F. M. LEAVITT.

DIVING GEAR FOR TORPEDOES.

APPLICATION FILED MAY 11, 1912.

1,033,810.

Patented July 30, 1912.

2 SHEETS—SHEET 1.

Fig. 1.

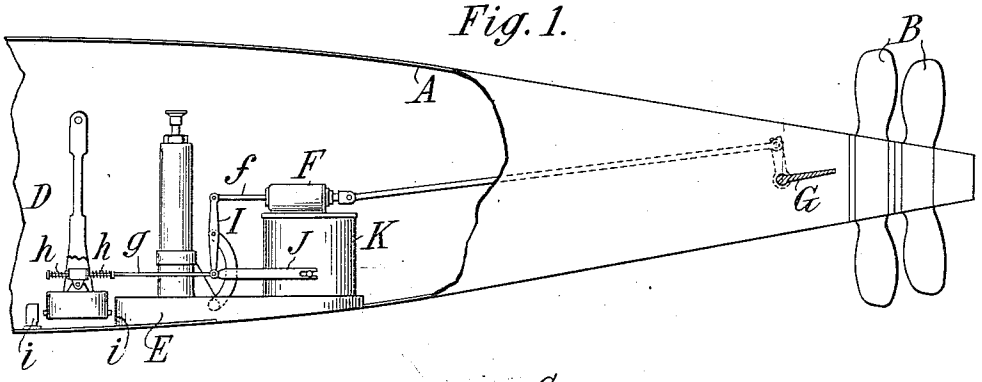


Fig. 3.

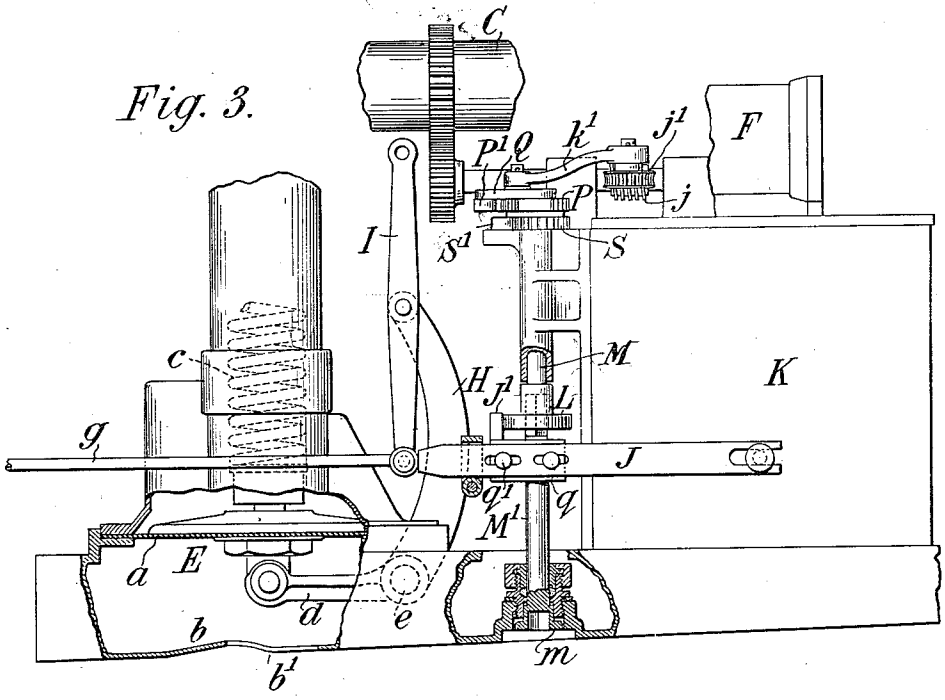
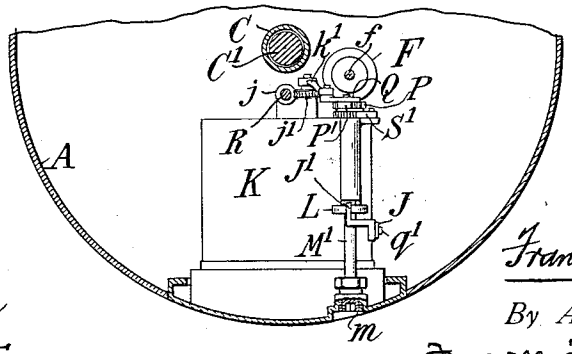


Fig. 2.



