Aug. 12, 1947. L. D. NORTON 2,425,486

ELECTRIC PHONOGRAPH

Filed April 19, 1945 2 Sheets-Sheet 1

Fig. 1.

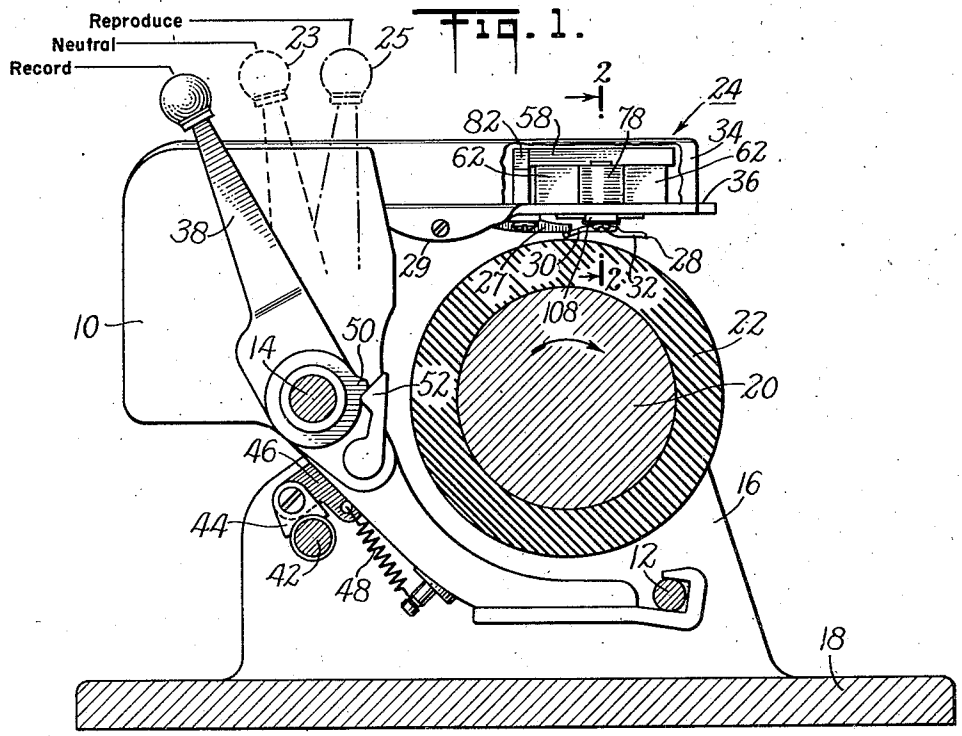


Fig. 2.

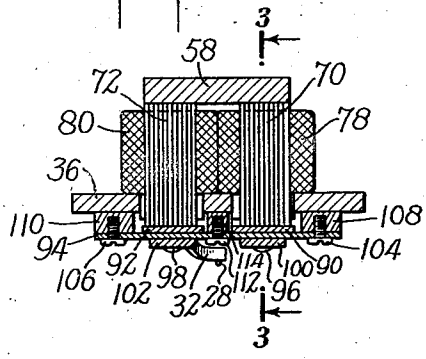
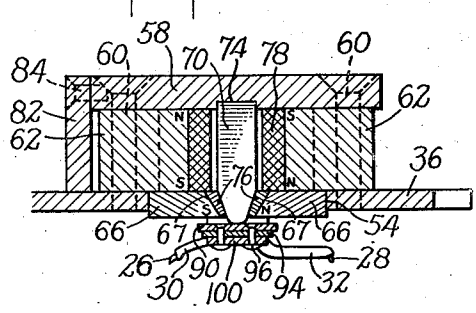


Fig. 3.



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5-5071 2-1

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ELECTRIC PHONOGRAPH

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Fig. 4.

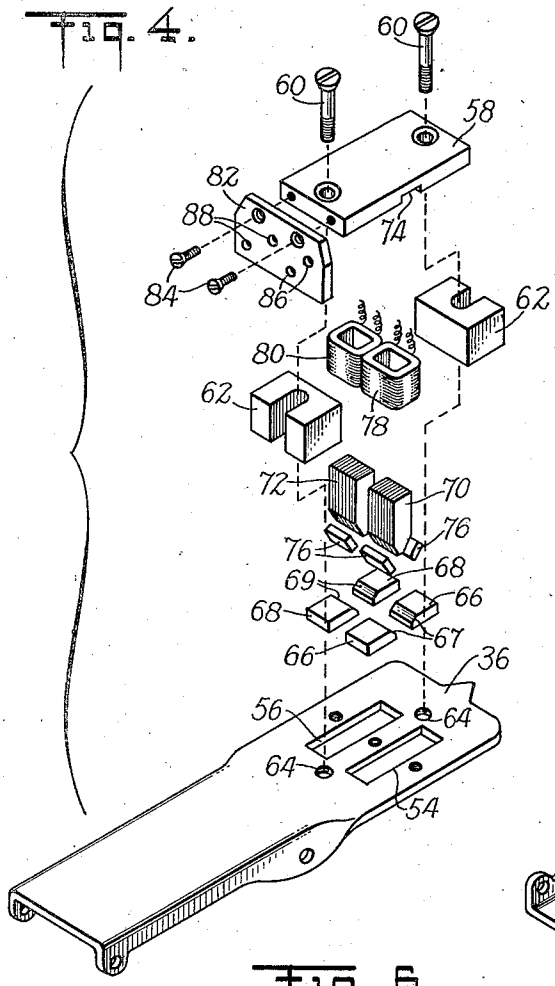


Fig. 5.

