

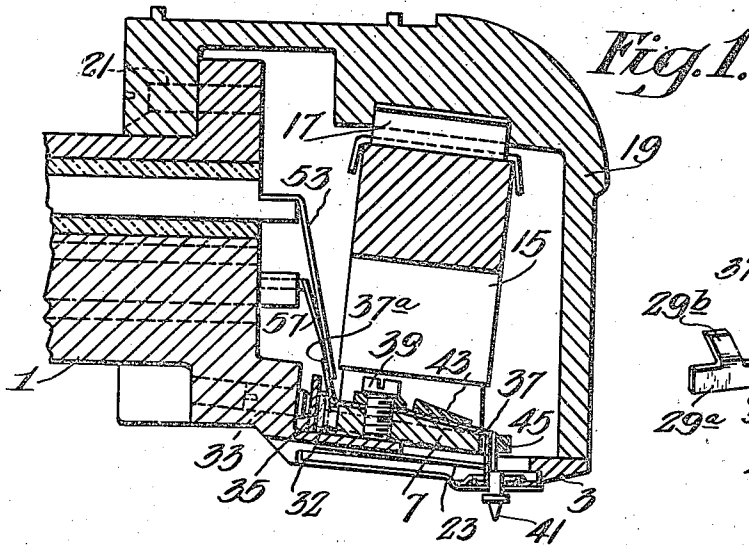
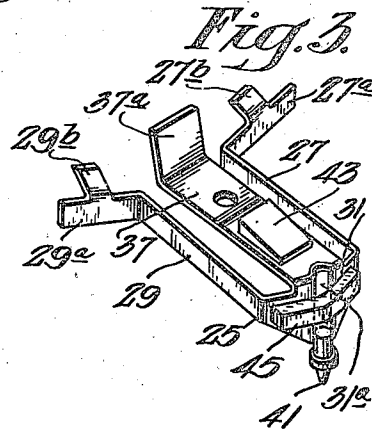
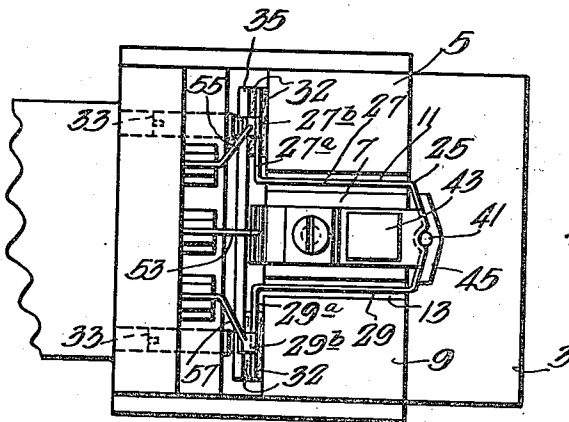
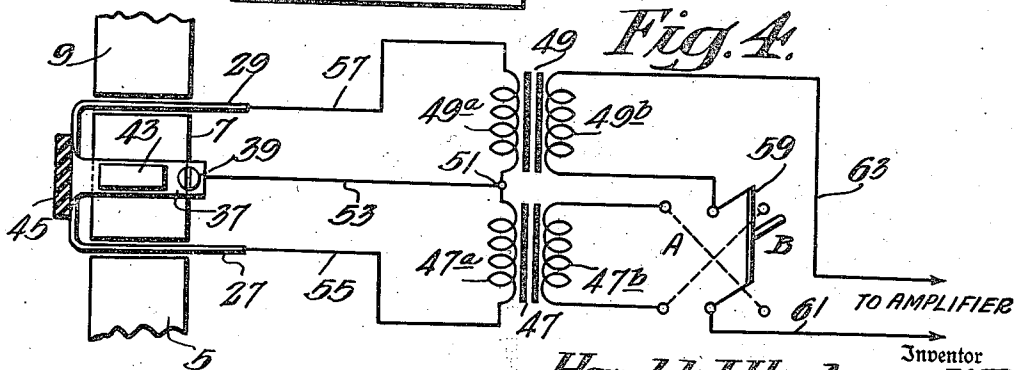
Feb. 16, 1943.

