

No. 825,739.

PATENTED JULY 10, 1906.

P. LEBIEDZINSKI.
SOUND BOX FOR PHONOGRAPHS AND THE LIKE.
APPLICATION FILED OCT. 14, 1905.

Fig. 1.

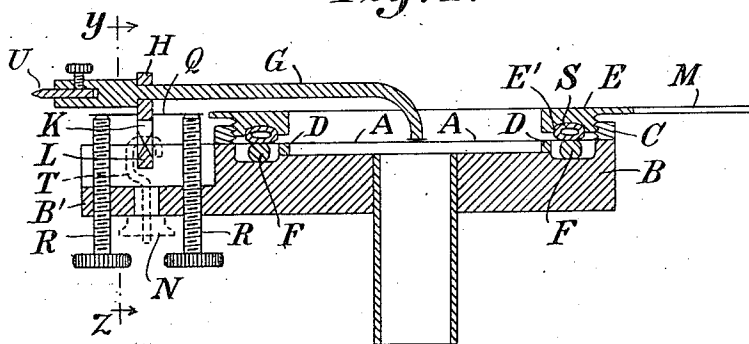


Fig. 3.

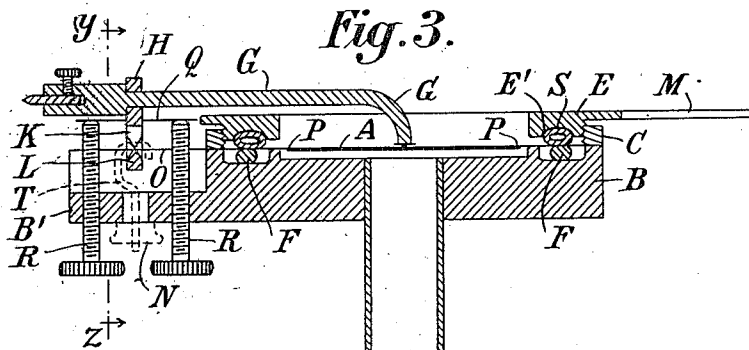


Fig. 2.

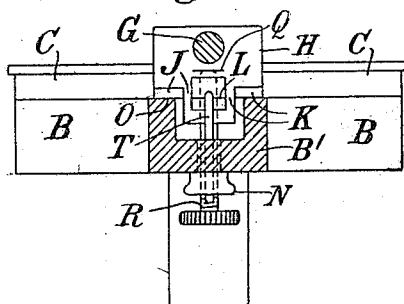


Fig. 4.

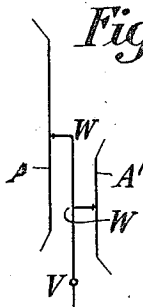
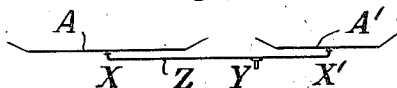


Fig. 5.



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SOUND-BOX FOR PHONOGRAPHS AND THE LIKE.

No. 825,738.

Specification of Letters Patent.

Patented July 10, 1906.

Application filed October 14, 1905. Serial No. 282,704.

To all whom it may concern:

Be it known that I, PIOTR LEBIEDZINSKI, a subject of the Emperor of Russia, residing at Warsaw, Russian Poland, in the Empire of Russia, have invented a new and useful Sound-Box for Phonographs, Telephones, and the Like, of which the following is a specification.

The capacity of a diaphragm for recording or reproducing sounds of a varying pitch in the proper strength and tone color chiefly depends upon its pitch or tone, and each pitch or tone of the diaphragm comprises only a certain progression of notes which may be recorded or reproduced approximately correctly. A lowly-keyed diaphragm will always reproduce the low notes in a louder and more natural manner than the high notes, which in a so-keyed diaphragm are feeble and have an unnatural color, while, on the contrary, a highly-tuned diaphragm will reproduce the high notes in a louder fashion and in a more correct tonality than the low notes, which in a so-keyed diaphragm are weaker and unnatural. In short, each diaphragm in accordance with its pitch will vary that proportion between the overtones and the fundamental which determines the color of the notes, so that also the true reproduction and strength of the tones will be more or less influenced.

