Jan. 16, 1951 H. F. HOPKINS ET AL 2,538,621

ELECTRODYNAMIC TRANSDUCER AND CONNECTOR THEREFOR

Filed April 23, 1945

FIG. 1

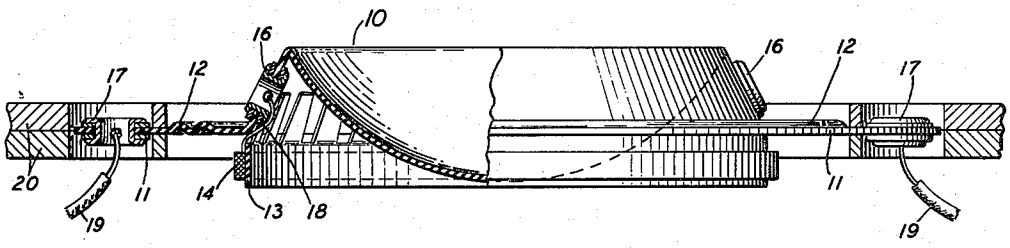
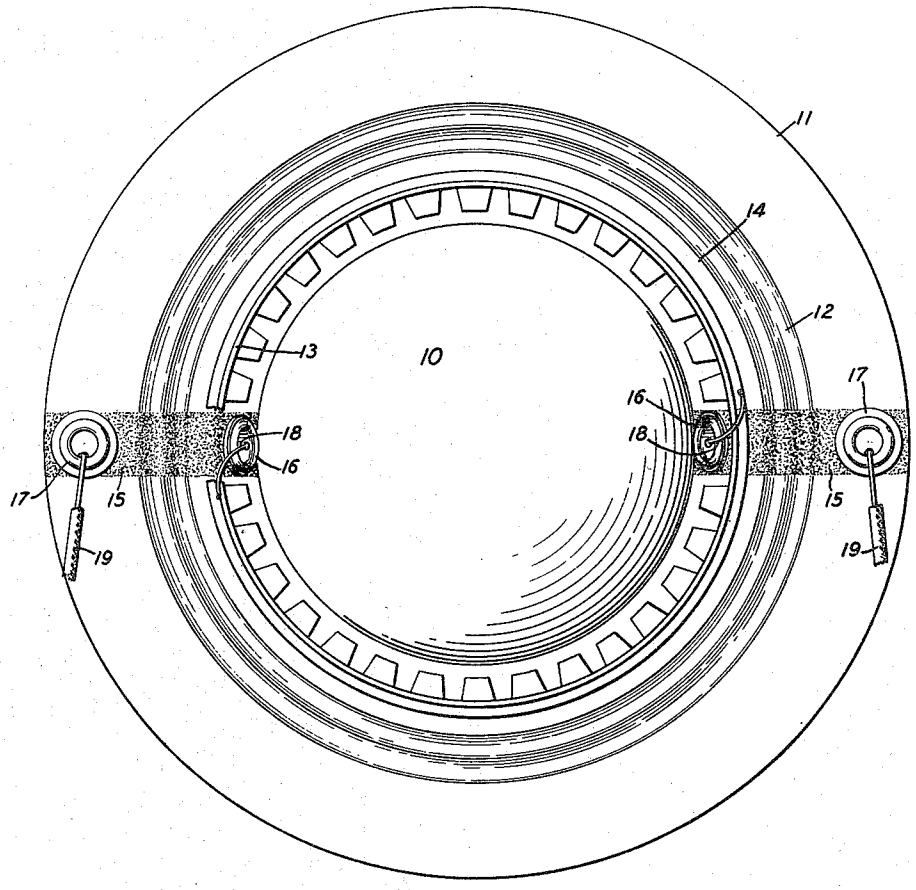



FIG. 2

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## ELECTRODYNAMIC TRANSDUCER AND CONNECTOR THEREFOR

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6 Claims. (Cl. 179—115.5)

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This invention relates to vibratory systems and more particularly to diaphragm assemblies for electromechanical transducers such as, for example, transmitters and receivers of the moving coil type.

Electromechanical transducers such as acoustic devices of the moving coil type comprise, in general, a vibratory member, such as a diaphragm and an electrical element, such as a signal coil, coupled thereto for converting vibrations of the member into electrical signals or conversely, converting electrical signals into vibrations. A major problem involved in the construction of such devices is that of establishing electrical connection between the electrical element and a circuit to be associated therewith. It is highly desirable that such connection be of low resistance, capable of withstanding repeated flexure or vibration without impairment and of such character as not to affect deleteriously the vibrating characteristics of the assembly.

One general object of this invention is to improve vibratory systems including an electrical connection between the system and a fixed terminal or a terminal vibrating in a different mode. More specifically, one object of this invention is to improve lead-in systems for the signal coil in electroacoustic transducers of the moving coil type.

Another object of this invention is to realize an electrical connection between a vibratory member and a stationary member or a member vibrating in a different mode which will be characterized by low resistance, long operating life and substantially no effect upon the vibrational characteristics of the vibratory member.

A further object of this invention is to simplify and facilitate the construction of diaphragm and signal coil assemblies for electroacoustic transducers of the moving coil type.

Still another object of this invention is to increase the ruggedness of such assemblies thereby to minimize damage thereof during manufacture, assembly and transportation.

