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W. T. WEIDENMAN, SR
ELECTROMECHANICAL AMPLIFIER

2,270,983

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Fig. 1

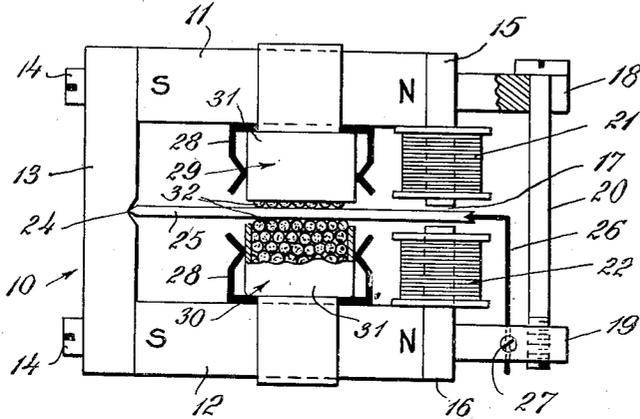


Fig. 2

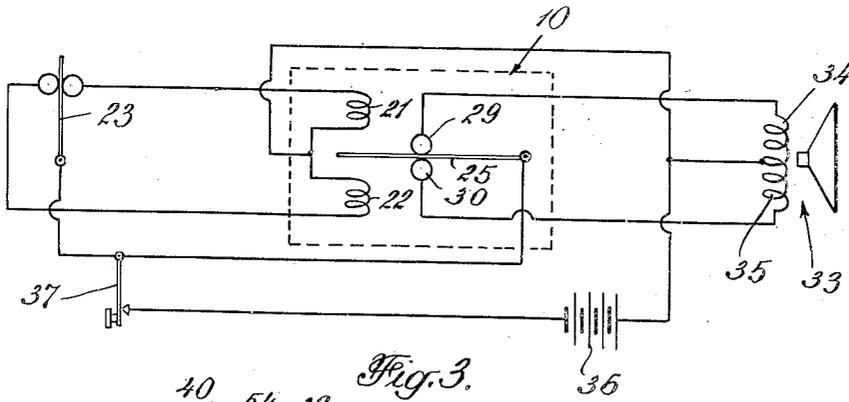
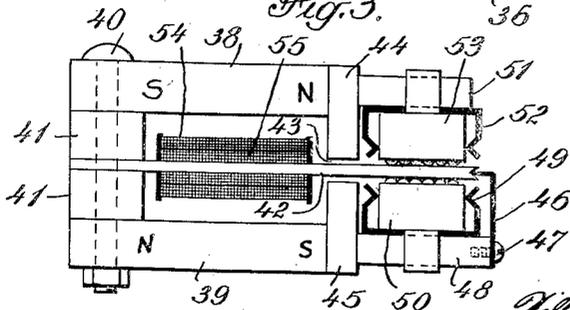


Fig. 3



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ELECTROMECHANICAL AMPLIFIER

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1 Claim. (Cl. 179—171)

This invention relates to electromechanical amplifiers and has particular reference to improvements in the portable microphone or mechanical types of electrical amplifiers.

The usual portable types of electromechanical amplifiers are subject to wide variations in operating characteristics whenever the position of the amplifier or the energizing microphone is changed. The various expedients heretofore employed with a view to correction of these objectionable characteristics of current portable type amplifiers invariably impair the flexibility of use, reliability, or performance of the amplifier.

In accordance with the present invention, an electromechanical amplifier is provided which maintains substantially uniform volume and quality of output regardless of the position or a change in the position of the exciting microphone or the amplifier itself, and which is simple and less expensive to manufacture and service than the current types of amplifiers without sacrifice of reliability or performance.

A preferred embodiment of the invention comprises a push-pull armature vibrated electromagnetically by balanced coils energized by voice currents developed by a push-pull microphone, the vibrations of the armature in turn actuating opposite carbon button electrodes, which results in amplification of the voice currents for reproduction in a push-pull receiver. With the armature in its normal vertical position, both electrodes supply the load current substantially equally, and in all other positions of the armature, including the horizontal position, one or the other electrode continues to function effectively, since a reduced air gap and increased electrode mass load on the armature reduce distortion to a minimum.

