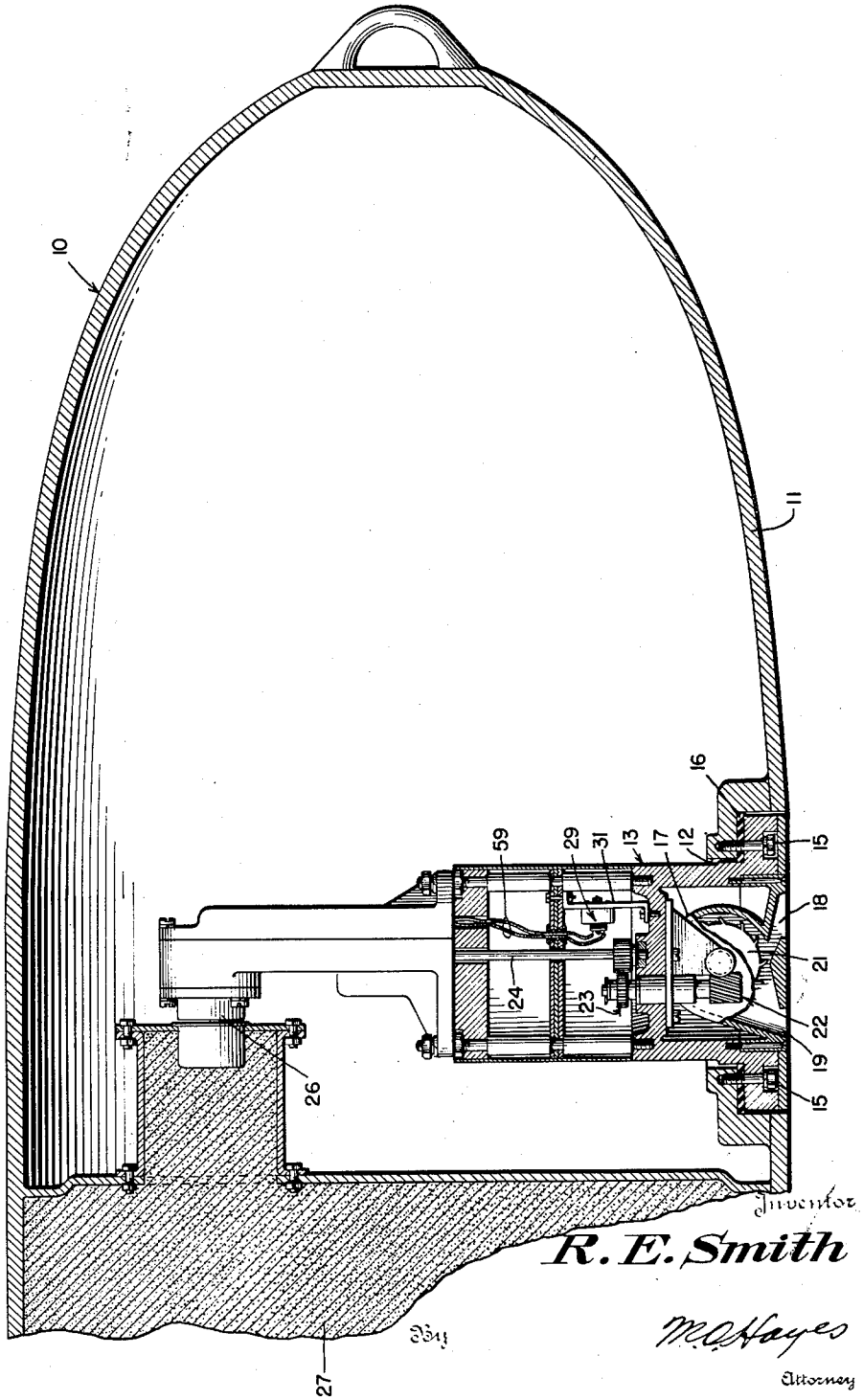
Jan. 29, 1957 R. E. SMITH 2,779,277

TORPEDO EXPLODER

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FIG. 1.



