

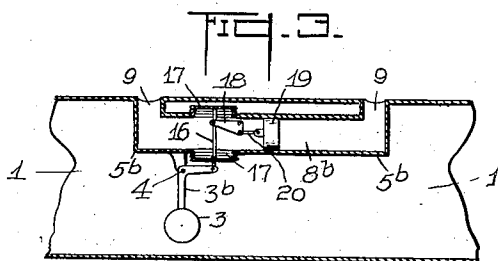
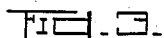
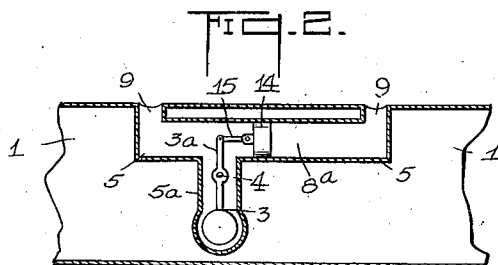
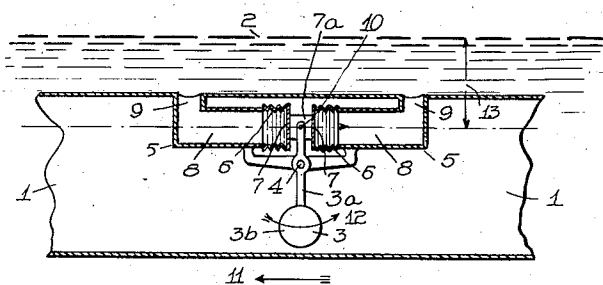
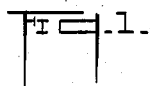
Nov. 25, 1941.

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2,263,553

STABILIZER

Filed Aug. 5, 1938



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2,263,553

STABILIZER

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Application August 5, 1938, Serial No. 223,161
In Italy August 5, 1937

3 Claims. (Cl. 114—16)

The present invention relates to improvements in stabilizing devices for submarines, torpedoes and other submersible bodies.

Submarines, torpedoes and similar submersible bodies move about while remaining submerged, and are required to control their horizontal positions during motion or to regulate said positions by automatic mechanism.

For this purpose use is generally made of a pendulum capable of oscillating in a vertical plane parallel to the longitudinal axis of the floating body. The pendulum, however, presents the disadvantage of swerving from the vertical during the speed variations, thus giving rise to erroneous indications or regulation.

With the foregoing in mind the present invention has for its object to provide a pendulum, which, during uniform motion and during motion at varying speeds of the floating body, maintains its vertical position even if the floating body is inclined during such speed variations, or rotates in its longitudinal plane. I accomplish the object of my invention by means of certain arrangements and combinations of parts hereinafter described, set forth in the claims and illustratively exemplified in the accompanying drawing, in which Fig. 1 is a substantially longitudinal sectional view of a submersible body having my improved stabilizer; Fig. 2 is a similar view showing the pendulum submerged; Fig. 3 shows a modified construction.

Referring to the drawing and particularly to Figure 1, 1 denotes a portion of the submerged floating body and 2 the surface of the water in which the body is submerged. A pendulum 3 is suspended from the fulcrum 4 and comprises a rod 3a and weight 3b. A tube or pipe 5 is arranged in the interior of the body 1 with its axis parallel to the direction of motion, and to the axis of the floating body, communicating with the outside by means of the end tubes 9.

The tube 5 is interrupted centrally thereof to receive collapsible and extensible bellows 6. The bellows are closed by the small end plates 7, which are joined together by a link 7a. The chambers 8 formed in the tube 5 outside the bellows are filled with water. When the two plates 7, which are integral with each other, are shifted in the direction of the arrow, or vice-versa, the water contained in the chambers 8 will not offer any resistance to such motion, because it is free to flow inwardly and outwardly of the tubes 9.

An extension of the pendulum suspension rod 3a is connected to the link 7a between the small

plates 7 at the point 10. In operation the pendulum will, during its oscillations, displace the plates 7. For example let it be supposed that the motion takes place in the direction of the arrow 11, and that such motion is not uniform, but accelerated. Then the pendulum will tend to swing in the direction of the arrow 12 due to the effect of a force equal to the mass, m multiplied by the acceleration a ($m \times a$). Simultaneously, the mass of water M contained in the tube 5 will act on the plates 7 with a force $M \times a$.

