J. GRAHAM.

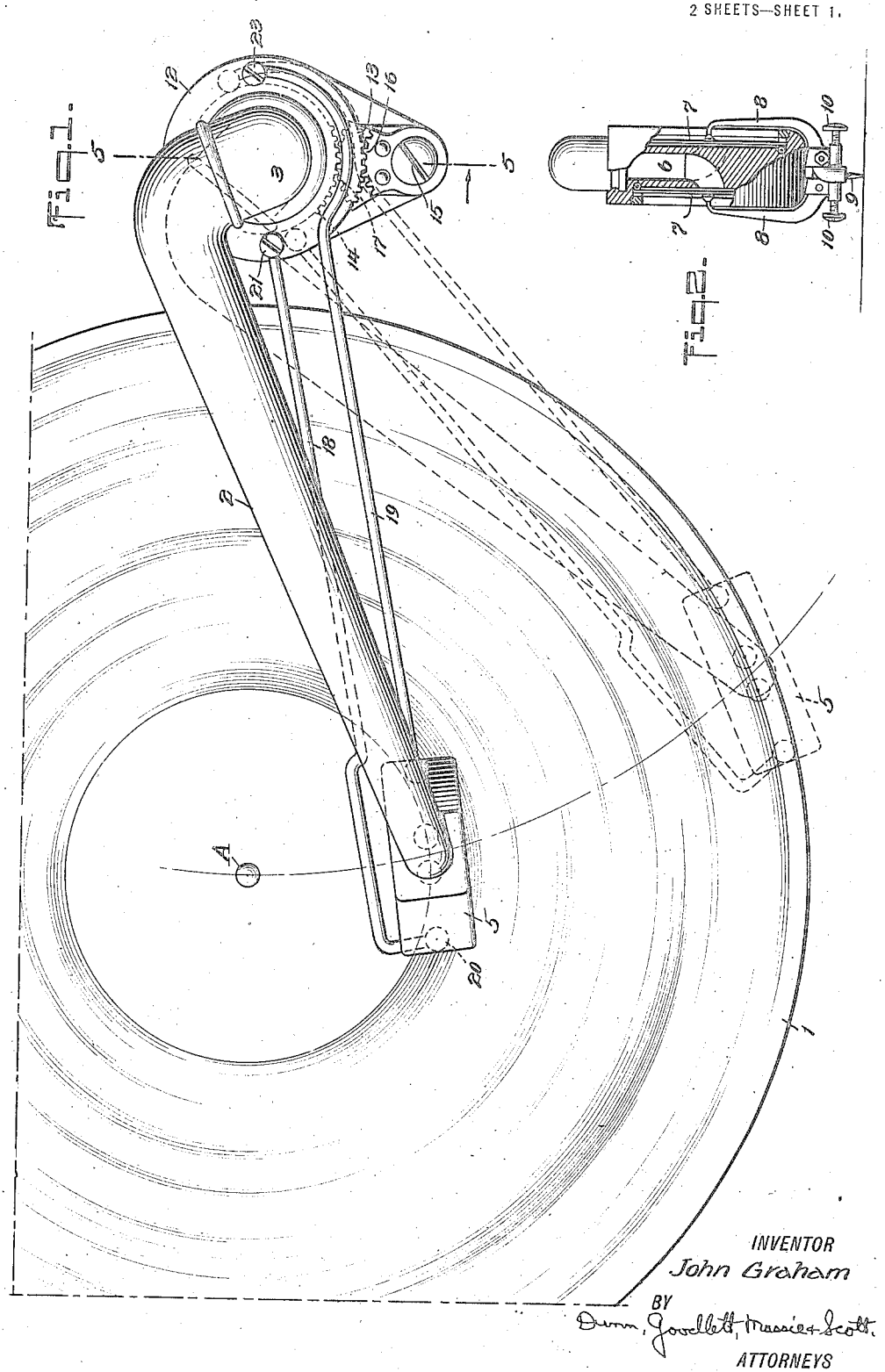
POLYPHONE SOUND BOX AND MOUNTING THEREFOR.

APPLICATION FILED JAN. 9, 1922.

1,438,642.

Patented Dec. 12, 1922.

2 SHEETS—SHEET 1.



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2 SHEETS—SHEET 2.

Fig. 2.

