Jan. 16, 1934. L. H. MATTHIAS 1,943,873

ELECTRIC PICK-UP FOR SOUND REPRODUCTION

Filed July 16, 1930 2 Sheets-Sheet 1

Fig. 1.

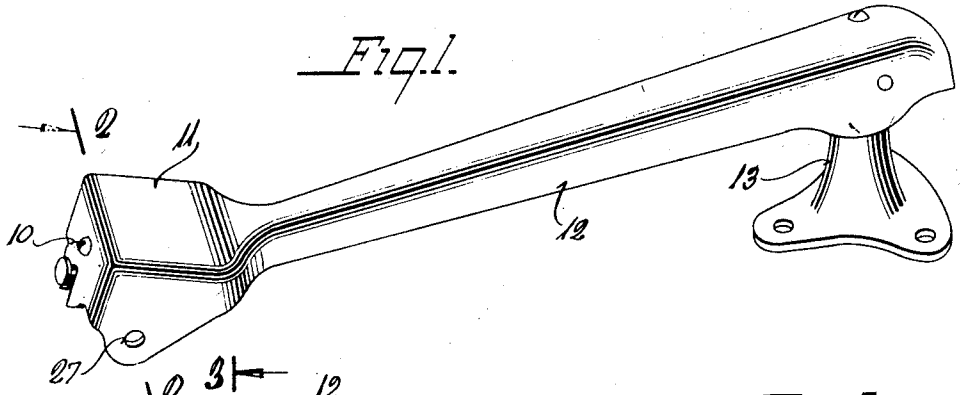


Fig. 2.

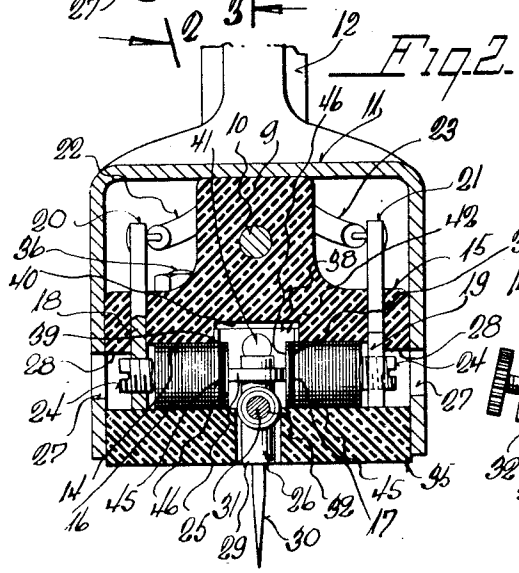
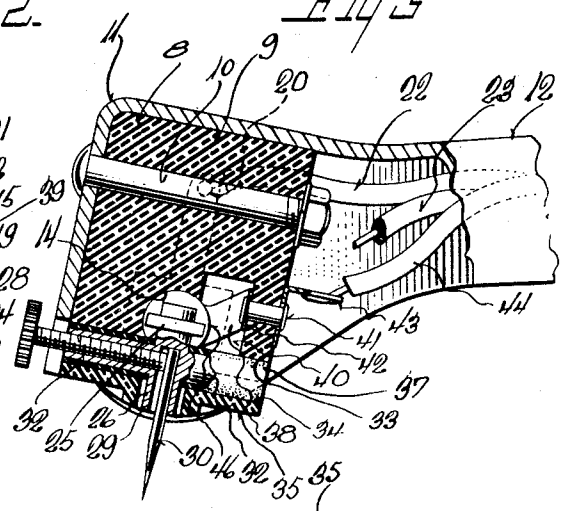


