Oct. 20, 1931. J. H. VAN WAGENEN 1,827,919

ELECTROMAGNETIC SOUND PRODUCING DEVICE

Original Filed May 10, 1923 4 Sheets-Sheet 1

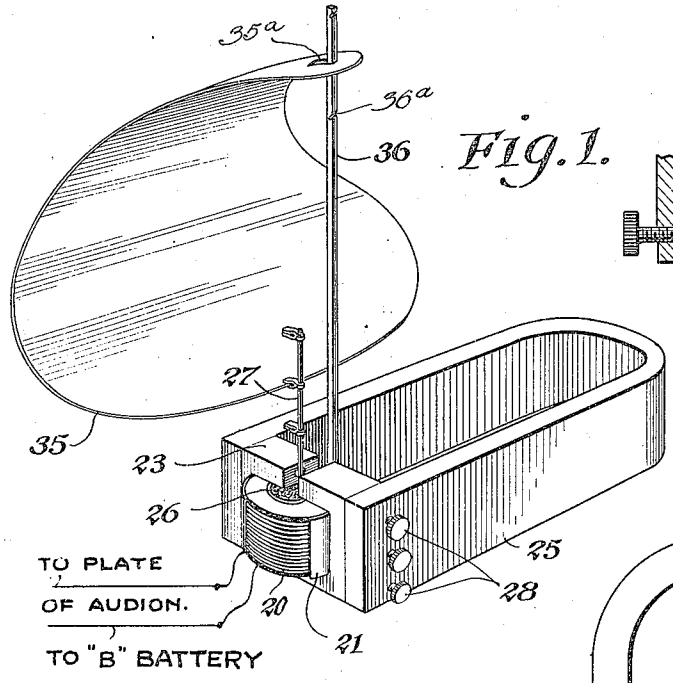


Fig. 1.

Fig. 5.

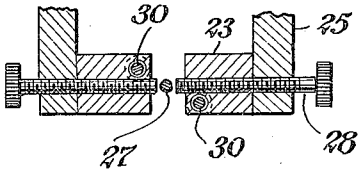


Fig. 3.

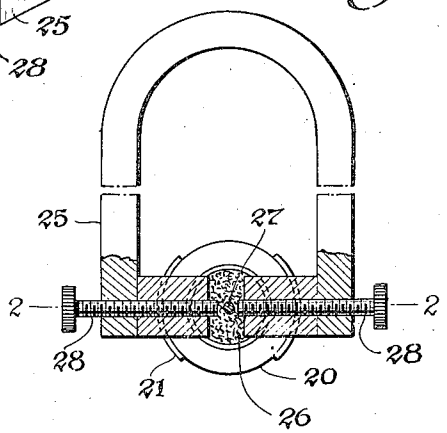
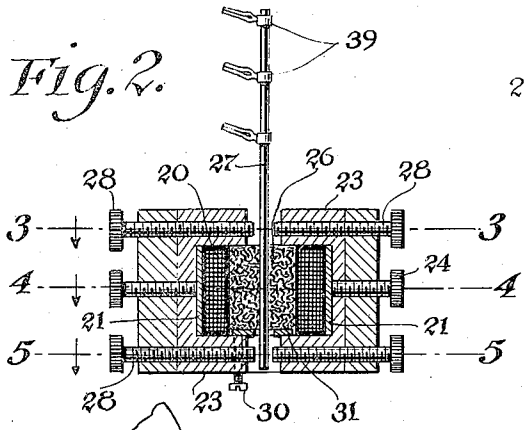


Fig. 2.



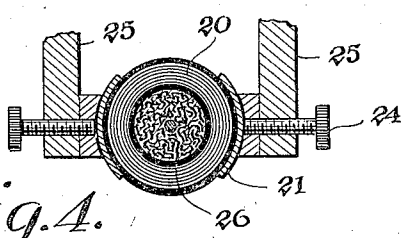


Fig. 4.

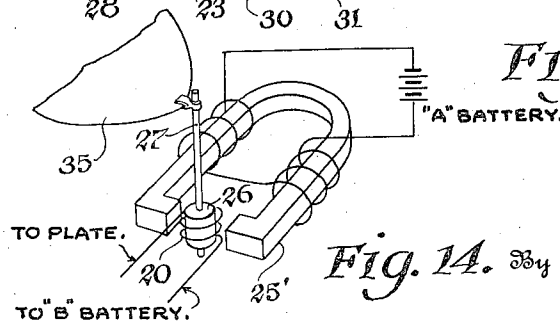


Fig. 14.

