

PATENT SPECIFICATION

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(54) TRANSDUCER DEVICE

(71) We, GENERAL ELECTRIC COMPANY, a corporation organized and existing under the Laws of the State of New York, United States of America, of 1 River Road, Schenectady 12305, New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to transducer devices.

Transducers such as loudspeakers and microphones used for converting electrical energy into linear mechanical motion and vice versa have conventionally had a relatively large stationary permanent magnet coupled to interact with a movable electrical coil which is connected to a membrane or diaphragm so arranged that when the coil is moved it imparts a corresponding movement to the membrane or diaphragm and when the membrane or diaphragm is moved it imparts a corresponding movement to the coil. When such a transducer is used as the actuating element in a loudspeaker of the type used in television and radio broadcast reception great care in manufacture is necessary in order to insure proper tolerances between the moving coil and permanent magnet structure. In addition, the mass of the moving coil is very critical because of acoustic tonal balance problems.

Thus, the conventional transducer not only has engineering requirements which must be satisfied but also requires considerable manual adjustment and care during the course of manufacture. It is a labor-intensive component to manufacture.

The present invention provides a transducer device for converting an electrical signal into an acoustical sound output, comprising a U-shaped core of magnetically permeable material, a stationary electrical coil around said core for the creation of an electromagnetic field, a pole piece mounted on each end of said core, the pole pieces

defining a gap between the core ends, a resilient pad bridging said gap, and a movable permanent magnet positioned on said pad to interact with said electromagnetic field and move in response to the electrical field impressed upon said stationary electrical coil.

The extent of movement of the permanent magnet in response to the electromagnetic field for a given magnet weight should be high, and cobalt-rare earth magnets are the preferred form of such permanent magnets.

In order that the invention may be clearly understood, a preferred embodiment thereof will now be described by way of example only with reference to the accompanying drawing, which is a schematic diagram showing the permanent magnet in the form of a bar magnet positioned on a resilient pad bridging the gap between the pole pieces of a U-shaped core of magnetically permeable material.

In utilizing a permanent magnet as the element for translating electrical energy into mechanical energy, it is important that the permanent magnet have as high a reaction force per unit of weight with respect to an external magnetic field as possible. Such a force is the product of the intrinsic magnetization of the permanent magnet and the strength of the external field. In the case of cobalt-rare earth magnets a very short heavily self demagnetized volume still has nearly the full intrinsic level of magnetization. Consequently, a low mass permanent magnet element of the cobalt-rare earth type can exert a very large force in an external field.

The cobalt-rare earth magnets which are the preferred permanent magnets for use in this invention are of the type described in Becker our U.K. patent specifications Nos. 1188059, 1319142, 1347763 and 1343536.

The reaction force achievable in a cobalt-rare earth magnet per unit of mass is greater by a factor of approximately 10 than older permanent magnet materials such as Alnico. Of the rare earths (elements 59—72) samarium alloyed with cobalt has been

shown to provide the greatest coercive force up to the present time. However, mixtures of rare earths commonly available under the designation "mischmetal" can be allowed with cobalt to produce satisfactory permanent magnets for use in the practice of this invention. For purposes of this invention yttrium and cerium are included with the rare earth elements.

In the drawing, a membrane or diaphragm 10, which is usually of circular configuration and which may be cone-shaped, is physically connected to a permanent magnet 11 by means indicated by a line 12. Movement of the permanent magnet 11 will impart comparable movement to the diaphragm 10. The permanent magnet 11 is positioned to interact with an external magnetic field produced by an electromagnetic assembly consisting of a U-shaped core 13 of magnetically permeable material with a stationary electrical coil 14 around it for the creation of an electromagnetic field. The polarity of the permanent magnet 11 is indicated by the letters "N" and "S"; the magnet 11 is a bar magnet attached to a resilient pad 15 bridging a gap between pole pieces 16 defining a gap between the ends of core 13 and mounted on the ends.

In operating the transducer as, for example, a loudspeaker, an electrical signal is fed to the coil 14 to produce a corresponding magnetic field which interacts with the permanent magnet 11. This interaction with the permanent magnet 11 converts the electrical signal to a corresponding mechanical movement in the permanent magnet 11. This movement is then transmitted to the diaphragm 10 which emits sound corresponding to the electrical signal introduced to the coil 14.

High interactions take place between the

field of the permanent magnet 11 and the field of the electromagnetic assembly provided by the core 13 and coil 14. Thus, larger tolerances between the permanent magnet 11 and core 13 are possible than is the case with moving coil dynamic speakers. These tolerances improve the reliability of the transducer device with respect to time and considerably reduce the cost of manufacture of such devices. In addition, the coil 14, being stationary, is no longer limited as to weight. Consequently, it can be provided with a high-impedance winding and thereby eliminate the need for a coupling transformer.

WHAT WE CLAIM IS:—

1. A transducer device for converting an electrical signal into an acoustical sound output, comprising a U-shaped core of magnetically permeable material, a stationary electrical coil around said core for the creation of an electromagnetic field, a pole piece mounted on each end of said core, the pole pieces defining a gap between the core ends, a resilient pad bridging said gap, and a movable permanent magnet positioned on said pad to interact with said electromagnetic field and move in response to the electrical field impressed upon said stationary electrical coil.
2. A transducer device as claimed in Claim 1, wherein the permanent magnet is a cobalt-rare earth magnet.
3. A transducer device as claimed in Claim 2, wherein the permanent magnet is a cobalt-samarium magnet.
4. A transducer device substantially as hereinbefore described with reference to and as shown in the accompanying drawing.

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In the drawing, a membrane or diaphragm 10, which is usually of circular configuration and which may be cone-shaped, is physically connected to a permanent magnet 11 by means indicated by a line 12. Movement of the permanent magnet 11 will impart comparable movement to the diaphragm 10. The permanent magnet 11 is positioned to interact with an external magnetic field produced by an electromagnet assembly consisting of a U-shaped core 13 of magnetically permeable material with a stationary electrical coil 14 around it for the creation of an electromagnetic field. The polarity of the permanent magnet 11 is indicated by the letters "N" and "S"; the magnet 11 is a bar magnet attached to a resilient pad 15 bridging a gap between pole pieces 16 defining a gap between the ends of core 13 and mounted on the ends.

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