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SIGNAL TRANSLATING APPARATUS

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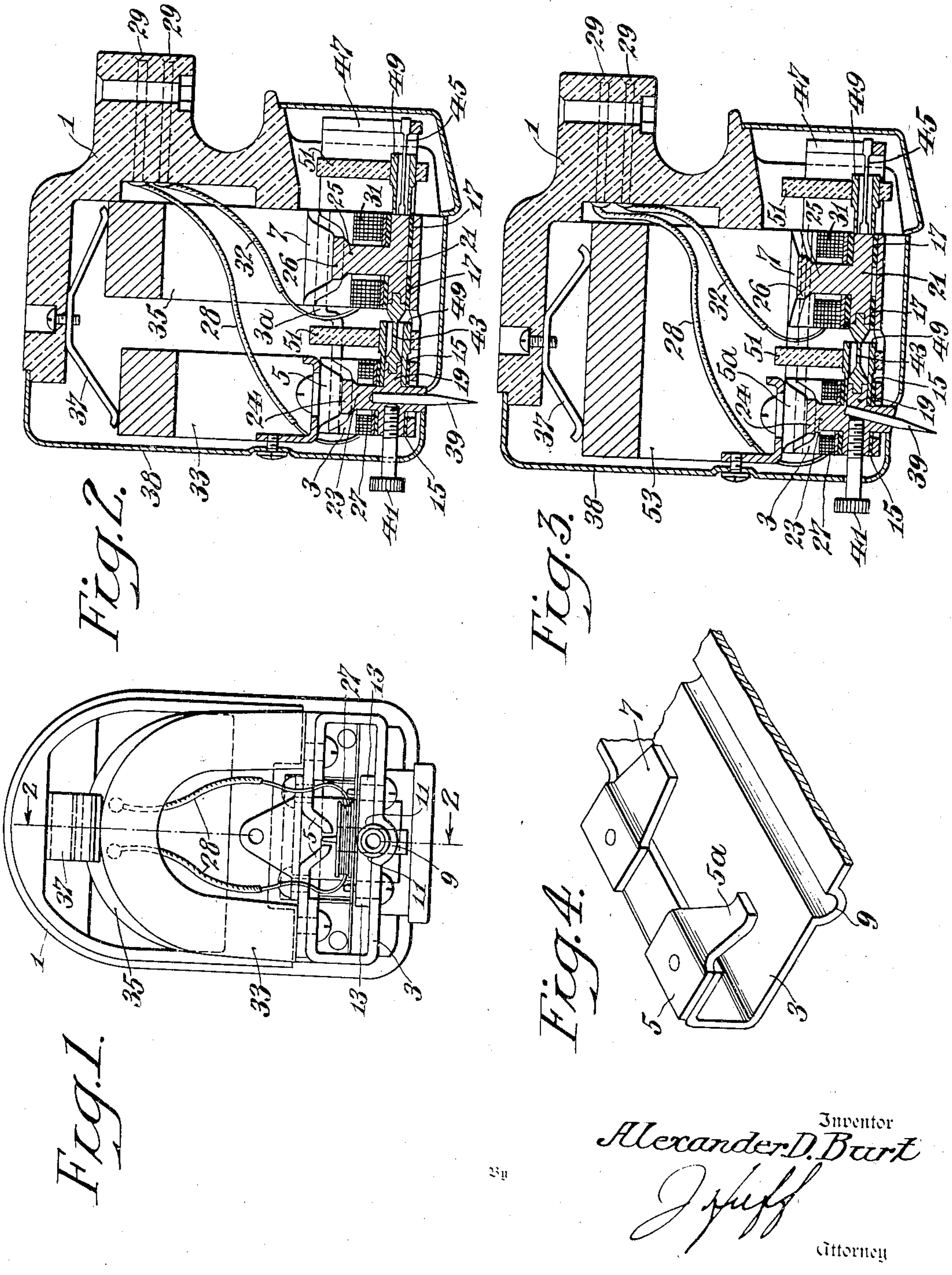

Fig. 2.

Fig. 3.

Fig. 1.

Fig. 4.

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By

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SIGNAL TRANSLATING APPARATUS

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17 Claims. (Cl. 179—100.41)

This invention relates to signal translating apparatus of the type employed in electrical phonograph sound recording and reproducing systems, and more particularly to a combined recorder and reproducer of the electromagnetic type for use in recording sound on or reproducing sound from a disc or similar record in which the sound track is in the form of a mechanical groove.

