May 5, 1931. J. L. KING ET AL 1,803,530

AIR BLOWING EXERCISE HEAD FOR TORPEDOES

Filed April 27, 1929 6 Sheets-Sheet 1

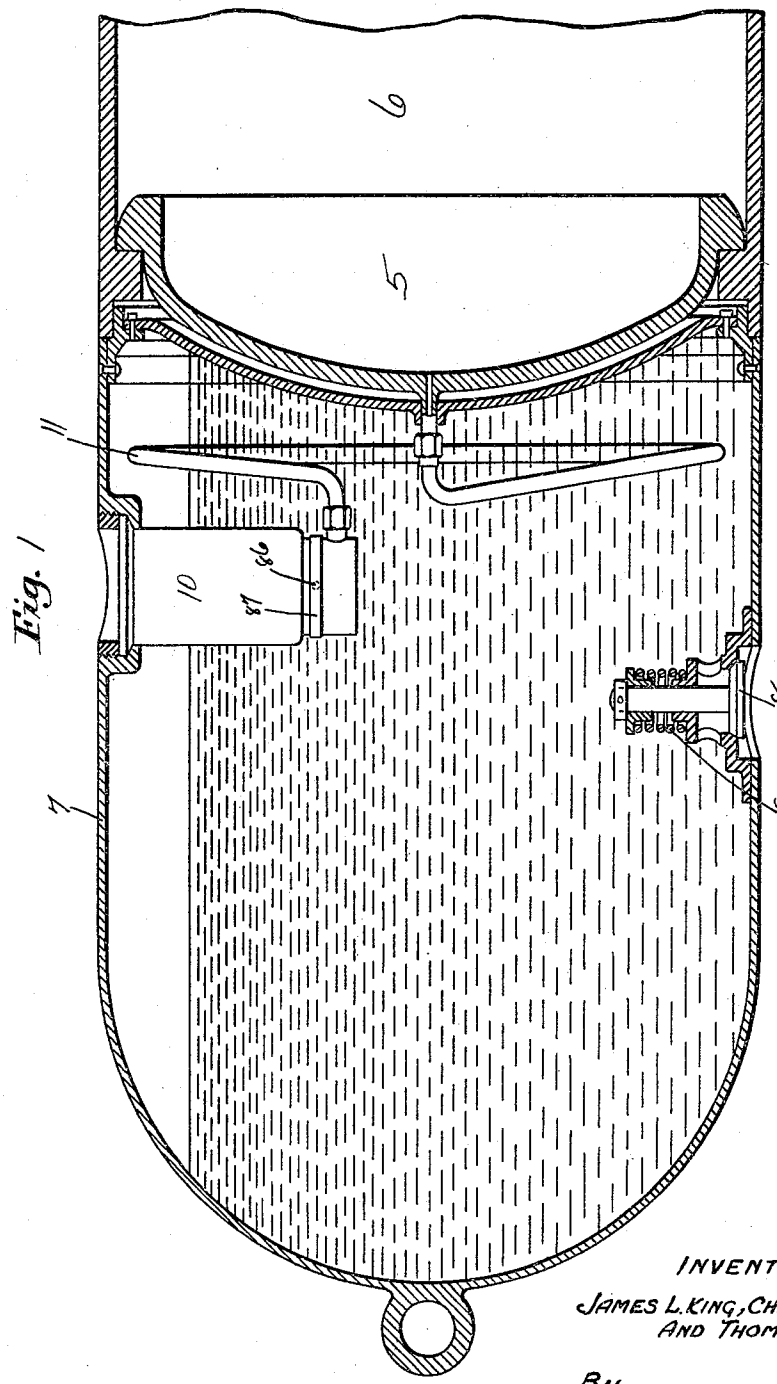


Fig. 1

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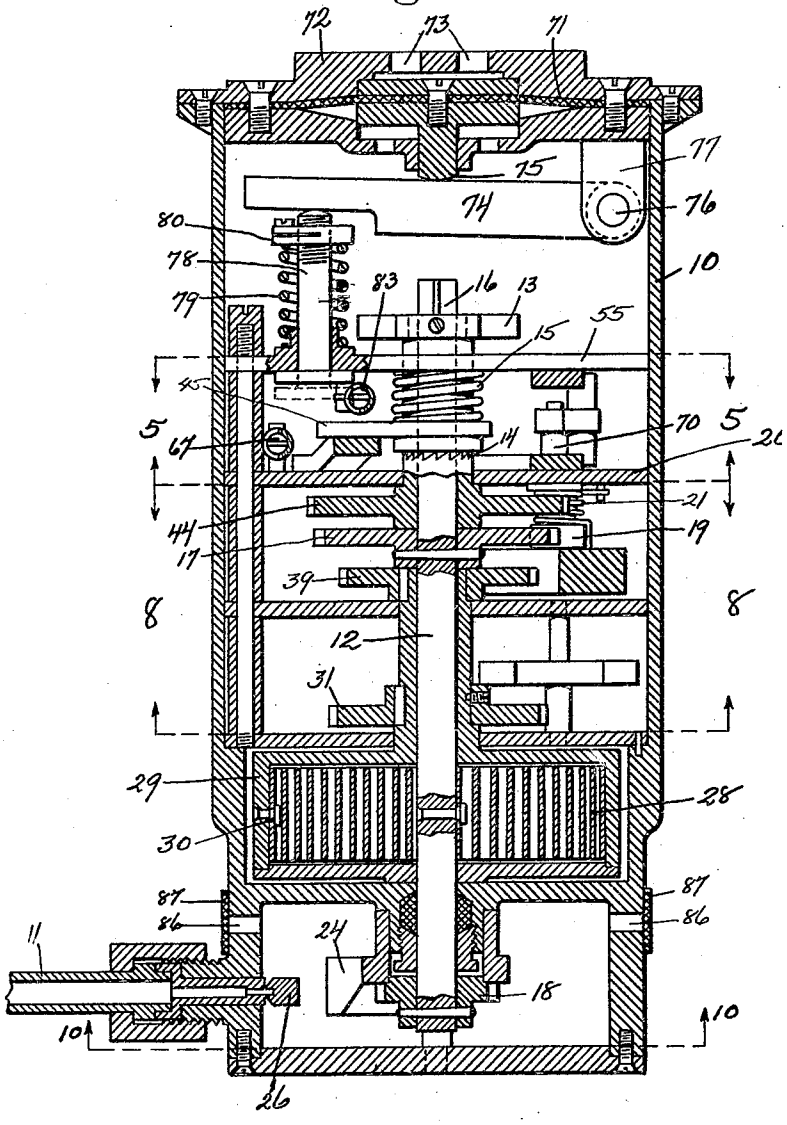
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May 5, 1931. J. L. KING ET AL 1,803,530