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FIG. 2.

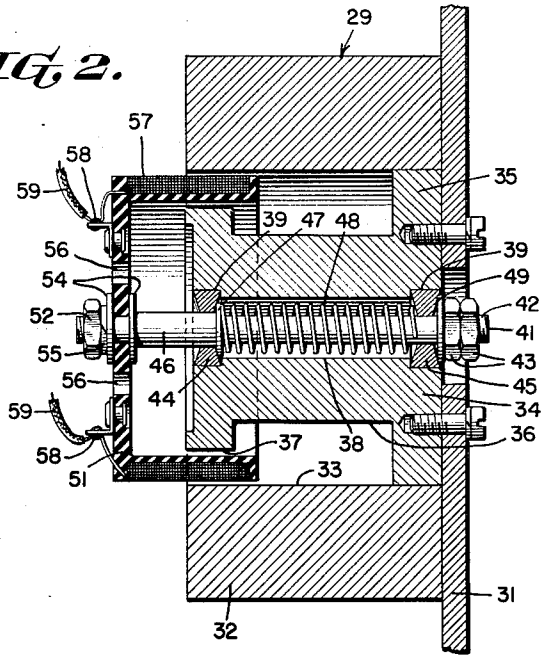
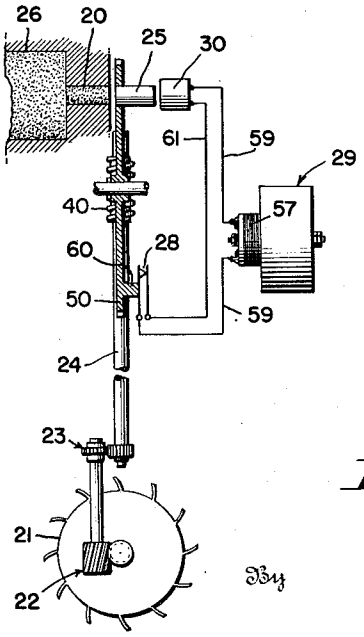


FIG. 3.



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TORPEDO EXPLODER

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7 Claims. (Cl. 102—16)

(Granted under Title 35, U. S. Code (1952), sec. 266)

This invention relates to an exploder mechanism for a torpedo and more specifically to a torpedo exploder in which the firing is accomplished by sudden movement of a coil disposed within a magnetic circuit sufficient to fire a low energy detonating device upon impact of the torpedo with a target.

In torpedo exploders of the type heretofore devised considerable difficulty has been experienced by failure of the torpedo to explode as it strikes the target or by premature firing of the torpedo due to pitch and roll or broaching during the travel of the torpedo through the water.

The device of the present invention retains all of the advantages of the devices of this class heretofore devised and possesses none of the foregoing disadvantages.

In the device of the present invention, the firing of the torpedo is accomplished by a sudden movement of a movable coil from an initial position of rest within a strong magnetic field thereby to generate an electrical signal of sufficient strength to fire a low energy detonator as the torpedo strikes the target regardless of the angle of impact of the torpedo with the target.

One of the objects of the present invention is to provide a new and improved exploder for a torpedo.

Another object is to provide an electromagnetic exploder for a torpedo in which new and improved means are employed for generating an electrical firing impulse as the torpedo strikes the target.

Still another object is to provide a new and improved electromagnetic exploder which is adapted to be employed with a torpedo of conventional design without material modification of the torpedo.

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

Fig. 1 is a view partially in section of a torpedo employing the device of the present invention in accordance with a preferred embodiment thereof;

Fig. 2 is an elevational view somewhat enlarged and partially in section of the inertia generator of Fig. 1; and

Fig. 3 is a diagrammatic view of the torpedo exploder of the present invention in an armed condition.

