

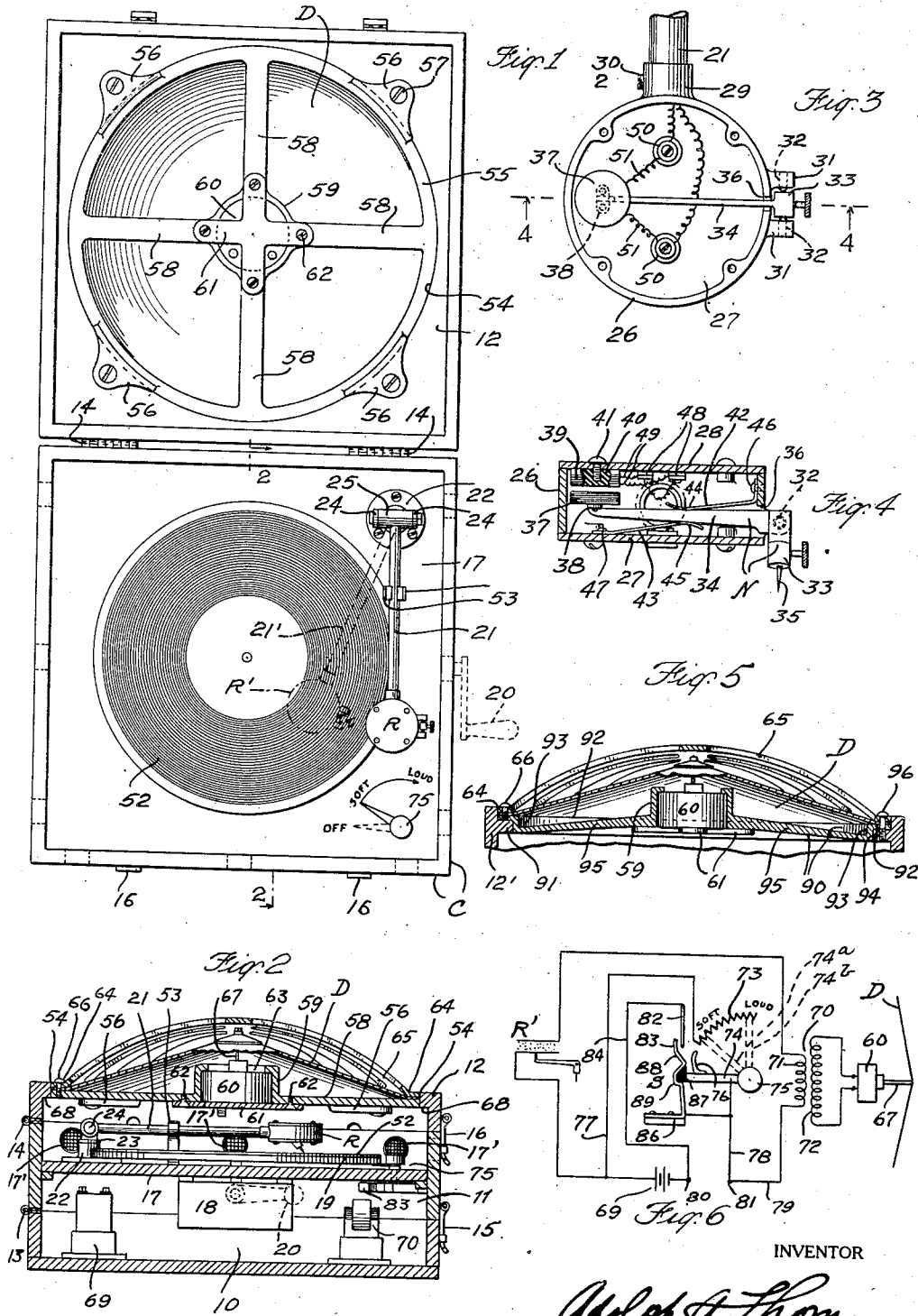
Jan. 7, 1930.

A. A. THOMAS

1,742,832

ELECTRIC SOUND REPRODUCING APPARATUS

Original Filed Dec. 29, 1926 2 Sheets-Sheet 1



INVENTOR

Adolph A. Thomas

UNITED STATES PATENT OFFICE

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

ELECTRIC SOUND-REPRODUCING APPARATUS

Application filed December 29, 1926, Serial No. 157,633. Renewed April 24, 1929.

