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TESSELLATED ELECTROMECHANICAL TRANSDUCER ELEMENT

Filed May 13, 1953

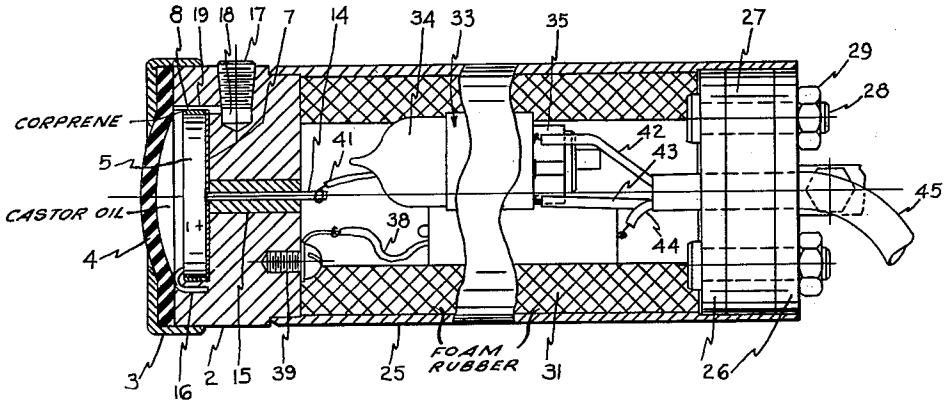

FIG. 1

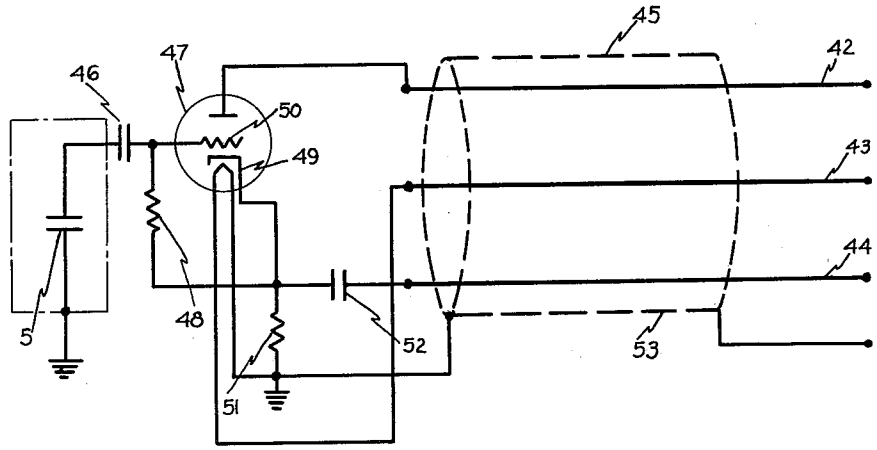

FIG. 3

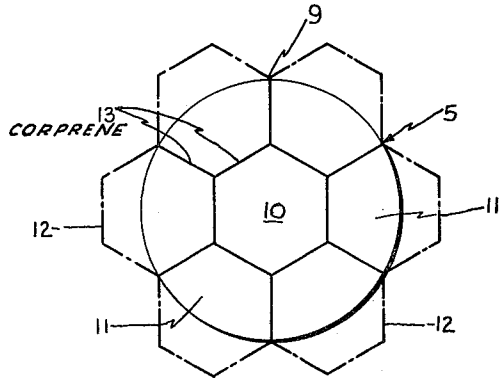

FIG. 2

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TESSELLATED ELECTROMECHANICAL TRANSDUCER ELEMENT

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This invention concerns a novel electromechanical transducer element for a hydrophone.

An object of the invention is to provide a novel transducer element for a hydrophone.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a view predominantly in section of a hydrophone including an electromechanical transducer element in accordance with this invention,

FIG. 2 is a plan view of a dual electromechanical transducer element in accordance with this invention, and

FIG. 3 is a schematic diagram showing the electrical system of the hydrophone shown in FIG. 1.

There is shown in FIG. 1 a housing **2** having a ring **3** that holds in place a rubber diaphragm **4**. Seated in housing **2** is an electromechanical transducer element **5** of disc-shape isolated against transfer of mechanical vibration on its bottom face by a layer **7** of Corprene and at its periphery by a layer **8** of Corprene. Corprene is a material described in U.S. Patent 2,529,648, column 3, lines 27–29, et seq.

