July 14, 1931. A. A. THOMAS 1,813,972

PHONOGRAPH

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Fig. 1.

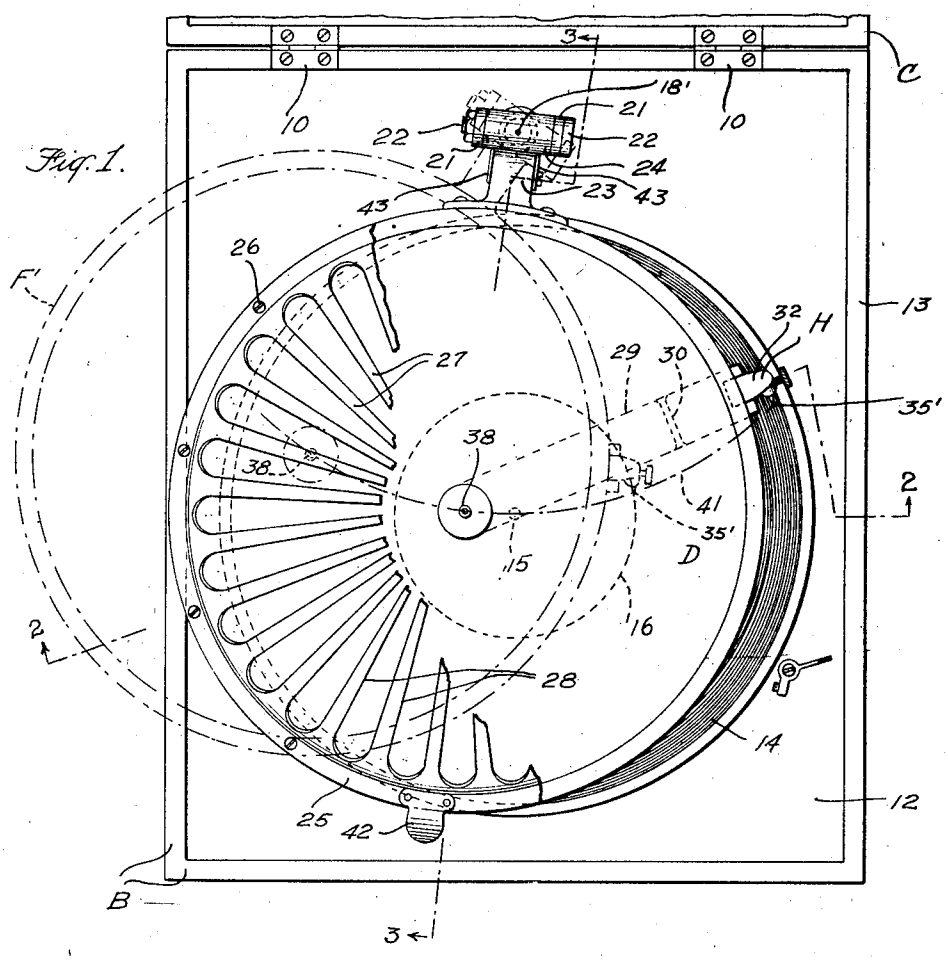
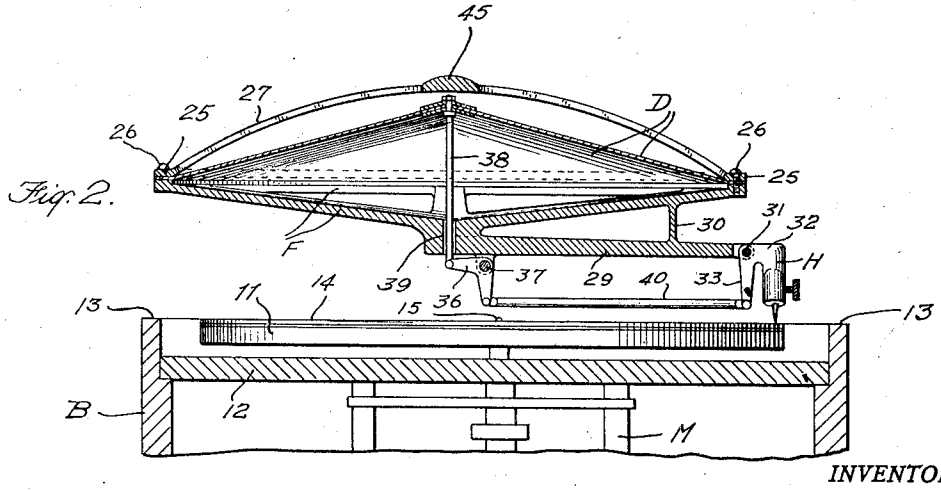


Fig. 2.



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Fig. 3.

