April 22, 1958 J. B. ROBERTSON ET AL 2,831,430

ARMING DEVICE FOR TORPEDO EXPLODER

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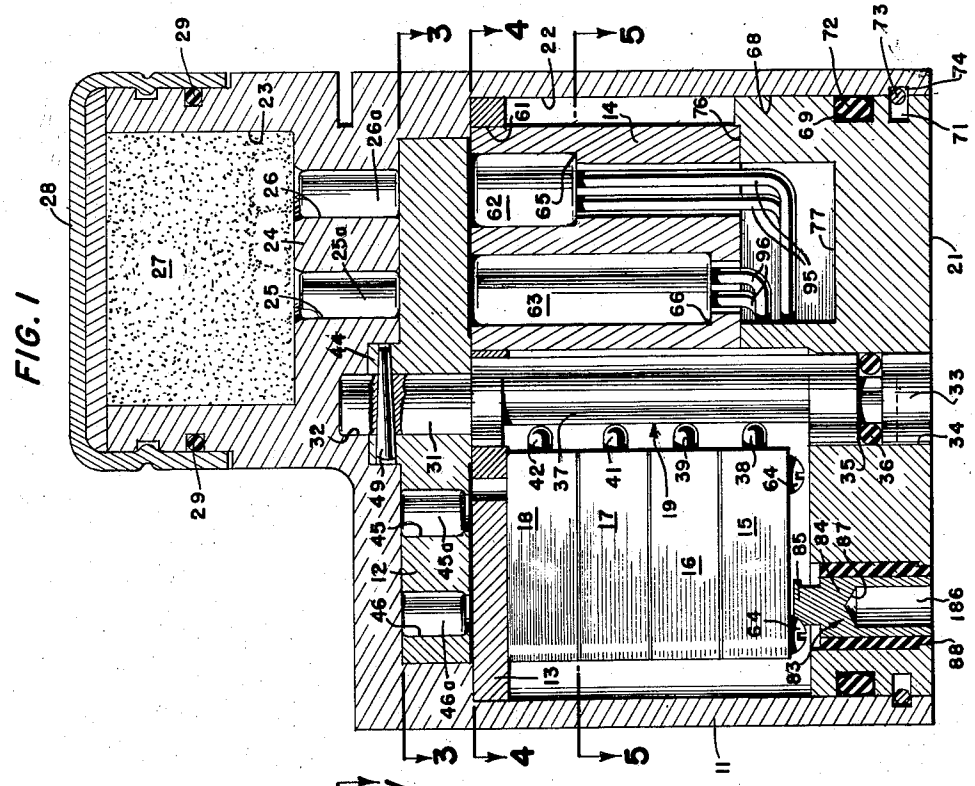