WITNESSES:

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2 SHEETS—SHEET 2.

Fig. 4.

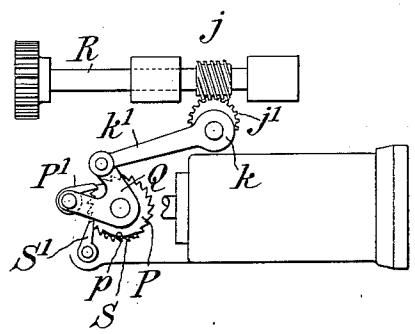


Fig. 7.

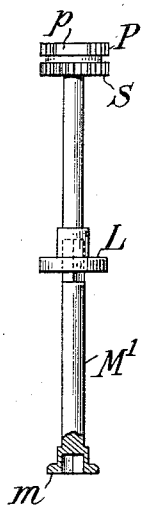


Fig. 5.

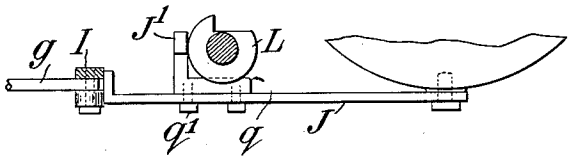


Fig. 9.

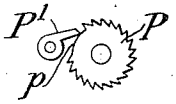


Fig. 6.

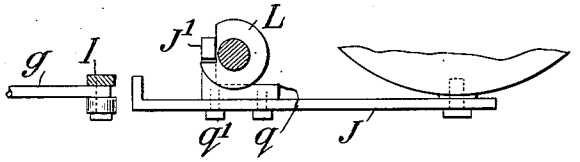
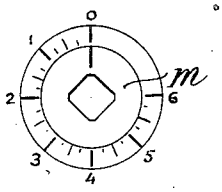


Fig. 8.



WITNESSES:

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UNITED STATES PATENT OFFICE.

FRANK M. LEAVITT, OF SMITHTOWN, NEW YORK, ASSIGNOR TO E. W. BLISS COMPANY, OF BROOKLYN, NEW YORK, A CORPORATION OF WEST VIRGINIA.

DIVING-GEAR FOR TORPEDOES.

1,033,810. Specification of Letters Patent. Patented July 30, 1912.

Application filed May 11, 1912. Serial No. 696,544.

To all whom it may concern:

Be it known that I, FRANK M. LEAVITT, a citizen of the United States, residing at Smithtown, in the county of Suffolk and State of New York, have invented certain new and useful Improvements in Diving-Gear for Torpedoes, of which the following is a specification.

This invention relates to the diving gear, or depth gear, or immersion mechanism of automobile torpedoes. Such mechanism comprises a rudder turning on a normally horizontal axis, a steerage engine or equivalent steering mechanism for operating the tiller of this rudder, and co-acting means for controlling such steering engine, these means comprising a hydrostat and a pendulum. The hydrostat consists of a diaphragm or equivalent receiving on one side the pressure of the water and on the other the pressure of a spring, the stress of which can be adjusted to determine the depth to which the mechanism will seek to steer the torpedo. The function of the pendulum is to maintain the axis of the torpedo in the horizontal plane. The pendulum and hydrostat reciprocally control the steering engine valve through the medium of levers in such manner that the valve is actuated by either or both the controlling members.