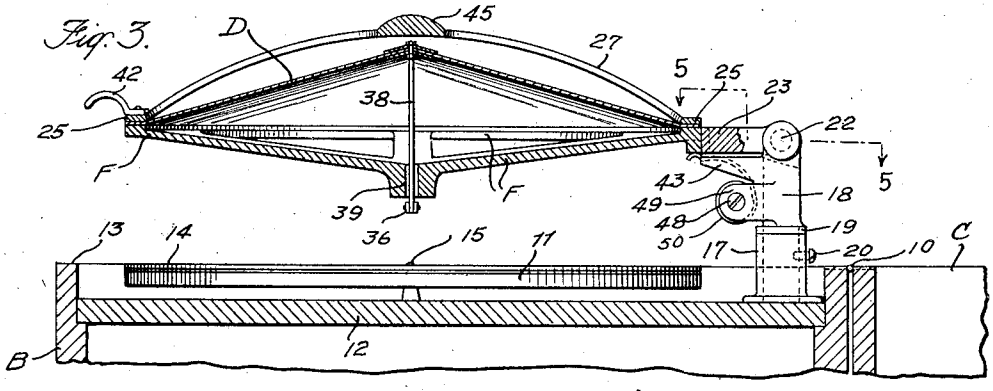


Fig. 4.

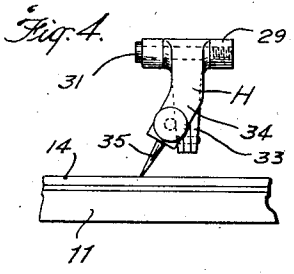


Fig. 5.

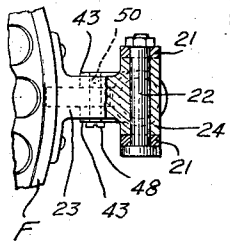


Fig. 6.

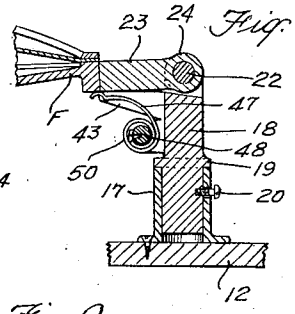


Fig. 8.

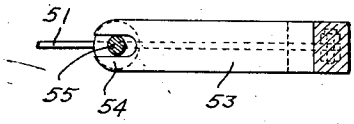


Fig. 9.

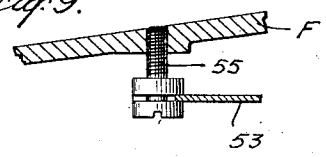
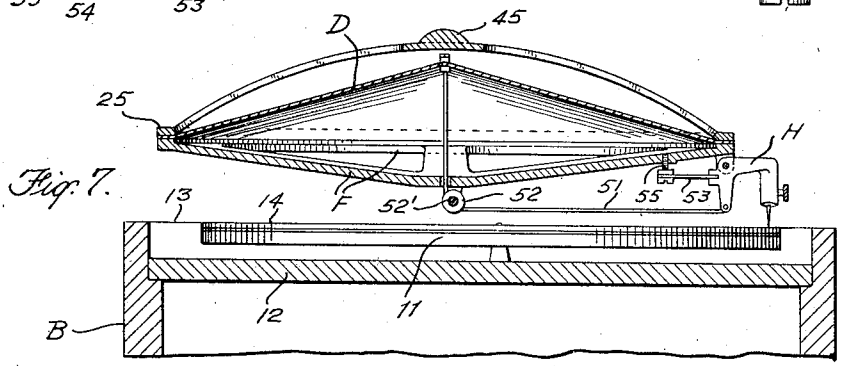


Fig. 7.



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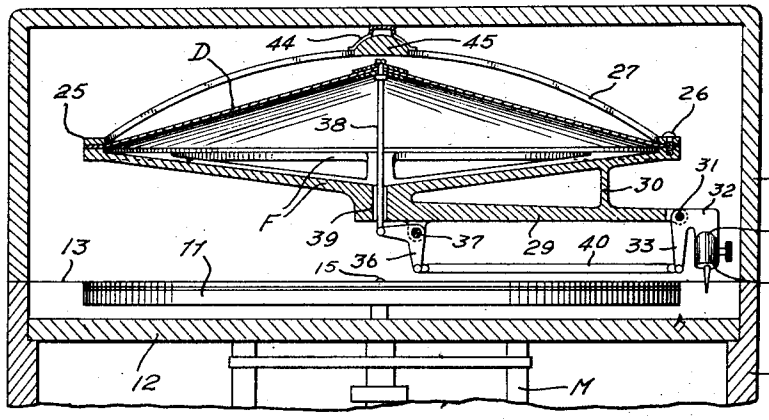
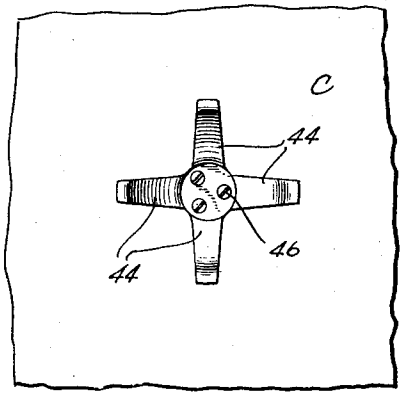


Fig. 10.

