

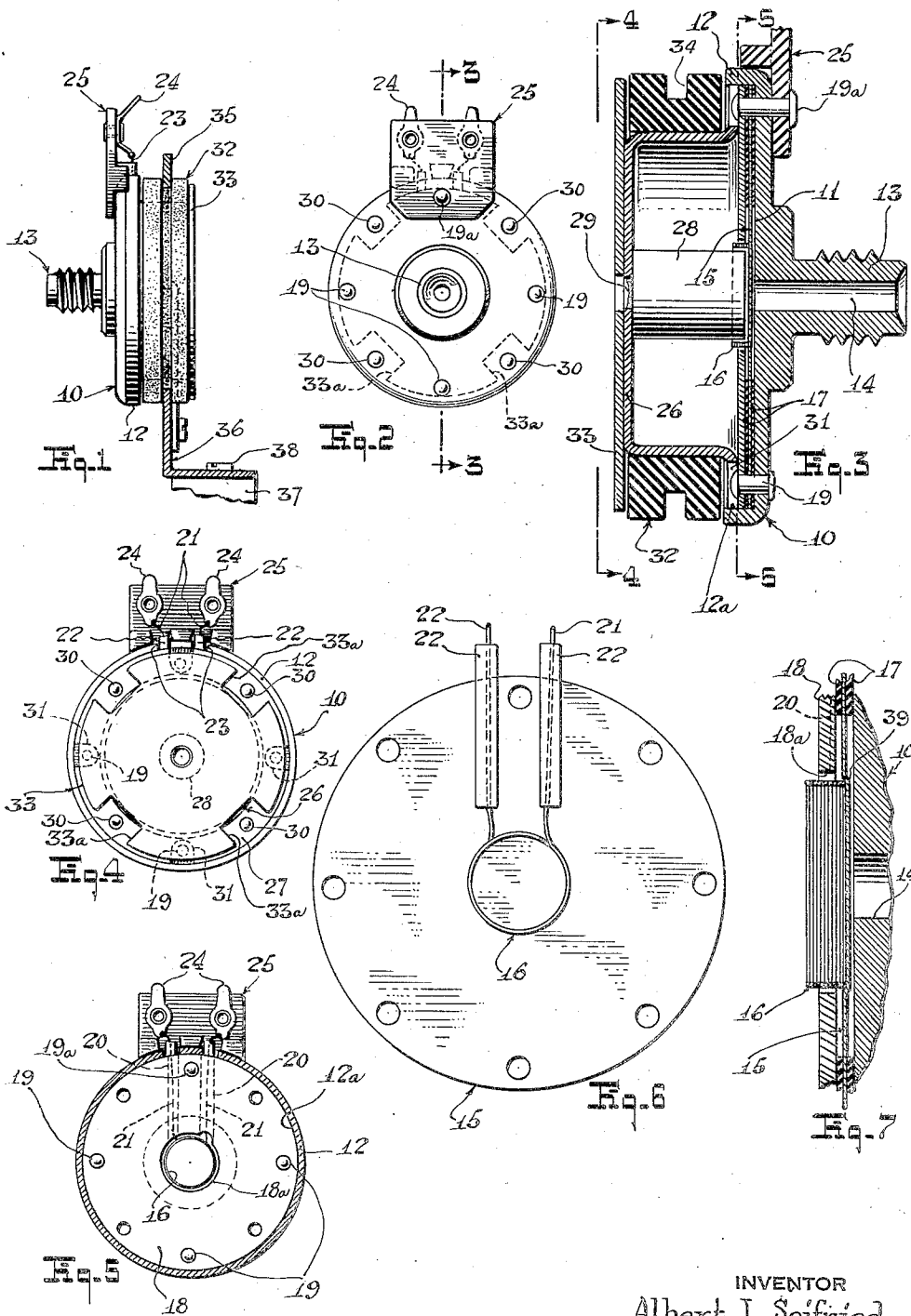
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A. L. SEIFRIED

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PERMANENT MAGNET ELECTRODYNAMIC TRANSDUCER

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INVENTOR
Albert L. Seifried
By *Henry Canahan*
ATTORNEY

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PERMANENT MAGNET ELECTRODYNAMIC
TRANSDUCER

Albert L. Seifried, Millington, N. J., assignor to
Thomas A. Edison, Incorporated, West Orange,
N. J., a corporation of New Jersey

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This invention relates to a small electroacoustical transducer for phonographs adapted for reproducing speech recordings, and more particularly the invention relates to an improved transducer which is adapted to feed into a small sound tube leading to an acoustic-type headset.