In order to satisfy as much as possible all the requirements, the diaphragms used in phonographs, gramophones, telephones, &c., are usually tuned to a mean succession of sounds, although the above-mentioned defects will remain unaltered at both ends of the scale. Thus, for example, the notes of the violin when reproduced will always resemble those of the flute or the whistles and the notes of a trumpet or the piano-bass notes will resemble cries, they being without depth and strength, while only the intermediate notes between certain limits, the pitch of which is in accordance with that of the diaphragm, will be reproduced comparatively truly and in the correct strength. The same is true of the recording-diaphragms which are not uniformly sensitive for all notes, and therefore will record the several sounds only in correspondence with its pitch and not always in a manner true to nature. Now that the musical scale comprises at least seven octaves, (certain overtones of the several notes remaining still without these limits,) but the capacity of the diaphragm

comprises only about two octaves, it follows that the diaphragm will have to satisfy other conditions in order to be able to correctly reproduce or record every sound or note possible. First of all, the diaphragm requires to have a pitch that may vary within very wide limits, and, secondly, the diaphragm requires to be combined with devices by means of which its pitch may be varied, not only when at rest, but also when working—that is, during the recording or reproducing operation. In other words, the diaphragm requires to be capable of accommodation in a similar manner as the eye or the ear.

The object of this invention is to provide a diaphragm which will record or reproduce accurately and distinctly tones of widely-varying pitch and be adaptable during operation to a tuning adjustment. To this end the diaphragm comprises a central portion composed of a hard material and an outer portion of an extremely-flexible fibrous material adapted to stretch radially to change the tension of the diaphragm.

I will now proceed to describe my invention with reference to the accompanying drawings, in which—

Figure 1 is a longitudinal central section through a sound-box. Fig. 2 is a cross-section through the line *y z* in Figs. 1 and 3. Fig. 3 is a section similar to Fig. 1, in which the diaphragm is modified. Fig. 4 shows diagrammatically the arrangement of two different diaphragms with a common stylus-lever, and Fig. 5 shows diagrammatically the arrangement of two different diaphragms with a common stylus-carrier.

Similar letters of reference refer to similar parts throughout the several views.

In Fig. 1, A denotes a diaphragm clamped at its periphery between the border or outer rib *b* of a sound-box B and a ring C, which latter is secured on the box B by means of screws (not shown) or the like. The diaphragm A may be placed in direct contact with the parts B and C or between annular washers of india-rubber, cork, or the like on the border of the box B and on the ring C, so as to enable the diaphragm A to move between elastic bodies. The clamping-ring C is provided with an internal screw-thread, into which the external thread of a clamping ring or bezel E engages. The latter is arranged to press on the diaphragm A, either direct or by means of an annular insertion, so as to more or

less stretch the diaphragm in all radial directions, whereby the pitch of the diaphragm is adjusted. The annular insertion when used is best made hollow, as S in Fig. 1, which insertion is embedded in an annular groove E' of the clamping-ring E and bears on the diaphragm A. The cavity of the elastic tube S may be filled with compressed air or with a liquid, so that a pressure may be thereby produced for acting upon the diaphragm A. Where so preferred, the endless elastic tube S may be connected with a suitable device without the sound-box by means of a hose or tube, so that by actuating the device the elastic tube S, filled with air or a liquid, may be inflated to increase its pressure upon the diaphragm A. Beneath the diaphragm A an air-space is formed by a concentric stretching-ring D, on which the former rests. According to the material from which the diaphragm is made this ring D may be elastic or inelastic. In the latter case the ring D may be made in one piece with the box B. In the annular space beneath the diaphragm A and between the border b of the box B and the ring D an elastic ring F is disposed, which serves for raising the diaphragm toward the clamping-ring E when the latter is unscrewed. The ring E may be turned direct with one's fingers or by means of an arm M, made in one piece with the ring E. This lever M may be turned by one's fingers or it may be actuated by means of a suitable mechanism or a pneumatic, hydraulic, or electromagnetic device in order to adjust the diaphragm A without any shocks.

In case the clamping-ring E is made to bear direct on the diaphragm it may be provided with a sharp circular edge, which acts upon the diaphragm A in a circle between the stretching-ring D and the border of the box B for stretching the diaphragm. Thus the latter can be tuned at pleasure and during the working. The endless elastic tube S, filled with compressed air or a liquid, can be made to bear upon the diaphragm A to stretch it by merely turning the ring E or its arm M through a corresponding angle. Instead of adjusting the clamping-ring E the device mentioned above, which is connected with the endless elastic tube S by means of a hose or the like, may be actuated for inflating the tube S. The elastic tube S will be found to be specially useful for adjusting the diaphragm during its work.