In electric signal translating devices of the electromagnetic type, an armature is arranged to vibrate between a pair of associated pole pieces either in response to variations in contour in the recorded record groove, as in reproduction of a record, or in response to signal currents flowing in one or more coils associated with either the armature or the pole pieces, as during recording of a selection on a record. The armature normally stands midway between the pole pieces in its unexcited condition, but during operation of the device, the armature is deflected from its central position either by the mechanical forces exerted thereon by the record groove, or by forces derived from electric currents flowing in the coil or coils, as the case may be.

In recent years, considerable advance has been made in the art of recording sound and it is now possible to satisfactorily record frequencies up to the order of 10,000 cycles. Obviously, if these high fidelity records are to be reproduced with any degree of faithfulness, it is necessary not only that the reproducing needle follow the groove variations accurately, but also that the armature of the sound translating device accurately generate voltages corresponding to the sound being reproduced. This necessitates an armature which has a small mass and a low moment of inertia about its vibratory axis because of the relatively slight power obtainable from the sound groove.

Along with the advances in the sound recording art, more or less extensive use has been made of electromagnetic devices of the type set forth above for making personal recordings, in both ungrooved as well as pregrooved record blanks, which could be played back directly. When recording sound, the translating device acts as a motor, and since it performs considerably more work upon the record blank in cutting or otherwise deforming the material thereof in conformance with the sounds being recorded than does a reproducer when sound is being reproduced from the record, it is necessary that the armature be made relatively large and heavy, consequently having a high moment of inertia about the vibratory axis thereof, and that it operate in a strong magnetic field. Thus, it will be seen that the requirements for an efficient reproducer and for an efficient recorder are divergent, and that a good reproducer cannot also be a good recorder within the same range. For best results, therefore, separate recording and reproducing devices are most generally used.

Attempts have been made heretofore to embody in a single unit of the type under consideration both a recorder and a reproducer. So far as I am aware, however, these have all necessitated making some compromise between the two with a corresponding loss in efficiency and limitation of the operating frequency range.

The primary object of my invention is to provide an improved signal translating device of the type set forth which will embody, in a single unit, both a recorder and a reproducer and which will not be subject to the disadvantages present in prior art devices of this type.

More specifically, it is an object of my invention to provide an improved signal translating device capable of acting either as a recorder or as a reproducer and from which a maximum frequency range can be obtained regardless of the purpose for which it may be used.

It is also an object of my invention to provide an improved sound translating device of the character described which is compact, simple and practical in construction, which can be readily assembled and adjusted for proper operation, and which is highly efficient in use either as a recorder as a reproducer.

In accordance with my invention, I provide the device with two armatures, one a relatively small, light-weight armature effective for wide range reproduction, and the other a relatively large, massive one effective for recording. Each has a separate coil associated with it and each operates in the gap formed by its own pole pieces, the two armatures being coupled mechanically by a compliant link and having but a single needle socket. The two coils may be connected either in parallel or in series, as desired, and the magnetic circuit can be arranged to employ either a single magnet, or two separate magnets.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description of several embodiments thereof when read in connection with the accompanying drawing wherein

Figure 1 is a front elevation of one form of my improved translating device with the cover removed,

Figure 2 is a central sectional view thereof taken on the line 2—2 of Fig. 1 and showing the cover in place,

Figure 3 is a view similar to Fig. 2 of a modified form of my invention, and

Figure 4 is a detailed perspective view of a portion of the pole piece structure of the modification shown in Fig. 3.

Referring more specifically to the drawing, wherein similar reference characters designate corresponding parts throughout, I have shown, in Figs. 1 and 2, a molded insulating base **1** on which is mounted a metallic frame **3** having two pairs of pole pieces **5** and **7** secured thereto in spaced relation to each other and providing two air gaps, one behind the other. The frame **3** is formed with a cylindrical depression **9** which, in conjunction with the cooperating curved ends **11** of a pair of plate members **13** secured to the frame **3**, serves to suitably retain two pairs of spaced rubber bearing sleeves **15** and **17** for the aligned pivot shafts **19** and **21** which are formed integrally with a pair of armatures **23** and **25**, respectively.

As will be seen from Fig. 2, the armatures **23** and **25** are spaced axially from each other along a common pivotal axis determined by the aligned pivot shafts **19** and **21**, and they extend radially away from their pivotal axis in parallel directions. The armature **25** is considerably longer and more massive than the armature **23** whereby its moment of inertia about the pivotal axis is much greater than that of the latter armature for a purpose shortly to be explained. The two armatures are so arranged that the upper, flattened end **24** of the armature **23** lies in the air gap between the pole pieces **5**, while the corresponding, flattened end **26** of the armature **25** lies between the pole pieces **7**. Since the armature end **26** is at a greater distance from its pivot shaft **21** than is the armature end **24** from its pivot shaft **19**, the pole pieces **7** must be higher than the pole pieces **5**. For this purpose, I provide the frame **3** with a stepped portion **3***a* (Fig. 2) and thus obtain proper alignment between the two sets of pole pieces and their respectively associated armature ends.

