

Dec. 19, 1950

S. M. MILLER

2,534,725

ELECTRODYNAMIC PICKUP HEARING U-SHAPED COIL HOLDER

Filed July 15, 1948

FIG. 1.

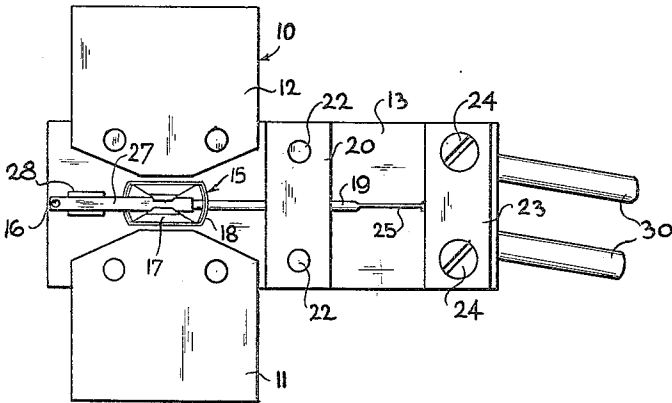


FIG. 3

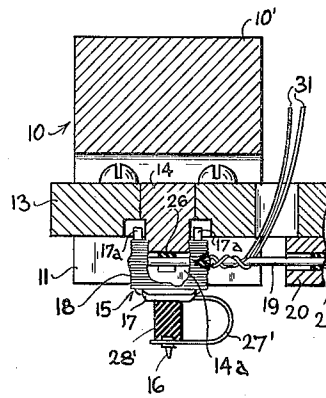


FIG. 2.

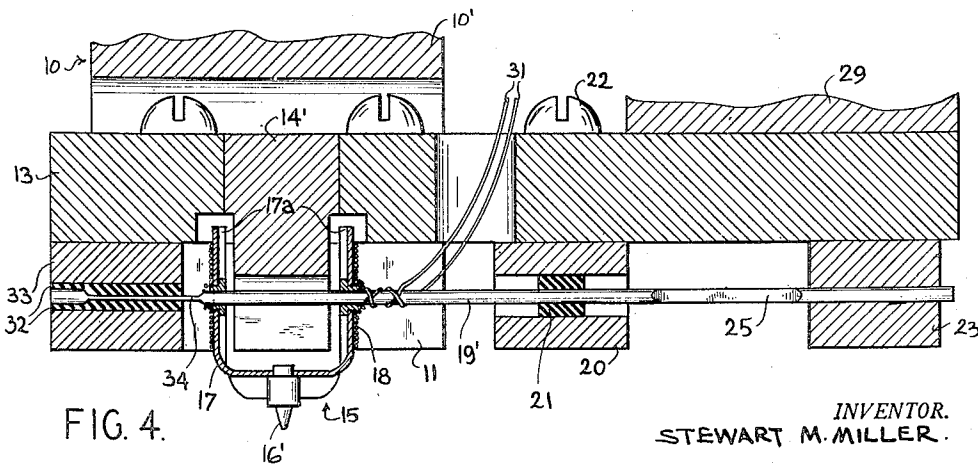
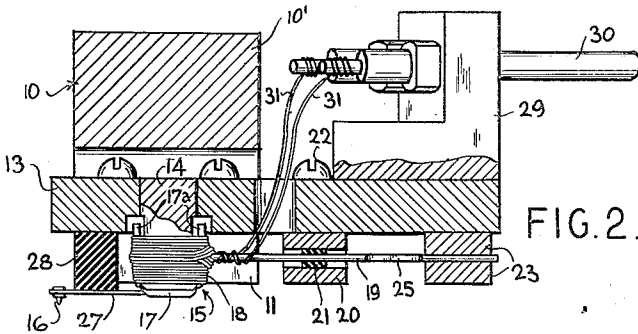


FIG. 4.

INVENTOR.
STEWART M. MILLER.

BY

Eric G. Johnson

ATTORNEY.

UNITED STATES PATENT OFFICE

2,534,725

ELECTRODYNAMIC PICKUP HEARING
U-SHAPED COIL HOLDER

Stewart M. Miller, Westfield, N. J.