My invention is for an electric phonograph and other sound-reproducing apparatus of novel construction, in which a loudspeaking diaphragm constitutes a structural part of the lid or other closure of the cabinet or outer casing in which the operative mechanism is mounted. When my invention is applied in the construction of electric phonographs, no horn or amplifying chamber is required, and the entire phonographic mechanism may be housed in a small case that is easily carried about. With proper transmission connections between the electric reproducer and the loudspeaking diaphragm, it is possible to have an inexpensive portable machine capable of full-toned reproduction comparing favorably with that of high-priced cabinet phonographs.

In a preferred form of my invention as applied to electric phonographs, I employ an electric reproducer of flat construction, lying horizontally close to the record and thus contributing toward a cabinet of reduced height. Another feature of my invention is for a volume-controlling device having means to cut out all circuits when the machine is not in use.

So that my invention may be fully understood by those who are skilled in this art to enable them to practice the same, I have selected several illustrative embodiments for a detailed description. I want it understood, however, that the specific constructions shown in the accompanying drawings are not to be regarded in the nature of restrictions or limitations, but rather as practical examples of my invention. In these drawings—

Fig. 1 shows in plan view an electric phonograph of the portable or table type constructed in accordance with my invention, the lid of the case being thrown back;

Fig. 2 is a transverse cross-section on line 2—2 of Fig. 1, with the lid in closed position;

Fig. 3 is an enlarged plan view of the electric reproducer shown in Figs. 1 and 2, the top plate being removed to show the parts within;

Fig. 4 is a transverse cross-section on line 4—4 of Fig. 3, the top plate being shown attached;

Fig. 5 shows in transverse cross-section a modified construction of lid;

Fig. 6 represents diagrammatically a form of transmission system between the electric reproducer and the loudspeaking diaphragm, including a switch controlled by a rheostat arm for opening the battery circuits;

Fig. 7 shows in plan view a modified construction of phonograph having a cylindrical casing, portions of the construction being broken away to show certain parts;

Fig. 8 is a transverse cross-section on line 8—8 of Fig. 7; and

Fig. 9 is a diagram of another form of transmission system between the electric reproducer and the loudspeaking diaphragm.

Before proceeding with a detailed description of the drawings, I want to explain that I have purposely exaggerated the dimensions of certain parts for the sake of clearness, so that the illustrations are not to be considered as shop drawings.

Referring to Figs. 1 and 2, there is a box-like cabinet or carrying case indicated as a whole by C, which in the present instance is of rectangular shape and is adapted to be easily carried about. In the broader aspect of my invention, any practical form or design of cabinet may be employed, but in certain instances I prefer a cabinet consisting of a bottom section 10, a middle section 11, and a top section or lid 12. The sections 10 and 11 are hinged together at 13, and lid 12 is hinged to section 11 at 14. Suitable locks or latches 15 and 16 hold the sections of the cabinet in closed position when needed. If desired, the cabinet may be provided with a suitable carrying handle (not shown). The intermediate section 11 of the cabinet has a motorboard 17, from which depends a motor 18 for operating a turntable 19 in the usual way. The motor 18 may be mechanical or electrical. In the present case I have assumed the motor to be mechanical, and so I have indicated a crank 20 for winding up the motor springs. If the motor is electrical, it may be driven from a battery housed within the cabinet, or it may be operated from the house-lighting circuit through suitable electric connections, which are well understood by those

familiar with this art. As phonograph motors, both mechanical and electrical, are readily obtained in the market in various sizes and styles, I need not show or describe any structural details of motor 18.