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ELECTROMAGNETIC SOUND PRODUCING DEVICE

Original Filed May 10, 1923 4 Sheets-Sheet 2

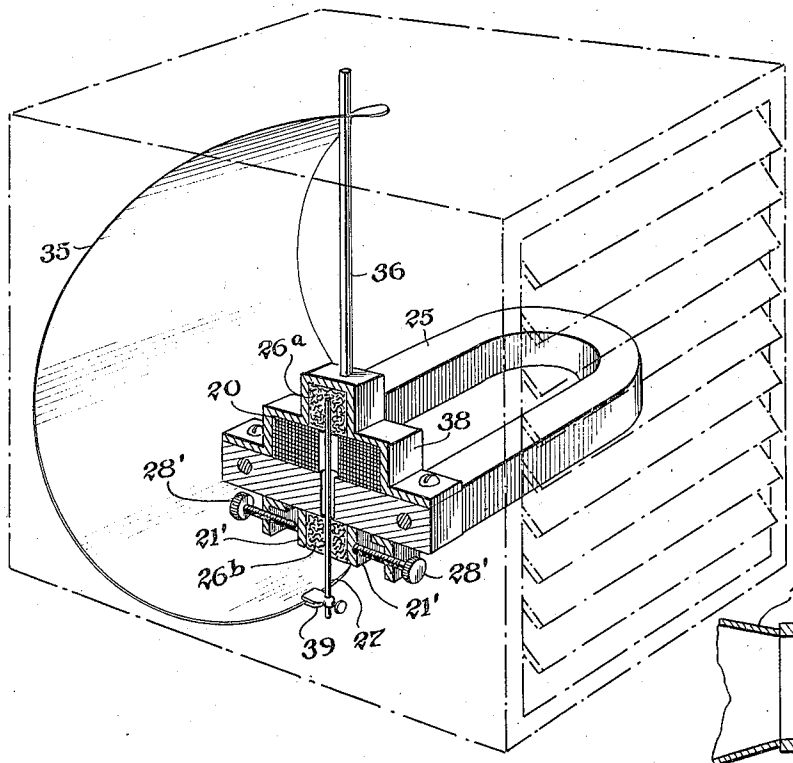


Fig. 6.

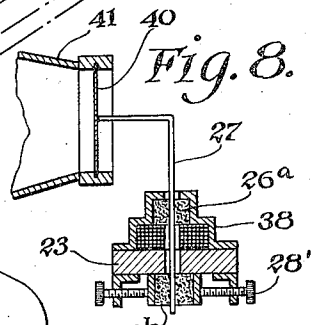


Fig. 8.

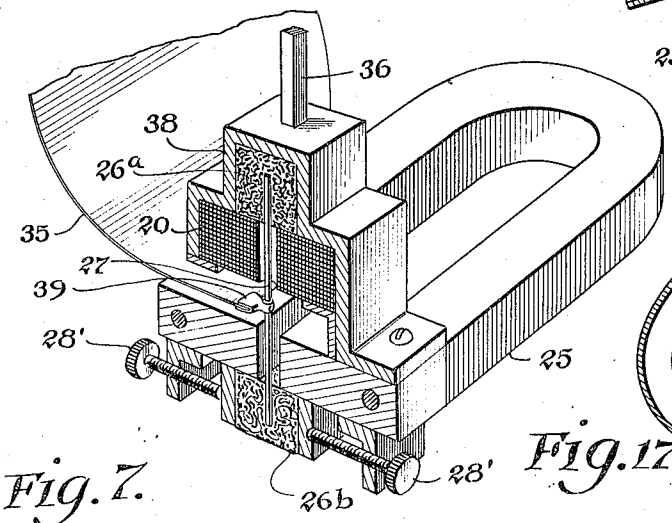


Fig. 7.

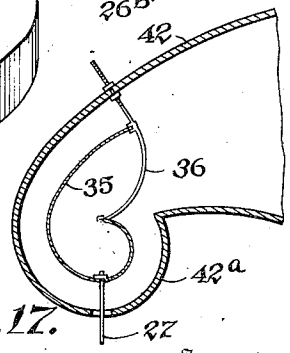


Fig. 17.

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Fig. 9.

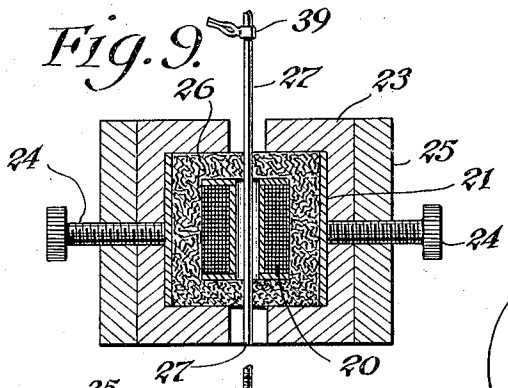


Fig. 10.

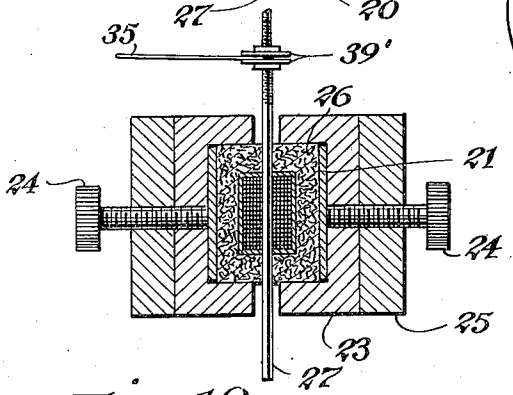


Fig. 11.

