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DAMPED ELECTRO-ACOUSTIC HIGH FREQUENCY TRANSDUCER

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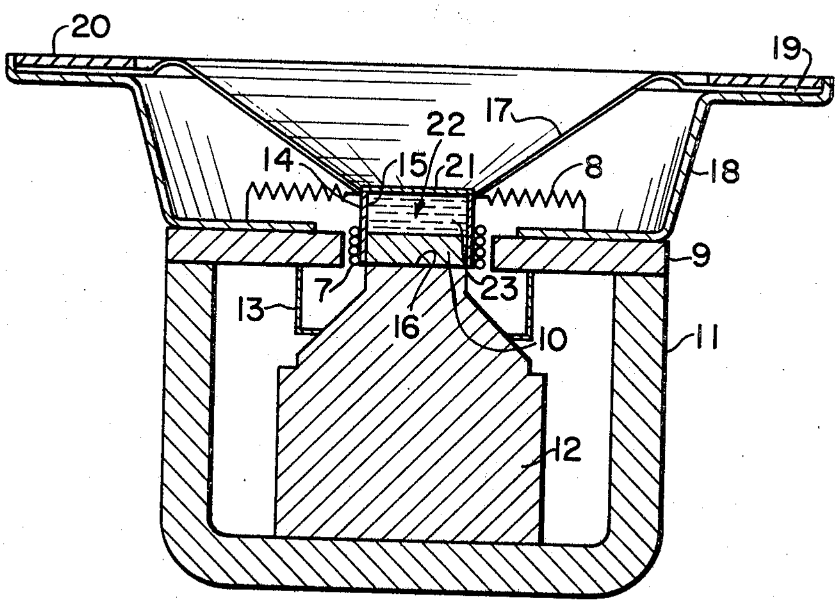

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DAMPED ELECTRO-ACOUSTIC HIGH FREQUENCY TRANSDUCER

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ABSTRACT OF THE DISCLOSURE

A damped electro-acoustic high frequency transducer which provides a chamber filled with a viscous substance which is relatively incompressible, which chamber is defined by the inner wall of a voice coil form, the end of a pole piece, and an elastomeric cap affixed to the voice coil form; movement of the voice coil form with respect to the pole piece varies the volumetric capacity of the chamber, causing the viscous material to move the elastic cap and exert thereby a damping effect upon the excursions of the voice coil form, and the diaphragm connected to it.

In the reproduction of musical sounds with a high degree of fidelity, loud speaker systems usually utilize a variety of transducers with appropriate crossover networks. It is common practice to use, in addition to a low frequency transducer, a mid-range transducer for reproducing the frequencies from 200 to 2,000 Hz. and a high range transducer for reproducing the frequencies from the vicinity of 1,000 to 20,000 Hz. Such transducers have a diaphragm, which may be of various shapes, but which is usually conical, made of an air impenetrable material and, consequently, capable of moving air. The diaphragm is attached to a voice coil form and the voice coil form is disposed with respect to a magnet to which it moves axially. Since the diaphragm is made of somewhat resilient material, it will assume a normal position. Signals applied to the voice coil wound on the form will cause it to move with respect to the magnet and to operate the diaphragm in correspondence with the signal. By reason of the natural resonance of the transducer, it is normal for such transducers to resonate in the area of 200 to 2,000 Hz. This introduced distortions into the sounds reproduced which were not present in the original signal. The ideal transducer is one which gives a flat response with respect to the signal applied to the voice coil. In order to achieve such a response, efforts are made to dampen the response sufficiently to nullify the natural resonance of the transducer. Such efforts frequently require substantial modification of the transducer system which adds to the complexity, invites additional wear and breakdown, and may introduce other additional resonances and distortions. It has been found that it is possible to make a very simple addition to a transducer that will have the effect of establishing a substantially linear relationship between the reproduced and the applied signal. This is accomplished by forming a chamber, the side wall of which is defined by the inner wall of the voice coil form, one end wall by the pole piece, and the other end wall by an elastomeric cap affixed to the other end of the voice coil form. In this chamber, a relatively thick viscous material is positioned. Thus, when the voice coil form moves, the volumetric capacity of the chamber is either increased or decreased. Since the viscous material in the chamber is relatively incompressible, the movement of the voice coil form will cause this viscous material to either distend or suck in the elastomeric material that caps the chamber. The force required to move the elastomeric cap is sufficient to exert a damping effect

upon the excursions of the diaphragm and, in this manner, produces a linear response.

This object and advantage may be attained, as well as other objects and advantages, by the device shown by way of illustration in the drawings in which FIGURE 1 is a vertical, sectional view of the transducer.

