May 5, 1936. C. E. STEVENS ET AL. 2,039,854

ELECTROACOUSTIC DEVICE

Filed May 27, 1929

Fig. 1.

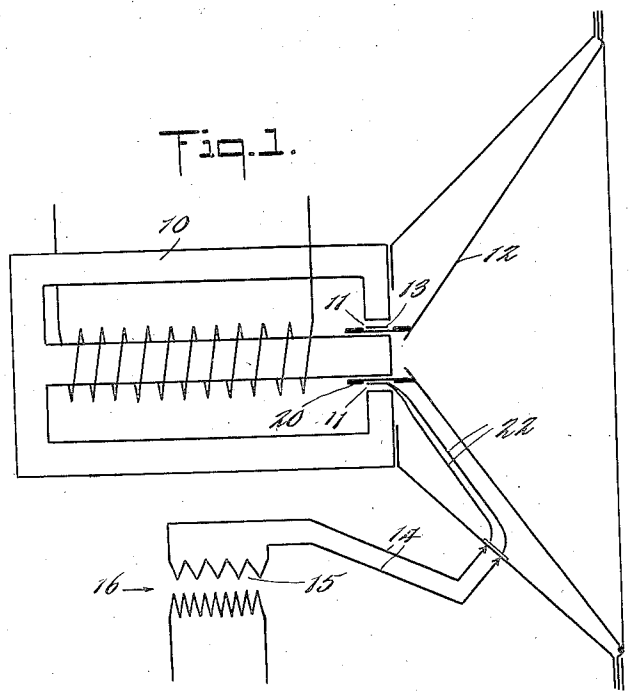
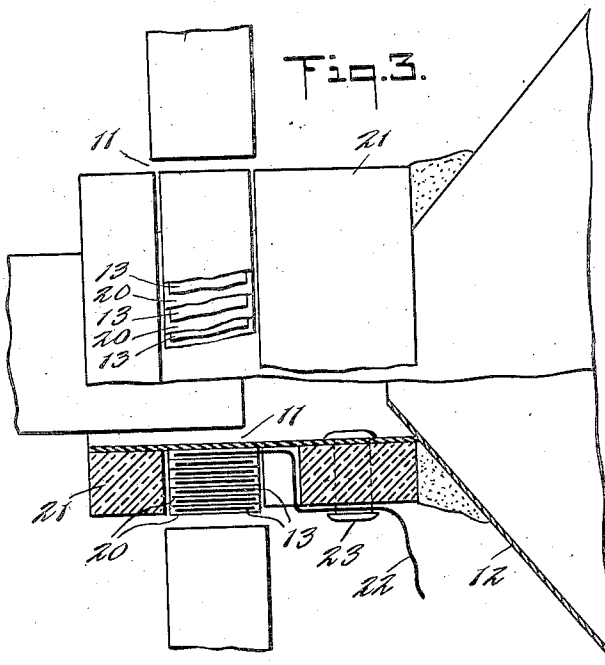


Fig. 3.



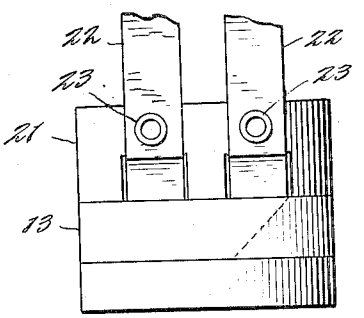


Fig. 2.

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UNITED STATES PATENT OFFICE

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ELECTROACOUSTIC DEVICE

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Application May 27, 1929, Serial No. 366,254

10 Claims. (Cl. 179—115.5)

This invention relates to electro-acoustic devices, and more particularly to telephone receivers and transmitters of the moving coil, or dynamic, type.

A particular object of the invention is to eliminate defects which have existed in dynamic receivers, and more particularly, radio loud speakers, as heretofore made, and to produce a receiver of this type accurately responsive to the audio-frequency pulsating signal current throughout the musical range without the use of tone filters or other auxiliary devices.

