

April 2, 1929.

C. W. RICE

1,707,570

LOUD SPEAKER

Filed April 20, 1925

Fig. 1.

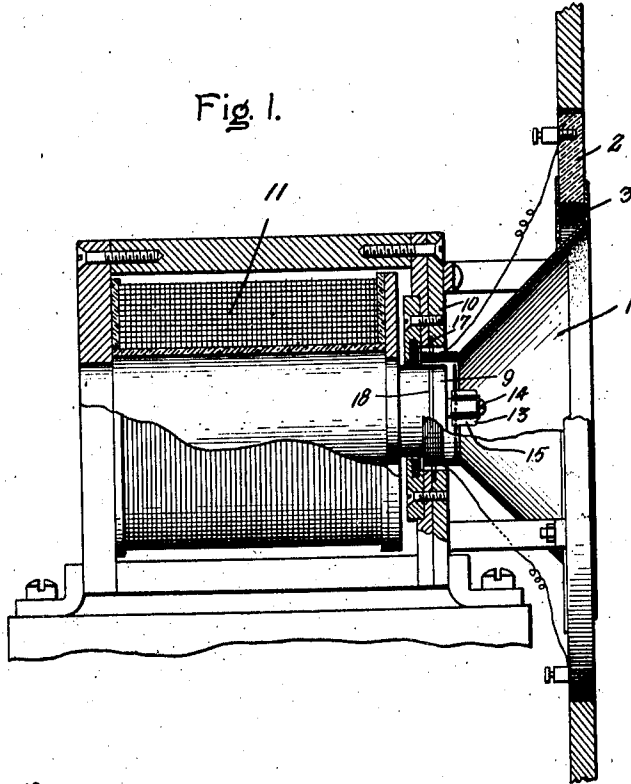


Fig. 2.

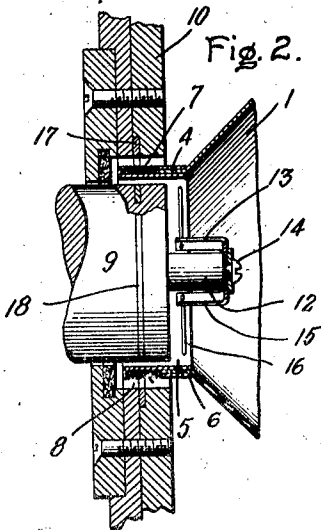
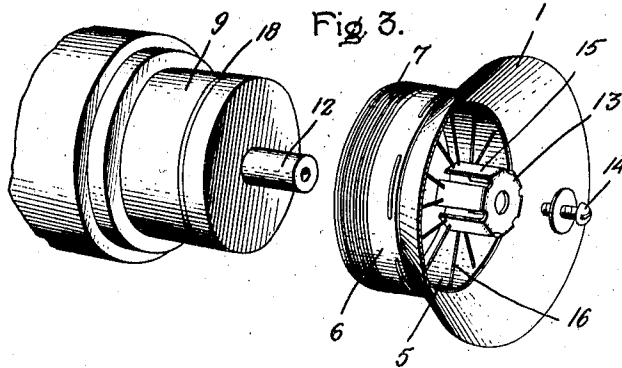


Fig. 3.



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UNITED STATES PATENT OFFICE.

CHESTER W. RICE, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

LOUD-SPEAKER.

Application filed April 20, 1925. Serial No. 24,341.

My present invention relates to apparatus for producing sound from electric currents corresponding to original sounds, and more particularly to devices now commonly known as loud speakers.

The object of my invention is to provide a device of the class mentioned wherein the efficiency of operation of one particular type of device may be increased.

The type of device to which my present invention is particularly applicable, is one in which a diaphragm is actuated by means of a movable coil located in an air gap in which a strong constant magnetic field is produced. When variable currents are supplied to this coil it is caused to move transversely in the magnetic field and thus actuate the diaphragm.

I have found that the efficiency of operation of such a device may be improved by the provision of means for lowering the impedance of the actuating coil. One way in which this may be accomplished is to provide in proximity to the coil and in inductive relation therewith, a second coil of very low impedance which acts as a short-circuiting secondary. In the case of a circular coil, which is located in an annular air gap, this low impedance coil may have the form of a ring or rings of copper, or other material of good conductivity, embedded in one or both of the pole pieces which form the air gap.