Referring now to the drawings in detail, there is provided a pole plate **9**, a pole piece **10**, a yoke **11**, and a magnet **12**. A dust cap **13** is attached to the pole plate **9** and surrounds the magnet **12**. A voice coil form **14** surrounds the pole piece **10** and has its internal diameter disposed extremely closely to the pole piece **12** without coming into contact with it. A voice coil **7** is wound on the voice coil form **14**; the voice coil form is positioned by the support or spider **8**. The end **15** of the voice coil form **14** extends above the top of the pole piece **10** to define a chamber. To the end **15**, a truncated conical diaphragm **17** is attached at its inner portion. A basket **18** is attached to the pole plate **9**. The outer end **19** of the diaphragm is secured to the basket **18** and a retainer **20** which is rigid in character is secured to the marginal flange or outer end **19** of the diaphragm **17**. A cap **21** is adhesively secured to the open end of the voice coil form **14**, thereby enclosing the chamber **22** defined by the inner wall of the voice coil form **14** and the top **16** of the pole piece **10**. In this chamber, a viscous, self-sustaining material **23** is deposited so as to fill the chamber at its normal volumetric capacity. This material **23** must have such a consistency that it will not normally enter the interstitial space between the inside of the voice coil form **14** and the outside of the pole piece **10** during excursions of the voice coil form **14**. High viscosity oils are not considered too satisfactory because they tend to flow and enter into the interstitial space. It has been found that high temperature silicone greases, which are self-sustaining, are quite satisfactory for this purpose. A high temperature silicone lubricant **23** is deposited in the chamber **22**. It will be seen that as the voice coil form **14** moves with respect to the top **16** of the pole piece **10**, in response to the signal applied, the volumetric capacity of the chamber **22** will change. If the excursion of the voice coil form **14** is such as to make the chamber **22** smaller, the grease or viscous material **23** will exert pressure on the cap **21** and tend to cause it to assume an externally convex position. On the other hand, if the excursion of the voice coil **14** is such as to enlarge the capacity of the chamber **22**, the grease or lubricant **23** will tend to cause the cap **21** to assume an externally concave configuration. The force required to deform the cap **21** is sufficient to dampen the excursions of the diaphragm **17** and to produce the desired flat response corresponding substantially to the applied signal. The damping effect achieved is most marked in the range of 200 to 2,000 Hz., where the natural resonance of the normal transducer frequently introduces undesirable distortions. It has been observed that the mass of viscous material functions as a heat sink, and permits the application of substantially greater power inputs to the voice coil of the transducer, beyond those normally applied. In spite of this, voice coil failures from overheating that might normally occur due to higher input levels, do not occur under these increased load conditions. Voice coil burn-out under higher input levels is reduced.

A speaker resonance peak of perhaps 9 to 12 decibels beyond that which might have been anticipated from the applied signal, in this manner is avoided.

The foregoing description is merely intended to illustrate an embodiment of the invention. The component parts have been shown and described. They each may have substitutes which may perform a substantially similar function; such substitutes may be known as proper substitutes for the said components and may have actually been known or invented before the present invention; these substitutes are contemplated as being within the scope of the appended claims, although they are not specifically catalogued herein.

What is claimed:

1. A damped electro-acoustic high frequency transducer comprising

(a) a pole piece,

(b) a voice coil form closely embracing the pole piece, and extending beyond it to define an open chamber with the end of the pole piece,

(c) the chamber filled with a self-sustaining viscous material,

(d) an elastomeric seal on the open end of the voice coil form to enclose the chamber and to contain the viscous mass,

(e) the volumetric capacity of the chamber varying with the movement of the voice coil,

(f) the seal normally tending to yield to the movement of the viscous material in the chamber upon changes in the volumetric capacity of the chamber.

2. A damped electro-acoustic high frequency transducer comprising

(a) the device according to claim **1**, and

(b) the viscous material in the chamber being a silicone grease.

3. A damped electro-acoustic high frequency transducer comprising

(a) the device according to claim **1**, and

(b) a spacing spider attached to the voice coil, to position it in surrounding and spaced relation to the pole piece.

4. A damped electro-acoustic high frequency transducer comprising

(a) the device according to claim **1**, and

(b) the elastomeric material having sufficient tensile strength to exert a damping influence on the excursions of the voice coil.

5. A damped electro-acoustic high frequency transducer comprising

(a) the device according to claim **1**, and

(b) the elastomeric material having sufficient tensile strength to exert a damping influence on the excursions of the voice coil in the frequency range of 200 to 2,000 Hz.

6. A damped electro-acoustic high frequency transducer comprising

(a) the device according to claim **1**, and

(b) the viscous material defining a heat sink, for maintaining the voice coil temperature at a safe level, under high power input conditions.

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