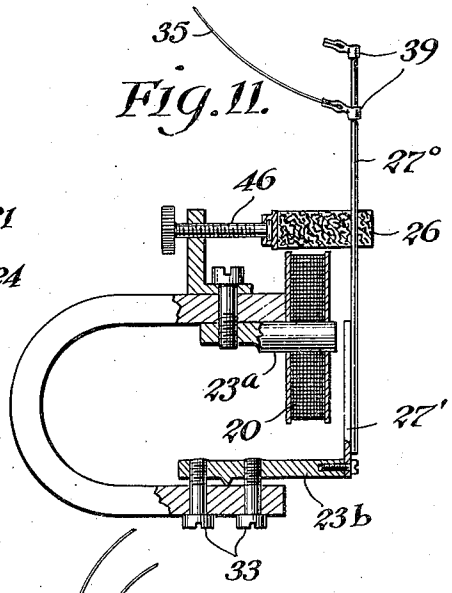


Fig. 12.

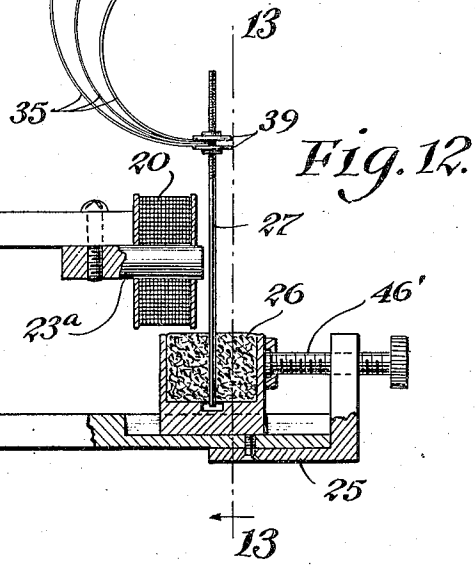
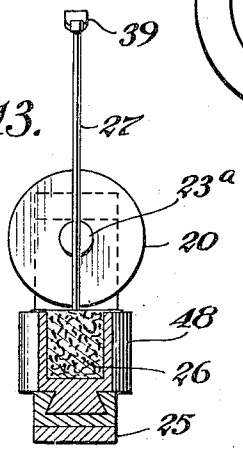


Fig. 13.



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ELECTROMAGNETIC SOUND PRODUCING DEVICE

Original Filed May 10, 1923 4 Sheets-Sheet 4

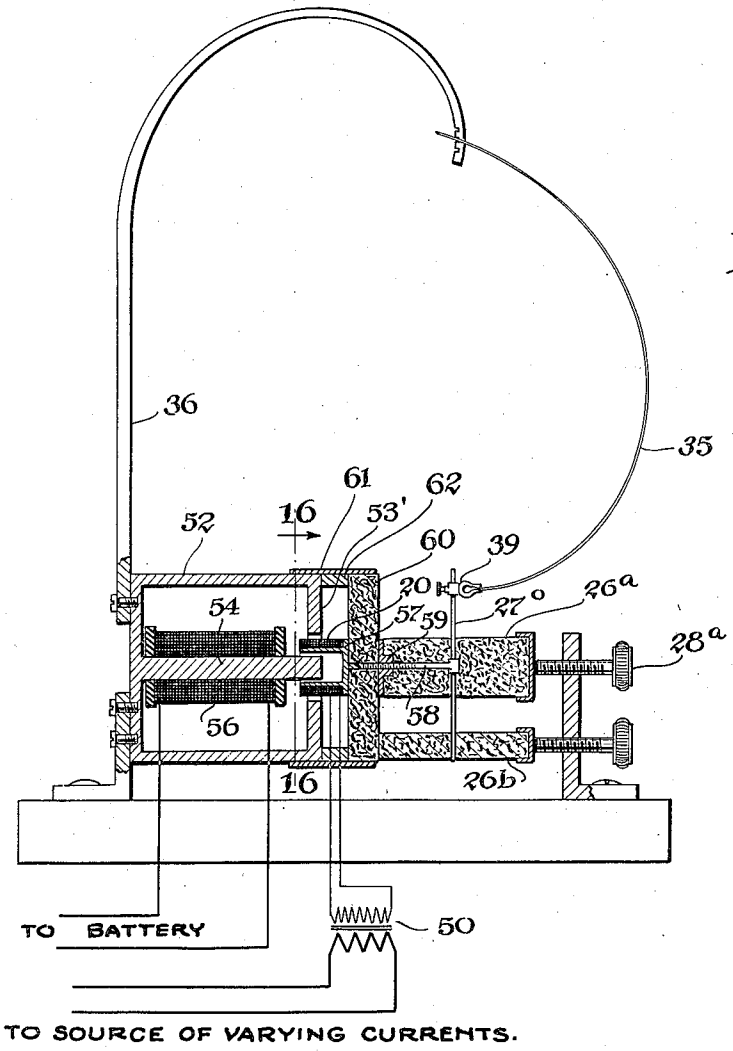


Fig. 15.

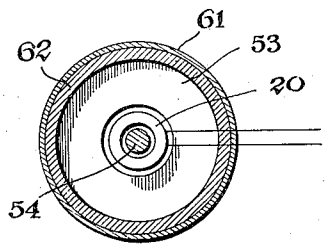


Fig. 16.

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UNITED STATES PATENT OFFICE

JAMES H. VAN WAGENEN, OF WASHINGTON, DISTRICT OF COLUMBIA

ELECTROMAGNETIC SOUND-PRODUCING DEVICE

Application filed May 10, 1923, Serial No. 638,079. Renewed April 26, 1926.