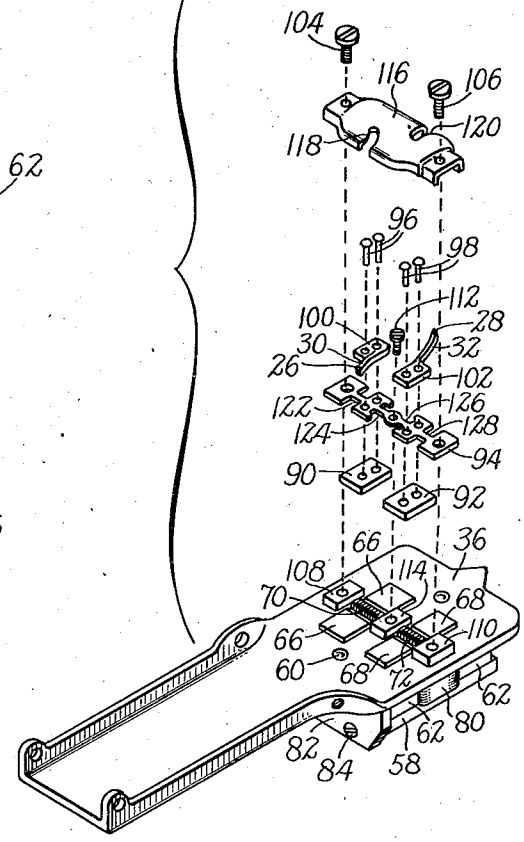
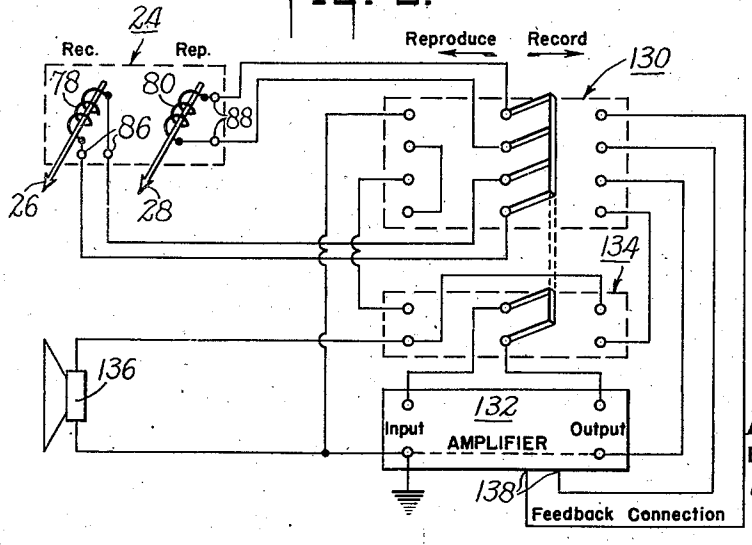


Fig. 6.



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S-5971 2-2

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UNITED STATES PATENT OFFICE

2,425,486

ELECTRIC PHONOGRAPH

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Application April 19, 1945, Serial No. 589,109

17 Claims. (Cl. 179—100.4)

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This invention relates to electric phonographs and, more particularly, to an improved electro-mechanical translating device for use as a recorder and/or reproducer unit in such phonographs.

It is an object of this invention to provide an improved electro-mechanical translating device of great simplicity and high efficiency for use as a recorder and/or reproducer unit in sound recording apparatus, and especially for use in such apparatus designed for office dictation and transcription.

It is a further object of this invention to provide such a translating device of improved and simplified construction such that an entire unit may be contained in small space, and one in which portions of separate recording and reproducing elements are combined to do double duty, thus forming a combination unit of simplified construction and of size comparable to that of a single one of such elements.

It is an additional object of this invention to provide a recorder and reproducer translating device of such construction as to permit it to be used in a sound recording and reproducing apparatus incorporating the features of external hum pickup compensation when reproducing, and amplifier degenerative feedback operation when recording, to provide a desired recording response characteristic, and to permit these features to be used without the need for any additional parts in the recorder-reproducer unit.

These and other apparent objects and advantages of this invention are obtained by the means described in the following specification and may be more readily understood by reference to the accompanying drawings wherein:

Figure 1 is a cross-sectional view of a portion of an office dictating machine incorporating a translating device in accordance with the present invention;

Figure 2 is a cross-section of the translating device shown in Figure 1 taken on line 2—2 thereof;

Figure 3 is another cross-section of this translating device taken on line 3—3 of Figure 2;

Figure 4 is an exploded view of the upper portion of the translating device of Figure 1;

Figure 5 is an exploded view of the lower portion of this translating device; and

Figure 6 is a schematic wiring diagram of sound recording and reproducing apparatus incorporating a translating device in accordance with the present invention.

A portion of an office dictating machine for recording and reproducing office dictation is shown in Figure 1 for the purpose of illustrating this invention. This machine has a carriage 10 mounted on guide rods 12 and 14 supported on a frame 16 attached to a base 18.