It is necessary to provide means for locking the pendulum or otherwise preventing it from communicating a steering moment to the steering engine during the launching of the torpedo and for a suitable time thereafter. This is necessary because when the torpedo is launched the inertia of the pendulum causes it to lag so that it swings to the rear, which tends to put the rudder down and give the torpedo a deep initial dive, which is objectionable, especially in shoal water. Such lag of the pendulum continues during the acceleration of the torpedo after launching and until uniformity of speed is attained, whereupon the pendulum recovers its plumb position and may exercise its normal function. For preventing the lag of the pendulum during the accelerating movement of the torpedo from influencing the steering engine, it is common to provide what is called a locking gear which locks the valve rod of the steering engine and prevents it being moved by the pendulum.

The present invention provides an improved means for preventing the lag of the pendulum from influencing the steering engine of the depth mechanism, for a sufficient period during the initial run of the torpedo to complete the acceleration and enable the torpedo to reach its normal speed.

To this end the present invention provides a lock or stop located to oppose the communication to the valve of the lagging movement of the pendulum; and means actuated by a timing or counting mechanism for automatically removing this stop after the elapsing of a certain time, or preferably after a certain number of revolutions of the torpedo shaft. In the preferred embodiment the stop consists of a bar, slide or other locking part held in position by a cam, with a counting or ratcheting mechanism for turning this cam until at the end of the predetermined period the cam ceases to oppose the retraction of the locking bar or part.

In the accompanying drawings,—Figure 1 is a side elevation of the after part of a torpedo partly in vertical section to show the depth steering mechanism; Fig. 2 is a transverse section; Fig. 3 is a side elevation on a larger scale being partly in section; Fig. 4 is a fragmentary plan view; Figs. 5 and 6 are fragmentary horizontal sections; Fig. 7 shows the cam shaft separately; Fig. 8 is a bottom view of the lower end of the shaft; Fig. 9 shows the ratchet and pawl in plan.

In Figs. 1 and 2, A is the torpedo hull or shell and B B are the propeller screws. The engine for driving these is not shown. In Fig. 2 the propeller shafts C and C′ are shown in cross-section, the latter within the former. In Fig. 3 a fragment of the shaft C is shown. The diving gear or immersion mechanism comprises a pendulum D, a hydrostat E, a steering engine or other steering mechanism F controlled by both the pendulum and hydrostat, and a horizontal rudder G the tiller of which is operated by the steering engine. In the particular construction shown the hydrostat E comprises a diaphragm *a* which forms one side of a chamber *b* which is in communication through an opening *b′* with the water outside the hull. The diaphragm receives on its opposite side the stress of a spring *c* which is adjusted to balance the hydrostatic pressure at the depth at which it is desired the torpedo shall steer. The hydrostat dia-

phragm is connected to the short arm *d* of a lever fulcrumed at *e* and having an upwardly projecting arm H to the upper end of which is pivoted a secondary lever I, the upper arm of which connects with the valve rod *f* of the steering engine F; while the lower arm of this lever connects with a rod *g* which engages the pendulum D. This rod engages the pendulum through buffer springs *h h* (Fig. 1) with sufficient strength to operate the valve rod, but not strong enough to resist the movements of the pendulum when the pendulum lock (hereinafter explained) is engaged. The pendulum as usual swings between buffer stops *i i* which limit it to a very slight movement.

So far as described the operation is that of any of the known immersion gears; that is to say, the hydrostat seeks to operate the steering engine to cause the torpedo to steer to the prescribed depth, and the pendulum tends to operate the steering gear to maintain the torpedo on a level axis. If the torpedo is above or below the prescribed depth the diaphragm is displaced and the lever H is correspondingly moved, so that if the pendulum remains stationary the lever I communicates this movement to the valve rod and the steering engine turns the rudder in such direction as to cause the torpedo to dive or rise until the prescribed depth is reached. If on the other hand the torpedo be not on a level axis, its inclination causes the pendulum to move relatively forward or aft and therefore to pull or push upon the rod *g* and thereby move the lever I, which movement, assuming the hydrostat to be unchanged, acts upon the valve rod *f* and the rudder is turned to such angle as will tend to restore the torpedo to the horizontal position. Sometimes both hydrostat and pendulum act simultaneously, in which case the valve is moved as the resultant of their respective controlling movements.

