July 16, 1968 T. J. MEYERS 3,393,401

ELLIPTIC FREE-FLOODING MAGNETOSTRICTIVE SCROLL

Filed Dec. 12, 1966 2 Sheets-Sheet 1

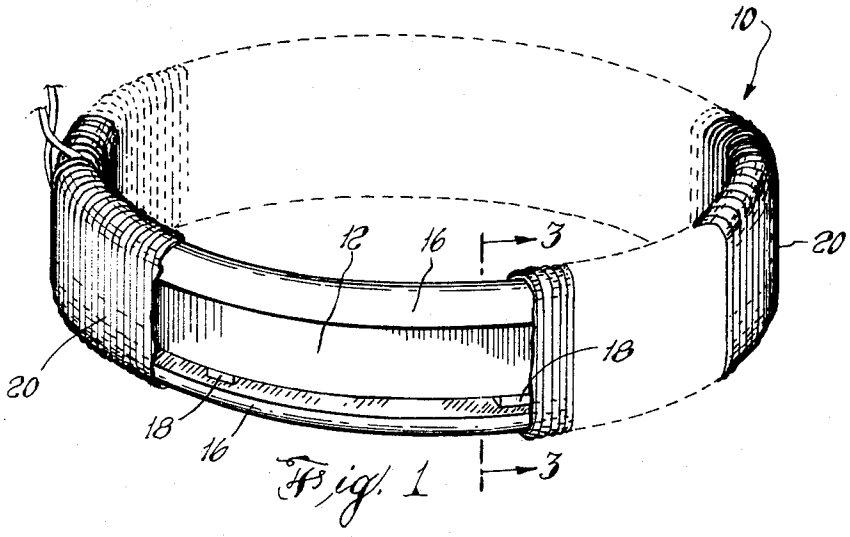


Fig. 1

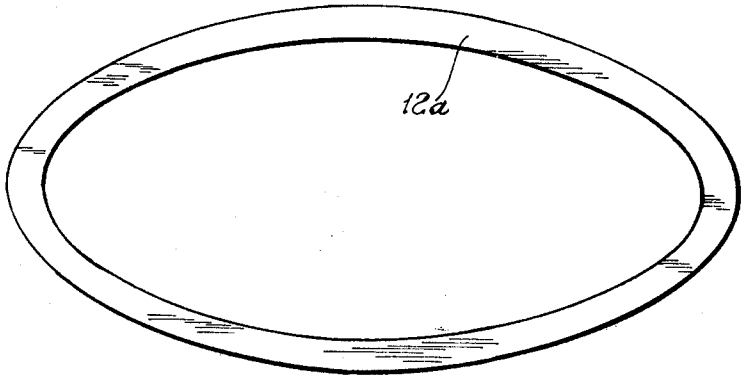


Fig. 2

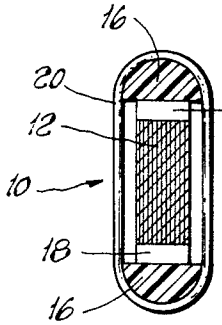


Fig. 3

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ELLIPTIC FREE-FLOODING MAGNETOSTRICTIVE SCROLL

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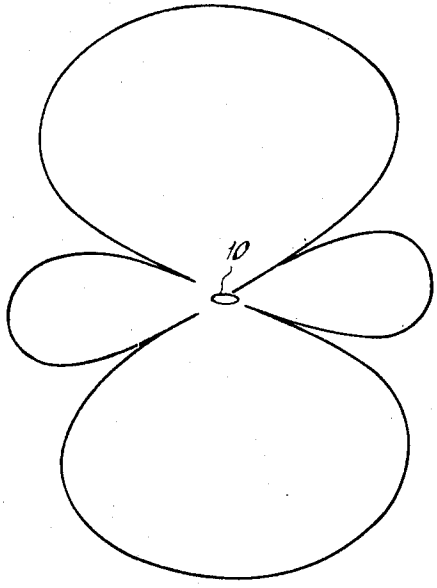
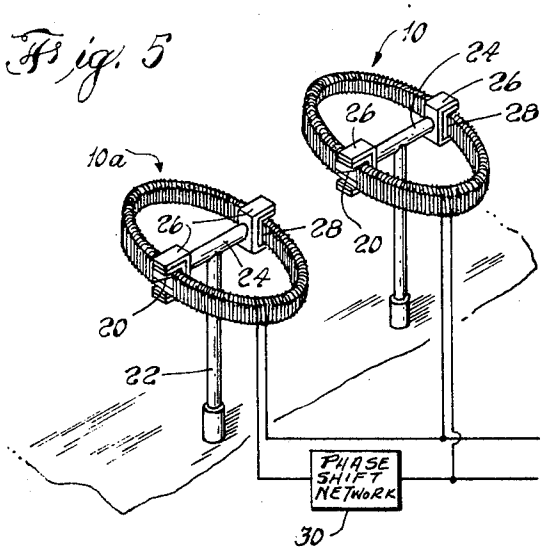


Fig. 4

Fig. 5



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ELLIPTIC FREE-FLOODING MAGNETOSTRICTIVE SCROLL

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2 Claims. (Cl. 340—11)

ABSTRACT OF THE DISCLOSURE

An elliptic, hollow, open ended, free-flooding magnetostrictive transducer with no depth limitation having a magnetostrictive core supporting a toroidally coiled conductor to provide a dipole beam pattern when used singly and to provide a directive beam pattern when paired properly spaced and properly phased.

