Dec. 26, 1922. 1,439,718

W. M. VENABLE.
PHONOGRAPH.
FILED APR. 1, 1920. 2 SHEETS-SHEET 1

Fig. 1.

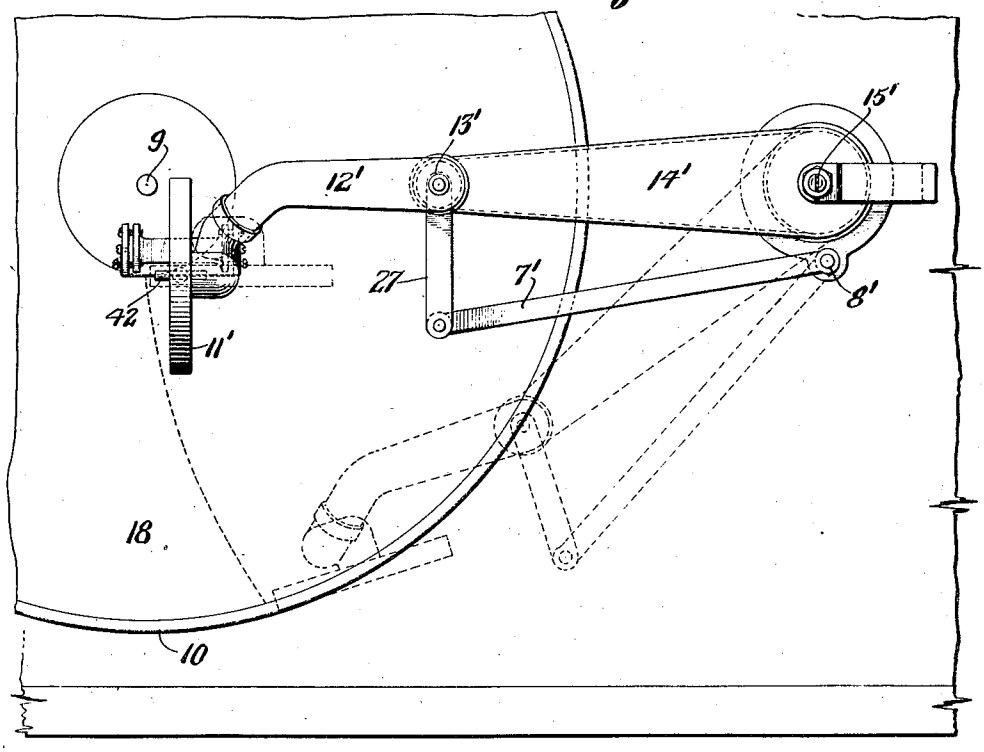
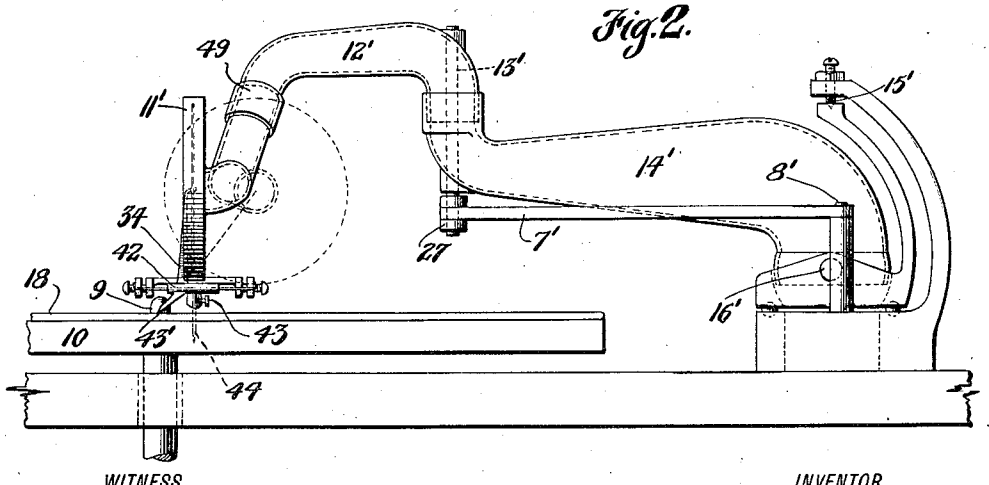


Fig. 2.