On motorboard 17 is mounted an arm 21 pivoted at its rear end to swing horizontally over the turntable and also to have movement in a vertical plane. A simple way of mounting the arm 21 is by means of a hollow stand 22 fixed on the motorboard and supporting a horizontally rotatable post 23 which has a pair of trunnions 24. The arm 21 is provided with a transverse hub or bearing 25 adapted to be supported between the trunnions 24 for vertical movement. The swivel post 23 permits free horizontal movement of the arm 21. Any other practical form of mounting for the arm 21 may be employed. The free end of this arm carries an electric reproducer indicated as a whole by R. This reproducer is of flat construction, so as to occupy minimum space in a vertical direction and thereby permit a reduction in the height of the cabinet. For this purpose, the reproducer R consists of a flat casing 26 having a bottom plate 27 and a top plate 28. The casing 26 is preferably cylindrical (of pill-box shape, I might say) and is provided with a radially extending hub 39 adapted to fit over the free end of supporting arm 21. The plates 27 and 28 may be separate disks secured to the cylindrical body of the casing, or one of these parts may be cast integral with the casing structure. Suitable means, such as a screw 30, secures the reproducer casing rigidly to the supporting arm, which is preferably a small light tube (as of aluminum, brass, etc.) adapted to conceal the connecting wires that run from the reproducer to the transmission system below the motorboard. The reproducer casing 26, which is best made of light non-magnetic material, is provided with a pair of laterally projecting ears 31, which carry suitable bearing members 32. These bearing members, which may be adjustable pointed screws, support a stylus arm indicated as a whole by N. This arm is in the shape of a bellcrank lever comprising a short vertical arm 33 and a long horizontal arm 34. The arm 33 is a hollow cylindrical part adapted to receive and support a stylus 35, which may be a needle or any other practical member for engaging in a record groove. The horizontal arm 34 of stylus lever N extends into the casing through a slot 36. The free inner end of arm 34 carries a small cylindrical coil 37, which is rigidly attached in any practical way, as by means of a small plate 38. On the top plate 28 of casing 26 is fixed a coil 39 in substantially axial alignment with coil 37. Coil 39 is preferably provided with a magnetic core 40 for intensifying the magnetic effect of the coil. A screw 41, which may be of magnetic material, engages the core 40 to secure the

same and coil 39 in fixed position within the reproducer casing. Two leaf springs 42 and 43 are arranged in the casing to engage the extension 34 of needle arm N at opposite points, as indicated at 44 and 45 respectively. The upper spring 42 is secured to the cylindrical wall of the casing at 46, and the lower spring 43 is secured at 47 to the bottom plate 27 of the casing. The contact points 44 and 45 of the two springs are substantially in vertical alignment, so that the springs exert equal and opposite pressures on the needle arm to hold the same in normal predetermined position, as indicated in Fig. 4. The top disk 28 of casing 26 carries a pair of insulated binding posts 48 to which are connected the leads 49 of coil 39. Similarly, the bottom disk 27 has a pair of insulated binding posts 50 for receiving the leads 51 of coil 37. The leads 51 being of very fine wire and readily flexible, do not interfere with the vibratory movements of the stylus lever.

The operation of electric reproducer R will be clear from the preceding description, and may briefly be described as follows, reference being had to Fig. 4. As the needle or stylus 35 vibrates laterally in the record groove, the long arm 34 vibrates in a vertical plane and coil 37 moves toward and away from fixed coil 39. Assuming that coil 39 is traversed by a primary current and that coil 37 is properly connected in circuit in an amplifying transmission system, it is clear that the movements of coil 37 with respect to fixed coil 39 will induce secondary current impulses in the circuit of coil 37 in accordance with the vibrations of the stylus point. The induced secondary impulses in coil 37 may be amplified in any practical way to operate a loudspeaking diaphragm, as will later be explained more in detail. It will be observed from Fig. 4 that the vibrations of the stylus 35 are mechanically transmitted to coil 37 in amplified ratio, which in the present instance is about 1:3. The coil 37 is very light and does not appreciably increase the inertia of stylus lever N, which responds without hindrance to the vibrations of the record groove. The springs 42 and 43 are so made and adjusted as to exert the right amount of mechanical impedance on the stylus arm. The absence of a magnet reduces the weight of the reproducer, and there is practically no magnetic drag on the stylus arm, as in those prior constructions where an armature vibrates in a magnetic field. By arranging the springs 42 and 43 so as to extend in opposite directions and yet have their contact points at the same distance from the pivot of the stylus arm, I am able to use springs of considerable length in a small shallow casing.

In Fig. 2, the reproducer R and supporting arm 21 are indicated in playing position by dotted lines R' and 21', a record 52 being shown on turntable 19. In order to hold

the reproducer arm 21 in firm position when the machine is carried about, I provide a suitable support or rest, which may simply consist of a pair of spring fingers 53 mounted on the motorboard and adapted to hold the tubular arm 21 clamped between them, as shown in Figs. 1 and 2.