Fig. 11.



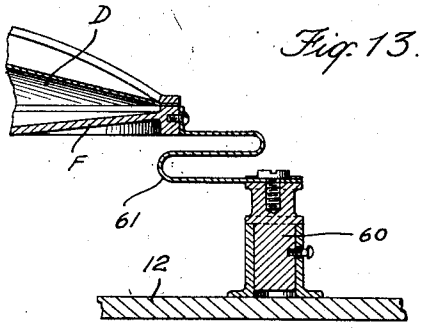


Fig. 13.

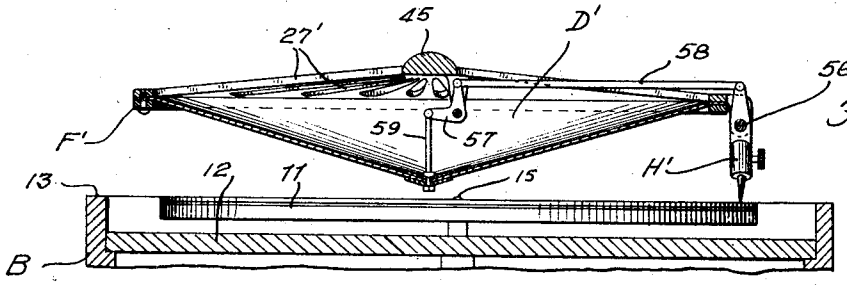


Fig. 12.

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Patented July 14, 1931 1,813,972

UNITED STATES PATENT OFFICE

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

PHONOGRAPH

Application filed June 11, 1926. Serial No. 115,150.

My invention relates to phonographs or talking machines, and its object is to provide novel reproducing mechanism of improved construction and operation. I dispense with both horn and tone arm, employing instead a large diaphragm mounted horizontally close to the record. A needle holder is pivoted to the supporting frame of the diaphragm in easily accessible position. The horizontal diaphragm, which is operatively connected to the needle holder, is preferably of the so-called cone type, but it may be constructed of any practical material and design adapted to give a loud reproduction without the need of a horn or other amplifier.

By eliminating the old horn and tone arm, and mounting the reproducer diaphragm in horizontal position over the record, I produce a construction of unusual compactness, which is especially useful in portable phonographs. The frame of the diaphragm is pivoted to swing horizontally over a record and is also capable of vertical movement. This frame is preferably cast of a light and strong material, like aluminum, so that the total weight at the needle point on the record groove may not be excessive. If necessary, a spring may be used to regulate the pressure exerted by the reproducer mechanism on the stylus point.

Another feature of my new phonograph is a needle holder so constructed and mounted as to operate on lateral-cut records and vertical-cut records without any change or adjustment, it being only necessary to insert the right kind of stylus. The connections between the needle holder and the diaphragm are such that the latter is actuated equally well in the playing of either style of record.

In a preferred embodiment of my invention, particularly when applied to portable phonographs, I provide means for automatically locking the reproducer mechanism against movement when the cover of the box is closed. For this purpose, the horizontal frame carrying the diaphragm has a central projection, and the cover is provided on the inside with suitable gripping means, such as spring fingers, arranged to engage the projection when the cover is closed. This automatically locks the reproducer frame against movement and thus protects it from possible injury, as during transportation of the box.

The foregoing and other objects and advantages of my invention will be fully understood from a detailed description of the accompanying drawings, in which I have illustrated, by way of example, several constructions embodying the ideas of my invention. In these drawings—

Fig. 1 shows in a plan view a phonograph embodying my invention;

Fig. 2 shows a cross-section on the broken line 2—2 of Fig. 1;

Fig. 3 is a cross-section on line 3—3 of Fig. 1;

Fig. 4 is a detached side view of the needle holder;

Fig. 5 is a fragmentary view partly in cross-section on line 5—5 of Fig. 3 to show the mounting of the reproducer frame for vertical movement;

Fig. 6 shows the mounting of the diaphragm frame in cross-section, the frame resting on a bracket in idle position;

Fig. 7 represents, in cross-section, a modification employing a taut filar connection (like a wire) between the diaphragm and the needle holder;

Figs. 8 and 9 are fragmentary views partly in section showing enlarged details of the centering spring blade connected to the needle holder in Fig. 7;

Fig. 10 is a view similar to Fig. 2, showing how the closed lid of the box or cabinet holds the reproducer frame against movement;

Fig. 11 is an enlarged face view of the spring fingers attached to the lid for gripping the reproducer frame when the lid is closed;

Fig. 12 shows a modification in which the cone diaphragm is supported with the apex toward the turntable; and

Fig. 13 is a fragmentary view in cross-section of a spring connection permitting vertical movement of the diaphragm and yet forming a rigid connection for the horizontal movements of the diaphragm.

