

Jan. 27, 1942.

L. A. DUNAJEFF

2,271,185

FLOATING SUBMARINE MINE

Filed April 20, 1938

2 Sheets-Sheet 1

Fig. 1

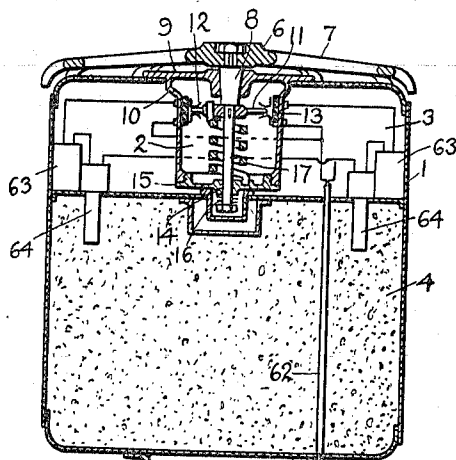


Fig. 2

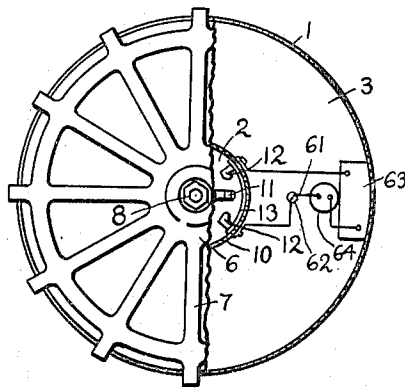


Fig. 3

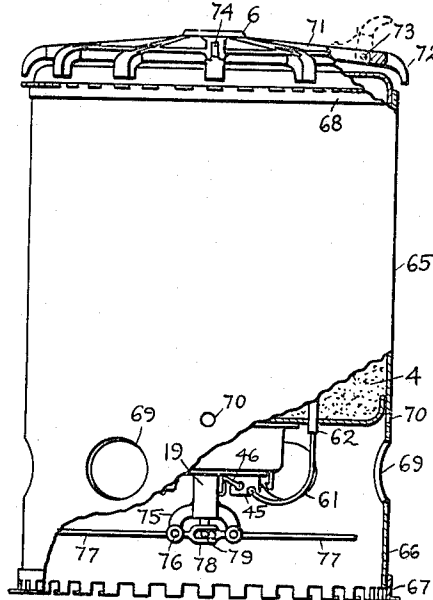
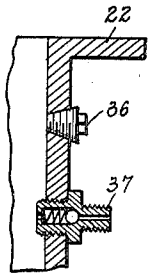
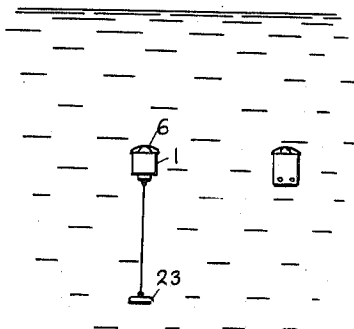


