L. FORT.

SUBMERGIBLE VESSEL.

APPLICATION FILED JUNE 28, 1917.

1,382,073.

Patented June 21, 1921.

3 SHEETS—SHEET 1.

Fig. 1.

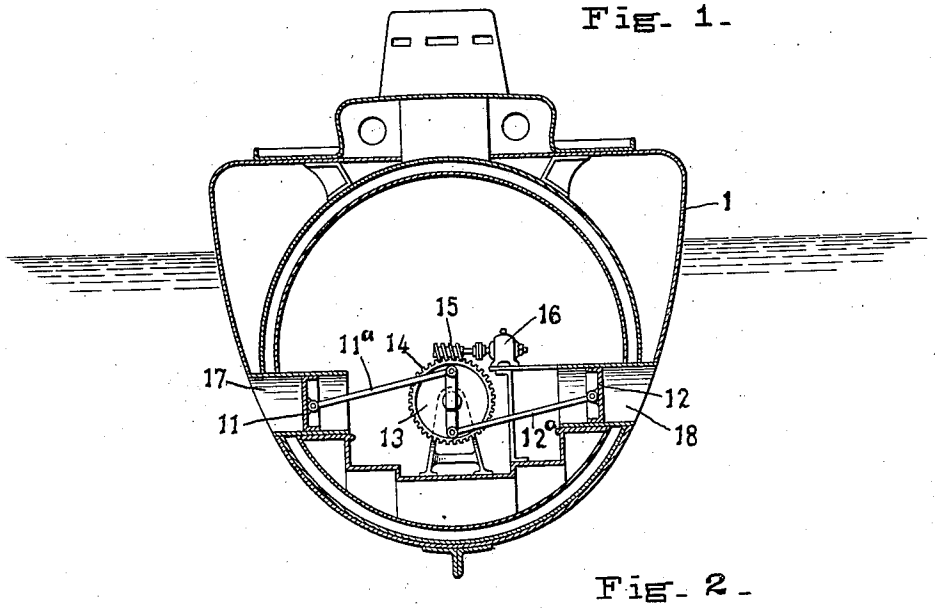


Fig. 2.

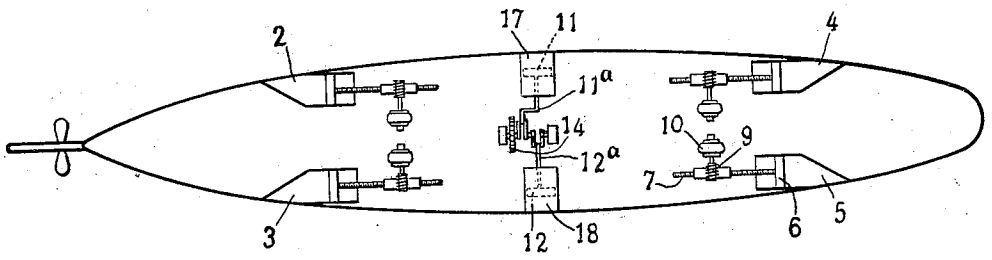
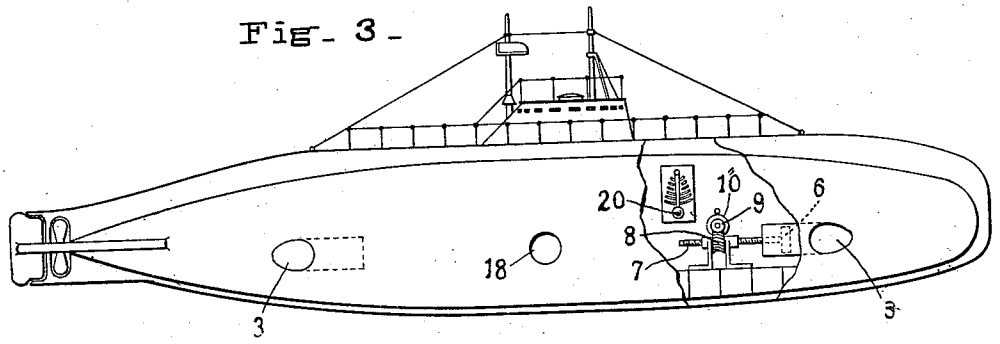


Fig. 3.