H. J. HASBROUCK, JR

2,311,385

SOUND TRANSLATING APPARATUS

Filed May 1, 1940



Harold J. Hasbrouck, Jr.

By

J. J. Huff

Attorney

UNITED STATES PATENT OFFICE

2,311,385

SOUND TRANSLATING APPARATUS

Harold J. Hasbrouck, Jr., Merchantville, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application May 1, 1940, Serial No. 332,635

13 Claims. (Cl. 179-100.41)

This invention relates to sound translating apparatus, and more particularly to a sound translating device which may be employed for either hill-and-dale operation or for lateral cut operation, the principal object of my present invention being to provide a sound translating device of this type which is simple in construction and highly efficient in use.

More particularly, it is an object of my present invention to provide an improved combination lateral cut and hill-and-dale sound translating device in which the type of operation is selected by a means external to the pickup itself.

Another object of my present invention is to provide an improved sound translating device as aforesaid which will provide high quality reproduction from either lateral cut records or from records of the hill-and-dale type.

Still another object of my present invention is to provide an improved sound translating device as aforesaid which employs very low needle pressure and which, therefore, will insure increased life of records, particularly records having surface coatings of relatively soft material.

A further object of my present invention is to provide an improved sound translating device of the type set forth which will have a long life.

It is also an object of my present invention to provide an improved sound translating device as aforesaid which is much less subject to damage than similar devices heretofore known.

According to this invention, I provide a pair of serially connected, straight conductors in separate air gaps and form the conductors with a center hinge which flexes about an axis normal to the conductors when the device operates on hill-and-dale records and which undergoes torsion about an axis parallel to said conductors when the device operates on a lateral cut record. The voltages generated by said conductors, as they move in their respective air gaps either simultaneously in the same direction when operating upon a record of hill-and-dale type or simultaneously in opposite directions when working on a record of the lateral cut type, are brought out to a suitable amplifier by means of a pair of small transformers the primary windings of which are serially connected and the common point of which is connected to the aforementioned hinge which constitutes a center tap for the conductors. The secondary windings of the transformer may be connected either in series or in parallel relation, but in any case they are always connected in current aiding relation by means of a reversing switch, the position of the

switch being determined by the type of service or operation which the device is called upon to perform.

The entire structure is of very light mass and has great flexibility, its vertical compliance being relatively high. Because of this and the absence of any moving iron, distortion is extremely low. The device also has a low mechanical impedance. The weight on the record is of the order of approximately one ounce. Thus, wear on the records, and particularly records having surface coatings of soft material, is greatly reduced.

One of the requirements in a combination translating device of this type is that it shall be insensitive to vertical modulation when playing a lateral cut record. Due to the pinch effect in lateral cut records, the result of cutting with a cutting stylus having a plane or flat advance cutting face and thereafter reproducing with a stylus having a spherical tip, a vertical component results at twice the signal frequency, and this seriously affects the quality of reproduction. This double frequency cancels out in my improved translating device because of the two out of-phase conductors which have a common center tap. The best analogue is a push-pull amplifier wherein second harmonic distortion is cancelled in the output transformer.

In connection with my improved translating device, I preferably employ a diamond point needle and mount it in a manner such that, in spite of the apparent delicate construction of the device, it is less easily damaged than similar translating devices heretofore known because of its vertical flexibility, which enables the needle to withdraw if it is dropped on or slid laterally across a record. The life of the diamond point of my improved translating device on shellac abrasive discs, such as are commonly used for home entertainment, is in excess of 5000 playings, while on non-abrasive records, a life of from two to three times as much is not improbable. The needles are so mounted that they can very easily be replaced when worn.

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 one embodiment thereof, when read in connection with the accompanying drawing, in which

Figure 1 is a sectional view of one form of

sound translating device embodying my present invention,

Figure 2 is a top plan view thereof with the cover and magnet removed,

Figure 3 is a perspective view of the movable conductors, and

Figure 4 is a circuit diagram showing the manner in which the conductors may be connected to an amplifier.