Fig. 9

Fig. 4



LEONID A. DUNAJEFF
INVENTOR

BY *John P. Wilson*
ATTORNEY

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L. A. DUNAJEFF

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2 Sheets-Sheet 2

Fig. 5

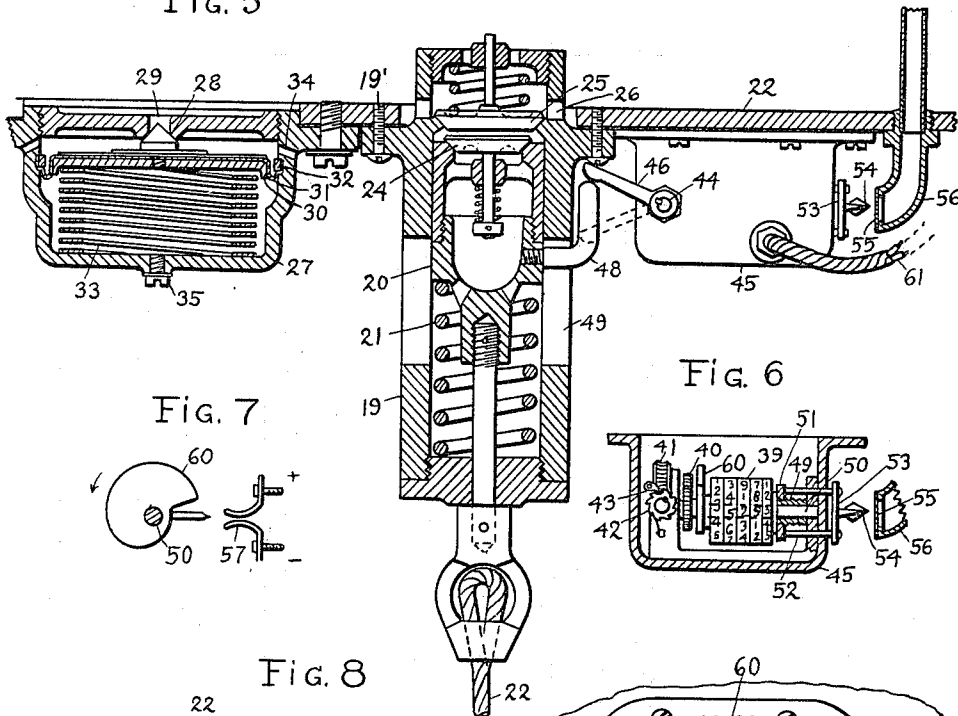


Fig. 7

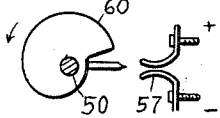


Fig. 6

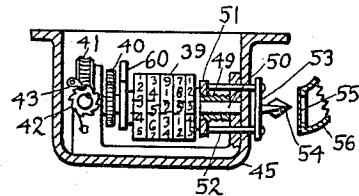
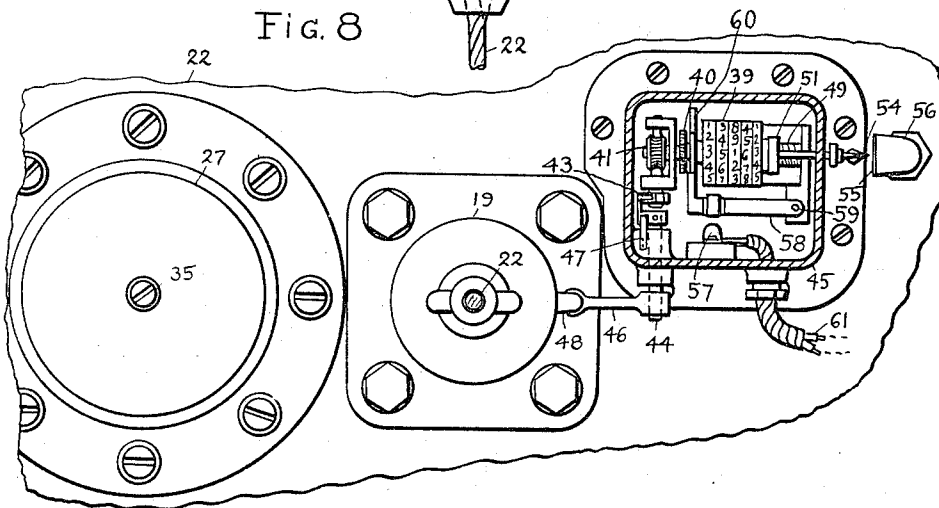


Fig. 8



LEONID A. DUNAJEFF

INVENTOR.

BY

John P. Nironow

ATTORNEY.

UNITED STATES PATENT OFFICE

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FLOATING SUBMARINE MINE

Leonid A. Dunajeff, New York, N. Y., assignor to
Commercial Ingredients Corporation, New
York, N. Y.

Application April 20, 1938, Serial No. 203,031

10 Claims. (Cl. 102—3)

My invention relates to floating submarine mines and has particular reference to mines adapted to explode on contact with moving vessels.

The purpose of a floating mine is to serve for defense as, for instance, when such mines are launched from a pursued vessel in the path of a pursuing ship, and also for offensive warfare when they are planted in certain areas of the high seas in order to prevent or endanger the passage of enemy ships. The mines, in order to be effective, must be invisible and must explode at the most vulnerable parts of ships below their water-line, so that it is necessary to provide submarine mines with a mechanism for causing the mines to float at a certain depth of submergence. This is usually accomplished by providing the mine with a mechanism so arranged that either the volume or the weight of the mine is being constantly changed thereby keeping the mine oscillating about the desired depth of submergence. The time of the effective operation of the mine is limited, however, by the amount of available energy stored in the mine, such as an electric battery, compressed gases, etc.

My invention has for its object to provide a mine which will float at a predetermined depth of submersion, automatically maintaining this depth for an indefinite length of time. For this purpose I provide a mechanism utilizing the inexhaustible energy of the surrounding moving water instead of using a source of energy stored in the mine itself and which necessarily would have become exhausted in a relatively short time.