This invention relates to apparatus for producing sound from a vibrating sound generator which is actuated by the armature or vibratory member of an electromagnetic device.

One purpose of my invention is to provide an electromagnetic actuator having a responsive element capable of universal movement and which is free from mechanical stresses and strains so that its movements are due entirely to the magnetic forces created by the energizing electric currents traversing its actuating coil.

Another object of my invention is to provide a sound reproducer suitable for use with radio broadcast receiving sets wherein the actuating vibrations of the electromagnet are communicated to a vibratable member from the edge thereof.

A still further object of my invention is to provide an apparatus of very simple construction that will accurately respond to the varying currents in the oscillating circuits of radio receiving apparatus, although its use is not confined to such apparatus, and is adapted to many other types of electromagnetic mechanism.

In the accompanying drawings, I have illustrated several forms in which this invention may be embodied. Figure 1 shows one form which is particularly adapted for use in connection with the audio amplifying circuit of a radio receiving apparatus; Fig. 2 is a vertical sectional view on the line 2—2 of Fig. 1; Figs. 3, 4 and 5 are transverse sectional views on the lines 3—3, 4—4 and 5—5 respectively of Fig. 2; Figs. 6, 7, 8, 9, 10, 11, 12 and 15 illustrate various modifications of the invention; Fig. 13 is a vertical sectional view on the line 13—13 of Fig. 12; Fig. 14 is a diagrammatic view showing the use of an electromagnet instead of the permanent magnet shown in the other figures; Fig. 16 is a vertical sectional view on the line 16—16 of Fig. 15; and Fig. 17 shows one arrangement of mounting the sound-producing vibrating element within an amplifying chamber, such as a horn.

Electromagnetic actuators universally employ an armature which is pivoted or is otherwise held by a rigid support, so that the armature is permitted to move only in a prescribed manner. Such arrangements not only confine the armature to certain predetermined movements but also cause internal mechanical stresses therein besides creating extraneous disturbing influences. Even if the armature is suspended by a cord, it is not entirely free, being held from bodily movement in at least one direction. I have found that an armature which is subjected to internal mechanical stresses will have an acoustic periodicity of its own, which will interfere with and distort the movements or vibrations of the armature responsive to changes in the magnetic field controlling the same, which varies in response to variations in the electric currents flowing in the energizing coil thereof.

In the embodiment of my invention illustrated in Figs. 1 to 5, the energizing coil 20, which is connected to the auditory circuit or to any other source of varying or intermittent currents, is held between curved plates 21 seated in recesses within the pole-pieces 23 of a permanent magnet 25 and clamped by screws 24. The central space within the coil is filled by a block of any suitable elastic material 26, such as spongy rubber, cork etc. The armature consists of a magnetizable rod 27 and is centrally held or suspended between the pole pieces by passing through the block of elastic material. Fine adjustments that may be required to accurately center the armature between the poles may be made by means of the iron screws 28 which constitute adjustable portions of the pole pieces. The elastic suspending or supporting medium permits the armature to assume its natural position free from any rigid restraint, such as would be imposed by a spring suspension and therefore without any internal mechanical stresses and to move bodily in any direction or to vibrate in any manner in response to the magnetic forces created by the energizing currents flowing in the coil 20; and at the same time said elastic suspending medium protects the armature from disturbing external influences. Moreover, it serves to absorb and prevent any tendency to natural

vibrations or acoustic periodicity inherent in any part of the structure. Inasmuch as there is no fixed pivot, the lateral vibrations of the armature will oscillate about a variable center determined only by the resultant forces and which may or may not be on the central axis of the magnet; that is to say, without confining the position or location of a nodal point in the armature it is rendered aperiodically sensitive or in other words uniformly sensitive and responsive to all frequencies. The amplitude of vibration or amount of movement produced by the magnetic forces, may be regulated or damped to any desired degree by adjusting the screws 30, bearing upon the disk 31, to compress the elastic medium 26.

The electromagnetic vibrations of the armature are transformed into sound waves by connecting the rod 27 to a vibratable member 35 which may be made of paper, metal or other suitable material. Mounted on the rod 27 are adjustable clips 39 which are adapted to clamp one edge of the vibratable member 35.

The vibratable member 35 comprises a sheet that may be of any desired shape and is so mounted as to have all edges thereof entirely free to vibrate.

It has been found desirable to place the sheet under a slight tension which is accomplished by bowing the sheet as shown in Figs. 1 and 6. The lower edge may be secured at one point in one of the clips 39 as shown in Fig. 1 and the upper end of the sheet has an elongated aperture 35*a*, which is adapted to receive the post or standard 36 which is shown as permanently mounted as a part of the unit. The post 36 is provided with a series of notches 36*a* into which the sheet 35 fits so as to retain the sheet in its predetermined form. Thus, while the edges of the sheet are free to vibrate, the sheet is held bent.

It will be noted that the vibrations of the magnetic armature are communicated to the vibratable member 35 at the edge thereof so that the sound waves are propagated from the edge of the vibratable member toward the center thereof and throughout the length of the sheet 35, with consequent advantage in the reproduction of the sounds received in the electromagnet.

