No. 881,136. PATENTED MAR. 10, 1908.

K. O. LEON.

APPARATUS FOR REGULATING THE DEPTH OF MOORED FLOATING BODIES.

APPLICATION FILED NOV. 16, 1906.

3 SHEETS—SHEET 1.

Fig. 2

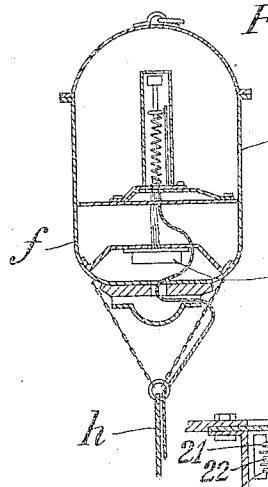


Fig. 3.

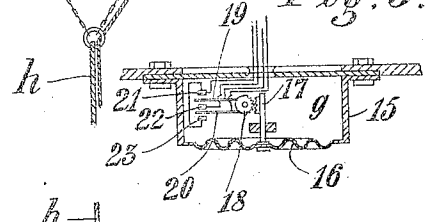
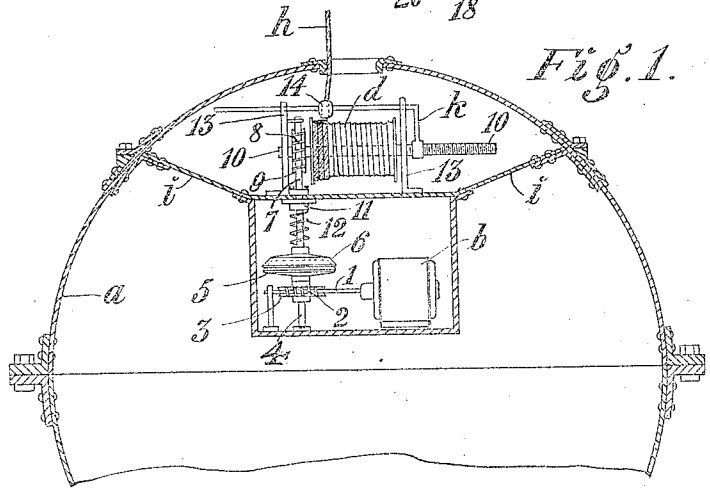


Fig. 1.



Witnesses

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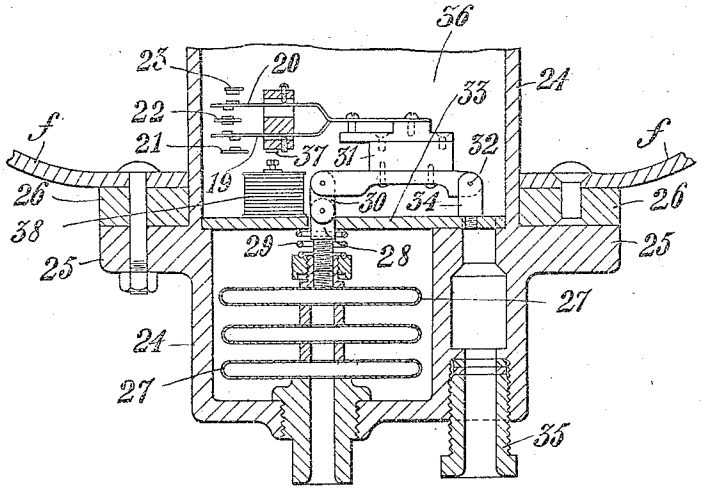
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3 SHEETS—SHEET 2.

Fig. 4.



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3 SHEETS—SHEET 3.

