H. G. DORSEY.

SUBMARINE MINE.

APPLICATION FILED DEC 14, 1915.

1,390,768.

Patented Sept. 13, 1921.

3 SHEETS—SHEET 1.

Fig. 1.

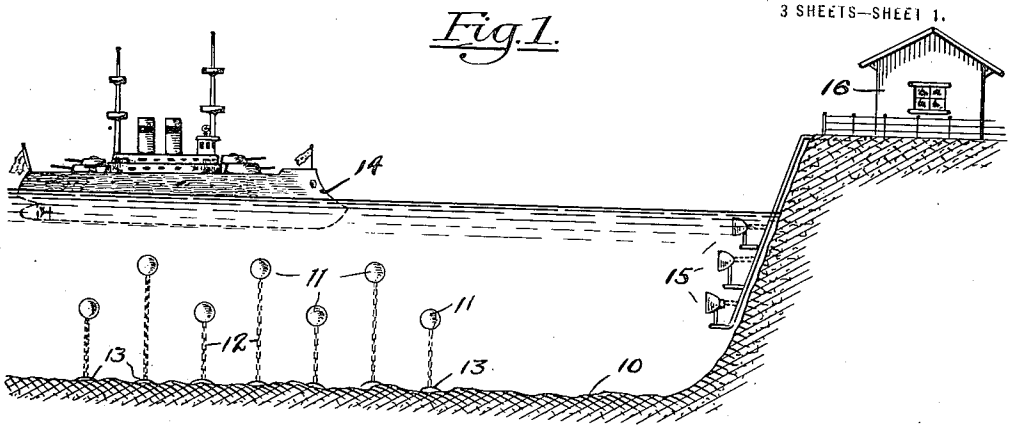


Fig. 2.

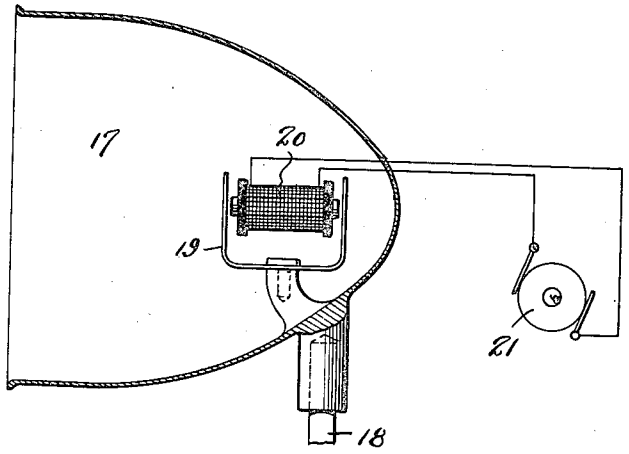
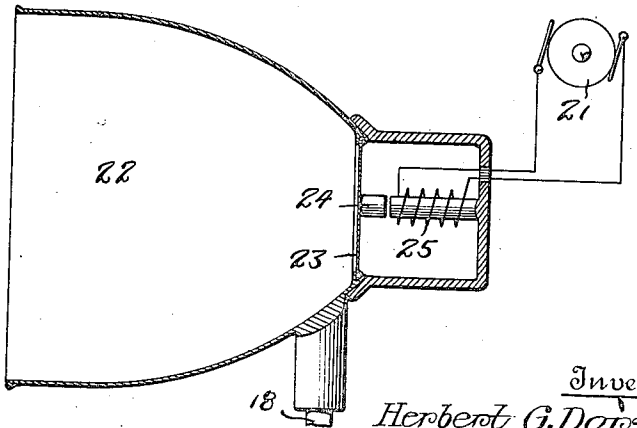


Fig. 3.



Witness:-

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3 SHEETS—SHEET 2.

Fig. 4.