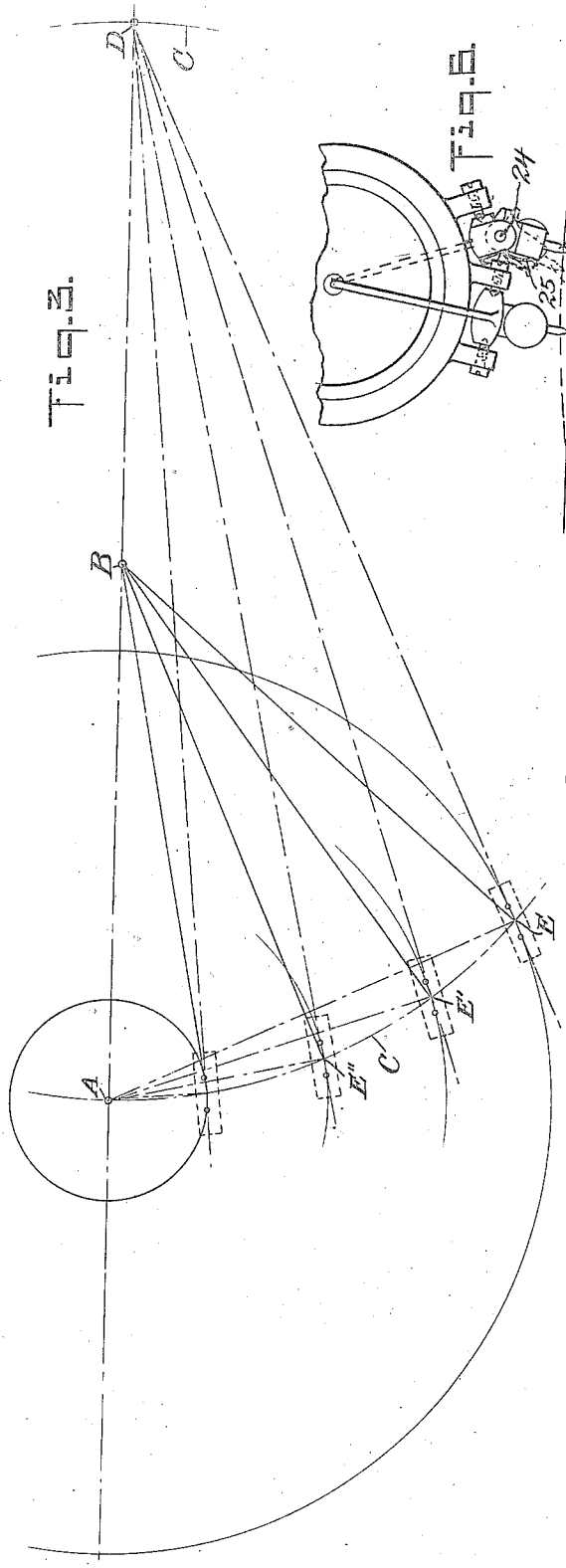


Fig. 3.

Fig. 5.

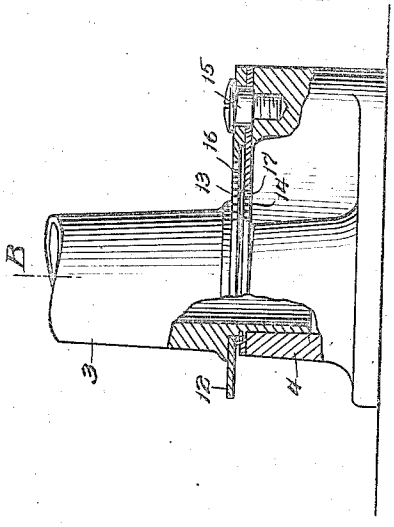
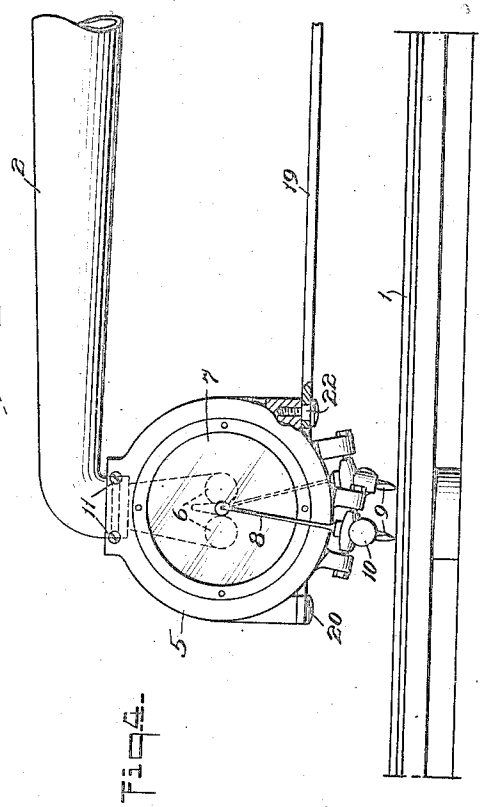


Fig. 4.



