G. F. ATWOOD.

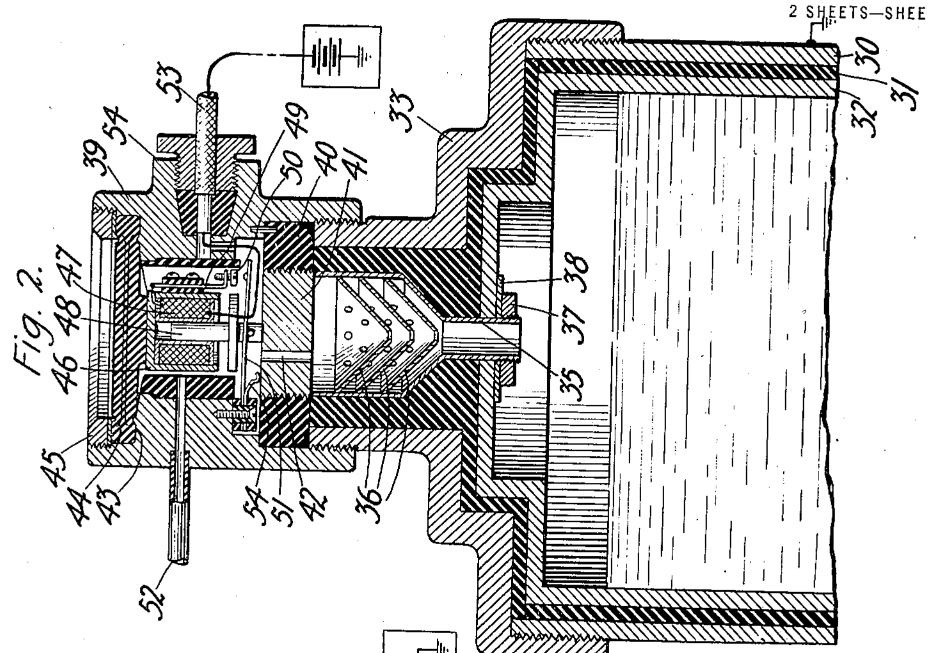
SUBMARINE SIGNALING.

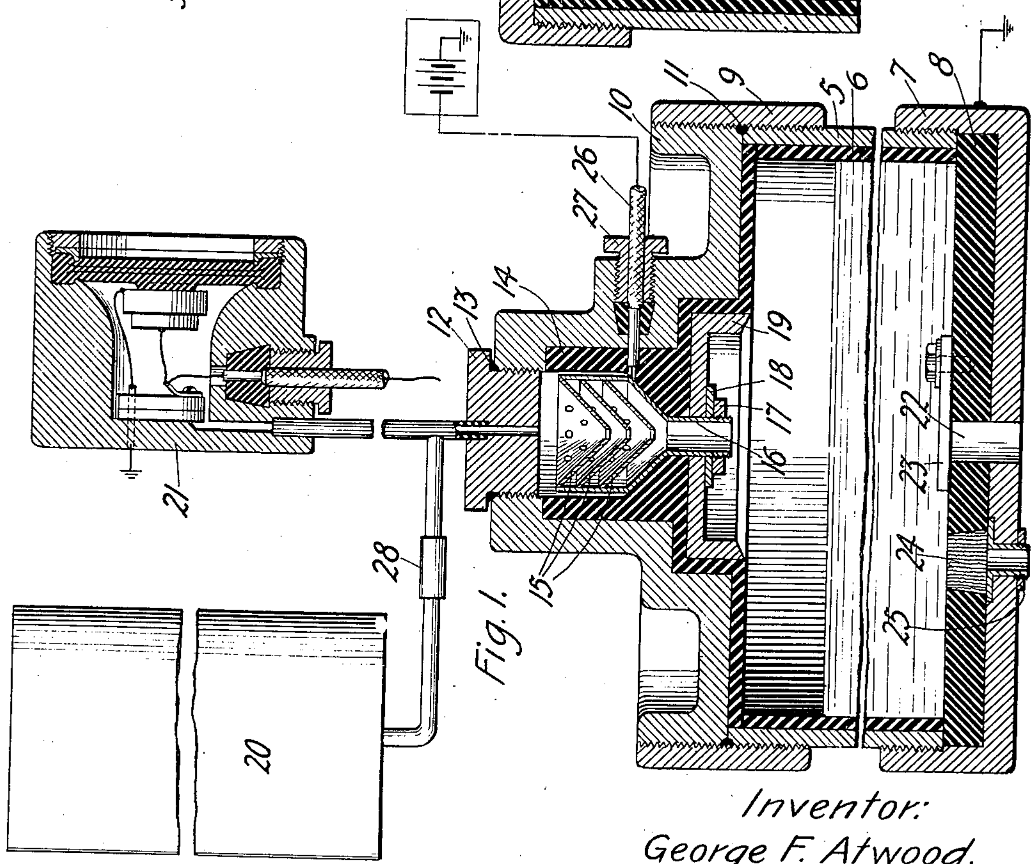
APPLICATION FILED JUNE 24, 1919.