If the moments of $m \times a$ and of $M \times a$ relatively to the fulcrum 4 are equal, the pendulum remains motionless, viz. it is balanced or in equipoise, but it will still be able to turn if the floating body becomes inclined. During such inclination the pressure exerted by the column of water corresponding to the depth of submersion 13 has no effect either on the plates 7, or on the pendulum, as the small plates are very close together. The same conditions apply to retarded motion.

In Fig. 2 the pendulum 3 is submerged in a transverse arm 5a of the tube 5 and the upper end of the rod 3a is linked to a piston 14 by means of a piston rod 15, the piston 14 being disposed in the chamber 8a which in this case is continuous in the tube 5.

In Figure 3 the rod 3b is a bell crank arm, the lateral shorter arm thereof being provided with a link 16 which is connected to an elastic bellows 17 the axis of which is perpendicular to the axis of the body 1. A pivoted lever 18 is mounted in the chamber 8b of the tube 5b and is connected to a piston 19 in the chamber 8b by means of a piston rod 20.

The subject matter of the application involves the use of a pendulous weight, the rod of which is pivoted so that the relative movement of the body and of the weight will be about an axis at right angles to the direction of movement of the body. The effectiveness of the weight is secured by providing a mass of liquid acting upon a piston-like mechanism, and developing an equal and uniform pressure upon opposite sides of this mechanism by reason of the fact that the mass of this liquid within chambers communicating with the surrounding liquid in which the body is submerged is supplied from this surrounding liquid. The mass of this liquid is so proportioned in relation to that of the weight as to secure the desired stabilizing action due to acceleration or retardation in the movements of the body. Since the chamber in which the piston or its equivalent has a free opening exteriorly of the body, the action of liquid in a chamber in co-operating with

the weight is determined by the mass of this liquid and not by any variation in the pressure conditions within the chamber, since these are always constant and proportioned to the density of the fluid exteriorly of the body, due to the degree of submergence thereof.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:

1. In a stabilizer, the combination with a submersible body, of means forming two chambers extending longitudinally of said body and having ports opening exteriorly of said body at the opposite ends thereof respectively, whereby the liquid in which said body is submerged may flow into said chambers, a pivotally mounted lever rod having a short arm and a long arm, a weight carried by said long arm, a member movable in both of said chambers, and a pivotal connection between the short arm of said rod and said member, whereby with acceleration or retardation of said body, inertia of said weight will cause movement of said member to stabilize the movements of said body by the displacement of water in one of said chambers, and movement of said member will be retarded by the displacement of the mass of liquid in the other of said chambers.

2. In a stabilizer, the combination with a submersible body, of means forming two chambers extending longitudinally of said body and having ports opening exteriorly of said body at the opposite ends thereof respectively, whereby the liquid in which said body is submerged may flow into or from said chambers, a piston common to and movable in both of said chambers, a lever rod pivotally mounted below said chambers and hav-

ing a short arm operative upon said piston, and a weight carried by the long arm of said lever, whereby with acceleration or retardation of said body, inertia of said weight will cause movement of said piston to stabilize the movements of said body by the displacement of water in one of said chambers, and movement of said weight to a position of equilibrium will be retarded by the displacement of liquid in the other of said chambers.

3. In a stabilizer, the combination with a submersible body, of means forming two chambers extending longitudinally of said body and having ports opening exteriorly of said body at the opposite ends thereof respectively, whereby the liquid in which said body is submerged may flow into or from said chambers, the adjacent ends of said chambers being spaced in relation to each other, connected diaphragms in the space between the ends of said chambers, a collapsible and extensible bellows connecting said diaphragms respectively with the spaced open ends of said chambers, whereby said diaphragms may have similar simultaneous movement in relation to one of said chambers or the other, a lever rod pivotally mounted below said chambers and having a short arm operative upon said diaphragms, and a weight carried by the long arm of said lever, whereby with acceleration or retardation of said body, inertia of said weight will cause movement of said diaphragms to stabilize the movements of said body by the displacement of water in one of said chambers, and movement of said weight to a position of equilibrium will be retarded by the displacement of liquid in the other of said chambers.

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