June 29, 1937. R. L. WILLIAMS 2,085,055

SYSTEM AND APPARATUS FOR SUBMARINE SIGNALING

Original Filed Sept. 12, 1927

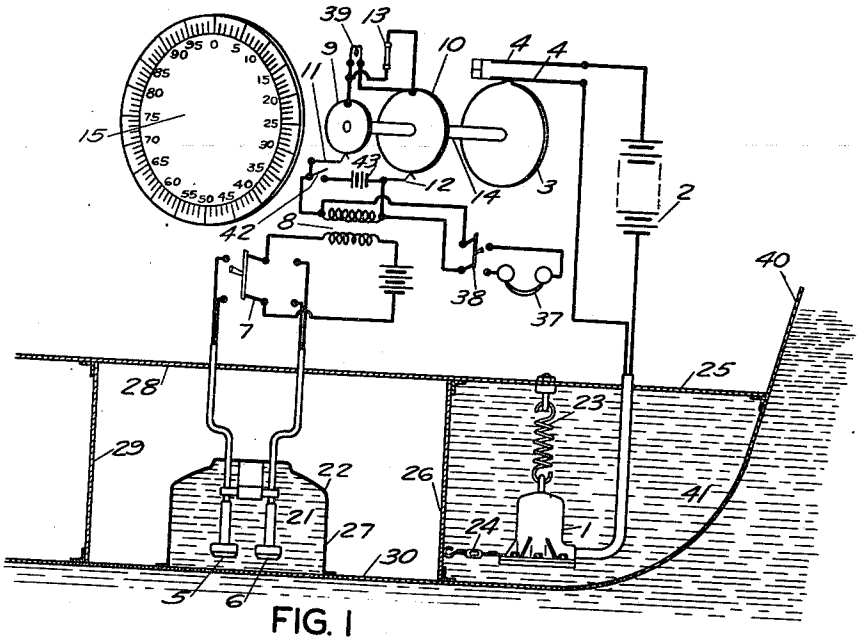

FIG. 1

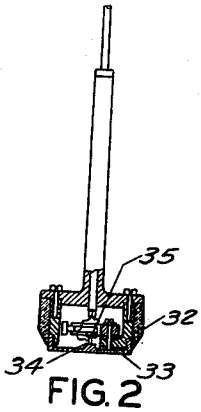

FIG. 2

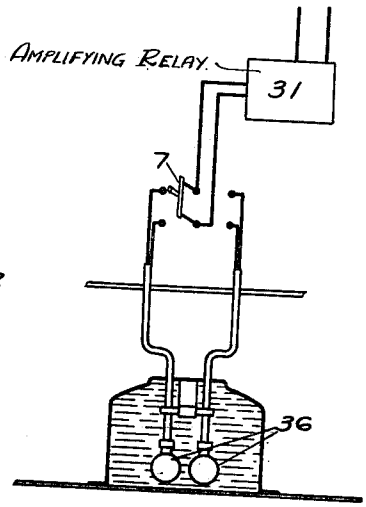

FIG. 4

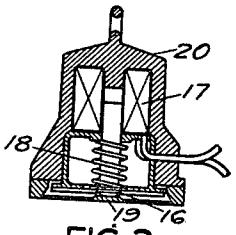

FIG. 3

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SYSTEM AND APPARATUS FOR SUBMARINE SIGNALING

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3 Claims. (Cl. 177—386)

The present invention is a division of applicant's copending application Serial No. 219,002, filed September 12, 1927, now Patent Number 1,883,433, and relates to a System for submarine signaling, particularly for the measurement of depths and distances.

In my United States Patent No. 1,725,038 I have described a relay type of sound receiver. In the present invention I employ this type of sound receiver in a depth sounding system in combination with a sound producer of the impact type. By means of the present invention an extremely simple depth sounding system is provided in which no amplification need be employed to operate the indicator. I have found that the relay type of sound receiver is extremely well suited to receive an impact type of sound signal and that the combination of this type of sound receiver with an impact sound producer in a depth sounding system is particularly effective if the relay receiver be adequately insulated from direct operation by the impact by transmission of the latter through the structures of the vessel in which the apparatus is placed. This is of particular advantage in depth sounding systems since it will be appreciated that in order to measure shallow depths by the aid of the time of travel method it is essential to keep the receiving apparatus in sensitive and receiving condition practically all the time.

