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SUPPORT FOR ELECTRO-ACOUSTIC TRANSDUCER

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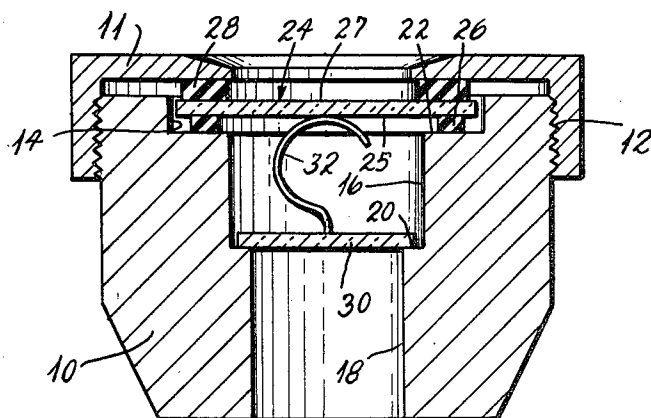


Fig. 1 PRIOR ART

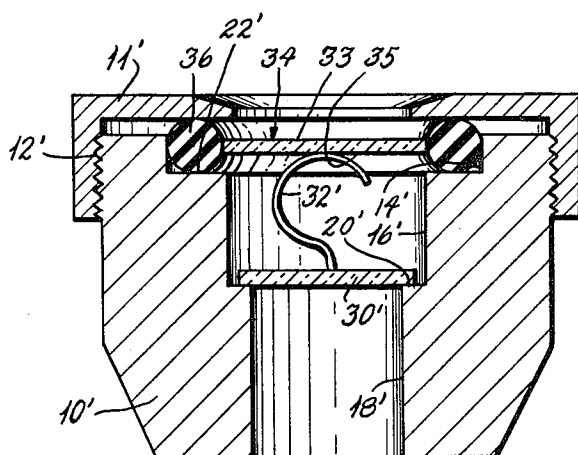


Fig. 2

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1

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SUPPORT FOR ELECTRO-ACOUSTIC TRANSDUCER

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3 Claims. (Cl. 340-10)

(Granted under Title 35, U.S. Code (1952), sec. 266)

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 supports for transducers and more particularly to supports for electro-acoustic transducers intended for underwater operation.

The conventional means for supporting the vibrating element, viz; the ferroelectric, electrostrictive, or piezoelectric vibrator which may be a polarized barium titanate crystal, or the like, with the usual electroded faces, has been to rest one face of the vibrator on a flat surface and to compress a gasket against the other face to provide a pressure seal. The use of such a seal has many disadvantages. For example, although the vibrating element should be supported at its node to prevent undesirable damping, with this type device the vibrator cannot be so clamped. Another disadvantage is the possibility of damage to the vibrating element because of overcompression of the gasket. Still another disadvantage is the necessity of using insulating washers or spacers to achieve electrical isolation of the vibrator.

It is, accordingly, a primary object of the present invention to provide a support for the vibrating element of an electro-acoustic transducer wherein said element is clamped at a node and the effects of non-uniform clamping pressure are substantially reduced.

It is a further object to provide a support for the vibrating element of an electro-acoustic transducer wherein the need for insulating washers or spacers is eliminated and wherein the assembly of the transducer is facilitated by the capability of preassembling the vibrating element and the associated gasket into one unit.

It is another object to provide a support for the vibrating element of an electro-acoustic transducer wherein said vibrating element is easily replaceable because the support permits electrical contact without the use of soldered connections.

Another object is to provide a support for a vibratile disc which will have a minimum of adverse effect on the vibrations of the disc.

One feature of the present invention resides in the support of the vibrating element mainly at its peripheral edge surface.

Another feature resides in the provision by the support of a pressure seal.

Still another feature resides in the provision of a pressure seal which also electrically insulates the vibrating element from the other components of the transducer assembly.

In accordance with the present invention, there is provided an electro-acoustic transducer which comprises an electromechanical vibrator having substantially parallel (electroded) major surfaces and a perimeter edge surface which is substantially perpendicular to the major surfaces. Resilient means are provided for intimately embracing and supporting the vibrator at its perimeter and a housing is provided for receiving the resilient means and embraced vibrator. The housing includes means for compressing the resilient means in a manner to cause the latter to firmly grip the vibrator at its perimeter.

2

There is also included means for making electrical contact with the vibrator.