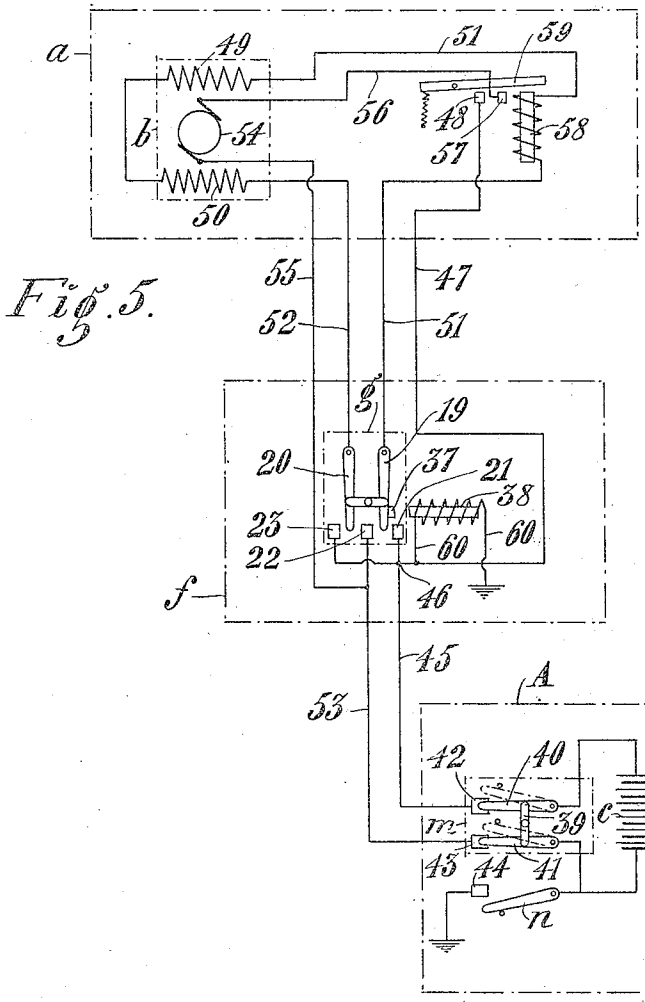


Fig. 5.

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UNITED STATES PATENT OFFICE.

KARL OSKAR LEON, OF STOCKHOLM, SWEDEN.

APPARATUS FOR REGULATING THE DEPTH OF MOORED FLOATING BODIES.

No. 881,136. Specification of Letters Patent. Patented March 10, 1908.

Application filed November 16, 1906. Serial No. 343,685.

To all whom it may concern:

Be it known that I, KARL OSKAR LEON, a subject of the King of Sweden, and resident of 38 Riddaregatan, Stockholm, Sweden, have invented new and useful Improvements in Apparatus for Regulating the Depth of Moored Floating Bodies, of which the following is a specification, reference being had to the drawing acompanying and forming a part hereof.

This invention relates to apparatus for regulating the position or depth of the immersion of submarine mines, parts of mines, buoys and other moored floating bodies.

The invention is especially applicable in submarine mines moored in places where the tide makes itself strongly felt. It is applicable either when the whole mine is to be raised and lowered or when the main body of the mine, *i. e.* the part of the mine containing the explosive charge or detonator, is moored at a constant distance from the bottom of the sea and is connected with a separate contact buoy or circuit closing apparatus adapted to be raised and lowered.

The inventon can also be utilized for automatically regulating the position or depth of the immersion of buoys, sea-marks, and the like, or, generally, for regulating the level of any floating bodies adjustably attached to the bottom or to moored bodies.

The chief object of the invention is to make it possible to maintain the mine, or other body, at a substantially constant position or depth beneath the water surface, independently of the rising and lowering of the latter due to the tide or other influences.

In carrying out the invention an electromotor is used, said electromotor being caused to wind up or unwind, in any known manner, a rope or similar connection by which the floating body is fastened. The electromotor can be placed either in the floating body or in a stationary part outside the latter, for instance in the anchor. In mines having outside the mine proper or main body of the mine a floating contact buoy inclosing the shock apparatus for closing the circuit of the firing battery, the electromotor can suitably be placed within the casing of the main body of the mine or within the contact buoy.

The invention consists, chiefly, in providing a special electric-circuit-closing-device automatically operated by the water pressure in such a way that, when the water pressure is increased or decreased beyond certain limits, the motor circuit is closed for rotating the motor in one or the other direction. The circuit connections of the motor are such that the motor is started for winding up the rope and lowering the floating body at a certain lower pressure and is started for unwinding the rope and allowing the floating body to ascend at a certain higher pressure.

In the drawings, I have illustrated, by way of example, one form of a submarine mine arranged according to this invention. The mine illustrated in the drawings is of the kind having a so-called contact buoy, *i. e.* of the kind where the part of the mine containing the detonator is moored at such a distance from the bottom as to secure a sufficient bulk of water above the mine even in low water, whereas the shock apparatus for closing the mine-exploding circuit is inclosed within a separate casing forming the contact buoy.

The invention is, however, as before stated, also applicable to submarine mines in which the apparatus for closing the mine-exploding circuit is inclosed within the mine proper.

Figure 1 is a central vertical section of part of the main body of the mine. Fig. 2 is a central vertical section of the contact buoy containing the shock apparatus for closing the mine-exploding circuit. Fig. 3 is a central vertical section, on an enlarged scale, of the apparatus, contained in the contact buoy, for closing the depth-regulating circuit. Fig. 4 is a central vertical section of a modified form of the apparatus for closing the depth-regulating circuit. Fig. 5 is a diagram of apparatus and circuits belonging to the system.

