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MAGNETOSTRICTION HYDROPHONE

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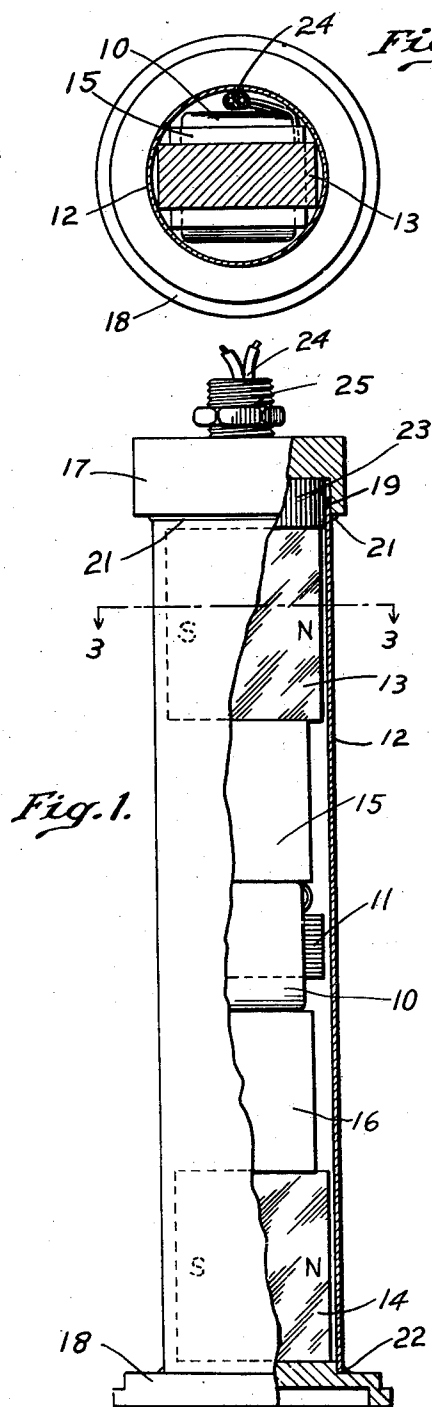
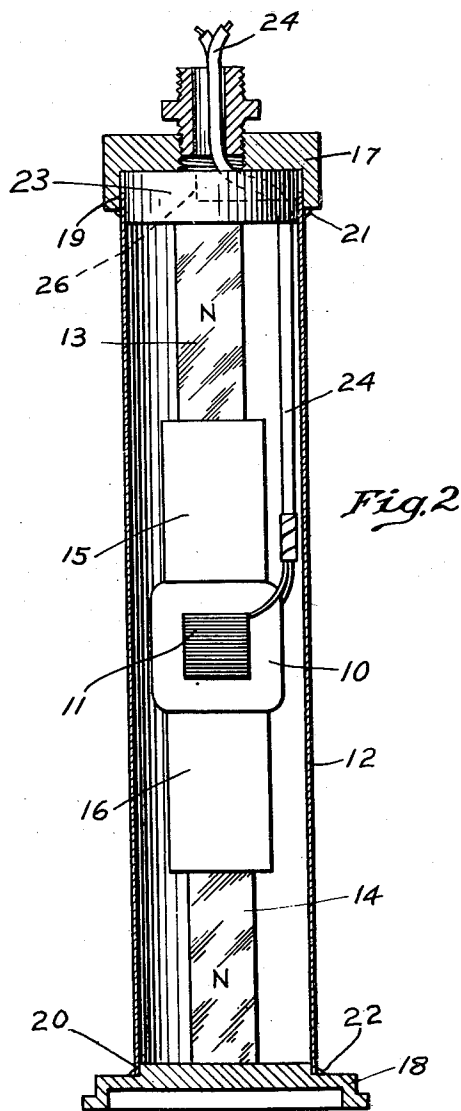
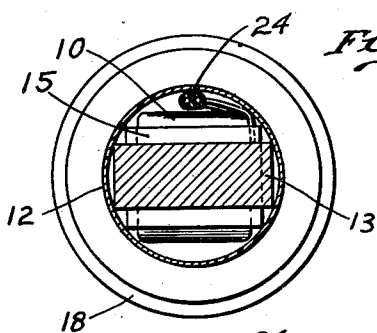


Fig. 3.



