against impact and shock noises due to the fact that it requires the integration of a considerable number of the successive cycles of a sustained signal to charge a condenser to sufficient voltage to render the circuit operative and let the signal pass.

The output of the amplifier is applied to a rectifier and filter which converts the audio signal into a direct current proportional to the amplitude of the signal.

Recapitulating, we have thus far picked up, selected, amplified and rectified a signal originated by the torpedo, and have at this point in the system a varying direct current whose value is inversely proportional to the distance between the torpedo and the microphone. With this condition established, it is only necessary to determine the instant the current reaches maxi-

mum to indicate the instant the torpedo is closest to the microphone. To accomplish this purpose the rectified current is passed through the primary of a transformer whose secondary operates a control tube. The operation of this tube is such that it will pass current only when the secondary of the transformer tends to make the grid less negative. The transformer polarity is chosen so that this occurs when the primary current is decreasing, thus during the period of approach the current is increasing and the tube does not conduct, but as it reaches maximum and begins to decline, the secondary voltage reverses polarity and operates the control tube. The tube current closes a sensitive relay and detonates the charge.

In order to give an added protection against extraneous noises of short duration and very high amplitude, which would crash through the above mentioned protective circuit, it is suggested that an additional relay of the "slow operate" type be energized by a primary current of the control tube transformer. This relay can be made to close at some suitable time interval after the application of current. If this relay's contacts be inserted in series with the voltage supply of the control tube, the control tube will be inoperative until a sustained signal of the required duration has been applied. Thus only under the proper conditions will the control tube become active and capable of detonating the charge.

Elements capable of performing the foregoing functions are illustrated in Figs. 7 and 8 and may be more specifically described as follows.

In Fig. 7, 25 indicates one of the microphones; 35 the band pass filter; 36 the input gain control; G, H, I conventional radio tubes adapted to yield any desired stages of amplification; J, the output gain control having terminals 1A and 2A connected at 1B and 2B with the input terminals of the control unit shown in Fig. 8. A Q control or squelch circuit may be incorporated at J.

The amplifier of Fig. 7 may also include a minimum signal valve K. The control unit of Fig. 8 includes a rectifier L, a low pass filter M, control tube N, manually operable switch O adapted to disconnect the control unit from the explosive circuits except at such times as it is intended to render the explosive charges responsive to the passage of a torpedo.

A step relay R of a conventional and well-known form is adapted to bring the circuits S, S', S², S³ and S⁴ successively into action, these being the circuits which lead to the explosive initiating devices such as conventional blasting caps, for example, preferably disposed at the head of each stringer. Thus, if the outside stringer be destroyed by its own explosive, the next stringer inward is automatically rendered responsive to the presence of a torpedo.

It is to be understood that the particular apparatus described is shown merely for purposes of explanation. It will be apparent that many different ways may be resorted to for exploding a charge under the influence of the presence of a torpedo, and my experiments have included such additional methods. For example, I have set up about a trailing cable in the water, a zone of induced electricity and have succeeded in securing aboard the ship carrying such cable, a variable electric current proportional to the variations effected in the conductivity of the induced field under the influence of the introduction into such field of a foreign metallic body such, for example, as a torpedo.

I have also experimented with exploding the explosive charges under the influence of magnetism. However, the short range of action of a magnetic field renders magnetic detectors far less efficient than the arrangement herein shown and described. Further, an important advantage of the arrangement shown is that all of the parts are well-known and may be easily and quickly secured at a relatively low cost.

As far as I am aware, I am the first to effect the counter-mining of torpedoes without relying upon actual physical contact of the torpedo with the explosive charge. Further, as far as I am aware, I am the first to provide means for automatically exploding a destructive charge underwater and under the influence of the receding action of the torpedo. Further, I believe that I am the first to mount an explosive charge upon a supporting body of elongated streamer or stringer-like form in conjunction with detectors of any type whatever, and particularly is this true, in conjunction with streamers which as a whole are flexible so that they may trail or conform with wave action without imposing undue drag upon the ship towing the same.

While the submarine kites or paravane elements are usually employed without self-contained propulsion means, it is within the purview of this invention to power such paravanes if it be deemed desirable to do so, in order to prevent such element from sagging too far rearwardly of the vessel's bow. In Fig. 3, the head of a convoy is shown as being initially protected by a relatively small pilot boat P, which is itself protected by a plurality of streamers 8^a. This pilot boat may tow one or more streamers 8^b to protect the head vessel 8^c of the convoy and this head vessel may, in turn, tow one or more streamers 8^d, and so on.

