This invention is for an electric phonograph reproducer capable of selectively playing lateral-cut and vertical records without adjustment of the device on its supporting arm. Briefly stated, my double-acting pickup comprises a pair of electric elements arranged in variable inductive relation and adapted to be connected in circuit. A stylus member playing lateral-cut records operates one of the electric elements, and a second stylus member playing vertical-cut records operates the other element. The vibratory movements of either element produce corresponding variations in their inductive relation, whereby electric impulses are generated. These impulses are suitably amplified and translated into sound. The electric elements vibrated by the stylus members may be condenser plates or coils.

The novel features and practical advantages of my invention will be fully understood from a detailed description of the accompanying drawings, in which—

Fig. 1 is a vertical section through a double pickup embodying my invention, in which each stylus member carries a condenser plate;

Fig. 2 is a plan of Fig. 1, without the housing;

Fig. 3 represents a modified construction, mainly in section, in which a pair of condenser plates are mounted on pivoted supports connected each to a stylus member;

Fig. 4 is a plan of Fig. 3 without the housing;

Fig. 5 is a transverse section on line 5—5 of Fig. 4;

Figs. 5a and 5b are sectional views of a needle arm and holder cast or molded as a single member;

Fig. 5b being a section on line 5b—5b of Fig. 5a;

Fig. 6 shows a vertical section through a construction in which each condenser element consists of a plurality of plates;

Fig. 7 is a plan of Fig. 6 with the housing removed;

Fig. 8 represents a modification using a pair of coils mounted in inductive relation and each adapted to be vibrated by a stylus member;

Fig. 9 is a plan of Fig. 8 with the housing removed;

Fig. 10 is a side view of Fig. 9;

Fig. 11 is a fragmentary detail in section showing one of the coil-supporting members used in Figs. 8–10;

Fig. 12 shows a plan view (partly in section) of a modified form of elastic mounting for the vibratory supporting arm of one or both stylus members;
metal and its lower end carries a stylus holder 19 adapted to support needles 20 for playing lateral-cut records. The needle holder 19 may be a cylindrical casting of brass or aluminum having a slot for receiving the lower end 18 of arm 18. A rivet 21 or the like holds the portal 17 and 19 rigidly together like a single member. A thumb-screw 22 operating in a lateral hole 22' of needle holder 19 (see Figs. 5a and 5b) clamps the inserted needle in position. The line 23 in all figures represents diagrammatically the playing surface of a lateral-cut disk record engaged by the needle 20. The cylindrical needle holder 19 may be cast or molded integral with the needle arm, as shown in Figs. 5a and 5b, and for this purpose the material used may be aluminum, duralumin, brass, iron, "Bakelite", and so on. The arm 19 may be flat or und. To avoid useless repetition later on, let me say right here that the integral construction of needle arm and holder is applicable to all the various forms illustrated in the other views.

The spring blade 16 is twistable at the center to permit lateral vertical motion of the needle arm 18. In other words, the member 16 acts like a resilient pivot about which the needle arm vibrates, and which automatically restores the arm to normal position. The dimensions of the spring blade 16 are so chosen as to have the proper amount of elasticity and torsional resistance. It will be observed that the plane of the spring blade 16 is approximately at right angles to the plane of the disk record 23. This means that spring 16 is in a position of maximum strength to support the weight of the arm 18 and to contribute during the playback of a record. The base 10 has an opening 24 through which the needle holder 19 extends, and this opening may be lined with a rubber ring 24' which always presses radially against the cylindrical needle holder all the way round to damp the vibrations. The elasticity of the damping ring 24', which may be fasten ed to the needle holder or to the walls of opening 24, readily allows vibrations of the needle arm at all amplitudes in accordance with the record groove, and yet it stops (or at least reduces to a minimum) the tendency of the unit to vibrate by virtue of its inertia or inherent resonance. In some cases the damping ring 24' may be omitted.