The hinged lid 12 is provided with a circular opening 54 in which is fitted an annular frame 55. This frame has radially extending lugs 56 adapted to receive fastening screws 57 for securing the frame to the inside face of the lid. The frame 55 is formed with radial arms 58, which terminate in a cylindrical support 59 adapted to receive an electromagnetic driving unit 60. A cross-shaped piece or spider 61 is secured by screws 62 to the arms 58 for rigidly holding the driving unit 60 against the circular shoulder 63 of support 59, as best shown in Fig. 2. Any other practical means may be used for securing the driving unit 60 in proper position on the supporting frame 55. A loudspeaking diaphragm D, most conveniently made in cone form, is mounted on the circular frame 55, so as to cover completely the opening 54 in the lid. The diaphragm D is fixed in position by being clamped between the annular frame 55 and a ring 64, which forms part of a grille or open shield 65. Screws or rivets 66 secure the annular parts 55 and 64 together, with the diaphragm D rigidly clamped between. A link or rod 67 connects the apex of the diaphragm with the electromagnetic driving unit 60. As such units are well known in the art, it will not be necessary to show or describe any structural details thereof, and it is sufficient to say that the link 67 represents any practical operative connection, whether mechanical or magnetic, between the driving unit and the diaphragm.

It will be clear from Fig. 2 that the cone diaphragm D constitutes the greater part of lid 12 and forms a portion of the outer wall of the phonograph cabinet. Putting this differently, it may be said that the top of lid 12 consists of a vibratory wall D, which functions as a loudspeaking diaphragm. By so mounting the cone diaphragm D that its apex extends outwardly, the supporting frame 55 and the parts carried thereby are substantially flush with the inner face 68 of lid 12, except for the lugs 56 which need only be a small fraction of an inch in thickness. This construction permits the use of a carrying case or cabinet of comparatively small height. The different parts carried by the supporting frame 55 are secured to the frame before the latter is attached to lid 12, thereby facilitating the assembling and adjusting of the parts. The frame 55 and the parts carried thereby are attached as a unitary structure to the lid of the cabinet.

In the tray-like bottom section 10 of the

carrying case or cabinet C are mounted the electric devices that go to make up the system for transmitting (with or without amplification) the electric impulses produced by reproducer R to the driving unit 60. In Fig. 2 I have shown, by way of example, a battery 69 and an amplifying transformer 70, but it will be understood that such other parts are mounted in the chamber below the motorboard as are required for the particular transmitting and amplifying system selected by the designer. If the reproducer R is of the electromagnetic type, as above described, the feeble electric impulses produced by the vibrations of stylus arm N must be amplified sufficiently to effect proper operation of the driving unit 60. If the electric reproducer is of the microphone type, a single amplifying transformer will usually be sufficient to operate diaphragm D with the required volume. An instance of such a simple transmission system is illustrated diagrammatically in Fig. 6, where a microphone reproducer R' is connected in the circuit of battery 69. The primary coil 71 of transformer 70 is also connected in the battery circuit in series with reproducer R'. It may be supposed that the microphone reproducer R' comprises a flat cylindrical casing mounted horizontally on its supporting arm like casing 26 of the electromagnetic reproducer R. Since the phonograph of Figs. 1 and 2 may have either type of electric reproducer, reproducer R' may be mounted on arm 21 in place of reproducer R. The secondary coil 72 of transformer 70 is connected with driving unit 60 and amplifies the current impulses in primary coil 71 sufficiently to cause the driving unit to operate diaphragm D with requisite efficiency. Amplifying transformers for this purpose are easily constructed or may be bought in the market.

The machine of Figs. 1 and 2 is best operated with the diaphragm lid open, but it may also be operated with the lid closed. In the latter event, the cabinet ought to have sound-openings above the motorboard, as indicated at 17', to prevent damping of the diaphragm and to allow the sound-waves produced by the bottom face of the diaphragm to issue freely into the outer air. The openings 17' may be covered with gauze or otherwise rendered inconspicuous; or they may be formed in an ornamental grille comprising part of the outer cabinet structure.

The volume of reproduction in the system of Fig. 6 is controlled by a rheostat 73 having a pivoted conducting arm 74 turned by a knob 75 on the motorboard. Arm 74 carries a brush or contact member 76 for engaging the resistance element 73. One end of this resistance is connected to one side of the battery through a conductor 77. The arm 74 is connected by a conductor 78 to circuit lead 79.