WITNESS
Gustav Genzlinger.

INVENTOR
William M. Venable
BY
Synnestvedt & Lechner
ATTORNEYS

Dec. 26, 1922. 1,439,718

W. M. VENABLE.
PHONOGRAPH.
FILED APR. 1, 1920. 2 SHEETS-SHEET 2

Fig. 3.

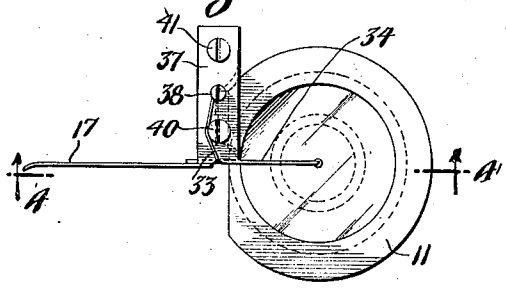


Fig. 8.

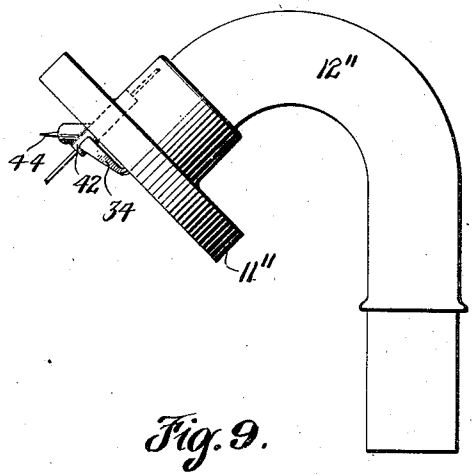


Fig. 4.

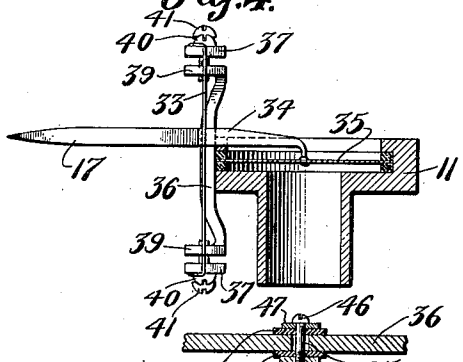


Fig. 9.

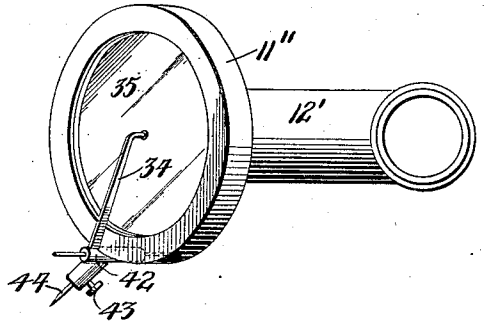


Fig. 7.

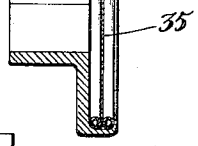


Fig. 5.

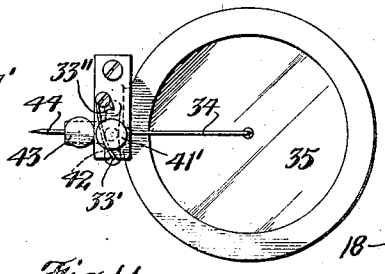


Fig. 6.

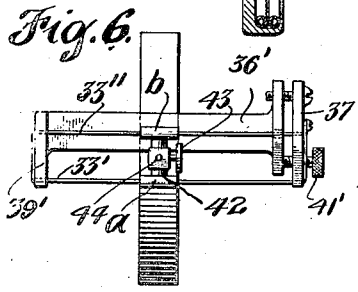


Fig. 10.

