Jan. 13, 1925. 1,523,262

M. GUÉRITOT

SOUND PRODUCING APPARATUS OR ELECTROMAGNETIC RECEIVING OR EMITTING DEVICE

Filed April 12, 1922

Fig. 1

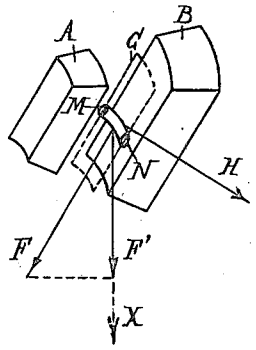


Fig. 4

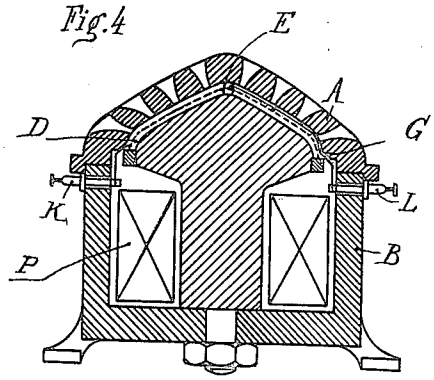


Fig. 3

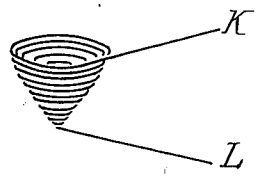


Fig. 2.

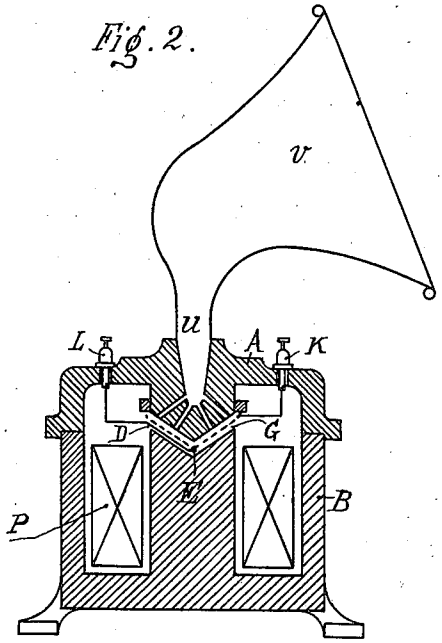
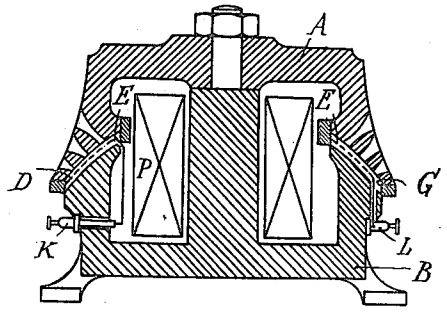


Fig. 5



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UNITED STATES PATENT OFFICE.

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SOUND-PRODUCING APPARATUS OR ELECTROMAGNETIC RECEIVING OR EMITTING DEVICE.

Application filed April 12, 1922. Serial No. 551,802.

To all whom it may concern:

Be it known that I, MAURICE GUÉRITOT, a citizen of France, and a resident of Paris, France, have invented new and useful Improvements in Sound-Producing Apparatus or Electromagnetic Receiving or Emitting Devices, which is fully set forth in the following specification.

Receivers of the electro-magnetic type are in use wherein an iron diaphragm is attracted by the poles of an electro-magnet. Other types of telephone receivers have been devised with the use of a non-magnetic diaphragm, the vibratory motion being transmitted to the diaphragm by a light rod and produced by the armature of an electro-magnet or by a coil disposed in the field of a magnet and employed after the manner of a galvanometer coil.

This invention relates to an apparatus for the production of sounds essentially comprising a vibrating diaphragm which is constituted together with suitable turns of a conducting wire which are juxtaposed and imbedded in the mass thereof. The diaphragm as a whole is submitted to the action of a magnetic field, and the shape of the diaphragm as well as the direction of the magnetic field are so combined that when a telephonic current is sent into the conducting wire entering into the composition of the said diaphragm the latter is caused to vibrate and will reproduce the sounds.

This new disposition will afford diaphragms of a very light construction to which very considerable forces can be applied in spite of their small mass. Furthermore, and this advantage is appreciable as concerns the quality of the sound produced, the motive force is set up directly and equally at all points of the diaphragm. Inasmuch as the motive force is produced at each point where it is consumed and is not transmitted from one point to the other of the diaphragm, this will afford the construction of acoustic diaphragms of larger sizes than are obtained by the known methods.