An electromechanical transducer element **5** suitable for the hydrophone shown in FIG. 1 comprises a circular disc **9** that is made up of a hexagonal plate **10** surrounded by six plates **11**. An embodiment in accordance with this invention may be about 1¼ inches diameter and about ½ inch thick. The circular disc **9** is made by assembling initially about hexagonal plate **10** a series of six similar hexagonal plates **12** to form a tessellated pattern, the six plates **12** being bonded to the central hexagonal plate **10** and to each other by a thin layer **13** of Corprene. The composite assembly is then cut down to a circular contour to provide disc **9**. In the resulting combination, the peripheral plates **12** each have three adjoining hexagonal sides and an arcuate side joining the ends of two of its hexagonal sides and whose radius is approximately twice the length of one of said hexagonal sides. The individual plates **10**, **12** are cut from an extruded bar of barium titanate so as to be substantially identical to each other in transducing properties and the assembly fabricated from a group of selected elements which show a variation in piezoelectric sensitivity not in excess of plus or minus three per cent. Effectively, therefore, element **5** consists of a 1¼ inch diameter disc **9** subdivided into seven isolated smaller parts including a central hexagonal plate **10** surrounded by six plates **11**. The isolation of the plates **11** serves to prevent undesirable transverse resonance modes.

A conductive pin **14** (FIG. 1) extends axially from the rear of element **5** through an axial insulating tubing **15** in housing **2** and conducting pin **14** extends externally of housing **2** in a direction away from element **5**. A conducting pin **16** is anchored at one end in housing **2** and at its other end is connected to the front of element **5** and at the periphery thereof. Conducting pin **16** is imbedded in housing **2** to provide a minimum of contact resistance.

A pipe plug is tapped into an opening **18**, in housing **2** and opening **18** is provided with a connecting port **19** that opens into the space in housing **2** at the front of

element **5**. Pipe plug **17** can be removed for the purpose of filling openings **18** and **19** and the space at the front of element **5** with oil such as castor oil. Disposed to the rear of housing **2** is a tubular housing **25**. The forward rim of tubular housing **25** is forced over the rear periphery of housing **2**.

Disposed in the rear of housing **25** are a pair of spaced discs **26** between which is a compressible gland **27**. Discs **26** and gland **27** are assembled together by means of screws **28** and nuts **29** turned thereon.

Lining housing **25** is a tubular shock mount **31** of foam rubber. Nested in shock mount **31** is a preamplifier **33** including a tube **34** and a tube socket **35**. A conductor **38** connects preamplifier **33** to conducting pin **16** through screw **39**. A conductor **41** connects preamplifier **33** with the rear extremity of conducting pin **14**. Conductors **42**, **43** and **44** connect preamplifier **33** through a shielded cable **45** to other parts of the hydrophone circuit (not shown).

There are shown in FIG. 3 details of the electrical system of the hydrophone. The transducer element **5** is coupled to the triode tube **47** through a condenser **46**. The plate supply of tube **47** is provided through lead **42** and the heater supply of the tube is provided through lead **43**. The tube **47** is arranged to be self biased by connecting resistor **48** between the cathode **49** and the grid **50**. The output is derived from the cathode side of the tube through a resistor **51** which output is coupled to lead **44** through a condenser **52**. The shield **53** of the cable **45** serves as a common return path for both the plate supply and the heater supply of tube **47**.

Each of the two transducing parts of the transducer displays a different directional pattern at a prescribed frequency of operation. These two individual patterns are combined electrically to result in an optimum overall directional characteristic.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

I claim:

1. An electromechanical transducer element adapted for use in a hydrophone in connection with underwater sound systems, said element comprising a circular disc, said disc including a central hexagonal plate and six peripheral plates surrounding said central hexagonal plate, a thin layer of Corprene insulation disposed between matching faces of the plates included in said disc, each peripheral plate comprising a partial hexagon having three adjoining hexagonal sides of dimensions the same as the sides of said central hexagonal plate and an arcuate side joining the ends of two of its hexagonal sides and whose radius is approximately twice the length of one of said hexagonal sides, and said central and peripheral plates forming a tessellated pattern.

2. An electromechanical transducer element for use in a hydrophone in connection with underwater sound systems, said element comprising a circular disc of about 1¼ inches diameter and about ½ inch thickness, said disc including a central hexagonal plate of barium titanate and six peripheral plates of barium titanate surrounding said central hexagonal plate, a thin layer of Corprene insulation disposed between matching faces of the plates included in said disc, each peripheral plate comprising a partial hexagon having three adjoining hexagonal sides of dimensions the same as the sides of said central hexagonal plate and an arcuate side joining the ends of two of its hexagonal sides and whose radius is approximately twice the length of one of said hexagonal sides, and said

central and peripheral plates forming a tessellated pattern.

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