

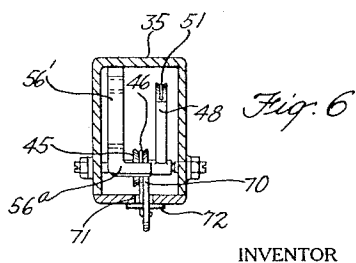
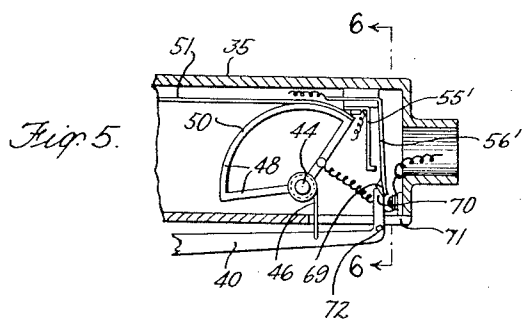
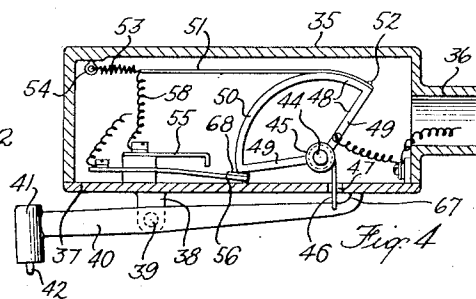
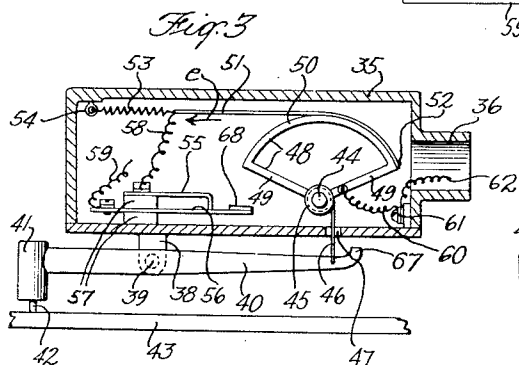
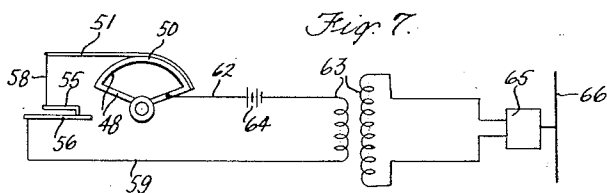
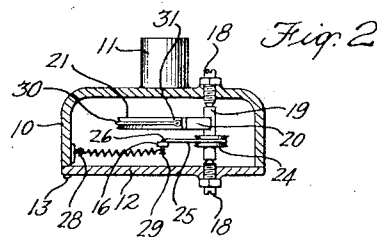
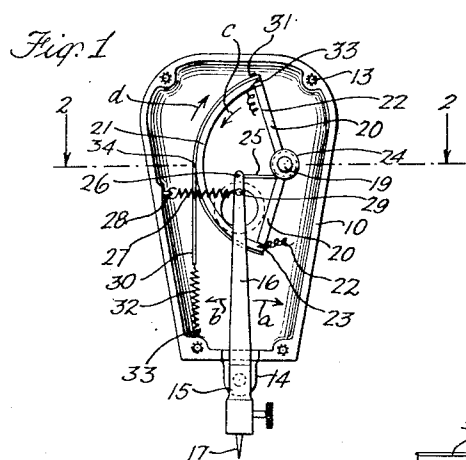
May 27, 1930.

A. A. THOMAS

1,759,967

ELECTRIC SOUND TRANSMITTER

Original Filed Dec. 11, 1926



INVENTOR

Adolph A. Thomas

UNITED STATES PATENT OFFICE

ADOLPH A. THOMAS, OF NEW YORK, N. Y.

ELECTRIC SOUND TRANSMITTER

Application filed December 11, 1926, Serial No. 154,059. Renewed May 29, 1928.

My invention relates to electric sound-transmitting devices, and its object is to provide a new and improved electric reproducer for converting mechanical vibrations into electric impulses. One of the practical uses of my new instrument is as an electric phonograph reproducer particularly adapted to operate efficiently on the so-called long-playing records, in which the spiral track has several hundred lines to the inch. The old method of mechanical reproduction cannot be applied to such finely grooved records, which require an electric reproducer of high sensitivity and one that is free from an impeding drag or load on the exceedingly delicate stylus vibrations. It is such an electric reproducer that forms the subject-matter of this invention.