The stylus-lever G is fastened with its one end on the diaphragm A in the center of the latter, as usual. It is to be noted that at its fulcrum the stylus-lever G requires to be connected with the sound-box in a safe manner, and at the same time it must be possible to strain at will the stylus-lever G and therewith also the diaphragm A. This is effected in the following manner: Near its other end the stylus-lever G is rigidly connected with a

slotted plate H at right angles to it. This slotted plate H has the shape shown at Fig. 2, and its two external edges J and K and its internal edge L in the slot are in the same straight line and are oppositely-beveled off to form sharp edges. The box B is provided with a recessed projection B', (see Fig. 2,) into the recess of which the projecting part of the plate H engages. A hook T (shown in dotted lines) engages in the slot of the plate H and is secured by means of a nut N, whereby the two external sharp edges J and K of the plates H are pressed on the corresponding faces O O of the projection B', which faces are in the plane of the diaphragm A. Thus the stylus-lever G is pivotally connected with the box B, while being at full liberty to rock. It is possible to adjust the pressure of the hook T upon the sharp edge L by means of the nut N without producing any strain in the stylus-lever G. A leaf-spring Q passes through the plate H and is therein secured parallel to the stylus-lever G. Two adjusting-screws R R are disposed in the projection B' on both sides of the fulcrum of the stylus-lever G and are arranged to more or less bend the two ends of this leaf-spring Q. It will be obvious that on unscrewing, say, the left adjusting-screw R in Fig. 1 to release the left part of the spring Q and on screwing so much the right adjusting-screw R that its point more or less bends the right part of the spring Q the stylus-lever G, and therewith also the diaphragm A, will be pressed upward, which means that the latter will be in proportion strained in all radial directions. On screwing the left adjusting-screw R so much that its point either touches or bends a little the left arm of the leaf-spring Q the strain in the diaphragm will be of course altered. In a similar manner the stylus-lever G, with the diaphragm A in Fig. 1, will be pressed downward if the left adjusting-screw R bends the left part of the spring Q, while the right adjusting-screw R is removed from the right part of the spring Q. In this case the diaphragm A will be also strained, and its strain may be altered by screwing the right adjusting-screw R so much that its point either touches or bends a little the right arm of the spring Q. It is further evident that the strain of the diaphragm A may in either case be varied by more or less pressing the ring E alone or with the elastic tube S filled with compressed air or a liquid on the periphery of the diaphragm A without the ring D or by unscrewing the ring E. It is, moreover, evident that the strain of the diaphragm A in case it is pressed downward by the stylus-lever G will be different from that produced if the diaphragm A is pressed upward, since in the former case the ring D bears from below upon the diaphragm A, while in the latter case the ring D releases the diaphragm. In this manner the pitch of the diaphragm A

can be adjusted at will. Obviously this adjustment of the diaphragm A may be effected at any moment, either during the rest or during the operation of the diaphragm.

5 The described pitching devices may be employed for any of the known materials of the diaphragm—that is to say, mica, glass, metal, &c. These materials can be strained, however, within rather narrow limits only. For
10 enlarging the scale of the diaphragm it is therefore preferable to manufacture the diaphragms in other manners. A flexible, tensile, and elastic material should be used which can be strained by means of the above-
15 mentioned pitching devices in a similar manner as a drum-skin, so that the diaphragm so produced may be pitched within very wide limits. The exclusive employment of a flexible, tensile, and elastic material for the
20 whole diaphragm is, however, objectionable, for the reason that the several parts of such a diaphragm would make different independent vibrations, and thus produce an injurious interference with the sound. By the by, this
25 interference has also been stated with other diaphragms made of stiffer materials, such as mica, &c., more particularly in case the diameter of the diaphragm exceeds fifty millimeters. To obviate this defect and secure
30 great amplitude of vibrations in the same diaphragm, the diaphragm comprises a central portion composed of hard material—such as metal, ebonite, mica, wood, &c.—and an outer portion composed of extremely-
35 flexible and radially-stretchable fibrous material, such as leather, bladder, &c.

As the pitching of the diaphragm is effected simply by more or less stretching the elastic border or margin, while the central stiff part
40 does not in any way contribute to the pitch, it is preferable and possible to make the diameter of the central stiff part as large as possible—say almost as large as the internal diameter of the ring D—the more so as the strength
45 of the reproduced sounds increases with the diameter of the working surface.

