June 27, 1961 J. M. KENDALL 2,989,920

TORPEDO EXPLODER

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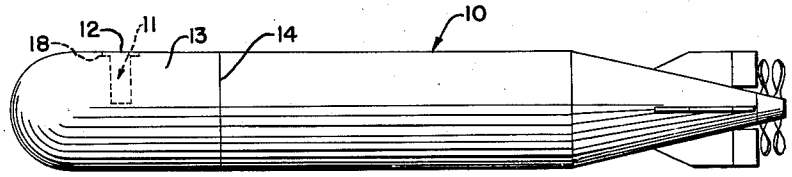
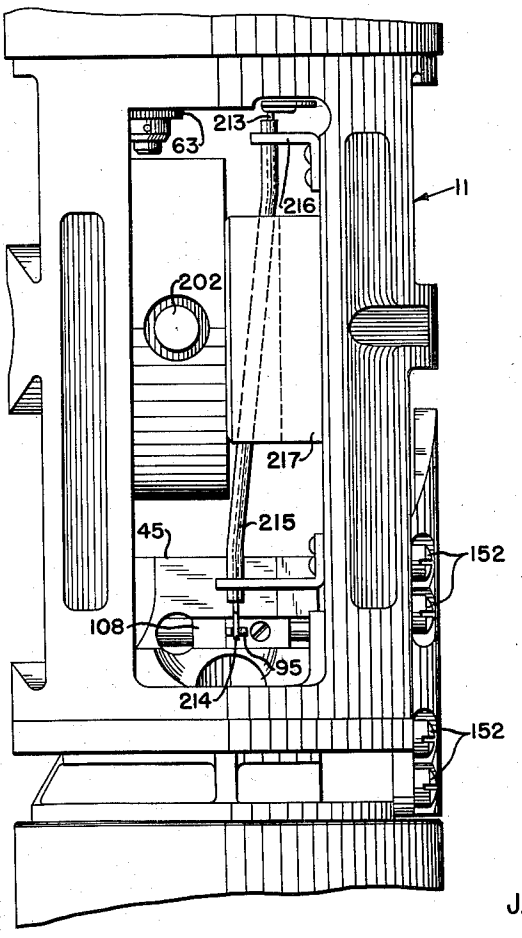


FIG.1.

FIG.12.



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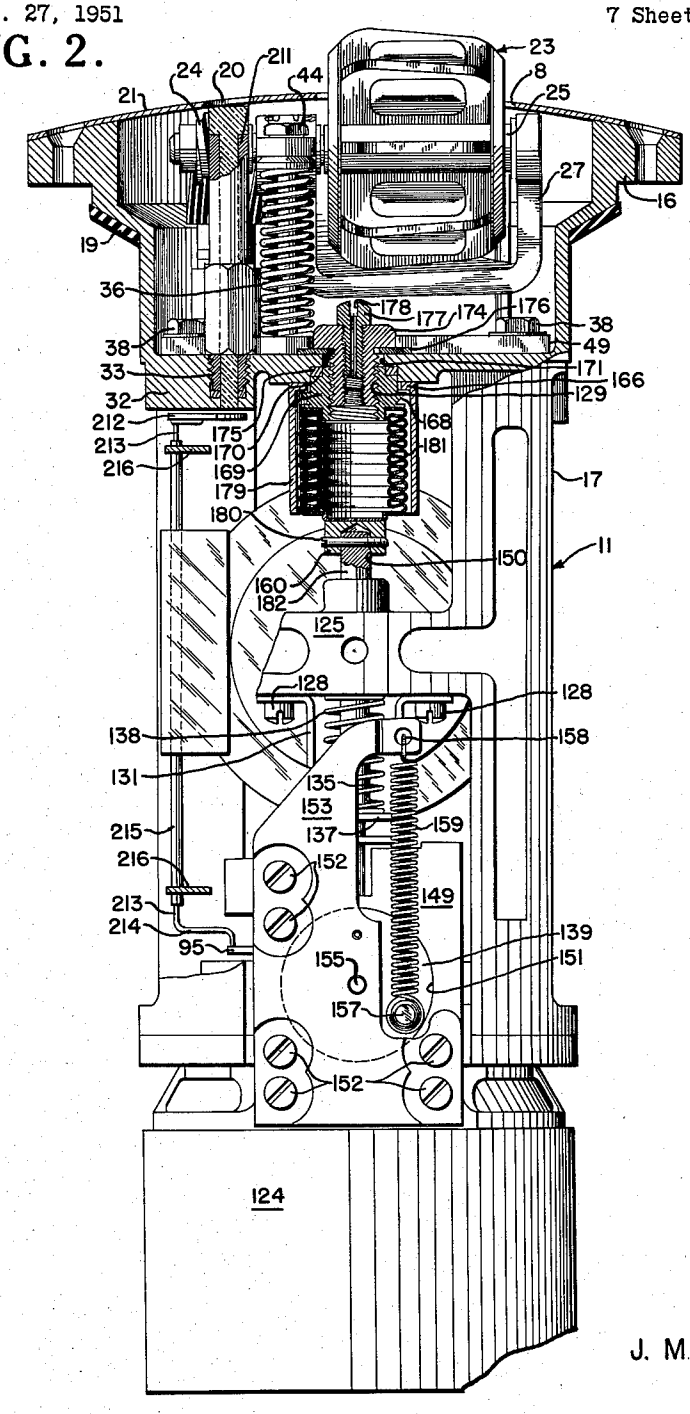
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FIG. 2.