In order to bring out the compactness of my new phonograph construction, the vari-

ous machines illustrated in the drawings are portable phonographs housed in small boxes which are easily carried about like a suitcase. I want it understood, however, that my invention is not limited to phonographs of the portable type. In order to make the drawings as clear as possible, I have purposely exaggerated the dimensions of certain parts and the illustrations are therefore not to be taken as accurate shop drawings.

I shall first describe the construction shown in Figs. 1–6. The various parts of the phonograph are mounted in a box or case B of suitable construction and design. A lid or cover C is hinged to the box at 10, and has means (not shown) for locking it in closed position. The box may be provided with a carrying handle for easy transportation. A motor M (indicated diagrammatically) operates a turntable 11 mounted over a topboard 12. The top edge 13 of the box is preferably so low as to be substantially flush with (or slightly lower than) a record 14 on the turntable. The purpose of this will presently be made clear. In Fig. 1, the small dotted circle 15 indicates the center of the turntable, and the large dotted circle 16 is supposed to represent arbitrarily the end of the playing surface of the record.

On the topboard 12 near the rear edge of the box is fixed a hollow bearing 17 adapted to receive a pivot post 18. A circular flange or shoulder 19 on post 18 rests on the top of bearing member 17, as best shown in Fig. 6. A screw or pin 20 operating in an arc-shaped slot in support 17 prevents the post 18 from being lifted off its seat, and yet allows rotary movement of the post. The upper end of post 18 terminates in a pair of spaced ears or lugs 21, in which is mounted a horizontal pin 22. There is a circular frame, indicated as a whole by F, which is provided with a rigid extension or bracket 23. This extension has a transverse bearing portion 24 adapted to be mounted on pin 22 between the ears 21 of pivot post 18. It will thus be seen that the frame F swings horizontally with the post 18 on bearing member 17, and also swings vertically about the pin on post 18.

The frame F is adapted to support a large reproducing diaphragm D, which I have conveniently shown in the form of the well known cone type. In the broader aspect of my invention, however, the diaphragm D may be of any practical construction capable of giving a loud reproduction without the need of an amplifying horn. Cone diaphragms are well known in the market, and are usually made of paper, parchment and the like. Large reproducing diaphragms may also be made of metal, such as aluminum, which is usually corrugated or ribbed to impart the requisite stiffness. The size and shape of frame F will obviously depend upon the size and shape of the diaphragm to be supported. For simplicity I have shown the diaphragm circular in outline, but it can be made elliptical and perhaps in other shapes. Diaphragm D is secured in position on frame F by means of a ring 25 and screws or other fastening devices 26. The ring 25 is preferably part of a cover 27 provided with sound openings 28 for the free passage of sound into the outer air. The cover 25—27 may conveniently be cast or molded as a single piece, and preferably will be in the form of an ornamental grille, which adds to the beauty of the machine and at the same time protects the diaphragm against accidental injury.

The reproducer frame F is best made in spider or skeleton form, and may be cast or molded as a single piece. Personally, I prefer to make the frame F of aluminum, which is light and strong. The lower side of frame F is provided with a radial arm 29, which may conveniently be formed integral with the body of the frame. To prevent possible vibration of the arm 29, a thin connecting web 30 may be employed. To the outer end of arm 29 is pivoted a needle holder H on a pin or bearing 31, which should be practically free from lost motion. The needle holder H is in the form of a bellcrank having a horizontal arm 32 and a vertical arm 33. The pivot point 31 is at the corner of these two right-angled arms. The needle-holding portion 34 of the needle holder is arranged to hold the needle 35 at the proper slant during the playing of a record, as best shown in Fig. 4. The needle holder parts 32, 33 and 34 are easily cast as a single piece. The frame F carries near the center a small bellcrank 36 pivoted on a suitable pin or bearing 37, with as little lost motion as possible. A stiff rod or wire 38 is connected at its upper end to the center of diaphragm D and at its lower end to the horizontal arm of bellcrank 36. The frame F is provided with a hole 39 for the free passage of rod 38. The vertical arm of bellcrank 36 is connected to the vertical arm 33 of needle holder H by means of a stiff connecting rod or wire 40, which can be made very light and rigid in the form of a thin hollow tube of metal. The connecting points between the parts 38—36—40—33 may be rigid, since the vibrations transmitted by the needle holder to the diaphragm are very small. Such rigid connections prevent lost motion and add to the efficiency of the machine.

