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LOUDSPEAKER CONE RIM TREATMENT

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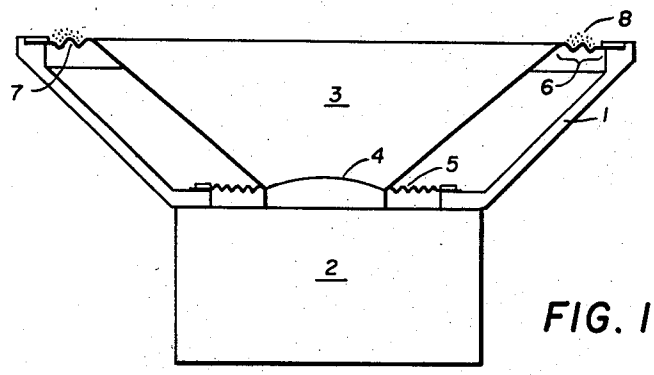


FIG. 1

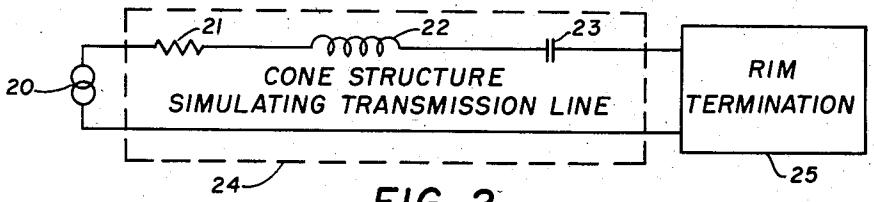


FIG. 2



FIG. 3

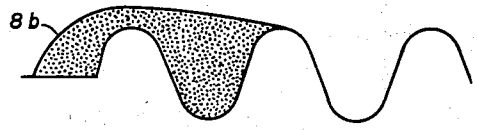


FIG. 4

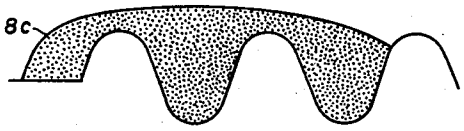


FIG. 5



FIG. 6

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LOUDSPEAKER CONE RIM TREATMENT

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13 Claims. (Cl. 181—31)

This invention relates to loudspeaker cones and more particularly to means for treating a loudspeaker to reduce cone rim reflection.

A loudspeaker cone may be analogically considered as an electrical transmission line with a power source located at the cone apex. Schematically then, the voice coil may represent the power source. The transmission line may be represented by three elements in series: a resistance which is similar to the distributed resistance of the cone material, an inductance which corresponds to the distributed mass of the cone material, and a capacitance which represents the distributed compliance of the cone material. This transmission line is terminated by cementing the cone to its basket mounting at the rim, known as rim termination. The rim termination actually represents the compliant material which is used to attach the cone to the speaker mounting frame or basket. The transmission line then simulates a frequency discriminatory structure and the rim termination should therefore present its characteristic impedance in order to reduce reflection.

Certain attempts have been made to reduce reflection by various methods of treating the cone rim. One method comprises attaching a compliant leather ring (such as carpincho) to the cone periphery, and then attaching this leather in turn to the mounting frame or basket. Another method is by moulding several corrugations at the periphery of the cone adjacent to where it is attached to the mounting frame or basket. Still another method includes the addition of supplemental compliance at the cone rim, such as by cutting radial slots, for example.

Accordingly, it is a primary object of the present invention to provide a new and improved loudspeaker.

Another object of the present invention is to provide a new and improved means for treating loudspeaker cone rims.

In accordance with this invention, the above cited objects are accomplished by means of a compliant adhesive mixed with a massive ingredient which is applied adjacent the cone rim to provide a distributed resistance, mass, and compliance in proper width and thickness of application to terminate the loudspeaker cone by presenting approximately its characteristic impedance. This treatment reduces the mechanical reflection at the rim of the sound waves traveling in the paper from the voice coil to provide more uniform sound radiation with respect to frequency.

