June 12, 1928. 1,673,661

C. E. BRIGHAM

ELECTROMAGNETIC SOUND REPRODUCING APPARATUS

Filed Feb. 16, 1926

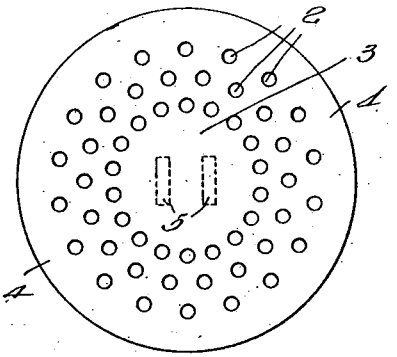


FIG. 1.

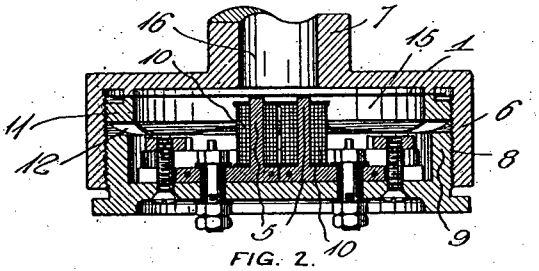


FIG. 2.

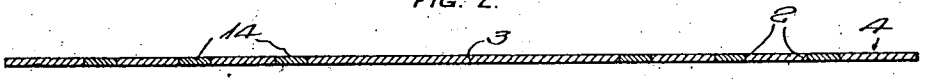


FIG. 3.

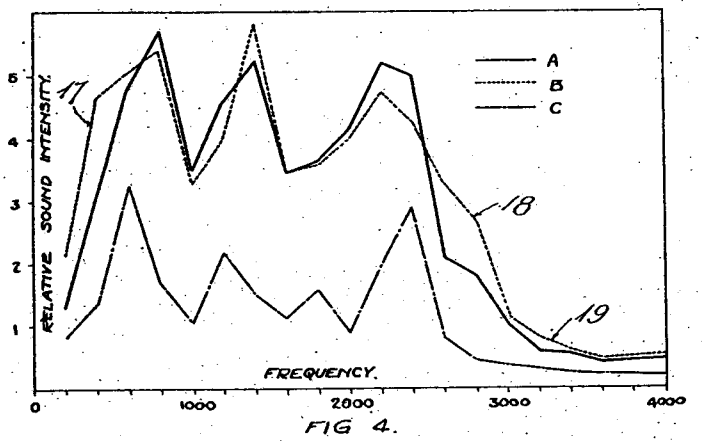


FIG 4.

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UNITED STATES PATENT OFFICE.

CECIL E. BRIGHAM, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO BRANDES LABORATORIES, INC., OF NEWARK, NEW JERSEY, A CORPORATION OF NEW JERSEY.

ELECTROMAGNETIC SOUND-REPRODUCING APPARATUS.

Application filed February 16, 1926. Serial No. 88,573.

My invention relates broadly to sound reproducing apparatus and more particularly to the construction of a diaphragm for an electromagnetic sound reproducer.

One of the objects of my invention is to provide a sound reproducing diaphragm for electromagnetic sound reproducers having such properties that more efficient reproduction may be obtained over a greater frequency range than has heretofore been possible.

Another object of my invention is to provide a construction of electromagnetic sound reproducing diaphragm having a greater path for magnetic flux through the diaphragm than has heretofore been possible, at the same time that increased flexibility in the diaphragm construction is obtained and interference between sound waves emanating from the opposite sides of the diaphragm substantially eliminated.

Still another object of my invention is to provide a diaphragm construction for electromagnetic sound reproducers in which a magnetic diaphragm is perforated over selected portions of its area and the perforations closed by material substantially inert to eddy currents and having a density less than the material of the diaphragm for obtaining great flexibility in the diaphragm structure, while preventing interference between sound waves emanating from opposite sides of the diaphragm.

Other and further objects of my invention will be understood from the specification hereinafter following by reference to the accompanying drawings, in which:

Figure 1 is a plan view showing the construction of my improved diaphragm; Fig. 2 is a cross-sectional view through an electromagnetic sound reproducer equipped with the diaphragm of my construction; Fig. 3 is an enlarged cross-sectional view through the diaphragm construction of my invention; and Fig. 4 shows a plurality of sound curves illustrating the improved results obtained by the use of the sound reproducing diaphragm of my invention as compared to diaphragms heretofore available in the art.

The electromagnetic sound reproducers used in the reception of radio broadcast entertainment it is extremely difficult to secure natural reproduction of all of the notes of the musical scale throughout the entire range of frequencies. The frequencies at either end of the scale are often sacrificed and the tones distorted or impaired. The sound reproducing diaphragm of my invention is constructed for the efficient reproduction of tone frequencies over a broad frequency range and produces results which are a marked improvement over the results obtained from diaphragm constructions heretofore available. I provide a magnetic diaphragm of increased thickness over the normal thickness of magnetic diaphragms heretofore commonly used for establishing a greater path for magnetic flux from the adjacent electromagnets through the diaphragm. The flexibility of a diaphragm of less thickness is obtained by perforating the diaphragm throughout portions of its area and these perforations are then closed for the preventing of interference between sound waves emanating from opposite sides of the diaphragm. The material employed for closing the perforations is an insulating compound which is inert to the effects of eddy currents and has a density less than the density of the magnetic material of the diaphragm. The construction of the diaphragm of my invention will be more clearly understood by a detailed reference to the drawings, wherein reference character 1 designates the magnetic diaphragm which is perforated as represented at 2 around the central solid portion 3. It will be observed that the outer periphery 4 is solid while the inner central portion 3 is solid and the magnetic lines of force which are incident upon the diaphragm are concentrated from pole pieces 5 immediately beneath the central solid portion 3 of the sound reproducing diaphragm 1. The perforations 2 fill the area intermediate the solid outer periphery portion 4 and the central portion 3. The perforations are formed in concentric circles and along radial lines, the perforations in one circle alternating with the perforations in the next adjacent circle.