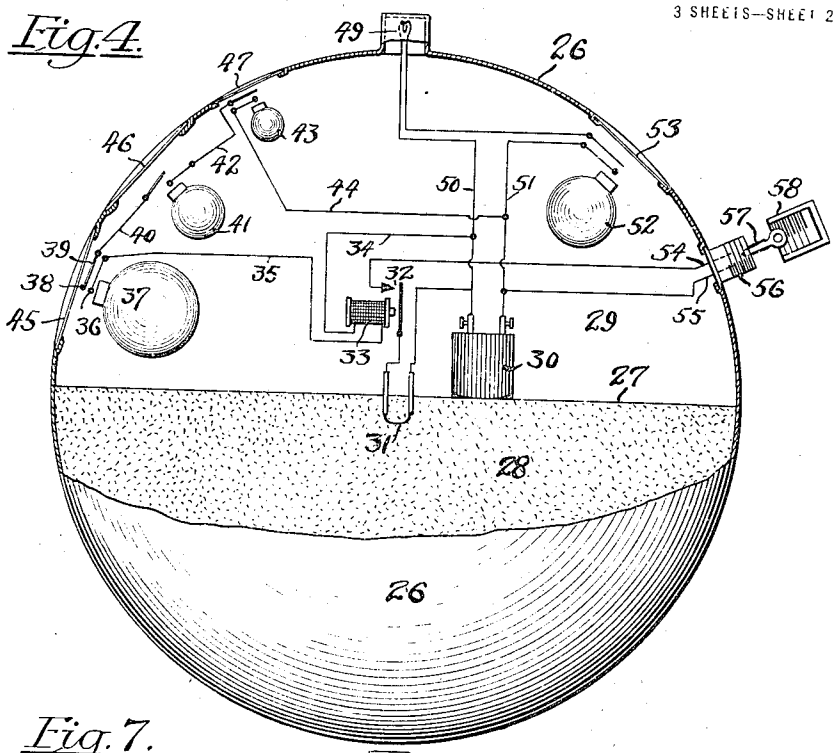
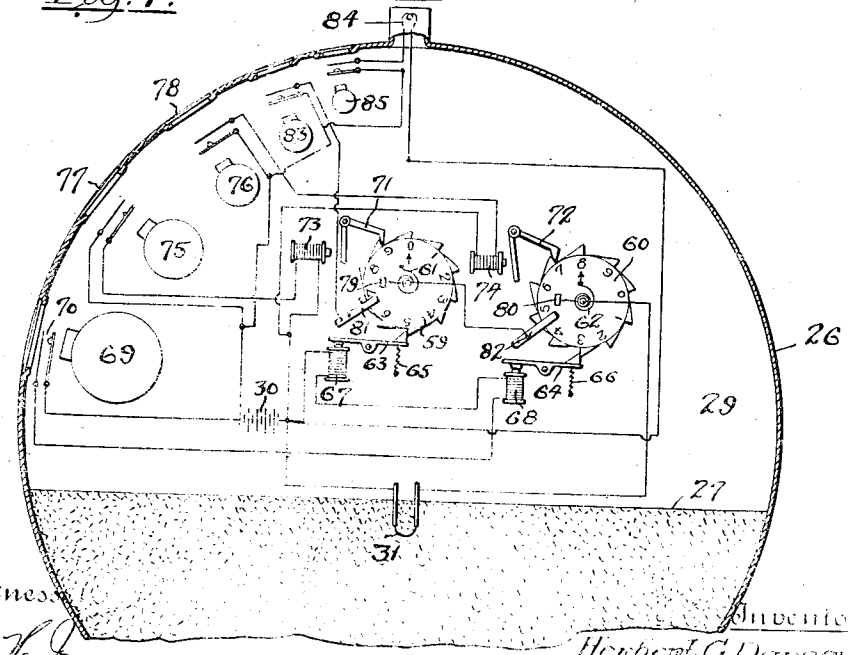


Fig. 7.



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3 SHEETS—SHEET 3.

Fig. 8.