In accordance with the invention, this object is attained by providing in the annular gap of a field magnetic circuit a moving, or "voice", coil consisting of a plurality of directly superimposed insulated turns of a thin wide strip of conducting material. The width of the conductor strip is most desirably nearly equal to that of the flux path in the gap of the magnetic circuit, so that each turn of the coil cuts substantially the entire magnetic flux in the gap. The voice coil avoids accentuation of any particular musical frequency, while, on the other hand, the efficiency of the coil is such that it provides sufficient force to vibrate a loud speaker or other diaphragm when supplied with a current of low amperage. The latter characteristic of the coil makes it possible to feed it through light flexible leads which do not introduce mechanical resistance interfering with the vibration of the loud speaker or other diaphragm.

To further clarify the nature of our invention, we will describe in detail a specific embodiment of it which is illustrated in the accompanying drawing, in which:—

Fig. 1 is a diagrammatic view of a dynamic speaker embodying our invention;

Fig. 2 is a side view on a larger scale of the voice coil and its tube or carrier; and

Fig. 3 is an enlarged sectional view of the voice coil and parts immediately associated with it.

The dynamic speaker illustrated in Fig. 1 includes the usual magnetic circuit 10 having an annular gap at 11. A diaphragm 12, which is shown as conical, is mounted in front of the gap 11, and carries at its smaller end a voice coil 13 which is fed through leads 14 with an audio-frequency alternating current from the secondary 15 of a transformer 16.

The construction of the voice coil and its mounting is illustrated in Figs. 2 and 3. The voice coil 13 consists of a plurality of turns of a thin wide strip or ribbon of conducting material, layer-wound with a thin insulating medium between the turns. The insulating medium may be a thin ribbon of insulating material, such as varnished paper 20, or a suitable substance such as varnish, enamel or oxidation applied to the conducting ribbon. The turns of the coil, including the insulating ribbon 20 if used, are most desirably cemented together so as to make the whole coil strong and rigid. The coil is carried in an external circumferential recess in a hollow cylinder or carrier tube 21 of cardboard or other suitable material, which is secured to the small end of the diaphragm 12 and projects through the annular gap 11 of the magnetic circuit 10. The strength and rigidity of the coil 13 is such that the carrier tube 21 may be made of very light material. The ends of the ribbon forming the coil are turned outward and form flexible connections 22 to the leads 14 as shown in Fig. 1. They may be connected to the cylinder 21 at spaced points, as by eyelets 23. Any usual or suitable means may be employed for centering the carrier tube in the gap while permitting vibratory movement in an axial direction.

The connecting means for the voice coil leads and the centering device for the carrier tube are more particularly described and claimed in an application of William T. Taber, Serial No. 366,341, filed Mary 27, 1929, and assigned to the same assignee as the present application.

It will be seen from Fig. 3 that the conducting ribbon forming the coil is of a width only slightly less than the width of the flux path across the gap 11, so that each turn of the coil cuts substantially the entire magnetic flux in the gap.

The thickness of the conducting ribbon forming the coil and the number of turns used may be varied to suit the electrical characteristics of the particular circuit in which the coil is used. We find it desirable to make the ribbon of copper or aluminum between one one-thousandth and five one-thousandths of an inch in thickness, and to use generally from five to twenty-five turns. The radial thickness of such a coil is very small, so that the gap in the magnetic circuit may be made narrow.

The coil avoids accentuation of the higher musical frequencies. This we believe to be due in part to the fact that the coil has only a moderate inductance and in large part to the fact that the superimposed turns of the ribbon act as a condenser giving a high distributed capacity. The complete linkage of each of its turns with the entire magnetic flux gives it an efficiency such that it actuates a direct-acting conical diaphragm when supplied with a current

of the order of one ampere. It may, therefore, be fed from a transformer 16 having a step-down voltage ratio of between seventy to one and three hundred and fifty to one. The low amperage required makes it possible to have the conductors leading to the coil so light and flexible that they do not introduce mechanical resistance to the movement of the coil and diaphragm; while the correspondingly high voltage used is sufficient to prevent any slight accidental resistance in the circuit from having any appreciable ill effect.

