No. 637,196. Patented Nov. 14, 1899.

E. BERLINER.

GRAMOPHONE SOUND BOX.

(Application filed Sept. 17, 1897.)

(No Model.)

Fig. 1.

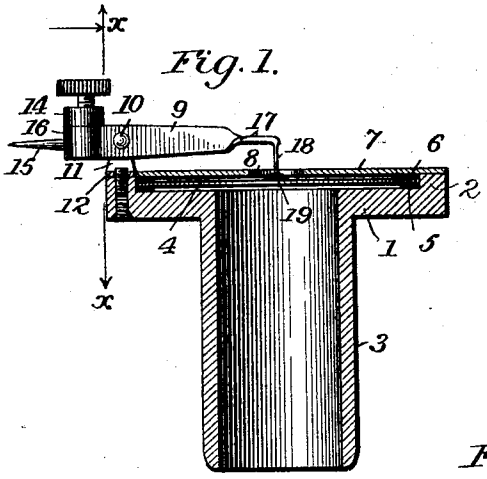


Fig. 3.

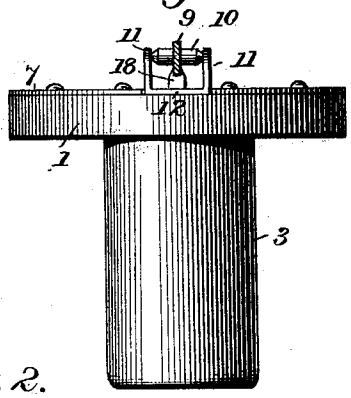


Fig. 2.

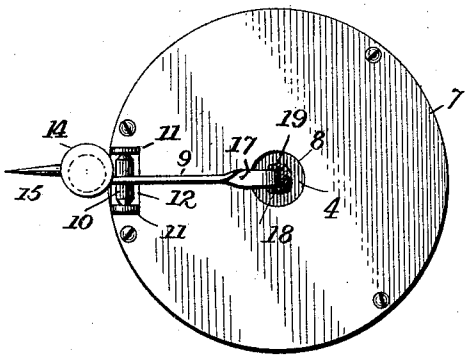


Fig. 4.

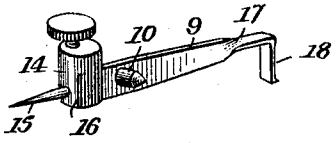


Fig. 5

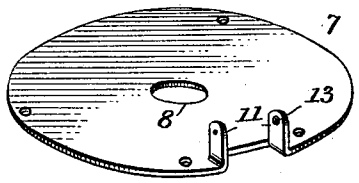


Fig. 6.

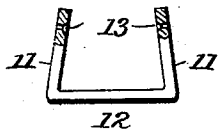


Fig. 7.

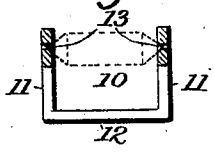
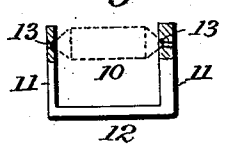


Fig. 8.



Witnesses
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UNITED STATES PATENT OFFICE.

EMILE BERLINER, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO THE UNITED STATES GRAMOPHONE COMPANY, OF SAME PLACE.

GRAMOPHONE SOUND-BOX.

SPECIFICATION forming part of Letters Patent No. 637,196, dated November 14, 1899.

Application filed September 17, 1897. Serial No. 651,968. (No model.)

To all whom it may concern:

Be it known that I, EMILE BERLINER, a citizen of the United States, and a resident of Washington, in the District of Columbia, have invented certain new and useful Improvements in Gramophone Sound-Boxes, of which the following is a specification.

This invention has reference to sound-boxes for gramophones, and is an improvement upon the sound-boxes shown and described in my Letters Patent No. 534,543, granted February 19, 1895.

In gramophones the sound-record is produced in the form of a sinuous line of even depth, usually arranged spirally upon a flat disk of suitable material. The receiving or reproducing diaphragm is placed at right angles to the face of the disk, so as to vibrate in a plane parallel to the disk. The vibrations or waves to be recorded or reproduced are transmitted from the diaphragm to the disk, or vice versa, by means of a lever carried by the sound-box and carrying at one end a stylus engaging the disk. This lever may be of the second order, as in the patent above referred to, or it may be of the first order, as in the present invention; but whatever its form, the vibrations, due to sounds to be recorded or reproduced, are transmitted between the diaphragm and disk by means of the lever.