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A mandrel 20, adapted to support a cylindrical sound record blank 22, is suitably rotatably mounted above the base 18 parallel to the guide rods 12 and 14. An electromagnetic recorder and reproducer unit, embodying the present invention and generally indicated at 24 is supported by an arm 36 which in turn is mounted on the carriage 10 by means of a suitable pivotal positioning structure incorporated therein. This recorder-reproducer unit 24 is encased by a cover 34 and is provided with a recording stylus 26 and a reproducing stylus 28 mounted on styli supporting arms 30 and 32, respectively, connected to the vibratory portion of the translating device 24 in the manner hereinafter to be described. The pivotal translating unit positioning structure, which secures the supporting arm 36 to the carriage 10, may be of any suitable type which permits positioning of the translating unit 24 in either "record," "neutral," or "reproduce" positions by means of a control lever 38. In "record" position it is so adjusted that the recording stylus 26 coacts with the record blank 22 to permit the formation of a sound record thereon. In "reproduce" position the translating unit 24 is moved into such position that the reproducing stylus 28 is moved into operative position with respect to the record blank 22 so as to permit the transcribing of a sound record therefrom. In "neutral" position the translating unit 24 is moved to a position intermediate these "record" and "reproduce" positions, in which position both styli of the translating device 24 are removed from operative contact with the record blank 22 to permit the record to be removed and replaced. In addition, this pivotal support structure in carriage 10 is arranged to permit motion of the translating unit 24 in only one plane, i. e., toward and away from the record tablet 22, when in "record" position; but to permit motion of the translating unit 24 in two directions, i. e., axially along the surface of the record tablet 22 as well as toward and away from the record tablet, when in "reproduce" position, so that the reproducing stylus 28 is free to follow a recorded sound groove. The control lever 38 is pivotally mounted on the carriage 10 to pivot around the axis of the guide rod 14. When this control lever 38 is in the position shown in Figure 1 the translating device is positioned for "recording" with the recording

stylus 26 in contact with the record tablet 22. As this control lever 38 is moved in a clockwise direction, as shown in Figure 1, it passes to a "neutral " position, shown in dotted lines 23, in which the translating device is removed from contact with record 22 and thence to a "reproduce" position, shown in dashed lines 25, in which the reproducing stylus 28 of the translating device 24 is placed in contact with the record 22. A "leader ball" arrangement 27 is provided for determining the average depth of the groove formed in the record blank 22 by the recording stylus 26 and this groove depth may be set by means of an adjustment screw 29.

The usual mechanism is also provided for progressively moving the carriage 10 along the surface of the record 22 so that the recording stylus 26 may cut a spiral sound groove thereon, or the reproducing stylus 28 may follow such a spiral sound groove previously cut. This is accomplished by means of a feed screw 42 rotatably supported on the frame 16 and preferably driven by the same motor which drives the mandrel 20. A feed nut 44, pivotally mounted on a pivoted arm 46 attached to the carriage 10 and normally held against the feed screw 42 by means of a spring 48, supplies the driving connection between this feed screw 42 and the carriage 10. A cam 50 mounted on the control lever 38, is provided for temporarily disengaging the feed nut 44 from the feed screw 42 when the translating device 24 is in "neutral" position. This cam 50 coacts with a cam follower lever 52 pivotally mounted on the carriage 10 to rotate the pivoted arm 46 to move the feed nut 44 away from the feed screw 42. Apparatus for accomplishing all of the functions just described may be any suitable apparatus, such, for example, as that shown in U. S. Patent No. 2,143,819 to Leland D. Norton, and will not be further described herein because such apparatus per se does not form a portion of the present invention.

The electromagnetic recording and reproducing unit 24 can best be described by referring to Figures 2, 3, 4, and 5. All of the elements of the translating device 24 are mounted on the supporting arm 36 which is made of non-magnetic material shaped generally as shown in Figures 4 and 5 and provided with two rectangular slots 54 and 56 running longitudinally on the end of supporting plate 36 as shown therein. Referring especially to Figures 3 and 4, an E-shaped magnetic circuit structure is mounted on the supporting plate 36. This magnetic circuit comprises a back plate or yoke 58 of highly permeable magnetic material secured to the supporting plate 36 by two screws 60, preferably of non-magnetic material, each of which passes through the center of a U-shaped permanent magnet portion and is threaded into a hole 64 tapped in the support plate 36. The bottom faces of the permanent magnets 62, which magnets are oriented so that their opposite poles are adjacent the yoke 58 as well as adjacent the supporting plate 36, rest on two pairs of pole pieces 66 and 68 of highly permeable magnetic material; these pairs of pole pieces being placed in the ends of the slots 54 and 56, respectively, and being fastened therein by brazing or other suitable means. In the structure thus far described, the yoke 58 forms the back portion, and the permanent magnets 62 and the pole pieces 66 and 68 form the outside arms of the E-shaped magnetic circuit structure. The center arm of this E-shaped structure is formed by two laminated rectangular core pieces 70 and 72, each made of a stack of laminations of highly permeable magnetic sheet material. One end of each of these core members 70 and 72 is square and is adapted to fit in a slot 74 of comparable dimensions cut in the under surface of the yoke 58. The free ends of these core pieces terminate in the form of isosceles prisms, the vertex edges of which are rounded to cylindrical surfaces as shown. These central magnetic cores 70 and 72 are held in position against the yoke 58 with their ends intermediate the pole pieces 66 and 68 by four blocks 76 of non-magnetic material positioned between the sloping faces of the central cores 70 and 72 and sloping surfaces 67 and 69 on the inner ends of pole pieces 66 and 68, respectively. The cylindrical tips of these central magnetic cores 70 and 72 are so dimensioned as to extend between and beyond the lower surfaces of the pole pieces 66 and 68 by an amount which determines the operating air gap between the armatures and the pole pieces of this electromagnetic translating device, as will hereinafter be described in greater detail. The cores 70 and 72 are each surrounded by a coil 78 and 80, respectively, whereby voltages related to flux variations in the magnetic circuit can be impressed on or derived from the translating device 24. A terminal strip of insulating material 82 is fastened by two screws 84 to one end of the yoke 58 and is provided with two pairs of terminals 86 and 88, to which are connected the ends of coils 78 and 80, respectively. All of these parts of the translating device are encased in a housing 34 as shown in Figure 1.