FIG. 1

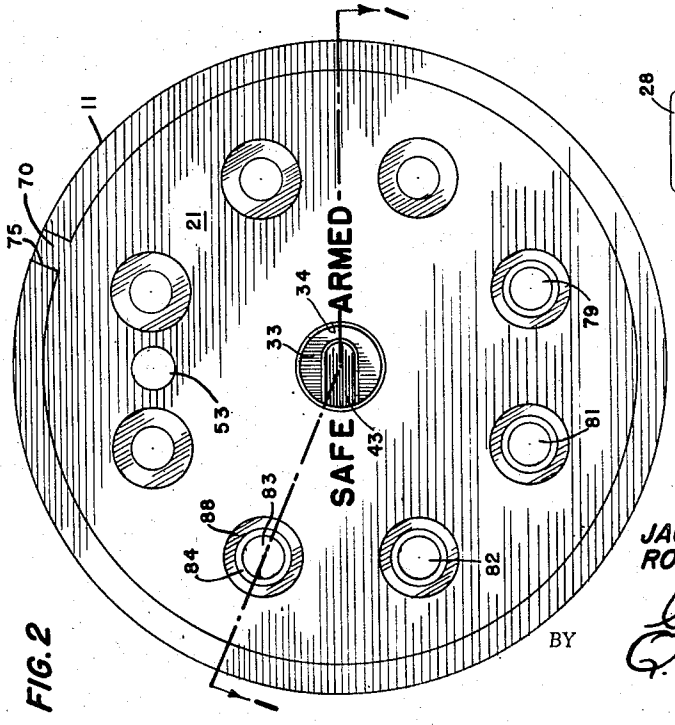


FIG. 2

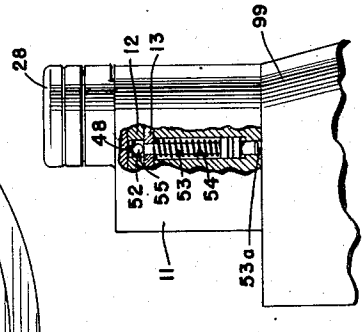


FIG. 11

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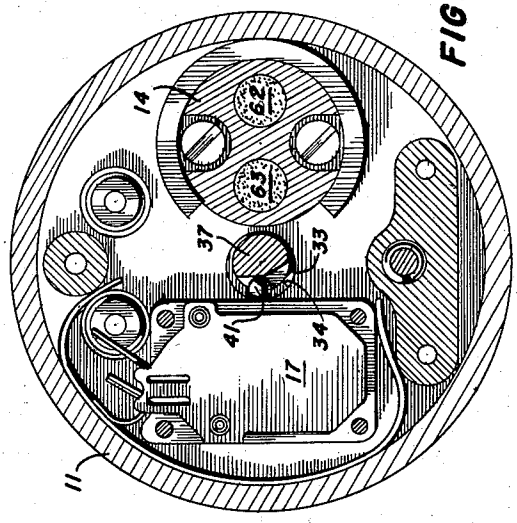