Electric phonograph reproducers of prior construction may be divided into two general types, both of which are well known: the electromagnetic (or magneto-electric) reproducer and the microphone reproducer. The former utilizes a coil subjected to a variable magnetic field, and there is usually a vibratory armature operated by the stylus arm to produce variations of magnetic flux through the coil. In the microphone type of reproducer, a vibratory diaphragm produces variable pressure on carbon granules in a chamber, thereby altering the resistance of the circuit and causing current variations therein.

Both forms of reproducer referred to possess certain inherent objections and disadvantages, especially in relation to the new type of long-playing records, where the stylus vibrations are almost microscopic and where the pressure of the stylus in the groove must be very light. In electromagnetic reproducers, there is always the weight of the magnet, which is considerable, and the total weight of the reproducer is communicated by the stylus point to the frail walls of the delicate record groove. Then, too, the constant magnetic interaction between the vibratory armature and the associated pole pieces places a normal drag or load on the stylus arm and thus impedes the freedom of movement that the stylus requires for proper reproduction.

This objection is aggravated where the armature consists of a magnetic diaphragm con-

nected to the stylus arm, because such a diaphragm, being necessarily stiff, offers strong mechanical resistance to the movements of the stylus. Also, vibratory diaphragms in electric reproducers are liable to emit disturbing noises. In the microphone type of reproducer, there is not only a relatively complicated construction, but the diaphragm that presses against the granules is so stiff as to interfere with the free movements of the stylus. It must be remembered that in finely grooved records the engagement between stylus point and groove is exceedingly small, so that the stylus point must be free to follow the microscopic sinuations of the groove. But a stiff diaphragm, such as a microphone requires, offers too much resistance to the movements of a record-playing stylus for correct reproduction. There is another objection to the microphone type of phonograph reproducer: the carbon granules are never twice in the same position, so that the stylus cannot reproduce the same sound twice exactly alike.

To overcome the foregoing and other objections and disadvantages in electric phonograph reproducers of prior construction, I have devised an electric reproducer which operates without any electromagnetic mechanism and without the use of carbon granules and diaphragm. Utmost simplicity of construction and high sensitivity characterize my new reproducer, as will presently be explained. Broadly stated, my invention comprises the combination of a high-resistance conductor and a low-resistance conductor properly connected in circuit. The vibrations of the stylus arm cause the low-resistance conductor to short-circuit a variable length or area of the high-resistance conductor. As a result, the resistance of the reproducer circuit is varied in strict accordance with the vibrations of the stylus arm, thereby generating current impulses that are utilized to operate suitable loudspeaker mechanism.

The basic idea of my invention may be carried out in practice in various ways by those versed in the art. In a preferred embodiment of my invention, one of the conductors

is in the form of an arc-shaped strip or sector mounted on a rotary shaft, and the other conductor is a flexible wire or ribbon connected at one end to the rotary conductor. It is immaterial which one of these conductors is the resistance element. There is a multiplying connection between the stylus arm and the rotary conductor, whereby the vibrations of the arm produce amplified variations in the contact length or area between the two conductors, so that the resistance of the circuit is altered accordingly. By using a filar connection between the stylus arm and the rotary shaft, there is practically no lost motion in transmitting the stylus vibrations to the rotary conductor. Spring means hold the movable parts in predetermined normal position and impose the right amount of mechanical load or counterbalance on the stylus arm for proper reproduction from the most finely grooved records.

When the reproducer of my invention is constructed for playing vertical cut records of the Edison type, I provide automatic means for opening all battery circuits of the reproducer system when the stylus arm is out of engagement with a record. A spring holds the stylus arm in floating or balanced condition during record-playing operation. When the reproducer is lifted off the record, the spring rocks the stylus arm into rest position on the casing, and at the same time a switch in the casing is automatically opened. When the stylus is again placed on a record, the switch is automatically closed. This automatic circuit control prevents waste of current when the machine is not in playing condition.