The practical advantage of mounting the needle holder H at the periphery of the horizontal diaphragm will be obvious to those familiar with this art. Heretofore attempts have been made to employ large diaphragms in phonographs, but in those prior machines the needle holder was arranged at the center of the diaphragm and thus out of sight of the operator, thereby making it very diffi-

cult to insert the needle point in the record groove. In the present machine, the needle holder H is mounted so as to project horizontally beyond the diaphragm, so that the needle is always visible in the playing of a record, and it is easy to insert a needle without lifting the diaphragm.

The mounting of needle holder H is such that the needle point traverses an arc which passes through the center 15 of the turntable. This is indicated by the dotted line 41 in Fig. 1. For this purpose, the distance between the axis of pivot point 18 and the needle point is approximately equal to the distance between the pivot axis and the center of the diaphragm. This may readily be determined by actual measurement in Fig. 1, when the point 18′ is the pivot about which the reproducer frame swings horizontally, and 35′ is the point of a playing needle. As the reproducing mechanism travels horizontally over a record, the frame and diaphragm project beyond the sides of the box or cabinet of the machine. This permits the use of a small box or case not much larger than the turntable, and yet allows full and free movement of the horizontal diaphragm from the beginning to the ending of a record. In Fig. 1 the dotted lines F′ represent roughly the position of the reproducer mechanism when the needle has reached the end of the record. The mechanism is easily swung back into alignment with the turntable to permit closing of the lid of the machine. A finger-piece 42 is attached to the front part of frame F for easy manipulation of the reproducer mechanism, which may be swung almost completely clear of the turntable to allow the easy removal and putting on of a record.

Special attention is directed to the double-functioning of the needle holder H, which is so constructed and mounted that it operates equally well on lateral-cut records and vertical-cut records, although it is mounted on a single pivot axis. Looking at Fig. 2, it will be seen that in the case of lateral-cut records where the undulations are in the sides of the groove, the needle holder vibrates right and left about its horizontal pivot 31. When the needle holder operates on vertical-cut records in which the undulations are in the bottom of the groove, the horizontal arm 32 of the needle holder rocks up and down, and that causes the vertical arm 33 to vibrate laterally, as in the case of lateral-cut records. I thus have a needle holder mounted on a single pivot and capable of operating without change or adjustment on both types of records. The transmission ratio between the diaphragm and the needle holder can be predetermined by calculating the relative lengths of the arms 32 and 33 and the arms of bellcrank 36. As a general rule, no amplifying transmission ratio is required with large cone diaphragms.

Referring to Figs. 3 and 6, it will be noticed that the pivot post 18 is provided with a pair of spaced extensions 43 arranged slightly below the connecting piece 23 attached to the frame F. When the machine is playing a record, the frame is held clear of the extension 43. When, however, there is no needle in the holder, or when the reproducing mechanism is swung to one side as shown in Fig. 10, the supporting frame F drops down on the extensions 43, which thus form a supporting bracket for the reproducing mechanism when the latter is not in playing position. When the reproducing mechanism rests on bracket 43, the needle holder and connecting rod 40 remain slightly above the top edge 13 of the box or cabinet, so that the entire mechanism may be swung horizontally to either side of the turntable. It is assumed here that the needle has been removed from the holder, but even then the mechanism can be swung laterally into any position by slightly lifting it.

It is desirable to lock the reproducing mechanism against movement when the box or cabinet is closed, as during the transportation of the machine. For this purpose I provide very simple means automatically operated by the closing of the lid to engage the reproducer frame. This idea may be carried out in several ways, and in the drawings I have shown the lid C provided with spring fingers 44 arranged to grip a rounded knob or projection 45 on the grille cover 27 when the lid C is closed. This is clearly seen in Fig. 10. It is understood, of course, that the reproducing mechanism is moved into practically central position before the lid is closed down. Even if the knob 45 is not exactly in line with the spring fingers 44, the latter will automatically move the knob into central position. The gripping fingers 44 may be stamped out of a single piece of spring metal, and are secured to the inside of the cover by screws 46 or otherwise.

It may happen that, in certain designs of phonographs built in accordance with my invention, the weight of the reproducing mechanism at the needle point is too great for the best acoustic results. To meet such a contingency, I provide a spring 47 fastened at one end to a pin or screw 48 on the pivot post 18, and at the other end bearing upwardly against the underside of the reproducer frame F, as shown in Figs. 3 and 6. The tension of spring 47 is such that it partially counteracts the weight of the reproducer mechanism at the needle point. The screw 48 is adjustably mounted in a pair of lugs 49 carried by the pivot post 18. By adjusting the screw 48 and securing it in adjusted position, as by means of a set-screw 50, the tension of spring 47 may be varied to regulate the effective pressure at the needle point.