FIG. 5

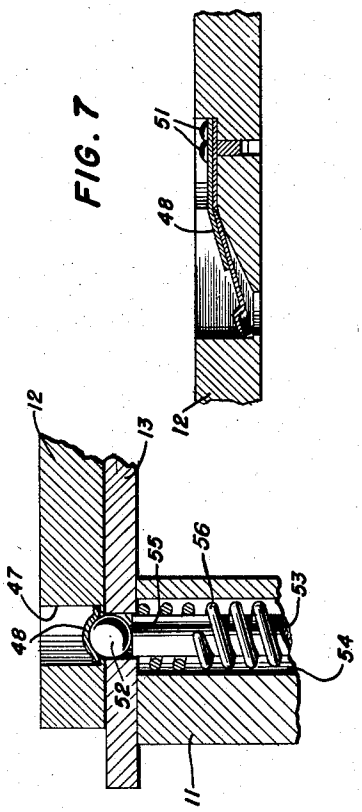


FIG. 7

FIG. 6

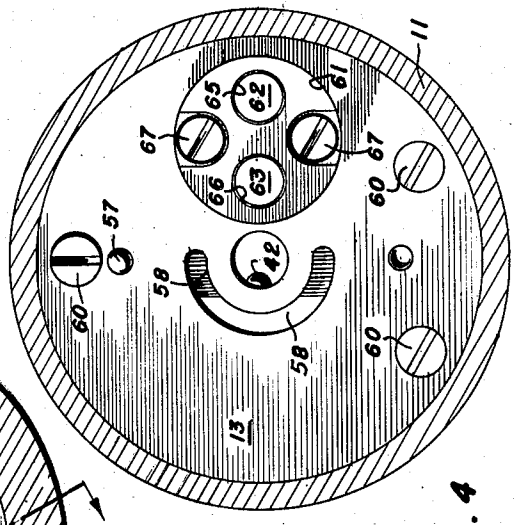


FIG. 4

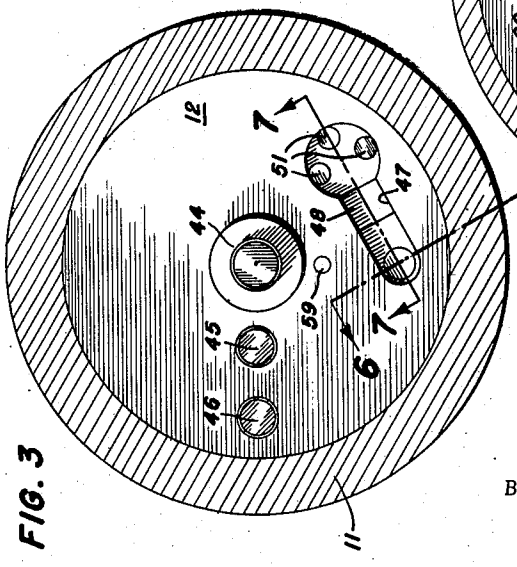


FIG. 3

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FIG. 8

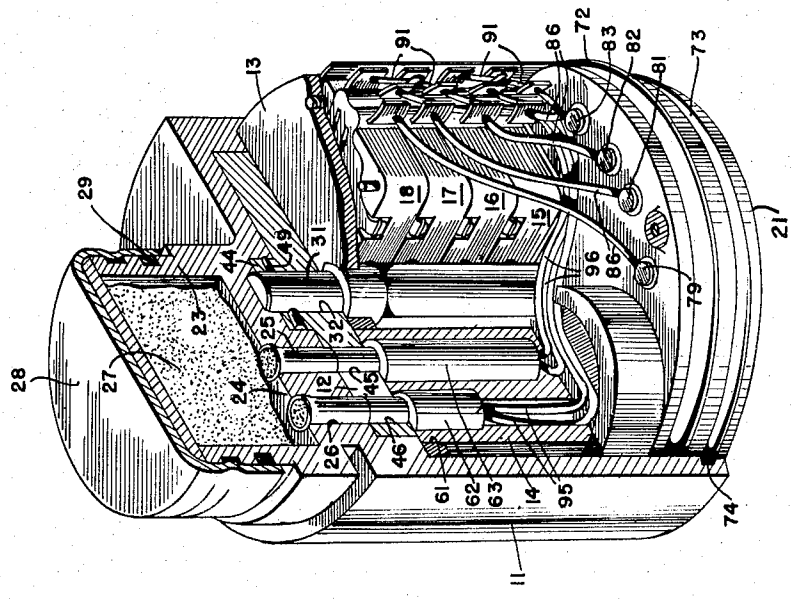


FIG. 9

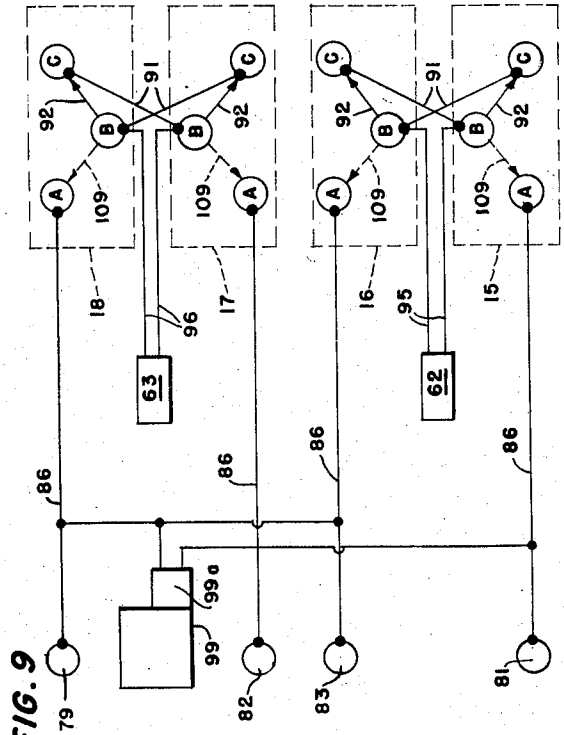
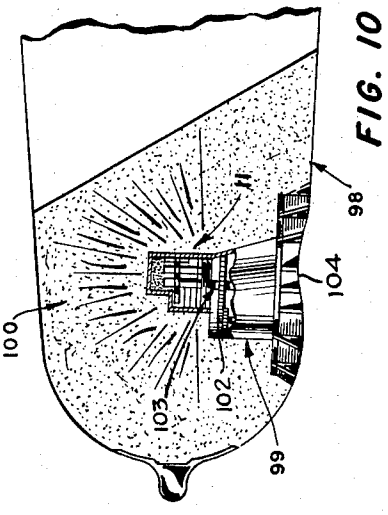


FIG. 10



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2,831,430

Patented Apr. 22, 1958

2,831,430

ARMING DEVICE FOR TORPEDO EXPLODER

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Application August 6, 1954, Serial No. 448,400

4 Claims. (Cl. 102—71)

This invention relates in general to torpedoes, and in particular to a means for arming torpedoes.

