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SOUND REPRODUCING APPARATUS

Filed June 28, 1929

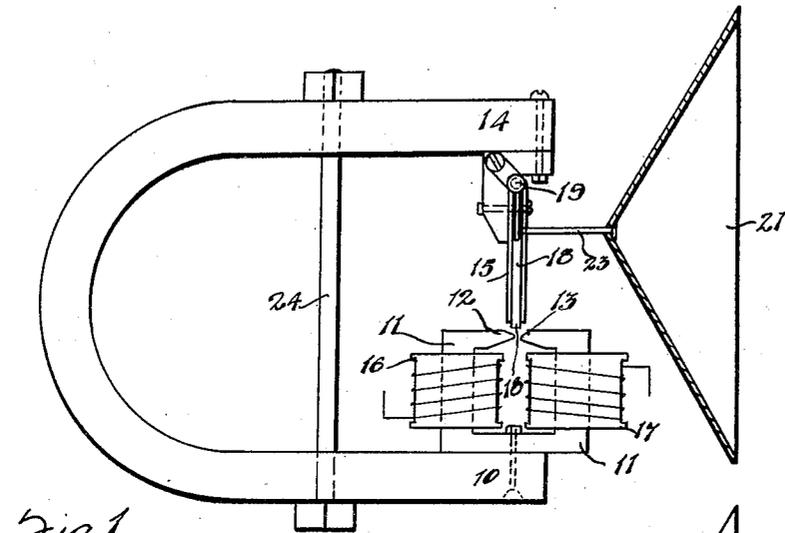


Fig. 1.

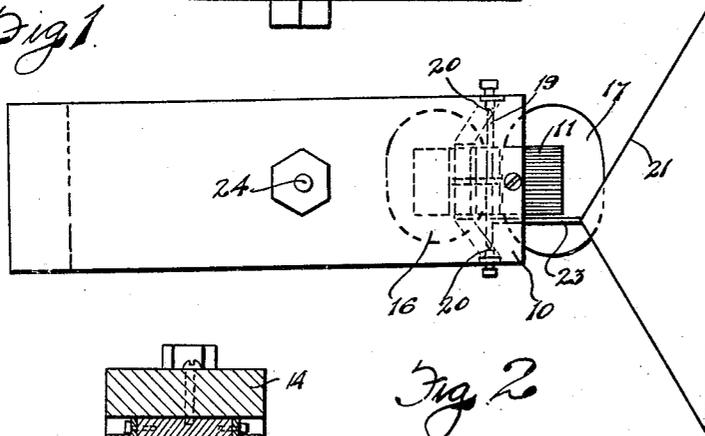


Fig. 2.

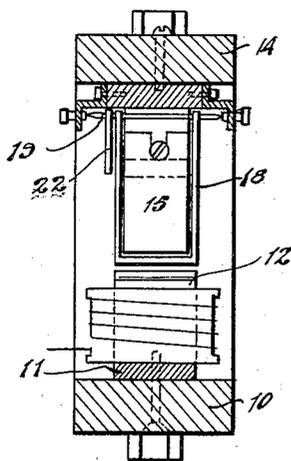


Fig. 3.

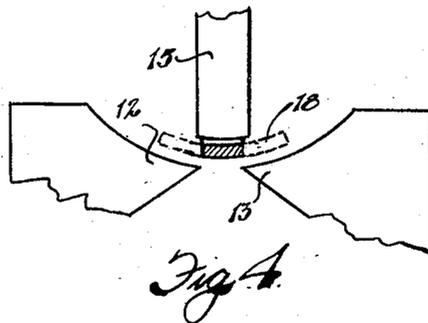


Fig. 4.

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SOUND REPRODUCING APPARATUS

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This invention relates to sound reproducing apparatus in connection with loud speakers or other sound amplifying or sound condensing devices. Its object is to provide means for receiving sound modulated electric currents whereby their resultant magnetic stresses are efficiently utilized to produce corresponding mechanical movements with intimate fidelity throughout their entire range, and to unify and connect these movements with a suitable diaphragm whereby the vibrations may be amplified or condensed as the case may be and delivered as sound waves.

The invention is obviously available conversely to receive sound vibrations and to so utilize their energy as to reproduce in replica their corresponding modulations of frequency and amplitude, in an electric current.

A further object of my invention is the provision of apparatus of this character which has a much greater inherent range of operation than is possible with many or all of such devices hitherto in vogue.

This extension of range becomes possible in consequence of the fact that the effective portion of the vibrational range of the diaphragm is absolutely free from any exterior limitations. It is thus enabled to respond to the most delicate and the most powerful vibrations with equal freedom from mechanical restraint.

The reasons for these attained objects are more clearly described by the aid of the drawings herewith which form a part of this application, and in which:

Figure 1 is a general side view of the device.

Figure 2 is a plan.

Figure 3 is a cross section of Figure 1, to an enlarged scale, and

Figure 4 is a view of the pole faces and vibrating armature, as shown in Figure 1, but to a much enlarged scale.