The following description, together with the accompanying drawings which are given by way of example, sets forth various embodiments of the invention.

Fig. 1 is a diagrammatic view of an explanatory nature.

Fig. 2 is a form of construction of an electro-magnetic receiver.

Fig. 3 is a perspective view of the diaphragm.

Figs. 4 and 5 are modified forms of construction of the receivers or electro-magnetic emission devices.

The reproduction of the sounds according to the invention can only be obtained by a special arrangement of the diaphragm and the magnetic field. This essential arrangement will be examined in its general principles before proceeding with a description of the apparatus based upon the same.

Fig. 1 represents two segments A and B forming part of the pole-pieces of a magnet. The air-gap between A and B is made narrow, so that in the air the magnetic force H is substantially perpendicular to the two parallel surfaces on either side of the air-gap. An element G of the diaphragm is shown between A and B, and if the air-gap is narrow, it must necessarily be parallel to the adjacent pole surfaces. A portion of a conducting turn MN is disposed upon the element G of diaphragm surface as above set forth. When a current i is sent through the conductor, the portion MN of the latter having a length l is submitted to a force f whose value in the field having an intensity H is given by the formula

$$f=lHi$$

This force is perpendicular to MN as well as to H.

Should the said turn, drawing with it the element of surface adhering thereto, yield to this force and move in the sense of the latter, thus employing the force to the maximum extent, the element of the diaphragm G would be caused to move in its own plane, thus sliding upon itself. In these conditions it would exert no pressure upon the air and would produce no acoustic effect. The sound will have the maximum value if the element of the diaphragm is caused to move perpendicular to its own plane. But in this event the motion will be perpendicular to the motive force f. For this motion, the motive force would lose all its efficacity. It will be observed that this motion will be no more advantageous in its effect than the preceding.

It is therefore required to find a disposition wherein the displacement of the element of diaphragm in question shall take place in a direction oblique to the two directions above considered. Should the displacement take place in the direction X making an angle α with the force, the component of the force utilized is:

$$f' = ilH \cos\alpha$$

It will effect a displacement of the element G of area s by an amplitude $\triangle x$ in the direction X. The acoustic effect, which is measured by the volume of air displaced, is in this case

$$W = s \triangle x \sin\alpha$$

As observed, it is required for the operation of the device that neither the useful component of the force nor the volume of air displaced shall be null, and this will prevent giving to α the values 0 or 90°. It is preferable to give values to α which are near 45°, but this particular value is not essential.

As an example of a diaphragm based upon this principle, the device may comprise a diaphragm having the form of a cone of revolution with an angle near 45° at the apex and disposed in an air-gap bounded by two conical coaxial surfaces having the same angle. The turns of conducting wire are disposed in spirals approximately representing circles parallel to the base of the cone, and the diaphragm will move in the axial sense under the action of a current sent into the conducting wire.

The said conical form is not an essential feature of the invention, as is set forth in the detailed description which precedes. The conical form is simply the one which may be produced with the greatest facility among the arrangements in conformity to the principle of the invention. It will be equally advantageous to construct diaphragms having the form of a surface of revolution which do not differ appreciably from the conical form, but it is obvious that the surface need not be a surface of revolution in order to obtain the desired effect.

Fig. 2 is an axial section of an electromagnet of the ironclad type. Between the pole-pieces A and B is provided a narrow air-gap D E G which is formed according to the above-mentioned principles. It is bounded by two parallel surfaces of revolution which differ but little from the conical form. The diaphragm has the same shape as the surfaces bounding the air-gap within which it is disposed, and is represented separately in the perspective view Fig. 3. As will be observed, it is provided with a coil of wire whose terminals are at K and L, the said coil being of somewhat spiral shape wherein the turns do not differ appreciably from circles which may be drawn upon the surface of revolution.

An energizing coil P shown in section produces a very strong magnetic field in the air-gap. Upon sending a telephonic current into the wire disposed on the said diaphragm, the latter will be set in vibration parallel to its axis of revolution, and the sound will be produced in the space between the diaphragm and pole-pieces. Suitable ducts formed in the pole-piece A are used to convey the sound produced upon the concave side of the diaphragm to a passage u having disposed therein the mouthpiece v for projecting the sound at a distance.

