

Nov. 8, 1960

R. W. WALLACE

2,959,124

HYDROSTAT SWITCH FOR A MINE

Filed Oct. 6, 1943

4 Sheets-Sheet 2

FIG. 2.

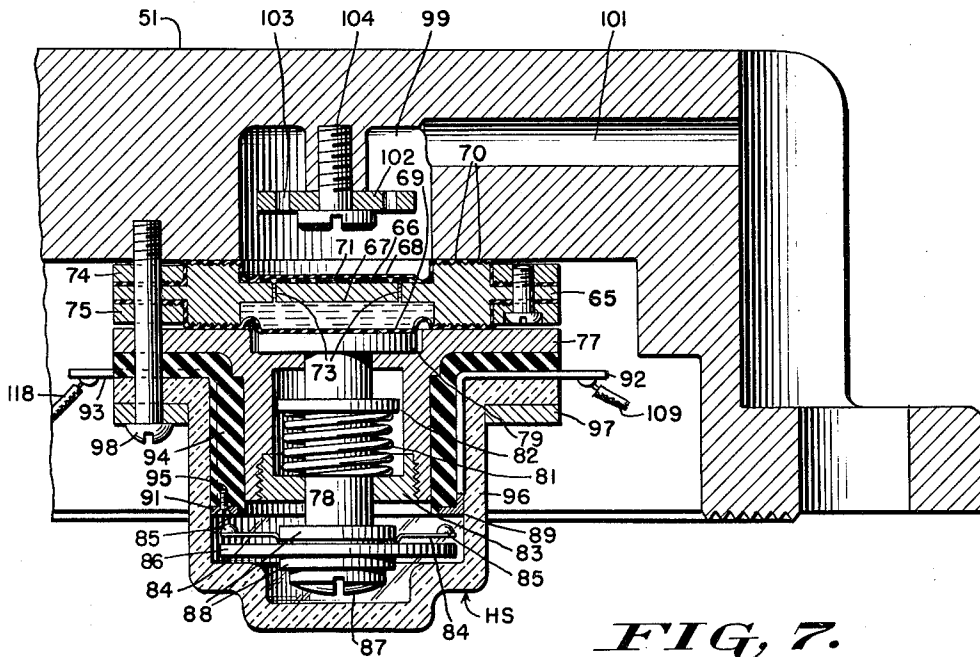
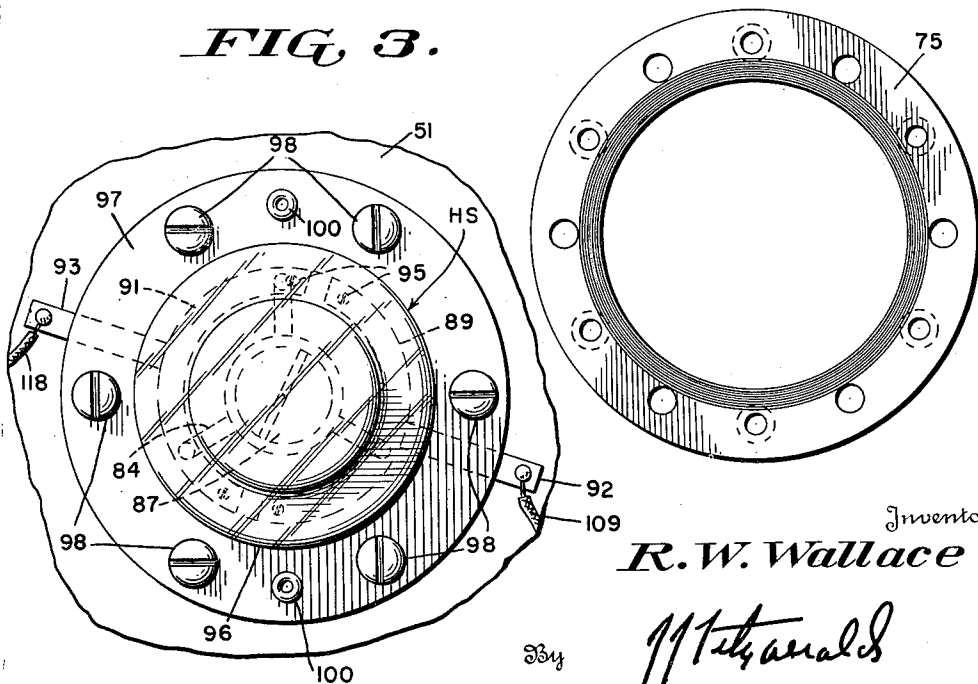


FIG. 3.



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FIG. 4.