Between the points 80 and 81 of the battery circuit is connected a switch S consisting of a fixed contact 82 and a movable spring contact 83. A conductor 84 leads from point 80 to contact 82, and a conductor 85 connects the spring contact arm 83 with conductor 78. The spring arm 83 is mounted on a suitable insulating support 86, which may conveniently be secured to the underside of motorboard 17. The normal set or tension of spring 83 is such that the switch is closed. The rheostat arm 74 carries at its free end a cam head or projection 87. The spring contact 83 is formed with an inclined offset 88 and with a recess 89. As long as the rheostat arm 74 engages the resistance 73, the switch contacts 82 and 83 remain closed and the battery current flows through the reproducer and the primary coil 71. It will be noticed that the rheostat is shunted across the battery 69. Consequently, when the rheostat arm is in position 74^a, the maximum amount of current is shunted around the battery and the volume of reproduction is weakest. When the rheostat arm is in position 74^b, the resistance of the shunt across the battery is a maximum and most of the current flows through primary coil 71, so that the reproduction is loudest. When the rheostat arm 74 is moved toward the "off" position, as shown in Fig. 6, the cam-head 87 strikes the inclined portion 78 of contact arm 83 and moves it away from the fixed contact 82. As soon as the cam-head 87 enters the recess 89 of spring contact 83, the rheostat arm is automatically locked against further movement in the same direction, and the contact 83 is thus held in open position. This breaks the circuit through primary coil 71 and rheostat 73. The shape of cam-head 87 and the recessed portion 89 of spring contact 83 is such that the rheostat arm is easily moved out of the recess by a slight turning pressure of the fingers on knob 75.

In Fig. 5 the cone diaphragm D is mounted in the top of lid 12' by means of a frame 90 adapted to be inserted into the lid from the outside. For this purpose, the lid 12' is formed with an annular ledge or shoulder 91 for receiving the ring 92 of frame 90. The diaphragm D is secured to ring 92 in the same way as in Figs. 1 and 2. I shall not therefore repeat that part of the preceding description. Frame 90 is formed with an annular flange 93 which fits into the opening 94 of lid 12'. From the base of the annular shoulder 94 project radial arms 95, which are the equivalent of the radial arms 58 in Figs. 1 and 2. The circular supporting frame 90 and all its parts are secured to lid 12' by screws or bolts 96, or other suitable fastening devices. Otherwise, what has been said about frame 55 of Figs. 1 and 2 is applicable to frame 90 of Fig. 5. It is to be supposed that lid 12' and all parts mounted thereon

may be substituted for lid 12 in Fig. 2. The main difference between the constructions in Figs. 2 and 5 is that in Fig. 2 the frame 55 and the attached parts are secured to the inner face of the lid, while in Fig. 5 the frame 90 is attached to the lid from the outside and is firmly seated on the annular ledge 91. Such parts as are common to Figs. 2 and 5 are indicated by the same reference numerals.

In the modification of Figs. 7 and 8, the cabinet or carrying case C' is of cylindrical shape. In this instance, the lid consists of a circular frame 97 having an extension 98 to provide a hinged connection 99 with the body of the case. The extension 98 may be formed with a depending lug 100 adapted to rest against a shoulder 101 on the case when the lid is thrown open in upright position, as indicated by dotted lines in Fig. 8. The circular frame 97 is provided with radial arms 102 adapted to support the driving unit 60, as explained in detail in connection with Figs. 1 and 2. The loudspeaking diaphragm D is mounted on frame 97 by means of a clamping ring 103, which is secured to frame 97 by screws 104 or otherwise. The clamping ring 103 carries a dome-shaped panel 105, which performs the double function of shielding the diaphragm D against injury and deflecting sound waves through openings 106 into the outer air. The member 105 may also be described as forming a recessed chamber 107, open at its periphery to the outer air and housing the diaphragm D. The parts 103 and 105 are preferably cast or molded as a single piece, being connected only by short radial arms 108. The outer wall of dome 105 may be colored and ornamented to suit the taste of the designer. To permit easy lifting of the lid, the annular frame 97 is formed with a finger-piece 109. When the lid is in open upright position, the sound waves produced by the front face of the diaphragm are projected forwardly, and these sound waves are reenforced by the sound waves produced by the rear face of diaphragm D and projected into the outer air by the domeshaped member 105. If the machine is to be operated with the lid closed, it is desirable to provide the upper portion of casing C' with sound openings of ample area, as indicated by dotted lines 110. If the machine is to be used only in the home and is not intended to be transported like a piece of hand luggage, the outer casing wall above the motorboard may consist wholly or partly of ornamental grille work through which the sound waves pass easily into the outer air when the machine is operated with the lid in closed position. In that event, the sound waves produced by the diaphragm will issue partly through the grille work of the casing and partly through the annular passage 106 at the circumference of member 105.