Looking at Fig. 2, it will be seen that the back thrust exerted by the needle point on the reproducer mechanism in the playing of a record is transmitted through the arm 29 to the center of frame F. In other words, the entire mechanism is supported by the needle point in a substantially balanced condition, thus relieving the supporting parts of undue strain.

In the modification of Fig. 7, I use a flexible wire 51, or other filar connection, between the diaphragm D and the needle holder H. The connection 51 may be a thin steel wire, like a piano wire, and a small pulley 52, pivoted at 52′ on frame F, holds the wire properly guided from vertical to horizontal position. The supporting member 52′ may be a pin which is fixed in frame F and on which the pulley 52 is rotatably mounted, or the pulley may be fixed on the pin if the latter is rotatably supported on the frame. A spring 53, connected at one end to the needle holder and at the other end to the frame, normally holds the wire 51 taut, and yet permits vibration of the needle holder with lateral-cut as well as vertical-cut records. The spring 53 is shown in the form of a flat blade having a slotted end 54 arranged to engage a screw 55 secured to the frame F. This permits the spring 53 to move longitudinally during the vibrations of the needle holder. Any other suitable spring connection may be used for normally holding the wire 51 taut, and at the same time maintaining the needle holder H in proper position. Otherwise, what has been said about the operation and the advantages of the construction previously described, is applicable to Fig. 7.

The embodiment shown in Fig. 12 differs from the preceding constructions mainly in that the diaphragm D′ is mounted on frame F′ in inverted position—that is, with the apex toward the turntable. In this instance, the needle holder H′ is intended to operate only on lateral-cut records, because the pivot point 56 is in line with the axis of the needle. The grille cover 27′ is provided with a pivoted bellcrank 57, which is connected with the needle holder H′ through a link 58. The other arm of bellcrank 57 is connected to the center of diaphragm D′ by a link 59. One of the practical advantages of the construction shown in Fig. 12 is the compactness of the reproducing mechanism in a vertical direction. It will be understood that the reproducing mechanism of Fig. 12 is operatively mounted for horizontal and vertical movement, as described in connection with Figs. 1–6.

In Fig. 13, the frame F is connected to a pivot post 60 by a flat spring 61, which is preferably bent back upon itself in order to provide greater length and correspondingly increased resiliency. The spring 61 constitutes a rigid connection between the reproducer frame F and the pivot post 60, so far as the horizontal movements of the frame are concerned, and yet the resiliency of the spring is such that it allows vertical movement of the frame to a limited extent. If necessary, the initial tension or set of spring 61 may be such as to partially counteract the weight of the reproducer mechanism at the needle point. In this way a single spring may be made to perform the three-fold function specified.

It will be seen from the preceding description of several illustrative embodiments of my invention that I have provided a hornless phonograph of simple construction and efficient operation. As far as I know, I am the first to provide a hornless phonograph having a large reproducer diaphragm mounted in horizontal position and having a stylus holder in accessible position at the periphery of the diaphragm—a construction especially useful in machines of the portable type. The specific constructions herein shown and described are not to be taken as limitations of my invention, but rather as practical examples thereof, for it is evident that the various features of my invention may be mechanically embodied in other ways than herein set forth.

When I speak of certain parts as being in horizontal position and other parts as being in vertical position, I want it understood that I use the terms "horizontal" and "vertical" in an ordinary mechanical sense, and not in the strictly mathematical meaning used by surveyors. Also, when I speak of a needle, I do not necessarily mean a sharp pointed needle of steel, but any kind of stylus capable of playing a phonograph record.

What I claim as my invention is:

1. A hornless phonograph having a turntable, a substantially horizontal pivoted frame movable horizontally over the turntable, a substantially horizontal loudspeaking diaphragm secured at its edge in said frame and directly open to the free air, the pivot of said frame being so placed that the center of the diaphragm moves substantially over the center of the turntable during the horizontal swinging movements of the diaphragm, a stylus holder pivoted to said frame at the edge thereof so as to be readily accessible, and means mounted on said frame for transmitting the vibrations of said holder to said diaphragm.

2. In a phonograph having a turntable, a horizontally swinging support having a horizontal frame, a large reproducing diaphragm secured at its edge to said frame, and thereby supported in horizontal position, said diaphragm being directly open to the free air and capable of loud reproduction, a needle holder mounted at the edge of said frame so as to oscillate about an axis substantially at right angles to the axis of said diaphragm,

and operative connections between said needle holder and the center of said diaphragm.

3. In a phonograph having a turntable, a horizontally swinging support having a horizontal circular frame, a reproducing diaphragm carried by said frame, a rigid arm projecting radially from the center of said frame toward the periphery thereof, a needle holder pivoted to said arm so as to oscillate about an axis substantially at right angles to the axis of said diaphragm, and means for transmitting the vibrations of the needle holder to said diaphragm.