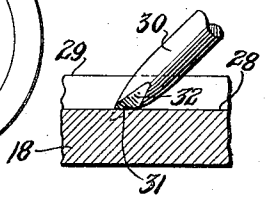
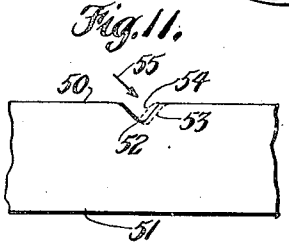


Fig. 11.



WITNESS
Gustav Genzlinger.

INVENTOR
William M. Venable
BY
Synnestvedt & Lechner
ATTORNEYS

Patented Dec. 26, 1922. 1,439,718

UNITED STATES PATENT OFFICE.

WILLIAM M. VENABLE, OF PITTSBURGH, PENNSYLVANIA.

PHONOGRAPH.

Application filed April 1, 1920. Serial No. 370,521.

To all whom it may concern:

Be it known that I, WILLIAM M. VENABLE, a citizen of the United States, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Phonographs, of which the following is a specification.

This invention relates to phonograph apparatus which may be used either for recording or reproducing purposes and it is particularly applicable to phonographs of the disc type.

The principal objects of the invention are first to provide a simple means for maintaining the soundbox stylus in its correct position with respect to the record without abandoning the use of the fixed pivotal support for the soundbox which has proven so advantageous in practice as to have become almost universally applied: second, the provision of means which will permit the stylus to yield slightly in directions other than those normally demanded by the vibrations of the soundbox diaphragm: and third, the provision of means embodying both of the foregoing which will conveniently adapt my invention for use in the reproduction of either lateral cut, vertical cut or slanting cut records upon the same machine. Another object of the invention is the provision of a fulcrum support which is insulated from the soundbox shell by means of some vibration absorbing material such as rubber. It is the further intention of this invention to provide means which will accomplish the foregoing objects which can be readily applied to the various types of phonographs already on the market with but little, if any fitting or change. These, together with such other objects as are incident to my invention, or which may appear hereinafter, I obtain by means of a construction which I have illustrated in preferred form in the accompanying drawings, wherein:

Fig. 1 is a plan view of one embodiment of my invention which can be used either with vertical or lateral cut records; Fig. 2 is a side elevation of the apparatus illustrated in Fig. 1; Fig. 3 is a side view of a soundbox embodying my invention; Fig. 4 is a section on the line 4—4 of Fig. 3. Fig. 5 is a side elevation of a soundbox embodying a modification of my invention; Fig 6 is an end view of the construction of Fig 5; Fig. 7 is a cross section through a soundbox illustrating the manner in which the fulcrum support is insulated from the soundbox shell; Fig. 8 is a plan view of a soundbox and its carrier arm, the soundbox embodying my invention, illustrating the manner in which it can be applied for playing records of either the vertical, lateral, or slanting types without changing the position of the soundbox; Fig. 9 is a side elevation of the construction illustrated in Fig. 8; and Fig. 10 is a greatly enlarged section longitudinally of a record groove illustrating the manner in which a playing stylus wears; and Fig. 11 is a cross section on a greatly enlarged scale through a portion of a record disc illustrating the character of the undulations in what is termed a slanting cut groove.

In Figs. 1 and 2 the invention is illustrated in association with a construction which is readily adaptable for playing either lateral cut or vertical cut records.

In these figures, the swinging guide arm is represented by the tone arm 14′ and its pivotal support by 15′. The soundbox 11′ carried by the arm 12′ is connected to the guide or tone arm by means of the vertical pivot 13′. At this vertical pivot 13′ there is fixed to the carrier arm 12′ the supplemental arm 27 to the outer end of which is pivoted one end of the guide bar 7′. The other end of the guide bar is connected to a fixed support by means of the pivot 8′. By this simple construction the point of the stylus 17′ can be maintained at all positions of the guide arm 14′ in its correct position with respect to the groove in the record 18 in which it is traveling. To this end the proportion of the various parts are geometrically worked out and the various points of pivotal support properly located. When the soundbox is placed upon the outer edge of a record the parts will assume the positions indicated in dotted lines in Fig. 1 and when the record has been played the parts will assume the positions indicated in full lines in the same figure. As the guide arm 14′ swings inwardly toward the center of the record the soundbox carrier arm 12′ will be moved in the opposite direction on its pivot 13′.