In the accompanying drawings I have shown several forms of electric phonograph reproducers as illustrative embodiments of my invention. I shall now describe these drawings in detail, so that those who are skilled in this art may fully understand my invention and practise the same. Before going into this description, however, I want to make it plain that the constructions shown in the drawings are not to be considered as limitations of my invention, but rather as practical examples of reproducers embodying the ideas of this invention. In these drawings—

Fig. 1 shows an interior face view of an electric phonograph reproducer constructed in accordance with my invention, the cover plate of the casing being removed to show the parts within;

Fig. 2 is a sectional plan view approximately on the broken line 2—2 of Fig. 1;

Fig. 3 is a cross-sectional view of a modification particularly adapted for playing Edison records, the stylus arm being shown in playing position;

Fig. 4 is a view similar to Fig. 3, with the stylus arm in idle or rest position, and also

showing how the reproducer circuit is automatically opened when the stylus arm is held in rest position;

Fig. 5 shows in cross-section a portion of a reproducer like that of Figs. 3 and 4, except that there is a slightly different arrangement for interrupting the battery circuit when the stylus arm is in rest position;

Fig. 6 is a cross-sectional view on line 6—6 of Fig. 5; and

Fig. 7 is a simplified diagram of a suitable transmission system between the reproducer and a loudspeaking diaphragm.

Before proceeding with the detailed description of the drawings, I want to explain that I have purposely exaggerated the proportions of the various parts in order to make the views as clear as possible. The actual devices are made considerably smaller and more compact than would appear from the drawings.

Referring to Figs. 1 and 2, there is a suitable casing, indicated as a whole by 10, adapted to be mounted on a supporting arm by means of a hub 11 projecting from the rear wall of the casing. The front wall of casing 10 is preferably in the form of a removable cover plate 12 secured in place by screws 13 or other fastening devices. The lower end of casing 10 is provided with a pair of spaced lugs 14 adapted to receive a suitable pivot bearing 15 for supporting a stylus arm 16. In the present instance the arm 16 is adapted to receive a needle 17, but any other form of practical stylus point may be used. The front and rear walls of casing 10 carry a pair of adjustable bearing members 18, which are here shown in the form of pointed screws of suitable bearing material. Between the aligned bearings 18 is mounted a rotary stud or arbor 19 carrying a pair of rotary arms 20 on which is supported an arc-shaped member 21 of high-resistance material, such as carbon and the like. The arms 20 are either of insulating material, or the resistance element 21 is otherwise insulated. Instead of separate arms 20, a single sector plate may be used. The parts 19, 20 and 21 comprise a section of a wheel and may therefore be described as a wheel with an insulated resistance rim. The circular rim 21 need not be entirely of resistance material, but it may consist of an insulating strip provided with an outer surface of resistance material. The important point is that the circular member 21 shall have an outer contact rim of high-resistance material connected at opposite ends in a battery circuit. In Fig. 1 I have indicated a pair of conductors 22 connected to the ends of resistance 21 at points 23.

On the rotary shaft or hub 19 is fixed a small grooved pulley 24 to which is secured one end of a filar connection 25, which may be a thread, fine wire, thin chain, or any other flexible member adapted for this use.

For convenience I shall refer to connection 25 as a thread, without intending thereby any limitation. The other end of thread 25 is secured at 26 to the inner end of stylus arm 16. The pulley 24 need not be much larger than the hub 19 itself and may be regarded as a grooved enlargement of the hub. In fact, the thread 25 may be wound in a groove formed in the hub itself. A coil spring 27 is connected at 28 to the casing, and at 29 to the needle arm at or near the inner end thereof.

To one end of the rotary resistance element 21 is connected a wire or thin band 30 of good conducting material, which may be copper, a copper alloy, or the like. The point of connection between the conducting members 21 and 30 is indicated at 31. In Figs. 1 and 2 I have shown the conductor 30 in the form of a round wire, and the resistance member 21 is slightly grooved to receive the wire. The contact surface of the resistance member 21 may be flat, and the conductor 30 may be in the form of a flat strip or band adapted to make good contact with the outer surface of resistance 21. The free end of conductor 30 is connected to one end of a coil spring 32, the other end of which is secured at 33 to a convenient part of the casing. It will be clear from Fig. 1 that the spring 32 tends to rock the needle arm in the direction of arrow *a*, and the spring 27 tends to pull it in the direction of arrow *b*. The tension of these two springs is so adjusted that normally the stylus arm is held in the position shown in Fig. 1, or approximately so. In the normal position of the stylus arm 16, the conductor 30 engages the resistance member 21 up to the point 34, which is about midway of the resistance member. Obviously, the extent of normal contact between the elements 21 and 30 may vary in different cases and may be more or less than half the length of the arc 21.