4. Phonographic reproducing mechanism comprising a horizontal circular frame mounted to swing horizontally over a record, a cone diaphragm supported in said frame, a horizontal pivot provided on said frame at the periphery thereof, an upstanding needle holder mounted on said pivot so as to vibrate in a plane substantially radial with respect to said diaphragm, an extension on said needle holder, and connecting means between said extension and the center of said diaphragm.

5. A phonograph having a horizontal circular frame mounted near its periphery on a vertical pivot so as to swing horizontally over a record, a reproducing diaphragm carried by said frame, a pivoted needle holder mounted on said frame at or near the periphery thereof so as to vibrate laterally of the diaphragm about an axis substantially at right angles to the axis of said diaphragm, a horizontal connection leading from said needle holder, a vertical connection leading from the center of said diaphragm, and a pivoted member carried by said frame near the center thereof for uniting said connections.

6. A hornless phonograph having a cone diaphragm mounted in horizontal position to swing over a record in close parallel relation thereto, a pivoted needle holder mounted near the periphery of said diaphragm so as to vibrate in a plane substantially radial to said diaphragm about an axis substantially at right angles to the axis of the diaphragm, said needle holder projecting laterally beyond the edge of the diaphragm for easy access, means for connecting said needle holder with said diaphragm, and means for operatively supporting said diaphragm independently of said connecting means.

7. A hornless phonograph having a cone diaphragm mounted in horizontal position to swing about a substantially vertical pivot over a record in close parallel relation thereto, a needle holder pivotally mounted at the periphery of said diaphragm in a position circumferentially about midway of a diameter passing through the pivot mounting of the diaphragm, means for transmitting the vibrations of said needle holder to said diaphragm, and means for supporting said diaphragm independently of said transmitting means.

8. In a phonograph having a turntable, a circular frame provided at its periphery with a radial extension, means engaging said extension for mounting said frame in horizontal position to swing horizontally over the turntable, said mounting means permitting vertical movement of the frame, a cone diaphragm carried by said frame, an arm extending radially from the center of said frame in a direction approximately at right angles to a diameter passing through the pivot of said frame, a needle holder pivoted transversely to the outer end of said arm, and connecting means between said needle holder and the center of said diaphragm.

9. A hornless phonograph having a large horizontal diaphragm mounted to swing over the turntable in parallel relation thereto, a needle holder mounted on a single pivot and constructed to vibrate about said pivot in a plane approximately radial to said diaphragm, the axis of said needle holder being displaced laterally with respect to said pivot, whereby the needle holder vibrates in response to needle vibrations produced by lateral-cut and vertical-cut records, and means for transmitting the vibrations of said needle holder to said diaphragm.

10. In a hornless phonograph having a turntable, a large circular frame supported in horizontal position and adapted to swing horizontally over the turntable, a diaphragm mounted in said frame, a bell-crank pivoted on said frame, a vertical connection between the center of said diaphragm and one arm of said bell-crank, a needle holder pivoted on said frame independently of said bell-crank, and a horizontal connection between said needle holder and the other arm of said bell-crank.

11. In a hornless phonograph, a large loudspeaking diaphragm mounted substantially parallel with a record on the turntable, means for supporting said diaphragm to swing horizontally over a record, a stylus holder, means for supporting said holder at the periphery of said diaphragm so that the stylus is always visible and accessible in the horizontal position of the diaphragm, said stylus holder being positioned about ninety degrees from a diameter passing through the pivot of said diaphragm, and means for operatively connecting said stylus holder to the diaphragm, which is supported independently of said connecting means.

12. In a hornless phonograph, a large loudspeaking diaphragm mounted substantially parallel with a record on the turntable, a frame in which said diaphragm is held at its periphery for vibratory movement, means for supporting said frame to swing horizontally over a record and also to

move vertically, and a stylus holder carried by said frame approximately at the periphery thereof and connected to the center of said diaphragm, said stylus holder being mounted to oscillate about an axis substantially at right angles to the axis of said diaphragm.

13. In a hornless phonograph, an upright pivot member mounted on the top board to turn horizontally, a horizontal circular frame mounted on said member to swing horizontally over a record on the turntable, means whereby said frame is pivoted on said member to move vertically, a diaphragm carried by said frame, a needle holder mounted on said frame and operatively connected to said diaphragm, a spring mounted on said pivot member to engage said frame and adapted to counteract the weight of the frame when a record is played, and a bracket movable with said pivot member to support said frame in idle position clear of the turntable.

14. A hornless phonograph having a large loudspeaking diaphragm mounted in substantially horizontal position to swing over a record on the turntable, a frame in which said diaphragm is operatively supported, a stylus holder pivoted on said frame approximately at the periphery thereof, and operative connections mounted on said frame between said stylus holder and said diaphragm, said connections including a right-angled member movable about a point separate from the pivot of said stylus holder.