Referring now to the drawings on which like numerals of reference are employed to designate like parts throughout the several views and more particularly to Fig. 1 thereof, there is shown thereon a torpedo indicated generally by the numeral 10 comprising a casing 11 provided with the usual hand hole 12 in the nose portion thereof. Fitted within the hand hole is a torpedo arming mechanism indicated generally by the numeral 13 and secured thereto in any convenient manner as by the bolts 15, a gasket 16 being provided to insure a watertight seal therebetween. The torpedo arming mechanism may be of any type suitable for the purpose such, for example, as the torpedo arming mechanism described and claimed in the copending application of J. M. Kendall et al. for Torpedo Exploder Mechanism, Serial No. 750,615, filed

May 26, 1947, the mechanism comprising a chamber 17 having a water inlet 18 and an outlet 19 arranged to cause a flow of water therethrough as the torpedo travels through the water on a run toward the target. Within the chamber is rotatably mounted an impeller 21 adapted to be rotated by the aforesaid flow of water and through suitable gearing indicated generally at 22 and 23 causes a shaft 24 to rotate slowly from an initial position to a final position during the travel of the torpedo through the water. The shaft carries a worm 40 which drives a worm wheel 50, Fig. 3. The rotation of the shaft causes an element 25 of the explosive train of the exploder carried by wheel 50 to be moved from an initial safe position to an armed position in operative relation with a tetryl pellet 20 communicating with a booster charge within the casing 26 and in operative relation with a low energy detonator or squib 30. The explosion of the booster charge causes the main charge 27 within the torpedo to be fired. There is also provided an arming switch 28 adapted to close a firing circuit when the shaft 24 has made a predetermined degree of rotative movement during the travel of the torpedo toward the target such that a cam 60 carried by wheel 50 moves into a position to close switch 28. As the torpedo strikes the target, the firing circuit is energized by an electrical impulse received from an inertia controlled voltage generating mechanism indicated generally by the numeral 29 and secured to the arming mechanism 13 in any suitable manner as by the support 31 with the axis of the device preferably arranged in the direction of the line of travel of the torpedo as illustrated.

The voltage generating mechanism 29, Fig. 2, comprises a pot magnet 32 composed of any material suitable for the purpose and having a bore 33 therein within which is fitted a pole piece 34 preferably composed of material having magnetic properties similar to those of soft iron. The pole piece 34 is generally cylindrical in shape and provided with a circular flanged portion 35 for engagement with the bore 33 of the pot magnet whereby the pole piece is secured to the pot magnet in concentric relation therewith. The pole piece 34 is also provided with a cylindrical portion 36 of reduced diameter and a head 37 of somewhat greater diameter contiguous therewith, the head having a cylindrical periphery in concentric spaced relationship with respect to the bore 33.

It will now be apparent from the foregoing description that the pot magnet 33 sets up a magnetic circuit which includes the pole piece 34 and the annular gap between the head 37 thereof and the bore 33 of the magnet such that the magnetic field of the magnet is highly concentrated within the gap adjacent the cylindrical periphery of the head. The pole piece 34 is also provided with a centrally disposed bore 38 having end portions 39 thereof of greater diameter than the central portion of the bore. Within the bore 38 is arranged a plunger or rod 41 preferably composed of nonmagnetic material and threaded at 42 to receive a pair of locking nuts 43. Within the end portions 39 respectively of the bore 38 are secured a pair of bearings 44 and 45 adapted to support the plunger 41 for reciprocal movement within the bore, bearing 44 having a bearing surface therein for engagement with an enlarged cylindrical portion 46 of the rod. A shoulder is provided on the rod between the portion 46 thereof and the central portion of the rod in abutting relation with a washer 47. A resilient spring 48 is disposed within the bore 38 and in engagement with the washer 47 and the bearing 45, the tension of the spring being adjustable by the nuts 43. A washer 49 is preferably provided between the nuts 43 and bearing 45.