After the above explanations it will be understood how the sound-box is operated, as it is only necessary to vary the pitch of the
50 diaphragm at the respective moments during the record or reproduction of a speech, song, piece of music, or the like. The pitching of the diaphragm A may be effected either without the stretching-ring D or within the same,
55 or on both places at the same time. In order to strain the diaphragm A without the said ring D, the ring E may be turned through a convenient angle, when it will act direct or by means of the elastic tube S, filled with
60 compressed air or a liquid, upon the border or margin of the diaphragm, or the above-mentioned device for inflating the elastic tube S may be actuated. In order to strain the diaphragm A within the annular support
65 D either of the two adjusting-screws R R, or

both of them, may be adjusted. By so adjusting the diaphragm A it can be given the desired pitch for the speech, song, piece of music, or the like to be recorded or reproduced. During the operation of the phono-
70 graph, gramophone, or the like the pitch of the diaphragm may be varied in the manner explained above. These various adjustments coöperate in rendering the diaphragm exceedingly sensitive in a wide variety of pitch.
75 For instance, a given adjustment in either direction within the stretching-ring D by the stylus G will have a different effect under different adjustments outside the stretching-ring D by the inflating-ring S.

In the case of telephones or the like of course the stylus U is dispensed with, while the lever G, with the leaf-spring Q, the hook T, and the two adjusting-screws R R, may be either employed or omitted.

85 The described sound-box may serve for receiving or transmitting sounds and presents the following advantages: In sound-reproducing devices the stylus-lever G being secured with its end on the stiff part P (in Fig. 3) of the diaphragm A will put into vibration
90 not the center of this part P alone, but the entire part P—that is, nearly the whole surface of the diaphragm destined for the work—and in the same amplitude as the stylus U, so that
95 a louder reproduction of the sound will be the consequence. On the other hand, not only the own tones, (vibrations of the free diaphragm,) but also the disagreeable scraping noise (ringing) during the reproduction of
100 sounds, are very strongly damped or deadened. In sound-recording devices the advantage is obtained that the diaphragm will receive and record only the actual and own
105 vibrations of the sound to be recorded without being influenced by its own vibrations. In both cases the chief advantage resides in the fact that the diaphragm is rendered highly capable of accommodation, so that its pitch
110 may be adjusted during its work not only for any piece of music, but also for any musical phrase, for any instrument, any voice, &c. Thus a tone color and a strength of the notes true to nature are obtained during the re-
115 production and an increased sensitiveness for any sound during the record is insured and rendered possible.

All the advantages named of the sound-box according to my invention will be more
120 apparent when applying the pitching devices to the known sound recorders and reproducers with two or more simultaneously-working diaphragms. In this case it is preferable for the correct record or reproduction of the whole scale to make the several dia-
125 phragms different in size and to pitch them for different successions of notes. As is well known the several diaphragms may be put into vibrations either independently of each other by several styluses disposed in the
130

same furrow between two waves or conjointly by a common stylus. In the former case the several diaphragms are permitted to work independently of each other, while in the latter case the several diaphragms are connected with the common stylus in the following manner opposite to the usual way in order to procure all the advantages of the above-described sound-box: Seeing that the resistance which is to be overcome for putting the diaphragm into vibrations increases with the height of the pitch, while the amplitude decreases in the same proportion, it will be clear that it is preferable in devices with rocking stylus-levers to connect the several diaphragms not with one and the same point of the common stylus-lever, but with different points of the same, as is diagrammatically shown at Fig. 4. The distances between the fulcrum V of the lever and the joints W and W' of the two diaphragms A and A' should be in the inverse proportion of the resistances of the latter, but in proportion to their amplitudes. In devices without rocking stylus-levers—that is to say, in devices in which each diaphragm has its own stylus in its center and at right angles to it—the centers of the several diaphragms are according to my invention rigidly connected with a common stylus-carrier, as is diagrammatically shown at Fig. 5. In this figure the centers X and X' of the two diaphragms A and A', respectively, are rigidly connected with the two ends of a common stylus-carrier Z, which latter is placed parallel to both diaphragms. The stylus Y should be so placed on the carrier Z that its distance from the center X of the one diaphragm A stands in a proportion to its distance from the center X' of the other diaphragm A', which is the reverse of the proportion between the two resistances of the two diaphragms A and A', respectively, but is the same as the proportion between their amplitudes. Thus it is possible by adjusting the said joints of the diaphragms or the stylus on the carrier to insure the correct effect and the correct properties (tone-color, pitch of the several notes, &c.) of each diaphragm, which is of special importance both for the record and for the reproduction of sounds.