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3 SHEETS—SHEET 2.

Fig. 4.

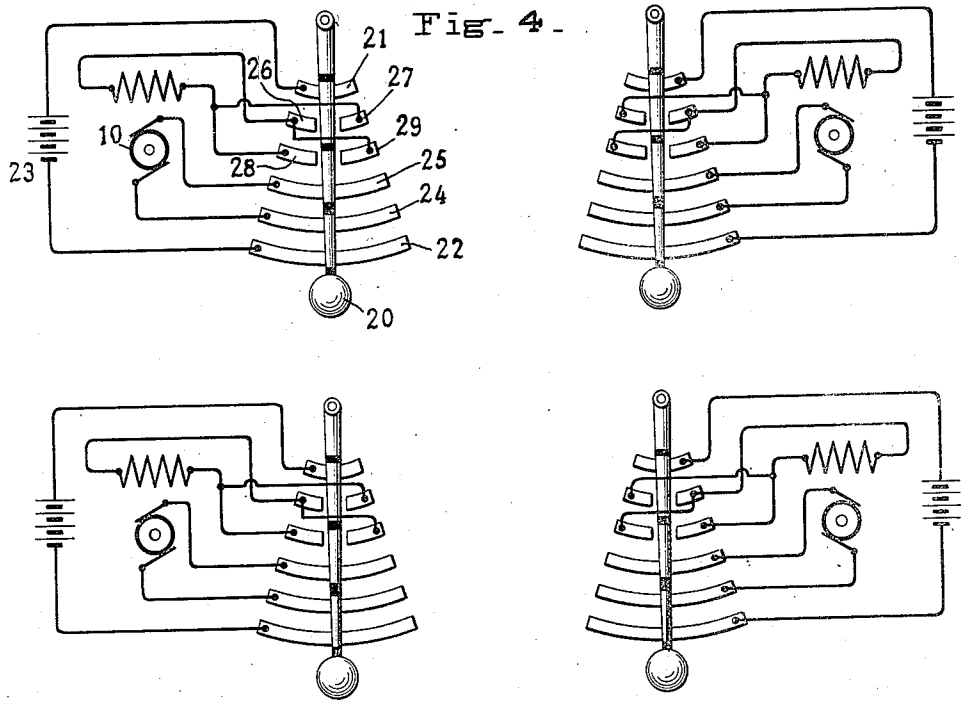


Fig. 5.

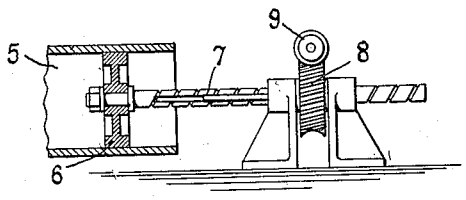
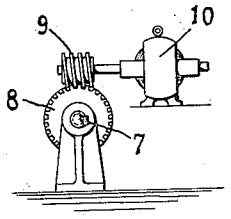


Fig. 6.



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3 SHEETS—SHEET 3.

Fig. 7.

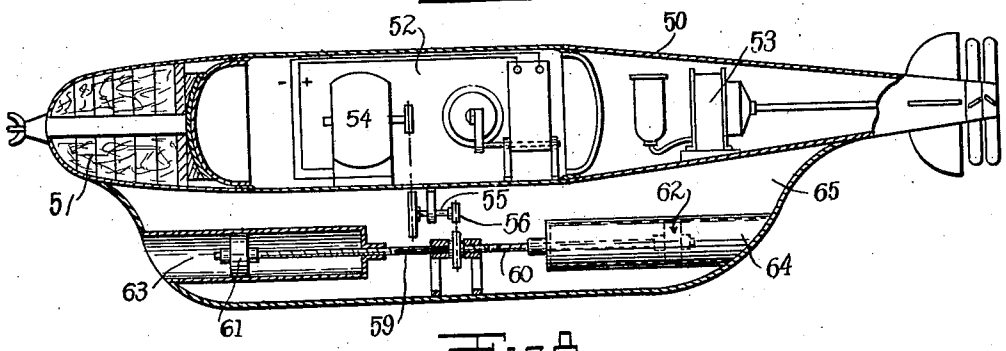


Fig. 8.