AIR BLOWING EXERCISE HEAD FOR TORPEDOES

Filed April 27, 1929 6 Sheets-Sheet 2

Fig. 2



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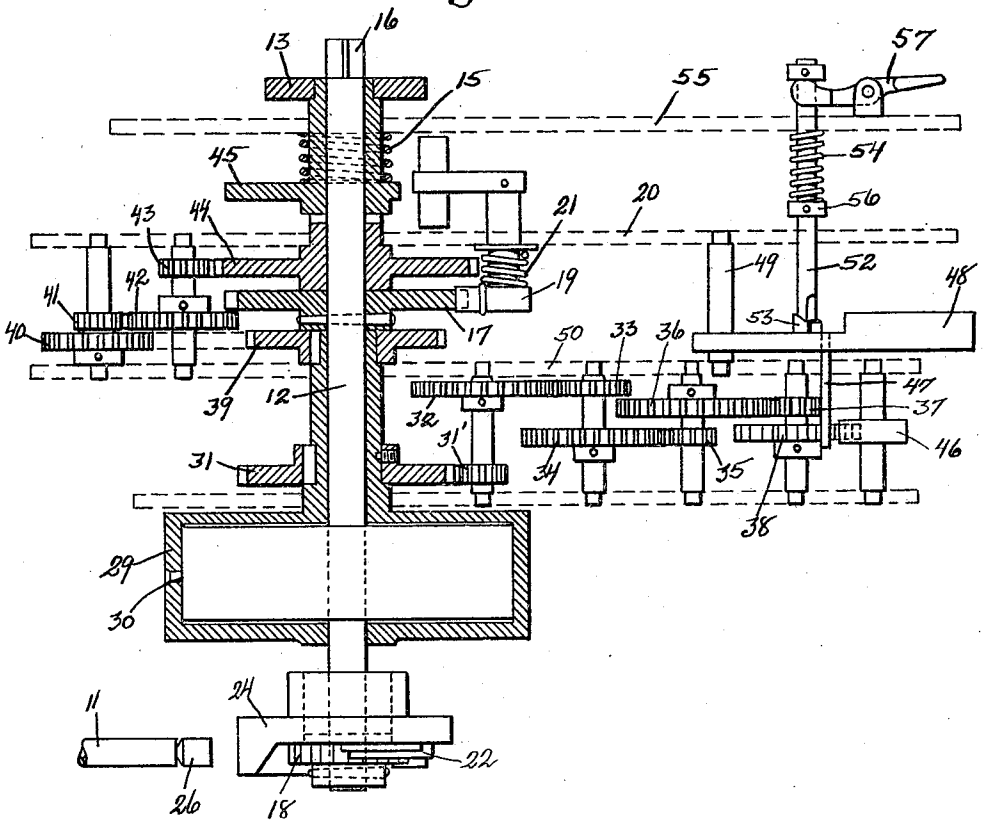
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AIR BLOWING EXERCISE HEAD FOR TORPEDOES