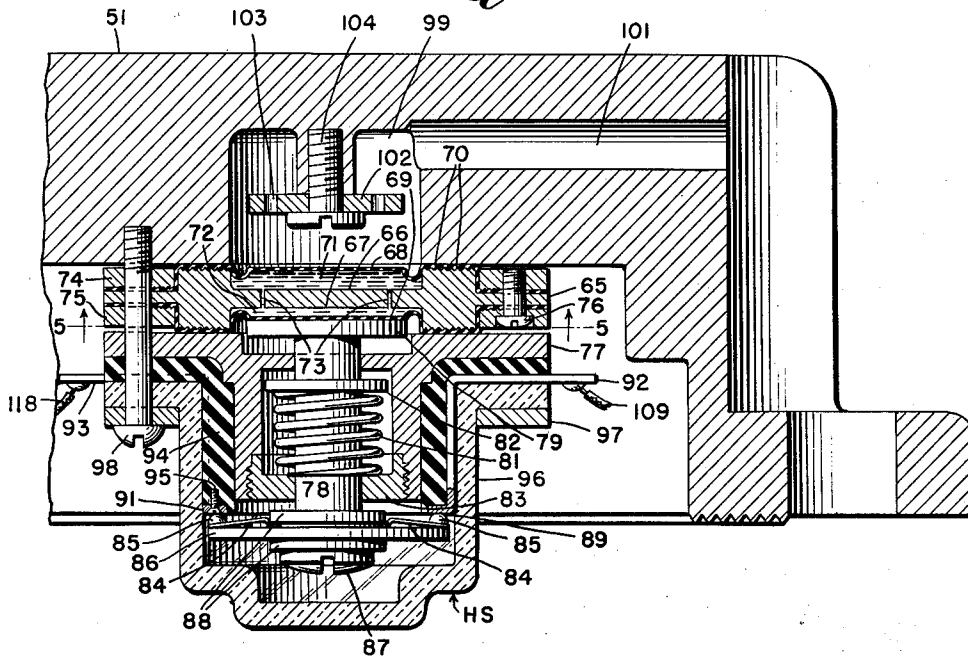


FIG. 5.

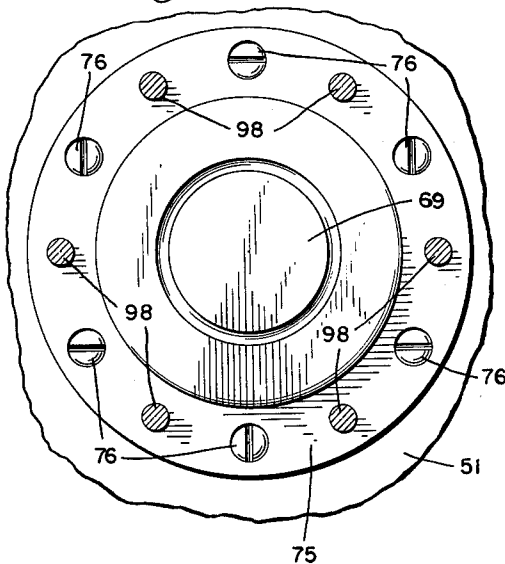
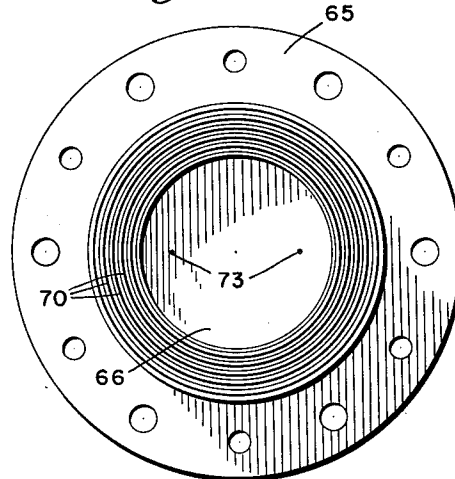


FIG. 6.



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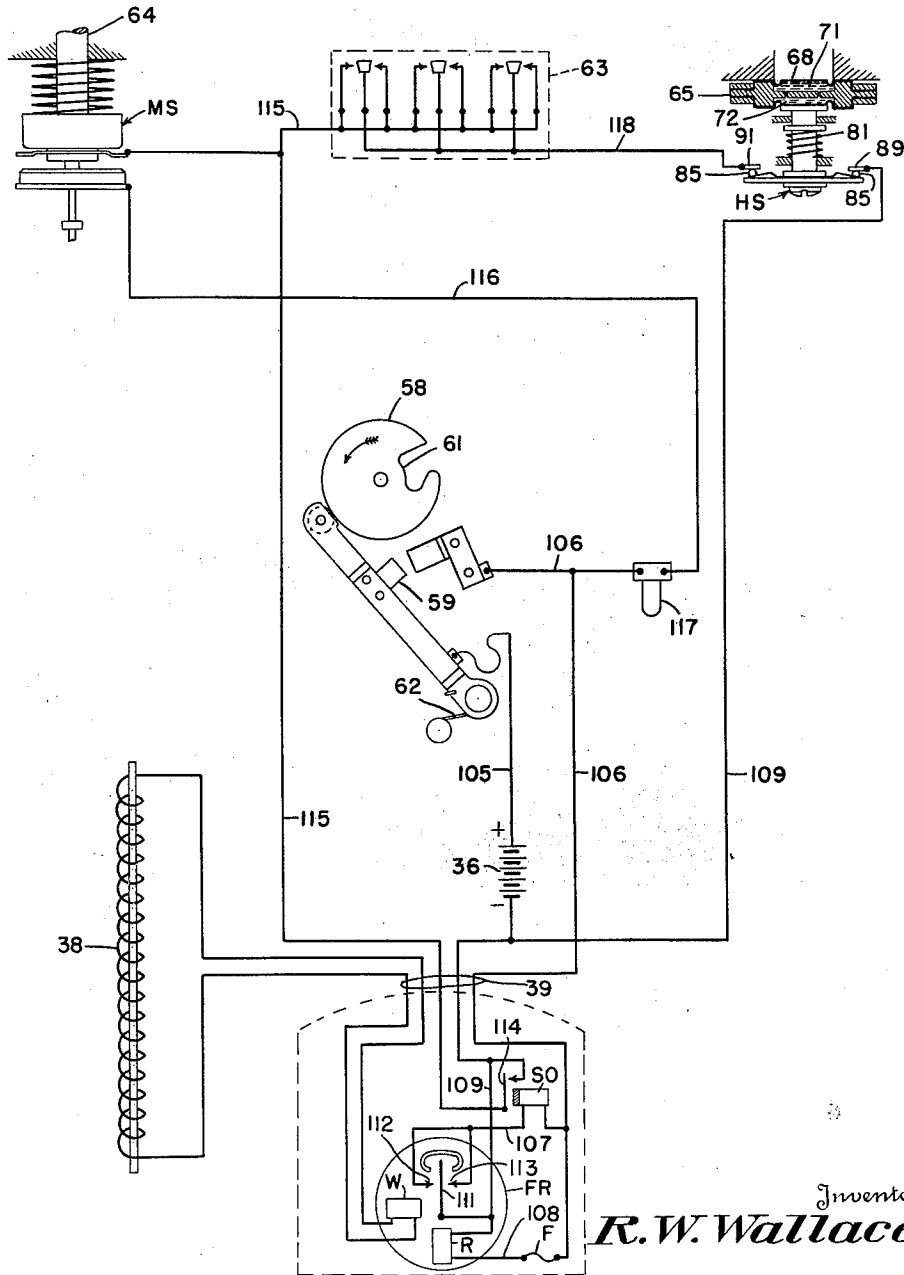
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HYDROSTAT SWITCH FOR A MINE