Fig. 3



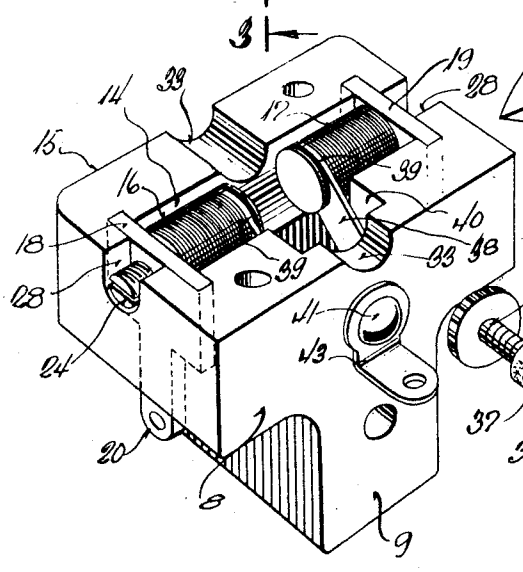
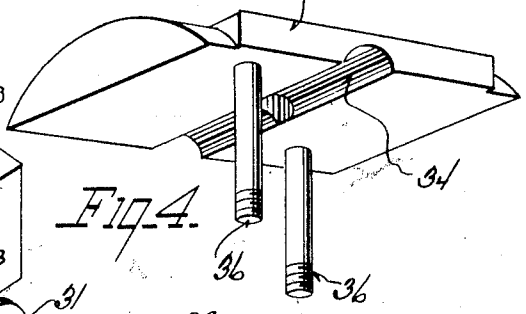
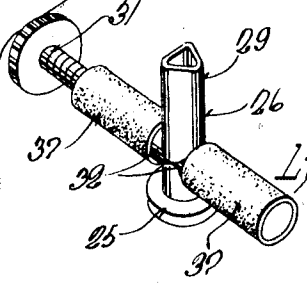


Fig. 4.





Inventor
Lynn H. Matthias
By Sandra Milton Jones
Attorney

Jan. 16, 1934. L. H. MATTHIAS 1,943,873

ELECTRIC PICK-UP FOR SOUND REPRODUCTION

Filed July 16, 1930 2 Sheets-Sheet 2

Fig. 5.

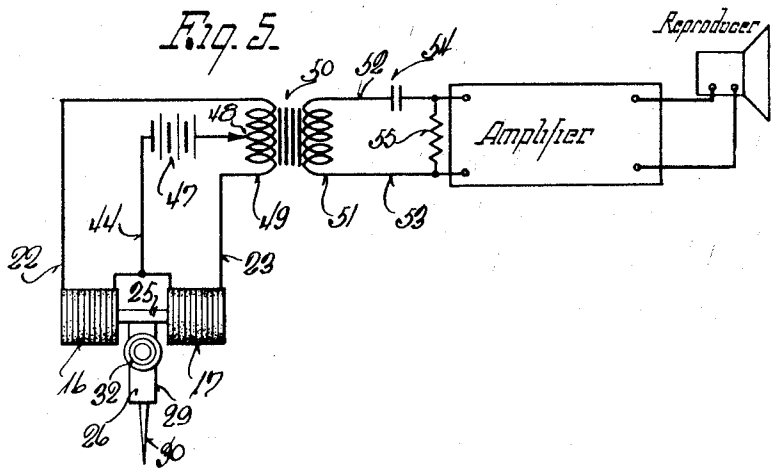


Fig. 6.

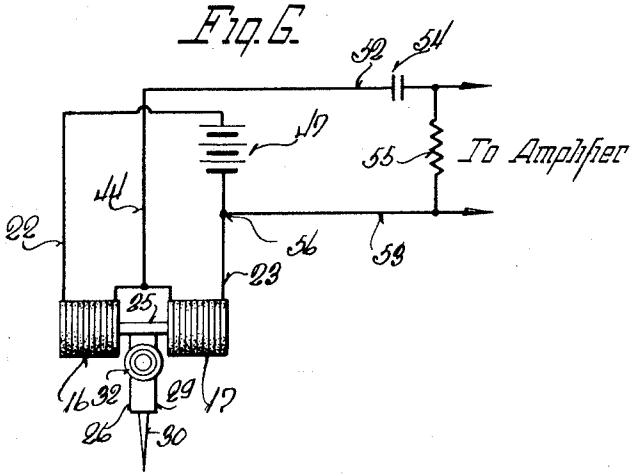
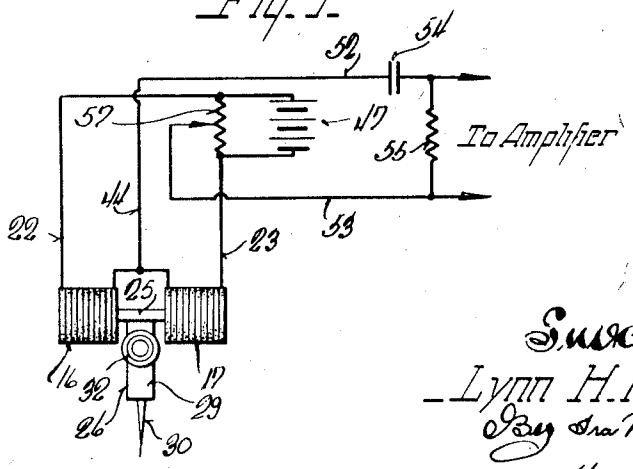


Fig. 7.