Filed April 27, 1929 6 Sheets-Sheet 3

Fig. 3



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AIR BLOWING EXERCISE HEAD FOR TORPEDOES

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Fig. 4

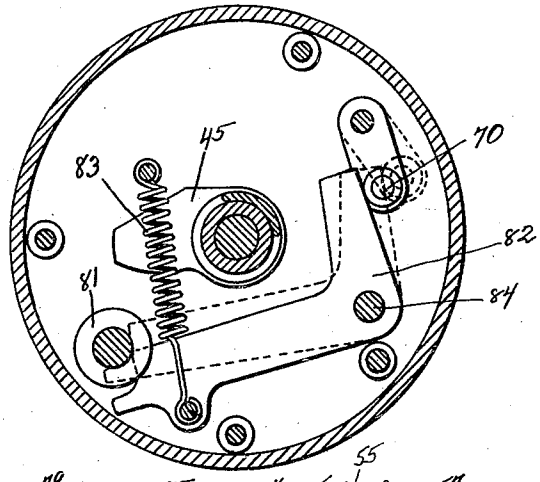


Fig. 5

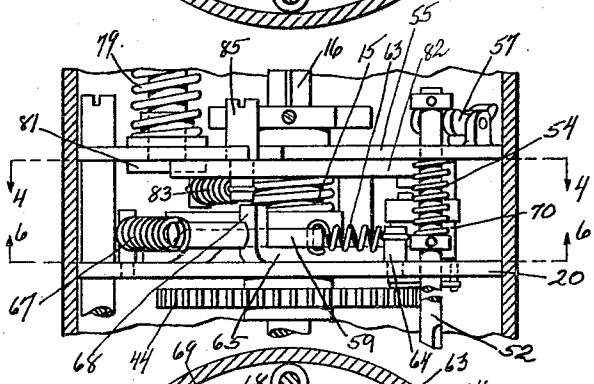
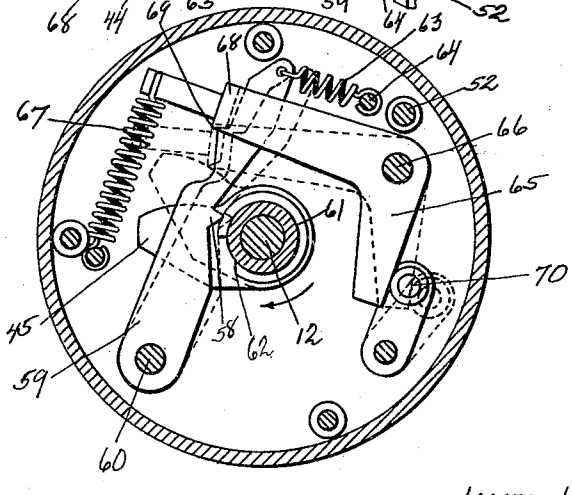


Fig. 6



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May 5, 1931. J. L. KING ET AL 1,803,530