Also, there is provided in accordance with the present invention an electro-acoustic transducer which comprises a substantially circular electro-mechanical vibrator, which may be made of barium titanate, and which has substantially parallel major surfaces and a perimeter edge surface which is substantially perpendicular to said major surfaces. A ring of an elastomeric material having an inner circumference substantially equal to the circumference of the vibrator snugly embraces the latter on its edge surface. There is provided a housing for receiving the ring and vibrator, the housing including a first tubular member wherein the inner circumference of a first portion is substantially equal to the outer circumference of the ring and a second portion wherein the inner circumference is smaller than the first portion whereby a first circular shelf is provided for resting the elastomeric ring, and a second tubular member for threadably receiving the first member and for compressing the ring. Means for making electrical contact with the vibrator is provided which includes a Phosphor bronze spring.

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 drawing wherein:

FIG. 1 is a cross sectional depiction of the heretofore used arrangement for supporting the vibrating element of an electro-acoustic transducer; and

FIG. 2 is a cross sectional depiction of an embodiment of the present invention.

Referring now to FIG. 1, there is shown a support or member 10 which may be tubular having a threaded section on its outer periphery 12 and portions 14, 16 and 18 of increasingly smaller inner diameters. With the arrangement of three portions having different diameters, circumferential inner shelves 20 and 22 are provided. A piezoelectric vibrating element 24 has one of its surfaces 25 resting on washer 26 which in turn rests on shelf 22. The vibrating element 24 may be formed of a suitable piezoelectric material or a ferroelectric material such as barium titanate or the like. As shown, element 24 does not make contact with the inner peripheral surface of member 10 and face 25 is prevented by means of washer 26 from contacting shelf 22. Resting upon face 27 of element 24 is a gasket 28. Member 10 threadably engages a member 11 at its threaded portion 12 and as a consequence of such engagement, compresses gasket 28. Members 10 and 11 may consist of a suitable resistive material such as a steel alloy and the like. Resting upon shelf 20 is an element 30 which has affixed thereto an electrically conductive spring contact 32 and its associated lead for making electrical contact with face 25 of element 24. In the arrangement of FIG. 1, uniform clamping pressures are not applied to element 24 and the element cannot be clamped at a node. Overcompression of gasket 28 can lead to damage of element 24. Spacer or washer 26 is required to achieve electrical isolation of element 24. It will be observed that with this construction, the vibrating element 24 could not be clamped at a node thereof. In order to prevent undesirable damping of a vibrating element, the element must be supported at its node, that is, at point which there is minimum or zero vibration.

Referring now to FIG. 2, there is shown a similar arrangement as that shown in FIG. 1, however in this figure, the vibrating or vibratile element or disc 34 which has parallel, approximately flat faces is peripherally encircled by an elastomeric gasket 36 such as an O-ring gasket, the element 34 fitting snugly into the inner opening thereof. The outer circumference of ring gasket 36 is closely re-

3

ceived within the portion 14' having the largest inner diameter in member 10', with the ring gasket 36 resting on shelf 22'. It is seen that when member 10' threadably engages member 11', as the engagement is tightened, pressure is brought to bear on ring gasket 36 causing it to be compressed against shelf 14' and since the outer periphery of the ring is confined against substantial radial expansion, the ring will be distorted radially inwardly of itself and into firm pressure contact against the peripheral edge surface of the vibrator, thus consequently causing it to grip element 34 along its perimeter. This forms a pressure-tight seal between the periphery of the element 34 and the gasket. The element 34 is a thin right circular cylinder which is excited so that its faces vibrate in directions parallel to the axis of the cylinder, during which the thickness of the cylinder, which is the distance between the faces, varies with the vibrations. When such a body expands in thickness, such as the length along the axis of the cylinder, the body, when free to do so, expands equally in both axial directions from a central plane which is parallel to the faces. Hence, there is no movement of the cylinder at this central plane during the vibration, so that this plane of substantially no motion during the vibration can be called a nodal plane. The ring 36 which engages the peripheral side edge of the cylinder best engages with the cylinder edge surface at this middle plane, called the nodal plane, that supports the cylinder where it has its minimum or no motion, and hence, it exerts a minimum damping of the vibration of the thin cylinder. Since it is physically impractical to support a cylinder along a line only, the contact of the support with the cylinder should be centered along this middle or nodal plane of the vibrating element or cylinder. It is necessary for the perimetric edge surface of element 34 to be substantially perpendicular to its back surface 35 and its radiating surface 33. As is shown in FIG. 2, electrical contact is made to the back surface 35 with a Phosphor bronze spring or pressure contact 32'. Of course, if it is desired, electrical contact may be made to the radiating surface 33 of element 34 with the pressure contact 32'.