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MAGNETOSTRICTION HYDROPHONE

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3 Claims. (Cl. 177-386)

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1

The present invention relates in general to microphones and more particularly to magnetostriction hydrophones.

An object of the invention is the provision of a device of the above type which shall be substantially non-directional.

Another object is the provision of a hydrophone capable of panoramic reception in at least one plane, and of small diametric dimensions in a plane of panoramic reception.

Another object is the provision of a device of the class described which shall be extremely compact and sturdy, and capable of rough usage without substantial variation in sensitivity.

A further object is to provide a magnetostriction hydrophone which shall be simple in construction and easy to repair, and which shall be capable of being constructed from relatively inexpensive materials with a minimum number of parts.

Various other objects and advantages of the invention will become apparent from a perusal of the following specification and the drawings accompanying the same.

In the drawings:

Fig. 1 is a side elevation partly in section showing a hydrophone embodying the invention.

Fig. 2 is a side elevation looking from the right at Fig. 1, with the casing in axial section and the inner elements in full.

Fig. 3 is a section on the line 3-3 of Fig. 1.

Referring to the drawings more in detail, the device comprises a pick-up coil 10 wound upon a laminated iron core 11 and positioned within the middle portion of a tubular casing 12 of magnetostrictive material preferably nickel. Also within the tubular casing 12 on each side of the pick-up coil and near the ends of the tube, are disposed permanent magnets 13 and 14 spaced from the pick-up coil by spaced elements 15 and 16 of non-magnetic, non-conducting material such as Bakelite, wood or the like. To maintain the walls of the cylinder 12 substantially freely responsive to compressional waves, the spacer elements 15 and 16 are given a cross-sectional contour, such that their area of contact with the cylinder will be a minimum. In the present instance they are of rectangular cross-section as shown and of such dimension as to lie loosely within the cylinder and not contact the latter at all four corners. Top and bottom end closures 17 and 18, preferably of non-magnetic metal, in the present embodiment brass, seal the top and bottom ends of the tube, being secured to the tube by sweating with solder to

2

the ends thereof at the adjoining surfaces 19 and 20 and further sealed by a fillet of solder as indicated at 21 and 22. A top spacer element 23 is positioned between the top end closure 17 and the top magnet to space the top magnet away from the top closure element so as to permit passage of a pair of circuit leads 24 over the top of the magnet and out through the tubular coupling 25 by way of a channel 26 in the spacer element. The circuit leads 24 constitute extensions of the terminals of the pick-up coil 10 which latter, in the present embodiment is comprised of about 600 turns of number 36 DSE copper wire, wound about the laminated core 11 and impregnated with insulating material in known manner. Magnets 13 and 14 may be of any suitable magnetizable metal capable of constituting a good permanent magnet. "Alcino" is to be preferred, and is what is used in the present embodiment, since it produces a permanent magnet having a very high field flux density.

As shown in Figs. 1 and 2, the magnets 13 and 14 are mounted within the tube with their polar axes aligned parallel to the core of the pick-up coil with like poles facing in the same direction and, like the coil core, extending diametrically across the interior of the tubular casing 12 preferably into contact with the walls of the casing or into very close proximity thereto so that the magnets, the core 11 and a portion of the nickel tubular casing 12 will be included in a common magnetic circuit.