AIR BLOWING EXERCISE HEAD FOR TORPEDOES

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Fig. 7

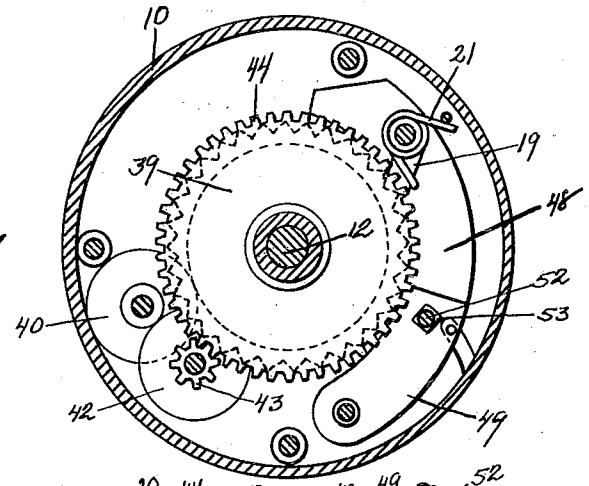


Fig. 8

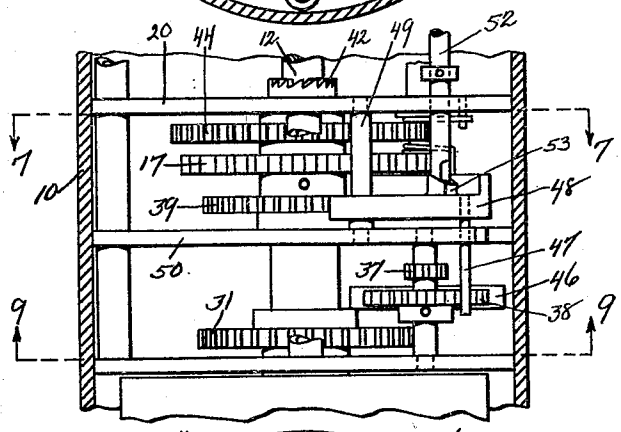
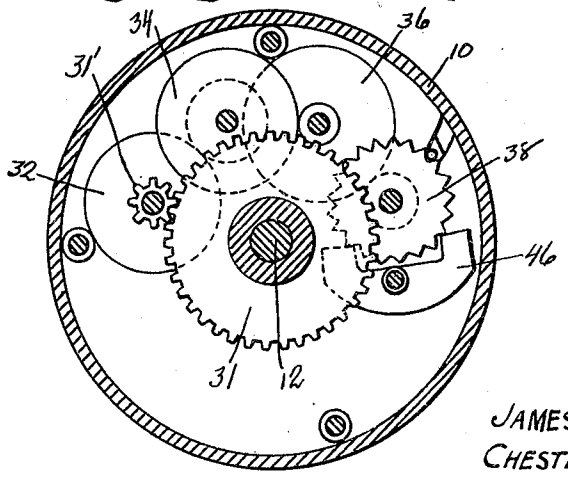


Fig. 9



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May 5, 1931. J. L. KING ET AL 1,803,530

AIR BLOWING EXERCISE HEAD FOR TORPEDOES

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Fig. 10

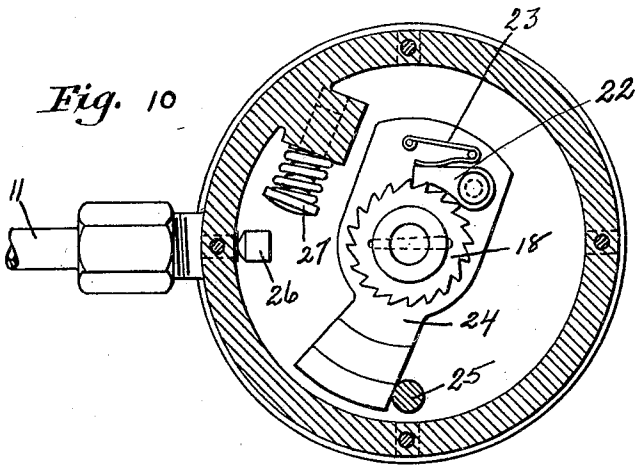


Fig. 11

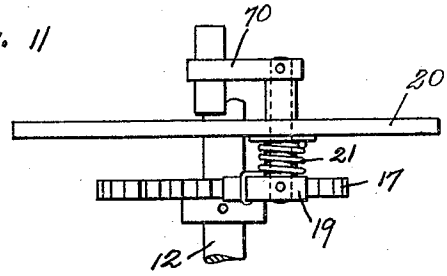


Fig. 12

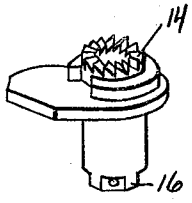


Fig. 13

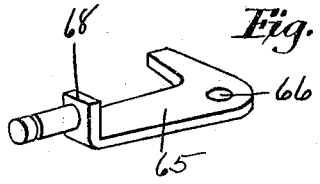


Fig. 14

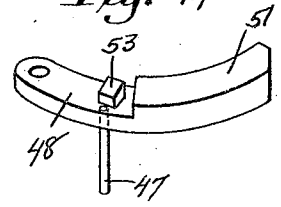
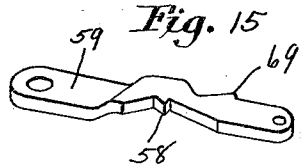


Fig. 15



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Patented May 5, 1931 1,803,530

UNITED STATES PATENT OFFICE

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AIR BLOWING EXERCISE HEAD FOR TORPEDOES

Application filed April 27, 1929. Serial No. 358,707.

(GRANTED UNDER THE ACT OF MARCH 3, 1883, AS AMENDED APRIL 30, 1928; 370 O. G. 757)

Our invention relates broadly to heads for torpedoes and more particularly to practice or experimental heads for torpedoes that are substituted for the usual warhead during practice or test runs of a torpedo.

