

Oct. 18, 1949.

S. R. RICH

2,484,960

PHONOGRAPH PICKUP UNIT

Filed March 8, 1946

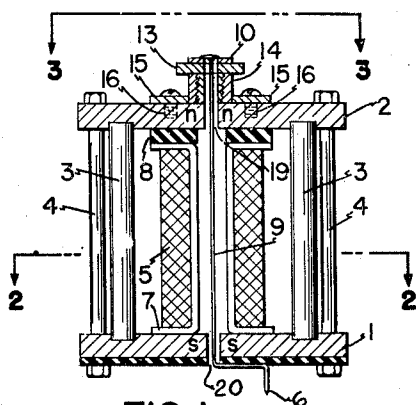


FIG. 1

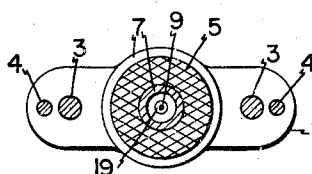


FIG. 2

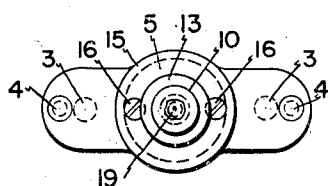


FIG. 3

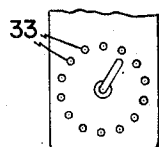


FIG. 5

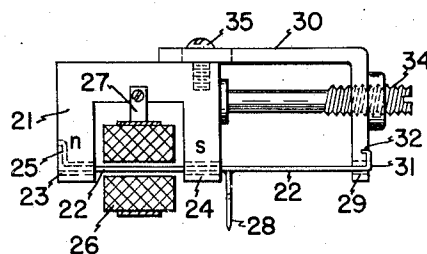


FIG. 4

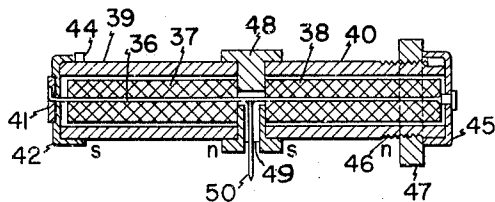


FIG. 6

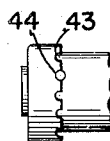


FIG. 7

INVENTOR.
STANLEY R. RICH

BY

Edith M. Rich
his ATTORNEY

UNITED STATES PATENT OFFICE

2,484,960

PHONOGRAPH PICKUP UNIT

Stanley R. Rich, Cambridge, Mass., assignor to
Tohe Deutschmann, Canton, Mass.

Application March 8, 1946, Serial No. 652,926

8 Claims. (Cl. 179—100.41)

1

The present invention relates to a phonograph pick-up unit for converting mechanical vibrations into corresponding electrical vibrations or vice versa, and is particularly useful in the reproduction of sound from phonograph records, but may of course be applicable to any other type of energy conversion between mechanical vibrations and corresponding electrical current.

The present invention is an improvement over my copending patent application Serial No. 624,362, filed October 25, 1945, now U. S. Patent No. 2,471,542, granted May 31, 1949, and relates to various other means for the conversion between mechanical vibrations and electrical current than shown in the above application.

In common with the means of the application referred to above, the structures of the present invention use a magnetostrictive wire or rod under tension or torsion or under the combination of both such strains in the means for interchanging mechanical and electric energy.

The present invention will be more fully described and explained in connection with the embodiment of the same as illustrated by the drawings, in which:

Figure 1 shows a sectional view of one form of the invention.

Figure 2 shows a section taken on the line 2—2 of Figure 1.

Figure 3 shows a fragmentary section taken on the line 3—3 of Figure 1.

Figure 4 shows a modification of the form shown in Figure 1 with elements in fragmentary section.

Figure 5 shows an enlarged view of a detail of Figure 4 as viewed from the right of Figure 4.

Figure 6 shows a still further modified form in a sectional view, and

Figure 7 shows an enlarged detail of the form of Figure 6.

In the modification shown in Figures 1 to 3, the pick-up unit comprises a frame formed by two end plates, 1 and 2 of magnetizable material, such for instance as iron having a low reluctance for the flow of magnetic flux. Between these end plates 1 and 2 there may be positioned one or more bars, 3—3 etc., of permanent magnet material, such as an alloy of nickel and copper known by the trade name as "Alnico," or some other similar material which has a high magnetizing force.