In the modification shown in Fig. 6, the coil 20 is held in a frame or bracket 38, secured to the upper side of the pole-pieces and to which the standard 36 is also attached. The armature is supported for universal movement in the blocks of elastic material 26^a and 26^b, the latter being clamped between plates 21′ which may be adjusted laterally to center the armature by means of the clamping screws 28′ and may also be compressed if desired. In this form the armature projects below the magnet and carries an adjustable clip 39 for attachment to the sound amplifier 35. Any of the structures illustrated in the drawings herein may be enclosed in a cabinet having one or more sides thereof ventilated to the open air. I have illustrated one such arrangement by dot-and-dash lines in Fig. 6. The sound reproducer unit may be mounted in the cabinet in any suitable manner.

In Fig. 7 the sound amplifying sheet is clamped to an intermediate point of the armature, one foot of the bracket 38 being omitted to permit the sheet to pass through. In the forms shown in Figs. 6 and 7, the armature moves bodily and freely in vibrating between the magnet poles.

Instead of using a flexible bowed sheet as the sound amplifier, the armature may be connected directly to the diaphragm 40 of a sound producing or amplifying horn 41 as indicated in Fig. 8. Again the bowed sound producing sheet may be enclosed in an amplifying horn 42 and may conform more or less to the contour of the resonance chamber 42^a when the horn is so constructed, as indicated in Fig. 17.

In order that the coil may closely surround the armature, the coil 20 may be placed within a recess in the elastic cushioning medium 26, in the manner illustrated in Fig. 9.

In the arrangement shown in Fig. 10, the coil 20 is embedded in the elastic block 26 and is wound directly upon the armature. Furthermore, in this arrangement, the armature may consist of the coil alone and the iron rod 27 may be replaced by a rod of wood, brass or other light material which serves merely to transmit the vibrations of the coil to the amplifying sheet 35, the energizing coil 20 being thus free to vibrate in the elastic mass 26, and thereby constituting also the vibrating armature.

In Fig. 11, the actuating coil 20 is carried by the pole-piece 23^a and the armature 27′ is carried by the pole-piece 23^b, the latter being angularly adjustable by means of the screws 33, to thereby adjust the armature toward or from the pole-piece 23^a. An arm 27° of any suitable light material attached to the armature, passes through the cushioning block 26, supported by the adjusting screw 46, and carries the clips 39 for attachment to the sound amplifying sheet 35.

In the arrangement shown in Fig. 12, the lower end of the armature is embedded in a block of cushioning material carried by a box 48 slidably mounted on the lower pole-piece and provided with an adjusting screw 46′. I have also shown in this figure that a plurality of bowed sound creating or amplifying sheets 35 may be connected to armature.

A further modification is illustrated in Fig. 15 in which the armature consists of the coil 20 connected to the source of varying currents, indicated conventionally by the trans-

former 50. The magnet may be in the form of a tubular soft iron shell 52 with an inwardly directed annular flange 53, constituting a pole piece, and a centrally disposed core 54 surrounded by the magnetizing coil 56.

The actuating coil 20, constituting the movable element, may be attached to a spool or disk 57, having a stem 58 upon which a nut 59 is threaded, for the purpose of clamping the coil to a disk 60 of elastic material, such as cork, sponge rubber etc. The disk 60 may be held by a sleeve 61 surrounding the magnet, the position of the coil 20 being determined by the thickness of an interposed non-magnetic ring rod 27° of any suitable light material is attached at an intermediate point to the end of the stem 58, the rod passing through a block 26^a of elastic material and having its lower end anchored in another block 26^b of elastic material. The position of the coil 20 can be adjusted by means of the screw 28^a. All of the parts of the moving element may be constructed of very light material which will transmit vibrations to the amplifying bowed sheet 35, in response to exceedingly feeble currents flowing in the coil 20.

I have shown the amplifying sheet attached by clip 39 directly to the actuator rod of the apparatus, but it will be evident that the free end of the sheet may be attached to a suitably supported vibratory member, which in turn is vibrated by said actuator rod. Or the amplifying sheet may be attached directly to the stem 59, the particular manner of connecting the sheet to the actuating member depending upon the degree of amplitude of vibration desired.

I claim:—

1. An electro-magnetic actuator for sound reproducing apparatus comprising a magnet, a magnetizable member so positioned within the magnetic field of said magnet as to permit vibratory movements transverse to the longitudinal axis of said member, an elastic cushioning medium in which said member is floatingly disposed without confining the position of a node therein, and an energizing coil surrounding said member and operating to vary the stresses exerted thereon to thereby cause said vibratory movements of said member in said elastic medium.

2. In a device as set forth in claim 1, means for varying the degree of flexibility of said elastic medium.

3. A device as set forth in claim 1, and a flexible vibratory sound producing device operatively connected to said member.

4. An apparatus as set forth in claim 1, and means for adjusting the pole-pieces of said magnet toward or from said member.

5. An electro-magnetic actuator, comprising a magnet, a magnetizable member so positioned within the magnetic field of said magnet as to permit vibratory movements transverse to the longitudinal axis of said member, an elastic cushioning medium for floatingly mounting the member so that a substantial portion thereof is restricted from free vibrations floatingly supporting the same, and an energizing coil actuating said member and operating to vary the magnetic flux within the field of said magnet to thereby cause said movements of said member.