Another object of my invention is to provide a floating mine with an explosion mechanism operating when a moving ship comes in frictional contact with the mine thereby insuring a more positive action of the explosive mechanism.

Other objects of this invention will be apparent from the accompanying description and drawings in which—

Fig. 1 is a sectional elevational view of the mine.

Fig. 2 is a top plan view of the same partly in section.

Fig. 3 is an elevational view of a modified mine partly in section.

Fig. 4 is a view showing the two types of mines floating at a predetermined depth.

Fig. 5 is a detail view of a mechanism for keeping the mine at a predetermined depth.

Fig. 6 is a sectional elevational view of a mechanism for sinking the mine after a certain period of time.

Fig. 7 is a diagrammatic view of an electrical contact arrangement for arming the mine at a certain time after its launching.

Fig. 8 is a bottom plan view of the assembly shown in elevation in Fig. 5.

Fig. 9 is a detailed view of an air valve.

The mine of my invention consists of a cylindrical housing 1 (Fig. 1) divided inside into a few separate compartments including a central chamber 2 which serves as a housing for electric switches controlling explosion fuses, a surrounding chamber 3 with batteries, coils and other ignition devices; a chamber 4 for explosive or detonating substances, and a chamber 5 for compressed air and ballast water. An umbrella-shaped body or cap 6 is provided on top of the housing with radial ribs 7, mounted on a vertical shaft 8 with a conical upper portion rotatively fitted in the cover 9 of a casing 10 of the housing 2 (Fig. 1). A double-armed switch lever 11 is mounted and keyed on the shaft 8 and is adapted to close the contacts on any one of the two pairs of contact jaws 12 of the ignition system fitted on insulation bases 13 mounted on the inside wall of the casing 10.

The lower end of the shaft 8 is journaled in a bearing 14 in the bottom cover 15 of the casing 10 with spring washers 16 to keep the shaft drawn reasonably tightly into the conical seat in the cover 9. A strong spring 17 is placed around the shaft 8, one end of the spring being connected with the bottom cover 15 and the other end engaging the contact arm 11 so as to keep the arm in a position midway between the pairs of contacts 12 as shown in Fig. 2. With this arrangement it is possible to close the contacts 12 only by twisting the spring, and this can be accomplished by the application of an outside turning force on the cap 6, this force being supplied by a ship striking the mine. In order to render this operation more effective, the ribs 7 extend beyond the housing 1 as shown in Fig. 1, i. e. the outer diameter of the ribs being larger than the diameter of the body of the mine or housing 1.

The relative volumes of the chambers and their loads are proportioned so as to keep the center of gravity of the mine below the center of buoyancy in order to keep the mine in an upright position. The total weight and volume of the mine are so proportioned as to make its average specific gravity slightly less than the specific gravity of water so that the mine will have tendency to float up toward the surface of water. In order to keep the mine submerged, an addi-

tional water ballast 18 is provided in the chamber 5 rendering the specific gravity of the mine equal to that of the surrounding water. In order to keep the mine submerged at a predetermined depth, a special system is provided comprising a small water pump 19 (Fig. 5) attached as by screws 19' to the bottom of the casing 22 and extending into the chamber 5 and adapted to continuously pump water into the chamber 5 with every stroke of its piston 20. A retrieving spring 21 forces the piston upward while it is pulled downward by the tension of a cable 22 with a floating anchor or weight 23 at the lower end. These opposite forces of the spring and of the weight are proportioned so as to balance each other, keeping the piston in its upper position as shown in Fig. 1. Despite the fact that the specific gravity of the mine with the weight 23 is made substantially equal to that of the surrounding water, the mine will oscillate up and down with every wave occurring at the surface of the water, but the mine and the weight will oscillate in different phases due to the difference in the inertia of the mine and of the weight and to the difference in their resistance to the moving up and down mass of water. As a result, the spring 21 will alternately expand and contract causing the piston to oscillate and to pump the water into the chamber 5 for which purpose the piston has a valve 24 which is opened during the downward stroke, the upper portion of the cylinder 19 of the pump having a valve 25 admitting water into the chamber 5 with the upward stroke of the piston through ports 26.