Application July 15, 1948, Serial No. 38,763

8 Claims. (Cl. 179—100.41)

1

This invention relates to improvements in electromagnetic sound translating devices for use in phonograph sound recording and sound reproduction systems and this application is a continuation-in-part of my co-pending application Serial No. 599,614, filed June 15, 1945, now abandoned.

Electrical translating devices of the electromagnetic type are generally characterized by having an armature arranged to vibrate in the magnetic flux path between a pair of pole pieces, the vibration of the armature being accomplished either in response to contour variations in the recorded record groove, as in the reproduction of a record; or alternatively in response to variable signal currents flowing in the coil associated with either the armature or the pole pieces, as in the recording of a sound track on a record.

As has been pointed out in my co-pending application referred to hereinabove, high fidelity reproduction of a record required that the armature of the sound translating device be mounted in such a manner as to accurately generate voltages corresponding to the sound being reproduced. Therefore, in order to attain such high fidelity reproduction the armature desirably has a small mass and low moment of inertia together with a relatively free oscillatory movement about its vibratory axis for accurate and sensitive response to contour variations in the record groove.

The resonant frequency of a vibratory sound translating structure depends upon the effective mass and mechanical resistance or stiffness of the vibratory structure which supports the stylus. The lower the effective mass, the higher the resonant frequency, and the greater the stiffness, the higher the resonant frequency. However, the stiffness in a pickup device or similar sound translating device should be kept as low as possible so that the record groove will exert a minimum contact pressure on the stylus and yet still retain desirable high fidelity reproduction characteristics for the device.

Accordingly, it is an object of the invention to provide a pickup device or similar sound translating device having a low effective mass and a low degree of stiffness in order to minimize record wear while attaining high fidelity reproduction by insuring a relatively high resonant frequency under such control that no spurious responses occur in the range of frequencies employed in presently available recordings.

The provision of a vibratory structure of low stiffness and effective mass attached to the stylus minimizes record wear by preventing the develop-

2

ment of sufficient force to cause permanent deformation of the record groove. The forces developed between the stylus and groove increases as the stylus is required to change its direction of motion more rapidly so that record wear is initially evidenced by loss of high frequencies.

It is therefore another object of the invention to reduce wear of the records so that they may be reproduced even after repeated playings without loss of high frequencies which are usually mechanically removed during the first playing by conventional pickups.

Low mass of a pickup mechanism, while desirable, usually results in a delicate mechanism having a low output and requiring extra amplification to be effectively utilized in a reproduction system. Accordingly, it is a further object of the invention to provide a sound translating device of low mass which allows a short air gap and high intensity in the magnetic fields to produce a greater output and to obviate the necessity for extra amplification. This object is achieved by providing a U-shaped coil form or holder and by running the coil wire straight across the sides of the U-shaped coil form and by forming the pole pieces with square faces adjacent the coil, rather than with curved faces and a circular coil form as in the disclosure of my co-pending application Serial No. 599,614. The present structure also simplifies the winding of the coil and the manufacture of the pole pieces.

Another object of the invention is to provide a pickup device of the character indicated wherein the stylus is resiliently mounted in such a manner as to rise somewhat in response to the "pinch effect" between the stylus and groove, which effect is particularly noticeable at higher frequencies, without concomitant elevation of the pickup head and tone arm, thereby further minimizing contact pressure and friction and further preventing record deterioration.

The novel manner of resiliently mounting the stylus on the coil form or holder in the present invention avoids damage to both the stylus and record as might otherwise result from accidental jarring of the device or dropping the pickup onto the record, while still allowing lateral movement of the stylus, in response to the record groove to be faithfully transmitted to the coil holder and coil which is enabled to generate voltages accurately corresponding to the sound being reproduced.

The foregoing objects as well as additional objects and advantages of the invention will be readily apparent in the course of the following

3

detailed description taken in connection with the accompanying drawing illustrating some preferred embodiments of the invention, and wherein:

Figure 1 is a bottom plan view of a pickup device embodying the features of the invention;

Figure 2 is a view partly in section and partly in elevation of the pickup device;

Figure 3 is a sectional view of a modification having a somewhat different form of resilient mounting for the stylus; and

Figure 4 is a sectional view on an enlarged scale of a further modification of the pickup device.