In Figure 2 an electromagnetic sound reproducer has been illustrated comprising a casing 6 which terminates in a sound con-

veying conduit 7. The interior walls of the casing 6 are screw threaded as represented at 8 permitting a screw threaded carrier 9 to be adjustably positioned therein. The screw threaded carrier 9 carries the electromagnets 10 having pole pieces 5. An annular screw threaded member 11 is provided for supporting the diaphragm 1 within the casing 6. A resilient gasket 12 interposed between the ring member 11 and the carrier 9 permits adjustment of the electromagnets 10 and pole pieces 5 with respect to diaphragm 1, without setting up interfering noises and rattles in the sound reproducer.

The enlarged cross-sectional view of the diaphragm, as illustrated in Fig. 3 sets forth the invention more clearly showing the perforations 2 closed by the insulating compound 14 having a density less than the magnetic material of the diaphragm and substantially inert to the effects of eddy currents. The insulating compound 14 does not impair the flexible properties of the sound reproducing diaphragm and yet prevents interference between sound waves from the rear of the diaphragm in the area designated at 15 in Fig. 2 from interfering with sound waves in front of the diaphragm in the area designated at 16 in Fig. 2. One of the inherent defects in many constructions of loud speakers is the reaction between the differing phase of sound waves emanating from opposite sides of the diaphragm and my construction avoids the setting up of this undesired disturbance.

Fig. 4 shows the results of investigations of sound reproducing diaphragm and a comparison of the results obtainable with diaphragms of the usual construction and the results obtainable with the diaphragm of my improved construction. The chart is plotted to show relative sound intensity with respect to frequency range obtainable from an electromagnetic sound reproducer employing sound reproducing diaphragms of differing construction; that is a solid diaphragm of the usual construction, a diaphragm perforated in accordance with the construction of diaphragm described herein, but without the material 14 closing the perforations and a diaphragm constructed in accordance with the invention herein having perforations entirely closed by the sound insulating material 14. Curve A shows the results obtainable with a standard solid construction diaphragm. Curve C illustrates the results obtainable with a diaphragm which is perforated as represented at 2 in Fig. 1, but without the filling of sound insulating material 14 in the perforations. The curve C shows the decided decrease in sound intensity which is obtainable when the diaphragm is perforated. Curve B, however, shows the marked improvement which is obtainable by means of the diaphragm construction of my invention where the perforations are closed by means of sound insulating material which has been indicated at 14. It will be observed that the low notes over the portion 17 of curve B are brought out more efficiently and the frequency range of the electromagnetic sound reproducer is considerably improved as represented by the extent of curve B at portions 18 and 19 at greater sound intensity than is possible in diaphragms of solid construction.

The diaphragm construction of this invention is the result of an extended series of sound investigations and the practical results obtainable have established the real merit in this type of diaphragm. The low notes which are normally sacrificed with the standard diaphragm construction are faithfully reproduced by the diaphragm construction of my invention.

I desire that it be understood that various kinds of sound insulating material may be employed to fill the perforations 2 in the sound reproducing diaphragm and that no limitations upon the invention are intended other than those imposed by the scope of the appended claims.

What I claim and desire to secure by Letters Patent of the United States is as follows:

1. A sound reproducing magnetic diaphragm, comprising an outer peripheral solid portion arranged to be supported adjacent an electromagnet, a central solid portion, and an intermediate portion perforated in concentric circles along radial lines of said diaphragm with the perforations of one circle alternately positioned with respect to the perforations of an adjacent circle for increasing the flexibility of said diaphragm, and sound insulating non-magnetic material filled within said perforations for preventing reaction between sound waves emanating from the opposite sides of said diaphragm whereby a relatively wide path for the threading of magnetic lines through the center of said diaphragm is provided independent of the flexibility of said diaphragm.

2. A sound reproducing magnetic diaphragm positioned adjacent a set of electromagnets, said sound reproducing diaphragm having an outer solid peripheral edge arranged to be supported from the edge thereof and a solid central portion arranged to be positioned in immediate alignment with the set of electromagnets, and an intermediate perforated portion between said central portion and said outer peripheral edge for increasing the flexibility of said diaphragm, the perforations of said intermediate portion being arranged in concentric circular rows, with one circular row of perforations offset with respect to the adjacent circular row of perforations, said perforations being filled with non-magnetic mate-

rial having a density less than the density of the diaphragm and being substantially inert to the effects of eddy currents whereby a relatively wide path for the threading of magnetic lines through said diaphragm is provided independent of the flexibility of said diaphragm and sound waves emanating from one side of said diaphragm are prevented from reacting with sound waves emanating from the opposite side of said diaphragm.

In testimony whereof I affix my signature.

CECIL E. BRIGHAM.