Jan. 8, 1935. W. KALIN 1,987,445

ELECTRODYNAMIC DEVICE

Original Filed Feb. 12, 1932 3 Sheets-Sheet 1

FIG. 1

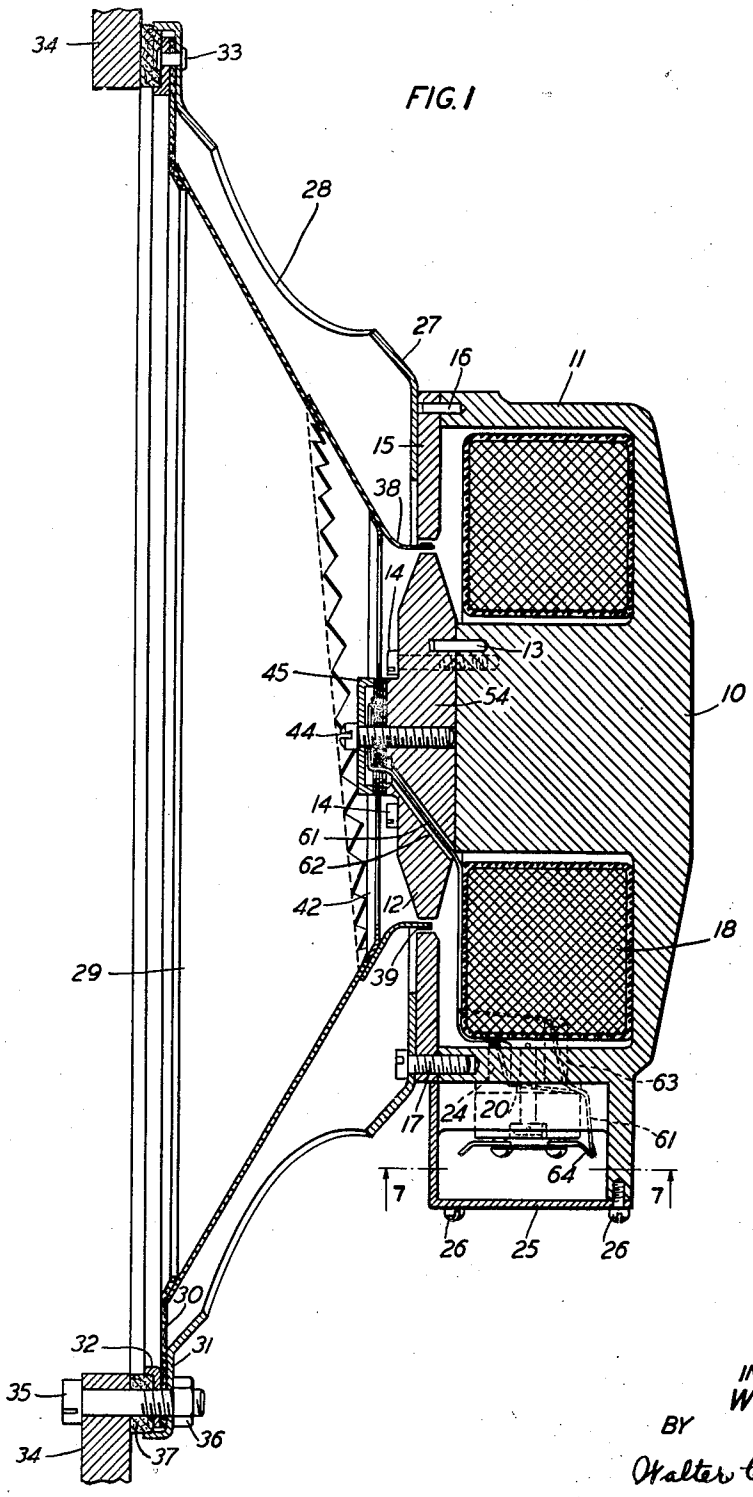

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FIG. 2

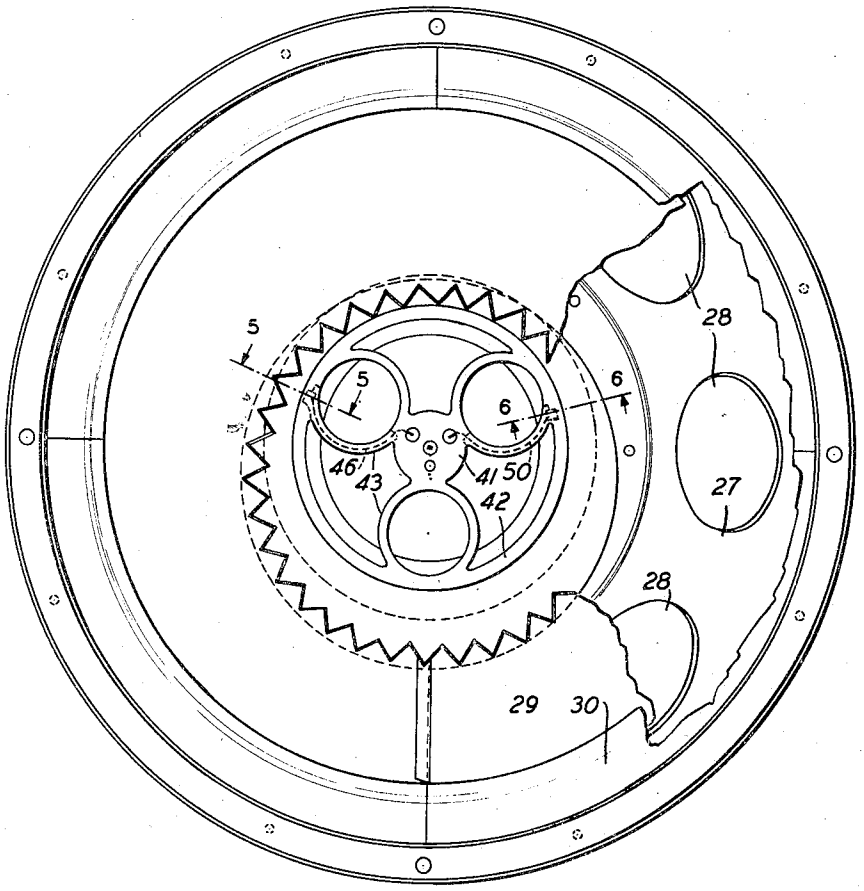

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FIG. 3

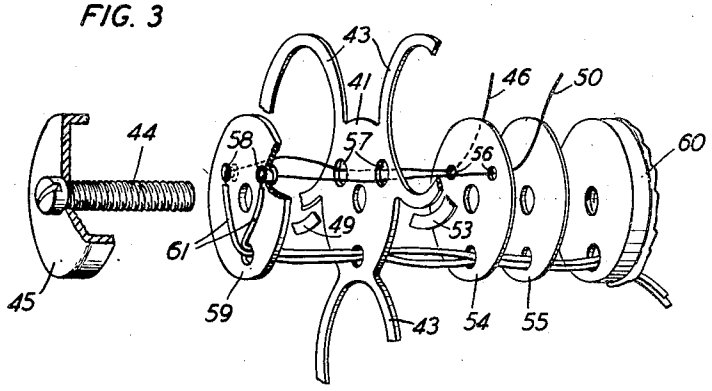


FIG. 4

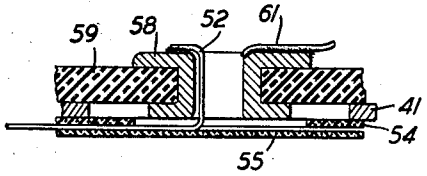


FIG. 5

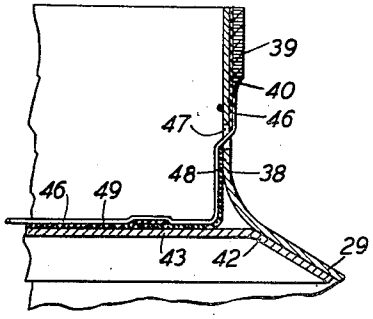


FIG. 6

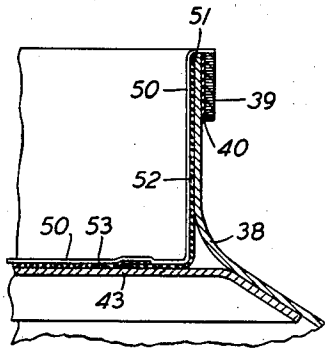
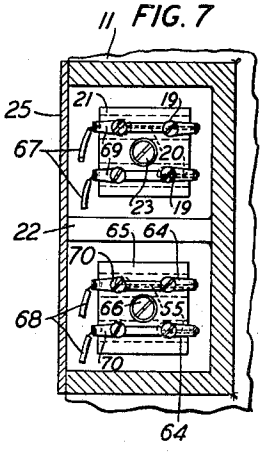


FIG. 7



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Patented Jan. 8, 1935 1,987,445

UNITED STATES PATENT OFFICE

1,987,445

ELECTRODYNAMIC DEVICE

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Original application February 12, 1932, Serial No. 592,498. Divided and this application September 22, 1932, Serial No. 634,343. In Great Britain April 28, 1932

2 Claims. (Cl. 179—115.5)

This invention relates to electrodynamic devices and more particularly to moving coil actuated loudspeakers such as shown and described, for example, in my copending application Serial No. 592,498, filed February 12, 1932, of which the present application is a division.