Referring to the drawings, the moored part *a* of the mine (Fig. 1) incloses an electric motor *b* supplied with current from any suitable source of electricity, such as a battery *c* (Fig. 5) placed on shore. Connected with the motor shaft 1 by any suitable gearing is a drum *d* which is rotated in one or the other direction, according to the direction of rotation of the motor, and thereby causes the contact buoy *f* (Fig. 2) to be raised or lowered. Placed within the contact buoy is a depth-regulating instrument *g* (Fig. 3) serving to close the motor circuits in such a manner as to cause the motor to rotate in one or the other direction. Wound on the drum *d* is a wire rope *h* or similar flexible

connection in which the contact buoy *f* is attached. The buoy *f*, like the main body *a* of the mine, has a certain floating-power so as to constantly keep the part of the rope *h* unwound from the drum stretched, the position or depth of the immersion of the buoy *f* in the water being thus dependent upon the length of the unwound part of the rope *h*. The motor *b*, suitably constructed as a continuous current motor with a low speed of rotation, is shown placed beneath the drum. The gearing from the motor to the drum shaft consists, in the form of embodiment illustrated, of an endless screw 2 formed on the motor shaft 1 and engaging a screw wheel 3 attached to a vertical shaft 4 carrying, at its upper end, a friction disk 5 engaging a second friction disk 6 attached to the lower end of a shaft 7 journaled coaxially with the shaft 4, said upper shaft 7 being provided, at its upper end, with an endless screw 8 engaging a screw-wheel 9 on the drum shaft 10. The friction disks 5, 6 together form a friction brake serving to prevent the motor from being overloaded. The shaft 7 passes through a water-tight partition *i* in the main body of the mine and is surrounded, where it passes the said partition, by a water-tight stuffing-box 11 so that water is prevented from penetrating from the outer, water-filled room inclosing the drum into the compartment containing the motor and the apparatus to be protected from water. Situated between the stuffing-box 11 and the friction disk 6 is a strong spiral spring 12 serving to keep the friction disks pressed one against the other. The drum *d*, which is suitably provided with a spiral groove for the winding rope *h* of the contact buoy *f*, is attached to the shaft 10 and rotates therewith. The shaft 10 is journaled in standards 13, or the like, attached to the partition *i* and provided, at one end, with a screw-thread engaging a nut forming part of a rope guide *k* whose upper, horizontal part, moving in notches in the standards 13, is provided with an eye 14 through which the rope *h* passes. During the turning of the drum for winding up the rope, the rope guide moves along the drum to secure an even winding.

The depth-regulating instrument *g* placed in the buoy *f* can, if desired, be constructed somewhat similar to an aneroid barometer. In the constructional form illustrated in Fig. 3 it consists of a box 15 (Figs. 2 and 3) the bottom 16 of which is provided with concentric corrugations. Attached to the middle of the bottom 16 is a rack 17 catching into a pinion 18, and attached to the said pinion, but insulated therefrom, are two contact springs 19, 20 coöperating with three insulated contact-pieces 21, 22, 23. These contacts are suitably carried by a part adapted to be moved parallel to the axis of the box by means of a set screw or the like so as to enable an accurate adjustment with relation to the contact springs, said movable part and screw having been omitted in the drawing for the sake of simplicity. The contact spring 19 enters between the contact pieces 21 and 22, and the contact spring 20 enters between the contact pieces 22 and 23. Under normal conditions, the contact springs take up the middle positions shown in the drawing, in which they are out of contact with the contact pieces. When, on the other hand, on account of the raising or lowering of the water level, the water pressure exerted on the bottom 16 of the box 15 is sufficiently increased or decreased, the spring 19 makes contact with one or the other of the contact pieces 21, 22 at the same time as the spring 20 makes contact with one or the other of the contact pieces 22, 23.

In the constructional form of the depth-regulating instrument illustrated in Fig. 4, the box and the parts inclosed therein are substituted by a switch box 24 of different construction to the above described, attached to the lower part of the contact buoy. This switch-box is shown arranged for expeditious mounting, which is performed in such a manner that the flange 25 at the outer side of the box is screwed on to a corresponding flange or ring 26 at the shell of the contact buoy. For closing the circuits for rotating the motor in one or the other direction and thereby causing the desired functions to be performed, the lower part of the box contains bellows 27 which are widened, when the water pressure increases, and thereby cause a rod 28 connected with the bellows to move upwardly, whereas, when the water pressure decreases, a spring 29 pulls the rod downward, thereby compressing the bellows. The rod 28 is connected by a link 30 to a contact carrier 31 pivoted at 32 in a support 34 screwed into a plate 33. The electric cable (not shown) is introduced into the contact room 36 through a stuffing box 35. Attached to the contact carrier 31 are the contact springs 19, 20, which, in the manner above described, enter between the insulated contact pieces 21, 22, 23. Carried by the contact springs 19, 20 is an armature 37, and placed beneath the said armature is an electro-magnet 38, which, when supplied with current, attracts the armature against the action of the elasticity of the contact springs so as to cause the contact spring 19 to make contact with the contact piece 21 and the contact spring 20 to make contact with the contact piece 22, by which the motor is started for pulling down the contact buoy. The current through the electro-magnet 38 is regulated from shore as hereinafter described.