The invention, both as to its organization and method of operation together with further objects and advantages thereof, will be understood best by making reference to the following specifications taken in connection with the accompanying drawing in which:

Fig. 1 illustrates a cross-sectional view of a typical loudspeaker;

Fig. 2 illustrates the electrical circuit which is equivalent to a loudspeaker;

Fig. 3 illustrates the application of a weighted compliant adhesive to the rim edge of a loudspeaker cone in accordance with the present invention; and

Figs. 4 through 6 illustrate alternative methods of applying the weighted compliant adhesive.

Referring now more particularly to the drawings, there is illustrated in Fig. 1 thereof, a cross-sectional view of a typical loudspeaker. In general, the loudspeaker shown in Fig. 1 provides means for vibrating a mass of air comprising a diaphragm or cone 3 and a cone-supporting basket 1 attached to a suitable transducing element housing 2. The loudspeaker cone 3 has a dust cap 4 attached near its apex. This is especially valuable in case the transducer of element 2 includes a magnetic structure which might otherwise attract dust and dirt. A compliant support 5, preferably corrugated in cross section, is generally provided near the apex of the cone and a second support 6 is provided for attaching the cone to the basket at the outer edge or rim thereof. Elements 5 and 6 thus cooperate to support the speaker cone. Element 6 comprising grooves or rolls 7 provides means having predetermined compliance for supporting the cone adjacent the outer periphery thereof. These grooves may be of suitable configuration as concentric annular corrugations, for example.

In accordance with the present invention, as will be described in more detail hereinafter, a compliant material is added in these rolls in element 6 adjacent the outer periphery or rim as is shown at 8 to provide a proper cone rim termination.

A typical loudspeaker may be shown by an equivalent circuit as in Fig. 2. The voice coil 20 is loaded acoustically by the resistance of the cone 21, the mass of the cone 22, and the compliance of the cone 23. It will be seen that these three elements provide a frequency discriminatory circuit since the cone is loaded at the outer periphery by attachment to the basket. This may be shown electrically as rim termination 25. It will be seen that without this rim termination the loudspeaker would have resonance at any frequency to which the discriminatory circuit may be tuned. This generally occurs in the 500 to 1500 cycle region. By loading the rim periphery with a suitable compliant material having relatively appreciable mass, the characteristic impedance of the speaker is met at the rim termination and the resonance disappears.

Several methods may be used to provide rim loading as by a combination or mixture of loading and holding materials uniformly distributed to terminate the cone at the circumference thereof. However, the embodiment of the invention shown in the drawings uses a holding material in the form of a suitable compliant adhesive which is loaded by some other compound having relatively appreciable mass. The adhesive vehicle may be any which is flexible provided that the degree of flexibility is stable with respect to time, temperature and humidity. For example, the adhesive which is made and sold under the name "Geon 576" has been found to have suitable characteristics. Any suitable mass ingredient, such as lead powder, for example, may be used. Other suitable mass ingredients comprise lead oxide, mercuric oxide, fine sand, and the like. In the case of a lead powder and "Geon 576" mixture satisfactory for use on a typical 8 inch speaker, a proper speaker operation may be had where the proportions are one part by weight "Geon 576" and one part by weight lead powder 200 mesh.

It should be understood that the preceding illustration of a mixture comprising an adhesive and a loading compound is cited by way of example only and that many flexible materials may be impregnated with a massive ingredient to provide a similar result.

It should be further understood that the preceding ex-

ample of lead powder 200 mesh is given by way of example only and that the mass particle size and compliance of the treated area will vary depending upon the characteristics of each speaker. If the particles are made relatively smaller, the mixture becomes more compact, stiffer and less compliant, since the distances between particles are smaller. On the other hand, the mixture becomes less compact, lighter per unit volume, and also more compliant, if the particles are relatively larger since the distances between the particles are greater. The compactness of the mixture is selected according to the speaker requirements and relates to the thickness and the amount of paper used in the cone. Hence, it is seen that the mass distribution of the mixture varies directly with the mass distribution of the paper.