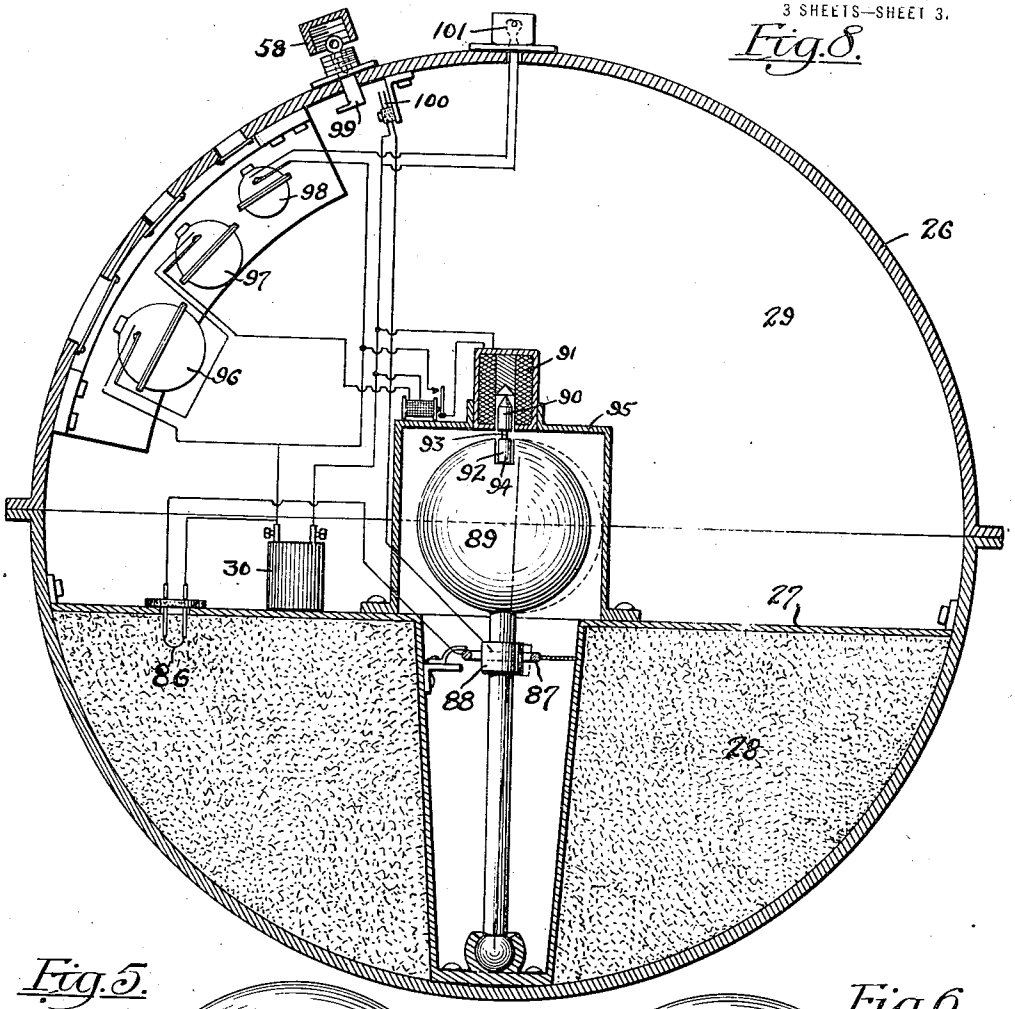


Fig. 5.

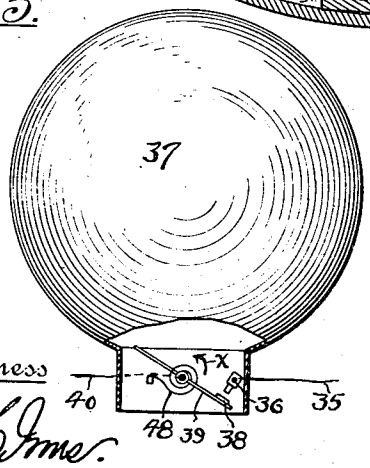
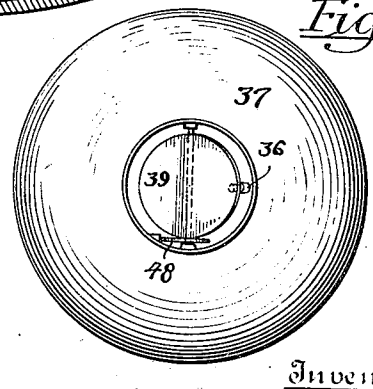


Fig. 6.



