Dec. 2, 1947. A. L. THURAS 2,431,846

WOOD CORE MAGNETOSTRICTION HYDROPHONE

Filed March 16, 1944

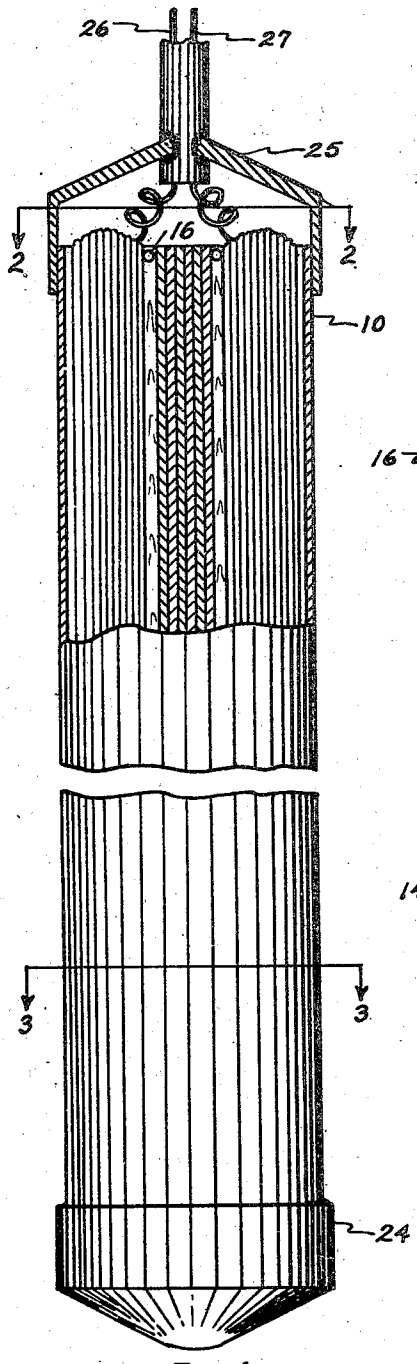

Fig. 1

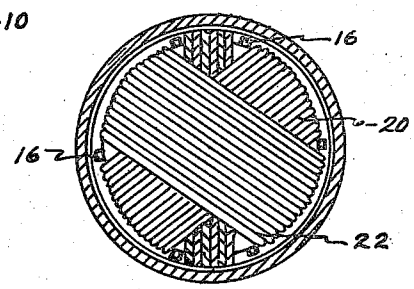

Fig. 2

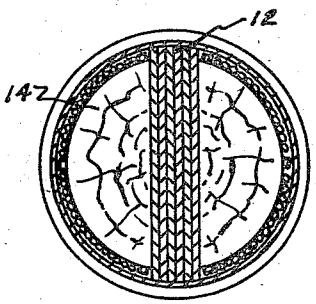

Fig. 3

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WOOD CORE MAGNETOSTRICTION HYDROPHONE

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2 Claims. (Cl. 177—386)

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This invention relates to underwater hydrophones of the tubular magnetostrictive type and as such represents an improvement on the disclosure set forth in application Serial No. 519,233, filed January 21, 1944.

Hydrophones of this general nature are known and rely on magnetostrictive effect, as present for instance in nickel, to establish alternating changes in flux of the remnant magnetism of the magnetostrictive material when it is subjected to external alternating pressures. The effect is produced by sound waves in water impinging on the hydrophone tube. To make practical use of this effect, a coil is so placed with reference to the tube that an alternating E. M. F. will be generated in the coil as the flux field of the tube is alternately changed as indicated above. This E. M. F. may be amplified and reproduced as desired by the person who seeks to interpret the meaning of the sound waves causing the disturbance.

The object of the present invention has been to provide an improved hydrophone which will most efficiently pick up and transmit the impulse of the sound waves which strike it. Another object of the invention has been to provide a hydrophone in which the turns of the coil winding are as close as possible to the inner wall of the tube. A further object of the invention has been to provide a simple, compact and rugged hydrophone of the character described which will be easy to manufacture and service. Other objects will be apparent from the following description and from the features which, believed to be novel, are hereafter set out.

In the annexed drawings:

Fig. 1 is a broken view, partly in section, of a hydrophone built in accordance with the present invention;

Fig. 2 is a section through the hydrophone as indicated by lines 2—2 on Fig. 1, and;

Fig. 3 is a section through Fig. 1 as indicated by the lines 3—3 thereon.