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Patented Dec. 12, 1922. 1,438,642

UNITED STATES PATENT OFFICE.

JOHN GRAHAM, OF STRATFORD, CONNECTICUT.

POLYPHONE SOUND BOX AND MOUNTING THEREFOR.

Application filed January 9, 1922. Serial No. 527,860.

To all whom it may concern:

Be it known that I, JOHN GRAHAM, citizen of the United States, residing at Stratford, Connecticut, have invented a new and useful Improvement in Polyphone Sound Boxes and Mountings Therefor, of which the following is a specification.

This invention relates particularly to talking-machines of the type known as polyphones, wherein two or more styli track simultaneously in the record-groove. Broadly stated, the invention comprises firstly a novel polyphone sound-box; and, secondly, suitable mechanism whereby the plurality of reproducing-styli are maintained in such relative position that they can be lowered with certainty into simultaneously operative engagement with the same groove, and whereby said styli will always be in tangential relationship with the side-wall of the engaged portion of the groove. Furthermore, said mechanism is likewise applicable to the ordinary talking-machine with a single stylus, for maintaining such stylus in said tangential relationship.

More particularly, the invention comprises a sound-box having two separate and distinct diaphragms, each with its own stylus, the two styli being in proximity for tandem engagement in the same convolution of the record-groove. The invention further comprises, in its preferred form, the swivelling of a sound-box (having either a single stylus or two styli) for rotative adjustment upon vertical axis at the end of the tone-arm or other carrier; and, in combination with such swivelled sound-box, the provision of suitable mechanism actuated by the advance or swing of the tone-arm or carrier for automatically imparting to the swivelled sound-box the progressive rotary adjustments requisite for maintaining the stylus or styli in the desired tangential relationship aforesaid. Said polyphone sound-box can be used without the adjusting-mechanism aforesaid; and said adjusting-mechanism can be used with a single-stylus sound-box; but preferably the two features are employed in combination. Finally, the invention comprises the various features of construction and arrangement hereinafter set forth and claimed.

The invention will be best understood by reference to the accompanying drawings, which set forth a preferred embodiment thereof in the form of a polyphone machine carrying two styli and designed for playing records of the disc form having a spirally-disposed record-groove of the laterally-undulating or zigzag type. But said drawings are presented merely for the sake of illustration, since the invention is not limited to that specific type of machine and record, nor to the preferred structure thereby set forth.

In said illustrative drawings:

Fig. 1 is a plan view showing in full lines the swinging arm presenting a polyphone sound-box in one position of operative engagement with the record-disc, another operative position of said arm and sound-box being indicated by broken lines;

Fig. 2 is an edge view, partly broken away, of the new polyphone sound-box itself;

Fig. 3 is a diagram illustrating the relationship of the parts with respect to the tangential feature aforesaid;

Fig. 4 is a side-elevation or face-view of said polyphone sound-box, partly broken away, showing portions of adjacent parts;

Fig. 5 is a side-elevation, partly in vertical section, of the down-turned elbow of the tone-arm, and of certain adjacent features of the automatic adjusting-mechanism aforesaid; and

Fig. 6 is a side elevation of a modification of the structure of Fig. 4.

Referring first to Fig. 1: 1 is the usual record-disc, and A is its axis-of-revolution (in the center of the usual stud on the turntable). 2 is a swinging-arm for carrying the sound-box, here shown as a hollow sound-conveying member, which may be of the usual or any preferred shape. The inner end of said arm is shown as a horizontally-offset elbow which is swivelled, on horizontal axis, to a corresponding horizontal offset or elbow at one side of the upper end of the vertical tubular member 3, which latter is rotatably mounted upon stationary upright tube 4, to swivel on vertical axis B. Said stationary tube 4 communicates with the usual horn (not shown). The two hollow members 2 and 3 thus constitute the usual swinging tone-arm, of which member 3 is the down-turned elbow. The foregoing is old.

The new polyphone sound-box 5, carried by the outer end of said arm 2, has two

cavities 6—6, one in each of its opposite faces, each closed by its own diaphragm 7, there being thus provided the usual chamber at the rear of each diaphragm. These chambers communicate with a common passage-way leading into and through the tone-arm (see Figs. 2 and 4). On each face of said sound-box is a suitably-fulcrumed stylus-lever 8, each carrying its own reproducing-stylus or needle 9, as by the usual set-screw 10. The parts are so constructed and arranged that the two needles 9 and 9 are quite close together (see Fig. 4); and preferably their operative tips lie in the same vertical plane, which is parallel with the two diaphragms and midway between them (see Fig. 2).