In the present improvement I use a lever of the first order, since I find, among other things, that it is possible by properly proportioning the leverage to considerably amplify the sounds, especially when the sound-box is designed for reproduction. I have also found that a lever of the first order must be fixed at the inner end securely to the diaphragm, so that there may be no lost motion, and it is mainly to this connection between the stylus-carrying lever and the diaphragm that the present invention is directed. This connection between the inner end of the lever and the diaphragm is of vital importance, since the lever in moving about its pivot travels through an arc at the point where it is connected to the diaphragm, and if this connection be a rigid one the diaphragm is put under a strain, due to the apparent shortening of the lever, except at the instant when it is parallel to the diaphragm. This I have found to be detrimental to the clear and sharp recording or reproduction of sound. I have overcome this objectionable feature by making the connection between the lever and the diaphragm flexible in the direction of the length of the lever, whereby the apparent shortening of the said lever is neutralized. At the same time this connection must be rigidly secured to the diaphragm and lever and must also be rigid in the plane of vibration of the lever, so that there may be no lost motion. Such a connection I have produced by making it in the form of a flat spring constituting an integral part of the lever, and the free end of this spring I securely cement or otherwise attach to the diaphragm. It is also necessary that the lever should have a fulcrum which permits a free and unrestrained movement of the lever. A fulcrum of the blade-spring type with a normal bias would tend to hold the lever in a given position and to return it to that position when moved therefrom. This would distort the motion of the diaphragm and interfere with perfect sound recording or reproduction. The diaphragm is thus relieved from all strain and is thereby made more responsive to delicate vibrations, whereby a more faithful record of sound or reproduction of recorded sound is obtained.

This improvement and other related improvements in sound-boxes are fully set forth in the following detail description with reference to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a central section of the sound-box. Fig. 2 is a top plan view. Fig. 3 is a side elevation, with the lever or stylus-carrier in section on the line $x\,x$ of Fig. 1. Fig. 4 is a perspective view of the lever or stylus-carrier. Fig. 5 is a perspective view of a modified form of the top plate of the sound-box. Figs. 6 and 7 are views of the pivot-support for the lever or stylus-carrier, and Fig. 8 is a view of a modified form of the said pivot-support.

Referring to the drawings, there is shown a sound-box body composed of a flat circular head 1, with a peripheral ledge 2 on one face

and a neck 3 projecting centrally from the other face. A central opening through the head and neck forms the passage for the sound-waves. The neck and ledge may be formed in one piece with the head or either or both may be separately formed and secured to the said head. A diaphragm 4, of mica, metal, or other material and of such size as to easily fit inside the ledge, is carried by the head, but is held from direct contact therewith by an elastic ring 5, of rubber, felt, or other material. Another similar ring 6 is placed upon the diaphragm, and the whole is firmly clamped in place in the shallow chamber or recess formed by the ledge 2 by means of a top plate 7, secured by screws or otherwise to the ledge. The top plate has a small central perforation 8 for the passage of a connection between the lever or stylus-carrier and the diaphragm.

The stylus-carrier is composed of a lever 9, formed of a flat piece of metal tapering toward one end and set edgewise relative to the diaphragm, with its plane of vibration at right angles to the diaphragm, so as to be as stiff as possible in that direction. Near its wide end the lever is provided with a double-pointed pivot-pin 10 and is passed through the lever and soldered or otherwise secured to it. This pivot-pin is grasped by the upturned prongs 11 of a **U**-shaped yoke-piece 12, secured to the ledge 2 by a screw, as shown, or otherwise, the top plate 7 being notched or cut away at one edge to fit around this yoke-piece. The two upturned prongs 11 of the yoke-piece have each a conical seat 13 for the corresponding pointed or tapered end of the pivot-pin. In order to hold the pivot firmly against rattling and at the same time allow freedom of movement on its axis, one or both of the prongs 11 have a normal slight inward spring, so as to grasp the pivot with the requisite degree of pressure.