A cup-shaped spool 51 composed of nonmagnetic material is secured to the plunger 41 by a nut 52 threaded thereon, a pair of washers 54 being preferably arranged

on opposite sides of the end portion of the spool in abutting relation with the enlarged cylindrical portion 46 of the rod and a lock washer 55 respectively. The spool 51 is preferably provided with a plurality of apertures 56 to prevent dash pot action of the spool as it moves within the bore 33 of the pot magnet. A coil 57 is arranged about the spool and secured thereto, the ends of the coil being connected to a pair of terminals 58 secured to the spool head. The terminals 58 are connected to a pair of conductors 59 thereby establishing an electrical connection between the coil and the detonator 30 by way of the arming switch 28 and an additional conductor 61.

The switch 28, it will be noted, is normally open and premature movement of the coil 57 within the magnetic field set up by the magnet 32 prior to closure of the arming switch will be ineffective to fire the detonator. When the torpedo has traveled a predetermined distance through the water, however, the arming switch is closed and the circuit is completed between the coil 57 and the detonator. This circuit, herein referred to as a firing circuit, is not energized until the torpedo strikes the target, the coil 57 being held immovable with respect to the magnetic field set up by the magnet 32 by reason of the force of the spring 48 against the washer 47, the tension in the spring being calibrated to a predetermined value by adjustment of nuts 43 such that forces corresponding to accelerations less than seven times gravity, for example, will not cause movement of the coil. Thus, during the travel of the torpedo through the water the coil does not move regardless of the pitch and yaw of the torpedo or whether the torpedo should broach during the torpedo run.

As the torpedo strikes the target, the coil 57 is suddenly moved inwardly within the bore 33 and the number of flux linkages of the coil with the field set up by the magnet 32, is suddenly increased. When this occurs, the coil generates a voltage of sufficient strength to cause a current flow to fire the detonator 30 and explode the torpedo regardless of the angle of inpact of the torpedo with the vessel.

While the invention has been described with reference to a particular example thereof which gives satisfactory results, it will be understood by those skilled in the art to which the invention pertains, after understanding the invention, that various changes and modifications may be made without departing from the spirit and scope of the invention, and it is intended, therefore, in the appended claims to cover all such changes and modifications.

The invention herein described and claimed may be manufactured and used by or for the Government of the United States of America for governmental purposes without 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 for use in a torpedo comprising, in combination, a firing circuit including an electroresponsive squib, fluid driven arming means for closing said circuit during the operation of said means, and electromagnetic means connected in said firing circuit and adapted to generate a current for firing said squib, said electromagnetic means comprising a permanent magnet provided with a longitudinal bore substantially parallel to the longitudinal axis of the torpedo, bearing members mounted within said bore, a plunger resiliently mounted within the bore for longitudinal sliding movement on said bearings, and a coil rigidly connected to said plunger and adapted to be moved within the field of said permanent magnet in response to impact of the torpedo with its target, a coil spring disposed within said bore and maintained under compression by said bearing members, said spring being sleeved on the plunger for normally biasing and supporting the plunger and coil to an initial position within the field of the magnet.

2. A torpedo exploder of the character disclosed comprising, in combination, a firing circuit, an electroresponsive squib included in said circuit, and electromagnetic means connected in said firing circuit and adapted to generate a current for firing said squib, said electromagnetic means comprising a substantially cylindrical permanent magnet provided with a longitudinal bore, an inertia responsive coil, a plunger slidably mounted within said bore and rigidly connected to said coil for moving the coil within the field of said magnet as the torpedo strikes its target, a coil spring under compression disposed within said bore and sleeved to the plunger for normally biasing and supporting the plunger and inertia coil to an initial position within the field of the magnet, and adjustable means mounted on said plunger for varying the tension of said spring.