As is well known to those familiar with the subject, submarine torpedoes are exceedingly complicated and have a large number of delicate mechanisms closely confined in a small space. In order to establish their reliability and accuracy it is necessary that, from time to time, the torpedo be given practice or test runs, during which runs the usual war-time head has heretofore been replaced by a practice head for the following reason. During these practice or tests runs, it frequently happens that due to inherent negative buoyancy, deficiencies in certain mechanical respects, untimely stopping of its engine, or other unforeseen circumstances, the torpedo does not function properly and sinks below the desired depth. Should any of the above mechanisms fail to function properly, the torpedo may become submerged in very deep water, and, in fact, may become deeply embedded in the mud forming the water's bed. Should this occur, it is with great difficulty that it is located by a diver, unless some means is provided to indicate the position of the sunken torpedo. Various mechanisms have been devised for accomplishing this purpose but they have been open to various objections and in most instances have failed to function as intended.

The present invention is, therefore, directed to an improved practice head adapted to function at a predetermined time, or when the torpedo reaches a predetermined depth, in such a manner as to exhaust the air from the air flask so that the bubbles coming to the surface of the water may mark the location of the torpedo. The present invention also functions by expelling water ballast from the exercise head and unused air from the air flask to give the torpedo positive buoyancy.

The present invention is designed to release water ballast from the practice head and air from the air flask of a torpedo to indicate its position, and operates either on excess hydrostatic pressure as would obtain when the torpedo sinks, at the end of its run, to a depth greater than that for which the mechanism is set, or through the medium of a mechanism set into operation after a predetermined interval of time has elapsed after discharging the torpedo.

The invention comprehends a simple and practical mechanism which will be reliable and efficient in operation, inexpensive to manufacture and install, and which will positively provide for the release of water ballast from the practice head and air from the air flask of a torpedo at the proper time.

With the above and other objects in view the invention consists in the construction, combined and arrangement of parts as will be hereinafter more fully described.

Reference is to be had to the accompanying drawings forming a part of this specification, in which like reference characters indicate corresponding parts throughout the several views, and in which—

Figure 1 is a longitudinal section of a torpedo practice head and portion of the air flask showing our invention installed,

Figure 2 is a vertical section through the air releasing mechanism,

Figure 3 is a diagrammatic elevational sectional view showing the clock train employed in the time controlled mechanism,

Figure 4 is a sectional view on the line 4—4 of Figure 5,

Figure 5 is an elevational view in the region of and between the lines 5—5 of Figure 2,

Figure 6 is a sectional view on the line 6—6 of Figure 5,

Figure 7 is a sectional view on the line 7—7 of Figure 8,

Figure 8 is an elevational view in the region of and between the lines 8—8 of Figure 2,

Figure 9 is a section view on the line 9—9 of Figure 8,

Figure 10 is a sectional view on the line 10—10 of Figure 2,

Figure 11 is an elevation of a ratchet arrangement employed in our invention, and

Figures 12 to 15 are details of various elements employed in our invention.

Referring more particularly to Figure 1 of the drawings, 5 indicates an air flask mounted

within the body 6 of any conventional type of torpedo to which a practice head 7 is attached, in any suitable manner. The practice head is then filled with a liquid ballast, preferably water. A valve 8 is mounted within the practice head and is held normally seated against the wall thereof. The purpose of this valve will be explained hereinafter. The mechanism of the present invention is mounted within a casing 10 secured to the upper interior wall of the practice head, and which has communication with the air flask through a connection 11.

The mechanism above referred to is more clearly shown in Figures 2 and 3, and includes among other elements a winding spindle 12 that is provided with an upper end suitably constructed for the reception of a tool for winding purposes as shown in detail in Figure 12. Secured to the winding spindle and turning with it are two ratchet wheels 17 and 18, the upper one 17 being the winding ratchet wheel and being held against backward movement by a pawl 19 pivoted in the bearing plate 20, the pawl being held against the wheel by a spring 21, as is more clearly shown in Figure 11. The function of this ratchet and pawl is to prevent the spindle from unwinding after it has been wound. The mechanism is set into operation by pushing the pawl out of engagement with the ratchet, as will be later explained. The lower, or hammer ratchet wheel 18 is likewise engaged by a pawl 22, that is held in engagement therewith by a spring 23, see Figure 10. The function of this ratchet and pawl is to control the movement of a hammer 24 that is free to rotate on the spindle 12. The ratchet wheel 18 being keyed to the spindle and the pawl being mounted on the hammer, the latter does not turn with the spindle beyond a predetermined distance, this distance being regulated by a stop 25 against which the hammer butts when the mechanism is being wound. When the spindle is rotated in the opposite direction through a means to be later described, the pawl engages the teeth of the ratchet wheel, locking the hammer and ratchet wheel together so that they will move simultaneously in the same direction the spindle is moving. In the course of this rapid rotation of the hammer it strikes a nipple 26 within the casing 10, shearing it from the high pressure air connection 11 to the air flask. A buffer 27 is positioned just beyond the nipple to stop the hammer in its flight and absorb the shock of its sudden stopping.