The fulcrum which I employ has no bias or trend to return the lever to a given normal position. I therefore designate it as a "non-biased" fulcrum. This is especially important when the spring construction between the end of the lever and the diaphragm is considered.

The inward spring of the prongs 11 of the yoke-piece 12 is shown somewhat exaggerated in Fig. 6, and the position assumed by the prongs when the pivot is in place is indicated in Fig. 7.

The stylus-lever carries at its wide or outer end a binding-post or clamp 14, which is arranged to receive a stylus 15, shown in the drawings as a simple needle-point, which is the form used when the sound-box is employed for the reproduction of recorded sounds. The thumb-screw of the binding-post or clamp and the perforation for the insertion of the stylus are at one side of the center of the body of the binding-post, so as to provide room for securing the binding-post to the stylus-lever in the manner shown. The body of the binding-post is slit, as shown at 16, and in this slit the end of the stylus-lever is placed, and the binding-post is then soldered or otherwise secured to the lever.

The narrow or inner end of the stylus-lever is twisted a quarter-turn, as shown at 17, and terminates in a portion 18, bent at right angles to the main portion of the lever and extending in the plane of vibration of the latter. The portion 18 serves as the connection between the lever and diaphragm, being secured to the latter by a drop of wax, pitch, or the like when a mica diaphragm is used or by a drop of solder or otherwise when a metal diaphragm is used. This cementing or soldering material is indicated at 19. The connection 18 is here shown as an integral part of the lever and is secured as firmly as possible to the diaphragm, so that there may be no lost motion to injuriously modify the sound-waves. It is, however, clear that the flexible connection between the diaphragm and the lever or stylus-carrier proper need not necessarily be integral with the latter; but in that case it must be rigidly secured to it in any suitable manner.

It will be understood that the stylus-lever is vibrated around its pivot, and consequently the inner end of the stylus-lever moves through an arc commensurate with the amplitude of said vibrations. As hereinbefore stated, I have found that though the arc described by the inner end of the stylus-lever is minute, still the relation between the lever vibrating in a curved path and the center of the diaphragm vibrating in a straight path is so changed that unless compensated for it has an injurious effect upon the character of the sound-waves, since the diaphragm is put under a strain that does not correspond to the said sound-waves. For this reason I make the connection 18 for the greater portion of its length in the form of a thin flexible flat spring, as indicated, so that it will compensate for the curved path of the inner end of the lever. At the same time this spring connection, being practically at right angles to the diaphragm, is stiff enough in the direction of the plane of vibration to resist any tendency to buckle.

I have shown in Figs. 5 and 8 two modifications of the pivot-bearings for the stylus-lever. In Fig. 5 the upturned socketed or perforated prongs 11 are formed by being struck up from the top plate 7, and they are similar to and perform the same function as those described with reference to Figs. 6 and 7. In Fig. 8 one of the prongs is made heavier than the other and only one of them has an inward spring. This form will be used with reproducing sound-boxes, for in the reproducing-gramophone the uppermost pivot-support must sustain the greater portion of the weight of the reproducing sound-box and associated parts, as will be evident from an inspection of the aforesaid Letters Patent.

While I have shown and prefer to use the

stylus made detachable from the lever or stylus-carrier, it is quite clear that the lever and stylus may be made integral without departing from my invention.

Having now fully described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a gramophone sound-box, the combination of a diaphragm, a lever having a non-biased fulcrum, for conveying vibrations to or from a record-surface, and a spring connection, between the lever and diaphragm, flexible in the direction of the length of the lever, substantially as described.

2. In a gramophone sound-box, the combination of a diaphragm, a lever having a non-biased fulcrum, for conveying vibrations to or from a record-surface, and a connection between the lever and diaphragm consisting of a spring integral with the lever and flexible in the direction of the length of the same, substantially as described.

3. A sound-box for gramophones, comprising a diaphragm, a stylus-lever having a non-biased fulcrum, connected to the diaphragm by a spring forming an integral part of and flexible in the direction of the length of the lever, and a support for the lever consisting of two opposing bearings provided with seats for a pivot-pin on the lever and grasping the same with spring-pressure, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EMILE BERLINER.

Witnesses:
HENRY E. COOPER,
F. T. CHAPMAN.