What we claim is:

1. In an electro-acoustic device, the combination with a diaphragm, and a magnetic circuit containing a gap, of a voice coil secured to the diaphragm, located in the gap of the magnetic circuit, and consisting of a plurality of superimposed insulated turns of a thin wide conducting ribbon arranged with its long tranverse axis perpendicular to the flux across said gap.

2. In an electro-acoustic device, the combination with a diaphragm, and a magnetic circuit containing a gap, of a voice coil secured to the diaphragm, located in the gap of the magnetic circuit, and consisting of a plurality of turns of a thin wide conducting ribbon separated by a thin wide insulating ribbon arranged with its long transverse axis perpendicular to the flux across said gap.

3. In an electro-acoustic device, the combination with a diaphragm, and a magnetic circuit containing a gap, of a voice coil secured to the diaphragm, located in the gap of the magnetic circuit, and consisting of a plurality of superimposed insulated turns of a thin conducting ribbon arranged with the long transverse axis of the ribbon perpendicular to the flux across said gap and having a width substantially equal to that of the flux path across the gap in the magnetic circuit so that each turn of the coil cuts substantially the entire flux.

4. In a dynamic receiver, the combination with a diaphragm, and a magnetic circuit containing a gap, of a voice coil secured to the diaphragm, located in the gap of the magnetic circuit, and consisting of a plurality of superimposed insulated turns of a thin conducting ribbon arranged with the long transverse axis of the ribbon perpendicular to the flux across said gap and having a width substantially equal to that of the flux path across the gap in the magnetic circuit so that each turn of the coil cuts substantially the entire flux, and means for supplying to the voice coil an audio-frequency alternating current of the order of one ampere.

5. In a dynamic receiver, the combination with a diaphragm, and a field magnetic circuit containing a gap, of a voice coil secured to the diaphragm, located in the gap of the magnetic circuit, and consisting of a plurality of superimposed insulated turns of a thin conducting ribbon arranged with the long transverse axis of the ribbon perpendicular to the flux across said gap and having a width substantially equal to that of the flux path across the gap in the magnetic circuit so that each turn of the coil cuts substantially the entire flux, and light flexible leads connecting the ends of the coil to the secondary of a step-down transformer having a step-down ratio of between seventy to one and three hundred fifty to one.

6. Acoustic apparatus of the electrodynamic type comprising a magnet system having an air gap of substantially predetermined width, a diaphragm, and a voice coil associated with the diaphragm and extending into said air gap, said voice coil consisting of a plurality of turns each of which is substantially as wide as said air gap.

7. Acoustic apparatus comprising a magnet system having pole faces forming an air gap across which there is a concentrated magnetic field, a vibratile system including a voice coil positioned in said air gap, said coil comprising plurality of turns each of which is substantially equal in width to the width of said pole faces whereby each turn cuts substantially all the flux of said concentrated magnetic field.

8. Acoustic apparatus of the electrodynamic type comprising a magnet system having an air gap across which there is a magnetic flux path, a diaphragm, and a voice coil attached to said diaphragm and extending into said air gap, said voice coil consisting of a plurality of superimposed turns of ribbon-like conducting material arranged in said air gap so that the plane of the ribbon at any line along its surface which determines the width of said ribbon is perpendicular to the direction of the flux across said gap.

9. In an electro-acoustic device a voice coil consisting of from five to twenty-five superimposed turns of wide conducting ribbon having a thickness of between one one-thousandths and five one-thousandths of an inch and having the long transverse axis of the ribbon parallel to the axis of the coil as a whole, a support for said ribbon, a diaphragm connected with said support and a magnet system having pole faces providing an air gap therebetween in which said coil is positioned.

10. A voice coil system for a dynamic receiver or transmitter consisting of a plurality of superimposed insulated turns of a thin, wide conducting ribbon cemented together to form a rigid structure and having the long transverse axis of the ribbon parallel to the axis of the coil as a whole, a magnet system having an air gap in which said coil is positioned with the axis of said coil extending in the direction of the axis of said air gap, means for supporting said coil and a diaphragm connected with said supporting means.

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