Surrounding the armature **23** is a suitable winding or coil **27** provided with terminal leads **28** which are connected to output terminals **29** embedded in the body **1** of the device for external connection with an electrical amplifying circuit (not shown). A second winding or coil **31**, preferably of a greater number of turns than the coil **27**, surrounds the armature **25** and is provided with terminal leads **32** which are also connected to the output terminals **29**. For supplying a flux to each of the pole piece pairs **5** and **7**, a relatively small permanent magnet **33** is placed on the pole pieces **5**, while a longer magnet **35** is placed on the pole pieces **7**. A spring **37** which is secured to the molded base **1** holds the magnets **33** and **35** in place on their respective pole pieces, and a suitable cover **38** fitted onto the base **1** protects the parts heretofore described against being disturbed.

As noted heretofore, when sound is being recorded, the device acts as a motor which does work on the record, and a relatively great amount of power is required. It is for this reason that the armature **25** is made considerably longer and heavier than the armature **23**; the coil **31** is formed of a greater number of turns than the coil **27**; and the magnet **35** is arranged to provide a flux of greater density than the magnet **33**. The limitations imposed by the relatively large, heavy armature **25** upon the range of frequencies which may be recorded are not at all serious for the reason that substantially similar limitations are usually imposed by the record blanks and recording needles used, for example, in making personal recordings in record blanks of the pregrooved type. It has been found that frequencies in excess of approximately 3500 to 4000 cycles cannot be satisfactorily recorded in such blanks, and therefore if the armature **25** transmits vibrations up to only approximately these frequencies, it is quite satisfactory. On the other hand, the armature **23** is made much smaller and lighter in order that high frequency undulations of the order of 10,000 cycles may be satisfactorily transmitted from the so-called "high fidelity" records, and the coil **27** and magnet **33** are made correspondingly smaller.

The armature **23** is provided with a needle socket for the reception of a needle **39** (either a reproducing needle or a recording needle) which is held in place in well known manner by a needle screw **41**. A compliant link **43**, such as a torsion spring, couples the armature shafts **19** and **21** along their pivotal axis, whereby vibrations may be transmitted from the armature **25** to the needle **39** and vice versa. The characteristics of the coupling link **43** are such that when transmitting relatively low frequencies, it suffers substantially no distortion and therefore the two armatures vibrate substantially as a unit. However, when the armature **23** vibrates at relatively high frequencies (for example, 4000 cycles or over), since the moment of inertia of the armature **25** is great, the link **43** does not transmit these vibrations to the latter armature.

The armatures **23** and **25** may be retained normally in a central position relative to their respective pole pieces **5** and **7** by an elongated torsional spring member **45** which lies in axial extension of the pivot shafts **19** and **21** and which is connected at one end to the pivot shaft **21** and at the other end to a bracket member **47** forming part of the frame **3**. For suitably loading the armatures at certain frequency peaks in order to provide a substantially uniform response characteristic, the armature shafts **19** and **21** may have force fitted thereon the sleeves **49** on which the blocks **51** of suitable damping material are mounted. This construction is preferably of the type more fully disclosed and claimed in the copending application of James M. Kendall, Serial No. 640,591, assigned to the Radio Corporation of America.

The modification of the invention shown in Fig. 3 is similar to that previously described but differs therefrom in that a single magnet **53** is employed to provide the necessary flux for both pairs of pole pieces. In order to satisfactorily accommodate the magnet **53**, the frame **3** is not stepped, as at **3***a* in Fig. 2, but remains in a single plane. With this construction, the pole pieces **7** may be formed of flat stock so as to lie on the same elevation as the armature end **26**, while the pole pieces **5** are downwardly offset at **5***a* so that the tips thereof will lie lower than the tips of the pole pieces **7** for proper alignment with the armature end **24**.