The several groups of streamers 8^b, 8^d etc., may be kept at any desired depth by conventional towing devices. These are well known among nautical men, being referred to as depressors or others.

While this invention has been described as being of primary utility in conjunction with the protection of vessels, it is clear that it would also be of utility in connection with the protection of fixed structures along beaches, such as buildings, wharves, harbors, lighthouses, buoys, anchored light vessels and many others.

While I have shown the microphone detector units as being carried by couplings disposed between flexible tubular sections, it is to be understood that the invention contemplates any location whatever for these microphones, for example, the tubular flexible sections might be connected directly together after the manner common in fire hoses, and the microphones be merely strapped or otherwise mounted upon said tubular sections. The microphones might be mounted upon either the exterior or upon the interior of the tubular sections without departure from the spirit of the invention.

It is therefore to be understood that the invention is not limited to any specific apparatus, but that it includes within its purview any and all means coming within either the terms or the spirit of the appended claims.

Having described my invention, what I claim is:

1. In protecting apparatus of the character described, a relatively slender, elongated streamer composed of a plurality of sections of flexible material, couplings between said sections, hydro-

static devices in said couplings constructed to maintain the streamer at a determined depth when drawn through the water, a plurality of microphones upon the streamer, explosive charges extending along the streamer, and electrical firing means for setting off the explosive charges under the influence of sound emanating from a torpedo in motion and acting upon said microphones.

2. In a protecting device of the character described, an elongated, laterally flexible, slender streamer, explosive charges disposed along the length of said streamer, a plurality of microphones carried by the streamer, of a nature to be affected by sound waves, an amplifying device comprising means for amplifying the sonic waves delivered from the microphones, means for filtering out sonic waves other than those peculiar to a torpedo and an electric firing circuit under control of the amplifying mechanism for firing the charges in a streamer under the influence of the microphones when the latter are affected by the presence of a torpedo and without physical contact by the torpedo with any part of the streamer.

3. A structure as recited in claim 2 wherein the amplifying device is of a nature to be effective in energizing the firing circuit under the influence of a decrease in amplitude of the impulses transmitted thereto by the microphones as a torpedo recedes from the streamer.

4. The combination with a vessel to be protected, of a cable extending laterally therefrom, a paravane to which the cable is connected and which paravane tends to travel away from the vessel and render the cable more taut, an elongated flexible streamer towed in substantial parallelism with the vessel by said cable and paravane, explosive charges disposed along the length of said streamer, a firing element for said explosive charges and detectors along said streamer set to be responsive to the presence of a torpedo without actual contact by said torpedo and means under control of the detectors for energizing the firing element to set off the explosive charges.

5. In combination an elongated, hose-like, streamer having explosive charges disposed along its length, means for supporting said streamer in the water and below the surface thereof, in substantially horizontal position and as a protective barrier across an object to be protected, a detecting microphone associated with the streamer, an electric firing element carried by the streamer, an amplifier to which the microphone and the electric firing element are connected said amplifier energizing the firing element under influences peculiar to a torpedo in motion as detected by the microphone, and without actual contact with the streamer by the torpedo.

6. Protecting apparatus of the character described, comprising a plurality of elongated streamers, means for towing said streamers in a group and in substantial parallelism with and upon the flank of a ship to be protected, each of said streamers carrying explosive charges spaced therealong and also carrying a plurality of detectors, said detectors being actuated by sonic waves, an amplifying device, an electric circuit through which the detectors are connected to the amplifier, and a circuit controlled by the amplifier through which the explosive charges are fired.

7. In means for protecting ships from torpedoes, the combination with an elongated laterally flexible streamer, of gear for towing said

streamer through the water in substantial parallelism with the path of the ship, explosives disposed along the length of said streamer, a plurality of detectors disposed along the length of said streamer set to be responsive to the influence of waves emanating from a torpedo in motion and without physical contact by said torpedo, an amplifier for amplifying the effect of said waves upon the detectors and means for firing said explosive under the control of said amplifier.

8. A structure as recited in claim 7 in combination with means for varying the effective depth at which the streamer will travel.