In Figs. 1 and 2, the right-angled needle arm 18 has a horizontal extension 18a, which carries at its free end a condenser plate 25 of brass, aluminum, or other conducting metal suitable for the purpose. The condenser plate 25 is here shown as a disk, although it may have any other practical shape. To isolate the disk 25 if the arm 18 is of metal, it is attached to an insulating piece of "Bakelite" or other insulating material by means of a screw 27. The insulating piece 26 consists of a disk provided with a cylindrical lug or extension 28 having a slot 29 for receiving the free end of the right-angled needle arm 18. A suitable fastening member 30 secures the condenser plate 25 to the needle arm 18. The lug or extension 28 may have a lateral opening 31 to receive a conductor 32 for connecting the condenser plate 26 in circuit. The conducting screw 27 which connects the condenser plate 25 to the insulating support 36 clamps the inserted end of conductor 32 in position and thereby connects the latter electrically to the condenser plate. The base 10 has a lug 33 on which one end of a spring blade 34 is mounted as by means of a screw 35, or otherwise. If the base 10 is cast or molded, the lug 33 may be formed integral there-
condenser plate 25, thereby producing variation in capacity which are finally translated into sound, as above explained. The damping ring 24 prevents vibration of the needle arm 18 and condenser plate 25 during the playing of vertical-cut records. Attention is called to the fact that, when the stylus point 37 is in playing position on a vertical-cut record, the lower edge 43 of the needle holder 19 is above the surface of the record, and is therefore out of the way.

On the other hand, when the needle 20 is on a lateral-cut record, the stylus point 37 is above the plane of the record and does not interfere with the operation of the pickup. It is assumed that, before playing vertical-cut records, the needle 20 will be removed from the holder 19.

In some instances, when no damping ring is used in the opening 48 for stylus member 36, it may be found desirable or advisable to have the free end of spring blade 34 normally engage a damping pad 50, which may simply be a small block or pad of rubber carrying a screw-threaded extension 51 mounted in base 10. In that case, the spring 34 is so mounted that normally its free end is in pressure contact with the top of damping pad 50. Consequently, when the right-handed arm 18 is brought into contact with the recording plates 30 of a base 24, the spring 34 and stylus member 36 are positively prevented from vibrating. When the stylus point 37 is placed on a vertical-cut record, the weight of the pickup causes the spring 34 to bend upward sufficiently to leave its free end clear of the damping pad 50. This separation is then enough to take care of the maximum vibrations of the stylus member 36. I mean by this that the damping pad 50 does not interfere with the free vertical movements of the spring 34 during the playing of a vertical-cut record. When a damping ring is used in opening 48, the pad 50 is not necessary.

In the modification of Figs. 3, 4 and 5, the base 10 carries a pair of spaced brackets 52, which may be formed integral with the base or attached thereto as separate pieces. The brackets 52 are provided with a pair of vertical slots 53 and a pair of aligned horizontal slots 54. These two pairs of slots support, respectively, a vertical spring blade 55 and a horizontal spring blade 56. The ends of these spring blades fit into the slots 30 and are secured by set-screws 57 and 58, or in any other practical way. A needle arm 59 is rigidly connected to the center of spring blade 55, which is laterally twistable to permit lateral vibration of the arm 59, as fully explained in connection with spring blade 16 and needle arm 18 of Fig. 1. The lower end of needle arm 59 carries the needle holder 19, which may be considered identical with the needle holder 19 of Figs. 1 and 5a. The inner end of needle arm 59 is connected at 61 to a right-angled lever or bellicrank 62, which is pivoted at its apex by means of a cross-pin 63 mounted at its ends in the brackets 52. Pointed screws 64 in brackets 52 engage correspondingly shaped recesses in the ends of pin 63 to support the latter for pivotal movement with substantially no lost motion. The bellicrank 62 may be made of metal or an insulating material like "Bakelite." A condenser plate 65 is mounted on the free end of bellicrank 63 in any practical way. In the example illustrated, the condenser plate 65 has an extension 66 inserted in a slot 67 in bellicrank 62 and secured by a screw or rivet 68, which may also serve as a binding post for a circuit conductor 69. The needle arm 59 and condenser plate 65 are prevented from vibrating during the playing of vertical-cut records by the vertical mounting of spring blade 55, but there may be a spring 70 adjustable engagement or in a tight joint secured by a cross-pin 74. The frame 70 carries a condenser plate 75 similar to the upper condenser plate 65 and secured to the frame in the same way in which the condenser plate 65 is attached to the bell crank 62. The fastening member 76 for condenser plate 75 may also be used as a binding post for a conductor to connect the condenser plate in circuit. Various methods may be used to normally hold the bracket 70 and the parts carried thereby against vibration, so that the condenser plate 75 will remain stationary during the playing of lateral-cut records. For example, the opening 48 may be lined with an elastic ring in pressure contact with stylus member 36. Or, the damping pad 50 of Fig. 1 may also be used in Fig. 3 for normally engaging the free end of extension 71, which is held against the pad by the normal set of the supporting spring 56. Another method for damping the vibrations of this unit is to mount an elastic block 77 on base 10 in permanent pressure contact with the bottom of frame 70 below the supporting spring 56. The block 77 may have a screw extension 77 secured to base 10, whereby the block is adjustably mounted on the base.