For locking the pendulum, that is to say, for rendering it impotent to affect the steering engine until its lag due to the acceleration of the torpedo shall have ceased, I provide a locking bar J which in the specific construction shown is mounted on the support K. This locking bar is essentially a stop or abutment the function of which is to render any backward or lagging movement of the pendulum impotent to affect the steering engine. Instead of locking the valve rod as heretofore, which incapacitates both the pendulum and hydrostat, the lock provided by this invention incapacitates only the pendulum, and does this only as to the backward or lagging movement. This is accomplished by arranging the locking bar J against and behind either the lower arm of the lever I or the rod *g*. It preferably engages both at their pivotal connection as shown. The stop or locking bar is arranged to be displaced in any suitable way so as to get it out of the path of the rod *g* or lever I, and for this purpose it is mounted as a slide so that it may recede when released. In its operative condition it is held immovable by means of a cam L on an upright shaft M, which cam engages an arm J′ projecting from the bar J. The cam stands behind the arm J′ and thereby prevents the pushing back of the locking bar by the rearward or lagging thrust of the pendulum. The cam L is turned little by little by means of a ratchet device comprising a ratchet wheel P fixed on the upper end of the shaft M, and which is turned by a pawl P′ carried on a rock arm Q which is oscillated by any suitable mechanism. The mechanism shown comprises a shaft R geared to the propeller shaft C (as shown in Fig. 3) and having a worm *j* which slowly drives a worm wheel *j′* which carries an eccentric *k* (Fig. 4) which through a rod *k′* communicates motion to the rock arm Q. A twin ratchet wheel S is provided engaged by a stop pawl S′ to prevent backward rotation.

Before launching the torpedo the cam L is turned to a position any desired number of degrees in advance of its final position (shown in Fig. 6), where its notch receives the arm J′ and permits the retraction of the locking bar. For this purpose provision is made for turning the shaft M from the exterior. In the construction shown an extension shaft M′ extends downward and terminates in a socket head *m* adapted to receive a wrench or key for turning it. Some suitable index is provided such as that shown in Fig. 8 for indicating either the angular distance through which it is turned, or corresponding thereto the distance which the torpedo will run during the turning of the cam that angular distance, or the number of revolutions the propellers will make during such time; or any other suitable guiding information. The operator has only to turn the head *m* in the direction of the arrow in Fig. 8 until its index mark reaches the desired point on the scale. Say for example this turns the cam to the position shown in Fig. 5, from which starting position it will have to turn 90 degrees before releasing the lock. Then upon the launching of the torpedo and the starting of the engine, the cam will be gradually turned at such speed as is determined by the ratio of gearing until the cam reaches the position shown in Fig. 6, whereupon the arm J′ is permitted to move back with the locking bar and thereby release the pendulum connection. When this releasing position is reached it is desirable that the cam should then remain stationary during the

remaining run of the torpedo. This is accomplished by forming the ratchet wheel P with a blank or toothless space p against which the pawl P′ may impotently move, as shown in Fig. 9.

It is desirable to have the arm J′ adjustable relatively to the bar J to facilitate the initial setting or adjustment, and for this purpose the arm is mounted on a block q which is fastened to the bar by clamp screws q'.

During the accelerating movement of the torpedo the resulting lag of the pendulum is taken up by compressing the spring h behind it, and without communicating any movement through the rod g, because the latter is held against movement by the advanced or locking position of the stop or locking bar J. During the preliminary dive the hydrostat is free to act and upon reaching the prescribed depth will act to operate the rod f and throw the rudder. The pendulum is also free to act in forward direction, that is to say, as soon as the downward inclination of the torpedo becomes effective to move the pendulum relatively forward when the effect of the acceleration ceases, such forward movement will carry the rod g forward and out of contact with the stop or locking bar J, and will operate the steering engine to bring the torpedo to the horizontal position. The duration of the locking engagement should be made as nearly as possible coincident with the period of acceleration of the torpedo, so that by the time the torpedo reaches its prescribed depth and so that it may seek to rise, the lock should be withdrawn so that the pendulum may be free to correct such rising tendency. This is as heretofore a matter of adjustment within the skill of the operator.