In the reproduction of recorded speech, acoustic receivers are commonly used which are worn on the head and adapted to fit over or into the ears, a pair of such receivers being herein referred to as a headset. Such acoustic headset is preferred over a headset of the electroacoustic type since it is typically smaller and lighter. However, heretofore the acoustic-type headset has been cumbersome because of the need for a fairly large and stiff acoustic tube coupling the headset to the reproducer. The present transducer is adapted to work into a very small, light coupling tube which will not encumber to any appreciable extent the users of such headsets. Additionally, this transducer is adapted to compensate for transmission deficiencies of such small sound tubes to enable faithful reproduction of recorded speech sounds through the audio spectrum to at least 6,000 cycles per second.

Objects of the invention are to provide an improved construction of such transducer which is simple in form, easy to assemble and economical to manufacture.

Another object is to provide such a transducer which has efficient high-frequency response to enable the faithful reproduction abovementioned.

Other objects and features of the invention will be apparent from the following description and the appended claims.

In the description of my invention reference is had to the accompanying drawings, of which:

Figure 1 is a side elevational view of an electroacoustical transducer, with a mounting bracket, in which my invention is embodied;

Figure 2 is a front elevational view of this transducer;

Figure 3 is a section to enlarged scale taken substantially on the line 3—3 of Figure 2;

Figure 4 is a back view of the transducer as seen from the line 4—4 of Figure 3;

Figure 5 is a section taken substantially on the line 5—5 of Figure 3;

Figure 6 is a view to enlarged scale of the diaphragm assembly; and

Figure 7 is a fractional sectional view to enlarged scale taken through the axis of the transducer to show details of the vibratory system of the transducer.

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The present transducer includes a diaphragm holder 10 in the form of a shallow plate-like member having a flat bottom wall 11 and a rim flange 12 and having at the back side an integral extending nipple 13 provided with a central opening 14 leading axially through the wall 11, the nipple 13 being intended for connection with the sound coupling tube aforementioned. As will appear, the inner surface 12a of the flange 12 is utilized as a common reference for locating the essential parts of the device in concentric relation to each other. For instance, positioned within the holder 10 is a thin circular diaphragm 15 the peripheral edge of which contacts the inner surface of this locating flange. A single-layer voice coil 16 is connected to the side of the diaphragm which faces away from the holder 10. This coil is located in concentric relation to the peripheral edge of the diaphragm and is therefore located in concentric relation to the flange 12. The diaphragm is spaced from the wall 11 by a thin annular gasket 17. Another such gasket is positioned against the outer side of the diaphragm and positioned flat against this gasket is an annular disk 18 the inner edge 18a of which surrounds the voice coil at a clearance spacing therefrom. This disk is made of magnetically soft material and forms part of the magnetic system of the transducer, as will appear. The outer peripheral edge of this disk, like that of the diaphragm, engages the locating surface 12a of the flange 12 to position the inner edge 18a of the disk in concentric relation with the voice coil.

The parts above described are secured together into one unitary subassembly by four rivets 19, or similar elements, spaced at equal intervals about the axis of the device. These rivets are positioned near the rim flange 12 and pass through the disk 18, the gasket 17, the diaphragm 15 and the wall 11 to clamp these parts tightly together. An advantage of securing these parts into a permanent unitary subassembly is that the delicate diaphragm is protected largely by the disk and the holder to permit stocking and handling of the subassembly without likelihood of damage thereto.