In order to prevent the premature explosion of a torpedo during handling, and for a short period of time following its release from the firing tube, a safety device must be incorporated therein which will render the torpedo unarmed during this period. It must subsequently be provided with a means of arming itself in order to become an effective weapon.

The arming device is placed in operation at the time the torpedo is released, and at the expiration of a predetermined interval completes its cycle of operation. The torpedo detonating circuit then becomes activated, and only remains to be fired by whatever means is employed in the particular missile.

One of the objects of this invention is to provide an arming device which will place a torpedo in a condition whereby it can be exploded by activation of its associated firing circuit.

Another object of this invention is to provide a means for delaying the arming time of a torpedo until a specified period of time has elapsed subsequent to launching from the firing tube.

Still another object of this invention is to provide a device which will render the torpedo incapable of being exploded by the normal firing circuit until such time as the torpedo has become armed.

Further objects and advantages of this invention will become apparent from the following detailed description made in conjunction with the accompanying drawings, and in which:

Fig. 1 is a longitudinal section on the line 1—1 of Fig. 2;

Fig. 2 is an end view of one end of the arming device;

Fig. 3 is a section of the arming device on the line 3—3 of Fig. 1;

Fig. 4 is a section of the inner portion of the arming device on the line 4—4 of Fig. 1;

Fig. 5 is a cross-section on line 5—5 of Fig. 1;

Fig. 6 is a fragmentary sectional view on the line 6—6 of Fig. 3;

Fig. 7 is a fragmentary sectional view on the line 7—7 of Fig. 3;

Fig. 8 is a perspective of the arming device with the outer casing removed, and showing the internal wiring thereof, the squib housing employed being shown in section;

Fig. 9 is a schematic of the internal circuitry of the arming device;

Fig. 10 is a fragmentary view of the arming device mounted in a torpedo; and

Fig. 11 is a side elevation, on a reduced scale and partly in section, showing the invention mounted on a torpedo exploder.

In accordance with the invention, there is provided a unique device for arming torpedoes. This device includes a housing having a large chamber, a small chamber, and an opening connecting the two chambers. A detonating charge is positioned in the small chamber. A plurality of switching members are located in the large chamber, with the switching members being initially open. In the large chamber, there is provided means for initiating detonation of the explosive charge. This initiating means is placed in alignment with the opening to the small chamber and it is electrically connected to the switching members.

A rotatably mounted shaft is located within the large chamber, which shaft has means integral therewith for closing the switching members. A rotatable member is mounted upon the shaft, and it constitutes a barrier between the initiating means and the opening to the small chamber. This rotatable member is provided with a bore disposed therethrough, with the bore being so positioned as to be in registry with the initiating means when the rotatable member has been rotated in a predetermined position. In addition, means are provided for establishing the firing train.

Turning now to Fig. 1 of the drawings, the arming device constituting the present invention is constituted by a case 11, a rotor 12, a spacing plate 13, a retaining block 14, microswitches 15, 16, 17 and 18, a center shaft 19, and an end closure 21.

The case 11 is of hollow cylindrical construction defining a main and large chamber 22 open at one end, and a second and smaller chamber 23, with an inner wall 24 intervening between the two chambers. Circular openings or bores 25 and 26, parallel to the main axis of the case 11, extend through the inner wall 24 to provide communication between the larger chamber 22 and the smaller chamber 23. Explosive pellets 25*a* and 26*a* are fitted into the bores 25 and 26, respectively, to form parts of explosive trains. An auxiliary detonating charge 27 is contained in the chamber 23, and is held in place by an end cap 28, with the cap being crimped onto the case 11 and provided with a sealing ring 29.

The chamber 22 is of stepped configuration defining four coaxial, cylindrical recesses of inwardly, successively diminishing diameter. The innermost recess journals the inner end 31 of the center shaft 19; a bearing surface 32 being provided by the wall defining this innermost recess. The second and third innermost recesses contain the rotor 12 and the outermost recess contains the remaining component of the arming device.