3. In a torpedo, the combination of an explosive train including an element initially positioned out of operative relation with respect thereto, means including an element responsive to the movement of the torpedo through the water for moving said element into operative relation with respect to the explosive train, an initially open firing circuit, switch means controlled by said last named means for closing said firing circuit, electroresponsive detonating means connected in the firing circuit for firing the explosive charge of the torpedo through said explosive train, and electromagnetic means also connected in the firing circuit and adapted to generate a voltage for firing said detonating means in response to the impact of the torpedo with its target, said electromagnetic means including a magnet having a longitudinal bore therein, a plunger slideably mounted within said bore, a spring sleeved on said plunger under compression and disposed within said bore for biasing and supporting the plunger toward a normal position thereof, adjustable means on the plunger for varying the tension of said spring, and an induction coil fixed to the plunger for movement therewith and within the field of said magnet.

4. In a torpedo, a firing circuit, a normally incomplete detonating train, electroresponsive means connected in said firing circuit for initiating the detonation of the explosive charge of the torpedo through said detonating train, an arming switch in said firing circuit, means for completing said detonator train and for closing said arming switch, and electromagnetic means also connected in said firing circuit, said electromagnetic means comprising a sleeve-like permanent magnet and a soft iron core adapted to close one end of the sleeve, said core having a head disposed in spaced relation with the inner wall of the other end of the sleeve to provide a peripheral air gap therebetween within which the field of the magnet is highly concentrated, said core having a central bore concentrically disposed with respect to said sleeve, a plunger rod having a shoulder and mounted for reciprocal movement within said bore, a coil carried by said rod at one end thereof, a coil spring sleeved on the rod and interposed under compression between the core and said shoulder on the rod whereby the coil is urged yieldably into an initial position of rest within said gap, and adjustable means carried at the other end of the rod for varying the tension in said spring whereby the coil is adapted to traverse the field in said air gap as the rod moves reciprocally within the bore in response to the impact of the torpedo with the target thereby to generate a voltage for firing said electroresponsive means.

5. In a torpedo, a firing circuit, a normally incomplete detonator train, electroresponsive means connected in said firing circuit for initiating the detonation of the explosive charge of the torpedo through said detonating train, an arming switch in said firing circuit, means for completing said detonator train and for closing said arming switch, and electromagnetic means also connected in said firing circuit, said electromagnetic means comprising a permanent magnet having an air gap and a centrally disposed longitudinal bore, a plunger slideably mounted in

said bore, and a coil connected to said plunger for movement within the air gap portion of the field of the permanent magnet in response to a force suddenly applied thereto, a spring sleeved on said plunger under compression for biasing and supporting said coil to an initial position of rest within the field of said permanent magnet, bearing means on said plunger and the permanent magnet in engagement with said spring for maintaining the spring under compression, and adjustable means mounted on the plunger for varying the tension of the spring.

6. An inertia generator of the character disclosed comprising, in combination, a pot magnetic structure including a sleeve-like permanent magnet and a soft iron core adapted to close one end of the sleeve, said core having a head disposed in spaced relation with the inner wall of the other end of the sleeve to provide a peripheral air gap therebetween within which the field of the magnet is highly concentrated, said core having a central bore concentrically disposed with respect to said sleeve, a plunger rod having a shoulder and mounted for reciprocal movement within said bore, a coil carried by said rod at one end thereof and adapted to traverse the field in said air gap as the rod moves reciprocally within the bore, a coil spring sleeved on the rod and interposed under compression between the core and said shoulder on the rod whereby the coil is urged yieldably into an initial position of rest within said gap, and adjustable means carried at the other end of the rod for varying the tension in said spring.

7. An inertia generator of the character disclosed comprising, in combination, means for setting up a highly concentrated magnetic field of annular cross section, said

means having a longitudinal bore, a plunger having a shoulder and slideably mounted in said bore, an induction coil mechanically connected to said plunger and positioned for transverse movement through said field in response to a sudden force appplied to said means to thereby effect relative movement between the means and the coil and generate a voltage proportional to the rate of said movement, a coil spring sleeved on the plunger and interposed under compression between said means and said shoulder on the plunger whereby the coil is urged yieldably into an initial position of rest within said field, and adjustable means carried at the other end of the plunger for varying the initial compression of said spring.

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