Since the surface of the usual disc record is not always a true plane, but is liable to be slightly warped (as exaggerated in dotted lines in Fig. 6) it might occur that with the rigid stylus-lever construction shown in Fig. 4 both needles 9 would not always maintain contact with the bottom of the record-groove. There may therefore be provided a horizontal hinge 24 just below the fulcrum of one of the stylus-levers, and a spring 25 to hold the needle 9 in operative engagement with the bottom of the record-groove. Thus the weight of the sound-box and tone-arm holds the needle carried by the rigid stylus-lever in operative position while the hinged construction gives the vertical play necessary to keep the other needle-point in proper position.

The above-described polyphone sound-box may be secured to the tone-arm rigidly if desired, in which case it will give a certain degree of satisfaction, in that the two stylus-tips (which will always be presented in the same fixed relative position) can be lowered for simultaneous engagement with the record-groove, and in that the two styli will vibrate two diaphragms instead of only one, and will thereby produce a greater volume of sound, and (in the judgment of some authorities) will confer the advantage of more richness or roundness and fullness of sound. But preferably, and according to the full embodiment of the present invention, as hereinafter set forth, said polyphone sound-box is rotatably adjustable on vertical axis with respect to the tone-arm, and suitable mechanism is provided for automatically maintaining its two styli in tangential relationship with the successively-engaged convolutions of the record-groove.

Referring now to Fig. 3: The arc C, drawn from B as its center and passing through the aforesaid axis A, represents the path of the two stylus-tips (here considered as a unit), as the tone-arm and styli swing upon the aforesaid axis B as their center of rotation. If the line AB be prolonged an equal distance BD, then the line AD (twice the length of line AB) is a diameter of the circle of which the arc C is a portion; the two lines drawn from any point in said circle to the extremities A and D of said diameter will constitute a right angle; and therefore any line drawn from D to any point as E, E′, E″, etc., on the circle will make a right angle with the line from such point to A. In other words, the point D is the common focus of the tangent-lines drawn from the successive points E, E′, E″, etc., where said arc C intersects the successive convolutions of the record-groove (here regarded as approximately concentric circles, whose center is A, rather than as convolutions of a true spiral). It is manifest that any and every line drawn from said focal point D to any position E (E′, E″, etc.,) will be perpendicular to the line drawn from the latter point to the point A; in other words, every line from said focal point D which intersects the arc C is tangent to the record-groove where the latter passes through that point of intersection. Hence it is obvious that if, in the course of the swing of the tone-arm on axis B, the sound-box can be progressively tilted (on vertical axis) to occupy the successive vertical planes of tangency radiating from said focal point D, then throughout the swing of the tone-arm, the sound-box with its two stylus-tips will always occupy the proper tangential relationship to the particular portion of the record-groove then engaged. Further, the angle ABE (subtended by the tone-arm) equals the sum of the two angles BED and BDE. But the two angles last-indicated are equal to each other; hence said tone-arm angle ABE is just twice the angle ADE (subtended from point D). In other words, in its travel across the record-disc, the sound-box should be progressively tilted on its vertical axis, at just one-half the angular rate at which the tone-arm is advancing, in order to keep the stylus points tangent with the groove then engaged.

For applying the foregoing, reference will be first made to Figs. 4 and 2 to disclose a preferred manner of swivelling the sound-box, to permit said progressive tilting, and then to Figs. 1 and 5, to disclose preferred mechanism for automatically producing the requisite progressive tilting. As shown in Figs. 4 and 2, a cylindrical recess provided in the upper portion of the sound-box is fitted freely over a reduced tip provided on the down-turned outer end of the tone-arm, and the sound-box is suitably secured in place as by two screw-threaded rods 11 passed horizontally through the sound-box and engaging in a circumferential groove around said down-turned tip. By this structure and arrangement, the sound-box can be tilted on vertical axis,

which axis is preferably in the same vertical plane with the two stylus-tips.