In the inner side of the annular disk 18 there are two approximately parallel grooves 20 running from the inner to the outer edges of the disk (Figures 5 and 7). These grooves form clearance openings between the disk and the adjacent gasket 17 for lead-out wires 21 of the voice coil 16, the portion of the lead-out wires adjacent to the disk being covered by insulating sleeves 22 (Figures 5 and 6). These lead-out

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wires and sleeves pass through clearance slots 23 provided in the rim flange 12 and the wires are connected to a pair of terminals 24 anchored to an insulating plate 25. This plate is secured to the diaphragm holder as by an elongated one of the aforementioned rivets indicated in Figure 3 as 19a.

The magnetic system of the transducer also comprises a member of magnetically soft material in the form of a cup 26. This cup has an outwardly-extending rim flange 27 which seats on the outer border of the annular disk 18 and the peripheral edge of which fits into the flange 12 to locate the cup also in concentric relation with the voice coil. Mounted in this cup at the axis thereof is a cylindrical core 28 which is staked or soldered to the bottom wall of the cup at 29. The outer end of this core fits within the voice coil at a clearance spacing therefrom. Since the core is positioned at the axis of the cup and the latter is positioned in concentric relation with the voice coil, the core is therefore also concentric with the coil. In the preferred construction, the core is made of permanent-magnet material as of one of the alloys of aluminum, nickel, cobalt and iron known as "Alnico," in which case the outer end of the core is preferably provided with a soft iron pole piece 28a. However, as an alternative construction, it will be understood that the core may be made of magnetically soft iron and may be energized by a suitable field coil not herein necessary to show.

The cup 26 is secured in assembled relation to the aforementioned subassembly by four rivets 30, or like elements, which are interposed between the rivets 19. These rivets 30 pass through the flange 27 and the parts within the holder 10 in the manner of the rivets 19. In order that the rim flange 27 of the cup may lie flat against the disk 18 for close magnetic coupling therewith, it is provided with four notches 31 to clear the heads of the rivets 19 (Figure 4).

A resilient mounting for the present transducer is preferred and comprises a rubber ring 32 placed around the magnetic cup and held thereon by a circular plate 33 secured as by spot welding to the back side of the cup. In this ring there is a peripheral groove 34 received by an apertured leg 35 of a mounting bracket 36 which is held to a suitable support 37 as by screws 38 (Figure 1). The plate 33 is welded to the cup before the latter is secured to the holder. To provide easy access to the rivets 30 this plate is provided with four respective clearance notches 33a.

The sensitivity of the present instrument is dependent, among other factors, upon the magnetic flux density in the air gap between the core 28 and the annular disk 18. In order that the gap density may be a maximum for a permanent magnet of given strength, the magnetic cup is made sufficiently large in diameter to minimize leakage losses.

In order that good high-frequency response is obtained the vibratory system—i. e., the diaphragm and voice coil—is designed to be resonant at the highest frequency to be reproduced. In this design, the diaphragm mass is kept low by choosing a thin diaphragm of light metal, say of .002" thick aluminum, and by cementing the coil directly to the diaphragm without use of a coil frame; further, the stiffness of the diaphragm is made high and break-up of the diaphragm at high frequencies is prevented by

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offsetting the central portion of the diaphragm at 39 and by using a diaphragm of effectively small diameter.

Novel features of the present invention whereby in a simple design leakage flux is minimized, the resonant frequency of the diaphragm is made high, and parts are accurately positioned relative to each other lie in the use of a large diaphragm and large magnetic cup equal in diameter to each other so that they can be centered by the common locating flange 13, and in the use of gaskets clamped against the sides of the diaphragm which have a relatively small central opening to reduce suitably the effective diameter of the diaphragm.

A further feature of the present invention lies in the use of simple parts having essential locating surfaces in concentric relation to each other so that these surfaces can be established with a high degree of accuracy, and in the use of a construction wherein these parts are located accurately in relation to each other by one common locating surface, which is the inner peripheral surface of the locating flange 13.