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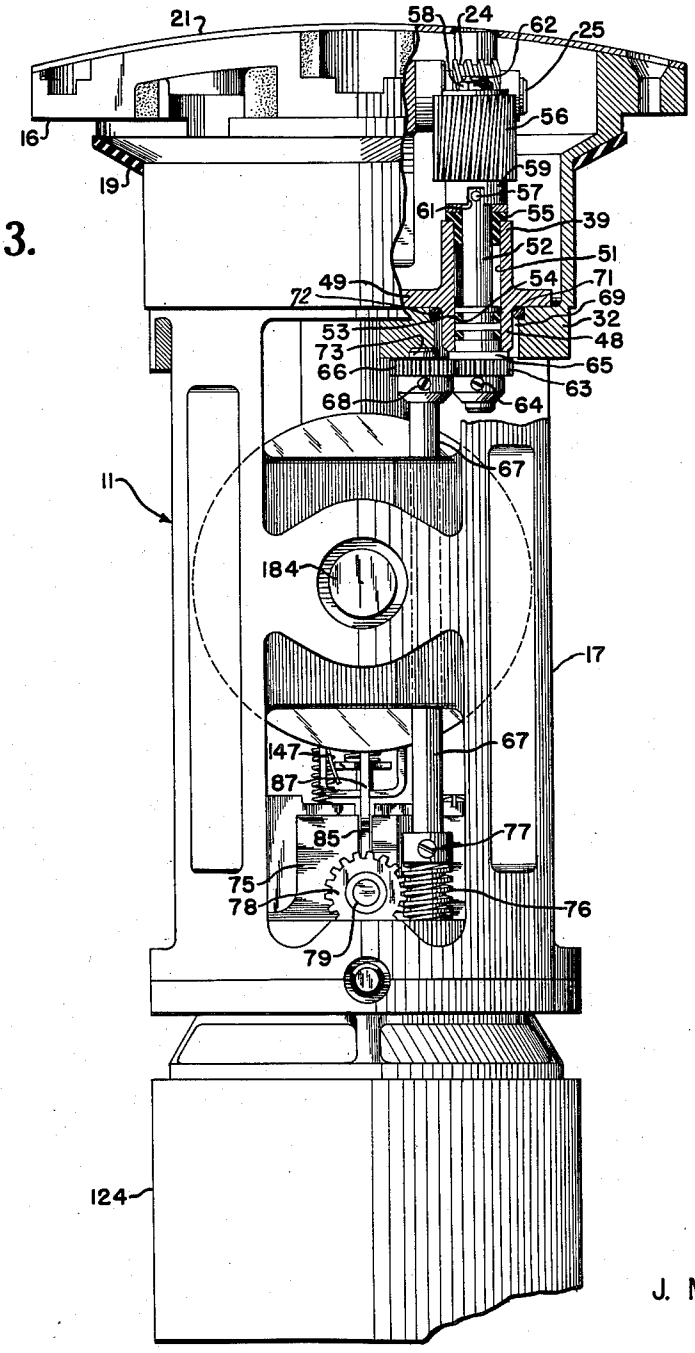
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FIG.3.



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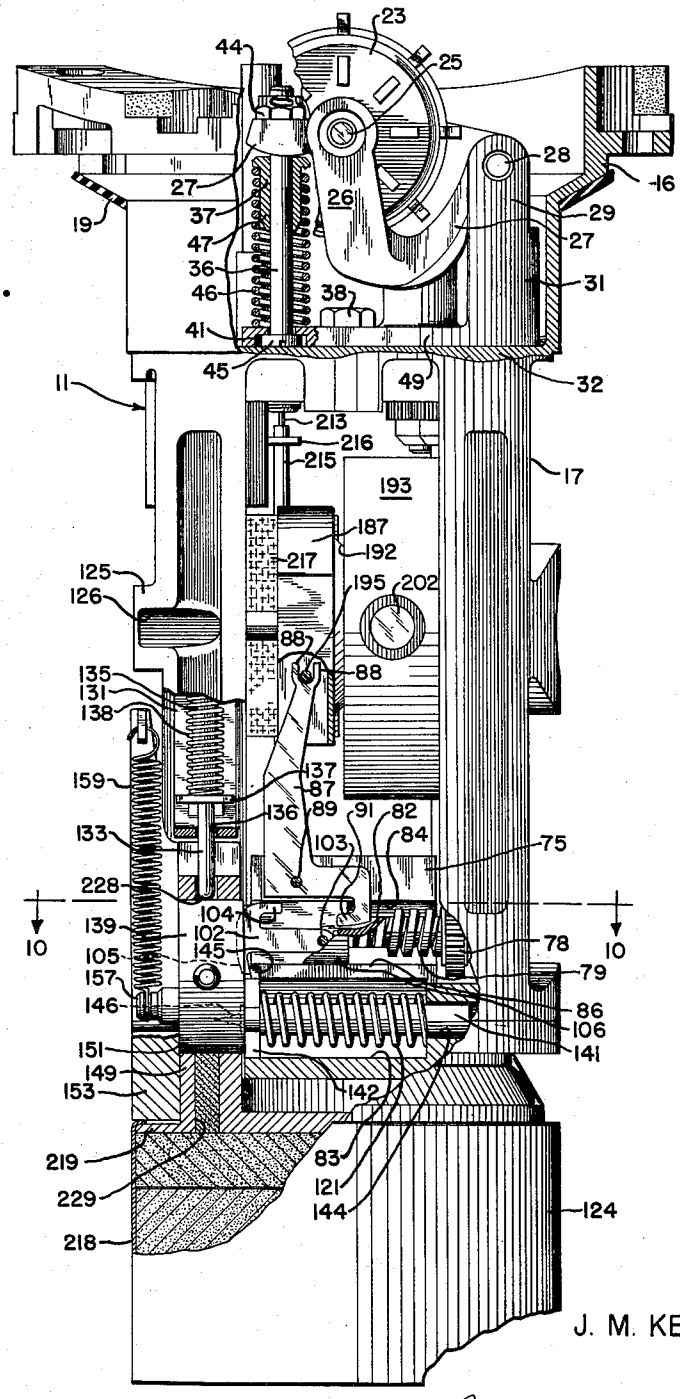
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FIG. 4.



