CAPACITIVE-TYPE LINE HYDROPHONE

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

This invention relates to line hydrophone apparatus and more particularly to an inexpensively constructed line hydrophone for use in the low frequency range which can be produced conveniently in quantity and made of any desired length.

Low frequency line hydrophones of present design for use when immersed in water or other bodies of conductive liquid generally have very limited sensitivity as well as one or more construction defects leading to leakage or undue strain on materials during prolonged pressures. These hydrophones now require special shields to prevent leakage thereinto as well as special materials and fabrication techniques in order to prevent dielectric rupture.

The present invention overcomes these and other disadvantages of prior constructions by utilizing an electrode having thereon a woven or latticed structure forming a large number of dielectric air cells. This screened electrode is then enclosed within an airtight bag of a pliable material for trapping these air cells when under pressure, and also for separating the water or other liquid outside from the electrode. This construction provides a large number of small air cells which are capable of withstanding a considerable pressure before being completely collapsed. The basic construction is rather simple and inexpensive, and involves a minimum of sealing problems.

A first object of the present invention is an inexpensively constructed line hydrophone for use in the low frequency range capable of withstandning high pressures over a prolonged period of time.

Another object of this invention is a low frequency line hydrophone for liquid immersion which can be made of any desired length without the use of special materials or fabrication processes.

Still another object of this invention is a line condenser hydrophone fabricated from common and inexpensive materials and capable of use under the most rigorous conditions.

Other objects and features of this invention will become apparent to those skilled in the art as the disclosure is made in the following detailed description of preferred embodiments of the invention as illustrated in the accompanying sheet of drawing in which:

Fig. 1 shows an isometric view partially cut away of one embodiment of this invention.

Fig. 2 shows a fragmentary view along section 2—2′ of the embodiment shown in Fig. 1.

Fig. 3 shows a fragmentary cross section view similar to that in Fig. 2 of another form of this invention.

The line hydrophone described herein is generally for use in bodies of water to detect and record the presence of sound waves. For example, the detection of underwater vehicles such as submarines or other vessels by their generated noise under conditions which make detection otherwise difficult is made more efficient by this device. Also, for oil well or other geographical explorations, explosive sounds are made more effective and economical by using the line hydrophone of this invention dipped in an exploratory hole filled with water or other conductive liquid.

Referring now to the drawing, there is shown in Fig. 1 the line hydrophone 10 constructed of a flat, elongated bag or container 12 terminating at each end into a pair of solid sections 14 and 16. The central section 18 of hydrophone 10 extends to any desired length as indicated. Within the central section 18 of container 12 is provided a latticed or screened sleeve 20 surrounding a flat electrode 24. Electrode 24 is made from a conductive material such as aluminum or copper and may be a foil to facilitate handling and storage, as for example, aluminum wrap. Container 12 is made from a pliable material such as Pliofilm or polyethylene waterproof bag or lay flat tubing. Screen 30 is constructed of dielectric material such as a sleeve-like plastic, nylon, or glass material, preferably soft to resist damage to electrode 24 or bag 12. Screen 20 forms a multiplicity of small air cells 33 against electrode 24 as shown in Fig. 2.

Extending from the opposite side of solid end 14 of container 12 is a solid, extended sleeve 26 which is attached to and may be integral with section 14. Through sleeve 26 passes an insulated lead 28 which passes through section 14 to the interior of hydrophone 10 for connection at 30 to the adjacent end 32 of electrode 24. A method for forming the solid end sections 14 and 16 with lead 28 extending through end 14 and providing sealing which will be satisfactory for the service intended for hydrophone 10 is shown in U.S. Patent No. 2,874,418 dated February 24, 1959, for "Method of Fabrication of Condenser Strip Hydrophones," in the name of Dominick J. Repici. It is understood that a second lead (not illustrated) terminates in the water or other liquid in which hydrophone 10 is dipped, as the water or liquid forms the other electrode for the device. For this purpose, the exposed end of the second lead may be attached anywhere to the outside of hydrophone 10 to insure the former's immersion along with the latter.