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4 Sheets-Sheet 4

FIG. 8.



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2,959,124

HYDROSTAT SWITCH FOR A MINE

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12 Claims. (Cl. 102—16)

(Granted under Title 35, U.S. Code (1952), sec. 266)

This invention relates to mechanism for arming and controlling the firing of a marine mine of the type adapted to be planted within a body of water from a mine laying craft such, for example, as an aircraft in flight. More specifically, the invention relates to an arming and firing mechanism for a marine mine in which new and improved means are employed to prevent the premature firing of the mine as the result of movement of a hydrostatically controlled switch in response to variations or impulses of pressure set up in the surrounding water by a counter-mine operation or by the explosion of another mine or depth charge within the vicinity of the mine.

In various types of mines heretofore devised in which means are employed to explode the mine by movement of a hydrostatically controlled switch in response to a reduction of the pressure in the surrounding water as the mine is moved upwardly within the water, it has been found that the mine may be countermined by setting off an explosive charge within the water within the vicinity of the mine thereby creating a wave of pressure in the surrounding water which is followed by a wave of reduced pressure sufficient to fire the mine.

In the arrangement of the present invention the movement of the hydrostatically controlled switch element from a predetermined position in response to sudden variations in the pressure of the surrounding water is greatly reduced by reason of the provision of two chambers connected by relatively small vents or apertures and having a quantity of viscous fluid therein such, for example, as oil, whereby sudden variations in pressure received by a diaphragm enclosing the outer one of the chambers in response to variations in pressure in the surrounding sea water with which the diaphragm is in communication cause the viscous fluid to flow at a relatively slow rate through the apertures from one to the other of the chambers thereby to retard the movement of a second diaphragm closing the other of the chambers. The last named diaphragm is employed to control a slideable rod or plunger having electrical contact elements operatively connected thereto thereby to close an electrical circuit selectively in accordance with the degree of movement of the plunger from determined position thereof.

One of the objects of the present invention is the provision of a new and improved hydrostatically controlled switch adapted to close an electrical circuit in response to a reduction in the pressure of the surrounding water when the reduced pressure of the water has been sustained for a predetermined interval of time.

Another of the objects is the provision of a hydrostatically controlled switch having new and improved means for retarding the movement of the switch actuating element.

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Another object is to provide a new and improved device for causing a marine mine to be exploded as the mine is raised toward the surface of the water in which means are employed for preventing the firing of the mine in response to the wave of reduced hydrostatic pressure immediately following the wave of increased pressure caused by a countermining operation.

A further object consists in the features of design, construction, combination of parts and in the unique relations of the members, and in the relative proportioning and disposition thereof, all as more completely outlined herein.

Still other objects, advantages and improvements will be apparent from the following description taken in connection with the accompanying drawings in which like numerals of reference are employed throughout the several views to designate like parts and in which:

Fig. 1 is a longitudinal sectional view, partly broken away, taken substantially centrally through a mine employing the device of the present invention;

Fig. 2 is an enlarged view in section taken substantially through the center of the device and showing the supporting means therefor;

Fig. 3 is a bottom view of the device of Fig. 2;

Fig. 4 is a view similar to Fig. 2 and showing the switch in closed position;

Fig. 5 is a view taken along the line 5—5 of Fig. 4;

Fig. 6 is a view of the baffle plate employed with the present invention;

Fig. 7 shows one of the clamping rings employed for securing the outer and inner diaphragms to the baffle plate thereby to enclose a quantity of viscous fluid between the diaphragms; and,

Fig. 8 shows in diagrammatic form a circuit arrangement of a system suitable for use with the present invention.