A horizontal pivot 16′ permits vertical movement of the soundbox, this pivot being located at the outer end of the tone or

guide arm 14′ in a manner well known in the art. The connections between the guide bar 7′ and the vertical pivots 13′ and 8′ are made loose enough so as to permit the slight up and down movement of the soundbox which is required without danger of binding.

In talking machines as hitherto made there has been but one vertical pivot provided and that is the one at 15′ around which the guide or tone arm 14′ swings. Consequently the stylus 44, as it moves inwardly over the surface of the record, makes a continually changing angle with respect to the groove in which it is traveling, the total amount of variation ranging anywhere from 10° to 20°.

The advantages secured by uniform and correct alignment of the stylus with reference to the groove are very great. In Fig. 10 I have illustrated on a greatly enlarged scale, the point of a steel stylus which has been much worn by proper use. The bottom of the groove on the record 18 is represented by the line 28, and its upper edge by the line 29. The dotted line represents that portion of the stylus 30 which has been completely worn away. This wear has produced a somewhat elongated sled-like bottom 31. The sides of the needle have also been ground by the sides of the groove, as indicated at 32. This needle has been thus evenly worn through proper use upon a machine embodying my improvement and it will be seen that as long as the point remains fine enough it could be used repeatedly without detrimental effect to the record groove. Without changing the needle, after it has been used to play a record, the soundbox can be replaced in the groove at the beginning of the record and the needle still fit exactly, but if the machine does not provide the swinging movement of the soundbox carrier 12′ on the pivot 13′ the worn edge of the needle from the end of the record does not fit into the groove at the beginning of the record, but sets diagonally across it. If an attempt is made to use the stylus twice it has to be worn in again when placed at the beginning of the record and this wearing in process cuts and damages the record groove very extensively. This is well known in the art and is the chief reason why instructions are given phonograph users to play but one record with each steel needle. The damage is especially serious to the records of most delicate quality and large diameter, which are the most expensive.

I will now refer more specifically to the improvements in the soundbox portion of the phonograph which are illustrated in the figures thus far considered and in greater detail with several modifications in Figs. 3 to 9, inclusive. Figs. 3 and 4 illustrate in greater detail and on an enlarged scale a soundbox, which is especially designed for recording purposes. It will be seen that the novel feature of construction is the provision of an elastic fulcrum for the vibration lever 34, consisting of a wire 33 under tension and disposed in a plane substantially at right angles to the plane of the diaphragm, the lever being connected to the center of the diaphragm 35. The stylus 17 is firmly fixed to the vibration lever 34 preferably by means of a mixture of beeswax and resin. The vibration lever is cemented or otherwise firmly attached to the wire.

The wire is supported by means of the yoke 36 attached to the shell of the soundbox 11. The ends of the wire are bent over a pair of clips 37 and attached thereto by means of small screws 38. The clips are held in place against the outer surfaces of the arms 39 of the yoke by means of the screws 40 and 41 which screws also serve as a means for adjusting the tension on the wire 33 and also the pressure of the vibration lever upon the diaphragm at its center for it will be observed, by means of the screws 40 and 41 it is possible to bodily move the fulcrum wire and all parts attached to it to a slight degree in one direction or the other longitudinally of the wire.

The above described construction provides a remarkably efficient instrument which, in the particular form disclosed in Figs. 7 and 8, is particularly useful as a recorder. This wire takes the place of the ordinary knife edge or other rigid fulcrum and is an improvement thereover. It cannot move appreciably in the direction of its length and it cannot become worn loose or gummed up. It is very efficient as a fulcrum for vibrations normal or at right angles to the diaphragm (those produced by sound waves acting upon the diaphragm), especially very slight ones and at the same time it will readily yield to slight forces normal to itself or in a plane across its length (in general forces which are longitudinal of the plane of the diaphragm). These forces or motions which I have termed normal to the wire, are due to wobbling of the turn-table or to variations or warpings of the surface of the record. By means of this slightly yielding contact between the stylus and the record a very uniform and at the same time, a very slight pressure of the stylus point against the record may be secured and maintained even though the turn-table and motor driving it be of comparatively crude construction such as is found in ordinary phonographs not intended primarily for recording purposes. By properly adjusting the tension in the wire, it is possible to raise the "natural pitch" of the system, as it might be termed,

so as to render it sensitive to high pitched notes but not sensitive to the raucous sounds which some soundboxes are prone to accentuate by resonance.