The armature portion of this electromagnetic translating device comprises two rectangular armatures of magnetic material 90 and 92 arranged to pivot about a resilient axis and see-saw on the tips of the central cores 70 and 72. To accomplish this, these armature pieces 90 and 92 are secured in spaced relation to the one side of a strip 94 of resilient material such, for example, as phosphor bronze, which can be seen in detail in Figure 5, by means of two pairs of rivets 96 and 98, respectively. These rivets also secure two stylus supporting plates 100 and 102, carrying the stylus supporting arms 30 and 32, respectively, to which in turn are secured the recording stylus 26 and reproducing stylus 28, respectively, to the armature elements 90 and 92, respectively. This resilient strip 94 is secured to the supporting plate 36 by two screws 104 and 106 which pass through holes in either end of the strip 94 and are threaded into pillar blocks 108 and 110 secured to the underside of the supporting plate 36 as shown in Figure 5. The central portion of resilient strip 94 intermediate the two armatures 90 and 92 is also secured to the support plate 36 by means of a screw 112 passing through a hole in the center of the strip 94 and threaded into a pillar block 114 positioned between the two rectangular slots 54 and 56 in the supporting plate 36. Pillar blocks 108, 110 and 114 are all of equal height, just sufficient to press the undersides of armatures 90 and 92 firmly against the cylindrical ends of the central core members 70 and 72, so that the armatures can see-saw on the ends of these core members, as is shown more clearly in Figure 3. Thus it can be seen that the resilient strip 94 acts as a torsion-bar support or a resilient pivotal axis for the armatures 90 and 92. As shown in Figure 5, the screws 104 and 106 also hold a casing 116 which completely covers this armature assembly so that only the styli supporting arms 30

and 32 project therefrom through slots 118 and 120, respectively, as shown in Figure 5. For purposes of simplicity, this casing 116 is not shown in any of the other figures of the drawings.

As mentioned above, the amount that the central core portions 70 and 72 project beyond the pole pieces 66 and 68 determines the length of the air gap between the ends of the armatures 90 and 92 and the pole pieces 66 and 68, respectively. This has been shown in an exaggerated amount in Figure 3, but in actual operation it has been determined that an extension of the central core portions 70 and 72 of about four or five thousandths of an inch beyond the bottom surfaces of the pole pieces 66 and 68 provides a satisfactory air gap for efficient operation. Further, the stiffness or compliance characteristics of the translating device may be controlled by controlling the stiffness characteristics of the resilient strip 94, both by suitable choice of its composition and of its dimensions. In addition, its stiffness can be controlled by cutting slots therein in the manner shown at 122, 124, 126 and 128 in Figure 5. By providing a different depth for these slots adjacent the recorder armature with respect to those adjacent the reproducer armature, the compliance of the translating device when operating as a recorder may be made different from its compliance when operating as a reproducer.

It can be seen that the magnetic structure of the electromagnetic recorder and reproducer unit 24 just described has a yoke 58 and two permanent magnets 62 common to both the recorder and reproducer portions of the unit, but four separate pole pieces 66 and 68 having two separate armatures 90 and 92 spanning the air gaps between these pole pieces and see-sawing on the central core members 70 and 72, each of which is surrounded by a separate winding 78 and 80, thus providing separate coils and vibratory systems for recording and reproducing.

With the translating device herein described, when a signal to be recorded is applied to the recording coil 78, this signal sets up a magnetic field in the central core 70 which aids or opposes the magnetic flux produced in the circuit by the permanent magnets 62 and causes one end of the armature 90 pivoted on the end of this core 70 to be attracted to one of the pole pieces 66 while the other end of the armature 70 is repelled by the other pole piece 66. This alternate attraction and repulsion will occur in accordance with the variations of the signal impressed on the winding 78, thus causing the recording stylus 26 to follow the movements of the armature 90 and form a sound groove on the surface of the record 22. When the conditioning lever 38 is thrown to "reproduce" position, moving the reproducing stylus 28 into contact with a sound groove recorded on the surface of a record blank 22, the movement of the reproducing armature 92 as it see-saws about the end of the central core element 72 in response to movements of the reproducing stylus 28 in the record groove, decreases the air gap between one end of the armature 92 and one of the pole pieces 68 while it increases the air gap between the other end of this armature 92 and the other pole piece 68, thus maintaining a uniform reluctance path from one pole piece 68 to the other but disturbing the flux balance between the pole pieces 68 and the central core 72 so that there is an alternation of the magnetic flux passing through the central core piece 72. This, in turn, induces a corresponding voltage in reproducing coil 80 which surrounds this central core 72 and thus provides a signal corresponding to the undulations of the sound record groove on record tablet 22.