In the chamber 111 below the motorboard

17 are housed the various parts that constitute the transmission system between the reproducer and the driving unit. The rectangular outline 112 is supposed to represent a dry battery consisting of such cells as are necessary to feed the required circuits in any particular transmission system that may be selected. By way of example, I have shown in Fig. 9 an amplifying transmission system between the electromagnetic reproducer R and the diaphragm D. The fixed primary coil 39 is connected in the circuit of battery 113, which may be shunted by a controlling rheostat 114 and a cut-out switch operated by the rheostat arm, as described in reference to Fig. 6. The secondary coil 37, which is mounted on the reproducer arm, is connected at one end to the grid 115 of an amplifying vacuum tube V. The other end of coil 37 is connected to one side of the filament 116 through a conductor 117. The filament 116 is fed by a battery 118 and controlled by a rheostat 119 in the usual way. In the circuit of the plate battery 120 is the primary coil 121 of transformer T, one end of this coil being connected to the plate electrode 122 of tube V. The plate circuit is completed in the usual way through filament 116 and conductor 123. The secondary coil 124 of transformer T is connected to the driving unit 60.

The operation of the amplifying transmission system illustrated in Fig. 9, will be clear to those familiar with the radio art, and so I need only say that the electric impulses produced in coil 37 by the vibratory movements of the stylus arm cause voltage variations in the grid 115. These voltage variations produce amplified current impulses in the primary coil 121 of transformer T, and these amplified impulses are transmitted by the secondary coil 124 to the driving unit 60. Fig. 9 has been drawn as simple as possible, omitting condensers and inductances that might be found necessary or desirable to improve the clarity and volume of reproduction. The use of such devices is well known to those who are familiar with audio amplifying systems employed in the radio art.

Although I have indicated only one audio amplifying tube in Fig. 9, it is obvious that several stages of amplification may be used. In Fig. 7, the dotted outline V represents the vacuum tube of Fig. 9, and it is supposed that this tube is properly supported in chamber 111. In Fig. 8 the transformer T is rigidly mounted in chamber 111. The batteries 114, 118 and 120 of Fig. 9 are properly supported in casing C', and they may be represented diagrammatically as a whole by the rectangular outline 112. By placing the batteries 112 at the rear of case C' opposite the carrying handle 125, the stability of the closed case is increased when the same is set down on the base provided by the straight extensions 126 and 127 on the top and bot-

tom of the outer case. Access to the parts in chamber 111 may be had either through openings in the motorboard or through doors in the outer wall of casing C' below the motorboard. This will be understood without the need of additional illustration. The wires 128 in Fig. 8 indicate how the electrical connections may be led from below the motorboard to the driving unit 60 without interfering with the opening and closing of the lid. In the finished machine this wiring may be concealed.

It will be clear from the foregoing description of several embodiments of my invention that I have provided an electric phonograph in which all the mechanism necessary for loud reproduction is mounted in a small cabinet or box that is easily carried about. By making the diaphragm a structural part of the lid, it is possible to reduce the height of the cabinet considerably, and this advantage is realized to even a greater degree by using the flat reproducer which constitutes one of the features of my invention. An electric phonograph contained in a small portable box, and yet capable of reproducing with the great volume and fine tonal quality of large cabinet machines fills the crying need of those who dwell in city apartment houses where the rooms are small and space is scarce. My new instrument may be placed on a table or chair for playing, and when not in use it is easily tucked away in a closet or otherwise disposed of in a small space, like a hat box or suitcase. Portable mechanical phonographs are not capable of giving a loud clear reproduction, owing to the necessarily small amplifying chamber, and therefore my invention possesses a usefulness wanting in those prior machines. Furthermore, my new phonograph may be manufactured at a much lower cost than large cabinet machines giving substantially the same or no better reproduction. Of course, my invention is not limited to electric phonographs of the portable type, for the various features above described may be embodied in a large household cabinet, or the small case containing the phonograph mechanism may be mounted on, or form part of, a cabinet having compartments for holding records or used for other household purposes.

The cylindrical case C' of Figs. 7 and 8 may be constructed in three parts like the rectangular cabinet C of Figs. 1 and 2. Either of the amplifying systems of Figs. 6 and 9 may be used in cabinet C or C', and either cabinet may have a reproducer like R or R', or any other practical form of electric reproducer. Nor is it necessary that all features of my invention shall be embodied in a single instrument, for it is evident that certain features may be used without other features.