The center shaft 19 extends through the case 11, the inner end 31, as mentioned above, being held in place by the bearing surface 32, while the outer end 33 revolves in a bearing surface 34 in the end closure 21. The shaft 19 is formed near its outer end 33 with an annular groove 35 which is used as a receptacle for an O ring 36, this ring providing a watertight seal. An intermediate section 37 of the shaft 19 is constructed eccentrically, and provides cams for engaging the moving elements 38, 39, 41, and 42 of the microswitches 15, 16, 17, and 18, respectively, to be described hereinafter.

The outer end of the shaft 19 is also formed with a U-shaped slot 43, shown in Fig. 2, to receive a coupling element, such as a tongue or key, for linking the arming device to the torpedo mechanism.

The rotor 12 is constructed with an end hub 44, circular holes or bores 45 and 46 which are formed parallel to the axis of the rotor, and a recess 47, containing a leaf spring 48 as shown in Figs. 3 and 7. The rotor 12 is held in place upon the shaft 19 by a tapered pin 49 which extends through the hub 44 and the shaft 19. The circular holes or bores 45 and 46 are so positioned as to aline with the circular holes or bores 25 and 26 through the inner wall 24 when the rotor 12 is in armed position. The bores 45 and 46 contain pellets 45*a* and 46*a* which cooperate with the pellets 25*a* and 26*a* to provide explosive trains between the squibs, to be described

hereinafter, and the charge 27. As best seen in Fig. 7, the leaf spring 48 is secured to the rotor 12 by drive screws 51 and urges a ball 52, as shown in Fig. 6, into lodgment between said rotor and the spacing plate 13, in a bore 55, to lock the rotor in fully unarmed position or in fully armed position.

Figs. 3 and 7 illustrate the leaf spring 48, while Fig. 6 illustrates the disposition of the ball 52 when the rotor 12 is in fully unarmed condition. Hence, referring to Fig. 6, a rod 53 is slideably contained within a bore 54 in the housing 11 parallel to the axis thereof, and partially extending into the corresponding hole or bore 55 provided in the spacing plate 13. The ball 52 is urged by the leaf spring 48 into contact with the rod 53 and into lodgment between the rotor 12 and spacing plate 13, the rod preventing the full inclusion of the ball 52 within the hole 55. A coil spring 56, arranged about the rod 53, resists the further inclusion of rod 53 within the hole 55, thereby preventing the full exclusion of ball 52 from the hole 55. In this manner, the ball 52 latches the rotor 12 to the spacing plate 13.

As shown in Fig. 4, the spacing plate 13 is provided with a spherical indentation 57 for receiving the ball 52 after rotor 12 has assumed armed position, by rotation of the center shaft 19 by the torpedo exploder mechanism as will be described in more detail hereinafter, thereby providing a detent position for the rotor 12 in said armed position.

As seen in Figs. 3 and 4, the spacing plate 13 is formed with an arcuate slot 58 which cooperates with a pin 59 projecting from the under side of the rotor 12 to limit the extent of movement of said rotor. A circular opening 61, in the spacing plate 13 and offset from the center thereof, permits the communication of firing squibs 62 and 63 carried by the retaining block 14 with the circular holes 45 and 46 when the rotor 12 is in armed position. Bolts 64 are used to mount the microswitches 15, 16, 17 and 18 in stacked formation upon the spacing plate 13, and tie bolts 60 secure the spacing plate 13 properly spaced from the end closure 21.

The retaining block 14 is of cylindrical construction with diametrically disposed cylindrical chambers 65 and 66 therein for containing, respectively, the squibs 62 and 63. As shown in Fig. 4, screws 67 are used to secure the retaining block 14 to the end closure 21.

The end closure 21 is of circular construction and is inserted in the outer end of case 11, fitting snugly against inner surface 68 of the case, as illustrated in Fig. 1. Annular grooves 69 and 71 are formed in the outer surface of the end of closure 21 and, respectively, form receptacles for a sealing ring 72 and a retaining ring 73. A similar annular groove 74 is provided in the inner surface 68 of the case 11 in order to lock the end closure 21 with respect to case 11 by means of the retaining ring 73.