Moving coil actuated loudspeakers comprise in general a diaphragm and a lightweight coil connected to the diaphragm, the coil being disposed in a conforming air gap of a magnet and adapted to vibrate the diaphragm in accordance with audio frequency currents passing through the coil. It is desirable for efficient operation that the mass of the vibrating element of the loudspeaker be small and that this element be capable of movement with but little restraint. For these reasons, the leading-in conductors for the driving coil usually comprise thin lightweight metallic wires. Such wires, however, are very fragile and are subject to fracture because of the flexure thereof when the diaphragm and driving coil vibrate.

One object of this invention is to prevent the fracture of the leading-in conductors for driving coils in electrodynamic apparatus.

Another object of this invention is to expedite the association of the driving coil in such apparatus with an external circuit.

In one embodiment illustrative of this invention, a moving coil actuated loudspeaker comprises a magnet having concentric pole pieces defining a narrow annular air gap, and a diaphragm which is flexibly supported at one end from the inner pole piece of the magnet by a spider member. The spider member comprises a central or hub portion secured to the inner pole piece, an outer or rim portion connected to the diaphragm, and a plurality of flexible arms connecting the hub and rim portions. A lightweight driving coil is secured to the portion of the diaphragm, adjacent the rim portion of the spider and is disposed in the annular air gap of the magnet.

In accordance with one feature of this invention, the leading-in conductors for the driving coil extend inwardly from the coil along certain of the arms of the spider and are secured to terminals insulatingly mounted on the inner pole piece adjacent the hub of the spider.

In accordance with another feature of this invention, the inner pole piece is provided with a bore through which conductors for associating the driving coil with an external circuit extend. These conductors are secured at one end to the terminals mounted on the inner pole piece and at the other end to terminals mounted on an easily accessible portion of the magnet.

These and other features of the invention will be understood more clearly from the following detailed description with reference to the accompanying drawings in which:

Fig. 1 is a side elevational view in cross-section of a moving coil actuated loudspeaker illustrative of one embodiment of this invention;

Fig. 2 is a front view of the diaphragm and the mounting therefor with a portion of the diaphragm broken away to show the form of the mounting more clearly, and illustrates the leading-in conductors for the diaphragm disposed in accordance with one feature of this invention;

Fig. 3 is an exploded view showing the relation of the spider, the inner pole piece of the magnet, the terminal members mounted thereupon, and the leading-in conductors for the driving coil in the loudspeaker shown in Fig. 1;

Fig. 4 is an enlarged detail view in cross-section showing the manner in which the leading-in conductors for the driving coil are connected to the terminals mounted on the inner pole piece of the magnet;

Figs. 5 and 6 are enlarged detail views in cross-section along lines 5—5 and 6—6, respectively of Fig. 2, showing the association of the diaphragm, the driving coil and the leading-in conductors for the coil; and,

Fig. 7 is a detail view partly in cross-section of the external terminal assembly for the driving coil and for the field coil of the magnet.

Referring now to the drawings, in one embodiment of this invention, a loudspeaker comprises a casting of magnetic material having a central pole 10 and an outer pole 11 disposed about the pole 10. A circular pole piece 12 is positioned on the central pole 10 by dowel pins 13, only one of which is shown, and is secured in position by bolts 14 extending through the pole piece 12 and threaded into the central pole 10. A pole piece 15 having a circular central opening is concentrically positioned about the pole piece 12 by dowel pins 16, only one of which is shown, to form a narrow annular air gap and is secured to the outer pole 11 by a plurality of bolts 17 threaded into the pole 11. The dowel pins 13 and 16 accurately position the pole pieces 12 and 15 with respect to each other and insure the proper relation thereof if the pole pieces are removed and then replaced upon the poles 10 and 11, for example, to allow repair or replacement of a field or magnetizing coil 18 which encircles the central pole 10. The coil 18 is electrically connected

to terminals 19 by leading-in conductors 20. The terminals 19 are mounted upon an insulating block 21 which is disposed in a pocket or chamber formed in the magnetic casting, divided by a partition 22, and is secured to the outer pole 11 by a single bolt 23. The conductors 20 extend through a bore 24 in the pole 11 and are connected to the terminals 19 as shown more clearly in Fig. 7. The pocket in which the terminal block 21 is disposed may be closed by a plate 25 having a suitable aperture therein for passing leading-in wires for the terminals 19 and secured to the casting by screws 26.

A dished metallic member 27 having a plurality of spaced apertures 28, as shown more clearly in Fig. 2, is mounted upon the annular pole piece 15 by the bolts 17 and houses and supports a large direct acting diaphragm 29, which may be of the construction shown and described in my copending application, Serial No. 592,498, filed February 12, 1932. The area of the apertures 28 is preferably such that free outward and inward flow of air adjacent the face of the diaphragm 29 contiguous with the member 27 is allowed so that substantially no air damping of the diaphragm 29 is effected.