Referring more particularly to the drawing, wherein similar reference characters designate corresponding parts throughout, there is shown a supporting arm 1 having a base 3 to which are fixed three pole pieces 5, 7 and 9, the pole pieces being spaced from each other to provide two parallel air gaps 11 and 13. Resting upon the end pole pieces 5 and 9 is a magnet 15 which supplies the flux for the air gaps 11 and 13. The magnet 15 may be held in place by means of a spring clamp 17, in turn held in place by a cover 19 which is secured to the supporting arm 1, as by means of one or more screws 21.

Secured to the base 3 by means of a flexible member, such as a wire 23, which is flexible vertically and laterally but not longitudinally is a conductor 25 formed preferably out of a single piece of some suitable, flat, resilient material, such as beryllium, copper or Duralumin. The conductor 25 is bent into a substantially U shape to provide a pair of parallel arms 27 and 29 extending from the base of the U, or cross arm 31, the arms 27 and 29 extending in parallel relation through the air gaps 11 and 13, respectively, and terminating in offset portions 27a and 29a by means of which the arms 27 and 29 are respectively clamped between insulating strips 32 to the inner ends of the pole pieces 5 and 9, as by screws 33 and a clamping plate 35. The end portions 27a and 29a of the arms 27 and 29 are provided, respectively, with upwardly extending and rearwardly bent tabs 27b and 29b to which may be secured suitable conductors for external connection to the primary winding of one or more transformers, as will be hereinafter described in greater detail. The conductor 25 is also provided with a tongue 37 which is bent back from the cross arm 31 and extends in substantially parallel relation to the parallel arms 27 and 29, but in a plane substantially normal to the planes of the ribbon conductors 27 and 29 and to the plane of the cross arm 31. The tongue 37 is secured to the center pole piece 7 by a screw 39 and is provided with an upwardly turned tab 37a to which a suitable lead may be secured for external connection.

It will be obvious, from the foregoing description, that the conducting elements or arms 27 and 29 are free to move in their respective air gaps simultaneously either in the same direction or in opposite directions. The cross arm 31 is provided with a groove 31a in which may be suitably received a needle 41 having a diamond or any other suitable point adapted either to record a sound groove in a blank disc or to track and reproduce from the groove of a recorded record. When the needle 41 operates in a record of the hill-and-dale type, the arms 27 and 29 move in phase simultaneously in the same direction in their respective air gaps with the tongue 37 flexing about an axis substantially normal to the planes of the parallel arms 27 and 29 and the cross arm moving substantially linearly in its own plane. On the other hand, when the needle 41 operates in a groove of the lateral cut type, the arms 27 and 29 move 180° out of phase in their respective

air gaps, that is, when one arm moves down in its air gap, the other arm moves up in its air gap, and vice versa. In this case, the tongue 37 undergoes torsion about an axis which extends through the center of the screw 39, or along the center of the tongue 37, and parallel to the arms 27 and 29, as the cross arm rotates in its own plane and about the torsion axis of the tongue 37 in response to actuation of the needle 41.

In some cases, it is found that the response curve of a system of the sort described is characterized by a dip due to whipping action in the tongue 37. To prevent this, there is preferably secured to the tongue 37 a block 43 of suitable damping material, such as that known commercially as "Neoprene." In any case, one or more similar blocks of damping material 45 are secured to the cross arm 31, only one block having been shown in the drawing extending substantially the whole length of the cross arm 31. However, two small blocks thereon, one placed on either side of the groove 31a, may also serve satisfactorily. The block 43 is found to be particularly effective when the device is operating with hill-and-dale records at around 6000 cycles, but the block or blocks 45, as the case may be, will be found to be effective when the device is used with either hill-and-dale or lateral cut records in the region of 9000 cycles.