1,432,945.

Patented Oct. 24, 1922.

2 SHEETS—SHEET 1.





Inventor:
George F. Atwood.
by J. G. Roberts Att'y.

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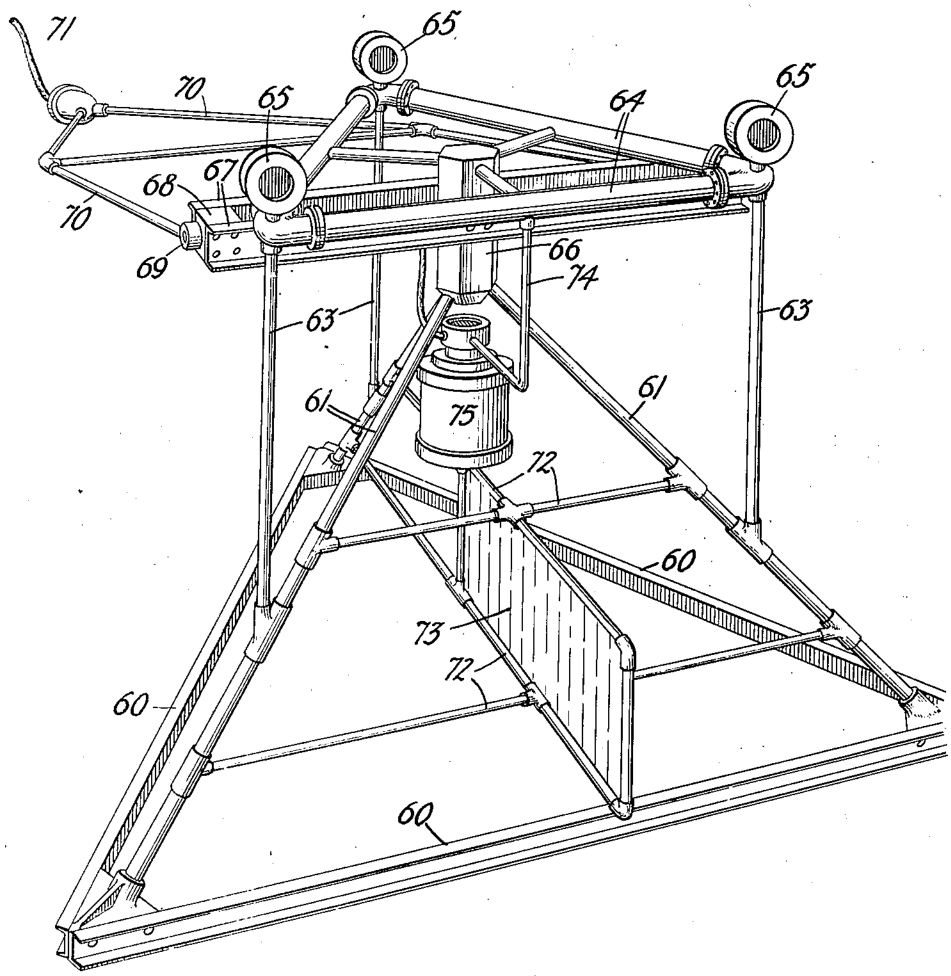
Fig. 3.