It is evident that with the continuous pumping of water into the chamber 5, the specific gravity of the mine will be increased with the result that the mine will gradually sink. In order to restore the equilibrium, a hydrostatic device 27 is provided of a usual type, having a valve 28 closing an aperture 29 in the wall of the casing 22 and mounted on a plate 30 supported on a flexible diaphragm 31 whose periphery is held against the inner walls of the casing 27 by a ring 32. A helical spring 33 presses against the plate 30, closing the aperture 29 by the valve 28. The space above the diaphragm is in communication with the outside water through ports 34. A screw plug 35 is provided in the casing 27 for permitting adjustment of the initial pressure in the spring chamber for which purpose the plug is temporarily removed in order to equalize the air pressure inside and outside the casing 27.

In order to facilitate the coming of the mine to the predetermined depth, the wall of the casing 22 is provided with an aperture closed by a screw plug 36, water being poured through this aperture in a quantity sufficient to make the mine sink. Air is then pumped through a suitable air valve 37 to a certain pressure in the chamber 5. With the chamber 5 thus charged, the mine will start to sink when launched until it reaches a predetermined depth at which the hydrostatic device will become operative, the pressure of water moving the diaphragm plate 30 downward and thereby opening the valve 28. As a result, some of the water will be expelled from the chamber 5, causing the mine to rise until the valve 28 closes again the port 29 at a certain depth. Because of the continuous operation of the pump, more water will be pumped into the casing 22 and the above described operations will be continuously repeated so that the

mine will oscillate at a desired depth of submergence.

In view of the fact that floating mines may change their positions and after sufficient length of time may be moved by currents far away from their charted positions so as to become a menace even to our own boats, it becomes necessary to cause the floating mines to sink at the expiration of a certain period of time.

In this connection, I have found that the time can be fairly accurately measured by the number of oscillations of the mine as caused by the waves in the ocean. These oscillations depend on the length of the waves and on the velocity of their propagation, and there is a certain ratio between the two, this ratio varying more or less with the seasons and weather variations. On the average, however, it can be considered as an approximately fixed quantity and it determines the frequency of the waves. In order to measure the time by the number of waves or oscillations of the mine, I provide a counting mechanism in the form of an ordinary cylindrical counter 39 connected by gears 40 on a shaft 40', and a gear 41' on a shaft 44 and 41 with a ratchet wheel 42 operated by a pawl 43 on the end of the shaft 44 passing through the wall of a casing 45 supported on the bottom wall of the casing 22 and provided with a lever 46. A spring 47 tends to keep the lever in the depressed position shown in dotted lines in Fig. 5. The lever is operated by a rod 48 extending from the piston 20 through a slot 49 in the wall of the cylinder 19. The counter, therefore, registers every stroke of the piston. The counters are usually made so that all their figure wheels begin to turn together as a unit when every wheel shows the numeral 9, or a five-wheel counter shows the number 99999. In the counter used by me in my mine, however, I make an arrangement whereby the wheel before last cannot pass the following wheel over the figure 9 so that all the wheels then become locked together and turn as a unit. The last wheel is connected with a tubular threaded shaft 49 rotatively supported on a common shaft 50 and having a movable nut 51 connected by rods 52 with a crossbar 53 outside the casing, the rods sliding in corresponding holes in the wall of the casing. The crossbar has a sharp pin 54 opposite a thin diaphragm 55 closing the end of a pipe 56 extending from the air space in the chamber 5. The threaded shaft 49 begins to rotate when the counter reaches the figure 999,999 etc., depending on the number of its wheels, causing the pin to advance and to finally pierce the diaphragm thereby permitting the air trapped in the casing 22 to escape. The mine will then cease to oscillate since the pump will continue to force water into the chamber 5, but water cannot escape from this chamber when the hydrostatic valve is opened there being no air pressure to expel water. The mine will then sink.

Assuming, for example, that the waves are 70 meters long and move with the velocity of 7 meters per second, the number of waves per hour will be 360 or 864,000 in 100 days. If the transmission ratio in the gears 40 and 41 to the first counter wheel is 100, then the counter must be set for the number 91360 in order to sink the mine in 100 days.

In order to render the mine safe for handling prior to its launching, a mechanism is provided for maintaining the circuit open before launching and until the mine has remained in water for a short time. For this purpose a switch is

provided at the counter consisting of contact jaws 57 and a contact bar 58 pivoted at 59 and having a lug engaging an eccentric 60 mounted on the first counter wheel at the side of its gear. An insulated cable 61 extends from the switch and passes through a protective tube 62 to the upper chamber 3 where the leads of the cable are connected with batteries 63 and ignition devices 64 through the main switch 12. The circuit of the ignition device remains, therefore, open even if the cap 6 is accidentally twisted thereby closing the contacts 12 by the arm 11, until the mine is launched and the counter start turning. Upon completion of a certain portion of one revolution of the first wheel of the counter, the eccentric 60 will push the bar 58 into the jaws 57 thereby closing the circuit for the main switch 12. The jaws are made so that they will retain the bar by friction (Fig. 1).