In the operation of the pickup illustrated in Figs. 3–5, the lateral vibrations of needle arm 59 about the elastic pivot support 55 rock the bellcrank 62 on its pivot 63, whereby the condenser plate 65 is moved to the left and from the stationary condenser plate 75. When the stylus member 36 is used to play vertical-cut records, the frame 70 is vibrated vertically about the twistable spring blade 56, so that the condenser plate 75 is moved toward and away from the stationary condenser plate 65. The variations in the capacity of the condenser due to the vibration of either condenser plate are translated into current impulses to operate suitable loudspeaker mechanism, as more fully explained in connection with Fig. 1. The connection 61 between the bellcrank 62 and needle arm 59 need not be in the form of a pivot member, but can be rigid, because the movements of the parts are very small.

The construction illustrated in Figs. 6 and 7 differs from that of Figs. 1 and 2 in utilizing a condenser in which each element consists of a plurality of plates. To avoid needless repetition of description, I have used the same reference numerals in Fig. 6 as in Fig. 1 to indicate similar parts. It will therefore be understood that the detailed description of Fig. 1 is fully applicable to Figs. 6 and 7, so far as like parts are concerned. A needle arm 78, which may be of metal or of strong insulating material, such as bakelite, is secured to the center of the twistable spring blade, and the inner end of this arm carries a condenser element consisting of a plurality of
U-shaped plates 79 connected by metallic fastening members 80. One of these metallic members may act as a binding post for a conductor 81. If the needle arm 78 is of metal, the condenser plates 78 will have to be suitably insulated from the arm. The vertically movable spring blade 54 which supports the stylus member 36 carries a vertical arm 32 either of metal or insulating material. A pair of U-shaped condenser plates 83 are connected to the upper end of arm 82 by metallic fastening members 84, to one of which the other circuit lead 35 is connected. As best shown in Fig. 7, the condenser plates 79 and 83 are interleaved to form a condenser of considerable overlapping area and capacity. The plates are spaced as closely together as mechanical conditions permit. The spring blades 16 and 34 prevent lateral movement of the condenser plates, so that there is no danger of their coming in contact with each other to produce a short circuit. If desired, the adjacent sides of the condenser plates may be covered or coated with suitable insulation. Otherwise, what has been said for the operation of Fig. 1 may be regarded as applicable to the construction of Fig. 6, and this includes all previous remarks concerning the damping of stylus members 19 and 36 and all parts connected thereto.

In the modification of Figs. 8–11, I use a pair of inductively related coils to produce current impulses when either stylus member is in operation. The base 10 carries a pair of spaced brackets 86, which may be cast integral with the base or attached thereto as separate pieces the brackets 86 have two pairs of aligned vertical slots 87 and 88 for receiving the ends of the two spring blades 88 and 90, respectively. Set screws 91 or other means hold the ends of the spring blades rigidly clamped to the supporting brackets 88. An arm or lever 92 is secured to the central portion of spring blade 89, which is laterally twistable to permit vibration of the arm. The lower end of arm 92 carries the usual needle holder 19, and the upper end of the arm supports a cylindrical shell or frame on which a coil 94 is wound. If the needle arm 92 is stamped from sheet metal, its upper end is twisted to provide a flat extension 92', which is easily secured to the shell 93 by a rivet or otherwise. The shell 93 is preferably of thin light material, such as spun aluminum, paper, celluloid and the like. As seen in Fig. 11, a portion of the shell is formed with a recess 95 to hold the coil firmly in place. Any other practical means may be employed to mount the coil 94 on the needle arm 92.

The spring blade 90 carries a bellcrank 96, which consists of a horizontal arm 97 and a vertical arm 98. The bellcrank 96, which may be stamped as a single member from sheet metal, is secured substantially at its apex to the center of the supporting spring blade 90. The horizontal arm 97 of bellcrank 96 terminates in a vertical extension 99, to which the stylus member 36 is attached. If the extension 99 is flat, as shown, an easy way to attach the stylus member 36 is to provide the latter with a slot for receiving the lower end of the extension, and a bolt or rivet 100 secures the parts rigidly together.

The inner end of the vertical arm 98 terminates in a lateral offset 101 for attaching a second shell 93 which carries a coil 102. The stylus members 19 and 36, and all parts connected thereto, are damped by elastic rings 24', previously explained in detail, or in any other practical way. The spring blade 90, which may also be mounted horizontally, is so dimensioned as to twist or pivot about its axis under the vertical movements of stylus member 36. Since the horizontal arm 97 is shorter than the vertical arm 98 of bellcrank 96, the coil 102 is connected to the inner end of arm 98 in amplification.