Inventor:
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by F. G. Roberts Att'y.

Patented Oct. 24, 1922. **1,432,945**

UNITED STATES PATENT OFFICE.

GEORGE F. ATWOOD, OF NEWARK, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

SUBMARINE SIGNALING.

Application filed June 24, 1919. Serial No. 306,463.

To all whom it may concern:

Be it known that I, George F. Atwood, a citizen of the United States, residing at Newark, in the county of Essex, State of New Jersey, have invented certain new and useful Improvements in Submarine Signaling, of which the following is a full, clear, concise, and exact description.

This invention relates in general to submarine signaling and more particularly to means for mounting the required apparatus and compensating for the excessive hydrostatic pressure exerted upon the apparatus when used at great depths.

In connection with submarine signaling and more particularly the detection of submarine vessels, it has often been found advisable to locate the listening stations at great depths below the surface of the water, installations having been designed for depths as great as one mile. When the apparatus is to be used under such conditions there are many difficulties to be overcome that need not be considered in case the apparatus is located at points where the water is relatively shallow. In the first place, it is necessary to change the method of planting the tripod or the frame upon which the detectors are mounted. The usual method of planting detector tripods consists of starting at the shore end and laying the cable seaward. When the point is reached where the tripod station is to be located, the end of the cable is secured to a buoy while preparations are made for planting the tripod. The ship carrying the tripod on its deck picks up the buoyed end of the cable which is spliced to the stub end of the cable of the tripod, this work being done while the ship lays at anchor. When the splicing is completed, the tripod is lowered over the side of the ship with lowering ropes so arranged as to be cast free when the tripod is planted on the seabottom. The slack cable is then thrown overboard which completes the work.

In cases where it is desired to plant the tripod at great depths, it is not considered feasible to buoy the end of the cable, neither is it considered feasible to anchor the ship in water at such depths nor to use a rope to lower the tripod to the bottom on account of the possibility of the ropes fouling the cable. Furthermore, the weight of the cable reaching from the deck of the ship to the tripod at the bottom of the sea will be several tons and it is not considered advisable to dump such a weight of cable on the tripod after it has been planted. For these reasons, when the tripod is to be planted at great depths, the procedure of planting has been reversed, that is the tripod is first lowered without ropes but by its own cable from the deck of a ship which is equipped with some form of dynamometer, the ship during this operation lying practically still at the point of installation. The dynamometer will show when the tripod has reached the bottom and the ship will then get under headway very slowly, paying-off the slack cable so as to lay the cable on the bottom and in the direction of the shore. After a sufficient amount of cable has been paid-out, a large mushroom anchor is attached to the cable and the cable-ship then proceeds to shore laying the cable in the usual manner. The purpose of the mushroom anchor is to take up any strains on the cable and the slack cable between the mushroom anchor and the tripod which will remain undisturbed by the cable-laying operation.

Since the detecting apparatus, commonly employed, contains an air chamber at the inner side of the diaphragm it becomes necessary to either provide a diaphragm which is capable of withstanding the hydrostatic pressure exerted on its outer side or else to arrange for some kind of compensating device which is capable of compensating for the hydrostatic pressure. When the pressure to be encountered is very small, it is possible to so construct the diaphragm that no compensating apparatus is required. However, the apparatus becomes less sensitive as pressure is exerted on the diaphragm tending to force it out of its normal position, and it has therefore been the common practice to mount the detectors on apparatus built in the form of a diving bell and having an air chamber which is also under hydrostatic pressure, a passage extending from this chamber to the chamber at the rear of the diaphragm. Such an arrangement is satisfactory for ordinary depths but cannot be used when the apparatus is installed at great depths since under these conditions the air is absorbed by the water itself. It is therefore necessary to provide an auxiliary compensating chamber for use under such conditions or to provide apparatus which will automatically generate a gas which can be employed to compensate for the hydrostatic pressure exerted on the diaphragm.

It is therefore an object of the present invention to provide a tripod or mounting framework which is provided with a compensating device making it possible to satisfactorily compensate for the hydrostatic pressure exerted upon the outer surface of the detector diaphragms.