Referring next to Figs. 1 and 5: Around the down-turned elbow 3 (which journals upon upright tube 4), and near its bottom, is supported and freely journalled the horizontal disk 12 presenting an arcuate toothed portion or segmental rack 13. Fast upon said elbow 3, and below said disk, is a second horizontal arcuate toothed portion or segmental rack 14. Journalled, by vertical pivot 15, upon a nearby standard, are two other segmental racks 16 and 17, rigidly secured together, one above the other, and engaging respectively the first-named racks 13 and 14. The ratio of the four racks aforesaid is such that the angular movement or rotation of fixed rack 14, due to the advance of the tone-arm, produces rotation of the disk 12 at just one-half that rate. For example, the two lower mutually-engaging racks 14 and 17 may be of equal radius, while the radius of upper rack 16 (fast to rack 17) is half the radius of its engaging rack 13 (on disk 12). Two links 18 and 19 pivotally connect the sound-box with said disk 12. The front end of link 18 is connected to the front of the sound-box by vertical pivot 20, while its rear end is connected to the front of said disk 12 by vertical pivot 21; and the front end of link 19 is connected to the rear of the sound-box by vertical pivot 22, while its rear end is connected to the rear of said disk by vertical pivot 23. The distance between pivots 20 and 21 (on the sound-box) equals the distance between pivots 22 and 23 (on the disk); while the effective lengths of the two links are likewise equal so that the two links and the sound-box and disk, with their four vertical pivots, constitute in effect a collapsible parallelogram whose opposite sides are always equal and parallel.

By means of the mechanism above described, it will be seen that the advance of the tone-arm, as it is fed across the record-disc, causes the sound-box and its two styli to assume the progressively-tilted positions indicated by the dotted lines in Fig. 3; and that the two styli will always be in proper tangential relationship to the particular convolution engaged by them.

As hereinabove set forth, said automatic progressive adjustment is especially desirable in connection with a polyphone sound-box, yet is equally applicable to a single-stylus sound-box; and the polyphone structure may be employed without such automatic adjustment, yet is preferably used in combination therewith.

The invention has thus been fully described in all its details, but only for the sake of clearness. The invention is not limited to the precise features and details herein set forth. Parts of the invention may be omitted, and others transposed, and other modifications of construction and arrangement resorted to, without in any case departing from the spirit of the invention.

The invention having been thus described, what is claimed is:

1. In a talking-machine comprising a member such as a tone-arm having a vertical portion by which it is journalled to swing horizontally, and comprising also a sound-box swivelled on a vertical axis upon the outer end of said member and carrying two separate and distinct diaphragms with a stylus-lever and a reproducing-stylus for each diaphragm, the combination (with the foregoing) of means for maintaining the tangential relation of said styli to the successive portions of the record-groove engaged thereby, said means comprising a horizontal rack fast to said vertical portion, a horizontal disc rotatable upon said portion and presenting a rack, two other horizontal racks secured fast together and pivoted to engage respectively the first two racks, and links whose ends are pivoted to said sound-box and to said disc respectively to constitute an angle-variable parallelogram, whereby the horizontal movement of said swinging-member produces angular swivelling of said sound-box at one half the rate of the angular swing of said member.

2. In a talking-machine, the combination of a member such as a tone-arm having a vertical-portion by which it is journalled to swing horizontally, a sound-box swivelled on a vertical axis upon the outer end of said member, a rack fast to said vertical-portion, a disk rotatable upon said portion and presenting a rack, two other racks secured fast together and pivoted to engage respectively the first two racks, and two links whose arms are pivoted to said sound-box and to said disk respectively to constitute an angularly-adjustable parallelogram, whereby the swing of said member produces angular swivelling of said sound-box at half the angular rate of said member.

3. In a talking-machine, a horizontally-swinging member such as a tone-arm, a sound-box swivelled at the outer end of said member upon a vertical axis and having two separate and distinct diaphragms with a stylus-lever and a reproducing-stylus for each diaphragm, the axis of said swivel being in the same vertical plane with said styli, and means actuated by the swing of said member for causing said sound-box to swivel at half the angular rate of said member, thereby maintaining the tangential relation of said styli to the successive portions of the record-groove engaged thereby.

4. In a talking-machine, a horizontally-swinging member such as a tone-arm pivoted on a vertical axis, a sound-box swiv-

elled at the outer end of said member upon vertical axis and carrying a stylus, and means actuated by the swing of said member for causing said sound-box to swivel at half the angular rate of said member, whereby said stylus is maintained in tangential relation to the record-groove throughout its travel across the record-disc.

5. A sound-box presenting two separate and distinct diaphragms and having a sound-passage leading from behind each diaphragm to a common sound-conveyor, and a stylus-lever co-acting with each diaphragm and carrying its own reproducing-stylus, one of said levers comprising a horizontally-pivoted joint with yielding means such as a spring for maintaining its stylus in operative engagement with the record.

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