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. Changes and modifications will doubtless occur to those skilled in the art without departing from the scope of the invention as defined in the following claims:

I claim as my invention:

1. An electric phonograph comprising a cabinet, a frame hinged at the top of said cabinet, a loud speaking diaphragm secured at its edge to said frame and forming therewith a lid for said cabinet, whereby said diaphragm is open to the outer air when said frame is in closed position on the cabinet, an electric reproducer, and operative connections between said reproducer and said diaphragm.

2. An electric phonograph comprising a cabinet having a hinged frame at the top provided with an opening, a loudspeaking diaphragm secured at its edge around said opening and covering the same, whereby said diaphragm forms an outer part of a lid for the cabinet, an electromagnetic driving unit carried by said frame for operating said diaphragm, an electric reproducer, and electric transmission connections between said reproducer and said unit.

3. A portable electric phonograph comprising a carrying case having a hinged top lid formed by a loudspeaking diaphragm secured at its edge to a part of the lid structure, and electric reproducing mechanism for operating said diaphragm, which is open to the outer air when the lid is closed.

4. In electric sound-reproducing apparatus, a cabinet having a hinged lid formed in part by a cone diaphragm, the apex of said diaphragm projecting outwardly, said diaphragm being open to the outer air when the lid is closed.

5. An electric phonograph comprising a cabinet having a hinged lid, a loudspeaking diaphragm secured at its edge to a part of the lid structure and forming an outer wall of said lid so that said diaphragm is open to the outer air when the lid is closed, an electromagnetic unit carried by said lid for operating said diaphragm, and electric reproducing mechanism for operating said unit.

6. In electric sound-reproducing apparatus, a cabinet having a lid formed in part by a cone diaphragm, and a substantially conical or dome-shaped disk carried by said lid over said diaphragm to deflect sound waves, said disk also shielding said diaphragm.

7. An electric phonograph comprising a cabinet, a frame hinged at the top of said cabinet and provided with an opening, a cone diaphragm mounted on said frame so as to close said opening, the apex of said diaphragm projecting outwardly, said frame and diaphragm forming a lid for the cabi-

net, whereby said diaphragm is open to the outer air when said lid is closed, an electromagnetic unit carried by said frame for operating said diaphragm, an electric reproducer operatively supported in said cabinet, and means for transmitting the electric impulses of said reproducer to said driving unit, said diaphragm and driving unit permitting closure of the lid.

8. An electric phonograph comprising a cabinet having a hinged section provided with an opening, a frame secured to said section and forming a rigid structural part thereof, a loudspeaking diaphragm mounted on said frame and covering said opening, whereby said diaphragm forms an outer structural part of the cabinet, and is open to the outer air when said frame is in closed position on the cabinet, an electromagnetic unit carried by said frame for operating said diaphragm, and electric reproducing mechanism for operating said unit.

9. An electric phonograph comprising a cabinet having a hinged section on top provided with an opening, a frame secured to said section, a cone diaphragm mounted on said frame and covering said opening, the apex of said diaphragm projecting outwardly, said hinged section and diaphragm forming a lid for the cabinet, whereby said diaphragm is open to the outer air when said lid is closed, an electromagnetic unit carried by said frame for operating said diaphragm, an electric reproducer operatively supported on the motorboard of the cabinet, and means for transmitting the playing action of said reproducer to said driving unit, said frame and the parts carried thereby lying substantially above the lower edge of said hinged section so that the lid may be closed without interference by said reproducer.

10. In an electric phonograph, an electric reproducer circuit including a battery, a rheostat shunted across said battery for controlling the volume of reproduction, said rheostat having a pivoted arm manually adjustable, a switch in said battery circuit, said switch including a spring contact arranged to be actuated by said arm into open position when the arm is turned into a certain position, said spring contact automatically moving into circuit-closing position when said arm is turned to volume-controlling position, and means whereby said spring contact when open holds the rheostat arm in an inoperative position.

11. A portable electric phonograph comprising a carrying case consisting of three sections adapted to be locked together, a bottom section of box-like shape for containing electric parts that constitute a system for transmitting electric impulses, a middle section hinged to the bottom section and having a motorboard which carries a turntable and driving mechanism therefor, said bottom

section being opened by the upward swinging of said middle section for easy access to said electric parts, a top or lid section hinged to the middle section and carrying a loudspeaking diaphragm and an electromagnetic driving unit therefor, and an electric reproducer mounted on said turntable and electrically connected with said driving unit through said transmission system.