Referring first to Figs. 1 and 2, the magnetic field structure 10 includes a pair of spaced pole pieces 11 and 12 supported on a base plate 13 of non-magnetic material. A third pole piece 14 is supported by base plate 13 between the pole pieces 11 and 12 to provide two magnetic fields and two magnetic flux gaps therebetween.

A vibratory unit or armature is resiliently mounted to traverse the path of magnetic flux of the two magnetic fields of the pickup device. One of the important features of the invention resides in the manner of mounting and vibratory unit or armature 15 and stylus 16 so that the stylus 16 may respond to small upward displacement as a result of pinch-effect without elevation of the associated components of the pickup and tone arm (not shown) and while faithfully transmitting lateral oscillation of the stylus to the armature.

Armature 15 comprises a preferably U-shaped coil form or holder 17 having a coil of fine wire 18 wound upon the sides 17a thereof and insulated by means of a layer of insulating paper or the like (not shown). In wound condition the portions of coil 18 between the sides 17a of coil form 17 are substantially planar so that the pole pieces 11 and 12 may be faced off square (as best shown in Fig. 1) to provide a short air gap and high intensity of the magnetic fields and consequently a greater output for the pickup device.

Coil holder 17 carrying the coil 18 is resiliently supported in the path of magnetic flux between outer pole pieces 11 and 12 and intermediate pole piece 14 by means of a torsion element 19 extending longitudinally of base plate 13 and perpendicularly to the center line of the magnetic fields and constitutes the oscillatory axis about which armature assembly 15 vibrates.

Torsion element 19 extends between sides 17a of coil holder 17, as shown in Fig. 3, and is fastened thereto in any suitable manner as by means of non-magnetic fittings of brass or the like.

In order to facilitate assembly and alignment of the coil holder 17 and coil 18 and to reduce the transmission of vibration to the stationary, non-oscillatory components of the pickup device, a pair of clamping blocks 20 is used to secure torsion element 19 within a resilient damper 21 of rubber or similar material, as by means of screws 22 threaded into base plate 13. A pair of positioning clamps 23 directly engage the free end of torsion element 19 without the interposition of a damping member therebetween and said positioning clamps are affixed to base plate 13 by means of screws 24 in order to properly locate the coil assembly with respect to the pole pieces and to securely anchor said torsion element.

While the torsion element 19 is preferably circular in cross-section it is provided adjacent

4

clamping blocks 20 with a flattened or reduced section 25, as best shown in Figs. 1 and 2. This arrangement further reduces the stiffness of the device and operates to minimize record deterioration.

The portion of torsion element 19 passing between the sides 17a of coil form 17 is received within a slot 14a (see Fig. 3) formed in the lower end of inner pole piece 14 and is preferably positioned within said slot by a vibration damper 26 (Fig. 3) of rubber or other resilient material.

As has been previously pointed out, an extremely significant feature of the invention resides in the provision of vertical movement or oscillation of the stylus in response to pinch effect without corresponding movement of the pickup head and tone arm so as to minimize deformation of the record groove and obviate distortion and lack of fidelity in reproducing the sound record. This effect is accomplished in the initial modification of Figs. 1 and 2 by employing a resilient member preferably in the form of flat spring 27 firmly secured to the underside of coil form 17 and supporting stylus 16 at its free end. A damper block 28 is interposed between spring 27 and the bottom base plate 13 to avoid vertical bounce of the pickup head and arm. By arranging the flat surface of spring 27 parallel to the record surface, stylus 16 may rise and lower in response to pinch effect, irregularity of turntable motion, warped condition of the record and the like without lifting the pickup head and tone arm, while still faithfully transmitting lateral movement to coil form 17 and coil 18.

Base plate 13 supports the insulated block 29 which carries terminal posts 30 for the ends 31 of coil 18 and to which terminal posts the tone arm leads (not shown) may be secured.

Fig. 3 illustrates a slight modification of the device employing a stylus-mounting spring 27' looped over or bent back upon itself to support the stylus 16 directly under the coil form 17 with damper block 28' interposed between stylus 16 and the coil form within the bend or loop of said spring.