Witness

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UNITED STATES PATENT OFFICE.

HERBERT GROVE DORSEY, OF DAYTON, OHIO.

SUBMARINE MINE.

1,390,768. Specification of Letters Patent. Patented Sept. 13, 1921.

Application filed December 14, 1915. Serial No. 66,881.

To all whom it may concern:

Be it known that I, HERBERT GROVE DORSEY, a citizen of the United States of America, and residing at Dayton, in the county of Montgomery and State of Ohio, have invented a certain new and Improved Submarine Mine, of which the following is a specification.

My invention relates to submarine mines and particularly to mines having a mechanism for the explosion thereof which may be controlled from a distance by means of submarine pulsations generated in any suitable way.

In the accompanying drawings,

Figure 1 is a diagrammatic section of a harbor provided with a series of mines in which my invention is embodied and a pulsating control-device operated from the shore;

Fig. 2 is a broken elevation of a pulsating control-device drawn to a larger scale;

Fig. 3 is a broken elevation of a modified form of control-device;

Fig. 4 is a vertical section through a mine in which my invention is embodied more or less diagrammatically;

Figs. 5 and 6 are respectively broken section and end elevation on a larger scale of a resonator used in the mine illustrated in Fig. 4;

Fig. 7 is a vertical section through a mine of modified construction; and

Fig. 8 is a vertical section through a mine embodying a further modification.

The devices illustrated in Figs. 1 to 7 inclusive relate to mines particularly adapted for harbor or channel use, the explosion of which is controlled from a shore station. In mines of this character now in general use the customary practice is to provide each mine with electrical exploding connections which are led from the mine to a suitable point of control on shore. This method of controlling mines however, is subject to great uncertainty by reason of the fact that the cables which carry the electric wires are likely to become defective either through the chemical action of the water in which they are placed, or by the destructive action of the various animal organisms which exist in the water or by being broken by the continual flexion to which they are subjected by the action of the waves and water currents in the harbor or channel in which the mines are placed. No satisfactory way of overcoming these difficulties has yet been found which will render the mines free from these dangers of deterioration in their control connections after the mines have been set for a few weeks. Moreover, it is an extremely difficult matter, as well as a dangerous matter, to reëstablish these connections to the mine.

By my invention I provide a mine which may be quickly set and which requires no firing connection to the shore, while on the other hand it possesses a firing mechanism not subject to deterioration or injury, but which may be accurately controlled from the shore by means of pulsations or vibrations imparted to the water. While these pulsations may be generated in various ways, I prefer an electrically operated pulsator and I have illustrated the invention with this particular type, although it is to be clearly understood that my invention is not limited thereto.

Referring to Fig. 1, the harbor 10 is protected by a series of buoyant mines 11 held submerged at a suitable level by chains 12 and anchors 13. The depth at which the mines are submerged is preferably below the draft of the vessels 14 likely to use the harbor or channel. The exploding mechanism of these mines, which will be hereinafter explained, is controlled by submerged pulsating mechanism 15 operated from a suitable station 16 on the shore. This pulsating mechanism may comprise a plurality of submerged horns 17 each mounted (see Figs. 2 and 3) on pivot 18 so that it may be turned in any particular direction to direct and concentrate its pulsations toward a particular mine or group of mines in the channel or harbor. The pulsations are, in Fig. 2, generated by means of a tuning fork 19 between the arms of which is arranged an exciting electro-magnet 20 through which an alternating or interrupted direct current is passed from a suitable source 21 controlled at the station 16. The frequency of the interrupted or alternating current of course controls the rapidity of the vibration of the tuning fork 19 and consequently the frequency of the pulsations emanating from the horns.