Referring now to the drawings and more particularly to Fig. 1 thereof there is shown thereon a marine mine indicated generally by the numeral 10 comprising a casing 11 adapted to be sealed by a cap 12 secured thereto as by the bolts 13, a gasket 14 being provided preferably to insure a watertight connection between the cap and the casing. The mine is also provided with a plurality of fins 15 adapted to guide the mine along a predetermined line or path of travel as the mine is launched from a mine laying craft. The mine is also provided with a cover 16 secured to the casing of the mine as by the bolts 17 thereby to close an aperture within the casing through which an explosive charge 18 of TNT or the like may be introduced within the casing. A gasket 19 is preferably assembled beneath the cover 16 to prevent leakage or seepage of water within the mine.

The mine is provided with a well 21 having a shoulder 22 adapted to support the arming and firing control mechanism 23 secured thereto as by the bolts 24, a gasket 25 being employed preferably between the control mechanism and the shoulder 22 to effect a watertight connection therebetween. The firing control and arming mechanism 23 is adapted to extend a detonating device into a suitable recess 26 within an explosive booster charge 27 arranged within a container 28 adapted to be disposed within the recessed member 29 comprising the lower portion of the well 21, a resilient member 31 being preferably provided within the bottom of the well to urge the container continuously against the arming mechanism 23. The recessed member 29 is preferably braced to the casing of the mine as by the support 32 thereby additionally to support the recessed member and prevent damage or injury thereto as

the result of the violent shock which is received as the mine strikes the surface of a body of water or lands on terra firma, as the case may be. There is also provided within the casing of the mine a tubular member or cable duct 33 extending between the well 21 and a partition 34, the tubular member having a branch 35 thereon thereby providing an arrangement in which an electrical circuit is established between the firing control mechanism 23, a battery 36, the mine firing mechanism 37 and an induction coil 38 by means of the conductors within the cable 39 arranged within the tubular member.

The induction coil 38 comprises a rod or bar of magnetic material suitable for the purpose such, for example, as a material known in the trade as Permalloy about which is arranged a winding comprising a large number of turns of relatively fine wire and having the ends thereof externally connected to the mine firing mechanism 37 by a pair of conductors within the cable 39. The induction coil 38 is supported at one end thereof by a resilient bushing 41 arranged within the well 42 and at the other end thereof by the resilient bushing 43 arranged within the well 44 secured to the casing 45 within which the battery 36 is arranged. The battery is preferably supported by a resilient pad or cushion 46 disposed within the casing 45 thereby to prevent damage or injury to the battery as the mine is launched. The mine firing mechanism 37 is supported by the resilient cushions or pads 47 and 48 arranged within the trailing end or tail of the mine casing and maintained in the assembled position thereof by the cap 12, the pad 47 having an aperture 49 therein of sufficient size to receive the cable 39.

The firing mechanism 37 may be of any type suitable for the purpose in which a firing circuit from battery 36 to the detonator is closed in response to signals picked up by the induction coil 38 such, for example, as the firing mechanism disclosed and claimed in the copending application of James B. Glennon et al. for Mine Firing Mechanism, Serial No. 406,236, filed August 9, 1941, now Patent #2,881,702.

The arming and firing control mechanism 23 is supported by a cap 51 to which is affixed a detachable bar 52 having one end formed as at 53 to engage the pin 54 and to be retained thereby and provided at the opposite end thereof with an aperture adapted to receive the safety screw 55 threaded within the cap 51, thereby providing an arrangement in which the bar 52 is maintained in the position shown on Fig. 1 by the pin 54 and safety screw until the mine has been placed in position on the aircraft, the bar being securely held in the assembled position by the pin 54 and a projecting member secured to the aircraft in abutting relation to the bar after the safety screw 55 has been removed. As the mine falls away from the aircraft the bar 52 is moved outwardly by a spring actuated plunger slideably arranged within the cap 51 thereby setting in operation an escapement mechanism 56 by movement of the member 57 slideably secured thereto. The escapement mechanism 56 is disclosed and claimed in the copending application of James B. Glennon and Roger W. Wallace for Arming and Firing Control Mechanism For a Marine Mine, Serial No. 458,146, filed September 12, 1942, now Patent No. 2,704,030, issued March 15, 1955. The escapement mechanism 56 comprises a spring driven motor adapted to cause the cam member 58 to be moved rotatably from an initial position to a position in which the arming switch member 59 engages the recessed portion 61 of the cam after sufficient time has elapsed to allow the mine to come to rest on the bed of a body of water within which the mine is planted. When this occurs the switch member 59 is moved to circuit closing position by the resilient spring 62, Figs. 1 and 8, thereby arming the mine, as will more clearly appear as the description proceeds.

The detonating device is moved to an extended position within the recess 26 by the mechanism 56 during

the movement of the cam member 58 from the initial position to the circuit closing or arming position thereof. The arming mechanism 23 includes an inertia switch 63, Fig. 8, of any type suitable for the purpose such, for example, as the inertia switch disclosed and claimed in the foregoing application of James B. Glennon and Roger W. Wallace, Serial No. 458,146, filed September 12, 1942, now Patent No. 2,704,030, issued March 15, 1955. The inertia switch is adapted to close a circuit between a master switch MS and the hydrostat switch HS thereby to render the hydrostat switch effective to destroy the mine in the event that the mine is subsequently raised toward the surface of the water. The details of construction of the master switch MS are set forth with particularity in the foregoing application of James B. Glennon and Roger W. Wallace, Serial No. 458,146, filed September 12, 1942, now Patent No. 2,704,030 and only sufficient details of the structure, therefore, will be described herein to enable one skilled in the art to understand the present invention. The master switch MS is adapted to close a pair of contact elements in response to inward movement of the plunger rod 64, Fig. 8, by the biasing spring illustrated and operatively connected thereto. The plunger rod is released for such movement under control of an arming wire as the mine falls away from the aircraft.