In the embodiment described in the following part of the specification, particular reference is had to the drawing in which Fig. 1 shows somewhat diagrammatically the system employing my invention; Fig. 2 shows the type of receiver which is preferably used; Fig. 3 illustrates the detail of the sending apparatus; and Fig. 4 shows a modification employing a somewhat different receiving and indicating system than shown in the other figures.

As indicated in Fig. 1, the apparatus is installed upon a vessel 40, which may be considered as floating upon the water or immersed therein. The sound producer 1 is immersed in a tank 41, filled with water, and likewise the sound receivers 5 and 6, which are immersed in the water filled tank 21.

In Fig. 1 the sound is emitted as an impact by the sounder 1 at times when the cam 3 closes the contacts 4, 4 through the energizing source 2, which in this case is a battery. At the same time, either the receiver 5 or 6 may be connected through the switch 7, by throwing the blade to the right or left, to the indicating device through the transformer 8, the output of which is represented as connected to the slip rings 9 and 10 by means of the brushes 11 and 12, respectively. In the operation of the system, the switch 7 is left in a position connecting one of the receivers to the indicator so that the receiving system is always operating.

It is often found that certain conditions cause one of the receiving units to be more or less sensitive than the other, depending upon the position of the unit in the tank and on its previous operation by signals and noises. In the present instance, therefore, the operator is provided with two units either of which may be selected that is most suitable at the times the observations are being made. It is also, of course, evident that with two units available an additional security is provided in the event that one should fail.

The signal emitted travels to the reflecting surface or object and is returned as an echo or otherwise to the receiving system.

In the entire system where distances are to be measured the elements 3, 9 and 10, together with the flashing indicator 13, rotates synchronously on the shaft 14 behind the transparent scale 15 graduated in the units desired to be measured. The signal being emitted at the same point on the scale, at the zero point, for instance, the angular travel of the indicator 13 will indicate a measurement on the scale 15.

The device preferably employed in the present system is an impact striker shown in Fig. 3 in detail. Here the energy is imparted to a striking hammer 16, by means of a solenoid 17, which draws the hammer 16 against a powerful spring 18, thereby compressing the latter. When the contacts 4, 4 are opened, the hammer is released and the spring forces it with a powerful thrust against the diaphragm 19, which emits an impact sound of great intensity.

The powerful thrust of the hammer 16 must be balanced by the casing 20, supporting the diaphragm. The pull on the casing in turn is taken up by the supporting structure which supports the sounding mechanism. If this structure were rigid, a substantial part of the sound energy due to the impact would be transmitted to the walls of the vessel, to the tank 21, the tank wall 22, and the interior structure and frame. It is for this reason that I employ a spring 23 which not only absorbs some of this impact energy from the sound emitter but also changes its characteristics with regard to frequency and the like so that the receivers are practically sound insulated from this source of disturbance. The sounder is also supported by the rods 24 to prevent any side-

wise movement and the striking, in the rolling of the boat, of the sides of the tank.

By suspending the striking mechanism in this fashion, it will no doubt now be appreciated that a good deal of the disturbing sounds which otherwise would be passed to the frame structure marked 25, 26, 27, 28, 29 and 30 would be excluded and that as a consequence a good deal of the impact affecting the receivers 5 and 6, traveling through the outer water into the tank 21, and through the tank frame 27, directly through the tank water to the receivers, will be avoided.

The results gained by this method of sound insulation of the sound emitter substantiate the theory discussed above and make it possible to use a relay type of receiver, as will be explained later, with a sounder of the impact type.