The device is so arranged that the air gap and armature tension and position may be adjusted readily, the suspended armature is easily removable, as are the carbon button electrodes, the device is extremely rugged for all uses and it is compact and lends itself to use with wearable hearing aids as well as for vehicular and stationary purposes. It will thus be seen that the electromechanical amplifier of this invention provides many advantages over those in current use.

For a more complete understanding of the invention, reference may be had to the accompanying drawing, in which:

Figure 1 illustrates the new electromechanical amplifier with certain parts thereof broken away to show their construction more clearly;

Fig. 2 is a typical circuit diagram utilizing the new amplifier; and

Fig. 3 illustrates a modified form of the amplifier.

Referring to Fig. 1 of the drawing, numeral 10

designates the electromechanical amplifier of this invention, which includes a frame comprising two permanent bar magnets 11 and 12 connected in spaced parallel relation at their south pole ends by a permeable bar 13 secured to them by screws 14 or the like. Mounted on the other ends of the bar magnets 11 and 12 are the respective pole pieces 15 and 16, whose inner ends are spaced apart to form the magnetic air gap 17.

The magnets 11 and 12 are provided at their free ends with non-permeable extensions 18 and 19, respectively, connected by a tap screw or bolt 20, threaded into extension 19 and passing through a slot in extension 18, as shown. The bar 13 is semi-flexible and so arranged that the air gap 17 is relatively wide. By tightening bolt 20, the pole pieces 15 and 16 are drawn together to provide any desired width of air gap 17. Conversely, by loosening bolt 20, the springiness of the bar 13 will spread the air gap 17.

The voice coils 21 and 22 are mounted on the respective pole pieces 15 and 16, being wound on spools in the usual way. As shown in Fig. 2, the coils 21 and 22 are connected in the circuit of the exciting microphone 23 which is of the double-electrode or push-pull type, i. e., both directions of movement of the sound-actuated diaphragm or reed result in the development of electrical current supplied to either coil 21 or 22, depending upon the direction of movement of the microphone 23 reed or diaphragm. Although coils 21 and 22 are not wound on the same core they function as a tapped winding, reducing even harmonic generation if wound alike and the circuits are adjusted properly.

Pivoted on its knife-blade inner end in a transverse groove 24 in bar 13 is a relatively rigid flat bar armature 25 with its free end lying in the air gap 17 and normally centered with respect thereto by a light centering spring 26 engaging in a notch in the free end of the armature, and supported in the extension 19, as shown. The armature 25 is connected in the circuit of the microphone, as illustrated in Fig. 2, and is made adjustable in the air gap 17 by the adjustability of its centering spring 26, which is slidable in extension 26 and locked thereto in any adjusted position by set screw 27. Of the two closed flux paths thus formed, one includes the magnet 11, pole piece 15, air gap 17, armature 25 and bar 13, while the other includes the magnet 12, pole piece 16, air gap 17, armature 25 and bar 13, the knife blade armature connection at 24 providing sufficient contact with bar 13 to insure good permeability.

It will be observed that the armature 25 may be readily slid into or out of place in its pivot 24 by simply retracting centering spring 26 to permit that operation. In this way, an arma-

ture 25 may be replaced by another giving a different resonance, and the spring 26 may likewise be readily replaced by a stiffer or more flexible spring to alter the response of the armature 25, as required.

Removably supported in insulating clips 28 mounted on the bar magnets 11 and 12 are the respective carbon button type electrodes 29 and 30. These electrodes preferably each comprise the cup 31 of metal or other conducting material, filled with the fluent conducting mass, preferably carbon balls 32, which engage the corresponding opposite surfaces of the armature 25 in all positions of the latter. The edges of the cups 31 are spaced from the corresponding surfaces of the armature 25, as shown, to enable free vibration of the latter. The clips 28 enable ready removal of the electrodes 29 and 30 as conditions require for repair or replacement. The electrodes 29 and 30 are connected in the circuit of the reproducer or receiver 33, such as the loud speaker shown in Fig. 2, suitably equipped with a push-pull or center-tapped winding, the opposite sides 34 and 35, of which are connected to corresponding electrodes 29 and 30, respectively.