The coils 94 and 102 are arranged as closely together as possible without actually touching, and they normally overlap a certain amount, as indicated for the operation of Fig. 1. If the coil 94 is connected in a circuit of substantially constant current to produce a magnetic field for inducing current impulses in the other coil during the vibration of either coil. Let us assume, by way of example, that the coil 94 is connected in a circuit of substantially constant current to produce a magnetic field of the required strength. A certain percentage of the magnetic lines of force will pass through the coil 102 supported on the inner end of bellcrank 96. When the stylus member 36 is vibrated vertically in playing a vertical-cut record, the coil 94 also vibrates and permits vibration of the bellcrank 96, so that the coil 102 moves transversely of the stationary coil 94 in a direction to cut the magnetic lines of force. The result of this operation is the generation of current impulses in the circuit of coil 102, and these induced impulses, which represent the recorded sound, are suitably amplified to operate loudspeaker mechanism. Since radio amplifying circuits are well known and have heretofore been used in electric phonograph reproducing, I do not think it necessary to encumber this case with a description and illustration of circuit connections. It is enough to say that the current impulses produced in coil 102 by cutting the magnetic flux of coil 94 are utilized to operate or control suitable sound-reproducing apparatus.

In playing lateral-cut records, the needle arm 92 vibrates the coil 94 laterally of the stationary coil 102, so that the lines of force passing through coil 102 are correspondingly varied to induce current impulses. It is clear from the above that the claims are included in which it is said that the two coils 94–102 constitute a miniature electric generator, one of them serving to maintain a magnetic field and the other operating as an armature. It is immaterial which is the field coil and which the armature coil. The transmission ratios between the limits of the operating stylus 20–37 and the coils 94–102 may be so adjusted that the movements of the stylus points are communicated to the coils either in increased ratio, or without amplification, or in decreased ratio, depending on the particular design of the instrument and the special form of amplifying circuit which it is proposed to use.

Figs. 12–15 show another form of resilient mounting for the needle holder 19. In this case, the laterally twistable spring blade of the preceding constructions is replaced by a rigid arm or shaft 103 pivoted at its ends in adjustable bearing screws 104, which are mounted in brackets 105 fixed on the base plate 10. Each bracket 105 has a recess 106 containing elastic material 107, such as rubber, which surrounds the end portions of shaft 103, or at least engages the opposite sides thereof. The recesses 106 are closed by plates 108, which are removably attached to the brackets by screws 109 or otherwise. The elastic material 107 in recesses 106 is held under predetermined normal compression, so as to resist rotary movement of shaft 103 which carries the needle holder.
of a pair of aligned bearings, a shaft pivoted at its ends in said bearings, a vibratory member connected to the center of said shaft, elastic means separate from said bearings for engaging said shaft to permit rotary movement thereof in either direction and at the same time damp said movement, means independent of said bearings for holding said elastic means under compression, and electric reproducing means connected to said member.

8. In an electric reproducer, a support provided with a pair of recesses, a pair of aligned bearings carried by said support, a shaft pivoted at its ends in said bearings and extending into said recesses, elastic material held under compression in said recesses and engaging said shaft in pressure contact to permit rotary movement thereof in either direction and at the same time damp said movement, said elastic material being separate from said bearings and operating independently thereof, and a vibratory member connected to said shaft.

9. In an electric phonograph reproducer for selectively playing lateral-cut and vertical-cut records, the combination of a pair of electric elements arranged in inductive relation and adapted to be connected in circuit, a stylus member for playing lateral-cut and vertical-cut one of said elements in playing lateral-cut records, and a second stylus member for vibrating the other element in playing vertical-cut records.

10. In an electric phonograph reproducer for selectively playing lateral-cut and vertical-cut records, the combination of a pair of independently operable stylus members for playing lateral-cut and vertical-cut records, said unit comprising a pair of inductively related elements adapted to be connected in circuit, and means carried by said unit for varying the inductive relation of said elements in accordance with variations in the stylus grooves of lateral-cut and vertical-cut records.

11. An electric phonograph reproducer adapted to be mounted as a unit on a supporting arm for selectively playing lateral-cut and vertical-cut records, said unit comprising a pair of inductively related elements adapted to be connected in circuit, and means carried by said unit for varying the inductive relation of said elements in accordance with variations in the stylus grooves of lateral-cut and vertical-cut records.