In addition to providing a compact and highly efficient recording and reproducing translating device, this structure with its separate, but closely adjacent, coils 78 and 80 permits the use of novel and advantageous circuit arrangements such as that shown in Figure 6 in which, on recording, the reproducing coil may be connected into the recording amplifier circuit in such a manner as to provide a desirable amount of degenerative feedback encompassing not only the recording amplifier but also portions of the translating device itself to provide more desirable response characteristics; and which, when the apparatus is conditioned for reproducing, permits the recording winding 78 to be connected in a circuit in such a manner as to cancel out all parasitic voltage pickups in the reproducing coil 80 caused by changes in magnetic fields external to the translating device itself. This is accomplished with the circuit arrangement shown in Figure 6. The recorder winding 78 and the reproducer winding 80 are connected through terminals 86 and 88, respectively, to the central poles of a four pole double-throw switch, generally indicated at 130. The other eight terminals of this switch 130 are connected as shown in Figure 6 to the input and output circuits of an electronic tube amplifier, generally indicated at 132, through a double-pole double-throw amplifier-reversing switch 134 which is also connected to a microphone-loudspeaker or transducer device 136. The contacts of the amplifier reversing switch 134 are preferably shielded from each other to prevent feedback from the output to the input terminals of the amplifier 132. Although this switch 134 may be separate from switch 130, it is preferably operated simultaneously therewith as switch 130 is moved to either "record" or "reproduce" position, as shown in Figure 6. If desired, these switches may be connected with the control lever 38 on carriage 10 so that the switches are operated in the desired direction by operation of this control lever. As can be readily seen by reference to Figure 6, when switches 130 and 134 are thrown to their right-hand or "record" position, recorder winding 78 is connected to the output of amplifier 132, transducer 136 is connected as a microphone to the input of amplifier 132, and reproducer winding 80 is connected to feedback terminals 136 on amplifier 132, suitably connected, as is well known in the art, so that a degenerative feedback effect is produced in the amplifier to provide a more uniform output characteristic. When the switches 130 and 134 are thrown into their left-hand or "reproduce" position, reproducer winding 80 is connected in a series bucking arrangement with recorder winding 78 to the input of amplifier 132 and transducer 136 is connected as a loudspeaker to the output of the amplifier 132. With this connection, the recorder winding 78 acts to pick up any stray fields in the neighborhood of the translating device 24 which would also be picked up by the reproducer winding 80 and cause the effect of these stray fields to be cancelled out, for example, as described in U. S. Patent No. 2,275,309 to Leland D. Norton.

As many possible embodiments may be made of the above invention and as many changes might be made in the embodiments above set forth without departing from the scope thereof, it is to be understood that all matter hereinbefore

set forth or shown in the accompanying drawings is to be interpreted as illustrative only and not in a limiting sense.

I claim.

1. For use in sound recording and reproducing systems, an electro-mechanical translating device, comprising, in combination, means forming an E-shaped magnetic circuit having air gaps therein between the pole pieces formed by the free ends of the outer arms of said E and the middle arm of said E, a strip of resilient material supported at its ends perpendicular to said E-shaped magnetic circuit means near the free end of the middle arm thereof, an armature extending from one of said pole pieces to the other and mounted on said strip of resilient material to see-saw on the free end of the middle arm of said E-shaped magnetic circuit means to oppositely vary the lengths of the air gaps between said pole pieces and said middle arm, means providing a magnetic flux in said magnetic circuit means, inductive means surrounding a portion of said magnetic circuit to carry an electric current which is a function of the change in magnetic flux in said magnetic circuit means, and stylus means attached to said armature for coacting with a sound record medium.

2. For use in sound recording and reproducing systems, an electro-mechanical translating device, comprising, in combination, means forming an E-shaped magnetic circuit having air gaps therein between the pole pieces formed by the free ends of the outer arms of said E and the middle arm of said E, a strip of resilient non-magnetic material supported at its ends perpendicular to said E-shaped magnetic circuit means near the free end of the middle arm thereof, an armature extending from one of said pole pieces to the other and mounted on said strip of resilient material to see-saw on the free end of the middle arm of said E-shaped magnetic circuit means to oppositely vary the lengths of the air gaps between said pole pieces and said middle arm, means providing a magnetic flux in said magnetic circuit means, inductive means surrounding a portion of said magnetic circuit to carry an electric current which is a function of the change in magnetic flux in said magnetic circuit means, and stylus means attached to said armature for coacting with a sound record medium.

3. For use in sound recording and reproducing systems, an electro-mechanical translating device, comprising, in combination, means forming an E-shaped magnetic circuit having air gaps therein between the pole pieces formed by the free ends of the outer arms of said E and the middle arm of said E, said middle arm terminating in a cylindrical surface the axis of which is perpendicular to said E-shaped magnetic circuit means, a strip of resilient material supported at its ends adjacent and parallel to said cylindrical surface on the free end of said middle arm, an armature extending from one of said pole pieces to the other and mounted on said strip of resilient material to see-saw on the free end of the middle arm of said E-shaped magnetic circuit means to oppositely vary the lengths of the air gaps between said pole pieces and the ends of said armature, said resilient strip holding said armature in line contact with said middle arm along lines forming elements of said cylindrical surface, means providing a magnetic flux in said magnetic circuit means, inductive means surrounding a portion of said magnetic circuit to carry an electric current which is a function of the change in magnetic flux in said magnetic circuit means, and stylus means attached to said armature for coacting with a sound record medium.