It is, of course, perfectly obvious that the principal of the wire fulcrum can be embodied in a soundbox which is intended for reproducing purposes only. Such an embodiment of my invention in a form which corresponds to the form shown in Figs. 3 and 4 is illustrated in the reproducer 11′ shown in Figs. 1 and 2. The only difference occurs in the provision of a suitable holding means for the reproducing stylus which will permit of its being changed whenever necessary. A very convenient manner in which to take care of this requirement is by the provision of a suitable matrix 42 which is illustrated in Figs. 1 and 2 and also in Figs. 5, 6, 8 and 9, which latter figures illustrate modifications of the invention to be described later. This matrix embraces both the wire and the vibration lever and it is constructed to provide the usual thumb screw holding means 43 for the reproducing stylus 44. The rest of the device can be made exactly the same or very similar to what has already been described in connection with the recording instrument illustrated in Figs. 3 and 4.

The yoke which supports the fulcrum wire is very rigid and, as the wire itself is incapable of appreciable stretchings under the influence of the small forces transmitted through the vibration lever, it is obvious that the lever vibrations will produce slight bendings of the fulcrum wire, the elasticity of which always tends to bring the lever back into its neutral position. Appropriate resistance in the wire is secured by making it of suitable length, thickness and composition and then by regulating its tension.

These parts are so proportioned that the vibration caused by a faint sound, since it is of but slight amplitude, demands but a slight bending of the wire, and, therefore, suffers very little resistance from it, while vibration caused by a loud sound encounters substantial resistance. The resistance may be increased or diminished by increasing or diminishing the tension on the wire.

A reproducer constructed to embody this invention will eliminate, to a great extent, the harsh, metallic scratching sounds always present in greater or less degree in the playing of a record. It will also cause less wear on the record because of the fact that it can yield slightly to compensate for any irregularities in the motion of the turn-table or in the surface of the record.

Instead of using but a single fulcrum wire it is obvious that I may use two or more. Such a construction is illustrated in Figs. 5 and 6 wherein I show the use of two wires 33′ and 33″. The matrix, in this case, is provided with two arms *a* and *b*, the arm *a* embracing the wire 33′ and the arm *b* the wire 33″. These two wires are preferably arranged at equal distances from the center of the diaphragm. The result of this duplication of wires insofar as the reproduction of sound is concerned, and the saving of the record goes, is the same as it would be with one wire but the construction is more substantial and less likely to be injured, especially when changing the playing stylus. It is not necessary in all cases to provide a clip and adjusting screws at each end of the fulcrum wire or wires and in these figures I have illustrated a soundbox for general purposes of a preferred construction in which there is but one clip 37′ at one end. At the other end the two lengths of wire, which can be made continuous, loop over the arm 39′ of the yoke 36′ as shown. A thumb screw 41′, adjustable by hand, is provided for regulating the tension on the wires, the particular value of which will appear hereinafter.

In the playing of records there is always present certain secondary or resonant vibrations which are not components of the recorded sounds which are being reproduced. Such secondary vibrations produce undesirable tone qualities which should be eliminated or softened to as great an extent as is possible. My construction accomplishes this result to a degree heretofore unobtainable. When the stylus 44 is vibrated by the undulations of the record groove it must, as above stated, produce slight bendings in the wire or wires in transmitting such vibrations to the diaphragm. The resistance of the wires tends to hold the stylus and its lever in neutral position and the tighter and stiffer they are the greater will be the resistance they offer. By regulating the tension it is possible to quite markedly regulate the quality of the reproduced sound. A wire under great tension accentuates the vibrations which produce the higher pitched sounds while one under a somewhat lesser tension will permit the tones of lower pitch to predominate.