The operation of the reproducer above described will now be apparent and may be summarized as follows: When the stylus arm is vibrated in the direction of arrow *a* against the tension of spring 27, spring 32 instantly rocks the resistance wheel counter-clockwise, as indicated by arrow *c*. This decreases the contact length or area between the conducting members 21 and 30, and the resistance of the circuit is correspondingly increased. When the stylus arm is rocked in the direction of arrow *b*, it pulls on the filar connection 25 and rocks the resistance wheel in the direction of arrow *d* against the tension of spring 32. This movement of the resistance wheel increases the contact length or area between the conducting members 21 and 30, and the resistance of the circuit is correspondingly lowered. The resistance changes thus produced in the circuit by the vibrations of stylus arm 16 cause the flow of current impulses which are utilized to operate suitable loudspeaking mechanism. Since my inven-

tion is not concerned with any particular transmission system or loudspeaking mechanism, I do not consider it necessary to show or describe such devices, especially as they are well known in the art. Amplifying systems borrowed from the radio art have heretofore been used in connection with electric phonograph reproducers.

It will be apparent from the preceding description that the action of conductor 30 is to short-circuit a variable amount of resistance element 21 as the stylus arm vibrates during the playing of a record, and these resistance changes are in amplified relation to the vibrations of the stylus point. In the first place, the stylus vibrations are transmitted in amplified form to the inner end of arm 16. Secondly, the small rotary movements of hub 19 caused by the filar connection 25 are transmitted in greatly amplified ratio to the contact surface of the resistance element 21. The mechanical amplification between hub 19 and the contact surface of resistance element 21 is in the ratio of the radii of those two parts, as will be clear to any mechanic. By virtue of these amplifying transmitting connections, the smallest movements of the stylus point are sufficient to produce resistance variations in the circuit of member 21. These resistance changes are strictly proportional to the stylus vibrations, since there is practically no lost motion between the stylus arm and conductor 30. The filar connection 25 is maintained taut at all times by the counterbalancing action of springs 27 and 32.

In Figs. 3 and 4 I have shown a modified construction for playing Edison records, which are vertical-cut and are usually played with a diamond point. The casing 35 is mounted in horizontal position on a suitable supporting arm by means of a hollow extension 36 or otherwise. The bottom plate 37 of the casing is provided with a pair of spaced lugs 38 carrying a pivot bearing 39 for the stylus arm 40. The head 41 of this arm carries a stylus 42 for operating in the vertical-cut spiral track of a record 43. A rotary shaft or arbor 44 is pivoted transversely of casing 35 by means of suitable bearings, which may be like the bearings 18 of Fig. 2. On shaft 44 is fixed a grooved pulley or hub 45, which is connected with the rear end of stylus arm 40 by a thread or fine wire 46. A portion of this thread or wire is wound in the groove of pulley 45, so that the movements of the stylus arm will produce oscillations of shaft 44. The filar connection 46 extends through a slot 47 in the bottom of the casing. On shaft 44 is fixed a conducting wheel 48, which may be stamped out of brass, copper or other good conducting metal. In the present instance the wheel 48 consists of a pair of radial arms 49 connected by a circular bridge 50. The conducting wheel 48 should be insulated from shaft 44, if the latter is of metal.

A wire 51 of high-resistance material is connected at 52 to the conducting wheel 48. The free end of resistance wire 51 is connected to one end of a coil spring 53, the other end of which is connected to a fixed part 54 in the casing. The normal tendency of spring 53 is to pull the wire 51 in the direction of arrow *e*.

In casing 35 is mounted a switch consisting of a pair of normally closed contacts 55 and 56 supported on an insulating block or blocks 57. The contact 56 is in the form of a spring blade, the normal tendency of which is to engage contact 55 and thereby close the reproducer circuit. It will not be necessary to show the complete circuit connections, because they will be understood by those familiar with electric amplifying circuits in the art of radio and electric phonographs. It is sufficient to show a wire 58 connecting the resistance element 51 with switch contact 55, a lead 59 connected to switch contact 56, a wire 60 connecting the rotary conductor 50 to a binding post 61, and a lead 62 connected to the same binding post. If the supporting arm of casing 35 is in the form of a tube, as it usually will be, the leads 59 and 62 may conveniently pass through this arm to the electrical devices below the motorboard of the phonograph. In the wiring diagram of Fig. 7, I have shown the lead 59 connected to one end of the primary coil of an amplifying transformer 63, and the lead 62 is connected to one terminal of battery 64. The other end of the primary coil is connected to the other terminal of the battery. The secondary coil of transformer 63 is connected to an electromagnetic driving unit 65 adapted to operate a diaphragm 66, which may be a loud-speaker cone, or a small diaphragm amplifying through a horn.