In Fig. 3 the pulsator comprises a horn 22 having at its small end a diaphragm 23 carrying a magnetic boss 24. This boss is sub-

jected to the influence of the solenoid coil 25 which is energized by an interrupted or alternating current from the generator 21.

The pulsations imparted to the water by the control device 15 are transmitted to a distance through the water in well understood manner and they are of sufficient strength to reach all parts of the mine field. Here they are received by the mines and operate the control mechanisms thereof.

These control mechanisms may be of any suitable sort adapted to be operated by pulsations of the character described. The mechanism here shown has as its basis a Helmholtz resonator combined with a Rayleigh disk or shutter. As Helmholtz discovered, the air in a bottle-like container such as shown in Figs. 5 and 6, will respond to and reinforce sound waves of certain definite frequencies and no other. Lord Rayleigh in his "*Theory of Sound*," volume 2, page 44 (2nd edition), shows that a light thin disk or shutter pivoted on a transverse axis in the mouth of a Helmholtz resonator and lying at an angle of about 45° to the axis of the resonator tends to rotate in a direction to close the mouth of the resonator when the latter is stimulated by the reception of pulsations of proper frequency.

Referring now to Fig. 4, the pulsations imparted to the water by the control device 15, above described, are received at the mine 26. In the form here shown, the mine comprises a casing, the interior of which is divided by a partition 27 into a chamber 28 for the reception of the explosive charge and a chamber 29 above it in which the exploding mechanism is arranged. This mechanism comprises a battery 30 of any suitable type having sufficient strength to operate the detonator 31 arranged in the explosive in the chamber 28. The circuit through the detonator 31 is normally interrupted at the armature 32 of the solenoid 33, but is adapted to be closed by the action of the solenoid when the latter is energized. The solenoid energizing circuit comprises a lead 34 from the battery connected to the solenoid winding and passing thence at 35 to a terminal contact 36 at a Helmholtz resonator 37 mounted in any suitable manner in the chamber 29. A coöperating contact 38 is carried by a Rayleigh shutter 39 arranged at the mouth of the resonator. This contact 38 leads the current through the axis of the shutter to the terminal of a lead 40 which in like manner extends to a second resonator 41 with a like arrangement of contacts and from which a lead 42 carries the circuit to a third resonator 43 from which the circuit is completed through the lead 44 to the other battery terminal.

Obviously the circuit through the solenoid 33 is not completed until the open contacts at each resonator 37, 41 and 43 are closed. In order to close these contacts, diaphragms 45, 46 and 47 are respectively arranged in the wall of the chamber 29 in predetermined relationship to the several resonators, each diaphragm being of a size such that it responds most readily to pulsations of a predetermined frequency adapted to stimulate corresponding vibrations in its associated resonator. When the air inside the resonator is set in motion, the shutter, pivotally arranged transversely of the mouth of the resonator, tends to rotate on its axis in a direction to close the mouth of the resonator. Consequently the contact 38, carried by the shutter 39 is moved in a direction to bring this contact 38 into engagement with the terminal 36 from the lead 35. If, at the same time the diaphragm 46 is set in motion by pulsations of proper frequency, the resonator 41 also becomes responsive and its shutter closes the open contact at that point, thus completing the circuit to the lead 42. Similarly, if the diaphragm 47 is set in motion by vibrations of proper frequency, the resonator 43 responds, closing the open contact at its mouth so that the circuit from one battery pole to the other battery pole is completed through the solenoid 33. This results in the closing of the armature contact 32 and the detonator 31 is consequently exploded and the charged fired.

It is obviously possible to use but a single resonator 37, if the situation is such as to permit of this. Where a large number of mines are used however, it is necessary to use a plurality of resonators of different frequencies in each mine in order to afford different "combinations," each of which is effective for only a single mine or group of mines in the mine field.

In Figs. 5 and 6 I have shown on a larger scale one of the resonators, for example, 37. The lead 35 is connected to the stationary terminal 36, while the terminal 38 is carried by the shutter 39. This is normally held in out-of-contact position by the coil spring 48, but when the air in the resonator is set in motion, the shutter tends to rotate in the direction of the arrow x, thus bringing the contacts 36 and 38 together and closing the circuit at this point. The several resonators are all of like construction, though of different frequencies, and need not be individually explained.