Inventor
Lynn H. Matthias.
By Ira Milton Jones
Attorney

Patented Jan. 16, 1934 1,943,873

UNITED STATES PATENT OFFICE

1,943,873

ELECTRIC PICK-UP FOR SOUND REPRODUCTION

Lynn H. Matthias, Milwaukee, Wis., assignor, by mesne assignments, to Allen-Bradley Company, Milwaukee, Wis., a corporation of Wisconsin

Application July 16, 1930. Serial No. 468,326

12 Claims. (Cl. 179—100.41)

This invention relates broadly to devices for transforming mechanical vibrations into electrical vibrations and refers more particularly to means for reproducing electrically, mechanical vibrations as recorded on phonograph records.

It is therefore an object of this invention to provide a simplified and inexpensive apparatus commonly referred to as an "electric pick-up" for transforming the mechanical vibrations recorded on phonograph records into a varying electric current.

Heretofore devices for this purpose have operated on a magnetic principle, i. e. the mechanical vibrations imparted to a stylus by the record were utilized to vary a flux set up by a magnet, which variation of flux produced an oscillating current in a reproducing circuit. This manner of reproduction necessitates a relatively costly apparatus and is objectionable in its requirement for a magnet.

It is therefore another object of this invention to provide an electric pick-up apparatus which operates on a non-magnetic principle and thus overcomes the objectionable features noted.

A more specific object of this invention resides in the provision of a pair of compressible pile resistance elements and means responsive to the mechanical vibrations as recorded on a phonograph record for oppositely varying the pressure thereon to create a varying electric current proportional to the recorded vibrations.

With the above and other objects in view which will appear as the description proceeds, my invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the herein disclosed invention may be made as come within the scope of the claims.

In the accompanying drawings, I have illustrated several complete examples of the physical embodiment of my invention constructed according to the best modes I have so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a perspective view illustrating a convenient manner of mounting my improved pick-up apparatus;

Figure 2 is a sectional view taken through Figure 1 on the plane of the line 2—2;

Figure 3 is a sectional view taken through Figure 2 on the plane of the line 3—3;

Figure 4 is a perspective view of the several units of the device shown apart from the supporting arm and separated to illustrate their relationship; and

Figures 5, 6, and 7 illustrate different electrical circuits by which the device may be electrically connected with a conventional reproducing circuit.

Referring now more particularly to the accompanying drawings, in which like numerals designate like parts throughout the several views, the numeral 8 represents the mounting member, body or casing of my improved pick-up apparatus, which is preferably molded of insulating material such as phenol condensation product and has an upwardly projecting boss 9 through which a screw 10 passes to secure the body or casing 8 within the outer cup-shaped end 11 of a carrying arm 12. The inner end of the arm 12 is connected with a supporting base 13 in a manner permitting substantially universal movement of the arm.

As is well known, the base 13 is adapted to be mounted adjacent the periphery of a phonograph turntable in such a manner that the needle or stylus of the pick-up apparatus traverses the record during playing thereof. This structure however is conventional and as it forms no part of my invention, has not been shown.

As best illustrated in Figure 4, the body of insulating material 8 has a cavity or chamber 14 extending longitudinally across its lower enlarged portion 15, the bottom of which is substantially semi-circular to receive therein two stacks of carbon discs forming a pair of resistance elements 16 and 17.

Adjacent the sides of the enlarged body portion 15 and embedded therein are plate members 18 and 19 which close the outer ends of the cavity 14 and have terminal lugs 20 and 21 formed respectively thereon to be extended through suitable openings in the body portion and project outwardly thereof. Conductors 22 and 23 are connected with the terminal members and the arm 12 to the base, through which they may be threaded to be connected with the necessary electrical circuits in a manner to be later described.