Fig. 4 shows another arrangement according to the principle of the invention. In this case the mouthpiece is eliminated, the diaphragm acts by its convex surface and the sound proceeds directly into the air without mouth-piece through the apertures formed in the pole-piece A.

In the device shown in Fig. 5, the useful air-gap is provided in the external wall of the ironclad electromagnet, but the operation remains the same as in the preceding cases, the diaphragm being of annular shape in this device.

In the various apparatus hereinbefore described the magnetic field is produced by an electro-magnet, but it is obvious that the magnetic field may be produced in like manner by one or more permanent magnets. Each of the said apparatus contains but a single diaphragm, but it is evident that a plurality of diaphragms according to the invention may be disposed in the same air-gap or in different air-gaps. The coil may be disposed upon the whole or only a part of the said surface, and the diaphragm can be confined to the region of the air-gap in place of extending outwardly of this region.

The diaphragm is generally wound with wire disposed in a single layer, but it may be found useful to form a winding of a plurality of superposed layers. The turns may be placed in contact or separated, or again wound in a number of distinct circuits. The winding may be carried out with wire of any suitable material such as copper, aluminum or magnesium. The wire may be of cylindrical or other shape, and it may be advantageous to make use of a conductor in the form of a ribbon. The insulation between the turns can be obtained by any suitable process.

The material of the diaphragm may be of any adequate substance, either rigid, elastic or soft, and the diaphragm can be constructed for example by causing the wire to adhere to the surface of cloth fabric, paper or the like. It may be preferable to weave the said wire with a textile thread, so as to form a sort of fabric; the turns of wire could furthermore be covered and connected together

by disposing thereupon a solution of collodion, rubber or like substance. This description of the methods of construction of the liaphragm is not however of a limitative nature.

The said diaphragm may be inserted upon its edge in a rigid or a flexible manner, or may be supported at various points in any sufficient number. Should it be desired, the weight of the diaphragm can be equilibrated by an electric current sent into the winding. The diaphragm can be used not only to produce sounds in the air, but may also be employed under water so as to emit the sounds in the water. In this event the water may come in contact with both sides of the same, or only one side.

The said devices may be supplied with telephonic current from any suitable source that can be used for all purposes requiring the emission of sounds. The hereinbefore described apparatus are of the reversible type; if a sound should strike against the diaphragm it is caused to vibrate, and its motion in the magnetic field will induce a current in the wire disposed thereupon. This current may be utilized in the same manner as the current from a microphone, whether the said apparatus be employed in the air or under water.

What I claim is:

1. An apparatus for the emission and reception of sound constituted by a magnet, a wire winding on a support, said wire having therein a variable current produced by the acoustic displacements or being capable of producing such displacements, said winding representing at the same time a mechanical element receiving or emitting vibrations and an electromagnetic element producing or receiving the variable current, said element being disposed in the air-gap of the magnet in such manner that the direction of vibration of the wire winding on a support, as a whole, shall be oblique to the direction of the magnetic field of the air-gap, whereby all points of the wire winding on a support, as a whole, shall be caused to vibrate upon the passage of the current, thus producing a loud sound in a direct manner and without any other means.

2. An apparatus for the emission and reception of sound constituted by a magnet, comprising two pole pieces of conical shape respectively convex and concave, a wire winding on a conical support, said wire having therein the variable current produced by the acoustic vibrations or set up by the same, said winding constituting at the same time the mechanical element emitting or receiving the vibrations and the electromagnetic element emitting or receiving the variable currents, said winding being disposed in the air-gap of the magnet and parallel to the faces of the said air-gap whereby the displacement of the wire winding on a support as a whole, which occurs parallel to the axis, is oblique to the direction of the magnetic field and whereby all the points of the wire winding on a support as a whole shall be caused to vibrate upon the passage of the current, thus producing a loud sound in a direct manner and without any other means.

3. An apparatus for the emission and reception of sound constituted by a magnet comprising two pole pieces whereof one is apertured in order to facilitate the transmission of vibrations to the surrounding air, a support having disposed thereon a wire coil and disposed in the air gap of the magnet in such manner that the direction of vibration of the diaphragm shall be oblique to the direction of the magnetic field of the air gap, whereby all points of the diaphragm shall be caused to vibrate upon the passage of the current, thus producing a loud sound in a direct manner and without any other means.

In testimony whereof I have signed this specification.

MAURICE GUÉRITOT.