4. For use in sound recording and reproducing systems, an electro-mechanical translating device, comprising, in combination, means forming an E-shaped magnetic circuit having air gaps therein between the pole faces formed by the free ends of the outer arms of said E and the free end of the middle arm of said E, said middle arm projecting through the plane of said pole faces by an amount equal to the operating air gap desired in said device, a strip of resilient material supported at its ends perpendicular to said E-shaped magnetic circuit means near the free end of the middle arm thereof, a flat armature coextensive with said pole faces and mounted on said strip of resilient material to see-saw on the free end of the middle arm of said E-shaped magnetic circuit means to oppositely vary the lengths of the air gaps between said pole faces and the ends of said armature, means providing a magnetic flux in said magnetic circuit means, inductive means surrounding a portion of said magnetic circuit to carry an electric current which is a function of the change in magnetic flux in said magnetic circuit means, and stylus means attached to said armature for coacting with a sound record medium.

5. For use in sound recording and reproducing systems, an electro-mechanical translating device, comprising, in combination, means forming an E-shaped magnetic circuit having air gaps therein between the pole pieces formed by the free ends of the outer arms of said E and the middle arm of said E, a strip of resilient material supported at its ends perpendicular to said E-shaped magnetic circuit means near the free end of the middle arm thereof, an armature extending from one of said pole pieces to the other and mounted on said strip of resilient material to see-saw on the free end of the middle arm of said E-shaped magnetic circuit means to oppositely vary the lengths of the air gaps between said pole pieces and said middle arm, permanent magnet means forming part of each at the outer arms of said magnetic circuit means arranged to provide a magnetic flux therein such that said pole pieces are of opposite polarity, a coil surrounding said center arm to carry an electric current which is a function of the change in magnetic flux therein, and stylus means attached to said armature for coacting with a sound record medium.

6. For use in sound recording and reproducing systems, an electro-mechanical translating device, comprising, in combination, E-shaped magnetic circuit means having air gaps therein between the pole pieces formed by the free ends of the outer arms of said E and the middle arm of said E, portions of the free ends of the arms of said E-shaped means being bifurcated to provide two parallel E-shaped magnetic circuits having common portions but separate poles in parallel planes, a strip of resilient material arranged to bridge the free ends of the middle arms of said E-shaped magnetic circuit means and supported at its ends and at its central portion between the pole faces of the middle arms of said E-shaped circuits, two armatures each mounted on said strip of resilient material to see-saw on the free end of one of said middle arms of said E-shaped magnetic circuit means and each extending from its respective pole piece on one side

of its middle arm to the corresponding pole piece on the other side thereof, means providing a magnetic flux in both of said magnetic circuits, inductive means associated with a portion of each of said magnetic circuits to carry electric currents related to the changes in magnetic flux in said magnetic circuits and stylus means attached to each of said armatures for coacting with a sound record medium.

7. For use in sound recording and reproducing systems, an electro-mechanical translating device, comprising, in combination, E-shaped magnetic circuit means having air gaps therein between the pole pieces formed by the free ends of the outer arms of said E and the middle arm of said E, portions of the free ends of the arms of said E-shaped means being bifurcated to provide two parallel E-shaped magnetic circuits having common portions but separate poles in parallel planes, a strip of resilient material arranged to bridge the free ends of the middle arms of said E-shaped magnetic circuit means and supported at its ends and at its central portion between the pole pieces of the middle arms of said E-shaped circuits, two armatures each mounted on said strip of resilient material to see-saw on the free end of one of said middle arms of said E-shaped magnetic circuit means and each extending from its respective pole piece on one side of its middle arm to the corresponding pole piece on the other side thereof, means providing a magnetic flux in both of said magnetic circuits, two coils each surrounding one of the bifurcated portions of said middle arm for carrying electric currents related to the changes in magnetic flux in said magnetic circuits, and stylus means attached to each of said armatures for coacting with a sound record medium.

8. For use in sound recording and reproducing systems, an electro-mechanical translating device, comprising, in combination, E-shaped magnetic circuit means having air gaps therein between the pole pieces formed by the free ends of the outer arms of said E and the middle arm of said E, portions of the free ends of the arms of said E-shaped means being bifurcated to provide two parallel E-shaped magnetic circuits having common portions but separate poles in parallel planes, a strip of resilient material arranged to bridge the free ends of the middle arms of said E-shaped magnetic circuit means and supported at its ends and at its central portion between the pole pieces of the middle arms of said E-shaped circuits, a permanent magnet in each of the outer arms of said magnetic circuit means, said magnets being oppositely polarized to provide a magnetic flux around both of said magnetic circuits, two armatures each mounted on said strip of resilient material to see-saw on the free end of one of said middle arms of said E-shaped magnetic circuit means and each extending from its respective pole piece on one side of its middle arm to the corresponding pole piece on the other side thereof to shunt magnetic flux through said middle arms in a direction dependent on the orientation of said armature, inductive means surrounding a portion of each of said magnetic circuits to carry electric currents related to the changes in magnetic flux in said middle arms of said magnetic circuits, and stylus means attached to each of said armatures for coacting with a sound record medium.

9. For use in sound recording and reproducing systems an electro-mechanical translating device, comprising, in combination, E-shaped magnetic circuit means having air gaps therein between the pole pieces formed by the free ends of the outer arms of said E and the middle arm of said E, portions of the free ends of the arms of said E-shaped means being bifurcated to provide two parallel E-shaped magnetic circuits having common portions but separate poles in parallel planes, a strip of resilient material arranged to bridge the free ends of the middle arms of said E-shaped magnetic circuit means and supported at its ends and at its central portion between the pole pieces of the middle arms of said E-shaped circuits, two armatures each mounted on said strip of resilient material to see-saw on the free end of one of said middle arms of said E-shaped magnetic circuit means and each extending from its respective pole piece on one side of its middle arm to the corresponding pole piece on the other side thereof, said resilient strip having portions of predetermined reduced cross-section on both sides of each of said armatures to determine the stiffness of the vibratory systems incorporating said armatures, means providing a magnetic flux in both of said magnetic circuits, inductive means associated with a portion of each of said magnetic circuits for carrying electric currents related to the changes in magnetic flux in said magnetic circuits, and stylus means attached to each of said armatures for coacting with a sound record medium.