The operation of the construction shown in Figs. 3 and 4 is precisely the same as that of Figs. 1 and 2, and I need not repeat that part of the specification. From what has been said before, it will be clearly understood that, as the stylus arm 44 vibrates vertically under the action of stylus 42, the contact length or area between conductor 50 and resistance 51 is varied in accordance with the stylus movements to produce current impulses in the primary of transformer 63. The coil spring 53 is so adjusted that it holds the stylus arm 40 in balanced or floating condition during the playing of a record, as will be understood from Fig. 3. In this construction there is no second spring necessary to counterbalance the action of spring 53, because the weight of the reproducer on the stylus tends to rock the rear end of arm 40 downwardly in opposition to the action of spring 53. The weight of the entire reproducer is such that it counteracts spring 53 the right amount. Since the reproducer is

of few parts which can be made very light, the spring 53 need not be strong or cumbersome. When the reproducer is moved into idle position, the spring 53 contracts and pulls the inner end of stylus arm 40 upwardly until the projection 67 of the stylus arm strikes the bottom of the casing. This position of the parts is illustrated in Fig. 4. When the stylus 42 is again brought into playing contact with a record, the weight of the reproducer automatically rocks the stylus until the counterbalancing action of spring 53 asserts itself. By thus maintaining the stylus arm in floating or balanced condition during the playing of a record, the instrument is exceedingly sensitive to the minute vibrations of the stylus point in the record groove.

I utilize the rotary wheel sector 48 to open the switch contacts 55 and 56 when the stylus arm 40 is in rest position. For this purpose, the spring contact blade 56 projects rearwardly into the path of movement of sector 48. As previously explained, the switch contacts are normally in closed position. When the spring 53 rocks the wheel sector 48 forwardly, the latter strikes the projecting end of spring contact 56 and moves the same into open position, as illustrated in Fig. 4. To prevent any short-circuit when the rotary sector 48 strikes the contact 56, one or both of the engaging surfaces are provided with suitable insulation. In the drawings I have shown an insulating block or pad 68 fastened to the upper face of spring contact 56.

Fig. 5 shows a modified construction for automatically opening the battery circuit when the stylus arm 40 is in idle position on casing 35. In this case the spring contacts 55' and 56' (corresponding to the switch contacts 55 and 56 of Figs. 3 and 4) are mounted in vertical position at the rear end of the casing. The free end of spring contact 56' is provided with an insulating cam-piece 69 arranged to engage the bevelled end 70 of stylus arm 40. A slot 71 is formed in the bottom of the casing to accommodate the upwardly projecting end of the stylus arm. Normally, the switch contacts 55' and 56' are closed, due to the inherent tension of spring contact 56'. When the spring 53 (not shown in Fig. 5) pulls the rear end of stylus arm 40 upwardly, as explained in connection with Figs. 3 and 4, the bevelled end 70 strikes the cam-piece 69 and moves the spring contact 56' rearwardly away from the associated contact 55', thereby opening the battery circuit. A suitable stop may be provided to limit the movement of the needle arm after the switch has been opened. For convenience I have shown the stylus arm 40 provided with a cross-pin 72, which strikes the underside of the casing and prevents further movement of the parts after the switch has been opened. It will be seen

from Fig. 6 that the switch contacts 55' and 56' are mounted to one side of sector 48, so as not to interfere with the rocking movements of that part. The switch contact 56' is provided at its free end with a lateral projection 56^a, which extends into the path of movement of the centrally arranged stylus arm 40. The circuit connections described in connection with Figs. 3 and 4 are to be regarded as applicable to Figs. 5 and 6 without the need of repetition.

Although I have shown the wheel sector 48 as a single member of conducting metal, it is not necessary that the arms 49 of the sector be of conducting material. For instance, the arc-shaped conducting bridge 50 could be mounted on a pair of insulating arms or on an insulating sector plate. In that case, the conductor 60 would be connected directly to the bridge 50.