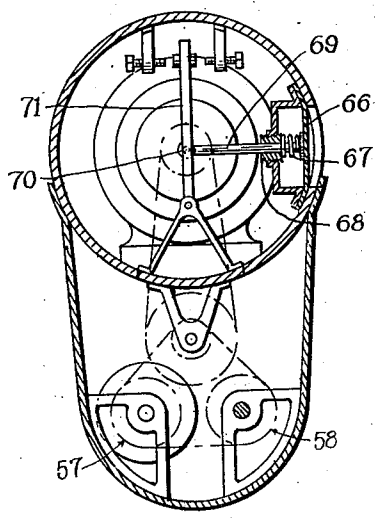
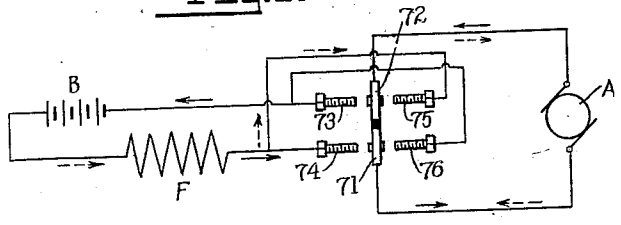


Fig. 9.



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UNITED STATES PATENT OFFICE.

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SUBMERGIBLE VESSEL.

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Application filed June 28, 1917. Serial No. 177,512.

To all whom it may concern:

Be it known that I, LOUIS FORT, a citizen of the United States, and a resident of Jersey City, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Submergible Vessels, of which the following is a full, clear, and exact description, whereby any one skilled in the art may make and use the same.

The invention relates to submergible vessels generally, and is particularly directed to submarines and what might be termed "dirigible torpedoes." It pertains to a method and mechanism for varying and controlling the displacement of the vessel in contradistinction to maintaining a constant displacement thereof, and controlling the submersion by varying the condition of weight or ballast.

In present practice, water pumped into and out of the tanks of the hull serves to vary the conditions of weight or ballast and these must be regulated as other weights, for instance, fuel, armament, etc., are varied.

The present invention contemplates maintaining a proper displacement of the vessel with reference to its buoyancy so that its submergence may be controlled and secured in a very short period of time.

In so far as known, it has been a common practice with a vessel of any given displacement and buoyancy to overcome the buoyancy by the addition of weight in the form of water ballast. This has been pumped into and out of suitable ballast tanks and has controlled the buoyancy or rather has been used to overcome the buoyancy of the vessel.

In vessels of this character, this taking on of ballast or expelling it has required unusually efficient and cumbersome apparatus and considerable power and the necessary power plant for securing quick changes in conditions in the various ballast tanks.

Furthermore, in such vessels, it has been necessary to keep the submarine "under way" in order to maintain the proper condition of ballast and submersion.

It is the principal object of the present invention to provide for a variation in displacement of the vessel so that its natural buoyancy and differing conditions of displacement will aid in making it more stable, giving a better control and providing a means whereby "hovering" may be effected.

In the device hereinafter described, it is possible to arrange to maintain the vessel at any desired degree of depth of submersion by a simple and efficient means and without requiring the vessel to be "under way."

Of course, all of the ordinary fins, planes, and directional rudders may be utilized in the device herein described in substantially the same form as in the present types of submarines. It is also intended that, when desired, ballast tanks with pumping devices, such as are at present employed, may be used. These are primarily effective in bringing the vessel down to the critical point of its loss of buoyancy during submersion. The full lowering or rising of the vessel may then be taken care of by the apparatus described.