In order to further avoid or nullify the effects of such secondary vibrations, I provide my improved soundbox with a vibration absorbing cushion between the parts which support the fulcrum wire and the soundbox shell or casing upon which they are mounted. The manner in which I do this is illustrated in Fig. 7. The yoke 36 is provided with an aperture 45 through which extends the fastening screw 46 of smaller diameter than the diameter of the hole 45. Between the yoke and the shell of the soundbox, and between the yoke and the washer 47, I provide insulating pieces of rubber or other suitable vibration absorbing material.

In other soundboxes there is no such cushion between the fulcrum and the shell of the soundbox. Instead they are provided with a rubber cushion between the soundbox and its carrier arm, or between the soundbox and the tone arm, which, in my construction, can be readily dispensed with. Any mechanical vibrations, which may be communicated by the wire fulcrum to its support, are cushioned in my construction from the soundbox casing.

As previously described, means for regulating the tension in the fulcrum wires is provided. This is very advantageous and, in conjunction with the rubber cushion shown in Fig. 7, it serves, in reproducers, in addition to the function of somewhat regulating the quality of tone, that of enabling me to vary the loudness with which a record is played without changing the stylus, or throttling the opening to the amplifier which are the two expedients hitherto employed, and each possessed of certain objectionable features. To effect this regulation of tension the more readily, I make one or more of the adjusting screws a thumb screw 41′ as shown in Figs. 5 and 6. By turning this screw in one direction the wires 33′ and 33″ are tightened, and greater resistance is offered by them to the vibrations, and consequently a portion of the energy of vibration is thereby communicated to the yoke 36′ and absorbed by the rubber pads 47 and 48 (Fig. 7) to any noticeable degree. The tone emitted by the reproducer is softened but not impaired in quality. The loud sounds, especially, are reduced, while the soft tones are not lost. By loosening the tension, the vibration is freer, and the volume of sound increases.

This feature is especially valuable where "semi-permanent" needles are used in playing, for it will be seen that the fulcrum support is in a sense a floating one, capable of bodily movement of translation. Its mass tends to resist vibrations and the pads 47 and 48 yieldingly hold the parts in place. The amplitude of movement depends upon the resistance offered to the vibration of the vibration lever. Thus, if the fulcrum wires are relatively loose, relatively less resistance is offered to the vibrations of the lever; whereas if the wires are relatively tight, the total resistance to be overcome is greater and the resistance of the fulcrum support is overcome and the latter moves bodily under the vibrations of the lever, the net result being that a portion of the stylus vibration is absorbed or lost in the shifting of the fulcrum support, and consequently the amplitude of vibration of the diaphragm is less than that of the stylus, correspondingly. By regulation of the tension of the wires, the amplitude of vibration of the diaphragm relative to that of the stylus may be altered at will, and the desired volume of tone reproduction obtained, and this without changing the needle.

My wire fulcrum has the further advantage of limiting the motion of the vibration lever with relation to the plane of the diaphragm so that the diaphragm need not be used at all to support the lever, but may be merely cemented to it, with a suitable wax and without the use of a screw or clamp as is frequently the case. The sole function of the connection in my construction is to transmit vibrations from lever to diaphragm, the lever being completely supported independently. Thus the connection to the diaphragm may be made lighter and more delicate, and the instrument is correspondingly more sensitive to feeble vibrations or to those of high pitch.

In Figs. 5, 6 and 7 I have illustrated an embodiment of my invention suitable for playing records of the so called "lateral" type in which the undulations in the groove are from side to side horizontally of the record. This is well known in the art and need not be described in detail. The playing stylus, in reproducing the sound waves of a record of this character, oscillates from side to side and it is, therefore, essential that the diaphragm of the sound-box be set in a plane which is substantially tangential to the groove in the record.

In contradistinction to this type of record there is a record which is known in the art as the vertical cut, or hill and dale record, in which the undulations which produce the sound, are in an up and down direction vertically of the record. The diaphragm of the soundbox when playing a record of this character must be located in a plane which is substantially transverse to a plane which is tangent to the record groove. In Figs. 1 and 2 I have illustrated a construction embodying my invention in which the soundbox can be so turned as to position its diaphragm in a plane transverse to one which is tangent to the groove. This construction has been designed so that it can play either lateral or vertical cut records, the position of the soundbox when playing lateral cut records being indicated in dotted lines and the position when playing vertical cut records in full lines.