Screws 24 threaded in the plates 18 and 19 in axial alignment with the resistance elements provide means for placing the stacks of discs comprising the elements under predetermined degrees of compression, the action of the screws being resisted by the upper enlarged end 25 of a pressure applying member 26 mounted between the resistance elements. Access may be had to the pressure screws 24 to facilitate their adjustment through openings 27 in the sides of the cup

shaped end 11 of the mounting arm and recesses 28 in the insulating body 8 adjacent thereto.

The lower portion 29 of the pressure applying member is tubular and of substantially triangular shape in cross section to receive a needle or stylus 30 clamped therein by a screw 31 threaded in one of a pair of transverse arms 32. The arms 32 are preferably formed integral with the pressure applying member and are journalled in suitable apertures formed at opposite sides of the cavity or chamber 14, and defined by substantially semi-circular recesses 33 and 34 in the meeting faces of the body 8 and a cover member 35 adapted to be secured thereto by bolts 36. An opening 35' through the cover member in communication with its recess 34 accommodates the lower needle receiving end 29 of the pressure applying member, and sleeve members 37 of rubber or other similar material are mounted on the transverse arms 32 as bushings to insure a firm mounting for the pressure applying member.

The distance from the axis of the arms 32 about which the pressure applying member rocks, to the enlarged inner end 25 of the armature is such that the end 25, which for convenience is preferably in the shape of an annular flange, is located in axial alignment with the resistance elements 16 and 17. Transverse vibrations of the outer end of the needle 30 thus oscillates the pressure applying member and simultaneously compresses one resistance element and releases the pressure on the other producing a variation in resistance of the elements proportional to the mechanical vibration of the needle point.

Hence it is seen that if the resistance elements are connected in series across the terminals of a battery or other source of potential difference, the common terminal between the elements varies in potential with respect to either battery terminal directly with the displacement of the pressure applying member from its normal position and produces a varying E. M. F. proportional to the needle point vibration which may be utilized in a conventional audio amplification system as will be later described.

The common terminal for the resistance elements 16 and 17 may be formed in any desired manner and in the present instance a substantially U shaped member 38 having the outer ends 39 of its arms engaging the innermost of the columns of discs comprising the resistance elements, is mounted within a recess 40 formed in the body 8 in communication with the cavity or chamber 14. The U shaped member is secured in place by a rivet 41 passing through its closed end 42 and an aperture in the body member 8. The rivet 41 also electrically connects a terminal 43 with the U shaped member 38 from which a conductor 44 extends to be carried rearwardly through the arm 12 with the conductors 22 and 23.

As stated, the ends 39 of the arms of the U shaped member engage the innermost of the piles of discs forming the resistance elements so that the conductor 44 is electrically connected with the inner ends of both elements. Rubber washers 45 protected by metal discs 46 are positioned between the inner faces of U shaped member ends 39 and the periphery of the pressure applying member carried flange 25 to insulate the pressure applying member and the needle from the resistance elements.

The varying electric current obtainable as a result of the alternate compression of the resistance elements may be utilized to audibly reproduce the sound vibrations recorded on a phonograph record and in Figures 5, 6, and 7 several methods have been diagrammatically illustrated for accomplishing this object.

In Figure 5, one side of a battery 47 or other means of providing potential difference, is connected with the conductor 44 leading to the common terminal of the resistance elements, and the other side of the battery is connected with a center tap 48 on the primary 49 of a transformer 50. The ends of the primary 49 are connected with the outer ends of the resistance elements 16 and 17 through the conductors 22 and 23, respectively. The resistance elements 16 and 17 and the two sides of the primary 49 together with the battery 47 and the conductor 44 thus form two complementary circuits with the battery or source of potential difference common to both. A variation of resistance in the circuits produced by the alternate compression of the resistance elements obviously causes a varying current to flow in the primary of the transformer which induces an alternating E. M. F. in the secondary 51, the terminals of which are adapted to be connected with a conventional amplifier and reproducer through leads 52 and 53.

The alternating current set up in the secondary circuit is proportional to the amplitude of vibration of the pressure applying member carrying the stylus and to approximate an output of alternating E. M. F. proportional to the stylus velocity, a condenser 54 is interposed in one of the leads extending from the transformer secondary, to the amplifier and a resistance 55 is shunted across the leads.