Although I have shown and described two embodiments of my invention, I am fully aware that many modifications thereof and changes therein are possible. For example, instead of connecting the two coils **27** and **31** in shunt relation with the output terminals **29**, they may be series connected therewith. If desired, three such output terminals may be provided, one of which is common to each of the coils and the other two of which may be connected separately to each coil. In such case, a suitable switching arrangement may also be provided for switching into the operating circuit, either one or the other of the two coils depending on how my improved signal translating device is to be used. Also, if desired, both armatures may be provided with needle sockets or other suitable record scanning elements instead of only the armature **23**. Many other changes will, no doubt, readily suggest themselves to those skilled in the art, and I therefore desire that my invention shall not be limited except insofar as is made necessary by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. In an electric signal translating device, the combination of a pair of vibratory armatures, coupling means mechanically coupling said armatures to each other, electric means for imparting mechanical motion to one of said armatures, and voltage generating means associated with the other of said armatures responsive to vibration of said other armatures.

2. In an electric signal translating device, the combination of a pair of vibratory armatures spaced axially from each other along a common vibratory axis, compliant means mechanically coupling said armatures to each other, electric means for imparting mechanical motion to one of said armatures, and voltage generating means associated with the other of said armatures responsive to vibration of said other armature.

3. In an electric signal translating device, the combination of a pair of vibratory armatures spaced axially from each other along a common vibratory axis, one of said armatures having a higher moment of inertia about said axis than the other, electric means responsive to signal currents for imparting vibratory motion to said first named armature, and voltage generating means associated with said other armature responsive to vibration of said other armature for generating signal voltages.

4. In an electric signal translating device, the combination of a pair of vibratory armatures spaced axially from each other along a common vibratory axis, one of said armatures having a higher moment of inertia about said axis than the other, compliant means mechanically coupling said armatures to each other, electric means responsive to signal currents for imparting vibratory motion to said first named armature, and voltage generating means associated with said other armature responsive to vibration of said other armature for generating signal voltages.

5. In an electric signal translating device, the combination of a recording armature and a reproducing armature, said armatures having a common vibratory axis and being spaced axially from each other along said axis, compliant means coupling said armatures to each other along said axis, electric means associated with said recording armature and responsive to signal currents for imparting vibratory motion thereto, and voltage generating means associated with said reproducing armature responsive to vibration thereof for generating signal voltages.

6. The invention set forth in claim 5 characterized in that said recording armature has a greater moment of inertia about said vibratory axis than has said reproducing armature.

7. In an electric signal translating device of the type adapted to cooperate with a record, a pair of vibratory armatures spaced axially from each other along a common vibratory axis, compliant means coupling said armatures to each other, and means carried by at least one of said armatures for scanning the record.

8. In an electric signal translating device of the type adapted to cooperate with a record, a pair of vibratory armatures spaced axially from each other along a common vibratory axis, compliant means coupling said armatures to each other, and means carried by only one of said armatures for scanning the record.

9. In an electric signal translating device of the type adapted to cooperate with a record, a pair of vibratory armatures spaced axially from each other along a common vibratory axis, one of said armatures having a lower moment of inertia about said axis than the other, compliant means coupling said armatures to each other, and means carried by said first named armature for scanning the record.

10. In an electric signal translating device, the combination of a supporting frame, a pair of armatures journalled in said frame for vibration about a fixed axis, said armatures being axially spaced from each other along said axis and extending away from said axis in parallel directions, one of said armatures being longer than the other, a torsion spring coupling said armatures along said axis, a separate coil surrounding each of said armatures, two pairs of pole pieces carried by said frame and providing spaced air gaps in one of which the free end of one armature is arranged to vibrate and in the other of which the free end of the second armature is arranged to vibrate, and means associated with said respective pole pieces for providing a magnetic field in each of said air gaps.

11. The invention set forth in claim 10 characterized in that both said armatures extend away from said vibratory axis on the same side thereof.

12. The invention set forth in claim 10 characterized in that said magnetic field providing means is constituted by a single magnet embracing both pairs of pole pieces.

13. The invention set forth in claim 10 characterized in that said magnetic field providing means is constituted by a pair of spaced magnets, one associated with one of said pairs of pole pieces and the other with the second pair of pole pieces.

14. The invention set forth in claim 10 characterized in that said magnetic field providing means is constituted by a pair of spaced magnets, one associated with one of said pairs of pole pieces and the other with the second pair of pole pieces, and characterized further in that the magnet associated with said longer armature provides a stronger field than is provided by said other magnet.

15. The invention set forth in claim 10 characterized in that said coils are series connected.

16. The invention set forth in claim 10 characterized in that said coils are shunt connected.

17. In an electric signal translating device, the combination of a pluralty of armatures spaced axally from each other along a common vibratory axis, and field structure including a plurality of pairs of pole pieces, each of said armatures having one pair of pole pieces associated therewith, and certain of said pole piece pairs having their pole faces in closer proximity to said vibratory axis than others.

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