As an auxiliary feature of the mine, I provide a signal lamp 49 arranged in the circuit 50, 51, from the battery, the circuit being normally open at the mouth of the resonator 52. It is closed however when the resonator responds to the vibrations of the diaphragm 53 and its frequency is of course different from that of any of the resonators used to control the detonator circuit.

As a precautionary measure, enabling the mine to be handled with safety until it is

about to be placed in position, I have provided a pair of open contacts 54 and 55 in the detonator circuit. These contacts are arranged at the opening of a screw nipple 56 on the side of the mine and are in such proximity that they may be closed by the insertion of a detachable plug 57. This plug need not be placed in position until the mine is about to be dropped overboard from the mine layer. The plug 57 is then inserted and a screw cap 58 is turned down on the nipple 56 to hermetically seal the opening.

A modified arrangement is shown in Fig. 7. In the construction above described it is obvious that in order to fire the mine it is necessary to have the several diaphragms of the mine operated by pulsations of proper frequency simultaneously in order to close the solenoid circuit. It may be desired to use but a single resonator to fire a field of mines, while at the same time providing each mine with selective mechanism by which only a particular one or group shall be fired at a given moment. To this end the mechanism illustrated in Fig. 7 may be utilized. Two ratchet wheels 59 and 60 are here employed, each being held in normal position by its spring 61, 62. Detaining pawls 63 and 64 are normally held out of engaging position by their respective springs 65 and 66, but are drawn into engagement with the ratchet wheels by the electro-magnets 67 and 58, upon the energization of the latter. This energization may be accomplished from the battery 30 by the response of the resonator 69 to pulsations of proper frequency closing the solenoid circuits at 70 in the same manner as heretofore explained.

While the detent pawls 63 and 64 are maintained in engaging position, the ratchet wheels 59 and 60 are now operated by means of pawls 71 and 72, each in the form of a bell crank lever, one arm of which is subject to the action of an electro-magnet 73 or 74. The circuits of these magnets are independently controlled by the resonators 75 and 76, the open contacts of which are closed only when pulsations of proper frequency are received by their respective diaphragms 77 and 78. Each ratchet wheel carries a contact 79, 80, adapted to coöperate with a stationary contact 81, 82, in the detonator circuit. Upon each successive energization of the solenoid 73 or 74, the ratchet wheels 59 and 60 are advanced one step by their respective pawls 71 and 72. Consequently by suitably locating the contacts 79 and 80 on the ratchet wheels and advancing the latter step by step through a predetermined number of intermittent transmissions from the control station of pulsations of proper frequency, the ratchets 59 and 60 will be rotated to proper position to bring the contacts 79 and 80 thereon into engagement with the stationary contacts 81 and 82. When these contacts are in engagement, the detonator circuit is completed at these points. It is still open however at the resonator 83 and this resonator must respond to pulsations of proper frequency to close its contacts before the detonator circuit is completed and the mine thus fired.

It is obvious that by using two ten point ratchet wheels and their corresponding resonators 75 and 76, it is possible to control any number of mines from 1 to 100 within a given area. By the use of a third ratchet and another resonator any number of mines up to one thousand could be controlled. In this type of mine also I have provided a lamp 84 which may be lighted by closing its circuit at the resonator 85, in like manner as above described.