The arrangement illustrated in Figure 6 differs from that shown in Figure 5 in that the source of potential difference 47 is connected directly across the end terminals of the resistance units 16 and 17 through the conductors 22 and 23, respectively. The center or common terminal from which conductor 44 leads, is connected with the one side of the condenser 54 and the conductor lead 53 is also connected with the source of potential difference as at 56, the resistance 55 being retained as in the embodiment illustrated in Figure 5. With this arrangement, the alternating fluctuation of resistance in the elements 16 and 17 produces an alternating E. M. F. across the output leads 52 and 53 by successive discharges across the condenser 54.

Figure 7 illustrates another manner of utilizing the variation in resistance in the two elements 16 and 17 and in this instance, the battery 47 like in the arrangement illustrated in Figure 6, is connected across the outer terminals of the resistance elements through the conductors 22 and 23 and the center or common terminal of the elements is connected with the condenser 54 through its conductor 44. The return circuit however, is established through the resistance 55, the lead 53 and a resistance 57 shunted across the battery 47, the lead 53 being connected with the resistance 57 at a medial point so as to divide the same into two resistance units. With this manner of connection, the resistance elements 16 and 17 and the two branches or units of the resistance 57 form, in effect, the arms of a Wheatstone bridge wherein the successive variations in resistance of the elements 16 and 17 produce succeeding unbalanced conditions in the two branches of the bridge and thereby effect a varying E. M. F. across the output leads 52 and 53.

Obviously, other circuits may be employed to utilize the varying E. M. F. produced by the alter-

nate compression of the resistance elements for sound reproduction and kindred uses, without deviating from the spirit of the invention; and from the foregoing description taken in connection with the accompanying drawings, it will be readily apparent to those skilled in the art to which an invention of the character described appertains, that I provide an improved and greatly simplified device for transforming mechanical vibrations into electrical impulses which by reason of its simplicity and low cost is particularly adaptable for use as an electric pick-up for electrical reproduction of sound waves, as recorded on phonograph records.

What I claim as my invention is:

1. In a phonograph pick-up, a supporting body having an open channel of the same cross sectional shape at its opposite end portions, abutments at the extremities of the channel, compressible resistor elements received in said opposite end portions of the channel with their outer ends engaging the abutments, said compressible resistor elements having a cross sectional shape different from that of the channel end portions, means for maintaining the adjacent ends of the compressible resistor elements spaced apart, and a stylus carrier having a part thereof engaging said means to bear against the adjacent ends of the resistor elements.

2. In a phonograph pick-up, a supporting body, spaced abutments carried by the supporting body and providing electric terminals, a center terminal member having spaced walls parts of which are in alignment with the abutments, compressible resistor elements confined between the abutments and the spaced walls of the center terminal member, and a stylus carrier having a part positioned between the spaced walls of the center terminal and bearing thereagainst, but electrically insulated therefrom, said spaced walls having the same freedom of movement in either direction from any initial position as determined by the adjustment of the compressible resistor elements to be freely movable with said stylus carrier part without affecting the response of the compressible resistor elements to vibration of the carrier.

3. In a phonograph pick-up, a pair of spaced electric terminals, a substantially U shaped member having the outer ends of its arms disposed in alignment with the spaced terminals, compressible resistor elements positioned between the terminals and the outer ends of the arms of the U shaped member, and a stylus carrier having a movable part positioned between said outer ends of the arms of the U shaped member and bearing thereagainst, and said arms of the U shaped member being in electrical contact with the adjacent ends of the compressible resistor elements but electrically insulated from the stylus carrier, whereby the U shaped member forms an electric terminal common to both compressible resistor elements independent of the stylus carrier.

4. In a phonograph pick-up, two spaced abutments carrying electric terminals, a central terminal member having spaced arms in alignment with the abutments, a compressible resistor confined between each abutment and the adjacent arm of the central terminal member, and a stylus carrier mounted with a part disposed between the spaced arms of the central terminal member to bear against the adjacent ends of the compressible resistors.

5. A phonograph pick-up comprising a body of insulating material having axially aligned spaced chambers, terminal members closing the outer ends of the spaced chambers, a terminal member received in a central cavity formed in the body of insulating material in communication with the inner ends of the spaced chambers, said terminal member having spaced portions substantially closing the inner ends of the spaced chambers, compressible resistor elements in said spaced chambers and confined between the outer terminals and the portions of the central terminal member, and a stylus carrier pivotally mounted from the body of insulating material and having a part bearing against the inner ends of the compressible resistor elements.