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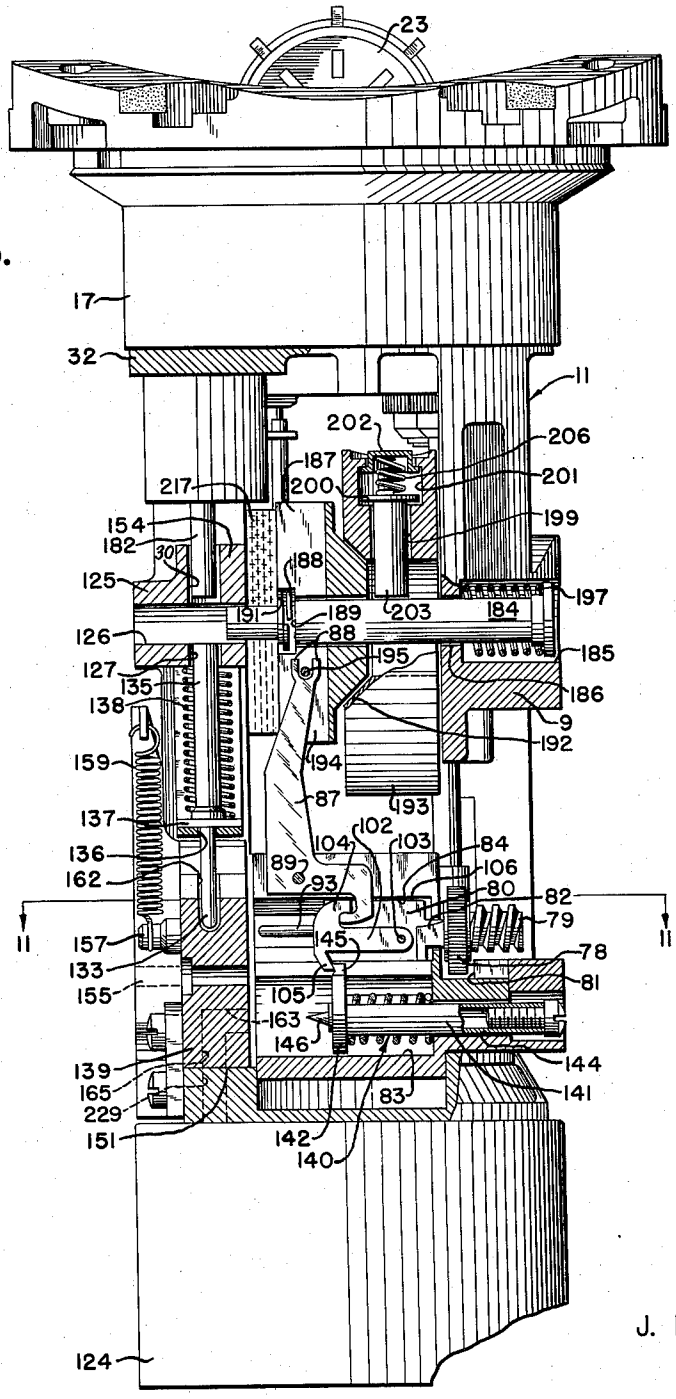
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FIG.5.



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FIG. 6.

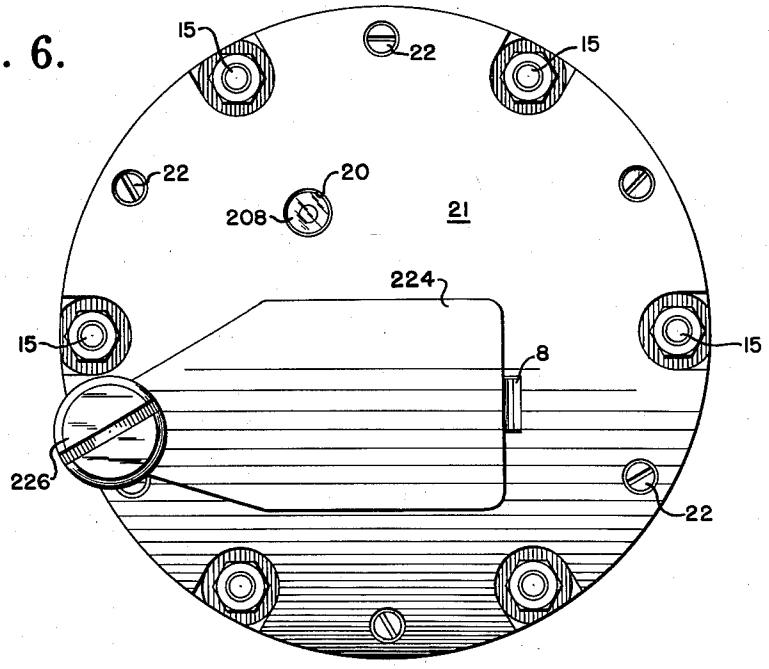
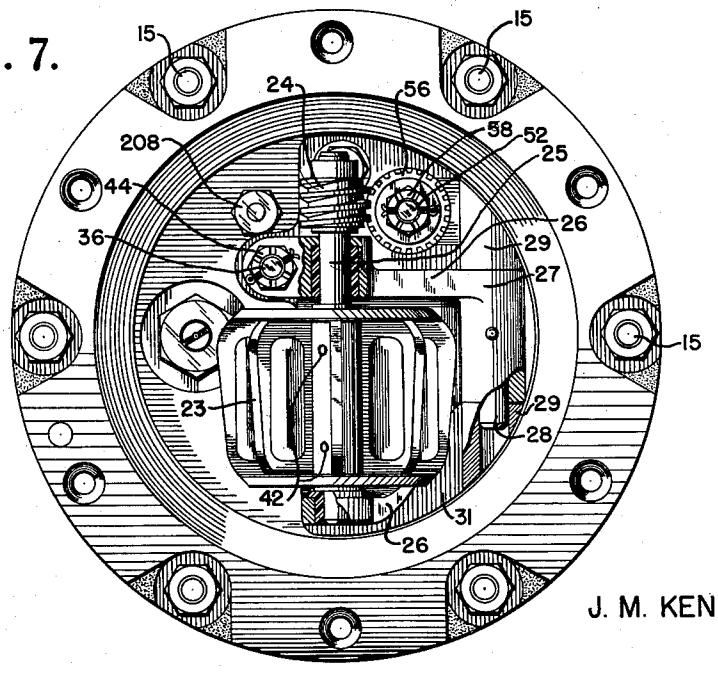


FIG. 7.



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FIG.8.

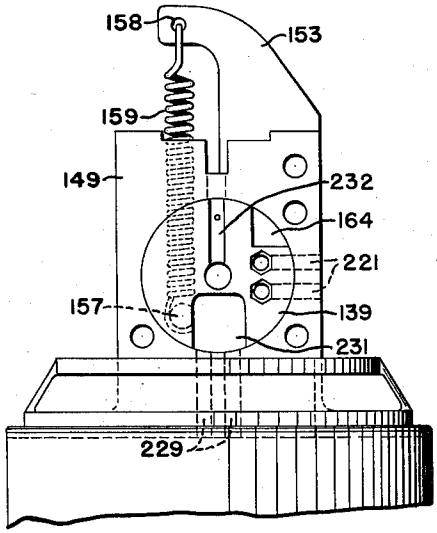


FIG.9.