6. An electro-magnetic actuator, comprising a magnet, a member so positioned as to permit of oscillatory movements of said member, an elastic cushioning medium supporting said member, and means operating to vary the magnetic flux within the field of said magnet to thereby cause said movements of said member.

7. A sound reproducing device comprising a membrane and a sound reproducing member attached tangentially to one edge of said member to impart vibrations tangentially to the plane thereof, said membrane being arcuate within the range of 90° whereby the edge opposite said one edge is free to vibrate.

8. A sound reproducing device comprising an arcuate membrane of at least 90° and a sound reproducing member attached tangentially thereto to impart vibrations to the marginal edge thereof.

9. A sound reproducing device comprising a flexed membrane completely exposed to surrounding atmosphere whereby said membrane acts as a direct sound radiator and a sound reproducing member attached tangentially to the marginal edge thereof.

10. A sound reproducing device comprising a membrane fully exposed to surrounding atmosphere whereby said membrane acts as a direct sound radiator flexed to form a portion of a cylinder and a sound reproducing member attached tangentially to the marginal edge thereof.

11. A sound reproducing device comprising a membrane, and a sound reproducing member attached tangentially to the marginal edge thereof, the edge of said membrane opposite the marginal edge being free to vibrate.

12. A sound reproducing device comprising a membrane, and a sound reproducing member attached tangentially thereto to impart vibrations tangentially to the plane thereof the edge of said membrane opposite the marginal edge being free to vibrate.

13. A sound reproducing device comprising a membrane supported at at least one edge thereof and flexed to form a portion of a cylinder, and a sound reproducing member attached tangentially to the marginal edge thereof, the supported edge of said membrane opposite the marginal edge being free to vibrate.

14. A sound reproducing device comprising a membrane fixed at at least one edge thereof and flexed to form a portion of a

cylinder, and a full floating sound reproducing member attached tangentially thereto to impart vibrations tangentially to the plane thereof.

15. A sound reproducing device comprising a membrane and an electro-magnetically operated sound reproducing member attached tangentially to the marginal edge thereof, the edge of said membrane opposite the marginal edge being free to vibrate.

16. A sound reproducing device comprising a membrane and an electro-magnetically operated full floating sound reproducing member attached tangentially thereto to impart vibrations tangentially to the plane thereof.

17. A sound reproducing device comprising a flexed membrane and an electro-magnetically operated full floating sound reproducing member attached tangentially to the marginal edge thereof.

18. A sound reproducing device comprising a flexed membrane and an electro-magnetically operated full floating sound reproducing member attached tangentially thereto to impart vibrations tangentially to the plane thereof.

19. A sound reproducing device comprising a membrane and a sound reproducing member attached tangentially to the marginal edge thereof, and a frame for supporting said membrane and member and an elastic cushioning medium for floatingly mounting the membrane so that free vibrations are substantially damped.

20. A sound reproducing device comprising a membrane and a sound reproducing member attached tangentially to the marginal edge thereof, and a frame for supporting said membrane and member, said frame also serving to act as a sounding board to reinforce the air vibrations set up by the membrane and an elastic cushioning medium for floatingly mounting the membrane so that free vibrations are substantially damped.

21. A sound reproducing device comprising a flexed membrane and a full floating sound reproducing member attached tangentially thereto to impart vibrations tangentially to the plane thereof, and a frame for supporting said membrane and member.

22. A sound reproducing device comprising a flexed membrane and a full floating sound reproducing member attached tangentially thereto to impart vibrations tangentially to the plane thereof, and a frame for supporting said membrane and member, said frame also serving to act as a sounding board to reinforce the air vibrations set up by the membrane.

23. A sound reproducing device comprising a membrane fixed at at least one edge thereof and a full floating sound reproducing member attached tangentially to the marginal edge thereof, and a frame for supporting said membrane and member, said frame also serving to act as a sounding board to reinforce the air vibrations set up by the membrane.

24. A sound reproducing device comprising a flexed membrane fixed at at least one edge thereof, and a sound reproducing member attached tangentially to the marginal edge thereof, and a frame for supporting said membrane and member and an elastic cushioning medium for floatingly mounting the membrane so that free vibrations are substantially damped.

25. A sound reproducing device comprising a flexed membrane fixed at at least one edge thereof, and a full floating sound reproducing member attached tangentially to the marginal edge thereof, and a frame for supporting said membrane and member, said frame also serving to act as a sounding board to reinforce the air vibrations set up by the membrane.

26. In an electrical acoustical device the combination comprising an electromagnet adapted to be actuated by a modulated electric current, a full-floating electromagnetic armature vibrated in accordance with the modulations of said current, a vibratile sound reproducing medium, means for connecting the armature to said medium at one edge thereof and means for applying a tension to said medium.

27. In an electrical acoustical device the combination comprising an electromagnet adapted to be actuated by a modulated electric current, a full-floating electromagnetic armature vibrated in accordance with the modulations of said current, a vibratile sound reproducing medium, said connection being off the center of said medium, and means for applying a tension to said medium.

28. In an electrical acoustical device the combination comprising an electromagnet adapted to be actuated by a modulated electric current, a full-floating electromagnetic armature vibrated in accordance with the modulations of said current, a vibratile sound reproducing medium of non-circular shape, means for connecting the armature to said medium, and means for applying a tension to said medium.