6. In a phonograph pick-up, a body of insulating material having a resistor receiving channel, terminal members carried by the body of insulating material and substantially closing the outer ends of said channel, a central terminal member having portions extended into said resistor receiving channel, compressible resistor elements in said channel confined between the first mentioned terminal members and the said portions of the central terminal member, and a stylus carrier having a movable part positioned between and engaging the said portions of the central terminal member.

7. In a phonograph pick-up, a body of insulating material having a resistor receiving channel and a central enlarged depression communicating with said channel, terminal members embedded in the body of insulating material and substantially closing the ends of the channel, a central terminal member received in said enlarged depression and having arms projected into the channel, compressible resistor elements in the channel confined between the first mentioned terminal members and the central terminal member arms, and a stylus carrier pivotally mounted from the body of insulating material and having a part engaged with the arms of the central terminal member but insulated therefrom.

8. A phonograph pick-up comprising a body of insulating material having a channel opening from one surface thereof with its ends substantially closed and having an enlarged central recess also opening from said surface and communicating with the channel, compressible resistors received in said channel with their outer ends engaging the closed outer ends of the channel, a member positioned in the enlarged central recess and engaging the inner ends of the compressible resistors to maintain the same spaced from each other, a stylus carrier, a transverse arm on the stylus carrier received in a groove formed in said surface of the body of insulating material, whereby the stylus carrier is pivotal about an axis substantially perpendicular to but spaced from the axis of the compressible resistors, part of said stylus carrier being engaged with the inner ends of the resistors through the member maintaining the same spaced, and a cover member secured over the said surface of the body of insulating material to close the resistor channel and the groove in which the stylus arm is journalled.

9. In a phonograph pick-up a pivotally mounted stylus carrier, a stack of carbonaceous discs at each of two opposite sides of the stylus carrier, said stacks of discs providing compressible resistor elements and being substantially axially aligned with their inner ends bearing against a carrier part spaced from the pivotal axis of the

carrier, and means engaging the outer ends of the stacks of carbonaceous discs and co-acting with said carrier part to maintain the stacks of discs in a predetermined state of compression, substantially medially of their range of compression, so that the resistor elements have constant resiliency to insure a positive response on the part of the resistor elements to vibratory displacement of the stylus carrier and a constant relationship between the variation in ohmic resistance of the elements and the displacement of the carrier.

10. In a phonograph pick-up, a supporting body having an axially straight channel, adjustable abutments at the ends of the channel, spaced electrically connected walls carried by the supporting body and projecting into the medial portion of the channel, a pair of opposed compressible carbon pile resistor elements in the channel, one between each abutment and the adjacent wall, and a vibratory stylus carrier having a part disposed between the spaced walls and bearing thereagainst, said walls having the same freedom of movement in either direction from any initial position as determined by the adjustment of the compressible resistor elements to be freely movable with said stylus carrier part without affecting the response of the compressible resistor elements to vibration of the carrier.

11. In a phonograph pick-up, a stylus carrier mounted to oscillate about a fixed axis, a pair of opposed compressible resistors arranged to bear against opposite sides of the stylus carrier at a distance from its axis of oscillation and each comprising a stack of carbonaceous discs, a center terminal member to electrically connect the adjacent inner ends of the resistors independently of the stylus carrier, said center terminal member having spaced walls, one disposed between each resistor and the stylus carrier part against which the resistors bear, said walls being mounted so as to have the same freedom of movement in either direction from any initial position as determined by the adjustment of the resistors, and means at the outer ends of the resistors to place the same in equal states of compression substantially medially of their range of adjustment so that the resiliency of the compressible resistors is made available to insure unassisted a positive response on the part of the resistors to vibratory oscillation of the stylus carrier.

12. In a phonograph pick-up, a stylus carrier mounted to oscillate about a fixed axis, a pair of opposed compressible resistors one at each side of the stylus carrier with their adjacent inner ends bearing against a carrier part spaced from its axis of oscillation, said compressible resistors having and being capable of obtaining an identical resistance at a given pressure throughout a long period of operation, and means at the outer ends of the resistors adjustable to place both resistors in a state of compression substantially medially of their range of compression so that the inherent resiliency of the compressible resistors is made available to insure a positive response on the part of the resistors to vibratory oscillation of the stylus carrier.

LYNN H. MATTHIAS.