The modification illustrated in Fig. 4 achieves vertical freedom or compliance for the stylus in a somewhat different manner. In this modification torsion element 19' extends forwardly of coil form 17 to be supported within a resilient damper 32 between a pair of clamping blocks 33 suitably secured to base plate 13. Slot 14b in inner pole piece 14' is made sufficiently wide and deep so that the portion of torsion element 19' extending between the sides of coil form 17 does not contact the inner pole piece. It will be noted that torsion element 19' is provided adjacent forward clamping blocks 33 with a flattened or reduced section 34 which operates together with flattened section 25 at the other end of said torsion element to increase the vertical compliance of stylus 16' attached to coil form 17. The positioning of clamping blocks 33 and 20 and the adjustment of the thickness of flattened sections 34 and 25 allows adjustment of the ratio of lateral to vertical compliance for optimum performance of the device. A pair of fittings 35 is employed in order to secure torsion element 19' to the sides 17a of coil form 17.

In addition to the advantages previously indicated the device is characterized by ease of assembly, simplicity and ruggedness of construction. Further the device has sufficiently high out-

put to be employed with standard reproducing equipment without the necessity for extra amplification, despite its low mass and stiffness.

Since certain modifications may be made in the device of the invention without departure from the scope thereof, it is intended that all matter contained in the foregoing description and shown in the accompanying drawing be interpreted merely as illustrative and not in a limiting sense.

What is claimed is:

1. In an electromagnetic sound translating device having a pair of spaced pole pieces and an intermediate pole piece defining two magnetic flux gaps on either side of said intermediate pole piece and an oscillatory coil resiliently mounted in the magnetic flux path of both of said gaps; a U-shaped coil holder disposed over the lower end of said intermediate pole piece and having a coil wire upon the outer sides thereof so as to encircle the lower end of said intermediate pole piece, a torsion element supporting said coil holder, said torsion element having its free end anchored at a point remote from said flux gaps, a resilient member fixed to said coil holder, and a stylus carried at the free end of said resilient member, whereby to permit vertical movement of said stylus while transmitting lateral movement to said oscillatory coil.

2. In an electromagnetic sound translating device having a pair of spaced pole pieces and an intermediate pole piece defining two magnetic flux gaps on either side of said intermediate pole piece and an oscillatory coil resiliently mounted in the magnetic flux path of both of said gaps; a U-shaped coil holder disposed over the lower end of said intermediate pole piece and having a coil wire upon the outer sides thereof so as to encircle the lower end of said intermediate pole piece, a torsion element supporting said coil holder, said torsion element having its free end anchored at a point remote from said flux gaps, a flat spring member fixed to said coil holder and disposed substantially in a horizontal plane to be parallel to a sound record surface, a stylus carried at the free end of said spring member, whereby to permit vertical movement of said stylus while transmitting lateral movement to said oscillatory coil.

3. In an electromagnetic sound translating device having a pair of spaced pole pieces and an intermediate pole piece defining two magnetic flux gaps on either side of said intermediate pole piece and an oscillatory coil resiliently mounted in the magnetic flux path of both of said gaps; a U-shaped coil holder disposed over the lower end of said intermediate pole piece and having a coil wire upon the outer sides thereof so as to encircle the lower end of said intermediate pole piece, a torsion element supporting said coil holder, said torsion element having its free end anchored at a point remote from said flux gaps, a flat spring member fixed to said coil holder and disposed substantially in a horizontal plane to lie parallel to a sound record surface, a stylus carried at the free end of said spring member, whereby to permit vertical movement of said stylus while transmitting lateral movement to said oscillatory coil, and a resilient damper element fixed to said spring member adjacent said stylus to prevent vertical bounce of said device and associated supporting arm.

4. In an electromagnetic sound translating device having a pair of spaced pole pieces and an intermediate pole piece defining two magnetic flux gaps on either side of said intermediate pole

piece and an oscillatory coil resiliently mounted in the magnetic flux path of both of said gaps; a U-shaped coil holder disposed over the lower end of said intermediate pole piece and having a coil wire upon the outer sides thereof so as to encircle the lower end of said intermediate pole piece, a torsion element supporting said coil holder, said torsion element having its free end anchored at a point remote from said flux gaps, a flat spring member fixed at one end to said coil holder and loped over upon itself in a plane containing the axis of said torsion member, a stylus carried at the opposite end of said spring member, whereby to permit vertical movement of said stylus while transmitting lateral movement to said oscillatory coil, and a resilient damper element interposed between said stylus and said coil holder to prevent vertical bounce of said device and associated supporting arm.