In one illustrative embodiment of this invention, in a diaphragm and signal coil assembly for moving coil transducers, the diaphragm being of a normally non-conducting material, leading-in connection to the coil is established through restricted areas of the diaphragm treated to render them electrically conductive. Specifically, in one illustrative construction, the diaphragm is of a fibrous material, such as a fabric, and restricted portions thereof, for example portions extending radially from adjacent the region at which the

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signal coil is coupled to the diaphragm to adjacent the periphery of the diaphragm, are impregnated with a finely divided conductive material in a suitable vehicle, for example with metal powder loaded resin, and the coil ends are connected to these portions.

The invention and the several features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing in which:

Fig. 1 is a side view partly in section of a diaphragm assembly illustrative of one embodiment of this invention; and

Fig. 2 is a plan view of the assembly shown in Fig. 1.

Referring now to the drawing, the diaphragm assembly comprises a diaphragm having a central, dished relatively rigid portion 10, a peripheral mounting portion 11 and an intermediate flexible portion 12 which may be corrugated as illustrated. Affixed to the diaphragm adjacent the junction of the central and intermediate portions 10 and 12 respectively, is a cylindrical form or support 13 upon which a signal coil 14 is mounted.

The diaphragm may be formed in one piece of a suitable fabric, such as muslin. Restricted portions thereof, shown clearly at 15 in Fig. 2, are impregnated with a material, such as a metal powder loaded in a suitable vehicle, to render these portions electrically conductive. An illustrative impregnating material which has been found satisfactory is composed of finely divided silver in the form of polished flakes in a vehicle of phenolic resin such as phenol polyvinyl butyrol, the powder constituting of the order of 35 per cent by weight of the mixture. The diaphragm may be impregnated subsequently with a suitable material such as a phenolic condensation product.

Carried by the diaphragm and in intimate contact with the portions 15 thereof are two pairs of terminals or connectors 16 and 17, such as eyelets. The ends 18 of the signal coil 14 are suitably affixed, as by soldering, to the eyelets 16; suitable conductors 19 for connection to an external circuit are affixed to the eyelets 17.

In use, the diaphragm is mounted upon a suitable support; for example, the peripheral portion 11 may be clamped between a pair of nonconductive rings 20 provided with apertures in which the eyelets 17 are positioned.

The diaphragm assembly may be fabricated in the following manner: The portions 15 of a circular blank of fibrous material, such as muslin, are impregnated with the metal powder loaded solvent or vehicle and dried to remove the ve-

hicle. The blank then is impregnated with the desired material, such as a phenolic condensation product, and dried. Thereafter, the blank is formed and moulded into the desired shape, e. g. into the form illustrated in Fig. 1. The eyelets 16 and 17 are installed and the support 13 with the signal coil 14 thereon is affixed in place, as by cementing it to the formed diaphragm. Finally, the coil ends 18 are secured, as by soldering, to the eyelets 16.

It will be noted that the completed diaphragm is of homogeneous construction, being impregnated throughout. From a mechanical impedance standpoint, there is no substantial difference between the portions of the diaphragm impregnated with the metal loaded resin and those impregnated with the phenolic condensation product, so that the portions 15 do not deleteriously affect the vibrational characteristics of the diaphragm. These portions, of course, vibrate with the diaphragm so that relative motion between the lead-in connections to the coil and the diaphragm is not present. The portions 15 may be made of substantial area so that a very low resistance lead-in connection is provided thereby. In a typical case, for example, a resistance of 0.08 ohm was obtained. Hence, power losses in the lead-in system are minimized. Finally, lead-in connections provided in accordance with the invention have been found to have a very long operating life, being capable of continuous vibration at the maximum diaphragm amplitude for long periods, without failure.

Although a specific embodiment of this invention has been shown and described, it will be understood, of course, that it is but illustrative and that various modifications may be made in the construction shown without departing from the scope and spirit of this invention as defined in the appended claims.

What is claimed is:

1. A vibratory system comprising a vibratory member having a portion of non-conductive foraminous material impregnated with a vehicle loaded with finely divided metal, an electrical element coupled to said member, and an electrical connection between said element and said portion.

2. A vibratory system comprising a vibratory member having spaced portions thereof of fibrous material impregnated with a metal powder loaded vehicle, an electrical element coupled to said member, terminals carried by said member and electrically integral with said portions, and electrical connections between said element and said terminals.

3. A diaphragm assembly comprising a diaphragm of fibrous material having two spaced portions impregnated with a metal powder loaded vehicle, a pair of terminal members electrically integral with each of said portions, one terminal member of each pair being adjacent the periphery of said diaphragm, and the other terminal member of each pair being adjacent the central portion of said diaphragm, and a signal coil coupled to said diaphragm adjacent said central portion, each end of said coil being connected to a respective one of said other terminal members.

4. A diaphragm assembly comprising a fibrous diaphragm having two spaced portions impregnated with a phenolic resin loaded with finely divided metal and the remainder impregnated with a phenolic condensation product, a coil coupled to said diaphragm, and electrical connections between said coil and said portions.

5. A diaphragm assembly comprising a fabric diaphragm having a central portion and a peripheral portion, a first pair of eyelets mounted by said diaphragm and in said peripheral portion, a second pair of eyelets mounted by said diaphragm and in said central portion, a signal coil coupled to said diaphragm adjacent said central portion and having its ends connected electrically to said second pair of eyelets, and an electrical connection between each of said second pair of eyelets and a respective one of said first pair of eyelets defined by portions of said diaphragm impregnated with a metal loaded resin.

6. A diaphragm assembly in accordance with claim 5 wherein said metal loaded resin is phenol polyvinyl butyrol having of the order of 35 per cent by weight of finely divided silver therein.

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