12. An electric phonograph comprising a cabinet provided on top with a hinged section having an annular opening, a frame having a ring fitted around the edge of said opening, means for securing said ring to said section, a cone diaphragm secured at its edge to said ring with the apex of the diaphragm pointing outwardly, said section and diaphragm constituting a hinged lid for the cabinet, a grille fitting over said diaphragm and having an annular flange secured to said ring, the edge of said diaphragm being rigidly clamped between said ring and flange, radial arms extending from said ring and terminating at the center in a support, an electromagnetic unit mounted in said support for operating said diaphragm, said frame and all parts carried thereby being mountable on and removable from said section as a unitary structure, and electric reproducing mechanism for operating said driving unit.

13. In an electric phonograph having an arm pivoted for horizontal swinging movement and also for vertical movement, an electric reproducer comprising a shallow casing fixed in horizontal position on the free end of said arm, a bellcrank lever pivoted to said casing so as to vibrate in a vertical plane, said lever consisting of a horizontal arm and a vertical arm, means provided on said vertical arm to support a stylus for lateral vibration, and electric reproducing means in said casing operatively connected to the free end of said horizontal arm, which receives vertical movement from the lateral vibrations of the stylus.

14. In an electric phonograph having an arm pivoted for horizontal swinging movement and also for vertical movement, an electric reproducer comprising a shallow casing fixed in horizontal position on the free end of said arm, a bellcrank lever pivoted to said casing so as to vibrate in a vertical plane, said lever consisting of a long horizontal arm and a short vertical arm adapted to support a stylus for lateral vibration, whereby the stylus vibrations are transmitted as vertical movements to the free end of said horizontal arm in amplified ratio, and electric reproducing means in said casing operatively connected to the free end of said horizontal arm.

15. In an electric phonograph having an arm pivoted for horizontal swinging movement and also for vertical movement, an electric reproducer comprising a shallow cas-

ing fixed in horizontal position on the free end of said arm, a pivot support and a slot at the edge of said casing, a bellcrank lever mounted on said support to vibrate in a vertical plane, said lever consisting of a horizontal arm extending through said slot into the casing and a vertical arm adapted to support a stylus, said arms being so proportioned that the stylus vibrations are transmitted to the inner end of said horizontal arm in amplified ratio, electric reproducing means in said casing operatively connected to the inner end of said horizontal arm, and a pair of horizontally arranged spring blades in said casing for engaging said horizontal arm on top and below, said spring blades opposing each other to hold said bell-crank in predetermined normal position.

16. An electric phonograph reproduced for lateral-cut records comprising a casing adapted to be mounted on a supporting arm, a bellcrank lever pivoted substantially at its apex to said casing so as to vibrate in a vertical plane, said lever comprising a vertical arm and a horizontal arm, means on said vertical arm to support a stylus for lateral vibration, whereby the stylus vibrations are transmitted to said horizontal arm as substantially vertical movements thereof, and electric reproducing means in said casing controlled by the vertical movements of said horizontal arm.

17. In electric sound reproducing apparatus, a case or cabinet having an outer hinged wall formed in part by a loudspeaking diaphragm, which thus constitutes an outer structural part of said case or cabinet, the edge of said diaphragm being rigidly connected to said hinged wall, an electromagnetic unit carried by said hinged wall for actuating said diaphragm, and electric mechanism in said case for operating said unit.

18. An electric phonograph reproducer comprising a flat cylindrical casing adapted to be secured flatwise to a swinging support, a horizontal arm carried by said casing and pivoted to vibrate in a vertical plane, a needle holder pivotally mounted on said casing to vibrate laterally for playing lateral-cut records, said needle holder being arranged at one side of the casing so as to be freely accessible, means for connecting said needle holder to said arm, electromagnetic means in said flat casing operated by the movements of said arm, and resilient means for holding said arm in predetermined normal position.

19. An electric phonograph reproducer comprising a flat cylindrical casing adapted to be fixed in substantially horizontal position on the free end of a horizontally swinging support, a bellcrank lever pivoted substantially at its apex to said casing so as to vibrate in a vertical plane, said lever comprising a vertical arm and a horizontal arm,

means on said vertical arm to support a stylus for lateral vibration, whereby the stylus vibrations are transmitted to said horizontal arm as vertical movements thereof, a pair of coils mounted horizontally in said casing, means for producing relative movement of said coils by the vibrations of said arm, and resilient means for normally holding said coils in predetermined normal position.

ADOLPH A. THOMAS.

10

15

20

25

30

35

40

45

50

55

60

65