The circumferential edge of the diaphragm 29 is supported in the housing member 27 by an aperiodic annulus 30 of vibration absorbing material, such as felt, which is clamped between a peripheral flange 31 of the member 27 and a ring 32 by eyelets 33. The member 27 may be mounted on a baffle board or wall 34 by bolts and nuts 35 and 36, respectively, a sealing and buffer ring 37 of felt or the like being disposed between the clamping ring 32 and the baffle or wall 34.

The diaphragm 29 is provided at its smaller end with a cylindrical flange 38 which extends into the air gap between the pole pieces 12 and 15 and carries a cylindrical driving coil 39. The driving coil 39, as shown more clearly in Figs. 5 and 6, may comprise a plurality of edgewound turns of insulated metallic ribbon, such as disclosed in A. L. Thuras Patent 1,707,544, April 2, 1929, and is suitably attached, as by cementing, to an insulating sleeve 40 secured to the flange 38.

A spider, which may be of a suitable light weight material such as duralumin, includes a hub portion 41, an annular rim portion 42 which is secured to the diaphragm 29 adjacent the smaller end thereof, and a plurality of flexible radially extending arcuate arms 43 connected to the hub and rim portions 41 and 42, respectively, and integral therewith. The spider is mounted upon the pole piece 12 by a bolt 44 which extends through a metallic cap 45 and is threaded into the pole piece 12 and accurately locates the driving coil 39 within the air gap between the pole pieces 12 and 15. The arcuate arms 43 are flexible radially of the spider so that the coil 39 may execute rectilinear movement within the air gap.

An extension 46 of the driving coil 39, as shown in Fig. 5, passes through an aperture 47 in the flange 38 and is secured, as by cementing, to overlapping insulating strips 48 and 49 attached to the flange 38 and to one of the arms 43 of the spider. Another extension 50 of the driving coil 39, as shown in Fig. 6, passes through a slot 51 in the flange 38 and is secured to overlapping insulating strips 52 and 53 likewise attached to the flange 38 and to one of the arms 43, respectively. The extensions 46 and 50 pass between insulating washers 54 and 55, as clearly shown in Figs. 3 and 4, and through corresponding apertures 56 and 57 in the washer 54 and hub 41, respectively, and are attached to terminal eyelets 58, mounted upon an insulating disc 59 which is seated upon the hub 41 of the spider. The disc 59, hub 41 and washers 54 and 55 are clamped as a unitary pile-up upon a raised hub 60 of the pole pieces 12 by the cap 45 through the bolt 44.

Insulated leading-in conductors 61 are attached at one end to the eyelets 58 and pass through aligned apertures in the disc 59, hub 41 and washers 54 and 55, through a bore 62 in the pole piece 12 and through a bore 63 in the pole 11. The conductors 61 are attached at their other ends to terminal clips 64 mounted upon an insulating block 65 secured to the pole 11 adjacent the partition by a single bolt 66.

The driving coil 39 and field coil 18 may be connected to external circuits through conductors 67 and 68, which are connected to terminal strips 69 and 70 associated with the terminals 19 and 64, respectively, as shown in Fig. 7.

What is claimed is:

1. A sound translating device comprising a diaphragm whose surface is a frustum of a surface of revolution, a magnet, a pair of concentric pole pieces for said magnet spaced to form an air gap, the inner of said pole pieces having a bore extending therethrough, terminals mounted on said magnet and insulated therefrom, a spider member having a central portion mounted on said inner pole piece, an outer portion secured to one end of the diaphragm, and angularly displaced flexible arms connecting said central and outer portions, a driving coil connected to said one end of said diaphragm, and leading-in conductors for said coil secured to certain of said arms, extending inwardly to said central portion and through said bore and connected in said terminals.

2. A moving coil actuated loudspeaker comprising a large direct acting frusto-conoidal diaphragm, a magnet having concentric pole pieces forming an annular air gap, the inner of said pole pieces having a bore extending therethrough, a spider member having a hub portion mounted on the inner of said pole pieces and a plurality of flexible radially extending arms connecting said hub and one end of said diaphragm, an insulating member seated on said hub portion, metallic members mounted on said insulating member, terminals mounted on said magnet and insulated therefrom, an annular driving coil connected to said one end of said diaphragm and disposed in said air gap, thin light weight extensions from said coil insulatingly secured to certain of said arms, and extending inwardly to said metallic members and secured thereto, and leading-in conductors for said coil extending through said bore and connected to said metallic members and said terminals.

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