To attain this object and in accordance with a feature of this invention, there is provided a tripod capable of supporting the detectors in the desired manner and provided with means whereby it may be safely planted in whatever position is desired without liability of being damaged by the weight of the cable to which it is attached.

In accordance with another feature of this invention, there is provided a gas generating device secured in place on the tripod and connected to compensating bags mounted within the framework of the tripod, which bags are connected by piping to the chambers at the rear of the detector diaphragms.

In accordance with another feature of the invention, there is provided a device which operates in conjunction with the gas generator to automatically start the generation of gas when the hydrostatic pressure against the detector diaphragms exceeds a predetermined value.

These and other features of the invention may be more clearly understood by reference to the accompanying drawings in which Fig. 1 shows a form of gas generator connected to a compensating bag and a detecting device; Fig. 2 shows a modified type of gas generator, the operation of which is automatically controlled by the pressure of the gas within the compensating chamber; and Fig. 3 illustrates a tripod equipped with a plurality of detecting devices and a gas generator adapted to supply gas under pressure to a compensating bag which is mounted within the piping upon which the detectors are mounted.

Referring now more particularly to Fig. 1, there is disclosed a gas generator comprising a metal casing 5, preferably of steel and equipped with an insulating layer 6 of rubber. The lower portion of the casing 5 is threaded to engage similar threads on a cap piece 7 which in turn is provided with an insulating lining 8 of rubber. The upper portion of the casing 5 is likewise threaded to engage similar threads on a ring member 9, while a cap member 10 is adapted to also engage the threads of a portion of the ring 9 as illustrated. A rubber ring or gasket 11 is provided as shown, to prevent the entrance of water within the casing along the threaded portion of ring 9. The upper portion of cap member 10 is closed by means of a plug member 12, a gasket 13 of rubber or similar material being located as shown to prevent the entrance of moisture in the chamber. The inner portion of cap member 10 is provided with an insulating lining 14 of rubber. Located within the insulated lining 14 is a water separator, the function of which is to separate particles of water from the gas generated by the decomposition of the sea-water. This device consists of a plurality of conical metal plates 15—15 provided with perforations and joined together at their peripheries by the funnel shaped member 16. The lower portion of this water separator is threaded to receive the nut 17 which bears against the washer 18 and forces the electrode member 19 against the lower surface of insulating member 14. The plug 12 is perforated at its center and piping is provided extending to the compensating bag 20 and the inner chamber of detector 21, the diaphragm of which it is desired to maintain in a normal position. A perforation 22 is provided in the cap piece 7 and lining 8, and over this perforation is fitted a flap valve 23 which functions to permit the rapid entrance of water but prevents its exit through this opening. A porous plug 24 is also located in a perforation in the insulating member 8 for the purpose of permitting the enclosed water to escape slowly and in alignment with this porous plug is an insulating member 25. An insulated electrical conductor 26 is brought through a stuffing box 27 located on the side of cap member 10 and is securely soldered to member 16 of the metal water separator, which in turn makes electrical contact with the electrode member 19.

The operation of this generator is as follows:

As the tripod upon which the generator is mounted is lowered below the surface, water rushes within the chamber through the perforation 22 and the flap valve 23. As the level of the water rises within the chamber, the air is compressed in the upper portion of the generator which is directly connected to the chamber of the detector at the rear of the diaphragm and thus the hydrostatic pressure exerted upon the outer surface of the diaphragm of detector 19 is compensated for. When the pressure within the generator has reached the point where the sea-water comes in contact with the electrode member 19, an electrical circuit is completed between a grounded source of energy located at the shore station, through electrical conductor 26, member 16 of the water separator, electrode member 19 and thence through the sea-water within the chamber and through the sea-water in the porous plug 24 and the sea-water outside of the chamber to the outer surface of casing 5 which is also grounded. The flow of electrical current causes the decomposition of the sea-water which results in hydrogen gas being liberated at the negative electrode member 19, while oxygen and chlorine gases are liberated on the outer surface of casing 5, which serves as the positive electrode. The hydrogen gas liberated within the casing 5 increases the pressure in the chamber of the detector and as this pressure increases water is also slowly forced out through the porous plug until contact is broken between the electrode 19 and the water within the chamber, thus discontinuing the generation of gas temporarily. The dangerous gases evolved at the outer surface of casing 5 escape directly without the possibility of causing any trouble. The closure of the bottom of the casing, except for the porous plug, serves to reduce the gas absorption by the water, thus rendering the device more efficient. A further object of this closure is to permit the generation of gas at a pressure greater than that of the surrounding hydrostatic pressure. As the device is first lowered in the water, the compensating bag 20 serves to compensate for the hydrostatic pressure until this bag has collapsed or the sea-water has filled the casing to a point where it makes contact with the electrode 19 and the hydrogen gas is generated in the manner described. Since the compensating bag 20 has a comparatively large area of contact with the sea-water, considerable absorption of the air into the water will occur through the rubber bag and to prevent such an absorption, a check valve 28 may be inserted in the piping between the bag 20 and the generator to practically cause the cutting off of this bag when it has once collapsed.