In preparing the amplifier 10 for operation, its normal position is with its armature 25 extending vertically lengthwise. When the amplifier is positioned with its armature extending upwardly from its pivot at 24, the effective leverage of the armature is different from that when the microphone is positioned with its armature extending downwardly from its pivot at 24, for the reason that the lowermost carbon balls 32 are effective in each case, so that the quality of the response of the microphone may be changed to suit the user simply by inverting the amplifier bodily. With this normal vertical position of the armature, both electrodes feed the load circuit substantially equally.

If the microphone is tilted from the vertical the weight of the carbon balls 32 of the uppermost electrode will cause them to engage the armature 25 the more firmly, improving the response to its vibrations, and thus the output is automatically maintained substantially constant, and distortion is reduced to a minimum, even though the sensitivity of the lowermost electrode is somewhat reduced. Likewise, the effect of tilting of the exciting microphone 23, as when a wearer of an amplified wearable hearing aid is seated in a partially reclining position, resulting in unbalanced input to the coils 21 and 22, is minimized by the mechanical centering of the armature, so that the output of the amplifier 10 remains substantially constant. Thus, a wide range of movement of either or both the exciting microphone 23 and the amplifier 10 from their normal vertical positions is permissible without loss of output to the speaker 33.

The operation of the electromechanical amplifier of the invention may be described by reference to Fig. 2, showing a circuit suitable for automobile chauffeur instruction, for example, although it has many other uses, including hearing aid, intercommunicating telephone, and the like. In the illustrated arrangement, the push-pull microphone 23 is energized from battery 36 when the switch 37 is closed and a uniform flux traverses the air gap 17 of the amplifier 10. In response to speech, microphone 23 supplies pulsating direct current to the coils 21 and 22 of

amplifier 10, thereby varying the flux traversing the air gap 17 and causing corresponding vibration of armature 25. This vibration of armature 25 is communicated mechanically to the carbon button electrodes 29 and 30, resulting in a rearrangement of the carbon balls 32, causing intensified fluctuating current to be supplied to the loudspeaker 33. The same or similar effect is obtained when the amplifier is employed for other uses, as will be readily understood.

In the modification illustrated in Fig. 3, the bar magnets 38 and 39 are secured together in parallel relation at ends of opposite polarity by a bolt 40, passing through permeable spacers 41 clamping the flat flexible armature 42 securely between them. The armature 42 extends through the air gap 43 formed between the spaced ends of the pole pieces 44 and 45 mounted on the corresponding free ends of the bar magnets 38 and 39, respectively. The armature 42 is resiliently centered in the air gap 43 by the spring 46 adjustably mounted by screw 47 on the extension 48.

Extension 48 is fitted with an insulating clip 49 removably supporting the carbon granule electrode 50, while a similar extension 51 on the end of magnet 38 carries the insulated clip 52 for removably supporting the other carbon granule electrode 53. Concentric voice coils 54 and 55, connected as illustrated in Fig. 2, are wound on the armature 42, as shown. The arrangement of the modification of Fig. 3 enables more compact construction but its operation is the same as that of the arrangement of Fig. 1, as will be readily understood.

While certain preferred embodiments of the invention have been illustrated and described herein, it is to be understood that the invention is not limited thereby, but is susceptible of changes in form and detail within the scope of the appended claims. For example, the electrodes 29 and 30 in the arrangement of Fig. 1 may be positioned beyond the coils 21 and 22 instead of between them and the armature pivot point 24, providing the longer armature is made sufficiently stiff, somewhat in the manner illustrated in Fig. 3, and the electrodes 50 and 53 of Fig. 3 may be positioned between the pole pieces 43, 44 and the bolt 40 connection, somewhat like the arrangement of Fig. 1, and the like. Also the armature of Fig. 3 may be pivoted as in Fig. 1, and vice versa.

I claim:

In a push-pull electromechanical amplifier, the combination of a support, electromagnetic means on the support, including a pair of permanent magnets having poles of like polarity adjacent to each other and forming an air gap and voice coils associated with each magnet, an elongated armature pivoted at one end on the support in a substantially vertical position and extending through said air gap and polarized by said permanent magnets for vibration in response to flux variations, spring means connected to the armature for normally centering it in said air gap subject to vibration, an electrode positioned adjacent each side of said armature in the plane of the pivotal vibration thereof comprising a cup and conducting particles in said cups operatively engaging the corresponding side of the armature for rearrangement as the armature vibrates, and electrical connections to each of said electrodes.

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