Referring now to the drawing, the hydrophone is shown in Fig. 1 to be embodied in a cylindrical tube 10, preferably made of nickel. The tube thickness is kept small, i. e., about .035 inch, in order to cut down eddy current losses. The diameter of the hydrophone tube is a determining factor in the resonance of the device and this resonance varies inversely as the tube diameter. Diameters of two and three inches have given good results.

In order to provide for maximum flux transmission inside the tube, a series of transformer iron laminations 12 are provided as shown in Figs. 1 and 3, extending from one side of the cylinder 10 to the other and in contact with both. This core while preferably laminated, may be granular in composition. It may also be made of one piece of transformer iron, although this construction is less desirable than either of the first two. At a considerable sacrifice of efficiency the hydrophone may be built with no iron core. This construction is much less preferable than those with iron cores.

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The coil is wound lengthwise of the tube and positioned closely adjacent its inner surface. To position the turns a pair of semicylindrical dielectric cores are provided as shown at 14 in Fig. 3. Although various insulating materials may be used, the cores preferably are made of soft wood.

It is necessary that the turns of the coil cut across the iron core 12 in order that the flux field itself be cut. To permit the coil to be wound in this way, a series of spacing pegs 16 are provided at each end of the semicylindrical pieces 14 (Figs. 1 and 2). In winding the coil a series of turns 20 are first wound transversely of the ends of the core and lengthwise of the tube 10 as shown. The turns are so placed that the exposed surfaces of the dielectric cores between two pairs of the pegs 16 are covered. A second portion 22 of the coil is then wound on the wood cores, at its ends overlapping the first winding 20, as well as the ends of the iron core. This winding, as shown in Fig. 2, lies between two other sets of pegs 16.

To effectively seal the hydrophone at each end, caps 24 and 25 are provided, each snugly fitting over an end of the tube 10 as shown. The cap 25 is provided with a central opening through which is passed a pair of leads 26 and 27 connected to the coil. To provide an effective seal where the leads pass through the cap a piece of soft rubber containing the leads, and of considerably greater diameter than the opening, is stretched lengthwise and pulled through. It is then allowed to resume its original shape, at which time it overlies the edges of the cap opening as shown in Fig. 1.

As examples of hydrophones which have been built in accord with this invention some have been designed to have an impedance of 6 or 7 millihenries at a frequency of 5000 cycles per second. It may be noted here that in a device of this nature the impedance of the system varies considerably with the particular frequency at which the hydrophone is used. Although it is generally desirable to listen over a considerable portion of the sound spectrum, the unit should be so designed that the best response is obtained in the

desired spectrum band. In general, the greater the number of turns of wire in the winding, the higher will be the impedance at a given frequency.

Instruments of this type have been built in various sizes, ranging for example from 5 inches to 3 and 4 feet in length, and in diameter 2 or 3 inches. In winding the coils enameled wire was used. The coils were wound in three layers in the units 5 inches long, while in the longest hydrophone a single layer was employed.

I claim:

1. A magnetostrictive transducer for transforming the compressional waves in a fluid medium into corresponding electrical signals comprising, a casing of magnetic material capable of having its residual magnetic field vary proportionally to the force of the compressional waves acting on the casing, an iron core substantially rectangular in cross section inside the casing and extending laterally across the casing from wall to wall, and a coil wound about the ends of the core in two sections, the end portions of the wires in each section of the coil being parallel with each other, the said end portions of one section of the coil forming an X with the said end portions of the other section of the coil, the side portions of the wires of the coil being parallel to each other and disposed adjacent the inner walls of the casing to have induced therein a potential proportional to the varying magnetic field.

2. A magnetostrictive transducer for transforming the compressional waves in a fluid medium into corresponding electrical signals comprising, a casing of magnetic material capable of having its residual magnetic field vary proportionally to the force of the compressional waves acting on the casing, a laminated iron core substantially rectangular in cross section inside the casing and extending laterally across the casing from wall to wall, a dielectric core to space and support a coil, and a coil wound about the ends of the core in two sections, the end portions of the wires in each section of the coil being parallel with each other, the said end portions of one section of the coil forming an X with the said end portions of the other section of the coil, the side portions of the wires of the coil being parallel to each other and disposed adjacent the inner walls of the casing to have induced therein a potential proportional to the varying magnetic field.

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