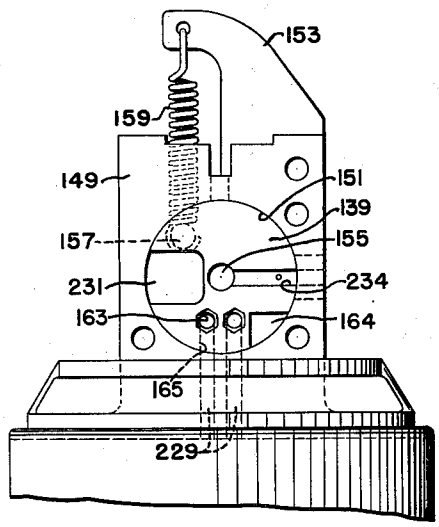


FIG.10

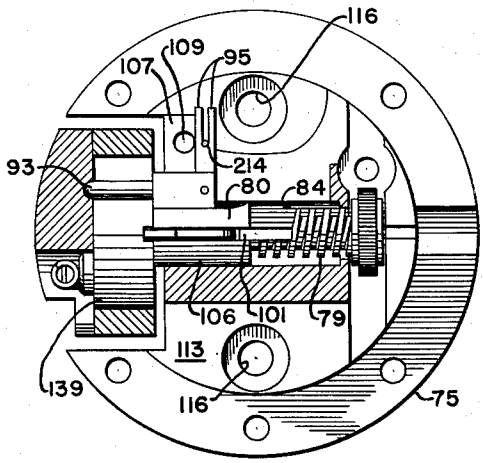
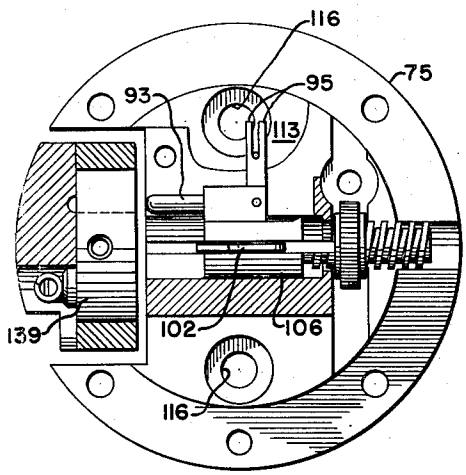


FIG.11.



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United States Patent Office 2,989,920 Patented June 27, 1961

2,989,920

TORPEDO EXPLODER

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Filed Feb. 27, 1951, Ser. No. 213,035
7 Claims. (Cl. 102—17)
(Granted under Title 35, U.S. Code (1952), sec. 266)

This invention relates to a torpedo exploder and more particularly to a torpedo exploder mechanism which is operated entirely by mechanical means and is suitable for use in torpedoes which are fired from a submarine, destroyer or aircraft. More specifically, the present invention contemplates an exploder mechanism which will move a firing pin from the uncocked position to the cocked position and a percussion cap and cooperate elements of an explosive train from an initial nonfiring or unarmed position to a firing or armed position with respect to the firing pin when the torpedo has moved a predetermined distance through the water. The firing pin operates to fire the percussion cap and explode the torpedo in response to the impact of the torpedo with a target vessel.

The invention further contemplates the provision of means for rendering the exploder mechanism ineffective to fire the torpedo if the torpedo sinks below a predetermined depth below the water surface when the torpedo has missed the target vessel and after the mechanism has been armed thereby to prevent the torpedo from exploding as it strikes the bed of the water when the bed is below the depth of the torpedo run.

One of the objects of the present invention is to provide a new and improved torpedo exploder which is suitable for use in submarine, destroyer or aircraft launched torpedoes.

Another object of the present invention is to provide a new and improved exploder mechanism for a torpedo which will operate to arm and fire the torpedo entirely by mechanical means.

Another object of the present invention is to provide a means for moving the firing pin of a torpedo exploder from an initially uncocked position to the cocked position while the torpedo moves a predetermined distance through the water.

A still further object of the present invention is to move a percussion cap and various elements of an explosive train from an initial position out of firing relation with respect to the firing pin into proper firing relation with respect thereto when the firing pin moves from the uncocked to the cocked position.

A still further object of the present invention is to provide means for indicating to an observer the degree of the arming operation prior to launching the torpedo thereby to apprise an observer of whether the torpedo is in a safe condition.

An additional object of the present invention is to provide a new and improved exploder mechanism which is effective to fire the torpedo in response to the shock of impact of the torpedo with a target vessel after the various parts of the exploder mechanism have been moved to the armed position.

Still another object of the present invention is to provide an exploder mechanism which is ineffective to fire the torpedo when the torpedo sinks below a predetermined depth.

A further object of the present invention is to provide a torpedo exploder having a firing pin movable in a direction such that the motion of the firing pin, as it strikes the percussion cap, is accelerated by the impact of the torpedo with the target vessel thereby to decrease the time interval between impact of the torpedo and detonation of the warhead.

Still an additional object of the present invention is to

provide an exploder mechanism which will fit within a handhole of a torpedo and which has no exernal parts which might become damaged during handling and shipping.

Still other objects, advantages and improvements will be apparent from the following description taken in connection with the accompanying drawings in which:

FIG. 1 is a side view of a torpedo showing the exploder mechanism mounted therein;

FIG. 2 is a front view in elevation, partly broken away, of the unarmed exploder mechanism;

FIG. 3 is a rear view, partly in section and partly broken away, of the exploder mechanism;

FIG. 4 is a view in elevation, partly broken away, of the left side of the exploder showing the various elements in the unarmed position;

FIG. 5 is a view similar to FIG. 3 but rotated through 90° and illustrating the position of the various elements moved to the armed position;

FIG. 6 is a view of the top of the exploder with the cover in place;

FIG. 7 is a view similar to FIG. 6 with the cover removed;

FIG. 8 is a view illustrating the position of the rotor disk in the unarmed position;

FIG. 9 is a view similar to FIG. 8 and illustrating the position of the rotor disk in the armed position;

FIG. 10 is a view taken along line 10—10 of FIG. 4;

FIG. 11 is a view taken along line 11—11 of FIG. 5; and

FIG. 12 is a view in elevation, partly broken away, of the right side of the exploder mechanism.