These figures illustrate in sufficient detail a preferred form of construction adapted for my device. I do not, however, bind myself to the precise details indicated except in so far as they may fall within the limitations of the claim.

In these drawings the numeral 10 indicates one pole of a permanent magnet of horseshoe form, supported in a suitable frame or casing. Secured against the pole 10 is an electromagnet 11 of modified horseshoe type, preferably finely laminated of soft iron, and having polar extremities 12 closely adjacent and shaped as shown at 13. Secured to the opposite pole 14 of the permanent magnet is a polar extension 15 extending towards the polar extremities 12 of the permanent magnet.

Thus far the construction disclosed consists of a closed magnetic circuit comprising an iron core which bifurcates at one pole to form two polar extremities which converge symmetrically towards the extension 15 from the opposite pole 14, being separated therefrom by narrow air-gaps. The bifurcated portion of the system carries spools 16 and 17 upon which are wound and connected convolutions of insulated wire, such that when an electric current flows therein, opposing magnetic poles are formed at the adjacent polar extremities 12.

It is obvious that when no current circulates through the winding on 16 and 17 the magnetic flux due to the permanent magnet with the poles 10 and 14 will divide in approximately equal paths through the core of the electromagnet 11 and will thence pass across the two symmetrical air-gaps at 13 into the polar extension 15, but that when the bifurcated path is magnetized by the ampere turns on 16 and 17 the flux due to the permanent magnetism will be augmented in one limb and polar extremity and diminished in the other opposite and corresponding part, and the polarity will vary with the direction of the current. As the current operating a loud speaker is alternating in character, the resultant magnetic flux will correspondingly oscillate between the polar extremities from one polar air-gap to the other in synchronism, but should the current operating the loud speaker be a rectified or direct current the resultant effect will be always in one direction and will be pulsating in character.

However this characteristic does not pre-

vent the apparatus from functioning perfectly, providing that the pulsations are in opposition to the direction in which the resistance of the vibrating diaphragm is the greater.

From the above it will be noted that the magnetic and dynamic effects combine to produce a pulsating magnetic flux oscillating between and crossing the fixed air-gaps at 12. To obtain the mechanical conversion of this magnetic pulsation I provide by preference a pivotal armature of U-shaped form, the sides and closed end of which are closely adjacent the sides and end of the polar extension 15, whereby the major part of the magnetic flux from the polar extremities 12 must pass through the end portion of the U-shaped armature 18, which latter is adapted to move in a direction substantially right-angular to the path of the flux.

As the armature 18 is connected rigidly to the spindle 19 which is held in substantially frictionless bearings at 20, it is free to take up any position within the air-gaps at 13, and will accordingly respond to the most minute variations of the magnetic flux, to which it provides a path of least resistance.

It is to be noted that the effective part of the pulsating armature which may be as light as is consistent with the requisite rigidity, is absolutely free of all mechanical limitations, and moreover the permeability of the path may be readily varied by increasing or decreasing the width of the air-gaps at any portion so that a calibration may be effected whereby the magnetic pull upon it may be accelerated or retarded at the extremities or at any portion of its pulsating swing.

In this connection it may be noted that if and when a uni-directional pull is exerted by the electromagnet this may be compensated for by slightly narrowing the air-gap on the opposite pole-face so that the resiliency of the cone may suitably coincide with the minimum value of the amplitude of the electrical pulsation.

The connection of the vibrating cone 21 and the pulsating armature 18 is made by the short arm 22 which being integral with the spindle 19 provides a corresponding leverage on the cone which is transmitted by the rigid rod 23. A simple means of adjusting the air-gaps is indicated in Figure 1 by the tie-bolt 24.

It should be noted that the elasticity of response and the intrinsic resiliency of the apparatus is due in part to the inherent self-centering function of the pulsating armature, which latter is held central by the flux of the permanent magnet when the electromagnetic flux is at zero value, but is also automatically released by the co-ordinated action of the two magnetic systems.

Having now partially described my invention, what I claim and desire to be protected in by Letters Patent, is:

In a sound reproducing apparatus relating to loud speakers and the like the combination with a permanent magnet of substantially horseshoe form and having a dual polar extension on one of its poles thus providing a bifurcated path thereat and having a single polar extension on its other pole, the said magnet construction being characterized by converging pole faces on the extremities of said dual extension, and the said single polar extension being central of said converging pole faces whereby the magnetic circuit is interrupted by a narrow air-gap, convolutions of insulated wire on said dual polar extensions, said wire carrying audio-frequency currents adapted to disturb the symmetrical flow of the magnetic flux in said permanent magnet and to concentrate the flux at either extremity of said air-gap, an armature of relatively thin material and of U-shaped form pivoted at its open end and adapted to vibrate freely around the sides and end of the said single polar extension and to vibrate edgewise towards either extremity of the said air-gap and with substantially constant clearance between itself and the said polar faces in correspondence with the movement of said flux, a vibrating member adapted to produce sound waves, and means for directly imparting the said vibrational movement of the armature to said vibrating member.

In testimony whereof I affix my signature.
ARTHUR J. HAYNES.