A modified construction of the mine is shown in Fig. 3. The housing 65 has an extension or skirt 66 at the bottom with a toothed rim 67 at the edge, a similar rim 68 being fitted at the other end of the mine. These rims are used for joining the mines into a floating body as described in my co-pending patent application Serial No. 119,446, filed January 6, 1937. The skirt in this case has openings 69 for admitting water under the skirt. Additional small holes 70 are provided for the escape of air which may be trapped in the compartment under the skirt. The cap 6 has ribs 71 with end portions or lugs 72 hinged at 73 and retained by springs 74. The lugs are raised as shown in dotted lines when the mines are assembled together into a floating body and snap back in place when the mine is detached. There is also another modification of means to move the piston of the pump, as the pump 19 has lugs 75 with pivots 76 on which are mounted flapper plates 77. The inner ends of the plates have forks 78 engaging a pin 79 on the end of the piston rod. The mine is balanced to float in an upright position, oscillating as described above. The flappers, having their own resistance to motion in water, move up and down during these oscillations, operating the pump 19.

I claim as my invention:

1. A floating submarine mine comprising a housing for an explosive substance weighted approximately to density of water, a closed container in the housing forming a chamber for air and water, a water pump connected with the container, a member operatively connected with the pump and having inertia to the moving water different from the inertia of the mine, the member being thereby adapted to reciprocate in relation to the mine when the mine is oscillating under action of waves in a body of water and to operate the pump, the pump being adapted to pump water into the container thereby rendering the mine heavier and causing it to sink, a hydrostatic valve adapted to release water from the container at a predetermined depth thereby causing the mine to rise, means to cause the mine to explode when contacted by a moving object, a counter, means to operate the counter by the relative movements between the mine and the reciprocating member, and means to render the explosive means operative after the counter has recorded a predetermined number of oscillations.

2. A floating submarine mine comprising a housing for an explosive substance weighted approximately to density of water, a closed con-

tainer in the housing forming a chamber for air and water, a water pump connected with the container, a member operatively connected with the pump and having inertia to the moving water different from the inertia of the mine, the member being thereby adapted to reciprocate in relation to the mine when the mine is oscillating under action of waves in a body of water and to operate the pump, the pump being adapted to pump water into the container thereby rendering the mine heavier and causing it to sink, a hydrostatic valve adapted to release water from the container at a predetermined depth thereby causing the mine to rise, an electric means to explode the mine on contact with a moving object, a counter, and an electric switch for the electric means adapted to render the explosive means operative after the counter has recorded a predetermined number of oscillations.

3. A floating submarine mine comprising a housing for an explosive substance weighted approximately to density of water, a closed container in the housing forming a chamber for air and water, a water pump connected with the container, a member operatively connected with the pump and having inertia to the moving water different from the inertia of the mine, the member being thereby adapted to reciprocate in relation to the mine when the mine is oscillating under action of waves in a body of water and to operate the pump, the pump being adapted to pump water into the container thereby rendering the mine heavier and causing it to sink, a hydrostatic valve adapted to release water from the container at a predetermined depth thereby causing the mine to rise, an electric means to explode the mine on contact with a moving object, a counter, an electric switch for the electric means adapted to render the explosive means operative after the counter has recorded a predetermined number of oscillations, and means to cause the mine to sink after the counter has completed a predetermined number of revolutions.

4. A floating submarine mine comprising a housing for an explosive substance weighted approximately to density of water, a closed container in the housing forming a chamber for air and water, a water pump connected with the container, a member operatively connected with the pump and having inertia to the moving water different from the inertia of the mine, the member being thereby adapted to reciprocate in relation to the mine when the mine is oscillating under action of waves in a body of water and to operate the pump, the pump being adapted to pump water into the container thereby rendering the mine heavier and causing it to sink, a hydrostatic valve adapted to release water from the container at a predetermined depth thereby causing the mine to rise, an electric means to explode the mine on contact with a moving object, a counter, an electric switch for the electric means adapted to render the explosive means operative after the counter has recorded a predetermined number of oscillations, the container being adapted to hold a constant amount of air under pressure of water, and means to release the air from the container by the counter when it has completed a predetermined number of revolutions, thereby causing the mine to sink.