Referring to the drawings, which are in a large measure diagrammatic:

Figure 1 illustrates a cross-sectional view amidships.

Fig. 2 is a diagrammatic plan of the balancing pistons.

Fig. 3 is a side elevation with parts broken away about one of the balancing pistons.

Fig. 4 illustrates in four diagrams a form of electrical control for each of the balancing motors.

Fig. 5 is a detail view illustrating a means of driving the balancing pistons.

Fig. 6 is a detail view of an end elevation of the parts illustrated in Fig. 5.

Fig. 7 is a sectional view of a torpedo illustrating a use of the invention.

Fig. 8 is a cross-sectional view of Fig. 7, illustrating the control.

Fig. 9 is a wiring diagram of the controlling device.

The shell or hull of the vessel may be of any well known type and is indicated as at 1, as being of the double skin formation.

Suitably arranged and opening out of the hull at as many points as may be desired are cylindrical openings 2, 3, 4, 5. As illustrated in Fig. 2, there are four of these cylindrical openings, two arranged fore and two arranged aft, there being two on the port and two on the starboard side. These, of course, are to be arranged below the normal water line and may be provided with suitable screens or other protective devices to prevent the ingress of mud and prevent fouling.

Each cylindrical tube which, of course, will be of suitable dimensions, is provided

with a piston 6, having any suitable means for moving it rapidly backward and forward in its cylinder. As illustrated, the piston 6, is connected through a quick pitch screw 7, with an actuating worm gear 8, which in turn is driven by a worm 9, connected with a suitable motor 10.

For the purpose of convenience, each of the pistons has an individual separate drive and is independently controlled through manual means, though preferably through automatically actuated means.

These cylinders and pistons form a means for varying the displacement of the vessel and as the pistons are moved forward and back, the vessel will have increased or decreased buoyancy depending upon the difference in the degree of its displacement.

The motors for each of the pistons being independently controllable, makes it quite possible to provide great stability and give unusual latitude of action of the crew. Obviously, the independent operation of the pistons will permit automatic ballasting and balancing.

To provide for maintaining definite depth of submersion and to quickly modify the critical condition of buoyancy, there is arranged amidships or in any suitable position, a pair of inter-connected pistons 11, 12. These are inter-connected through a common actuating driver 13, which may be driven by a worm-wheel 14, and worm 15, connected with a suitable motor 16.

As illustrated, the pistons 11, 12, have connecting rods 11^a, 12^a, and as the driving member 13, is rotated, these pistons are driven forward or backward in their respective cylinders 17, 18.

The movement of these pistons may be made very rapid and provides a very sensitive means of adjusting the displacement of the vessel for hovering. Even with the form of driving apparatus illustrated, their movement is readily controlled and is sensitive to slight modifications in pressures under submersion, as more fully hereinafter described.

It will be apparent that with the vessel at its critical point of buoyancy or loss of buoyancy, these pistons may re-act to vary that condition so that a "hovering" effect may be secured and the vessel may be held at any predetermined and pre-arranged depth of submersion.

As a simple means of controlling the operation of the pistons 6, through their respective motors, there is illustrated in Fig. 4, a series of electrical controls for the electric motors.

An effective simple means of controlling the circuits of the motors of the "hovering" pistons, 11, 12, is illustrated in conjunction with the torpedo of Figs. 7 to 9 inclusive, wherein the external pressures upon the hull determine the control of the circuits of the motors.

These devices, as illustrated, are of a ballistic type designed to control the electrical circuits of the motors whenever the vessel changes its position. There being a control for each motor, it is obvious that each motor will be controlled independently of the others and, therefore, the degree of movement of the respective pistons will be similarly controlled. Each of these devices, as illustrated, consists of a weighted pendulum 20, having a suitable switch bar normally in contact with the main circuit through contacts 21, 22, which are connected with the main source of power 23. The armature circuits are controlled through contacts 24, 25, and the fields through contacts 26, 27, 28, and 29. A glance at the diagrams will indicate that the swing of the pendulum from its normal central position will control the directional flow of current from the main source of power and as it swings from one side of normal to the other, the direction of current will be reversed by reversing the fields.