With the aid of the described arrangements in devices with several diaphragms the vibrations of each of the several diaphragms will be rendered nearly independent of those of the others. It is true that a similar effect has been obtained in known devices (*vide*, for instance, the German Patent No. 144,706) by employing elastic wires which connect the stylus-carrier with the several diaphragms but there is the defect that the injurious noise of these wires cannot be avoided.

The new sound-box, or particularly the new arrangement of several diaphragms capa-

ble of accommodation, may be utilized as receivers in photophonographs, in which case of course the stylus will require to be replaced by a reflector of any known construction or by a lens in a system of lenses.

The sound-box may be varied in many respects without departing from the spirit of my invention. For example, the clamping-ring E may be replaced by a flange of the ring C or of the border of the box B, so that the endless elastic tube S may be inserted between the diaphragm A and the said flange. This flange may be advantageous in case the elastic tube S is connected with the above-mentioned device for inflating it.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a sound-box for phonographs and the like, the combination of a sound-box provided with an annular stretching-ring and with an annular recess outside said ring, a clamping-ring adjustable on said box and provided with a recess opposite the annular recess of said box, a diaphragm comprising a central disk of hard material and a border of flexible material such as leather, and annular elastic rings disposed in said recesses above and below said border, the outer edge of said diaphragm being clamped between the rim of said box and said clamping-ring.

2. In a sound-box for phonographs, telephones and the like, the combination with a box, of a diaphragm in said box, a stylus-lever secured with its one end on said diaphragm, a slotted plate secured on said stylus-lever near the other end at right angles thereto and having within its slot a sharp edge and without the slot two opposite sharp edges which bear on a face of said box in the plane of said diaphragm, the three sharp edges being in the same axis, a hook in said box and adapted to engage in the slot of said plate and to bear on the respective sharp edge, and means for adjusting said hook, so that said stylus-lever is thereby pivotally connected with said box.

3. In a sound-box for phonographs, telephones and the like, the combination with a box, of a diaphragm in said box, a stylus-lever secured with its one end on said diaphragm, a slotted plate secured on said stylus-lever near the other end at right angles thereto and having within its slot a sharp edge and without the slot two opposite sharp edges which bear on a face of said box in the plane of said diaphragm, the three sharp edges being in the same axis, a hook in said box and adapted to engage in the slot of said plate and to bear on the respective sharp edge, means for adjusting said hook, a leaf-spring secured with its center in said plate parallel to said stylus-lever, and two adjusting-screws in said box on both sides of said plate and adapted to more or less bend the

two parts of said leaf-spring, so that said diaphragm may be strained to adjust it for any pitch.

4. In a sound-box for phonographs, tele-
 5 phones and the like, the combination with a
 box, of an annular support in said box and
 concentric therewith, a diaphragm secured at
 its periphery in said box and bearing on said
 annular support, a clamping-ring adjustable
 10 in said box by means of an arm, an endless
 elastic tube between said clamping-ring and
 said diaphragm and adapted to bear on the
 latter without said annular support, means
 for inflating said endless elastic tube, a stylus-
 15 lever secured with its one end on said dia-
 phragm, a slotted plate secured on said stylus-
 lever near the other end at right angles
 thereto and having within its slot a sharp
 edge and without the slot two opposite sharp
 20 edges which bear on a face of said box in the
 plane of said diaphragm, the three sharp
 edges being in the same axis, a hook in said
 box and adapted to engage in the slot of said
 plate and to bear on the respective edge,
 25 means for adjusting said hook, a leaf-spring,
 secured with its center in said plate parallel
 to said stylus-lever, and two adjusting-

screws in said box on both sides of said plate
 and adapted to more or less bend the two
 parts of said spring-leaf, so that by actuating 30
 said means or by adjusting said clamping-
 ring or said two adjusting-screws said dia-
 phragm may be strained without or within
 said annular support or on both sides at a
 time to adjust it for any pitch. 35

5. In a sound-box for phonographs, tele-
 phones and the like, the combination with a
 plurality of diaphragms each capable of ac-
 commodation to any pitch by varying its
 strain, of a common stylus-carrier connected 40
 at different points with said plurality of dia-
 phragms, the several diaphragms having dif-
 ferent sizes and being pitched for different
 progressions of notes and the proportion of
 the distances of their joints from the axis be- 45
 ing the inverse of that of their resistances and
 being the same as that of their amplitudes.

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

PIOTR LEBIEDZINSKI.

Witnesses:

HENRY HASPER,
 WOLDEMAR HAUPT.