In the modified type of generator as illustrated in Fig. 2, a metal casing 30 is provided with an insulating lining 31 of rubber and this in turn is provided with a lining 32 of conducting material. The upper portion of casing 30 is threaded to engage similar threads on a cover 33. The inner surface of cover 33 is likewise provided with an insulating lining 34 of rubber and in the central portion there is provided a water separator comprising a funnel shaped metal member 35 provided with a plurality of perforated metal discs 36 conical in shape. The lower portion of member 35 is threaded to engage the threads of nut 37 which together with the washer 38 holds the member 35 in firm electrical contact with the lining 32 which serves as the inner electrode. The upper portion of the cover 33 is threaded to engage similar threads in a cap member 39. An insulating ring 40 of hard rubber is pinned to the cap 39 and functions as a continuation for the insulating lining of the casing 30. In the center of this ring is secured a metal plug 41 in direct contact with member 35 and provided at its center with a perforation 42. The upper portion of cap member 39 is provided with a shouldered portion 43 upon which is seated a diaphragm 44, this diaphragm being securely clamped by means of the clamping ring 45. Securely fastened to the lower portion of the diaphragm is the metal shell 46 of a small electromagnet 47, which is provided with a solenoid armature 48. The metal shell 46 of the electromagnet carries a contact spring 49 insulated therefrom and containing a contact screw 50 which, in its movement, engages a second contact spring 51 secured to but insulated from the cap member 39. Extending from the chamber in which the electromagnet is located is the pipe 52 which leads to the rear chamber of the detectors and provides a passage for the generated gas. An insulated conductor 53 is brought through a stuffing box 54 into this chamber and is connected with the electromagnet 47.

The lower portion of the casing 30 is provided with an insulated cap portion similar to that shown in Fig. 1 and a porous plug and flap valve are also provided.

The operation of this device depends upon the hydrostatic pressure exerted upon the diaphragm 44 rather than the height of the water within the casing. As the hydrostatic pressure increases, the diaphragm is bowed inward carrying with it the electromagnet 47 and causing the contact screw 50 to engage the contact spring 51. Under this condition current flows from a grounded source of energy located at the shore station, through the electrical conductor 53, winding of electromagnet 47, contact spring 49, contact screw 50, contact spring 51, spring 54, plug 41, member 35 to the inner lining 32, thence through the seawater within the casing, through the porous plug at the bottom of outer casing 30 and through the sea-water to ground. Electromagnet 47 is thus energized maintaining the contact between spring 51 and screw 50 closed until sufficient gas is generated within the casing to return the diaphragm 44 to a normal position or even to bow it outward, depending upon the adjustment of the contact springs. Since the source of energy at the shore station is so poled as to make the lining 32 a negative electrode, the flow of electrical current results in the decomposition of the sea-water and hydrogen gas is liberated at the inner electrode while oxygen and chlorine are liberated at the outer surface of the casing 30 and pass freely to the sea-water. The hydrogen gas liberated passes through the discs 36—36 of the water separator, the perforation 42, the chamber surrounding the electromagnet 47 and thence through the pipe 52 to the rear chamber of the detector which it is desired to compensate.