The preferred embodiment of my invention herein shown and described is intended to be illustrative and not necessarily limitative of the invention, since this embodiment is subject to changes and modifications without departure from the scope of my invention, which I endeavor to express according to the following claims.

I claim:

1. An electroacoustical transducer comprising a circular diaphragm, a circular diaphragm holder having a peripheral flange engaging the peripheral edge of the diaphragm and having a central opening for the emission of sound from the inner side of the diaphragm, a voice coil mounted on the outer side of the diaphragm in concentric relation with the peripheral edge thereof, an annular disk of soft magnetic material in juxtaposition with the outer side of said diaphragm and in peripheral engagement with said flange with the inner peripheral edge of said disk confronting the outer side of said coil in spaced relation thereto, an annular gasket between one side of the diaphragm and the inner wall of said holder and another annular gasket between the outer side of the diaphragm and said magnetic disk to space the diaphragm from the disk and holder for free vibration of the central portion thereof, clamping elements spaced at intervals about the axis of said holder near the rim thereof and traversing the holder, gaskets, diaphragm and disk to secure the same into a unitary subassembly, a cup-shaped member of soft magnetic material having an outwardly-extending peripheral flange seated on said disk and engaging the inner peripheral surface of said flange of said holder, said flange of said cup having portions cut away to clear the flange of said clamping elements, a central magnetic core mounted in said cup having the end portion thereof within said voice coil at a clearance spacing therefrom, and other clamping elements interposed between said first-mentioned clamping elements and securing said peripheral flange of said cup in mounted relation to said subassembly.

2. The combination set forth in claim 1 wherein said diaphragm holder has a flat inner wall and wherein the diameters of the central openings of said gaskets are a minor fraction of the

diameter of said diaphragm to provide a cylindrical air chamber between the diaphragm and holder having a diameter less than half the overall diameter of the diaphragm and having a length equal to the thickness of one of said gaskets.

3. An electroacoustical transducer comprising a circular diaphragm, a circular diaphragm holder having a rim flange fitting the peripheral edge of said diaphragm and having a central opening for the emission of sound from the inner side of the diaphragm, a voice coil mounted on the outer side of said diaphragm in concentric relation therewith, an annular magnetic disk mounted in said holder in spaced relation to the outer side of said diaphragm and in peripheral engagement with said rim flange with the inner periphery of said disk confronting the outer periphery of said coil at a clearance spacing therefrom, a magnetic cup-shaped member having an outwardly-extending rim flange seated on said magnetic disk and fitting said first rim flange to locate the cup in concentric relation with said holder, a magnetic member mounted in said cup and having a circular end portion concentric with the cup and disposed within said voice coil at a clearance spacing therefrom, elements at the rim of said diaphragm holder securing said magnetic disk and diaphragm to said holder to form a permanent subassembly of said transducer, and other elements interposed between said first-mentioned elements and securing said magnetic cup in mounted relation to said subassembly.

4. An electroacoustical transducer comprising a circular diaphragm, a circular diaphragm holder having a rim flange fitting the peripheral edge of said diaphragm and having a central opening for the emission of sound from the inner side of the diaphragm, a voice coil mounted on the

outer side of said diaphragm in concentric relation therewith, an annular magnetic disk mounted in said holder in spaced relation to the outer side of said diaphragm and in peripheral engagement with said rim flange with the inner periphery of said disk confronting the outer periphery of said coil at a clearance spacing therefrom, a magnetic cup-shaped member having an outwardly-extending rim flange seated on said magnetic disk and fitting said first rim flange to locate the cup in concentric relation with said holder, a magnetic member mounted in said cup and having a circular end portion concentric with the cup and disposed within said voice coil at a clearance spacing therefrom, clamping elements traversing said magnetic disk, diaphragm and holder at the rim of the latter to secure the same into one subassembly, and other clamping elements between said first-mentioned elements and traversing said holder, diaphragm, disk and flange of said cup to secure the cup to said subassembly, wherein said flange of said cup has portions thereof cut away to clear the flange of said first-mentioned clamping elements.

ALBERT L. SEIFRIED.

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