Since the permeability of the laminated iron core 11 and the nickel tube are both much greater than that of air, a large portion of the flux produced by the permanent magnets will pass from their north poles to their respective south poles by way of the laminated iron core and a portion of the wall of the nickel tube. It will be understood, of course, that electro magnets similar in construction to the pick-up coil 10 may be substituted for the permanent magnets for production of the desired magnetizing field. Because the present embodiment is intended to respond to a band of compressional waves including super-audio frequencies the tubular casing 12 is formed with relatively thin walls, approximately 0.015 or one sixty-fourth of an inch, and a diameter of approximately one and seven-sixteenths of an inch, thus giving it a high, natural mechanical frequency in the neighborhood of the super-audio frequencies. Other physical characteristics of the particular embodiment here shown are that the tubular casing 12 has a length of approximately 7 inches, the pick-up coil core 11 a cross-

section of approximately a half inch square, and the permanent magnets a height of about one and one half inches and a width of about one half inch. This leaves a spacing between the magnets and the core 11 of about one and one half inches.

The above proportions and arrangement of parts has been found to produce in the walls of the nickel tubular casing 12 a high intensity of magnetization of a magnitude very favorable to effective utilization of the magnetostrictive properties of the tube. However, it is to be understood that considerable variation in the above proportions and arrangement of parts may be made without detriment to the operation of the device, the above specific embodiment having been described herein for the sake of disclosure and not for the purpose of limitation of the invention.

In operation, when the device is subjected to compressional waves as when submerged below the surface of a body of water through which compressional waves are passing, the body material of the tubular casing 12 will be subjected all round to variations in pressure, resulting in variations in the amount of flux passing through the magnetic circuit of the pick-up coil, and the production of voltage variations across the leads 24 corresponding to such waves, which voltage variations may be amplified in known manner for operation of suitable responsive means.

It will be clear from the foregoing that the device is capable of panoramic reception in the sense of an equal response to sounds from all directions in a horizontal plane, particularly where the diameter of the tube is small in proportion to the wave length, for example less than a quarter wave length. The device has been found to lend itself well to use as a hydrophone for the reception of underwater sound in the neighborhood of super-audio frequencies. It has also been found to operate as a microphone in air, for which use the cylinder 12 should be made considerably thinner than one sixty-fourth of an inch.

While one specific embodiment of the invention has been shown and described herein for the sake of disclosure, it is to be understood that the invention is not limited to such specific embodiment but contemplates all such modifications and variants thereof as fall fairly within the scope of the appended claims.

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.

What is claimed is:

1. A hydrophone comprising a water-tight tube of magnetostrictive material closed at each end, a pick-up coil disposed in said tube with its axis

transverse to the axis of the tube, a permanent magnet disposed on either side of the pick-up coil within the tube with like poles pointed in the same direction normal to the axis of the tube, said pick-up coil and the permanent magnets being spaced apart along the axis of the tube, and a core comprising a laminated iron structure upon which said pick-up coil is wound with its axis parallel to the polar axis of the magnets, whereby when the casing of said hydrophone is subjected to compressional stresses representative of under-water sound the permeability of said tube will be altered to vary the flux which passes through it and the pick-up coil with resultant voltage variations in said coil.

2. A hydrophone transducer comprising a closed hollow shell of circular cross-section in at least one plane and composed, in at least said circular portion, of magnetostrictive material, a pick-up coil and core therefor situated within said shell, said core having its axis positioned normal to the axis of said circular portion, and a magnet situated within the shell spaced to one side of said core and coil outside the coil with its polar axis substantially parallel to the axis of said core to establish a flux field independently of the coil including a substantial portion of said circular portion and the said core.

3. A hydrophone comprising a closed hollow cylindrical shell having at least its cylindrical wall composed of magnetostrictive material, a pick-up coil and core therefor situated within said shell, said core having its axis positioned normal to the axis of said cylindrical wall, a magnet situated within the shell with its polar axis substantially parallel to the axis of the said core, and a spacer element of nonmagnetic, substantially nonconducting material interposed between said magnet and said core.

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