The hydrostat switch HS is shown in the open position and in the closed position thereof on Figs. 2 and 4 respectively of the drawings, the switch comprising, among other elements, a baffle plate 65 having recessed portions 66 and 67 on opposite sides thereof adapted to be enclosed by a pair of flexible diaphragms 68 and 69 respectively and a plurality of concentric annular ridged portions 70 adapted to seal the diaphragms additionally to the baffle plate when the baffle plate is clamped to the cap 51. By enclosing the recessed portions 66 and 67 of the baffle plate in the manner disclosed, a pair of chambers 71 and 72 is provided within which is enclosed a quantity of viscous fluid suitable for the purpose, such, for example, as an oil known in the trade as Unisolv No. 40 and adapted to flow at a relatively slow rate from one to the other of the chambers by reason of the provision of a pair of small orifices 73 within the baffle plate and extending between the chambers thereby to prevent the effective transfer of a sudden pressure impulse from one to the other of the flexible diaphragms enclosing the respective chambers. The flexible diaphragms 68 and 69 are clamped in sealed relation to the baffle plate 65 by a pair of clamping rings 74 and 75 maintained in the assembled position shown on the drawings by a plurality of clamping screws 76.

There is also provided within a support 77 a plunger or rod 78 having an enlarged end 79 adapted to be yieldably urged against the diaphragm 69 by a spring 81 having one end in engagement with a shoulder or collar 82 affixed to the plunger rod and the other end thereof in engagement with the inner end of the bearing support 83 detachably secured in any suitable manner to the support 77 as by threading the parts together.

The plunger 78 is also provided with a flexible contact member comprising a plurality of outwardly extending arms 84 having contact elements 85 respectively arranged thereon, the contact member also including an annular member 86 of insulating material adapted to be clamped to the plunger by the screw 87. The contact member is electrically insulated from the plunger in any suitable manner as by the insulating washers 88. The contacts 85 are adapted to be brought into electrical contact with a pair of arcuate contact members 89 and 91 and thereby establish a circuit connection between the terminals 92 and 93 respectively connected thereto when the switch is in a closed position shown on Fig. 4. The contact members 89 and 91 are secured to a cylindrical member 94 of suitable insulating material as by the screws 95. The cylindrical member 94 is disposed about the

support 77 and enclosed by a cylindrical cover or cap 96 of suitable insulating material such, for example, as a material known in the trade as Lucite.

The cover is secured with a clamping ring 97 having a plurality of clamping screws 98 extending therethrough and adapted to clamp the entire hydrostatic switch assembly to the cap 51 with the flexible diaphragm 68 thereof extending across a recessed portion 99 within the cap and in sealed relation with respect thereto, the switch mechanism being maintained in unitary relationship prior to the assembly thereof with the baffle plate structure in any suitable manner as by the rivets 100. The diaphragm 68 is in communication with the surrounding water by reason of the provision of a plurality of apertures or ducts 101 within the cap 51 extending to the recessed portion 99 thereof. There is also preferably provided a screen or plate 102 having a plurality of apertures 103 therein and secured to the cap 51 as by the screw 104 intermediate the diaphragm 68 and the ducts 101 thereby to prevent foreign bodies or sea growths from interfering with the movement of the diaphragm 68 as the pressure of the surrounding water is varied.

Prior to the launching of the mine, the contacts 85 are maintained continuously connected to the contact members 89 and 91 by the spring 81 which forces the plunger rod 78 outwardly to the position shown on Fig. 4 with the contacts 85 in circuit closing position. As the mine is planted, the pressure of the water upon the outer surface of the diaphragm 68 causes the viscous fluid to flow inwardly through the orifices 73 into the lower or inner chamber 72 thereby causing the rod 78 to be moved inwardly against the force of the spring 81 to the open circuit position shown in Fig. 2 and be maintained in the open circuit position by the pressure of the surrounding water.

When a wave or impulse of hydrostatic pressure such, for example, as may result from a countermining operation or the explosion of another mine within the vicinity of the submerged mine is received and followed by a wave or impulse of reduced pressure in the surrounding water, the pressure of the plunger 78 against the diaphragm 69 causes a flow of fluid from the chamber 72 to the chamber 71. The switch contacts, however, are prevented from closing during this wave of reduced pressure by reason of the restriction to the flow of the fluid from the chambers 72 and 71 through the relatively small orifices 73. When the wave of reduced pressure has passed, the increase in the pressure of the surrounding water causes the plunger rod to be moved again to the fully extended position shown on Fig. 2 with the enlarged end portion 79 thereof in engagement with the support 77.