29. In an electrical acoustical device the combination comprising an electromagnet adapted to be actuated by a modulated electric current, a full-floating electromagnet armature vibrated in accordance with the modulations of said current, a vibratile sound reproducing medium of greater length than width and non-conical in shape, means for connecting the armature to said medium and means for applying a tension to said medium.

30. In an electrical acoustical device the combination comprising an electromagnet adapted to be actuated by a modulated electric current, a full-floating electromagnetic armature vibrated in accordance with the modulations of said current, a vibratile sound

reproducing medium, means for connecting the armature to said medium, means for connecting the armature to said medium so that the vibrations of said armature are caused to progress toward the center of said medium.

31. In an electrical acoustical device the combination comprising an electromagnet adapted to be actuated by a modulated electric current, an electromagnetic armature resiliently supported without fixing the position of a node therein and vibrated in accordance with the modulations of said current, a vibratile sound reproducing medium, means for connecting the armature to said medium and means for mounting said medium so that all edges thereof are free and unsupported.

32. In an electrical acoustical device the combination comprising an electromagnet adapted to be actuated by a modulated electric current, an electromagnetic armature vibrated in accordance with the modulations of said current, a vibratile sound reproducing medium, means for connecting the armature to said medium at one edge thereof and adjustable means for applying a tension to said medium and mounting said sound reproducing medium in a cushioning means for substantially damping any free vibrations.

33. In an electrical acoustical device the combination comprising an electromagnet adapted to be actuated by a modulated electric current, an electromagnetic armature resiliently supported without fixing the position of a node therein and vibrated in accordance with the modulations of said current, a vibratile sound reproducing medium, means for connecting the armature to said medium at one edge thereof, means for applying a tension to said medium and a ventilated enclosure in which the electromagnetically actuated medium is mounted and mounting said sound reproducing medium in a cushioning means for substantially damping any free vibrations.

34. In an electrical acoustical device the combination comprising an electromagnet adapted to be actuated by a modulated electric current, an electromagnetic armature resiliently supported without fixing the position of a node therein and vibrated in accordance with the modulations of said current, a vibratile sound reproducing medium of greater length than width and non-conical in shape, means for connecting the armature to said medium, means for applying a tension to said medium and a ventilated enclosure in which the electromagnetically actuated medium is mounted and mounting said sound reproducing medium in a cushioning means for substantially damping any free vibrations.

35. In an electrical acoustical device the combination comprising an electromagnet adapted to be actuated by a modulated electric current, an electromagnetic armature vibrated in accordance with the modulations of said current, a plurality of vibratile sound reproducing mediums, means for connecting the armature to said mediums at the edges thereof and means for applying a tension to said mediums and mounting said sound reproducing medium in a cushioning means for substantially damping any free vibrations.

36. A sound reproducing device comprising a membrane and an electrically operated sound reproducing member attached tangentially thereto to impart vibrations tangentially to the plane thereof, the edge of said membrane opposite the attached edge being free to vibrate.

37. A sound reproducing device comprising a membrane and a full floating electrically operated sound reproducing member attached tangentially thereto to impart vibrations to the marginal edge thereof.

38. A sound reproducing device comprising a flexed membrane and a full floating electrically operated sound reproducing member attached tangentially to the marginal edge thereof.

39. A sound reproducing device comprising a membrane flexed to form a portion of a cylinder and a full floating electrically operated sound reproducing member attached tangentially to the marginal edge thereof.

40. A sound reproducing device comprising a membrane flexed to form a portion of a cylinder and a full floating electrically operated sound reproducing member attached tangentially thereto to impart vibrations tangentially to the plane thereof.

41. A sound reproducing device comprising a membrane fixed at at least one edge thereof, and a full floating electrically operated sound reproducing member attached tangentially to the marginal edge thereof.

42. A sound reproducing device comprising a membrane fixed at at least one edge thereof, and a full floating electrically operated sound reproducing member attached tangentially thereto to impart vibrations tangentially to the plane thereof.

43. A sound reproducing device comprising a membrane fixed at at least one edge thereof and flexed to form a portion of a cylinder, and a full floating electrically operated sound reproducing member attached tangentially to the marginal edge thereof.

44. A sound reproducing device comprising a membrane fixed at at least one edge thereof and flexed to form a portion of a cylinder, and a full floating electrically operated sound reproducing member attached tangentially thereto to impart vibrations tangentially to the plane thereof.

45. In an acoustical device the combination comprising a stationary magnet, a conductor

responsive to modulated current juxtaposed to the core of the magnet, non metallic resilient means for supporting said conductor at a normal predetermined position with respect to said core, a vibratile membrane, and means to connect the conductor tangentially to the membrane.

46. In an acoustical device the combination comprising a stationary magnet, a conductor responsive to modulated current juxtaposed to the core of the magnet, a membrane, resilient means enclosing the conductor and forming the sole support therefor and maintaining the conductor at a normal predetermined position with respect to said magnet, and means to connect the conductor tangentially to the membrane.

47. In an acoustical device the combination comprising a stationary magnet, a conductor responsive to modulated current juxtaposed to the core of the magnet, resilient means for supporting said conductor in compressed equilibrium at a normal predetermined position with respect to said core, a vibratile membrane and means to connect the conductor tangentially to the membrane, and means to adjust the normal position of the conductor.