The obvious result of this is to drive the motor in one direction or the other and thereby move the respective pistons in either direction.

Of course, many means might be devised for controlling the motors automatically or they may be controlled manually and whether of the electric or other type, they may be individually or collectively controlled by other apparatus so that the pistons can be moved to any desired degree.

No attempt has been made herein to elabrate in detail the various parts of the mechanism and structure, and in fact, the drawings are of more or less diagrammatic type. It is a matter of indifference just what power or means is employed for propelling the various pistons, so long as there is an arrangement of them which will change the displacement of the vessel and thereby produce efficient means for submerging it to any degree and with features of balancing the vessel while submerged.

It is also possible to use water ballast entirely in place of the main balancing cylinders 2, to 5, inclusive and still maintain the "hovering" pistons 11, 12, which will operate for the critical point of buoyancy during submersion.

The depth control is not specifically indicated in conjunction with the hovering pistons of Figs. 1 to 3, and for clearness is illustrated in Figs. 7 to 9, where the invention is shown as applied to a dirigible torpedo.

Referring to Figs. 7 to 9, 50, indicates the shell of the torpedo having a head 51, bearing a charge of explosives and a power compartment for the driving mechanism.

As illustrated in the diagram, there is a driving motor 53, which may be of the ordinary compressed air type commonly employed or may be an electric motor. In either case, it drives the propellers of the torpedo.

The source of electrical energy for operating the torpedo and its depth controlling apparatus may be storage batteries, although these are not specifically illustrated herein.

Within the compartment 52, there is a motor 54, suitably geared to a countershaft 55, which through a pinion 56, and sprockets 57, 58, drives the piston rods 59, 60, in such relation that their respective pistons 61, 62, are moved away from or toward each other, depending upon the direction of rotation of the countershaft, and motor shaft. As illustrated in the diagrams, sprockets and chains are indicated where any desired form of drive may be employed and, as shown, the sprockets 57, 58, are threaded to engage threads upon the piston rods 59, 60.

The pistons 61, 62, are arranged to move in tubes or cylinders 63, 64, which are arranged respectively on opposite sides of the center line of the torpedo to give balance and at opposite ends of its fin or keel 65.

It is obvious that as the pistons are moved backward and forward, the torpedo will be submerged to a greater or less degree and may be maintained at a constant depth of submergence.

For controlling the degree of submergence, a circuit of the motor 54, is controlled through a simple switch mechanism which reverses the direction of current in the motor.

As illustrated in Fig. 8, there is a diaphragm 66, which is sensitive to the external pressures of the hull of the torpedo. This is backed up by an adjustable spring 67, which, through any desired indicator mechanism, may be set to different tensions. As illustrated, an adjusting nut 68, is provided upon a spindle 69, which is connected with the diaphragm 67, and is pivotally connected as at 70, with swinging switch blades 71, 72.

As illustrated in Fig. 9, B, indicates the source of power; F, the field; A, the armature of the motor.

When the diaphragm throws the switch blades 72, 71, out of the normal, open circuit position as, for instance, into engagement with the contact members 73, 74, the flow of current will be through the field F, and armature A, in the direction of the full arrows indicated in the circuit.

When the diaphragm throws the switch blades 71, 72, into engagement with the contacts 75, 76, the flow of current will be though the field and armature, in the direction of the dotted arrows.

In other words, the controlling device reverses the motor connections to give a reversed rotation to the armature.

As the motor receives a supply of current, it moves the pistons in one direction or the other to increase or decrease the displacement of the torpedo. With this arrangement, the torpedo may be held constantly at a given depth below the surface.