The operation of the system will best be understood by consideration of Fig. 8 of the drawings on which is shown in diagrammatic form the complete system. Let it be assumed, by way of example, that the mine is launched from an aircraft in flight and that the escapement mechanism 56 has been set in operation thereby to cause the cam member 58 to move rotatively from an initial position into an armed position after sufficient time has elapsed for the mine to come to rest on the bed of the body of water within which the mine is planted. When this occurs the switch member 59 is moved into circuit closing position by the resilient spring 62, the detonator, as heretofore stated, moving to an extended position within the recess 26 of the explosive booster charge concurrently with the movement of the cam 58 to the circuit closing position thereof. As the mine strikes the surface of the water the sudden shock received by the mine causes the inertia switch 63 to operate and establish a circuit connection between the master switch MS and the hydrostat switch HS. The hydrostat switch, however, is opened by the pressure of the water against the diaphragm 68 before the arming switch 59 is moved to circuit closing position and the operation of the inertia switch, therefore, produces no immediate effect upon the firing of the mine.

As the arming switch 59 moves into the closed position after the mine has come to rest, a circuit is completed from the positive terminal of battery 36, conductor 105, contacts of the arming switch 59, conductor 106, winding of the slow operating relay SO, from whence the circuit is continued by way of conductor 107 to the contacts of the firing relay FR, a circuit also being closed from the positive terminal of battery 36 by way of conductor 106, slow acting fuse F, conductor 108, winding of the reset magnet R of the firing relay FR, conductor 109 and thence to the negative terminal of battery 36.

The relay FR is a sensitive relay having an operating winding W adapted to be energized by an electromotive force generated in the induction coil 38 in response to a predetermined change in the magnetic field adjacent thereto. The energization of the reset magnet R of relay FR causes the contact element 111 thereof to be moved to a neutral position intermediate the relay contacts 112 and 113. As the fuse F operates in response to the flow of current therethrough, the circuit to the reset magnet R is interrupted and the contact element 111 is in readiness for operation in response to signals received from the induction coil 38.

When a vessel having a preponderance of magnetic material approaches the mine, the magnetic field adjacent the coil 38 is changed sufficiently to move the armature 111 of relay FR into circuit closing position, thereby causing a circuit to be closed from positive battery by way of conductor 105, contacts of the arming switch 59, conductor 106, winding of relay SO, conductor 107, contact 112 or 113, as the case may be, and contact member 111 of relay FR, conductor 109, and thence to the negative terminal of battery 36, thereby causing relay SO to operate. Relay SO is a slow operating relay by reason of the provision of a copper slug or sleeve about the core of the electromagnet or by reason of dashpot or other suitable time delay mechanism controlled thereby and the relay armature, therefore, does not move into circuit closing position until a predetermined period of time has elapsed after the operating magnet W has been energized. When this occurs, a circuit is closed from negative battery by way of conductor 109, make contact and armature 114 of relay SO, conductor 115, contacts of the master switch MS, conductor 116, detonator 117, conductor 106, contacts of the arming switch 59, conductor 105, and thence to positive terminal of battery 36 thereby firing the detonator and exploding the mine under a vulnerable portion of the vessel by reason of the delayed action of the relay SO.

In the event that the mine, when dropped from an aircraft, lands upon terra firma or upon the surface of a body of water of insufficient depth to cause the hydrostat switch HS to operate and move the contacts thereof to open circuit position, the mine is fired as the arming switch 59 is moved into circuit closing position over the following circuit: Positive terminal of battery 36, conductor 105, contacts of the arming switch 59, conductor 106, detonator 117, conductor 116, contacts of the master switch MS, conductor 115, contacts of the inertia switch 63, conductor 118, contacts of the hydrostat switch HS, conductor 109, and thence to the negative terminal of battery 36.

In the event that the mine should be raised by unauthorized persons toward the surface of a body of water within which the mine has been planted or the mine should be moved into sufficiently shallow water by the action of tidal currents, storms and the like of insufficient depth to maintain the contacts of the hydrostat switch HS open, the closure of the hydrostat switch contacts in response to the continued reduction in the pressure of the water against the flexible diaphragm 68 thereof closes a circuit from the positive terminal of battery 36 by way of conductor 105, contacts of the arming switch 59, conductor 106, detonating device 117, conductor 116, contacts of the master switch MS, conductor 115, con-

tacts of the inertia switch 63, conductor 118, contacts of the hydrostat switch HS, conductor 109, and thence to the negative terminal of battery 36 thereby operating the detonator and exploding the mine. An arrangement is thus provided in which the mine is adapted to be self-destructive in the event that the enemy attempts to recover the mine from the body of water within which the mine is planted or the mine is moved into shallow water of less than a predetermined depth.

In the event that the mine receives a wave or impulse of hydrostatic pressure through the surrounding water followed by a wave of reduced pressure either as the result of a countermining operation or as the result of the explosion of another mine or depth charge within the vicinity of the mine, the contacts of the hydrostat switch HS are prevented from being moved to closed position in response to the wave of reduced pressure following the wave of increased pressure by reason of the provision of the baffle plate 65 between the fluid filled chambers 71 and 72 and the small orifices within the baffle plate which restrict the flow of the fluid from the chamber 72 to the chamber 71 sufficiently to prevent the contacts of the hydrostat switch HS being moved to a closed position by the spring 81.

Briefly stated in summary, the present invention contemplates the provision of new and improved mechanism for causing a mine to explode as the mine is moved toward the surface of the water in which means are employed to prevent the premature explosion of the mine in response to a wave of reduced pressure set up within the surrounding water by a countermining operation or by the explosion of another mine or depth charge within the vicinity of the mine.

While the invention has been described with respect to a particular example thereof which gives satisfactory results, it will be understood by those skilled in the art to which the invention pertains, after understanding the invention, that various changes and modifications may be employed without departing from the spirit and scope of the invention and it is my intention, therefore, in the appended claims to cover all such changes and modifications.