Referring now to the drawings for a more complete understanding of the invention and more particularly to FIG. 1 there is shown thereon a torpedo generally designated 10 having an exploder mechanism 11 which is adapted to be mounted in a handhole 12 in the warhead 13 which contains the main explosive charge of the torpedo. A bulkhead 14 separates the warhead 13 from the rear compartments which contain the propulsion and steering mechanisms (not shown) for operating the torpedo.

The exploder mechanism 11 is secured within the handhole 12 in watertight relation therewith by means of bolts 15, FIGS. 6 and 7, which force the flange portion 16 of the main casting 17, FIG. 2, of the exploder mechanism against the flange 18 of the handhole, a circular gasket 19 being compressed between flanges 16 and 18 to form a watertight seal therebetween as the bolts 15 are tightened. A cover plate 21, shaped arcuately to conform to the contour of the torpedo warhead is provided with two openings 20 and 8 therethrough. The cover 21 is secured to the flange 16 by screws 22, FIG. 6. A flat guard 224 is hooked at one end beneath opening 8 in the cover plate 21 and the other end of the guard is held flat to the cover plate 21 by means of a knurled screw 226 threadably secured to flange 16 of the main casting 17 thereby to depress the impeller 23 within the outer contour of the device. The generally tubular main casting 17 is divided by a bulkhead 32 having bores 69, 171 and a threaded bore 33 therethrough, FIGS. 2 and 3, parallel to the axis of the casting. The casting is also provided with diametrically disposed web portions 125 and 9, FIG. 5, having axially aligned bores 126 and 186, respectively. Bore 186 has an axially aligned enlarged counterbore 185 and bore 126 has an intersecting vertical bore 30 extending through web portion 125. Casting 17 is provided with a pair of vertical web members 154 having a pair of stop blocks 217 composed preferably of phenolic material secured thereto by screws (not shown).

As seen more clearly in FIG. 3, bore 69 has disposed

therein a cylindrical member 48 which extends therethrough with O ring gasket 71 compressed against the shoulder formed by counterbore 72 in the bulkhead with the gasket sleeved about the boss to form a watertight seal therebetween as the pair of bolts 38, FIG. 4, force the base plate 49 of the impeller mount 31 against the bulkhead. Base plate 49 is provided with a vertically extending boss 39, FIG. 3, with a bore 51 extending through bosses 39 and 48. Shaft 52 is journalled in bore 51 by flanged bushing 55, a plurality of grooves 53 being formed on the shaft. A pair of O ring gaskets 54 sleeved about shaft 52 are located within grooves 53 to form a watertight seal between the shaft 52 and bore 51. Mounted on the upper end of shaft 52 is a helical gear 56 which is prevented from turning on the shaft by pin 57 which extends through the shaft and engages a pair of diametrically disposed slots 61 formed in the hub 59 of the gear.

Gear 56 is held in place on shaft 52 by castle nut 58 and a cotter pin 62 on the end of the shaft 52. Gear 56 is driven by worm 24 secured to drive shaft 25 as by a pin (not shown). Spur gear 63 is secured to the bottom end of shaft 52 by pin 64 which extends through the hub of gear 63 and the shaft with washer 65 sleeved about the shaft and interposed between the gear and lower boss 48.

As shown more clearly in FIG. 7, impeller mount 31 is provided with a pair of arms 29 on which is journalled shaft 28. Pinned to shaft 28 is an impeller bracket 27 having a pair of arms 26 in which is journalled impeller shaft 25. Secured to impeller shaft 25 by a pair of pins 42 is impeller wheel 23. As shown more clearly in FIGS. 2 and 4, spring post 36, having castle nut 44 threaded on the upper end thereof and a head 45 formed on the other end is slidably arranged in a bore (not shown) through bracket 27 and bore 41 through base plate 49. Sleeved about spring post 36 is a spring bushing 37 having an elongated hub portion 47 slidably arranged about post 36. Sleeved about post 36 and hub 47 is a spring 46 which is interposed under compression between the flange formed on bushing 37 and the plate 49 and which yieldably urges the bracket 27 into engagement with nut 44.

As clearly shown in FIG. 3, spur gear 63 meshes with and drives spur gear 66. Gear 66 is secured at the upper end of arming shaft 67 by pin 68 engaging the arming shaft and the hub of gear 66. The upper end of the arming shaft 67 is journalled in recess 73 formed at the bottom of bulkhead 32 and the lower end of the shaft is journalled in a recess (not shown) formed in the arming bar housing 75. The lower end of shaft 67 is provided with a worm 76 which is secured thereto by set screw 77. Worm 76 meshes with and drives arming worm gear 78. Worm gear 78 threadably engages the threaded portion 79 of the arming bar 80, FIG. 5, with the lower portion of gear 78 extending within slot 81 formed in arming bar housing 75. Part of the threads of threaded portion 79 are cut away as at 82 in order that arming worm gear 78 will become disengaged from the threads when the cut away portion is moved into registry with gear 78. As shown in FIGS. 5, 10, and 11, threaded portion 79 is provided with a cylindrical extension 106 having a slot 101 formed therein. Rotatably disposed within slot 101 on pin 103 is latch member 102 having lateral projections 104 and 105 extending therefrom. Secured to the side of extension 106 is pin 93, FIG. 5, extending longitudinally therefrom and a bifurcated member 95, FIG. 10, extending laterally therefrom.

Cylindrical extension 106 is slidably arranged within horizontal bore 84 formed in housing 75. Housing 75 is provided with a longitudinal slot 108, FIG. 12, through the side thereof through which member 95 extends for limited lateral movement therein. The outer end of slot 108 is closed by block 107 which is held to housing 75 by a screw within aperture 109 threaded to the housing.

As shown in FIGS. 3 and 4, housing 75 is provided with a bore 83 arranged parallel to and beneath bore 84 and connected by slot 85. Housing 75 is provided with a second longitudinal slot 86 which forms an opening into bore 84.

Trigger 87, having a bifurcated extension 88 on the upper end thereof and a hooked portion 91 formed on the bottom end, is mounted for pivotal movement within slot 86 on trigger pin 89.

Bore 83 has an axially disposed reduced bore 144 in which is slidably arranged rod 141 of the firing pin 140.