10. For use in sound recording and reproducing systems, an electro-mechanical translating device, comprising, in combination, E-shaped magnetic circuit means having air gaps therein between the pole pieces formed by the free ends of the outer arms of said E and the middle arm of said E, portions of the free ends of the arms of said E-shaped means being bifurcated to provide two parallel E-shaped magnetic circuits having common portions but separate poles in parallel planes, a strip of resilient material arranged to bridge the free ends of the middle arms of said E-shaped magnetic circuit means and supported at its ends and at its central portion between the pole pieces of the middle arms of said E-shaped circuits, first and second armatures each mounted on said strip of resilient material to see-saw on the free end of one of said middle arms of said E-shaped magnetic circuit means and each extending from its respective pole piece on one side of its middle arm to the corresponding pole piece on the other side thereof, means providing a magnetic flux in both of said magnetic circuits, a first coil wound around one of the bifurcated portions of the middle arm associated with said first armature and adapted to be connected to a source of signals to be recorded to produce in its magnetic circuit a flux varying with said signal to move said first armature in response thereto, a second coil wound around the other of said bifurcated portions of said middle arm responsive to variations of the flux in its magnetic circuit caused by movement of said second armature to carry a current varying with a recorded signal and adapted to be connected to a sound reproducer, a recording stylus attached to said first armature, and a reproducing stylus attached to said second armature.

11. For use in sound recording and reproducing systems, in combination, an electro-mechanical translating device, including magnetic circuit means having common portions providing a polarizing magnetic flux and bifurcated portions providing two separate sets of poles and air gaps in parallel planes, first and second armatures each

mounted to vibrate with changes in magnetic flux through one of said sets of poles and air gaps, a recording stylus attached to said first armature, a reproducing stylus attached to said second armature, a first coil wound around the one of said bifurcated portions of said magnetic circuit means associated with said first armature and adapted to be connected to a source of signals to be recorded to produce in its magnetic circuit a flux varying with said signal to move said first armature therewith, a second coil wound around the other of said bifurcated portions of said magnetic circuit means responsive to variations of the flux in its magnetic circuit caused by movement of said second armature to generate a voltage varying with a recorded signal, an electron tube amplifier having input and output circuits and terminals for applying a degenerative feedback voltage to said amplifier, a source of signals to be recorded connected to the input circuit of said amplifier, means connecting said first coil to the output circuit of said amplifier, and means connecting said second coil to the feedback terminals of said amplifier to supply a degenerative feed back voltage thereto.

12. For use in sound recording and reproducing systems, in combination, an electro-mechanical translating device, including magnetic circuit means having common portions providing a polarizing magnetic flux and bifurcated portions providing two separate sets of poles and air gaps in parallel planes, first and second armatures each mounted to vibrate with changes in magnetic flux through one of said sets of poles and air gaps, a recording stylus attached to said first armature, a reproducing stylus attached to said second armature, a first coil wound around the one of said bifurcated portions of said magnetic circuit means associated with said first armature and adapted to be connected to a source of signals to be recorded to produce in its magnetic circuit a flux varying with said signal to move said first armature therewith, a second coil wound around the other of said bifurcated portions of said magnetic circuit means responsive to variations of the flux in its magnetic circuit caused by movement of said second armature to generate a voltage varying with a recorded signal, an electron tube amplifier having input and output circuits, a transducer unit, means connecting said second coil to the input circuit of said amplifier, means connecting said transducer unit to the output circuit of said amplifier, and means connecting said first coil in series opposition with said second coil whereby stray magnetic fields picked up by said coils are canceled out.

13. For use in sound recording and reproducing systems, in combination, an electro-mechanical translating device, including magnetic circuit means having common portions providing a polarizing magnetic flux and bifurcated portions providing two separate sets of poles and air gaps in parallel planes, first and second armatures each mounted to vibrate with changes in magnetic flux through one of said sets of poles and air gaps, a recording stylus attached to said first armature, a reproducing stylus attached to said second armature, mechanical means for selectively positioning said recording stylus or said reproducing stylus in operative relationship to a record medium, a first coil wound around the one of said bifurcated portions of said magnetic circuit means associated with said first armature and adapted to be connected to a source of signals to be recorded to produce in its magnetic circuit a flux varying with said signal to move said first armature therewith, a second coil wound around the other of said bifurcated portions of said magnetic circuit means responsive to variations of the flux in its magnetic circuit caused by movement of said second armature to generate a voltage varying with a recorded signal, an electron tube amplifier having input and output circuits and terminals for applying a degenerative feedback voltage to said amplifier, a transducer unit, switching means operative upon movement of said selective means to recording position to connect said transducer unit to the input to act as a source of signals to be recorded, said first coil to the output circuit of said amplifier, and to connect said second coil to the feedback terminals of said amplifier to supply a degenerative feedback voltage thereto, and said switching means being operative upon movement of said selective means to reproducing position to connect said second coil to the input circuit of said amplifier, to connect said first coil in series opposition with said second coil, and to connect said transducer unit to the output circuit of said amplifier.