The plates 1 and 2 may be bolted together by long bolts 4, 4, etc., of non-magnetic material. Spaced between the two end plates 1 and 2 may be also a coil 5 serving to act as a transmitter

2

or as a receiver, depending upon whether the stylus 6 is to be used for cutting purposes or to run over the record and pick up the vibrations due to the sound track in the record. The coil 5 may be wound on a form 7 and be clamped in place by means of an end plate 8 abutting against the plate or bar 2. The coil 5 surrounds the magnetostrictive wire 9. One end of the wire 9 may be fixed in an end plate 10, which rests on the screw cap 13. The screw cap 13 is threaded into a collar 14 which is clamped to the front end of the bar or plate 2 through outwardly extending flanges 15 through which the screws 16 pass to clamp the collar in place. The cap 13 may be turned to back away from the end plate 10 to provide desired tension on the wire 9. The lower end of the magnetostrictive wire is bent at an angle over the outer face of the lower base plate 1, which may be covered with a layer of clamping material to clamp the arm portion of the wire to which the stylus 6 is attached. Tension on the wire 9 is exerted between the plate 10 and the angle portion at the other end lying over the plate.

The permanent magnet formed by the bars 3, 3, may be assumed to make the gap in the bar 1 a south pole and the gap in the bar 2 a north pole, in which case when the coil 5 is energized in one direction, the flux will be increased tending to contract the magnetostrictive wire, if made of nickel; and in the other case when the current is reduced in the coil 5 or flows in the opposite direction, the flux in the wire will decrease and the wire will be permitted to expand. This vibration will be transmitted to the stylus 6 and cause it to vibrate in accordance with the sound and electrical undulations impressed upon the circuit. As a receiver the stylus 6 will be vibrated and cause the magnetostrictive wire to perform similar vibrations which will induce corresponding currents in the coil 5 which may be amplified and reproduced.

The magnetostrictive wire 9 passes through a hole 19 at the top pole and through a similar hole 20 at the lower pole. The permanent magnet has an effect of producing a definite polarization on the wire 9, while the signal or voice current impressed upon the coil 5 will produce the change in flux in the wire 9 which will cause its vibration, or if the stylus causes the wire to move, the flux will be varied inducing corresponding currents in coil 5.

In the arrangement shown in Figures 4 and 5, the magnetic circuit is shown somewhat differently than that shown in Figures 1 and 2. Here

3

the permanent magnet 21 is formed as a U-shaped element and a magnetostrictive wire 22 passes through the open end of the U-shaped magnet either through holes 23 or 24 formed in the ends of the magnet or through grooves which may be covered to support the wire therein, if necessary. The magnetostrictive wire at the end 23 is provided with an angular extending arm 25 which sets in a groove or slot in the outer face of the pole. A coil 26 is supported between the two poles 23 and 24 and surrounds the magnetostrictive wire 22. This coil 26 may be supported by a bracket support or in any other suitable manner as indicated at 27. The magnetostrictive wire has attached to it the stylus 28 either at its mid-point or somewhere between the ends. The magnetostrictive wire is supported at its other end in a hole 29 in the adjustable angular arm or bracket 30. The magnetostrictive wire passes through the hole 29 and may be given a torsional strain by setting the turned-in arm 31 with its projection 32 in any one of the holes or recesses 33 (Fig. 5), thereby producing the desired torsional strain on the wire. The arm 31 is adjustable longitudinally with respect to the magnetostrictive wire and thereby the wire 22 may be put in tension by means of turning the adjusting screw 34. By turning this screw 34 the arm 30 may be moved outward giving additional strain to the wire 22. When the desired strain has been obtained, the arm 30 is clamped in position by means of the clamping screw 35 which passes through a slot in the arm and clamps the arm to the base of the magnet 21. The supporting arm 30 is preferably not of magnetic material.

In the arrangement shown in Figures 4 and 5, both torsion and tension may be imparted to the magnetostrictive wire 22, to the exact desired degree.

A further modification of the invention is shown in Figures 6 and 7. In this case the magnetostrictive wire 36 may be surrounded with two cylindrical coils 37 and 38 contained within cylinders 39 and 40, respectively, which are permanent magnets and may be magnetized with the external end of the magnet 39 as a south pole and the internal end as a north pole, while the magnet 40 has its internal end as a south pole and has its external end as a north pole. The magnetostrictive wire is supported at the left end by means of a plate 41 which is fixed in an end cap 42 extending over the end of the cylinder 39. This cap is provided with recesses 43 spaced around its edge as indicated in Figure 7, and the cylinder 39 is provided with a pin 44 so that the cap may be turned in any position to give the wire 36 the desired torsion. The other end of the magnetostrictive wire is fixed in a cap 45 permanently and the outside of the cylinder 40 is threaded as indicated at 46 with a tension adjusting nut 47 engaging the threaded section of the cylinder. The threaded nut or collar 47 may be turned to extend the cap 45 in a direction longitudinal with the wire 36 and exert a tension on it. The cylinders 39 and 40 at their inner ends fit into a base 48 which has shoulder portions forming collars or sleeves within which the cylinders 39 and 40 rest. The base 48 is provided with a hole at the center through which the wire 36 passes and also a passage extending radially as indicated at 49, through which the stylus 50 extends. The stylus 50 works under torsion to produce vibrations in a plane perpendicular to the paper as shown in Figure 6. An increase in

4

flux through the magnetostrictive wire 36 will increase the tension and therefore rotate the stylus in the direction of increased torsion. A decrease in flux will have the opposite effect. As a reproducer of sound the same principles will, of course apply.