It will be realized from the preceding description of several illustrative embodiments of my invention, that I have provided an electric phonograph reproducer of simple construction and efficient operation. The underlying idea of my invention is not confined to electric reproducers for phonographic reproduction, for it is clear that, by substituting an acoustic diaphragm for the stylus arm, the invention is capable of use as a telephone transmitter. This will be understood without additional illustration. By dispensing with a magnet and armature, I not only lessen the weight of the reproducer, but also liberate the stylus arm from the impeding magnetic drag inherent in prior constructions. The practical advantages of these factors become particularly important in the playing of new-style records where the needle track is almost microscopic. In these records the walls of the tiny groove are necessarily very frail and the movements of the stylus point are exceedingly small. It is therefore important that the weight or pressure exerted by the stylus point on the groove shall be very small, and that the movements of the stylus arm shall not be dampened or interfered with by an extraneous load or bias. In the reproducer of the present invention, the spring or springs connected to the stylus arm exert just the right amount of mechanical resistance without imposing an impeding load. The correct tension of the spring or springs will have to be determined by experiment in each particular design of instrument.

The practical advantages of my reproducer over those of the old microphone type lie in the greater simplicity and cheapness of construction, and in a better reproducing operation. Those who are familiar with the construction of microphone transmitters and reproducers will see at once that those prior constructions are considerably more complicated than the reproducer of the present invention. As for the improved operation of

my new reproducer over the microphone type, I need only point to the fact that here we have a high-resistance conductor and a low-resistance conductor arranged to produce resistance variations by a smooth rolling contact which is devoid of friction and abrasion. In the operation of a microphone, the carbon granules exert a frictional and grinding contact against each other, and these movements are liable to produce electrical disturbances known as microphone noises. Furthermore, in my reproducer the same needle vibrations always produce exactly the same changes in resistance, and therefore the same electrical impulses. In a microphone, however, the carbon granules can never occupy exactly the same position twice, and therefore the same sound cannot be reproduced twice alike.

Although I have shown and described certain specific constructions, I want it understood that I have done so merely to explain my invention and not by way of restriction or limitation. As far as I know, I am the first to produce an electric sound reproducer comprising the combination of a high-resistance conductor, a low-resistance conductor, and a vibratory acoustic member for operating one of these conductors to cause the low-resistance conductor to short-circuit a variable length or area of the high-resistance conductor. I therefore claim this combination in a fundamental way.

I claim as my invention:

1. In an electric reproducer, the combination of a high-resistance conductor adapted to be connected in circuit, a low-resistance conductor associated with said first-named conductor, and a vibratory member for operating one of said conductors to cause said low-resistance conductor to short-circuit a variable length or area of said high-resistance conductor, whereby the resistance of said circuit is varied in accordance with the vibrations of said member.

2. An electric reproducer comprising a rotary conductor having a curved contact surface, a flexible conductor engaging said contact surface, one end of said flexible conductor being connected to said rotary conductor, spring means connected to the other or free end of said flexible conductor to hold the same taut in contact with said curved surface during the oscillatory movements of said rotary conductor, one of said conductors being of relatively high resistance and the other of relatively low resistance, the high-resistance conductor being adapted to be connected in a reproducer circuit, and a vibratory member operatively connected with said rotary conductor to oscillate the same and thereby vary the contact length or area between the two conductors for correspondingly varying the resistance of said circuit.

3. An electric reproducer comprising a

rotary conductor having a curved contact surface, a flexible conductor engaging said contact surface, one end of said flexible conductor being connected to said rotary conductor, spring means connected to the other or free end of said flexible conductor to hold the same taut in contact with said curved surface during the oscillatory movements of said rotary conductor, one of said conductors being of relatively high resistance and the other of relatively low resistance, the high-resistance conductor being adapted to be connected in a reproducer circuit, a shaft on which said rotary conductor is mounted, a vibratory member, and a filar connection between said member and said shaft for transmitting the vibrations of said member to said rotary conductor in amplified ratio, whereby the contact length or area between the two conductors, and therefore the resistance of said circuit, is varied in accordance with the vibrations of said acoustic member.