While a microphone may be used, as indicated in Fig. 4 where 36 represents the microphones connected through the switch 7 to an amplifying relay 31 or the like which connects through the transformer 8 to the indicator 13, it will be apparent that by the use of the present invention with the relay type of receiver as shown in Fig. 2, no amplifier is required.

The relay 32 is described in my above-mentioned United States Patent No. 1,725,038. Briefly described for the purposes of the present application, it comprises a diaphragm 33 on which is mounted a conducting contact 34, which normally just makes contact with a second balanced contact 35, balanced very sensitively above the contact 34. While an excessive jar may not necessarily injure the instrument, nevertheless it is quite possible to give the balanced contact such a large amplitude of motion that it will not return to normal operating condition for an appreciable time. In this manner a series of false indications may be given for a considerable time.

On examination of the system of the present invention, it should be noted that the minimum depth of water which can be measured depends almost entirely upon how quickly the receivers can get back to normal condition after the direct sound has been emitted. If the echo of the direct signal returns to the receiver while the latter is still recovering from excitation directly by the sender, the echo can not be distinguished from the direct signal. Since the velocity of sound in water is about 4800 feet per second, it will be appreciated that the time intervals involved are of the order of $\frac{1}{1000}$ of a second and that refinements of the type herein described are of utmost importance for good observations and measurements.

On the other hand, it will be noted that there is a distinct advantage in employing an impact type of sound producer since the diaphragm 33 of the receiver 32 will by an impact sound signal, due to the steep wave front, be given an extremely rapid upward motion sufficient to open the contacts 35 even though the signal echo itself is not of great amplitude. Furthermore, since the major part of the energy of the impact element in the sound producer is concentrated in the first half cycle of the signal, the amplitude of the echo will usually be greater than the amplitude of the water noises so that the contact in the relay receiver 32 need not be so lightly balanced as if a continuous wave acoustic oscillator were used to produce the signal. In fact, both transmitter and receiver further have the same characteristics not from a point of view of tuning, as is known in the prior art, but rather from the point of characteristic operation inasmuch as a single impulse is transmitted and a single pulse operates the receiver. This gives such a sharp point of measurement both with regard to the transmitted signal and the received signal that the accuracy of measurement is very great.

Having now described my invention, I claim:

1. In combination in a system for distance or depth measurement, impact means for transmitting compressional waves of an impact character comprising a diaphragm exposed to the medium in which the measurements are made, an impact element, means enclosing said impact element on one side of the diaphragm, means within said enclosure for causing the impact element to strike the diaphragm and means responsive to the impact signal produced by said impact element comprising a receiver having a casing with an acoustic diaphragm at one side thereof adapted to be exposed to the medium, an electrode mounted on said diaphragm and a second electrode adapted to make light contact with said first electrode and be operated to break said contact when a reflected signal is received from the impact element.

2. In combination in a system for distance or depth measurement, impact means for transmitting compressional waves of an impact character comprising a diaphragm exposed to the medium in which the measurements are made, an impact element, means enclosing said impact element on one side of the diaphragm, means within said enclosure for causing the impact element to strike the diaphragm, means responsive to the impact signal produced by said impact element comprising a receiver having a casing with an acoustic diaphragm at one side thereof adapted to be exposed to the medium, an electrode mounted on said diaphragm and a second electrode adapted to make light contact with said first electrode and be operated to break said contact when a reflected signal is received from the impact element, and means acoustically insulating said impact receiving means from direct agitation by said impact producing means.

3. In a system for depth measurement in combination with a vessel having two liquid-filled tanks therein comprising in one of said tanks impact means for transmitting a compressional wave of impact character comprising a diaphragm exposed to the medium in which the measurements are made, an impact element, means enclosing said impact element on one side of the diaphragm, means within said enclosure for causing the impact element to strike the diaphragm and in the other of said tanks means responsive to the impact signal produced by said impact means comprising a receiver having a casing with an acoustic diaphragm at one side thereof adapted to be exposed to the medium, an electrode mounted on said diaphragm and a second electrode adapted to make light contact with said first electrode and be operated to break said contact when a reflected signal is received from the impact means.

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