5. A floating submarine mine comprising a housing for an explosive substance weighted approximately to density of water, a closed container in the housing forming a chamber for air

and water, a water pump connected with the container, a member operatively connected with the pump and having inertia to the moving water different from the inertia of the mine, the member being thereby adapted to reciprocate in relation to the mine when the mine is oscillating under action of waves in a body of water and to operate the pump, the pump being adapted to pump water into the container thereby rendering the mine heavier and causing it to sink, a hydrostatic valve adapted to release water from the container at a predetermined depth thereby causing the mine to rise, an electric means to explode the mine on contact with a moving object, a counter, an electric switch for the electric means adapted to render the explosive means operative after the counter has recorded a predetermined number of oscillations, a pipe extending from the container and closed at the outer end, and means to open the pipe by the counter when the latter has completed a predetermined number of revolutions thereby causing the mine to sink.

6. A floating submarine mine comprising a housing for an explosive substance weighted approximately to density of water, a closed container in the housing forming a chamber for air and water, a water pump connected with the container, a member operatively connected with the pump and having inertia to the moving water different from the inertia of the mine, the member being thereby adapted to reciprocate in relation to the mine when the mine is oscillating under action of waves in a body of water and to operate the pump, the pump being adapted to pump water into the container thereby rendering the mine heavier and causing it to sink, a hydrostatic valve adapted to release water from the container at a predetermined depth thereby causing the mine to rise, an electric means to explode the mine on contact with a moving object, a counter, an electric switch for the electric means adapted to render the explosive means operative after the counter has recorded a predetermined number of oscillations, a pipe extending from the container and closed at the outer end by a thin diaphragm, and a pin operatively connected with the counter and adapted to pierce the diaphragm upon completion by the counter of a predetermined number of revolutions thereby causing the mine to sink.

7. A floating submarine mine comprising a housing for an explosive substance, a closed container in the housing forming a chamber for air and water, a water pump connected with the container having a piston, a retrieving spring for the piston, a member depending from the piston at a fixed distance for submergence in water, the housing and the member with the container being weighted to approximately the density of water, the member and the housing having different inertia resistance to the vertical movement of the surrounding water, the member being thereby adapted to reciprocate the pump when the mine is oscillating under action of waves in a body of water, the pump being adapted to pump water into the container thereby rendering the

mine heavier and causing it to sink, and a hydrostatic valve adapted to release water from the container at a predetermined depth thereby causing the mine to rise.

8. A floating submarine mine comprising a housing for an explosive substance, a closed container for the housing forming a chamber for air and water, a water pump connected with the container having a piston, retrieving spring for the piston, a member depending from the piston at a fixed distance for submergence in water, the housing and the member with the container being weighted to approximately the density of water, the member and the housing having different inertia resistance to the vertical movement of the surrounding water, the member being thereby adapted to reciprocate the pump when the mine is oscillating under action of waves in a body of water, a spring adapted to oppose the action of the reciprocating member, the pump being adapted to pump water into the container thereby rendering the mine heavier and causing it to sink, and a hydrostatic valve adapted to release water from the container at a predetermined depth thereby causing the mine to rise.

9. A floating submarine mine comprising a housing for an explosive substance, a closed container in the housing forming a chamber for air and water, a water pump connected with the container, and having a piston and a cylinder, a spring adapted to move the piston into the cylinder, a member operatively connected with the piston and depending at a substantially fixed distance therefrom for complete submergence in water, the housing with the container and the member being weighted to approximately density of water, the member and the housing having different inertia resistance to the vertical movements of the surrounding water, the member being thereby adapted to reciprocate the piston in relation to the mine when the latter oscillates under action of waves in a body of water, the pump having valves adapted to admit water into the container when the piston is moved by the spring and to admit water into the cylinder when the piston is moved out by the relative movement between the mine and the floating member.

10. A floating submarine mine comprising a housing for an explosive substance, a closed container in the housing forming a chamber for air and water, a water pump connected with the container, and having a piston and a cylinder, a spring adapted to move the piston into the cylinder, a member in the form of paddles adapted to be fully submerged in water pivotally connected with the piston having inertia and resistance to moving water different from the inertia and resistance of the mine, the member being thereby adapted to reciprocate with the piston in relation to the mine when the latter oscillates under action of waves in a body of water, the pump having valves adapted to admit water into the container when the piston is moved by the spring and to admit water into the cylinder when the piston is moved out by the relative movement between the mine and the member.

LEONID A. DUNAJEFF.