This mixture may be positioned in or applied to any of the grooves or rolls in the outer periphery of the speaker cone or combination thereof as illustrated in Figs. 3 through 6 by reference numerals 8*a*—8*d*, respectively. The proper weight, location and thickness of this material depends primarily upon the particular speaker being used.

The mixture is applied uniformly about the circumference of the speaker cone. While many different methods of application may be used, it is found that one suitable method comprises applying the mixture with a paint brush. Obviously, some of the loading ingredient may tend to move from the tops of the grooves or rolls to the bottoms thereof before the adhesive sets; however, these variations have been found to have little effect.

While we have described only a few embodiments of our invention, it should be understood that various modifications thereof may be made. Therefore, we intend to claim all modifications that fall within the true spirit of our invention.

What is claimed is:

1. In a loudspeaker, a vibratile diaphragm having a predetermined compliance at the periphery thereof, means for supporting said diaphragm adjacent the outer periphery thereof, said means for supporting said diaphragm comprising means for providing a circumferentially and uniformly distributed mixture of a holding material and a loading material adjacent said periphery for determining the mechanical action of said support, whereby said periphery is terminated by a substantial mass, said mixture being such that said predetermined compliance remains unchanged.

2. The loudspeaker of claim 1 wherein said holding material comprises a flexible, adhesive vehicle and said loading material comprises a massive ingredient.

3. The loudspeaker of claim 2 wherein said massive ingredient is lead powder.

4. The loudspeaker of claim 3 wherein said mixture of vehicle and massive ingredient comprises equal proportions by weight of said vehicle and said lead powder.

5. The loudspeaker of claim 2 wherein said massive ingredient comprises lead oxide.

6. The loudspeaker of claim 2 wherein said massive ingredient comprises mercuric oxide.

7. The loudspeaker of claim 2 wherein said massive ingredient comprises fine sand.

8. A loudspeaker comprising vibratile means having a particular degree of stiffness, means for supporting said vibratile means adjacent the outer periphery thereof, and means comprising a mixture of a massive ingredient and a flexible, adhesive vehicle circumferentially and uniformly distributed adjacent said periphery, said ingredient comprising a plurality of particles, the flexibility of said adhesive vehicle being such that said particular degree of stiffness is maintained.

9. The loudspeaker of claim 8 wherein said means for supporting said vibratile means comprises a plurality of grooves formed adjacent said outer periphery thereof, said mixture being applied adjacent the outermost of said grooves.

10. The loudspeaker of claim 8 wherein said means for supporting said vibratile means comprises a plurality of grooves formed adjacent said outer periphery thereof, said mixture being applied on a plurality of said grooves.

11. The loudspeaker of claim 8 wherein said means for supporting said vibratile means terminates in a plurality of rolls, said mixture being applied on an inner one of said rolls.

12. In a loudspeaker, means for vibrating a mass of air having a characteristic rim termination, means having a predetermined compliance for supporting said first named means adjacent the outer periphery thereof, and means for providing a substantially uniformly and circumferentially distributed mass comprising a mixture of flexible adhesive vehicle and particles of massive ingredient positioned adjacent said outer periphery, the size and weight of said massive ingredient particles being determined by the nature of said rim termination and said predetermined compliance.

13. In a loudspeaker, means having a predetermined compliance at the periphery thereof for vibrating a mass of air, means including said periphery for supporting said first named means, means comprising a mixture of an adhesive vehicle and a finely divided massive ingredient carried by said periphery, said mixture being such that said predetermined compliance remains unchanged, whereby said massive ingredient is distributed substantially uniformly and circumferentially adjacent said periphery.

References Cited in the file of this patent

UNITED STATES PATENTS

2,549,091	Hopkins	Apr. 17, 1951
2,734,591	Olson et al.	Feb. 14, 1956

FOREIGN PATENTS

237,699	Great Britain	Aug. 6, 1925
293,414	Great Britain	Mar. 4, 1929
320,802	Great Britain	Oct. 24, 1929
534,412	Germany	Sept. 26, 1931
596,893	Great Britain	Jan. 13, 1948