Because of the low electrical impedance of the conducting elements 27 and 29, it is impractical to bring out leads directly from these elements. Consequently, I prefer to employ two small transformers 47 and 49 the primary windings 47a and 49a of which, respectively, are serially connected at a common point 51. The tongue 37 acts as a center tap for the conducting elements 27 and 29 and may be connected to the common point 51 by a lead 53, a lead 55 connecting the conducting element 27 to the free end of the winding 47a and a lead 57 connecting the conducting element 29 to the free end of the winding 49a. The secondary windings 47b and 49b, respectively, of the transformers 47 and 49 may also be connected in series with each other by means of a reversing switch 59, and the output from the transformers 47 and 49 may be fed to a suitable amplifier through the leads 61 and 63. When the device is operated on a hill-and-dale record and the conductors 27 and 29 move in unison in the same direction, the current in the secondary windings 47b and 49b also flows in one direction and the switch 59 may be thrown to the position A (Fig. 4) to connect the secondary windings 47b and 49b in series, with the currents in the two windings in aiding relation. When, however, the device is operating on a lateral cut record, the arms or conductors 27 and 29 move simultaneously in opposite directions, whereupon the current in the secondary winding 47b flows in an opposite direction from that in which the current in the winding 49b flows. Consequently, it is necessary to reverse the polarity of the winding 47b with respect to the winding 49b, and for this purpose, the reversing switch 59 is thrown to the B position (Fig. 4). The secondary windings are therefore again connected in series, and the currents in the two secondary windings are again in aiding relation, just as in the case where the device operates with a hill-and-dale record.

Although I have shown and described but one embodiment of my invention, I am fully aware that many other modifications thereof are possi-

ble. For example, if desired, the parallel conductors or arms 27 and 29 may each be provided with one or more transverse corrugations or grooves to stiffen them somewhat. Other changes of a similar nature will, no doubt, also suggest themselves to those skilled in the art. 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 electrical signal translating device, the combination of means providing a magnetic circuit and including two air gaps, and a substantially U-shaped conductor having its parallel arms disposed one in each of said air gaps, the ends of said arms being anchored to said means and the cross arm of said conductor being freely supported for movement in its own plane either substantially linearly or rotatably, and hinge means coupled to said cross arm, said hinge means including two hinge axes about one of which said cross arm is movable linearly to cause said parallel arms to move simultaneously in the same direction in their respective air gaps and about the other of which said cross arm is movable rotatably to cause said parallel arms to move simultaneously in opposite directions in their respective air gaps.

2. In an electrical signal translating device, the combination of means providing a magnetic circuit and including two air gaps, and a substantially U-shaped conductor of resilient material having its parallel arms disposed one in each of said air gaps, said conductor also having a tongue thereon extending from the cross arm of the U and in substantially parallel relation to said parallel arms, the ends of said parallel arms and a portion of said tongue being anchored to said means, and said cross arm being freely supported for movement in its own plane, said conductor and said tongue being formed of a single integral piece of flat material, and said tongue and parallel arms all being formed by bending said parallel arms and said tongue out of the plane of said cross arm.

3. The invention set forth in claim 2 characterized in that said tongue is disposed in a plane substantially normal to the plane of said parallel arms.

4. The invention set forth in claim 2 characterized in that said tongue is disposed in a plane substantially normal to the planes of said parallel arms and also to the plane of said cross arm, said parallel arms being adapted to move simultaneously in their respective air gaps either in the same direction or in opposite directions, and said tongue being adapted to act as a hinge for said parallel arms to flex about an axis normal to said parallel arms when said parallel arms move simultaneously in the same direction and to flex torsionally about an axis parallel to said parallel arms when said parallel arms move simultaneously in opposite directions.

5. In an electrical signal translating device, the combination of means providing a magnetic circuit and including two air gaps, a substantially U-shaped conductor having its parallel arms disposed one in each of said air gaps, the ends of said arms being anchored to said means and the cross arm of said conductor being freely supported for movement in its own plane either substantially linearly or rotatably, hinge means coupled to said cross arm, said hinge means including two hinge axes about one of which said

cross arm is movable linearly to cause said parallel arms to move simultaneously in the same direction in their respective air gaps and about the other of which said cross arm is movable rotatably to cause said parallel arms to move simultaneously in opposite directions in their respective air gaps, and a needle carried by said cross arm adapted to cooperate with a phonograph record groove for moving said cross arm either linearly or rotatably.