12. An electric phonograph reproducer adapted to be mounted as a unit on a supporting arm for selectively playing lateral-cut and vertical-cut records, said unit comprising a pair of inductively related coils adapted to be connected in circuit, and means carried by said unit for varying the inductive relation of said coils in accordance with variations in the stylus grooves of lateral-cut and vertical-cut records.

13. In an electric phonograph reproducer for playing lateral-cut and vertical-cut records, the combination of a pair of electric elements arranged in inductive relation and adapted to be connected in circuit, a pivoted needle arm for playing lateral-cut records connected to one of said elements, a vertically movable stylus holder for playing vertical-cut records connected to the other element, and resilient means for holding said needle arm and stylus holder in predetermined normal position.

14. An electric phonograph reproducer comprising a shaft with flat pointed ends, a support carrying a pair of bearing screws for receiving said pointed ends and thereby supporting the shaft for rotary movement, elastic packing mounted in said support and surrounding the flat ends of said shaft to damp the vibrations thereof, means on said support for holding said packing
compressed, and electric reproducing means having a vibratory member connected to said shaft.

15. In an electric phonograph reproducer for playing lateral-cut and vertical-cut records, the combination of a pair of electric elements arranged in inductive relation and adapted to be connected in circuit, a stylus member for vibrating one of said elements in playing lateral-cut records, a second stylus member for vibrating the other element in playing vertical-cut records, a mounting for each of said stylus members, and elastic damping means for said stylus members.

16. In an electric phonograph reproducer for selectively playing lateral-cut and vertical-cut records, the combination of a pair of electric elements arranged in inductive relation and adapted to be connected in circuit, a stylus member for vibrating one of said elements in playing lateral-cut records, a second stylus member for vibrating the other element in playing vertical-cut records, and a resilient mounting for each of said stylus members, said mountings being also adapted to hold said elements in predetermined normal position.

17. In an electric phonograph reproducer for selectively playing lateral-cut and vertical-cut records, the combination of a pair of electric elements arranged in inductive relation and adapted to be connected in circuit, a pivoted needle arm for playing lateral-cut records connected to one of said elements, a vertically movable stylus holder for playing vertical-cut records connected to the other element, and a pair of twistable spring blades on which said needle arm and stylus holder are mounted for independent operation, said spring blades also holding said elements in predetermined normal position.

18. An electric phonograph reproducer comprising a casing adapted to be operatively mounted on a supporting arm, a pair of stylus members carried by casing and projecting through openings in the bottom thereof, so that either member may be placed in playing contact with a record, one of said members being adapted to play lateral-cut records and the other member being operable on vertical-cut records without adjusting the position of the casing on its supporting arm, a pair of electric elements in said casing, said elements being arranged in variable inductive relation and adapted to be connected in circuit, and means whereby the operation of one stylus member vibrates one of said elements and the operation of the other member vibrates the other element.

19. In a phonograph reproducer for vertical-cut records, a casing provided with an opening at the bottom, an element supported horizontally in said casing for vibratory movement in a vertical direction, a stylus member secured to said element for vertical movement by a vertical-cut record groove, said stylus member extending through said opening, resilient material surrounding said stylus member for closing said opening and damping the vibrations of said member, and means for converting the movements of said member into electric impulses.

20. An electric phonograph device comprising the combination of a horizontally pivoted shaft, a stylus holder connected to said shaft and adapted to vibrate laterally, a stationary element, a second element connected to said shaft to vibrate therewith, said elements being operatively associated to produce electric impulses when the second element vibrates, and elastic damping means surrounding said shaft.

21. In a phonograph reproducer for vertical-cut records, a casing provided with an opening at the bottom, an element supported horizontally in said casing for vibratory movement in a vertical direction, a stylus member secured to said element for vertical movement by a vertical-cut record groove, said stylus member extending through said opening, resilient material surrounding said stylus member for closing said opening and damping the vibrations of said member, and means for converting the movements of said element into electric impulses.

22. In a phonograph reproducer for vertical-cut records, a casing provided with an opening at the bottom, a flat resilient element supported horizontally in said casing for vibratory movement in a vertical direction, one end of said element being secured and the other end being free to vibrate, a stylus member connected to the free end of said element and supported thereby for vertical movement by a vertical-cut record groove, said stylus member extending through said opening substantially at right angles to said element, resilient material surrounding said stylus member for closing said opening and damping the vibrations of said member, and means for converting the movements of said element into electric impulses.

ADOLPH A. THOMAS.