The firing pin 140 is provided with a pair of stab pins 146 and a flanged portion 142 which is slidably arranged within bore 83. Sleeved about firing pin 141 is a spring 121 which is interposed between flange 142 and the shoulder formed by bore 83 to urge the firing pin toward the left as viewed in FIGS. 4 and 5 and in the direction of movement of the torpedo whereby the inertial force of the firing pin assists the spring 121 in firing the torpedo when a direct hit with the target is effected. Sear 145, projecting laterally from flange 142, is slidably arranged within slot 86 and is engaged for lateral movement by projection 105 as the arming bar 80 moves rearwardly, as will hereinafter be more fully described.

Screws (not shown) extend through suitable bores 116 formed in flange portion 113 of housing 75 to secure the housing to main casting 17, a dowel or the like being preferably employed to secure proper registration between the parts.

An arming indicator is provided which indicates the degree of the arming operation as the various parts of the exploder mechanism move from the unarmed to the armed position and comprises, among other elements, a cylinder of transparent material or window 208, FIG. 7, such, for example, as Lucite or the like, having tube 211 sleeved thereabout in watertight relation therewith. As seen in FIG. 2, tube 211 is threadably secured in watertight relation within threaded bore 33 formed in bulkhead 32 with the upper end of the window disposed in alinement with the opening 20 of the cover plate 21. Appearing in window 208 is one of a series of numbers, namely, 0, 1, 2, 3 and 4, appearing on the face of disk segment 212. Segment 212 is secured to an arm formed at the upper end of rod 213. Rod 213 extends downwardly toward the base of casting 17 and terminates at its lower end in the shape of a crank arm 214 which is disposed within and operated by the bifurcated member 95 of the arming bar pin 92. Rod 213 is journalled in tube 215 which is secured to the main casting 17 by a pair of brackets 216 secured to the main casting 17.

Booster head 124, FIG. 4, is provided with an integral upstanding portion 149 having a longitudinal bore 151 therethrough and a circular flanged portion 219 at the base of the head for securing a booster cup 218 thereto by crimping the cup to the flange. The booster cup 218 is entirely filled with any explosive material suitable for boosting the main charge. A pair of vertical bores 229 filled with an explosive material as, for example, tetryl leads forms a link of the explosive train between the bore 151 into the booster cup 218.

As best seen in FIGS. 2, 8 and 9, the face of the upstanding portion 149 has secured thereto by suitable screws a rotor supporting plate 153. Rotor supporting plate 153 is provided with an axially extending pin 155 disposed within an axial bore in the rotor 139. A bore 158 through rotor supporting plate 153 is provided for securing one end of tension spring 159.

Mounted for rotation on rotor pin 155 and disposed within bore 151 of upstanding portion 149 is rotor 139. Secured to the face of rotor 139 is pin 157 for securing the other end of tension spring 159. As seen more clearly in FIGS. 8 and 9, the inner face of the rotor 139 is provided with radially disposed slots 231 and 232 and

the periphery of the rotor is provided with a notch 164. The rotor 139 is provided with lateral bore 234 therethrough.

The rotor 139 is also provided with a radial detent 162 formed in the periphery thereof to receive the detent pin 133 when the rotor is in the armed position, FIG. 5. As more clearly shown in FIGS. 2 and 5, the web 125 of main casting 17 has suspended therefrom a stirrup 131 which is held thereto by a pair of screws 128. Stirrup 131 is provided with a vertical bore 136 in which is slidably arranged pin 133 which is formed integrally with collar 137. Collar 137 is provided with a cylindrical extension 135 which is slidably arranged within vertical bore 127 formed in web 125. Compression spring 138, sleeved about cylindrical extension 135 and interposed between web 125 and collar 137, urges the collar into engagement with the base of the stirrup 131 and the pin 133 downwardly. Secured to a leg of the stirrup 131 by a pair of rivets 148 is leaf or ratchet spring 147, FIG. 3, which is bent outwardly from the stirrup and engages collar 137 to lock the collar to the base of the stirrup when the collar is moved into engagement with the base of the stirrup.

Bore 171 through bulkhead 32, FIG. 2, has disposed therein the threaded extension of bellows nut 174 which threadably engages the threaded bore 129 of bellows head 169. A metallic washer 176 is interposed between the head of nut 174 and the bulkhead 32 and O ring gasket 175 is interposed between shoulder 170 formed on the bellows head 169 and the bulkhead 32 to form a watertight seal therebetween. Bellows nut 174 is provided with a threaded opening therethrough in which screw 177 is secured, screw 177 having a restrictive orifice 178 through the screw for admitting water through the orifice at a predetermined rate. The bellows head 169 has secured thereto in watertight relation an expansible metallic bellows 181, the other end of the bellows being closed in watertight relation by rod holder 160. Rod holder 160 has secured thereto a rod 182 disposed within detent 150 formed in holder 160 and secured thereto by pin 180. Rod 182 is slidably arranged within the upper portion of the vertical bore 127 formed in the web 125, the bottom of the rod normally lying above the intersection of horizontal bore 126. A bellows guard 179, sleeved about the bellows 181, is provided with an inturned flange 166 which engages shoulder 168 formed on head 169, the flange 166 being pressed between the bottom of the bulkhead 32 and the bellows head 169 as the bellows nut 174 is tightened.

Slidably arranged within bores 126 and 186 is disposed a headed inertia shaft 184 with the axis of the shaft arranged parallel to the longitudinal axis of the torpedo. The inertia shaft is urged to the right as viewed in FIG. 5 by compression spring 197 which is sleeved about the shaft 184 and interposed under compression between the shoulder formed by bore 185 and the head of shaft 184. Shaft 184 is provided with circumferential groove 189 formed therein into which is fitted a portion of split washer 188. Washer 188 is fitted within groove 191 formed in inertia member 187 which has a centrally disposed opening 134 for receiving shaft 184 therein. Inertia member 187 is provided with a vertical groove 194 formed in the face of member 187 and having pin 195 laterally disposed through the groove and secured to the member by a force fit. The bifurcated extension 88 of the trigger 87 is engaged by pin 195.

A pair of matching cam surfaces 192 formed on inertia member 187 and inertia weight 193, respectively, are urged into engagement with each other by compression spring 197.