The only other connection that is made to the spindle 12 is the inner end of a ribbon like mainspring 28, the other end of which is secured to a housing 29 forming a mainspring case. Turning the winding spindle in a clockwise direction winds up the mainspring concentrically about the spindle, and, hence, at all times, the potential energy of the mainspring is tending to turn the spindle in a reverse direction but it is prevented from so doing by the engagement of the winding pawl 19 with the winding ratchet wheel 17. Once again it is pointed out that it is the mechanically performed disengagement of this pawl which causes the hammer 24 at the predetermined time to fly around and shear off the nipple on the air pressure connection.

As above stated the outer end of the mainspring 28 is secured to the inside of the mainspring casing 29 at 30. In winding up the mainspring through the spindle the casing therefore tends to follow the winding spindle in rotation, but is prevented from so doing by a gear train composed of the gears 31, 31', 32, 34, 35, 36, 37 and escapement gear 38, see Figure 3. The casing, therefore, becomes a driver through the effort of the mainspring to unwind, and as such drives two separate gear trains, one of which consists of the gears above referred to and the other train consists of the gears 39, 40, 41, 42, 43 and 44. The second of these gear trains, with its different gear ratios drives a cam 45 which functions with the firing mechanism and the time setting index in a manner hereinafter described.

The escapement of the first train is governed by the escapement gear 38 and pallet bar 46. The pallet bar and its pallets are similar in design and operation to the well known "anchor escapement" except that they operate in a horizontal plane, and therefore a pendulum is not required. Neither is there a balance wheel and hair spring as the pallet bar is heavily constructed and the pallet design such as to render these parts unnecessary. When the torpedo is fired, the escapement gear 38 is freed to turn as rapidly as the inertia of the pallet bar 46 and pallets will permit, it being driven by the mainspring casing through the gear train of which it is a part. Previous to the time of discharging the torpedo, however, this train is held locked by a long vertical pin 47 connected at its upper end to an inertia starting arm 48, shown in detail in Figure 14. This pin rests between two adjacent teeth of the escapement gear and prevents it from turning until the pin is released as will now be considered.

The inertia starting arm 48 is pivoted at one end to a post 49 positioned between the bearing plates 20 and 50, and is weighted at the other end, as at 51, by increasing its thickness or by adding thereto a mass serving as a weight. This arm rotates horizontally about its pivot, except in so far as escapement gear locking pin 47 prevents it in one direction and an inertia starting arm locking pin 52, that normally rests against a lug 53 on the inertia starting arm 48, prevents it in the other direction. The intertia starting arm lock pin can be lifted vertically against

the tension of a small spiral spring 54 which bears against the bearing plate 55 and a collar 56 on the pin 52. This movement is accomplished automatically through the shock when the torpedo is discharged by the inertia of the inertia starting arm 48. The arm 48 swings relative to the locking pin 52 with such force as to cause the pin 52 to ride up a beveled face of the lug 53 secured to the arm. Manifestly, once this lug has swung clear of the pin 52, the pin is forced downward by the spring 54 and locks the starting arm out so that it cannot swing back to its original position which would cause pin 47 to again seat itself between the teeth of the escapement gear 38 and stop movement in the train of gears, as, for example, if the torpedo should dive into the mud. It will be understood, of course, that when the inertia starting arm is swung, the locking pin becomes disengaged from the escapement gear. When it is desired to reset the mechanism, after it has ceased to function at the end of its run, the inertia starting arm 48 is restored to its former position by pressing one end of a small lever 57 pivoted to the bearing plate 55, which lifts the pin 52 against the pressure of the spring 54, and then by inclining the mechanism, the starting arm 48 falls back to its safety position, that is, to that position in which the pin 52 will again drop behind the lug, when pressure is removed from the lever. This causes the escapement gear locking pin to again engage the teeth of the gear 28 holding it against movement. Pressure is now removed from the lever and the mechanism is ready for the next shot.