There are particular advantages in such an arrangement of the invention as is applied to torpedoes. They may be run at the desired speed from the self-contained power plant, giving a great radius of operation, and need not rely upon a given speed and given regulated angles of controlling veins and fins such as are commonly employed. Where an electrical plant is employed for driving such a torpedo, there is little showing of its wake as naturally there are no air-bubbles.

It is to be understood that the hovering device for a submergible vessel, such as illustrated in Fig. 1, may be automatically controlled by the same diaphragm mechanism illustrated in Fig. 8.

It is obvious that no attempt has been made to go into exact detail of the various mechanisms for a submerging vessel or a torpedo, but the showing is more or less diagrammatic and confined to illustrating a means for trimming and balancing a vessel and maintaining a given depth of submergence.

By adjusting the pistons of the bow or stern, the vessel may be caused to dive when "under way," or the bow and stern pistons may be utilized for changing the displacements of the vessel very rapidly up to its critical point of complete loss of buoyancy. Thereupon, the hovering pistons will operate to maintain proper equilibrium. A very slight adjustment of the hovering pistons, which can be made very rapid, will suffice to give submergence and maintain the vessel in hovering position when it is not "under way."

The advantages of this are apparent as from a point of rest the vessel may be immediately submerged and when it has reached a given pre-determined depth, it may be put "under way" with safety and without liability of running to too great a depth as is often the case with present methods where vanes and fins are utilized.

It is understood that such modifications in detail and design as are necessary may be employed. The main elements and means of operation and purpose thereof are hereinabove set forth.

The hovering tubes 17, 18, and their appurtenances are effective for maintaining a definite condition, causing either positive or negative buoyancy of the vessel, as they may be moved with great rapidity. It is

apparent that the vessel, when submerged, becomes either positively or negatively buoyant, and the hovering tubes will correct these conditions before they become so predominant as to cause the vessel to sink under absolute loss of buoyancy, or rise under positive buoyancy. It follows that with the rapidity of change possible, as above described, the vessel may be sunk to any predetermined level and maintained at said level.

The same condition follows with the use of the tubes 63, 64, which serve to provide the variation in displacement for the torpedo or vessel as well as to maintain it at its critical point of loss of buoyancy after it has been set for a definite displacement.

The buoyancy of the vessel may be controlled with such accuracy and ease that the system is particularly well adapted for what might be termed a "one-man" submarine, capable of firing torpedoes. As the vessel can be made automatically adjustable for trim, all the operator would be compelled to do would be to give it proper directional course and release his torpedoes. His equilibrium, after the change in displacement due to discharge of torpedoes, may be compensated for by the moving pistons.

What I claim as my invention and desire to secure by Letters Patent is:

1. A submersible vessel having a plurality of "trimming" tubes opening outwardly through the hull of said vessel, pistons traversing said tubes, individual means for driving each of said pistons in opposite direction to vary the displacement and "trim" of the vessel, means for controlling the movement of said individual means, and means for controlling the buoyancy of the vessel at its critical point of loss of buoyancy.

2. A submersible vessel having a plurality of "trimming" tubes opening outward through the hull of said vessel, pistons traversing said tubes, means for moving said pistons in opposite direction to vary the displacement of the vessel, automatic means controlling the movement thereof, and automatically controlled means for varying the buoyancy of said vessel at its critical point of entire loss of buoyancy.

3. A submersible vessel carrying a power plant and means for driving the vessel and having tubes fore and aft opening through the hull thereof, pistons traversing said tubes, individually actuated means for rapidly moving each of said pistons in the tubes to vary the displacement of the vessel, means for controlling its critical point of loss of buoyancy, and automatic means operable by the changes in position of the vessel for controlling the driving means of said pistons.

4. A submersible vessel having tubes fore and aft opening through the hull thereof, reversible motor devices for rapidly moving said pistons forward and backward in their respective tubes to vary the displacement of the vessel, means for controlling its critical point of loss of buoyancy, and automatic electro-mechanical means dependent upon the changes in position of the vessel for controlling the direction of rotation of the motor and the consequent movement of the pistons.

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