14. For use in sound recording and reproducing systems, an electro-mechanical translating device, comprising, in combination, E-shaped magnetic circuit means having air gaps therein between the pole pieces formed by the free ends of the outer arms of said E and the middle arm of said E, portions of the free ends of the arms of said E-shaped means being bifurcated to provide two parallel E-shaped magnetic circuits having common portions but separate poles in parallel planes, a strip of resilient material arranged to bridge the free ends of the middle arms of said E-shaped magnetic circuit means and supported at its ends and at its central portion between the pole pieces of the middle arms of said E-shaped circuits, first and second armatures each mounted on said strip of resilient material to see-saw on the free end of one of said middle arms of said E-shaped magnetic circuit means and each extending from its respective pole piece on one side of its middle arm to the corresponding pole piece on the other side thereof, a recording stylus attached to said first armature, a reproducing stylus attached to said second armature mechanical means for selectively positioning said recording stylus or said reproducing stylus in operative relationship to a record medium, means providing a polarizing magnetic flux in both of said magnetic circuits, a first coil wound around one of the bifurcated portions of the middle arm associated with said first armature and adapted to be connected to a source of signals to be recorded to produce in its magnetic circuit a flux varying with said signal to move said first armature in response thereto, a second coil wound around the other of said bifurcated portions of said middle arm responsive to variations of the flux in its magnetic circuit caused by movement of said second armature to generate a voltage varying with a recorded signal, an electron tube amplifier having input and output circuits and terminals for applying a degenerative feedback voltage to said amplifier, a transducer unit, switching means operative upon movement of said selective means to recording position to connect said transducer unit to the input circuit of said amplifier as a source of signals to be recorded to connect said first coil to the output circuit of said amplifier, to connect said second coil to the feedback terminals of said amplifier to supply a degenerative

feedback voltage thereto, and said switching means being operative upon movement of said selective means to reproducing position to connect said second coil to the input circuit of said amplifier, to connect said first coil in series opposition with said second coil, and to connect said transducer unit to the output circuit of said amplifier.

15. For use in sound recording and reproducing systems, in combination, an electro-mechanical translating device, including two magnetic circuit means each having polarizing flux means and separate sets of poles and air gaps, first and second armatures each mounted to vibrate with changes in magnetic flux through one of said sets of poles and air gaps, a recording stylus attached to said first armature, a reproducing stylus attached to said second armature, a first coil associated with the one of said magnetic circuit means coacting with said first armature and adapted to be connected to a source of signals to be recorded to produce in its magnetic circuit a flux varying with said signal to move said first armature therewith, a second coil associated with the other of said magnetic circuit means responsive to variations of the flux in its magnetic circuit caused by movement of said second armature to generate a voltage varying with a recorded signal, an electron tube amplifier having input and output circuits and terminals for applying a degenerative feedback voltage to said amplifier, a source of signals to be recorded connected to the input circuit of said amplifier, means connecting said first coil to the output circuit of said amplifier, and means connecting said second coil to the feedback terminals of said amplifier to supply a degenerative feedback voltage thereto.

16. For use in sound recording and reproducing systems, in combination, an electro-mechanical translating device, including two magnetic circuit means each having polarizing flux means and separate sets of poles and air gaps, first and second armatures each mounted to vibrate with changes in magnetic flux through one of said sets of poles and air gaps, a recording stylus attached to said first armature, a reproducing stylus attached to said second armature, a first coil associated with the one of said magnetic circuit means coacting with said first armature and adapted to be connected to a source of signals to be recorded to produce in its magnetic circuit a flux varying with said signal to move said first armature therewith, a second coil associated with the other of said magnetic circuit means responsive to variations of the flux in its magnetic circuit caused by movement of said second armature to generate a voltage varying with a recorded signal, an electron tube amplifier having input and output circuits, a transducer unit, means connecting said second coil to the input circuit

of said amplifier, means connecting said transducer unit to the output circuit of said amplifier, and means connecting said first coil in series opposition with said second coil whereby stray magnetic fields picked up by said coils are canceled out.

17. For use in sound recording and reproducing systems, in combination, an electro-mechanical translating device, including two magnetic circuit means each having polarizing flux means and separate sets of poles and air gaps, first and second armatures each mounted to vibrate with changes in magnetic flux through one of said sets of poles and air gaps, a recording stylus attached to said first armature, a reproducing stylus attached to said second armature, means for selectively positioning said recording stylus or said reproducing stylus in operative relationship to a record medium, a first coil associated with the one of said magnetic circuit means coacting with said first armature and adapted to be connected to a source of signals to be recorded to produce in its magnetic circuit a flux varying with said signal to move said first armature therewith, a second coil associated with the other of said magnetic circuit means responsive to variations of the flux in its magnetic circuit caused by movement of said second armature to generate a voltage varying with a recorded signal, an electron tube amplifier having input and output circuits and terminals for applying a degenerative feedback voltage to said amplifier, a transducer unit, switching means operative upon movement of said selective means to recording position to connect said transducer unit to the input to act as a source of signals to be recorded, said first coil to the output circuit of said amplifier, and to connect said second coil to the feedback terminals of said amplifier to supply a degenerative feedback voltage thereto, and said switching means being operative upon movement of said selective means to reproducing position to connect said second coil to the input circuit of said amplifier, to connect said first coil in series opposition with said second coil, and to connect said transducer unit to the output circuit of said amplifier.

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