The firing mechanism cam 45 and the time setting index 13 as before stated are driven by the gear train consisting of gears 39 to 44 inclusive from the mainspring casing 29. This combined unit (cam 45 and time setting index 13) is in engagement with the gear train through a saw tooth ratchet 14, one portion of which is formed on the unit member and the other on the gear 44. The driving faces of the teeth are vertical while the other faces are beveled to permit turning the unit independently of the gear 44 in one direction only. A small spiral spring 15 bearing against bearing plate 55 gives a continual pressure to the combined unit, tending to keep it engaged with the teeth on the gear 44, but at the same time permitting the independent movement above stated. The rotation of the gears in the train just mentioned is such as to cause the time setting index to make approximately three-fourths of a revolution in twenty minutes, which in turn consumes approximately one-third of the energy of the mainspring 28.

As the time setting index is made integral with the firing mechanism cam 45 it is apparent that if the index is set for any specific time according to adjacent graduations on the upper face of the bearing plate 55, then the firing mechanism cam will also be displaced this time interval from its zero time or firing position. The only precaution to be observed in this setting for time is that the teeth 14 on the connecting ratchet must be in contact at their driving faces.

There are two separate and distinct means for setting the mechanism into operation, one of which is the clock train above described and the other is a hydrostatic attachment, each of which performs its function independently of the other, but both set the mechanism into operation by disengaging pawl 19 from the ratchet wheel as previously stated.

Considering the clock releasing mechanism first, reference being had to Figures 5 and 6, it will be noted, particularly in Figure 6, that that a small toe 58 is formed on a bar 59 that is pivoted at 60 to the bearing plate 20. This toe is adapted to ride on the periphery of the common shaft 61 of the cam 45 and the time setting index 13. However, owing to the tension of a spring 63, one end of which is attached to the free end of the bar and the other end of which is attached to a post or similar member 64 mounted on the bearing plate 20, the toe drops into a groove 62 formed in the common shaft when the groove registers with the toe freeing a bell crank lever 65. The bell crank lever, that is pivoted at 66 to the bearing plate 20, is held against the tension of a spring 67 connected to one of its ends, by an upturned portion 68 that rests against a projection 69 on the side of the bar opposite to that of the toe. Freeing this restraining means permits the spring 67 to turn the lever about its pivot causing one arm thereof to bear against a trigger pin 70 secured to the winding spindle ratchet pawl 19. It is this pressure which disengages the pawl from the ratchet wheel 17 releasing the winding spindle 12 so that under the turning movement of the mainspring 28, the hammer 24 at the bottom of the spindle is caused to be swung around shearing off the nipple 26 on the end of the high pressure air line. Details of construction of the bar 59 and bell crank lever 65 may be seen in Figures 15 and 13 respectively, and also Figure 11 shows more clearly the trigger pin 70.

This type of releasing mechanism is again reset to its initial firing position by turning the time setting index 13, which in turn rotates the cam 45. As the cam is turned it pushes back the bell crank lever 65 so that the toe on the bar 59 can ride up the inclined side of the groove 62 in the common shaft 61 engaging the parts 68 and 69 to hold the bell crank lever away from the trigger pin 70 until the toe again drops into the groove.

The hydrostatic attachment, shown in Figures 2, 4 and 5, is for the purpose of setting into operation the mechanism for shearing off

the nipple, as above explained, should the torpedo sink below a predetermined depth. This attachment includes a diaphragm 71 that is secured in any desirable manner within a cover 72 to the casing 10, the cover being suitably constructed to receive the diaphragm and permit it to function. The water pressure, water entering through openings 73 in the cover, on the upper side of the diaphragm causes a downward pressure to be exerted on a lever arm 74 near its center point by a stud 75 carried by the diaphragm. The lever arm one end of which is pivoted at 76 to an ear 77 carried by the top, exerts a pressure on a vertical pin 78 against the action of a spring 79, which may be regulated in compression by a split nut 80 secured on the upper screw-threaded end of pin 78.

On the other end of this pin there is a cylindrical button 81 which holds a second bell crank lever 82, see particularly Figure 4, in a set position against the tension of a spring 83 attached to one end of the lever, which is pivoted at 84 between the bearing plates 55 and 20. At its other end, this bell crank lever bears against the upper end of the trigger pin 70, attached to the winding spindle ratchet wheel pawl 19. When the downward pressure on the pin 78 is sufficiently great to overcome the tension of the spring 79, the button at the lower end of the pin is pushed clear of the bell crank lever 82 which turns about its pivot, under tension of the spring 83, causing the free end thereof to bear against the trigger pin with the result above described.

To reset the hydrostatic releasing mechanism it is only necessary to push to one side the bell crank lever through the means of a resetting knob 85 attached to the lever, which permits the vertical pin and button to resume their original positions due to the pressure of the spring 79.