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 novel advantageous electroacoustic transducers.

An object of this invention is to provide a simple, rugged, inexpensive electroacoustic transducer for use at any depth.

A further object is to provide a simple rugged high power directional transducer array for use at any depth.

Other objects and advantages will appear from the following description of an example of the invention, and the novel features will be particularly pointed out in the appended claims.

In the accompanying drawings:

FIG. 1 is a perspective view, partly broken away, of an electroacoustic transducer having a scroll type core, showing a preferred embodiment of the invention;

FIG. 2 is a plan view of a lamina for an alternative core structure for the embodiment of FIG. 1;

FIG. 3 is a cross section of the transducer shown in FIG. 1;

FIG. 4 illustrates the beam pattern obtained from a transducer as in FIG. 1; and

FIG. 5 shows an array of two transducers of the type in FIG. 1.

This invention consists of a free flooding magnetostrictive transducer **10** comprising a cylindrical core **12** of elliptic shape that is of primarily magnetostrictive material. The core has the same cross section all the way around, and is very short in the axial dimension relative to the length of its minor axis. The length of the major axis of the core is approximately twice the length of the minor axis. In the broadest definition of the invention the core may be one integral member obtained by casting or forging the magnetostrictive material. However, most practical applications demand a laminated core to limit eddy current losses. A laminated core may be made by stacking elliptic laminae, one of which is shown in FIG. 2, and consolidating the laminae with resinous material used for the purpose in magnetostrictive cores. Alternatively, the laminar core is formed as a tightly coiled scroll of a continuous length of thin strip magnetostrictive material and consolidated with resinous material. An elliptic ring **16** of rigid, non-magnetic, relatively lightweight material, non-corrosive in sea water is attached to each end of the core by means of several elastomeric

spacers **18** bonded to core and elliptic ring. The surface of each elliptic ring facing away from the core is rounded as shown in FIG. 3 and is wider in cross section than in width of the core extending beyond the inner and outer surfaces of the core.

A continuous length of waterproof insulated conductor **20** is tightly coiled all around the core engaging the elliptic rings. Because the elliptic rings are wider than the core the conductor is spaced from the inner and outer surfaces of the core. The two ends of the conductor are connected to signal generating equipment and a source of polarizing current as is conventional.

The transducer is supported underwater by a surface ship or submarine by means of rigid post **22** secured to the ship. A cross piece **24** is secured to the free end of the post. The ends of the cross piece are provided with oppositely directed U-shaped terminations **26** provided with a liner **28** of elastomeric material such as neoprene. Opposite portions of the transducer in line with the minor axis are nested in the U-shaped terminations **26**. The conductor **20** skips across those portions engaged by the support structure on the outer side of the core.

For a transducer that will be used in low temperature seawater to reduce losses in the elastomeric material it is preferable that the elastomeric spacer and liner material be prepared from low temperature formulated neoprene; a commercial example of a suitable material is Dupont WRT.

A transducer described has a beam pattern of two major lobes and two minor lobes as shown in FIG. 4. In FIG. 5 there is shown an array of two such transducers supported coplanar with their minor axes in line and their spacing between centers approximately one-quarter or three-quarters of a wavelength in the water at the selected operating frequency. A phase shift network **30** is connected in series with one of the transducers **10A**. Both transducers are powered by the same source, not shown. By selection of the phasing, depending upon transducer parameters, array spacing, and frequency, a directive beam pattern as from a piston type transducer is obtained from the array. One pair or several pairs of transducers with proper phasing can serve as the radiator for a large echo ranging system.

The transducer described is rugged, reliable and does not appear to have any depth limit, and in any case can be used deeper than transducers currently used in echo ranging systems. Power capacity for its size and weight is very high.

It will be understood that various changes in the details, materials and arrangements of parts (and steps), which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.

I claim:

1. An elliptic cylindrical free-flooding magnetostrictive transducer comprising

an elliptic laminar core of magnetostrictive material consolidated with resinous material and of approximately the same cross section all around,

a pair of elliptic rings attached to opposite ends of the core respectively with several soft elastomeric spacers, the rings being wider in section than the corresponding dimension of the core to extend beyond the elliptic inner and outer surfaces of the core, and

a conductor toroidally coiled around said elliptic rings and core substantially completely around said core.

2. A transducer as defined in claim 1 wherein the length of the major axis of said core is approximately twice the length of the minor axis and the height of said core is a minor fraction of the length of the minor axis.

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