The circuits are shown in the diagram, Fig. 5. Placed at the mine station A, indi-

cated in the drawing by a dotted rectangle, are a battery *c* or other suitable source of electricity and switches *m*, *n* for closing the different circuits. The switch *m* is shown constructed as a common double-pole circuit-breaker having two arms 40, 41 connected by a link 39 of insulating material, each of said arms normally bearing on a contact piece 42, 43 respectively. The switch *n* is a common circuit-closer normally open but adapted to be brought on to a ground contact 44. The arm 40 is connected to the one (positive) pole of the current source *c*, while the arm 41 and the circuit closer *n* are connected to the other (negative) pole of the current source. Leading from the contact 42 is a conductor 45 branching at the point 46 within the contact buoy to the contact pieces 21 and 23. Extending from the point 46 is, further, a conductor 47 passing down to a contact 48 situated at the motor *b* in the mine proper *a*. The field magnet windings 49, 50 of the motor are connected by conductors 51, 52 to the contact arms 19, 20. Passing from the contact piece 43 at the mine station A is a conductor 53 leading to the contact piece 22 in the contact buoy *f*. The brushes at the armature 54 are shown connected by conductors 55, 56 the one to conductor 53 from the contact piece 43 and the other 56 to a contact piece 57 at the side of the contact piece 48. Inserted in the conductor 51 is an electro-magnet 58, which, when supplied with current, attracts an armature 59 and causes the latter to form a bridge between the contact pieces 48 and 57. The circuit through the armature 54 is thus closed through the armature 59, only when the electro-magnet 58 is supplied with current, which is the case only when the automatic circuit closing device *g* is in its one or other working position.

The electro-magnet 38 is shown inserted in an earth conductor 60 divided from the conductor 47.

When the switches *m*, *n* take up the positions shown in Fig. 5, a current flows from the battery *c* through the field magnets in one or the other direction, according as the automatic switch is thrown, by the variations in the water pressure, in its one or other working position. The current through the armature always flows in one and the same direction but only when the automatic switch takes up its one or other working position, due to the fact that the electro-magnet 58, when being deprived of current, releases its armature 59, which then breaks the armature circuit. The motor *b* will thus run in one or the other direction according as the automatic switch takes up its one or other working position. On account thereof, the rope *h* is wound up or unwound, respectively, until the contact buoy finds itself at the depth beneath the water surface in which the automatic switch takes up an idle position.

The switch *n* and the conductor 60 including the electro-magnet 38 are employed especially in submarine mines laid down in navigable channels in order to make it possible to make the contact buoy descend for admitting neutral vessels to pass and then again cause the contact buoy to rise so as to prevent hostile vessels from passing. When the switch *n* is closed, a current flows from the battery *c* through the electro-magnet 38 and earth back to the battery, whereby the electro-magnet 38 attracts its armature 37 and throws the automatic switch to the right (Fig. 5) so that the motor is started for winding down the contact buoy. The motor then rotates in the winding down direction, until the contact buoy has descended to a sufficient depth to allow the vessels to pass. In order to make the buoy ascend into its upper position, the switch *n* is again opened, and the buoy will then be self-regulating, as before, so that the contact arms 19, 20 are thrown on to their opposite contacts and the motor is caused to rotate in the opposite direction.

It is to be understood that the invention is not limited to the particular constructions and circuits hereinbefore described but can be varied in several ways without departing from the spirit and scope of my invention. Obviously, instead of reversing the field current, the armature current can be reversed, while the field current is caused to flow in one and the same direction. Further, instead of directly closing the field circuit, or the armature circuit respectively, by the automatic switch, a servo-motor might be employed, said servo-motor serving to start or stop the winding motor, eventually by cutting out or inserting resistances in the motor circuit.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:

1. The combination of a substantially stationary body, a floating body, a flexible connection between the two bodies, an electric motor placed in one of the said bodies, a source of electricity for supplying current to the said electric motor, electric connections between the source of electricity and the motor, a switch arranged in such a manner as to cause the motor to run in one or the other direction, according as the switch is thrown into one or the other of its working positions, a pressure-operated device carried by the floating body and connected with the switch in such a manner as to cause the latter to move toward the one or the other of its working positions, according as the water pressure increases or decreases, and means, driven by the motor, for winding up or unwinding the flexible connection between the