In order to adapt my improved soundbox for this double or universal use, I provide a swivel joint 49 in the soundbox carrier arm 12′. The stylus for playing vertical cut records is usually equipped with a permanent or jeweled point shown at 43′. The stylus used for playing lateral cut records is removed when playing vertical cut. I have so designed the soundbox carrier arm 12′ and the swivel joint 49 that the stylus, whether it be playing a lateral or a vertical cut record, comes at substantially the same point

and in each case in a plane which is tangential to the direction of rotation of the record at the point of stylus contact.

Other so called "universal tone arms" provide for a swivel motion of a soundbox, in which there is but one needle holder, the swivel motion being of such a character as to bring the same needle point to the same position upon the record while varying the position of the diaphragm. When playing vertical cut records such swivels bring the diaphragm into an inclined position. It is obvious that if, instead of maintaining the soundbox substantially vertical with respect to the disc and providing the point 43′, as shown in Fig. 2, I use the needle 44 and incline the soundbox to bring the needle to the proper point, I must make the fulcrum wire and its supports short enough to avoid touching the record surface. When I do this, my soundbox may be used upon other "universal" tone arms, and for this purpose the use of adjusting screws at one end of the fulcrum wire only, as in Fig. 6, is especially advantageous since it economizes space. My purpose, however, is not merely to produce a soundbox which may be used on other machines but comprehends making marked improvement in the phonograph as a whole; and it will be seen that these improvements all cooperate toward that end. Not only is the position of the parts shown in Fig. 2 most favorable for the perfect reproduction of sound, but there is the further advantage of having a permanent playing point for the finer hill and dale records such as the Edison. The changing of points used for such records is highly detrimental to the record groove.

When playing vertical cut records the fulcrum wire yields slightly to accommodate the stylus to lateral unevenness of motion due to inaccuracy in the rotation of the disc or other cause and when playing lateral cut records the wire fulcrum will yield slightly to accommodate the stylus to vertical unevenness of motion.

I have described my improved soundbox with relation to the position of the diaphragm and stylus for playing either lateral or vertical cut records. There is, however, an intermediate type of record known as the slant or inclined cut. This type of record has grooves cut in accordance with the diagrammatical illustration contained in Fig. 11 in which the upper surface of the record is indicated by the character 50 and the underface by the character 51. The normal depth of the sound groove is indicated by the full line 52 and the undulations produced by the sound vibrations by the dotted lines 53 and 54. These undulations are produced by means of a stylus acting in the direction indicated by the arrow 55. Such a record will play upon a machine in which the soundbox is set for playing either lateral or vertical cut records. My yielding fulcrum construction is particularly valuable when playing a record of this type upon an ordinary phonograph designed to play either lateral or vertical cut records. Under such circumstances there is a component in the undulations of the record groove which may be transmitted to the diaphragm to produce vibrations useful in sound reproduction and also a component which cannot be so utilized but which can, instead, cause undue record wear or transmit mechanical vibrations through the fulcrum to the soundbox casing which are exceedingly undesirable and very marring in their influence upon the reproduced sound. Under these circumstances, as above pointed out, my improved soundbox is exceptionally valuable, inasmuch as the yielding fulcrum and the sound vibration absorbing material between the fulcrum support and the soundbox casing tend to strain out or eliminate, to a great extent, the undesirable vibrations.

I can so design my machine and position the soundbox on its carrier arm as to make it possible to play any one of the three types of records which have been considered on the same machine without changing the position of the soundbox. I have illustrated the position of a reproducer 11″ on its arm 8″ in order to accomplish this in Figs. 8 and 9. The soundbox is set in a plane at an angle of substantially 45° to the position it would occupy if it were set to play either vertical or lateral cut records. The stylus 44 is made to project in the same direction in which it would project were the soundbox to be set at the proper angle for either vertical or lateral cut records. My improved soundbox construction makes the showing of Figs. 8 and 9 a successful possibility, for without the yielding fulcrum which I provide such a position of the soundbox would cause excessive wear on the ordinary vertical or lateral cut records.