Before the torpedo is discharged the cover 72 of the casing is removed and the escapement train locked as previously described; that is, by pressing downwardly on the lever 57 attached to the bearing plate 55 and inclining the mechanism forward so that the vertical locking pin 47 will engage with the escapement gear 58. The clock releasing mechanism is then set to function at the proper time by moving the time setting index 13 in a counter-clockwise direction to the nearest time indication shown on the graduations on the bearing plate 55 greater than the desired time and a slight movement of the driving faces of the ratchet 14 will bring them into proper engagement. The mainspring 28 is then fully wound and the cover and casing reassembled in a water tight condition. The high pressure air connection 11 is attached to the air flask 5 of the torpedo whereupon the torpedo is in condition for its trial run. As soon as the torpedo sustains the shock of discharge the clock releasing mechanism is set into operation, and after a determined interval of time the mechanism functions as described to shear off the nipple 26 permitting the air to escape from the air flash to the casing 10.

Circumferentially about the wall of the casing, just above the connection of the high pressure air line therewith, there are a number of outlets 86 protected by a suitable covering 87, which preferably is composed of a resilient substance such as rubber. As the air under pressure is admitted to the casing the pressure therewithin becomes greater than that therewithout, consequently forcing the protective covering away from the outlets, whereupon the air escapes into the exercise head itself. The air escaping into the exercise head increases the pressure therein forcing the liquid ballast outward through the valve 8 producing bubbles in the surrounding medium. These bubbles rising to the surface of said medium indicate the location of the torpedo, either at the expiration of the predetermined time interval or should the torpedo sink below a predetermined level.

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

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

Having thus described our invention what we claim is:—

1. In an exercise head for a torpedo, in combination, a high pressure air line normally closed, shearing means for opening said line, mechanisms controlling said means, and means permitting the freed air to escape to a surrounding medium.

2. In an exercise head for a torpedo, in combination, a high pressure air line normally closed, shearing means for opening said line at a predetermined time interval, a time controlled mechanism for operating said means, and means permitting the freed air to escape to a surrounding medium.

3. In an exercise head for a torpedo, in combination, a high pressure air line normally closed, shearing means for opening said line, a pressure controlled mechanism for releasing said opening means, and means for permitting the freed air to escape to a surrounding medium.

4. In an exercise head for a torpedo, in combination, a high pressure air line normally closed, a rotative shearing means for open-

ing said line at a predetermined time interval, means for operating the rotative means, and means permitting the freed air to escape to a surrounding medium.

5. In an exercise head for a torpedo, in combination, a high pressure air line, a rotative shearing means for opening said line when a predetermined pressure is exerted on the exterior of the exercise head, means for operating the rotative means, and means permitting the freed air to escape to a surrounding medium.

6. In an exercise head for a torpedo, in combination, a high pressure air line, a severable closure for one end of the air line, a rotative means for shearing off said closure to open said line, means for operating the rotative means, and means permitting the freed air to escape to a surrounding medium.

7. In an exercise head for a torpedo, in combination, a casing, a high pressure air line leading into the casing and being normally closed, a pressure controlled member forming a portion of the casing wall, a time controlled mechanism within the casing, shearing means for opening the air line, said shearing means being operable upon functioning of the pressure controlled member and the time controlled mechanism, and means permitting the freed air to escape to a surrounding medium.

8. In an exercise head for a torpedo, in combination, a high pressure air line normally closed, a spring controlled shearing member for opening said line, means for releasing the spring controlled member at a predetermined time, and means permitting the freed air to escape to a surrounding medium.

9. In an exercise head for a torpedo, in combination, a high pressure air line normally closed, a spring controlled shearing member for opening said line, means for releasing the spring member when the exterior pressure on the exercise head reaches a predetermined amount, and means permitting the freed air to escape to a surrounding medium.

10. A means for determining the position of a torpedo at the end of a run including, in combination, a supply of air under pressure, a practice head mounted on the torpedo, a liquid ballast in the head, a casing in the head communicating with the air supply, shearing means within the casing for liberating said air into the head, and means in the wall of the head permitting the escape of said ballast and air to a surrounding medium.

11. A means for determining the location of a torpedo at the end of a run including, in combination, a supply of air under pressure, a practice head mounted on the torpedo, a casing in the head communicating with the air supply, means within the casing for liberating said air into the head, a plurality of trains of gears within the casing, one of which frees said means for operation, and the other of which controls the rate of movement of said means, and means in the wall of the head permitting the escape of said air to a surrounding medium.

12. In an exercise head for a torpedo, in combination, a high pressure air line normally closed, a rotative shearing means for opening the line, a power element for driving said rotative means, means holding the power element from premature functioning, a time controlled mechanism for freeing said holding means, a pressure controlled mechanism for freeing the holding means, and means permitting the freed air to escape to a surrounding medium.

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