The inertia weight 193 is provided with a central opening 207 and three radially disposed bores 199 (one being shown in FIG. 5) each having communicating enlarged bores 201. Telescopingly arranged within bores 201 are cup shaped spring retainers 202 enclosing the outer ends of the bores 201 which are secured to the inertia weight 193 as by staking the parts together.

Slidably arranged within bores 199 and 201 are piston rods 203 and pistons 200, respectively. Compression springs 206 are interposed under compression between spring caps 202 and pistons 200 for yieldably urging the end of the piston rods 203 into engagement with shaft 184.

The operation of the exploder mechanism will best be understood by reference to FIGS. 2, 3 and 4 wherein the various parts of the exploder mechanism are arranged in the unarmed position. The rotor 139 has been rotated clockwise as viewed in FIG. 2, pin 93 has been moved into notch 164 of the rotor, FIG. 10, stab pins 146 are disposed within the rotor as shown, pin 133 is urged into engagement with the periphery of the rotor 139, cylindrical extension 135 blocks lateral bore 126 to prevent inertia shaft 184 from moving laterally, bifurcated member 88 of the trigger 87 engages pin 195 of inertia member 187, bifurcated member 95 engages crank arm 214 of the arming indicator and the digit "0" appears in registry with window 208 to indicate the exploder is in the unarmed condition and is safe to handle and load into the torpedo.

Before the torpedo is loaded into the torpedo tube, knurled nut 226 and guard 224 are removed from the torpedo cover and the impeller bracket 27 is urged upwardly away from bulkhead 32 by compression spring 46 to cause a portion of the blades of the impeller wheel 23 to protrude through opening 8 in the cover plate 21 as viewed in FIG. 2. As the torpedo is inserted into the launching tube, the breech of the launching tube forces the impeller to a retracted position substantially flush with the contour of the cover plate 21, the impeller resuming its protruding position as the torpedo emerges from the launching tube after firing.

When the torpedo has been fired from the launching craft and attains a predetermined speed through the water, the force developed by the water striking the protruding blades of the impeller wheel 23 causes the wheel to rotate. As the impeller wheel rotates it operates through a gear train comprising shaft 25, worm 24, helical gear 56, counter shaft 52, spur gear 63, spur gear 66, shaft 67, worm 76 and worm gear 78, to move threaded portion 79 and arming bar 80 to the right as viewed in FIGS. 10 and 11. As the arming bar 80 moves to the right, projection 105 engages sear 145 to compress firing pin springs 121 until projection 104 moves into hook 91 of trigger 87 at which time the movement of the arming bar will stop as the cut away portion 82 enters arming worm gear 78 to position the various parts as viewed in FIG. 5. The exploder is now armed.

During the movement of the arming bar 80, crank arm 214 and disk 212 rotate until figure "4" appears in registry with window 208 to indicate the exploder has moved to the armed position and pin 93 has been withdrawn from notch 164 of the rotor 139 whereby spring 159 will cause the rotor to move clockwise, as viewed in FIG. 8, until detent pin 133 moves into detent 162 to lock the rotor in the armed position as shown in FIG. 9. When the torpedo is in the armed position detents 163 with percussion caps therein are in registry with stab pins 146, radial bores 165 are in registry with bores 229 leading to the booster charge enclosed in the booster head 124 thereby to align the explosive train from the percussion caps to the explosive material contained within booster cup 218.

When the exploder mechanism is in the armed position and strikes a target vessel with a resulting net forward force parallel to the axis of the torpedo, inertia member 187 with the attached inertia shaft 184 and bifurcated extension 88 suddenly move forward of the torpedo and as trigger 87 rotates about pin 89, hook 91 engages extension 104 rotating latch 102 about pin 103 and projection 105 is moved out of engagement with sear 145

whereby firing pin **140** is moved forward by the firing pin spring **121** to fire the percussion caps contained in rotor **139** thereby to fire the torpedo. The firing pin **140** moves in the forward direction, i.e., in the direction of the motion of the torpedo so that the effect of the deceleration of the torpedo upon striking the target with a head on impact is to aid the action of the spring **121**, and thus decrease the delay in time which occurs between the instant of impact and the detonation of the main explosive charge in the torpedo warhead.

When the torpedo strikes a target vessel a glancing blow with a resulting force lateral to the longitudinal axis of the torpedo, inertia weight **193** is moved laterally with respect to shaft **184** and cam surfaces **192** wedge inertia member **187** forward to transform any lateral or vertical motion of the inertia weight into forward motion of inertia member and rod **184** thereby to release the firing pin to fire the torpedo.

Should the torpedo miss the target vessel and sink to a predetermined depth, such, for example, as 100 feet, water will gradually enter the bellows **181** by way of restrictive orifice **178** whereby water pressure will elongate the bellows to move stop rod **182** to block bore **126** into the place formerly occupied by rod **135** to block inertia shaft **184** thereby to prevent actuation of inertia shaft and trigger in response to the impact of the torpedo with the bed of the water and the torpedo will not be exploded as it strikes the bed of the body of the water.

The construction and arrangement of the weights **193** and **187** and the cam surfaces **192** is preferably such that the magnitude of the acceleration required to fire the torpedo can be varied as a function of direction of acceleration by proportioning of the weights **193** and **187** and the cam surfaces. The term "acceleration," as employed herein, generally means a time rate of change of velocity, either in magnitude or direction, and includes both positive acceleration in which the torpedo velocity is increasing with time as, for example, occurs when the torpedo is fired, and negative acceleration, frequently called deceleration, in which the velocity decreases with time, as well as lateral acceleration resulting from changing of direction of velocity, as, for example occurs when the torpedo strikes the target a glancing blow.

Included in the general term "percussion cap" as herein used are explosive initiators which operate either by striking (or by percussion) or operate by stabbing (or by piercing with a sharp pointed pin) such as the two stabbers **146** shown in FIG. 5, used to initiate the dual firing train.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

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

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A torpedo exploder of the character disclosed comprising, a spring loaded retractable impeller disposed for movement into communication with the surrounding water after torpedo launching and adapted to rotate as the torpedo moves through the water, an initially uncocked firing pin, a sear for releasably locking said firing pin in the cocked position, driving connections between said impeller wheel and said sear for moving the firing pin thereby from the uncocked position into a cocked position in releasable locking engagement with said sear when the impeller wheel has made a predetermined number of revolutions, means including a spring which is compressed by movement of the firing pin to a cocked position and a percussion cap normally disposed in a safe position out of alignment with the firing pin, means for positioning said percussion cap in alignment with said firing pin contemporaneously with firing pin cocking for firing the torpedo when the sear is moved out of locking engagement with said firing pin, and firing means including an inertial mass responsive to the impact of the torpedo with a target vessel and a trigger linkage operatively connected thereto for moving said sear out of locking engagement with said firing pin.