The invention herein described and claimed may be manufactured and used by or for the Government of the United States of America for governmental purposes without payment of any royalties thereon or therefor.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A hydrostatically controlled switch mechanism of the character disclosed comprising a casing, means including a baffle member secured to said casing and forming a pair of chambers therein, a flexible diaphragm in communication with the surrounding water and enclosing one side of one of said chambers, a second flexible diaphragm enclosing one side of the other one of said chambers, a quantity of viscous fluid disposed within said chambers, port means disposed within said baffle member for effecting the gradual transfer of the fluid from said one to the other one of said chambers selectively in accordance with the difference in pressure of the fluid within each of the said chambers, means including a spring actuated plunger device in engagement with said second diaphragm for applying pressure yieldably to said second diaphragm in opposition to the pressure of the surrounding water applied thereto through said fluid, and normally closed circuit closing means operatively connected to said pressure applying means and adapted to be moved to an open circuit position in response to a predetermined increase in the pressure of the surrounding water.

2. A hydrostatically controlled switch mechanism of the character disclosed comprising a flexible diaphragm in communication with the surrounding water, a baffle plate having a pair of oppositely disposed recessed portions therein, means for securing said flexible diaphragm in sealed relation to said baffle plate thereby to enclose one

of said recessed portions, a second flexible diaphragm, means for securing said second diaphragm to the baffle plate thereby to enclose the other of said recessed portions, a quantity of viscous fluid enclosed within said recessed portions by said flexible diaphragms, means within the baffle plate for effecting the gradual transfer of the fluid from one recessed portion to the other of the recessed portions selectively in accordance with the difference in pressures respectively applied to each of said diaphragms, means for yieldably applying a predetermined pressure to said second diaphragm in opposition to the pressure of the surrounding water applied thereto through said fluid, and a circuit controlling device operatively connected to said pressure applying means and adapted to be actuated thereby to a circuit closing position and to an open circuit position selectively in accordance with a predetermined decrease and a predetermined increase respectively in the pressure of the surrounding water.

3. A hydrostatically controlled device of the character disclosed comprising a casing, a baffle member secured to said casing, means on said casing and baffle member for forming a pair of fluid filled chambers within the casing, a flexible diaphragm in communication with the surrounding water, one of said fluid filled chambers being enclosed by said diaphragm, a second diaphragm, the other one of said fluid filled chambers being enclosed by said second diaphragm, port means disposed within the baffle member for effecting the gradual transfer of the fluid from said one to the other one of said chambers selectively in accordance with the difference in the pressure applied to each of said diaphragms, a plunger in abutting relation with said second diaphragm and controlled thereby, means including a resilient device adapted to urge the plunger yieldably toward said second diaphragm thereby to apply a predetermined pressure to the fluid within said second chamber in opposition to the pressure of the surrounding water applied thereto by said first named diaphragm, and a switching device adapted to be operated by said plunger.

4. A hydrostatically controlled switch mechanism comprising a flexible diaphragm in communication with the surrounding water, a casing, means on said casing and including a baffle member secured thereto for forming a chamber within the casing and enclosed by said diaphragm, a second flexible diaphragm, means on said baffle and casing for forming a second chamber within the casing and enclosed by said second diaphragm, a quantity of viscous fluid within said chambers, a plurality of ports disposed within said baffle member for effecting the gradual transfer of the fluid from one to the other of said chambers in response to a difference in pressure of the fluid respectively disposed therein, means including a slideable rod for applying a predetermined pressure to said second diaphragm in opposition to the pressure of the surrounding water applied thereto through said fluid, and a normally closed switch element operatively connected to said slideable rod and adapted to be moved to open circuit position in response to a predetermined degree of pressure of the surrounding water continuously applied to the first named flexible diaphragm, said switch element being adapted to be moved to circuit closing position in response to a predetermined decrease in the pressure of the surrounding water when said decrease in pressure has been maintained for a predetermined period of time.

5. In a hydrostatically controlled mechanism of the character disclosed, the combination of a flexible diaphragm in communication with the surrounding water, a second flexible diaphragm, means for enclosing a quantity of viscous fluid between said diaphragms, moveable switching means, a moveable element in engagement with said second diaphragm for supporting said switching means in different positions variably in accordance with the degree of movement of said moveable element, means including a resilient device for yieldably urging said moveable element against said second diaphragm thereby to apply pressure yieldably to said fluid in opposition to the

pressure of the surrounding water applied thereto by said first named diaphragm, said last named means being adapted to maintain the switching means in an initial position when the initial pressure of the surrounding water against the first named diaphragm is less than a predetermined value and to maintain the switching means in a moved position when the pressure of the surrounding water against the first named diaphragm is continuously maintained greater than a second predetermined value, and means including a baffle plate for retarding the movement of said second diaphragm in response to variations in pressure of the surrounding water against said first named diaphragm.

6. In a hydrostatically controlled device of the character disclosed, in combination, two fluid filled chambers, a pair of volume displacing devices respectively enclosing said chambers, means for applying pressure externally and yieldably to one of said volume displacing devices in a direction to decrease the volume of the fluid in the chamber associated therewith, means for applying the pressure of the surrounding water to the other of said volume displacing devices in a direction to decrease the volume of the fluid in the chamber associated therewith, and means for interconnecting the fluid in said chambers whereby said pressures are applied in opposition to each other through the fluid, said last named means being adapted to delay the transfer of fluid from one to the other of the chambers in response to variations in the pressure of the surrounding water sufficiently to prevent substantial movement of the volume changing devices in response to waves of reduced pressure set up within the surrounding water.