As shown in Fig. 2, a pin 70, projecting from the annular wall of the end closure 21, cooperates with a corresponding slot 75 in the case 11 to furnish a means for orientating and preventing the rotation of the end closure 21, and the components secured thereto, within the case 11.

The inner end wall of the closure 21 is further provided with a relatively shallow recess 76 to receive the retaining block 14. A relatively deep recess 77 is also formed in the end closure 21 to provide space for conductors 95 and 96, which electrically connect the squibs 62 and 63 with the microswitches 15, 16, 17 and 18.

As best seen in Fig. 8, the end closure 21 contains contact sockets 79, 81, 82, and 83, which are electrically connected to the appropriate terminals on the microswitches. Details of these sockets are best understood by referring to the sectional view of socket 83, as illustrated in Fig. 1. The socket 83 is constructed of a circular metal body 84 having a terminal head 85 to which the end portion of a conductor from a given microswitch is soldered. The metal body 84 is formed with an axial bore 186 having a tapered inner portion 87. This bore 186 receives a plug connected with the associated exploder mechanism. A rubber insulating sleeve 88 is provided to insulate the metal body 84 from the end closure 21. The sockets 79, 81, 82 and 83 are of identical construction.

Referring now to Figs. 8 and 9, the contact sockets 79, 81, 82 and 83 are electrically connected to the "A" terminals of the microswitches 18, 15, 17 and 16, respectively, by means of conductors 86. The lower pair of microswitches 15 and 16 are electrically connected by leads 95 to the squid 62 which contains an instantaneous primer, and the upper pair 17 and 18 are electrically connected by leads 96 to the squib 63, which contains a delay primer. The "B" terminal of each microswitch is connected through a conductor 91 to the "C" terminal of its corresponding mate, thus providing a double shorting arrangement favoring safety. Movable switching elements of the microswitches are designated in Fig. 9 by numeral 92.

The operation of the arming device will now be described. As shown in Fig. 11, the device is first installed on a torpedo exploder, with the lower end of the rod 53 engaging a stud 53*a* on the upper surface of said exploder. Upon installation, the rod 53 (Figs. 6 and 11) is first pushed up against the combined resistance of the coil spring 56 and the leaf spring 48, thus completely extricating the ball 52 from the hole 55 and releasing the rotor 12 for rotation. When placed in position in the torpedo 98, shown in Fig. 10, the microswitches 15, 16, 17 and 18, along with the firing squibs 62 and 63, are connected in series with the exploder circuit. This is done during installation by engagement of plugs on the exploder with the appropriate contact sockets 79, 81, 82, and 83.

When the torpedo 98 is fired from its tube, the water activated impeller 104 of the exploder mechanism 99, through a high ratio gear train 102 coupled to shaft 19 by means of a tongue or key at 103, revolves shaft 19 at a very slow rate. The rotor 12, which is connected to the shaft 19, also rotates, constraining ball 52 to ride along the surface of the spacing plate in an arcuate path until the armed position is reached, whereupon the ball 52, under the influence of leaf spring 48, becomes lodged in the spherical indentation 57, this providing a detent position for the rotor 12 in the armed position.

As the shaft 19 rotates, the moving elements 38, 39, 41, and 42 of the microswitches 15, 16, 17, and 18, respectively, are gradually depressed by the eccentric section 37 of shaft 19 until the exploder circuit is completed through the firing squibs 62 and 63. As can best be seen from Fig. 9, the movable contacts 92 of the microswitches break electrical contact with the "C" terminals and establish electrical contact with the "A" terminals, as indicated by the dotted lines 109. Under these circumstances the rotor 12 is in fully armed position, that is, the circular openings 45 and 46 through rotor 12 are in register with the circular openings 25 and 26 through the inner wall 24 and with the squibs 63 and 62, respectively. In this manner the firing train from the squibs 63 and 62 to the auxiliary detonating charge 27 is established.

It should be understood that the speed of rotation of the impeller shaft and the configuration of the face of the section 37 of the shaft 19 will predetermine the time interval between launching of the torpedo and closing of the microswitches 15, 16, 17 and 18. Thus, by presetting the speed of rotation of the impeller, the arming time may be predetermined as desired.