The mines so far explained are of a type adapted to be exploded from a distant station. The same principle of control however may be applied to a contact mine to render it safe to vessels having suitable safety apparatus aboard and being advised as to the safety "combination" of the mine field. This is illustrated in Fig. 8. In this mine the detonator 86 is fired by the battery 30 when the circuit is closed between the contacts 87 and 88. As seen from the drawing, the contact 87 is in the form of a ring surrounding but spaced from the pendulum 89 which carries the contact 88. As soon as the pendulum is freed, it falls to one side or the other and the contact 88 thereon engages the ring 87 and completes the detonator circuit. The pendulum 89 however is normally restrained from movement by the solenoid core 90 which drops by gravity from its position within the winding 91 into the well 92 in the head of the pendulum. This core is provided with a weakened portion 93 which is strong enough to hold the pendulum from swinging under wave action, but is weak enough to be ruptured when the mine is struck by a ship, thus permitting the pendulum to swing over and complete the detonator circuit at 87—88. The relation of the parts is such however that when the solenoid core 90 is drawn up into the winding 91, the heavy end 94 of the core extends between the mouth of the well 92 and the frame 95 and thus affords a rigid support for the pendulum which is not in danger of being ruptured even in case the mine is struck by a passing ship. Consequently, if the passing ship possesses means for energizing the coil 91 so that the core 90 is drawn up into its safety position, the ship may contact with the mine without danger to itself.

The means for drawing the core into safety position resemble the control devices above described in connection with Figs. 1 to 7. In other words, the resonators 96 and

97 which are arranged in the mine in series in the circuit of the controlling relay of the solenoid winding 91 from the battery 30 may be actuated by a suitable pulsating mechanism on the ship, such as that above described for use from a shore station. Pulsations of the proper frequencies are discharged into the water from the ship to close the solenoid circuits of any mines in the vicinity thus drawing their cores 94 up into safety position as the ship passes through the mine field. Obviously an enemy ship pursuing through the mine field and not possessing the mechanism for energizing or knowledge of the safety "combination" for the solenoid circuits 91, would be destroyed upon contact with a mine since as soon as the fleeing vessel passes out of the vicinity of the mine, the core 90 returns to its normal position and the weakened portion 93 affords the only support for the pendulum.

In this mine as well as in the others above described I have provided a plug or key device 99 for closing contacts 100 in the detonator circuit when the mine is laid. Also a discovery light 101, adapted to be lighted when the resonator 98 is set in motion.

The details of constructions above described are merely illustrative embodiments of my invention and variations will readily occur to those skilled in the art without departing from what I claim as my invention.

I claim as my invention:—

1. A submarine mine having an explosive charge and control mechanism associated with the mine, said control mechanism being operatively responsive only to a plurality of series of vibrations of predetermined frequencies imparted to the water of submergence, the vibrations of each series having a different frequency and comprising a plurality of associated vibratory diaphragms exposed to the water of submergence and respectively tuned to respond most readily to submarine vibrations of predetermined different frequencies.

2. A submarine mine having an explosive charge, and control mechanism associated with the mine, said control mechanism comprising a source of electric energy and a circuit therefrom, contacts in said circuit, a plurality of resonator mechanisms controlling said contacts and operative only when subjected to vibrations of predetermined different frequencies for the different resonators, and means exposed to the water of submergence and serving to impart to the resonators submarine vibrations.

3. A submarine mine having an explosive charge and control mechanism contained within the mine, said control mechanism comprising a source of electric energy and a circuit therefrom, contacts in said circuit, a plurality of resonator mechanisms controlling said contacts and operative only when subjected to vibrations of different predetermined frequencies and means exposed to the water of submergence serving to impart to the resonator mechanism submarine vibrations.

4. In a submarine mine system, a mine field comprising mines, each mine having associated control mechanism responsive only to a series of vibrations of predetermined different frequencies imparted to the water of submergence, in combination with means for generating such submarine vibrations.

5. In a submarine mine system, a mine field comprising mines, each mine having associated control mechanism responsive only to a series of vibrations of predetermined different frequencies imparted to the water of submergence, in combination with means for generating such submarine vibrations, and means for controlling said vibrations principally in a given area.

6. In a submarine mine system, a mine field comprising mines, each mine having associated control mechanism responsive only to a series of vibrations of predetermined different frequencies imparted to the water of submergence, in combination with means for generating such submarine vibrations, and means for directing said vibrations in different directions and concentrating the same principally in a given area.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses.

HERBERT GROVE DORSEY.

Witnesses:

OTTERBEIN L. CREAGER,

G. C. EDGETIO.