4. An electric phonograph reproducer comprising a casing adapted to be mounted on a movable supporting arm, a rotary conductor mounted in said casing and having a curved contact surface, a flexible conductor connected at one end to said rotary conductor, a spring connected at one end to said casing and at the other end to the free end of said flexible conductor to hold the same taut in contact with said curved surface during the oscillatory movements of said rotary conductor, one of said conductors being of relatively high resistance and the other of relatively low resistance, the high-resistance conductor being adapted to be connected in a reproducer circuit, and a vibratory stylus lever pivoted to said casing and operatively connected with said rotary conductor to oscillate the same, whereby the contact length or area between the two conductors, and therefore the resistance of said circuit, is varied in accordance with the vibrations of said lever.

5. An electric phonograph reproducer comprising a casing adapted to be mounted on a movable supporting arm, a rotary conductor mounted in said casing and having a curved contact surface, a flexible conductor connected at one end to said rotary conductor, a spring connected at one end to said casing and at the other end to the free end of said flexible conductor to hold the same taut in contact with said curved surface during the oscillatory movements of said rotary conductor, one of said conductors being of relatively high resistance and the other of relatively low resistance, the high-resistance conductor being adapted to be connected in a reproducer circuit, a shaft mounted in said casing for supporting said rotary conductor, a vibratory stylus lever pivoted to said casing, and a filar connection between said shaft and the inner end of said lever for transmit-

ting the vibrations of the stylus to said rotary conductor in amplified ratio, whereby the contact length or area between the two conductors, and therefore the resistance of said circuit, is varied in accordance with the movements of the stylus.

6. An electric sound transmitter comprising a pair of elements having different electric conductivities and mounted to have variable contact with each other, a vibratory member connected to one of said elements to short-circuit a variable length or area of the element having the lower conductivity, and non-acoustic elastic means for holding said elements in predetermined normal position.

7. An electric phonograph reproducer for playing vertical-cut records, comprising a casing adapted to be mounted on a movable arm, a stylus lever pivoted to said casing for vibratory movement in a vertical plane, resilient means for holding said lever in predetermined position on said casing when the stylus is out of engagement with a record, said resilient means permitting movement of the lever into record-playing position, electric reproducing mechanism operated by said lever, a switch in a circuit of said mechanism, and means whereby said switch is automatically controlled by the position of said lever on the casing.

8. An electric phonograph reproducer for playing vertical-cut records, comprising a casing adapted to be mounted on a movable arm, a stylus lever pivoted to said casing for vibratory movement in a vertical plane, electric reproducing mechanism mounted in said casing and operatively connected with said lever, a spring for normally holding said lever in predetermined position on the casing when the stylus is out of engagement with a record, said spring permitting movement of said lever on the casing into record-playing position and holding the lever in floating condition during reproducing operation, a switch in said casing adapted to be connected in circuit of said reproducing mechanism, said switch being closed when the stylus lever is in playing position, and means whereby said switch is automatically opened when said lever is moved into inoperative position by said spring.

9. In an electric phonograph reproducer, a casing having a stylus lever pivoted thereon, electric reproducing mechanism mounted in said casing and having a movable member connected with said lever, a spring for normally holding said lever and member in predetermined position when the stylus is out of engagement with a record, a switch in said casing adapted to be connected in a circuit of said reproducing mechanism, said switch consisting of normally closed contacts, and means operated by said member for opening said contacts when the stylus lever is moved by said spring out of playing position, said

contacts being automatically closed when the stylus lever is moved into playing position.

10. In an electric phonograph reproducer for playing vertical-cut records, the combination of a casing, a stylus lever mounted on said casing to vibrate in a vertical plane, means for holding said lever on said casing in playing position when the stylus engages a record and in an inoperative position when the stylus is out of engagement with a record, electric reproducing mechanism operated by said lever, a circuit for said mechanism, and means for controlling said circuit by the position of said lever on the casing.

11. An electric reproducer comprising a rotary conductor having a curved contact surface, a flexible conductor engaging said contact surface, one end of said flexible conductor being connected to said rotary conductor, spring means connected to the other or free end of said flexible conductor to hold the same taut in contact with said curved surface during the oscillatory movements of said rotary conductor, one of said conductors being of relatively high resistance and the other of relatively low resistance, the high-resistance conductor being adapted to be connected in a reproducer circuit, a shaft on which said rotary conductor is mounted, a vibratory member, a filar connection between said member and said shaft for transmitting the vibrations of said member to said rotary conductor in amplified ratio, whereby the contact length or area between the two conductors, and therefore the resistance of said circuit, is varied in accordance with the vibrations of said acoustic member, and a switch for said circuit automatically controlled by the position of said rotary conductor.