With the arrangement of FIG. 2, as ring gasket 36 is compressed it is forced radially inwardly and caused to grip element 34 around its peripheral edge surface of the element, and also into a pressure-tight seal with the inner circumference on member 10'. Ring gasket 36 also provides electrical isolation of element 34 so that it is not necessary to make use of a spacer or washer 26 as shown in FIG. 1. Also, since electrical contact is made to element 34 with pressure contact 32', the element 34 may be readily replaced by another vibrating element without having to unsolder any electrical connections.

In FIG. 2, it will be noted that the support 10' has a recess, including the portion 14', that opens outwardly through an end face of the support, and this recess has a rabbet or annular groove around its periphery with the shelf 22' forming one wall of this groove and the adjacent outer end part 14' of the peripheral wall of such recess forming another wall of this groove that is approximately perpendicular to the shelf wall 22'. The elastomeric ring or element 36 has portions on opposite sides of the recess in the groove, that fit against both walls of the groove. The vibratile disc or element 34 has parallel plane faces and a peripheral edge wall or face that is perpendicular to the planes of the large or main faces of this disc. This peripheral edge wall of element 34 is snugly received and confined between the elastomeric element portions or means 36 at opposite sides of the recess, so that the vibratile element or disc will be mainly supported frictionally by the pressure of this elastomeric member solely on the peripheral edge wall of disc 34. In the embodiment of the invention illustrated in FIG. 2, this recess in the support is cylindrical in shape, and the elastomeric member is an endless ring, generally circular in transverse cross-section. The disc 34 has its peripheral edge snugly engaged with and supported by the inner periphery of

4

this elastomeric ring. Because of the circular, transverse cross-section of this ring, the portions of the ring surface adjacent its inner periphery recede away from the opposite faces of the disc 34, and are entirely out of contact with the faces of the disc 34. The cap or member 11' is threaded on the body or support 10' at the end of the support having the recess in which the vibratile element or disc is mounted, for movement toward and from the bottom of rabbet groove, and has a portion that engages the elastomeric member or means 36 and confines it in and compresses it into the rabbet groove as the member 11' is threaded further upon the support or body 10'. This confining pressure by cap 11' on the elastomeric means deforms the latter by a flattening pressure, and since the elastomeric means is flattened except for possible expansion inwardly toward the disc 34, it will be pressed into tighter engagement with the disc periphery, so as to form the main support through frictional engagement with the edge wall of the disc, for the disc, while leaving the disc free to vibrate in any pattern within its entire face areas. While this disc 34 may be an electrostrictive or piezoelectric element, or a barium titanate disc, the invention as disclosed relates broadly to the support of any vibratile element or disc, usually planar, by elastomeric means that engages the vibratile element or disc solely on its peripheral edge wall, and is out of contact with the faces of such element or disc so as to leave the faces of such vibratile element or disc uncovered and free to vibrate in any pattern. This frictional pressure on the disc edge is variable by varying the pressure on the elastomeric means.

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. A vibratile disc and its support, which comprises a member having a recess opening through a face thereof, said member having an endless rabbet with two walls at angles to one another bordering said recess and opening outwardly of the recess and at its inner side into said recess, an endless elastomeric element disposed in said rabbet and abutting said two walls of said rabbet, a vibratile disc having a marginal edge face substantially perpendicular to its other faces, disposed across said recess with its said marginal edge face abutting the inner periphery of said element, and means carried by said member and adjustable thereon in a direction normal to the planes of said other faces of said disc to confine said element in said rabbet and compress it against said two walls and said marginal edge face under a pressure varying with the said adjustment of said means, the inner periphery of said elastomeric element, in transverse cross-section receding outwardly from and out of contact with the faces of said disc, abutting said disc solely along its said marginal edge, and forming the main support for said disc.

2. A vibratile element and its support, which comprises a support member having therein a chamber that opens outwardly through a face of said member, said member having an endless rabbet around said chamber opening towards said face, and also at about right angles thereto into the chamber, an endless elastomeric ring member disposed in said rabbet, abutting its walls, and projecting outwardly of said groove towards said end face for a distance slightly beyond said rabbet, a plate-like vibratile element disposed across said chamber and having its marginal edge wall approximately perpendicular to its faces and abutting frictionally with, and mainly supported by, the inner periphery of said elastomeric member, and means adjustable on said support member for movement toward and from said rabbet and engaging said elastomeric member, confining it in said rabbet and deforming it in said rabbet in a direction inwardly of the chamber into firmer contact with said marginal edge wall of said vibratile element and increase the pressure of

5

said elastomeric member on the marginal edge face of vibratile element, said elastomeric member being always free of any substantial contact with the faces of said vibratile element.

3. The construction according to claim 2, wherein said elastomeric member along its inner periphery is convex in transverse cross-section.

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