It should be noted that in the present application I make no specific claim to the guiding mechanism herein disclosed inasmuch as this subject matter has been claimed in a divisional application filed August 12, 1921, bearing Serial No. 491,656.

What I claim is:

1. In a phonograph sound box, the combination with a diaphragm and its vibration lever, of a fulcrum for the lever including a plurality of wires substantially parallel with one another and with the axis of the diaphragm.

2. In a phonograph sound box, the combination with a diaphragm and its vibration lever, of a fulcrum for the lever including a plurality of wires arranged in a plane which is substantially at right angles both to the plane of the vibrations of the lever and to the plane of the diaphragm.

3. In a phonograph sound box, the combination with a diaphragm and its vibration lever, of a fulcrum for the lever including a plurality of wires arranged in a plane substantially at right angles both to the plane of the vibrations of the lever and to the plane of the diaphragm and an attaching matrix for the lever having extended engagement with the wires.

4. In a phonograph sound box, the combination with a diaphragm and its vibration lever, of a fulcrum for the lever including two wires substantially equidistant from the parallel with the axis of the diaphragm, a stylus holder, and an attaching matrix for connecting the stylus holder to the wires.

5. In a phonograph sound box, the combination with a diaphragm and its vibration lever, of a fulcrum for the lever including two wires substantially equidistant from and parallel with the axis of the diaphragm and means for regulating the tension of the wires.

6. In a phonograph sound box, the combination with the diaphragm and its vibration lever, of an elongated yielding fulcrum for said lever disposed in a plane substantially at right angles to the plane of the diaphragm, a supporting member for said fulcrum, and cushioning means between the supporting member and the sound box casing whereby the supporting member may have limited bodily movement of translation with relation to the sound box casing.

7. The combination in a phonograph sound box, of a diaphragm, a vibration lever, and a fulcrum for the lever cushioned so as to permit of yielding bodily movement of translation and means whereby the amplitude of movement of translation may be varied.

8. The combination with a phonograph sound box device, having two vibrating members, the diaphragm and the stylus, of a vibrating means for connecting the stylus to the diaphragm, a support for said connecting means, a cushion between the support and the sound box adapted to permit bodily movement of translation on the part of said support, and adjustable means for offering resistance to vibration of the connecting means so as to vary the amplitude of vibration of the diaphragm relative to the stylus.

9. In a phonograph sound box, the combination of a stylus element actuating a diaphragm element; connecting means between said stylus and diaphragm, a cushioned support for said connecting means, and adjustable means for restraining the action of the stylus upon the diaphragm through the medium of the cushioned support.

10. In a sound box, a casing, a diaphragm secured therein, a stylus, a lever connecting the stylus with the diaphragm, a spring associated with the lever so as to be bent by oscillations of the lever, means for regulating the tension of the spring, a fulcrum supporting member for the lever, and a cushion between the fulcrum supporting member and the casing which permits limited vibratory motion between the supporting member and the casing.

11. In a phonograph sound box, the combination with a diaphragm and its vibration lever, of a fulcrum for the lever including a plurality of substantially parallel wires arranged in a plane which extends in a direction substantially at right angles to the plane of the diaphragm, said wires extending transversely of the diaphragm.

12. In a phonograph sound box the combination with the diaphragm and the stylus of means for transmitting vibrations from the latter to the former including a vibration lever, a stylus holder, at least two yielding members both subject to deflection by the sound vibrations, and means for regulating the relative yield of the two members.

13. In a phonograph sound box the combination with the diaphragm and the stylus of means for transmitting vibrations from the latter to the former including a vibration lever, a stylus holder, at least two members each capable of yielding movement under vibratory forces, and means sustained only upon said transmitting mechanism for regulating the yielding of said members.

14. A vibration transmitting mechanism for a phonograph sound box comprising in combination with the stylus, the diaphragm, the stylus holder, and the vibration lever, at least two yielding members cooperating with the foregoing parts, the yield of one being regulated by the yield of the other, and means for adjusting their combined resistance to yield in order to vary the volume of the reproduced sound.

In testimony whereof, I have hereunto signed my name.

WILLIAM M. VENABLE.