The operation of the device shown in Figs. 1 and 2 is as follows: With hydrophone 10 immersed in water 34, sound waves or other pressure changes occurring in the water adjacent to bag 12 cause the latter to move inwardly or outwardly depending upon the direction of the pressure change. The capacitance between water 34 and the electrode 24 will change as a function of the pressure because of the change in size of the individual air cells 33. This capacitance change is converted into an electrical signal by well known techniques. Water 34, which can be sweet water having the mineral content found in nature, or sea water, is conductive to a sufficient extent to make hydrophone 10 operative when immersed therein.

An alternate construction for line hydrophone 10 which may be suitable for particular circumstances, is shown in Fig. 3. It consists of a single sheet of latticed screen 36 similar to screen 20, the electrode 24, and the bag 12. A single layer of air cells 33 is formed, and functions as in the modification described above.

It will be seen that the constructions described above produce a large number of air cells 33 which are able to withstand considerable pressure before being completely collapsed. In fact, a complete collapse of the air cells 33 would require a physical deformation of electrode 24 itself, and with normal construction it has been found that the stresses set up in these parts are resisted up to pressures of a very high order.

Thus, it is seen that there has been provided a novel
line hydrophone which is capable of use over prolonged periods under high fluid pressures without the necessity of resorting to special or costly materials and fabrication processes. The small air cell construction is very simply and inexpensively formed by the use of screen material, metal foil, and plastic sheet material, all of which are inexpensive and readily available.

It should be understood, of course, that the foregoing disclosure relates to only preferred embodiments of the invention and that numerous modifications or alterations may be made therein without departing from the spirit and the scope of the invention as set forth in the appended claims.

What is claimed is:

1. A low frequency, high pressure condenser-type line hydrophone suitable for being made in any desired length, for being wound on a reel, and for being immersed in an electrically conductive fluid medium wherein the boundary surface of said medium at said transducer acts as one of the electrodes, comprising: only one elongated pliable foil strip of conductive material acting as the other of the electrodes, an elongated pliable watertight envelope of dielectric material flattened over its entire length in such a manner that its inner surface is adjacent to said foil strip, and an elongated pliable latticed screen woven of a dielectric material to form a multiplicity of perforations of substantially equal dimensions with respect to each other uniformly dispersed throughout its entire length, said screen being interpositioned between one flat side of said foil strip and the inner surface of said envelope in such a manner that the inner surface of said envelope and the one flat side of said foil strip touch the screen only along its outer sides and thereby forming a multiplicity of confined cells of substantially equal dimensions with respect to each other uniformly dispersed throughout its entire length and substantially intercellularly noncommunicating; whereby any sound waves or other pressure changes occurring in the fluid medium adjacent to said hydrophone will move said envelope with respect to said foil strip to alter the cell dimensions and will produce a change in electrical capacitance as a function thereof.

2. A low frequency, high pressure condenser-type line hydrophone suitable for being made in any desired length, for being wound on a reel, and for being immersed in an electrically conductive fluid medium whereby the boundary surface of said medium at said transducer acts as one of the electrodes, comprising: only one elongated pliable foil strip of conductive material acting as the other of the electrodes, an elongated pliable watertight envelope of dielectric material flattened over its entire length in such a manner that its inner surface is adjacent to said foil strip, and an elongated pliable latticed screen woven of a dielectric material to form a multiplicity of perforations of substantially equal dimensions with respect to each other uniformly dispersed throughout its entire length, said screen being interpositioned between one flat side of said foil strip and the inner surface of said envelope in such a manner that the inner surface of said envelope and the one flat side of said foil strip touch the screen only along its outer sides and thereby forming a multiplicity of confined cells of substantially equal dimensions with respect to each other uniformly dispersed throughout its entire length and substantially intercellularly noncommunicating; whereby any sound waves or other pressure changes occurring in the fluid medium adjacent to said hydrophone will move said envelope with respect to said foil strip to alter the cell dimensions and will produce a change in electrical capacitance as a function thereof.

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