My invention both as to its organization and method of operation will best be understood by reference to the following description taken in connection with the accompanying drawing in which Fig. 1 is a view partly in cross-section of a device constructed in accordance with my invention; Fig. 2 is an enlarged cross-sectional detail; and Fig. 3 is a perspective exploded view of a portion of the apparatus to which my invention is applied.

I have indicated in the drawing a sound reproducing device comprising a diaphragm 1 of conical form, which in the device illustrated is specifically a truncated cone. The outer edge or base of the diaphragm is secured to a supporting ring 2 by means of a ring 3 of flexible material, such as silk, rubber, or thin leather. The diaphragm 1 may be made of paper or other light material whereby it may be made rigid enough so that at the lower frequencies at least it will be capable of vibrating substantially as a

whole. The top or inner edge of the diaphragm is made in the form of a cylinder 4, which is provided with inner and outer reinforcing rings 5 and 6. Actuating means for the diaphragm comprises a coil 7 surrounding the inner reinforcing ring 5, and secured thereto in any suitable manner. Coil 7 is disposed in the annular air gap 8, which is formed between the concentric pole pieces 9 and 10. The inner pole piece 9 is surrounded by the coil 11 through which a steady direct current may be supplied for producing a strong magnetic field in the annular air gap 8.

When variable currents are supplied to the coil 7, diaphragm 1 will be caused to vibrate in accordance with the variations in the current supplied to the coil. Because of the flexible nature of the ring 3 there may be a tendency to lateral movement of the coil 7 in the air gap 8. To avoid this the pole piece 9 is provided with a projection 12 and a spider 13 is secured to this projection by means of the screw 14. This spider is provided with a plurality of resilient arms 15 extending in directions substantially parallel to the axis of the pole piece 9. These arms 15 are all connected by radially extending flexible connecting links 16 to the top of the diaphragm. When these connections are made taut they will substantially prevent all lateral movement of the coil 7 and at the same time will not interfere to any appreciable extent with the longitudinal movement of the coil in the air gap 8.

Pole pieces 9 and 10 are provided with annular slots in which rings 17 and 18 are fitted. These rings are preferably of copper or other low resistance metal and act as short circuited secondaries for the actuating coil 7. Without the copper rings the moving coil will have a certain impedance which is made up of resistance and inductive components. At low frequencies the impedance will be practically that due to the ohmic resistance of the coil while for high frequencies it may be mainly determined by the inductance of the coil. At constant applied voltage the current and hence the driving force produced by the coil will fall off as the frequency is increased. If now the stationary short circuiting winding is added its effect will be to reduce the self-inductance of the moving coil and therefore the im-

pedance will not increase so much as the frequency of the applied voltage is increased. For constant applied voltage the current and therefore the driving force produced by the coil will remain more nearly constant from the low to the high frequencies. The ideal condition would be to have the impedance and therefore the driving force at constant impressed voltage the same at all frequencies. The greater the mutual inductance between the moving coil and the stationary compensating winding the closer this ideal condition will be approached. Well known design considerations will determine the most economical applications of the principle to any particular problem in hand.

Certain features disclosed but not claimed herein are disclosed and claimed in an application of Edward W. Kellogg, Serial No. 702,455, filed March 27, 1924. Certain other features disclosed but not claimed herein are disclosed and claimed in the joint application of Chester W. Rice and Edward W. Kellogg, Serial No. 1,438, filed January 9, 1925.

What I claim as new and desire to secure

by Letters Patent of the United States, is:—

1. The combination in a sound-reproducing apparatus of a diaphragm, a pair of pole pieces separated by an annular air gap, means for actuating said diaphragm comprising a coil to which actuating currents may be supplied, said coil being located in the air gap between said pole pieces whereby a strong magnetic field is maintained in said air gap, and a ring of low resistance material embedded in one of said pole pieces for reducing the impedance of said coil.

2. The combination in a sound-reproducing apparatus of a diaphragm, a pair of pole pieces separated by an annular air gap, means for actuating said diaphragm comprising a coil to which actuating currents may be supplied, said coil being located in the air gap between said pole pieces whereby a strong magnetic field is maintained in said air gap, and a ring of low resistance material embedded in one of said pole pieces which acts as a low impedance secondary winding in inductive relation to said coil.

In witness whereof, I have hereunto set my hand this 18th day of April, 1925.

CHESTER W. RICE.