48. In an acoustical device the combination comprising a stationary magnet a conductor responsive to modulated current juxtaposed to the core of the magnet, resilient means enclosing the conductor and forming the sole support therefor and maintaining the conductor at a normal predetermined position with respect to said magnet, means to connect the conductor tangentially to the membrane and means to adjust the normal position of the conductor.

49. An actuator for sound reproducing devices comprising a member responsive to electrical impulses so positioned in a magnetic field as to be oscillated thereby, an elastic cushioning medium retaining the member in adjustable position and forming the sole support therefor without fixing the center of oscillation of said member.

50. A method of increasing the sensitivity of a member subjected to oscillation under the action of a variation in magnetic flux comprising floatingly mounting the member in a flexible medium without fixing a center of oscillation.

51. A method of increasing the sensitivity of a member subjected to oscillation under the action of a variation in magnetic flux comprising floatingly mounting the member in a variable resilient medium thereby insuring freedom to the variable positioning of the oscillatory center of said member.

52. A method of increasing the sensitivity of an oscillating member which is movable in response to sounds comprising floatingly mounting the member in a resilient medium and thereby insuring freedom to the variable positioning of the center of oscillation of said member.

53. An actuator for sound reproducing devices comprising a member subjected to and displaceable in response to variations in electrical energy in its field of action, and a resilient mounting for the member adapted to floatingly mount the member and thereby insuring freedom to the variable positioning of the center of displacement of said member.

54. A method of transforming electrical vibrations into sound vibrations comprising transforming the electrical vibrations into proportionate mechanical movements without utilizing a fixed pivot during such movements, impressing such movements upon an initially substantially cylindrically flexed member to vary the flexure thereof and correspondingly displace the adjacent medium.

55. An electromagnetic actuator for sound reproducing apparatus comprising a magnet, a magnetizable member so positioned within the magnetic field of said magnet as to permit vibratory movements transverse to the longitudinal axis of said member, an elastic cushioning medium in which said member is partially embedded and forming the sole support therefor without fixing the position of a node therein, and an energizing coil associated with said member and operating to vary the stresses exerted thereon to thereby cause said vibratory movements of said magnetizable member.

56. In a device as set forth in claim 55, means for varying the degree of flexibility of said elastic medium.

57. A device as set forth in claim 55, and a flexible vibratory sound producing device operatively connected to said member.

58. An apparatus as set forth in claim 55, and means for adjusting the pole pieces of said magnet toward or from said member.

59. An electro-magnetic actuator, comprising a magnet, an oscillatory magnetizable member so positioned within the magnetic field of said magnet as to permit vibratory movements transverse to the longitudinal axis of said member, an elastic cushioning medium forming the sole support for said member, and an energizing coil actuating said member and operating to vary the magnetic flux within the field of said magnet to thereby cause said movements of said member.

60. An electro-magnetic actuator, comprising a magnet, a member so positioned as to permit oscillatory movements, an elastic cushioning medium forming the sole support for said member, and means operating to vary the magnetic flux within the field of said magnet to thereby cause said movements of said member.

61. An electric translating device comprising an oscillatory element subject to mechanical impulses corresponding to sound vi-

bration and resilient means in direct contact with a substantial part of said element for damping its natural vibrating characteristic without utilizing a fixed pivot in said element.

62. An electric translating device comprising an oscillatory element subject to mechanical impulses corresponding to sound vibration and resilient means in direct contact with a substantial part of said element forming the support for said element and a cushioning medium for said element without utilizing a fixed pivot in said element.

63. The method of increasing the sensitivity of an electrically actuated oscillatory member comprising disposing the member within a resilient medium thereby establishing freedom of position of the center of oscillation of said member.

64. A method of increasing the fidelity of sound reproduction in which a member is vibrated in accordance with impressed vibrations which comprises floatingly mounting the member in a resilient medium and thereby establishing a variable center of oscillation of the member and damping all the natural vibrating characteristics of the member and largely absorbing extraneous vibrations.

65. The method of operating a member which comprises vibrating the member in accordance with sounds, and mounting said member in cooperative relation with a restrictive medium whereby all its free vibrations are substantially damped.

66. The method of operating a member which comprises vibrating the member in accordance with sounds, and counting said member in cooperative relation with a resilient cushioning means whereby its free vibrations are substantially damped.

67. The method of operating a member which comprises vibrating the member in accordance with the sounds in a magnetic field, and mounting said member in cooperative relation with a restrictive medium whereby its free vibrations are substantially damped.

68. In combination; an armature, an electromagnet, said armature being positioned in a magnetic field of said electromagnet, and a medium in which the main portion of said armature is mounted for damping the natural vibrations of said armature.

69. In combination; a magnet, an armature, a coil in cooperative relation with said armature and said magnet, a restrictive medium, the main portion of said armature being mounted in said restrictive medium whereby the natural vibrations of said armature are damped, and means for varying the degree of damping of said restrictive medium.

70. In combination; a magnet, an armature, a coil in cooperative relation with said armature and said magnet, a restrictive medium, the body of said armature being mounted in said restrictive medium whereby the natural vibrations of said armature are damped, and a vibratory sound producing device operatively connected to said armature.

In testimony whereof I affix my signature.

JAMES H. VAN WAGENEN.