2. A torpedo exploder mechanism of the character disclosed comprising in combination, an explosive train for firing the explosive charge of the torpedo when the train is detonated, an initially uncocked firing pin, a triggering means including a sear for said firing pin, a movable percussion responsive detonator initially displaced from proper firing relation with respect to the explosive train and said firing pin, a rotatable impeller in communication with the surrounding water and adapted to be operated thereby as the torpedo moves therethrough, distance measuring means adapted to be set in operation by said impeller as the torpedo moves through the water for progressively moving said firing pin from the uncocked position thereof to a position wherein it is cocked by said sear means including an interlock with said distance measuring means for moving said detonator into proper firing relation with respect to the explosive train and said firing pin after the impeller has made a predetermined number of rotations sufficient to move said firing pin to the cocked position thereof, inertia means effective when the detonator is in proper firing relation with respect to the explosive train and said firing pin for actuating said triggering means and said sear for releasing the firing pin to fire the detonator as the inertia means operates in response to the impact of the torpedo with a target vessel, and means having a dial element connected to said distance measuring means for visibly indicating at a position on the external surface of said exploder mechanism the amount of movement of the firing pin as the firing pin is moved to the cocked position.

3. A torpedo exploder mechanism of the character disclosed comprising, in combination, an explosive train for firing the explosive charge of the torpedo when the train is detonated, an initially uncocked firing pin, a movable percussion responsive detonator for detonating said train and initially positioned out of operative firing relation with respect to the explosive train and said firing pin, means including an impeller in communication with the surrounding water when the torpedo is launched therein and adapted to be rotated in response to movement of the torpedo through the water for cocking the firing pin and moving said detonator into operative firing relation with respect to said explosive train and firing pin when the impeller has made a predetermined number of revolutions, inertia controlled means effective when the detonator is in operative firing relation with respect to the explosive train and firing pin for releasing the firing pin to fire the detonator as the inertia means operates in response to the impact of the torpedo with a target vessel, and hydrostatic responsive means adapted to render said inertia means ineffective to release said firing pin to fire said detonator when the torpedo sinks below a predetermined depth of submergence.

4. A torpedo exploder mechanism of the character disclosed comprising, in combination, a percussion responsive detonator for firing the explosive charge of the torpedo when the detonator is fired, an initially uncocked firing pin for firing said detonator when the firing pin is released from a cocked position, means including an impeller in communication with the surrounding water and in driving connection with said firing pin for moving the firing pin from the uncocked to the cocked position when the impeller has made a predetermined number of revolutions, a sear for releasably locking said firing pin in the cocked position, a first inertia member constructed and arranged to move longitudinally of the axis of torpedo and move said sear from locking engagement with

said firing pin in response to the setforward force of the first inertia member when the torpedo strikes a target vessel, a second inertia member constructed and arranged to be moved transversely of the axis of the torpedo when the torpedo strikes a target vessel a glancing blow, co-acting cam means arranged on said first and second inertia members for causing said first inertia member to move longitudinally in response to said transverse movements of the second inertia member, and means responsive to the pressure of the surrounding water for rendering said first and second inertia members ineffective to fire the detonator when the torpedo is below a predetermined depth of submergence, thereby to prevent firing when the torpedo strikes the bottom of a body of water.

5. In a torpedo exploder mechanism of the character disclosed comprising in combination, an initially unarmed firing means including a percussion responsive detonator for firing the main explosive charge of the torpedo when the firing means is armed, means including an element responsive to movement of the torpedo through the water for arming said firing means in predetermined time delayed relation with respect to the launching of the torpedo on the target run, inertia controlled means for rendering said firing means effective to fire the detonator when the torpedo is armed in response to the impact of the torpedo with a target vessel, and means responsive to the pressure of the surrounding water for rendering said firing means ineffective to fire the detonator when the torpedo is below a predetermined depth of submergence.

6. A torpedo exploder mechanism of the character disclosed for firing the main explosive charge of the torpedo comprising, in combination, an explosive train for firing the explosive charge of the torpedo, a percussion responsive detonator initially positioned out of operative firing relation with respect to the explosive train, an initially uncocked firing pin, for firing the detonator when the detonator is in operative firing relation with respect to said explosive train, an impeller adapted to be rotated in response to the movement of the torpedo through the water, means operated by said impeller for moving the firing pin to the cocked position thereof and subsequent to a predetermined movement of the firing pin for moving the detonator into proper firing relation with respect to the firing pin and explosive train and after the impeller has rotated a predetermined number of revolutions, means including an inertia responsive device operatively connected to the firing pin after cocking thereof for releasing the firing pin thereby to fire the detonator in response to the impact of the torpedo with a target vessel when the firing pin has been moved to said cocked position, and means responsive to the pressure of the surrounding water for rendering said firing means ineffective to fire the detonator when the torpedo is below a predetermined depth of submergence.

7. In a device for exploding a torpedo having a main explosive charge therein, the combination of an explosive train in operative firing relation with respect to said explosive charge, a movable detonator initially positioned out of operative firing relation with respect to said explosive train, a normally uncocked firing pin positioned initially out of firing relation with respect to said detonator, a pivotally mounted normally retracted impeller, movable spring biased impeller mounting means for extending the impeller in a direction transverse to the axis of the torpedo from an inoperative retracted position into operative communication with the surrounding water after the torpedo is launched and for effecting rotatable actuation of the impeller as the torpedo moves through the water, means operatively connected to said impeller for moving said detonator into firing relation with respect to said explosive train and firing pin after cocking of said firing pin thereby at a predetermined interval of time controlled by the impeller after the impeller has been actuated, movable trigger means for rendering the firing pin effective to fire the detonator only after the detonator has been moved into proper firing relation with respect to said explosive train, and firing means including an inertia responsive element and a linkage element between said inertia element and said trigger means, which is effective only when the firing pin is cocked, to move said trigger means out of engagement with said firing pin, thereby to render the firing pin effective to fire the detonator.

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