12. In an electric phonograph reproducer for playing vertical-cut records, the combination of a casing adapted to be mounted on a movable arm, a fixed pivot bearing provided on said casing, a stylus lever pivoted on said bearing for vibratory movement in a vertical plane, said lever occupying substantially a horizontal position when playing a record, the supporting pivot of said lever being so positioned that the rear end of the lever vibrates in amplified relation to the stylus, electric reproducing mechanism mounted in said casing, said mechanism including a vibratory controlling member free from microphonic pressure and operatively connected to the rear end of said lever, and resilient means for holding said lever in balanced or floating condition during record-playing operation.

13. In an electric phonograph reproducer for playing vertical-cut records, the combination of a casing adapted to be mounted on a movable arm, a stylus lever pivoted to said casing for vibratory movement in a vertical plane, said lever occupying substantially a horizontal position when playing a record, the pivot of said lever being such that the

rear end thereof vibrates in amplified relation to the stylus, electric reproducing mechanism in said casing, said mechanism including a controlling member mounted on a rotary shaft, a filar connection between said shaft and the rear end of said lever for transmitting the movements of the lever to said controlling member in amplified ratio, and means for holding said filar connection constantly taut.

14. In an electric phonographic reproducer for playing vertical cut records, the combination of a casing adapted to be mounted on a movable arm, a stylus lever pivoted to said casing for vibratory movement in a vertical plane, electric reproducing mechanism controlled by said lever, resilient means for holding said lever in balanced or floating condition during record-playing operation, said resilient means also holding the stylus lever in predetermined position on the casing when the stylus is out of contact with a record, and a normally closed switch automatically opened when said resilient means moves said lever into rest position.

15. An electric phonograph reproducer comprising a resistance element adapted to be connected in circuit, a vibratory stylus arm, and means for short-circuiting a variable length or area of said element in accordance with the vibrations of said arm.

16. An electric phonograph reproducer comprising a resistance element adapted to be connected in circuit, a vibratory stylus arm, means for short-circuiting a variable length or area of said element in accordance with the vibrations of said arm, and connections whereby said short-circuiting means operates in amplified relation to the stylus end of said arm.

17. In an electric phonograph reproducer, the combination of a high-resistance conductor adapted to be connected in a reproducer circuit, a low-resistance conductor associated with said first-named conductor, and a vibratory stylus arm for operating one of said conductors to cause said low-resistance conductor to short-circuit a variable length or area of said high-resistance conductor, whereby the resistance of said circuit is varied in accordance with the vibrations of said arm.

18. An electric reproducer comprising a high-resistance conductor adapted to be connected in circuit, a low resistance conductor associated with said first-named conductor, a vibratory member for operating one of said conductors to cause said low-resistance conductor to short-circuit a variable length or area of said high-resistance conductor, whereby the resistance of said circuit is varied in accordance with the vibrations of said member, and means for so mounting said conductors that they engage each other in a rolling contact.

19. An electric phonograph comprising the

combination of a pair of elements having different electric conductivities and arranged to have variable contact with each other, a vibratory member for operating one of said elements to short-circuit a variable length or area of the element having the lower conductivity, and non-acoustic elastic means for holding said elements in predetermined normal position.

20. An electric phonograph reproducer comprising a casing, a vibratory arm pivoted to said casing and carrying a stylus, electric reproducing means controlled by the movements of said arm, spring means normally holding said arm in a predetermined position on said casing, and movable switch means controlled by said arm for automatically breaking the reproducer circuit when the arm is held in normal position by said spring means, said switch means being automatically closed when the stylus is placed on a record.

21. A phonograph reproducer comprising a casing adapted to be operatively supported in relation to a record, a movable arm mounted on said casing and carrying a stylus, and an electric switch controlled by said arm.

22. A phonograph reproducer comprising a casing adapted to be operatively supported in relation to a record, a pivoted arm mounted on said casing and carrying a stylus for playing vertical-cut records, and an electric switch controlled by said arm.

23. A phonograph reproducer comprising a casing, an arm movably mounted on said casing, a stylus connected to said arm, and an electric switch controlled by the position of said arm on the casing.

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