15. A portable hornless phonograph comprising a case or box provided with a top board and a hinged cover, a motor-driven turntable arranged over the topboard, a horizontal circular frame mounted on the topboard to swing horizontally over a record on the turntable, means whereby said frame is pivoted to swing vertically, a large diaphragm mounted in said frame and directly open to the free air, a needle holder carried by said frame and operatively connected to said diaphragm, and cooperating means on said cover and said frame for automatically connecting said frame to said cover when the latter is closed, whereby the reproducing mechanism is held against movement in protected position, said connecting means being separable to permit opening of the cover without disturbing said frame.

16. A portable hornless phonograph comprising a case or box provided with a top board and a hinged cover, a motor-driven turntable arranged over the topboard, a horizontal circular frame mounted on the topboard to swing horizontally over a record on the turntable, means whereby said frame is pivoted to swing vertically, a large diaphragm mounted in said frame and directly open to the free air, a needle holder carried by said frame and operatively connected to said diaphragm, a central projection provided on said frame over the diaphragm, and means on said cover for engaging said projection when the cover is closed to hold said frame against movement.

17. A portable hornless phonograph comprising a case or box provided with a topboard and a hinged cover, a motor-driven turntable arranged over the topboard, a horizontal circular frame mounted on the topboard to swing horizontally over a record on the turntable, means whereby said frame is pivoted to swing vertically, a large diaphragm mounted in said frame and directly open to the free air, a needle holder carried by said frame and operatively connected to said diaphragm, a central rounded projection provided on said frame over the diaphragm, and spring fingers on said cover for gripping said projection when the cover is closed to hold the frame against movement, said spring fingers automatically centralizing the frame when they engage said rounded projection.

18. A portable hornless phonograph comprising a case or box provided with a turntable, a cone diaphragm mounted in horizontal position to swing horizontally over a record on the turntable, said diaphragm being so mounted as to project horizontally beyond the side of the box when playing a record, and a needle holder connected to said diaphragm at a point circumferentially remote from a diameter passing through the pivot mounting of the diaphragm, which in normal inoperative position lies over the turntable within the confines of the case.

19. A hornless phonograph comprising a cabinet having a lid, a horizontal frame mounted in said cabinet to swing horizontally over a record, a reproducing diaphragm supported in horizontal position on said frame, a needle holder operatively connected with said diaphragm, and cooperating means on said lid and said frame for automatically locking the frame against movement when the lid is closed, said means being separable to permit opening of the lid without lifting said frame.

20. In a hornless phonograph, a circular frame mounted in horizontal position to swing horizontally about a vertical pivot over a record, a horizontal diaphragm supported in said frame, a needle holder carried by said frame approximately at the periphery thereof, and means for connecting said needle holder with said diaphragm, said needle holder being so arranged that the point of an inserted needle is approximately the same distance from said vertical pivot as the center of the diaphragm.

21. A hornless phonograph having a turntable, a direct acting diaphragm pivoted in a substantially horizontal position on a vertical axis to swing horizontally over the turntable, said diaphragm being so mount-

ed that its center describes an arc passing substantially through the center of the turntable during the horizontal travel of the diaphragm, a stylus holder mounted at the periphery of said diaphragm, and means for transmitting the vibrations of said holder to the diaphragm.

22. Phonographic reproducing mechanism comprising a horizontal circular frame mounted to swing horizontally over a record, a cone diaphragm supported in said frame, a horizontal pivot provided on said frame at the periphery thereof, a stylus holder mounted on said pivot so as to vibrate in a plane substantially radial with respect to said horizontal diaphragm, and means for connecting said stylus holder with the center of said diaphragm.

23. In a phonograph having a turntable, a substantially horizontal frame mounted to swing horizontally over a record, a loudspeaking cone diaphragm supported by said frame in substantially horizontal position, a stylus holder carried by said frame at the periphery thereof, and means for vibrating said diaphragm in accordance with the vibrations of a stylus in said holder, said horizontal diaphragm being so mounted that its center may be brought into substantial alignment with the axis of the turntable.

24. In a phonograph having a turntable, a frame mounted in horizontal position to swing horizontally about a vertical pivot over a record on the turntable, a horizontal loudspeaking diaphragm supported in said frame, a stylus holder carried by said frame at the periphery thereof in such position that the playing point of a stylus follows an arcuate path passing through the center of the turntable, and means for transmitting the vibrations of the stylus holder to said diaphragm.

25. In a phonograph having a turntable, a frame mounted in horizontal position to swing horizontally about a vertical pivot over a record on the turntable, a horizontal loudspeaking diaphragm supported in said frame, a stylus holder carried by said frame at the periphery thereof, said stylus holder being so positioned relatively to said vertical pivot that the point of a playing stylus follows an arcuate path which passes through the center of the horizontal diaphragm and the center of the turntable.

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