The tripod or framework upon which the generator and the detectors are mounted, as shown in Fig. 3, consists of channel beams 60—60 bolted together in triangular shape and at each apex there is provided a cast metal standard which serves to support a pyramid-shape framework of metal pipes 61—61 to which are secured upright standards 63—63 supporting the triangular framework 64 upon which are mounted the detectors 65—65. At the apex of the pyramid formed by the diagonal pipes 61—61 is the metal block 66 to which is securely bolted a pair of channel beams 67—67. At each end of these beams there is provided a spacing block 68 which also serves as a bearing for the trunnions 69 of a bail 70 by means of which the tripod is lowered. The cable 71 extending to the tripod is brought in through the hollow piping of the bail into the triangular member 64 which supports the detectors 65—65. Horizontal pipes 72—72 are provided as shown to support a fin or rudder 73 which permits the tripod being lowered without rotating and also makes it possible to set the tripod in a definite position. One of these horizontal pipes also supports the gas generator 75 from which pipe 74 leads directly to the triangular framework 64 and thence to the various detectors. The cable 71 passes through the bail 70 and is brought out between the channel beams 67—67 and is then led into the triangular framework 64. This triangle is so made that the rubber compensating bags as shown on Fig. 1 can be mounted therein and the piping from the bags lead directly to the detectors. In order that the compensating bags may be subjected to the outside hydrostatic pressure, the joints of triangle 64 are not made water-tight. If desired, a compensating bag can be provided for each detector, although more uniform results are obtainable if one bag is used to compensate for all detectors. The type of long bail provided makes it possible to lower the tripod by its own cable and yet when the slack cable is thrown overboard the length of the bail is sufficient to prevent the cable from falling upon the detecting apparatus.

What is claimed is:

1. The combination of an under-water detecting device having a member subjected to hydrostatic pressure and a gas generator for automatically generating gas to compensate for changes in hydrostatic pressure on said member.

2. In apparatus for the detection of under-water vibrations, a detecting device including a diaphragm and a hollow chamber back of said diaphragm, means for supporting said device under the water, a gas generator mounted upon said supporting means, and adapted to automatically generate gas to compensate for changes in hydrostatic pressure exerted on the front of said diaphragm and a passage way leading from the generator to the hollow chamber of the detecting device.

3. In apparatus for the detection of under-water vibrations, a plurality of detecting devices each including a diaphragm, means for supporting said devices under the water, means for initially compensating for the hydrostatic pressure exerted upon the fronts of said diaphragms, and additional means operable upon the hydrostatic pressure reaching a predetermined value for further compensating the pressure exerted upon said diaphragms.

4. In apparatus for the detection of under-water vibrations, a plurality of detecting devices, a framework for supporting said devices under water, a cable for lowering said framework, said cable including electrical conductors for said detecting devices, and a bail permanently attached to said framework and adapted to swing outward upon the framework resting in its lowered position.

5. In apparatus for the detection of under-water vibrations, a plurality of detecting devices each provided with a diaphragm and a hollow chamber at the rear of said diaphragm, a framework made of hollow piping for supporting said devices, a bail attached to said framework and a rudder unsymmetrically secured to said framework.

6. In apparatus for the detection of under-water vibrations, a plurality of detectors each provided with a diaphragm and a hollow chamber at the rear of said diaphragm, a framework for supporting said detectors under water, a collapsible gas bag mounted within said framework, a passage-way connecting said bag with said hollow chambers, means for preventing the flow of gas through the passage-way to said bag, and means for generating gas to compensate for the hydrostatic pressure exerted against said diaphragms.

7. In apparatus for the detection of under-water vibrations, a plurality of detectors each comprising a diaphragm and a chamber at the rear of said diaphragm, means for supporting said detectors under water, means for initially compensating for the hyrostatic pressure exerted against said diaphragms, and additional means operable upon the hydrostatic pressure reaching a predetermined value to cause a decomposition of sea-water to produce gas for further compensation of said hydrostatic pressure.

In witness whereof, I hereunto subscribe my name this 16th day of June A. D., 1919.

GEORGE F. ATWOOD.