Upon activation of the exploder, by proximity action or by contact with a target, squibs 63 and 62 are fired. More specifically, the instantaneous squib 62 is detonated upon operation of the exploder mechanism, in a well-known manner, when the torpedo strikes a ship or other target. If, however, the torpedo should be set to run

at below ship depth, the time delay squib **63** will be detonated, by a proximity fuze device not shown, for causing the torpedo to explode when it passes directly under the ship. The explosive discharge passes through the paths formed by openings **25** and **45**, and **26** and **46**. This, in turn, fires the detonator **27**, blowing off end cap **28** and exploding the main charge **100** in the torpedo warhead.

Among the features of the arming device as hereinbefore described are inherent water and gas tightness, the prevention of premature arming and therefore detonation, an indication of the degree or condition of arming of the device, and the inclusion of an instantaneous primer and a delay primer for detonating the torpedo, either on contact with a target ship or when the torpedo is directly under the ship, said primers being disconnected from the exploder circuit until a predetermined time after the torpedo has been launched.

Many other modifications and variations are suggested by the foregoing detailed description of this invention. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced other than as described above.

What is claimed is:

1. In an arming device for torpedo exploders, a squib for instantaneous operation, a squib for delayed action detonation, a pair of switches for each of said squibs, said switches each having a moving element and initially being in unarmed position, an auxiliary detonating charge, movable means obstructing the firing train between squibs and the detonating charge in unarmed position, a shaft rotatable for moving said movable means for completing the firing train between the squibs and the detonating charge, and a cam formed on the shaft and engageable with the moving elements of said switches for operating said switches, with the operation of said switches and movement of the movable means placing the arming device in armed position, said squib for delayed action detonation by proximity influence functioning in the event of nondetonation of said squib for instantaneous operation.

2. The combination with a torpedo having an exploder therein, of an arming device connected with the exploder and including an initially unarmed squib for instantaneous detonation upon contact of the torpedo with a target, an initially unarmed squib for delayed action detonation, a switch for each of said squibs and including a moving element, and means operable at a predetermined time following the launching of the torpedo for arming the squibs, said means including a shaft connected with the exploder and rotatable thereby, and a cam integral with the shaft and engaging the moving elements for operating the switches, said delayed action squib being detonated by proximity influence in the event of nondetonation of said instantaneous squib.

3. The combination with a torpedo exploder mechanism having a gear train and a coupling element rotatable by said gear train; an arming device including a housing having an auxiliary detonating charge therein, an initially unarmed squib for instantaneous detonation, a squib for delayed action detonation, means mounting the squibs in the housing in spaced relation to the detonating charge, switches connected with the squibs, a rotor in the housing and located between the squibs and the detonating charge and having bores for aligning said squibs with said detonating charge, said bores being initially positioned out of alignment with the squibs in unarmed position, explosive pellets in the bores, and means operable at a predetermined time following the launching of a torpedo containing the exploder for arming the squibs, said means including a shaft rotatable by the gear train and connected with said rotor, and a cam integral with the shaft and engaging the switches, said shaft placing said rotor and switches in operating condition and aligning said pellets with said squibs and detonating charge, whereby the arming device will be armed.

4. An arming device for a torpedo exploder, comprising, a housing having a relatively large chamber, a relatively small chamber, an opening connecting said chambers, an auxiliary detonating charge in said small chamber, an initially unarmed squib for instantaneous detonation, a squib for delayed action detonation by proximity influence, said squibs being located in said large chamber, means mounting said squibs in said large chamber in spaced relation to said detonating charge, switches connected with said squibs, a rotor in said large chamber and located between said squibs and the detonating charge and having bores for aligning said squibs with said detonating charge, said bores being initially positioned out of alignment with the squibs in unarmed position, explosive pellets in the bores, and means operable at a predetermined time following the launching of a torpedo containing the exploder for arming the squibs, said means including a gear train, a shaft rotatable by the gear train and connected with said rotor, and a cam integral with the shaft and engaging the switches, said shaft placing said rotor and switches in operating condition and aligning said pellets with said squibs and detonating charge, whereby the torpedo exploder will be armed.

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