7. A hydrostatically controlled switch mechanism for a mine adapted to be submerged within a body of water, a casing for said mine having a duct therein in communication with the surrounding water, a well within said casing in communication with said duct, a flexible diaphragm in communication with the surrounding water through said well and duct, means including a baffle plate for sealing said diaphragm to the casing thereby to enclose one end of said well, said baffle plate having a chamber therein enclosed by said diaphragm, a second flexible diaphragm, a second chamber within said baffle plate enclosed by said second diaphragm, a quantity of viscous fluid within said chambers, said chambers being adapted to transfer said fluid therebetween, means for yieldably urging said second diaphragm inwardly with respect to said second chamber and adapted to apply a predetermined pressure to the fluid within the second chamber in opposition to the pressure of the surrounding water applied thereto by said first named diaphragm, a normally closed contact device adapted to be moved to open position when a predetermined quantity of fluid has been transferred from the first named chamber to said second chamber by the pressure of the surrounding water, and means for retarding the transfer of fluid from said second chamber to said first named chamber sufficiently to prevent substantial movement of said contact device in response to a wave of reduced pressure within the surrounding water.

8. In a pressure controlled switch mechanism of the character disclosed, a casing, means including a baffle member secured to said casing for forming a chamber within said casing, means responsive to changes in said pressure for varying the size of said chamber, said baffle member and casing having means thereon for forming a second chamber within the casing, a moveable element disposed within said second chamber for varying the size of said second chamber as said element is moved in response to a predetermined amount of pressure applied thereto, a quantity of viscous fluid disposed within each of said chambers, means including a slideable rod and a coil spring sleeved thereon for yieldably applying said predetermined pressure to said moveable element in opposition to said first named pressure applied thereto through

said fluid, a switching device on said rod adapted to be moved to circuit closing position and to open circuit position selectively in accordance with the quantity of fluid within said second chamber, and port means arranged within said baffle member for effecting the gradual transfer of fluid from one to the other of said chambers in response to variations in said pressure.

9. In a pressure controlled switch mechanism of the character disclosed, the combination of a moveable member responsive to variations in said pressure, a second moveable member, fluid means interconnecting said members whereby the members are moved synchronously to different settings in response to variations in said pressure, means operatively connected to said second member for applying pressure to said fluid yieldably in opposition to said first named pressure thereon, and means for retarding the flow of said fluid sufficiently to prevent substantial movement of said moveable members in response to sudden variations in said pressure.

10. A submarine mine of the character disclosed adapted to be released from an aircraft in flight, an explosive charge arranged within said mine, a detonating device, means for extending said detonating device within the explosive charge as the mine falls away from the aircraft, a source of electrical power, an arming switch adapted to connect said detonating device to one terminal of said source of electrical power when sufficient time has elapsed for the mine to come to rest on the bed of a body of water, means for operating said arming switch, a firing circuit for connecting the detonating device to the other terminal of the source of electrical power, a hydrostatically controlled switch within said firing circuit adapted to maintain the firing circuit continuously interrupted while the pressure of the surrounding water equals or exceeds a predetermined value, and means on said hydrostatic switch for closing said firing circuit when the pressure of the surrounding water has decreased beyond said predetermined value for a predetermined period of time, said last named means being adapted to prevent closure of the firing circuit by said switch in response to a wave of reduced hydrostatic pressure less than said predetermined value.

11. In an arming device of the character disclosed for a submarine mine adapted to be released from an aircraft in flight, an explosive charge arranged within said mine, a detonating device adapted to explode said explosive charge, a source of electrical power, an arming switch adapted to be closed when sufficient time has elapsed for the mine to come to rest on the bed of a body of water, means for operating said arming switch, a firing circuit for said detonating device adapted to be closed in part by said arming switch, an inertia switch within said firing circuit having contact elements adapted to be closed as the mine strikes the surface of the water, a hydrostatically controlled switch having means for closing said firing circuit in response to a reduction in pressure of the surrounding water to at least a predetermined value when the reduced pressure has been sustained for a predetermined period of time, and means on said switch for preventing the closing of said firing circuit in response to a wave of reduced pressure within the water equal to or less than said predetermined value.

12. In an arming device for a submarine mine adapted to be released from an aircraft in flight, an explosive charge arranged within said mine, a detonating device adapted to explode said explosive charge, a source of electrical power, an arming switch, means for closing said arming switch when sufficient time has elapsed for the mine to come to rest on the bed of a body of water, a circuit for firing said detonating device by power from said source, an inertia switch within said firing circuit having contacts adapted to be closed as the mine strikes the surface of the water, a hydrostatically controlled switch in series with said inertia switch and included within said firing circuit for maintaining the firing circuit

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continuously interrupted while the pressure of the surrounding water equals or exceeds a predetermined value, means on said hydrostatically controlled switch for closing said firing circuit in response to a reduction in pressure of the surrounding water to a predetermined value when the reduced pressure has been sustained for a predetermined period of time and for preventing closure of the firing circuit when the reduced pressure has been sustained for less than said predetermined period of time.

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