Having now described my invention, I claim:

1. A phonograph pick-up device comprising a magnetostrictive wire, means supporting said wire at both ends, a stylus extending in a direction away from the wire with one end firmly attached thereto and the other end free, means for magnetizing said wire only on one side of the position of the stylus, and coil means contained within the magnetizing means for impressing on the wire or receiving therefrom, electrical oscillations corresponding to the mechanical vibrations thereof.

2. A phonograph pick-up device comprising a magnetostrictive wire, means supporting said wire at both ends, a stylus extending in a direction away from the wire with one end firmly attached thereto and the other end free, means for magnetizing said wire only on one side of the position of the stylus, and coil means contained within the magnetizing means for impressing on the wire or receiving therefrom, electrical oscillations corresponding to the mechanical vibrations thereof, and means applied only at the supporting ends comprising in part said supporting means for providing a biasing torsional strain on said wire between the points of support.

3. A phonograph pick-up device comprising a magnetostrictive wire, means supporting said wire at both ends, a stylus extending in a direction away from the wire with one end firmly attached thereto and the other end free, means for magnetizing said wire only on one side of the position of the stylus, and coil means contained within the magnetizing means for impressing on the wire or receiving therefrom, electrical oscillations corresponding to the mechanical vibrations thereof, and means applied only at the supporting ends comprising in part said supporting means for providing a biasing torsional and tensional strain on said wire between the points of support.

4. A phonograph pick-up device comprising a magnetostrictive wire, means supporting said wire at both ends, a stylus extending in a direction away from the wire with one end firmly attached thereto and the other end free, means for magnetizing said wire only on one side of the position of the stylus, comprising a U-shaped permanent magnet having pole ends adjacent the wire, a coil surrounding said wire between said pole ends for impressing oscillations thereon and receiving oscillations from the wire, and means applied only at the supporting ends for exerting a biasing tension between the ends of the wire.

5. A phonograph pick-up device comprising a magnetostrictive wire, means supporting said wire at both ends, a stylus extending in a direction away from the wire with one end firmly attached thereto and the other end free, means for magnetizing said wire only on one side of the position of the stylus, and coil means contained within the magnetizing means for impressing on the wire or receiving therefrom electrical oscillations corresponding to the mechanical vibrations thereof, and means applied only at the supporting ends comprising in part said supporting means for providing a biasing tensional strain in said magnetostrictive wire.

6. A phonograph pick-up device comprising a

5

magnetostrictive wire, means supporting said wire at both ends, a stylus extending in a direction away from the wire with one end firmly attached thereto and the other end free, means for magnetizing said wire only on one side of the position of the stylus, comprising a U-shaped permanent magnet having pole ends adjacent the wire, a coil surrounding said wire between said pole ends for impressing oscillations thereon and receiving oscillations from the wire, and means applied only at the supporting ends for exerting a torsional strain between the ends of the wire.

7. A phonograph pick-up device comprising a magnetostrictive wire, means supporting said wire at one end, means impressing a permanent magnetic field on said wire between its ends, coil means surrounding said wire within the positions of the poles of the permanent magnet, and means for supporting the other end of the magnetostrictive wire in adjustable tension and torsion, comprising a bracket, adjustable in the longitudinal direction of said wire with respect to said first supporting means for supporting the other end of said wire in the desired tension and means for applying and maintaining the end of said wire in permanent torsional position.

6

8. A phonograph pick-up device comprising a magnetostrictive wire, means supporting said wire at one end, means impressing a permanent magnetic field on said wire between its ends, coil means surrounding said wire within the positions of the poles of the permanent magnet, and means for supporting the other end of the magnetostrictive wire in adjustable tension, comprising a bracket adjustable in the longitudinal direction of said wire with respect to said first supporting means for adjustably supporting the other end of said wire in tension.

STANLEY R. RICH.

REFERENCES CITED

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

UNITED STATES PATENTS

20	Number	Name	Date
	351,905	Eickemeyer	Nov. 2, 1886
	1,882,400	Pierce	Oct. 11, 1932
	2,348,352	Mallina	May 9, 1944