5. In an electromagnetic sound translating device having a pair of spaced pole pieces and an intermediate pole piece defining two magnetic flux gaps on either side of said intermediate pole piece and an oscillatory coil resiliently mounted in the magnetic flux path of both of said gaps; a U-shaped coil holder disposed over the lower end of said intermediate pole piece, a torsion element supporting said coil holder and extending between the sides of said U-shaped coil holder, said torsion element having its free end anchored at a point remote from said flux gaps, said intermediate pole piece having a slot for the reception of the portion of said torsion element within said coil form, a damper element interposed between said portion of the torsion element and the slot of said intermediate pole piece, a resilient member fixed to said coil holder, a stylus carried at the free end of said resilient member, whereby to permit vertical movement of said stylus while transmitting lateral movement to said oscillatory coil, and a damper element fixed to said resilient member adjacent said stylus to prevent vertical bounce of said device.

6. In an electromagnetic sound translating device having a pair of spaced pole pieces and an intermediate pole piece defining two magnetic flux gaps on either side of said intermediate pole piece and an oscillatory coil resiliently mounted in the magnetic flux path of both of said gaps; a U-shaped coil holder disposed over the lower end of said intermediate pole piece, a torsion element supporting said coil holder and extending between the sides of said U-shaped coil holder, said torsion element having its free end anchored at a point remote from said flux gaps, said intermediate pole piece having a slot for the reception of the portion of said torsion element within said coil form, a damper element interposed between said portion of the torsion element and the slot of said intermediate pole piece, a flat spring member fixed to said coil holder and disposed substantially in a horizontal plane to lie parallel to a sound record surface, a stylus carried at the free end of said spring member, whereby to permit vertical movement of said stylus while transmitting lateral movement to said oscillatory coil, and a resilient damper element fixed to said spring member adjacent said stylus to prevent vertical bounce of said device.

7. In an electromagnetic sound translating device having a pair of spaced pole pieces and an intermediate pole piece defining two magnetic flux gaps on either side of said intermediate pole piece and an oscillatory coil resiliently mounted in the magnetic flux path of both of said gaps;

7

a U-shaped coil holder disposed over the lower end of said intermediate pole piece, a torsion element supporting said coil holder and extending between the sides thereof and in opposite directions therefrom, said torsion element being resiliently anchored at both ends at points remote from said flux gaps, said intermediate pole piece having a slot for the reception of the portion of said torsion element within said coil form and out of contact with said intermediate pole piece, and a stylus fixed to said coil holder, whereby to permit vertical movement of said stylus while transmitting lateral movement to said oscillatory coil.

8. In an electromagnetic sound translating device having a pair of spaced pole pieces and an intermediate pole piece defining two magnetic flux gaps on either side of said intermediate pole piece and an oscillatory coil resiliently mounted in the magnetic flux path of both of said gaps; a U-shaped coil holder disposed over the lower end of said intermediate pole piece, a torsion element supporting said coil holder and extending between the sides thereof and in opposite directions therefrom, said torsion element being resiliently anchored at both ends at points remote from said flux gaps, said intermediate pole

8

piece having a slot for the reception of the portion of said torsion element within said coil form and out of contact with said intermediate pole piece, and a stylus fixed to said coil holder, whereby to permit vertical movement of said stylus while transmitting lateral movement to said oscillatory coil, said torsion element having at least one section of reduced thickness adjacent its point of anchoring to reduce stiffness and increase vertical compliance of the device.

STEWART M. MILLER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,032,194	Wiebusch	Feb. 25, 1936
2,133,815	Harrison	Oct. 18, 1938
2,213,936	Thompson	Sept. 3, 1940
2,320,416	Dally	June 1, 1943
2,320,427	Guedon	June 1, 1943
2,363,497	Begun	Nov. 28, 1944
2,410,329	Albright	Oct. 29, 1946
2,441,651	Thompson	May 18, 1948