It will be understood that the ratchet device shown is a timing mechanism, and may be substituted by any other known or suitable timing or counting-down device whereby at the end of a prescribed number of revolutions of the propeller shafts, or at the end of a prescribed time, the locking device shall be withdrawn.

It will be understood that the mechanism shown may be greatly varied in its constructive features without departing from the spirit of the invention.

I claim as my invention:—

1. In an automobile torpedo the combination with a depth steering mechanism comprising a pendulum, a hydrostat, and a steering engine controlled by either of them, of means for preventing the transmission to said engine of the rearward or lagging movement of the pendulum during the acceleration of the torpedo at launching, such means adapted to leave the steering engine under control of the hydrostat.

2. In an automobile torpedo the combination with a depth steering mechanism comprising a pendulum, a hydrostat, and a steering engine controlled by either of them, of means for preventing the transmission to said engine of the rearward or lagging movement of the pendulum during the acceleration of the torpedo at launching, such means adapted to leave the steering engine under control of the hydrostat and also under control of forward movements of the pendulum.

3. In an automobile torpedo the combination with a depth steering mechanism comprising a pendulum, a hydrostat, and a steering engine controlled by either of them, of means for preventing the transmission to said engine of the rearward or lagging movement of the pendulum during the acceleration of the torpedo at launching, such means comprising a stop interposed behind a connection from the pendulum to said engine, and a timing mechanism for withdrawing said stop after a predetermined interval.

4. In an automobile torpedo the combination with a depth steering mechanism comprising a pendulum, a hydrostat, and a steering engine controlled by either of them, a lever communicating movement from said hydrostat, a second lever pivoted on the first and connected at one arm to the pendulum and at the other arm to said steering engine, and means for preventing the transmission to said engine of the rearward or lagging movement of the pendulum during the acceleration of the torpedo at launching, said means comprising a stop interposed behind a connection between said secondary lever and said pendulum, and means for withdrawing said stop after a prescribed time.

5. In an automobile torpedo, the combination with a depth steering mechanism comprising a pendulum, a hydrostat, and a steering engine controlled by either of them, of means for preventing the transmission to said engine of the rearward or lagging movement of the pendulum during the acceleration of the torpedo at launching, and timing mechanism for terminating the action of said means comprising a movable cam adapted to be set to move a greater or lesser distance, and a connection from the propelling mechanism of the torpedo for gradually advancing said cam.

6. In an automobile torpedo, the combination with a depth steering mechanism comprising a pendulum, a hydrostat, and a steering engine controlled by either of them, of means for preventing the transmission to said engine of the rearward or lagging movement of the pendulum during the acceleration of the torpedo at launching, and timing mechanism for terminating the action of said means comprising a movable cam adapted to be set to move a greater or

lesser distance, a connection from the propelling mechanism of the torpedo for gradually advancing said cam, and means accessible from the exterior of the torpedo for moving said cam to its desired starting position in initially setting the timing mechanism.

7. In an automobile torpedo, the combination with a depth steering mechanism comprising a pendulum, a hydrostat, and a steering engine controlled by either of them, of means for preventing the transmission to said engine of the rearward or lagging movement of the pendulum during the acceleration of the torpedo at launching, and timing mechanism comprising a rotary cam and a ratchet-and-pawl for turning it, said pawl reciprocated by connection with the propelling mechanism of the torpedo.

8. In an automobile torpedo, the combination with a depth steering mechanism comprising a pendulum, a hydrostat, and a steering engine controlled by either of them, of means for preventing the transmission to said engine of the rearward or lagging movement of the pendulum during the acceleration of the torpedo at launching, and timing mechanism comprising a rotary cam and a ratchet-and-pawl for turning it, said pawl reciprocated by connection with the propelling mechanism of the torpedo, and means accessible from the exterior of the torpedo for turning said cam to initially set the timing mechanism.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

FRANK M. LEAVITT.

Witnesses:
EDW. C. REDHEAD,
C. T. ZIEGLER.