6. In an electrical signal translating device adapted to reproduce sound from records of either the hill-and-dale type or the lateral cut type, the combination of means providing a magnetic circuit and including two air gaps, a substantially U-shaped conductor of resilient material having its parallel arms disposed one in each of said air gaps, said conductor also having a tongue formed integrally therewith and extending from the cross arm of the U in substantially parallel relation to said parallel arms, the ends of said parallel arms and the end of said tongue being anchored to said means whereby said cross arm is freely supported for movement in its own plane, and a needle carried by said cross arm adapted to cooperate with a phonograph record groove, said tongue serving as a hinge for said conductor and flexing about an axis normal to said parallel arms when said needle is actuated by a hill-and-dale record whereby said parallel arms move simultaneously in the same direction in their respective air gaps, and said tongue flexing torsionally about an axis parallel to said parallel arms when said needle is actuated by a lateral cut record whereby said parallel arms move simultaneously in opposite directions in their respective air gaps.

7. The invention set forth in claim 6 characterized by the addition of a damping member on said cross arm.

8. The invention set forth in claim 6 characterized by the addition of a damping member on said tongue.

9. The invention set forth in claim 6 characterized by the addition of a damping member on said cross arm, and characterized further by the addition of a second damping member on said tongue, said damping members being effective in different regions.

10. In an electrical signal translating device, the combination of means providing a magnetic circuit and including two air gaps, a substantially U-shaped conductor of resilient material having its parallel arms disposed one in each of said air gaps, said conductor also having a tongue thereon bent up from the cross arm of the U in substantially parallel relation to said parallel arms, said tongue lying in a plane substantially normal to the planes of said parallel arms and also to the plane of said cross arm, the ends of said parallel arms and a portion of said tongue being anchored to said means whereby said cross arm is supported for free movement in its own plane, said parallel arms thereby being adapted to move simultaneously in their respective air gaps either in the same direction or in opposite directions, said tongue being adapted to act as a hinge for said parallel arms to flex about an axis normal to said parallel arms when said parallel arms move simultaneously in the same direction and to flex torsionally about an axis parallel to said parallel arms when said parallel arms move simultaneously in opposite directions, at least one damping member secured to said cross arm, and

at least one other damping member secured to said tongue.

11. The invention set forth in claim 10 characterized in that one of said damping members is particularly effective over a predetermined range when said parallel arms move in the same direction, and characterized further in that the other of said damping members is particularly effective over another range at least when said parallel arms move in opposite directions.

12. In an electric signal translating device, the combination of means providing a magnetic field and including two air gaps, a pair of linear conductors disposed one in each of said air gaps, means anchoring one end of each of said conductors against movement, the other ends of said conductors being connected to each other and being freely supported for vibratory movement, a resilient hinge member extending from the junction of said conductors, and means anchoring said hinge member to provide two hinge axes for said conductors about one of which said conductors are free to move in phase with each other in their respective air gaps and about the

other of which said conductors are free to move 180° out of phase with each other in their respective air gaps.

13. In an electric signal translating device, the combination of means providing a magnetic circuit and including two air gaps, a pair of linear conductors disposed one in each of said air gaps, means anchoring one end of each of said conductors against movement, the other ends of said conductors being freely supported for vibratory movement, means connecting the free ends of said conductors and movable therewith, a resilient hinge member connected to said last named means and extending substantially parallel to said conductors, and means anchoring said hinge member to provide two hinge axes for said conductors about one of which said conductors are free to move in phase with each other in their respective air gaps and about the other of which said conductors are free to move 180° out of phase with each other in their respective air gaps.

HAROLD J. HASBROUCK, JR.