9. In a device of the character disclosed for destroying a moving torpedo, a flexible tubular member arranged within the water, said tubular member comprising a plurality of tubular sections having a plurality of explosive charges arranged therein, a plurality of devices for coupling said sections together in sealed relation, a plurality of microphonic devices respectively arranged within said coupling devices in operative communication with the water for generating electrical signals in response to impulses received through the water from the torpedo, and means including a signal amplifying device operatively connected to said plurality of microphonic devices for firing said explosive charges when the torpedo is adjacent said tubular member.

10. Protecting apparatus of the character described comprising an elongated streamer adapted to be towed lengthwise through the water, carrying explosive charges along its length and also carrying a plurality of detecting devices along its length and electrical means for exploding the charges under the control of the detecting devices, said detecting devices being responsive to and acting under the influence of a traveling torpedo without contact of said torpedo with the detecting devices, said detecting devices being responsive to sonic waves and operative to explode the charges during the retrogressive action of the source of such waves.

11. A device for destroying water borne propeller actuated bodies, comprising an elongated buoyant streamer carrying an explosive charge, a detecting device associated with the streamer, said detecting device being responsive to sonic waves transmitted through the water from a propeller actuated body, means to fire the explosive charge, and connections between the detecting device and the firing means including a device to delay the operation of the firing means until the sonic waves at the detecting device have passed their maximum intensity.

12. A device for destroying water borne propeller actuated bodies, comprising an elongated buoyant streamer carrying a plurality of explosive charges, a plurality of detecting devices associated with the streamer, said detecting devices being responsive to sonic waves transmitted through the water from a propeller actuated body, means to fire a charge, and connections between the detecting device and the firing means including a device to delay the operation of the firing means until the sonic waves at the detecting device have passed their maximum intensity.

13. A device for destroying water borne propeller actuated bodies, comprising an elongated buoyant streamer carrying an explosive charge, a detecting device associated with the streamer, said detecting device being responsive to sonic waves transmitted through the water from a propeller actuated body, means to fire the explosive charge, connections between the detecting device

and the firing means including a device to delay the operation of the firing means until the sonic waves at the detecting device have passed their maximum intensity, and a filtering means in said connections to intercept sounds which are not peculiar to the body to be destroyed.

14. A device for destroying water borne propeller actuated bodies, comprising an elongated buoyant streamer carrying an explosive charge, a detecting device associated with the streamer, said detecting device being responsive to sonic waves transmitted through the water from a propeller actuated body, means to fire a charge, connections between the detecting device and the firing means including a device to delay the operation of the firing means until the sonic waves at the detecting device have passed their maximum intensity, and a filtering means in said connections to intercept sounds which are not peculiar to the body to be destroyed.

15. In a protecting device of the character described, an elongated streamer, explosive charges disposed along the length of said streamer, a plurality of microphones associated with the streamer of a nature to be affected by sound waves, an amplifying device comprising means for amplifying the sonic waves delivered from the microphone, means for filtering out sonic waves other than those peculiar to a torpedo, and an electric firing circuit under control of the amplifying mechanism for firing the charges in a streamer under the influence of the microphones when the latter are affected by the presence of a torpedo and without physical contact by the torpedo with any part of the streamer.

16. In a protecting device for destroying water borne propeller actuated bodies, an elongated streamer, an explosive charge carried by the streamer, a microphone associated with the streamer of a nature to be affected by sound waves transmitted through the water from a propeller actuated body, an amplifying device comprising means for amplifying the sonic waves delivered from the microphone, means for filtering out sonic waves other than those peculiar to the bodies to be destroyed, and an electric firing circuit under control of the amplifying mechanism for firing the charge on the streamer under the influence of the microphone when the latter is affected by the presence of a body and without physical contact of the body with any part of the streamer.

17. Protecting apparatus of the character described comprising a plurality of laterally flexible elongated streamers, means for towing a group of said streamers upon one flank of a ship to be protected and in substantial parallelism with the path of the ship, each of said streamers carrying a plurality of explosive charges spaced therealong, a plurality of detectors of sound waves spaced along each of the streamers, set to be responsive to the sound of torpedoes in motion and means for firing said charges when a torpedo reaches a determined proximity to a detector, said means comprising an amplifier, circuits through which the detectors are connected to the amplifier, additional circuits controlled by the amplifier and leading to the explosive charges, firing means in the latter circuits for exploding said charges, and means for successively closing the said latter circuits under the influence of the amplifier, to thereby successively fire the explosive charges of the several streamers of a group.