

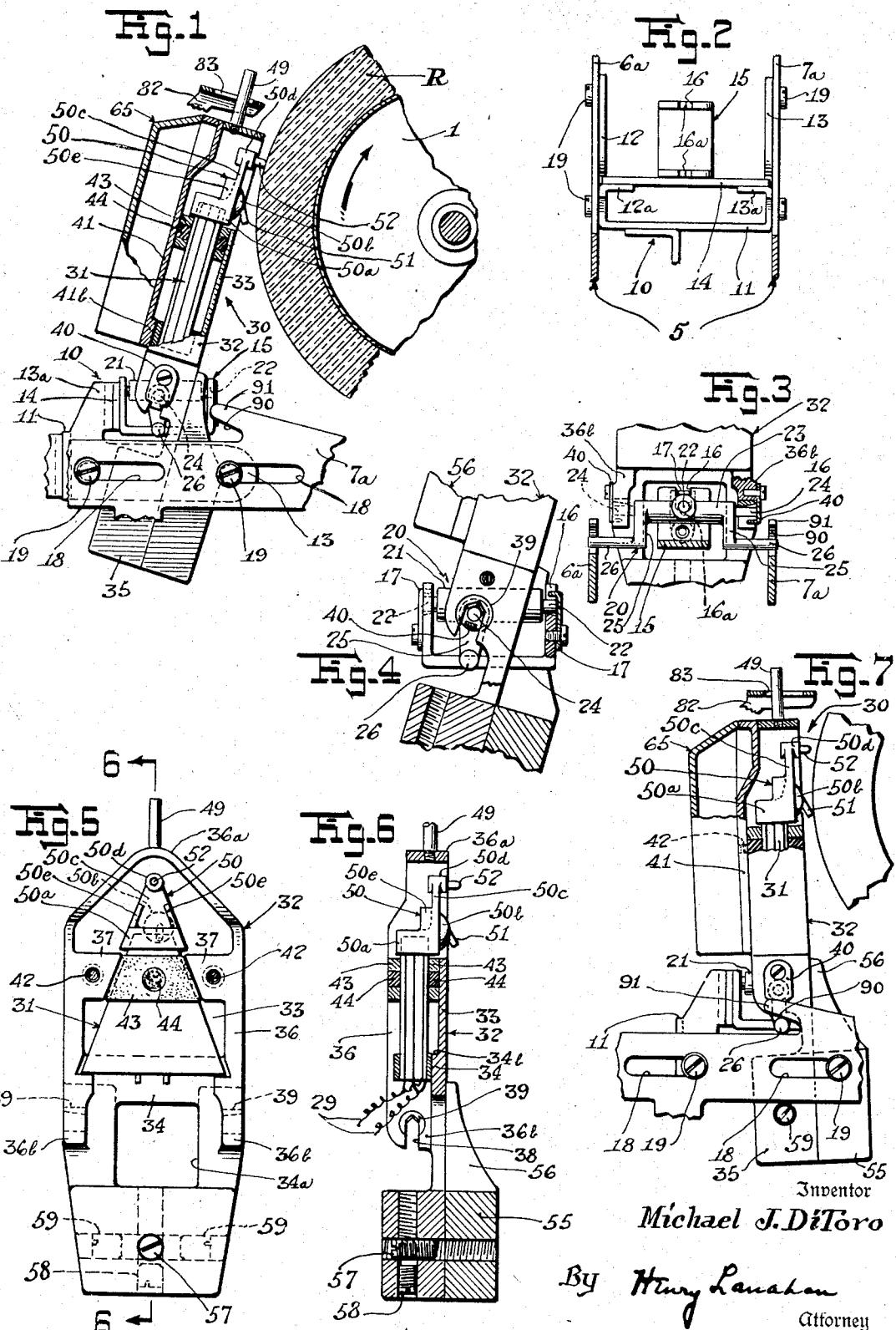
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M. J. DI TORO

2,267,693

## PHONOGRAPH

Original Filed Jan. 28, 1938



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Actor

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## UNITED STATES PATENT OFFICE

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## PHONOGRAPH

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10 Claims. (Cl. 274—30)

This invention relates to phonographs, and particularly to phonographs of the type adapted for both the recordation and reproduction of sound. The invention has been illustrated, and has especial utility, in connection with phonographs wherein the record is of a form (a wax cylinder, by way of example) adapted to be recorded upon, and reproduced from, by appropriate respective styli in engagement therewith. The invention contemplates the employment of a common translating device for recordation and reproduction, having a common translating unit for actuating the recording stylus and for response to the reproducing stylus; and while such a translating device and its translating unit proper may be of any form appropriate to an ultimate acoustic-mechanical translation, there has been particularly illustrated an electro-mechanical translating device and unit, for actuation by and production of sound-representing electric oscillations.

This application is filed as a division of my co-pending application Serial No. 187,388, filed January 28, 1938.

It is an object of my invention to provide an improved and simplified common translating device for both recordation and reproduction.

It is another object to provide especially simple means for holding both the recording and reproducing styli in a translating device, while providing the proper respective couplings of each to the active translating unit.

It is another object to provide improved means for holding a reproducing stylus in a translating device.

A general object is the provision of an improved phonograph for both the recordation and reproduction of sound.

Other and allied objects will more fully appear from the following description and the appended claims.

In the description reference is had to the accompanying drawing, in which:

Figure 1 is a partly elevational and partly vertical sectional view of a translating device in which my invention has been incorporated, together with fractional showings of the carriage therefor and the record with which the device operates, the device being adjusted for reproduction;

Figure 2 is a plan view of the cradle 10 herein-after described, together with the portions of the carriage which support it;

Figure 3 is an enlarged front elevational view of the rocker system 20 hereinafter described,

showing portions immediately adjacent thereto partly in section and partly in elevation;

Figure 4 is an enlarged side elevational view of the same apparatus as shown in Figure 3;

Figure 5 is a front elevational view of the translating device with the front casing and clamping plate, hereinafter mentioned, removed;

Figure 6 is a vertical cross-sectional view taken substantially along the line 6—6 of Figure 5; and

Figure 7 is a view generally similar to Figure 1 but illustrating an adjustment of the device for recordation.

The carriage, translating device, and controls therefor in the embodiment of my invention which I herein typically describe are intended to be similar to those disclosed in my co-pending application abovementioned. It is not herein necessary, however, to disclose all the features of that prior disclosure, in view of the restriction of subject matter of the present application, as will be understood.

Reference being had to Figure 1, there will be seen a mandrel 1 serving as a support for a cylindrical record R, which may be removably mounted thereon; the mandrel may be rotated, for example in the direction of the arrow, by any suitable means. There will also be seen the upper part of the righthand side frame portion 1a of a carriage 5, which carriage in the operation of the phonograph may be slowly driven in a side-to-side direction (i. e., parallel to the mandrel axis) by means not herein necessary to show. The side frame portion 1a and the corresponding lefthand side frame portion 6a appear in Figure 2. Between them there is slidably held, for forward and rearward movement, a cradle 10, seen in plan in Figure 2. The principal portion of the cradle may conveniently be formed from flat stock, folded into a U-shaped member whose base or forwardly disposed cross-portion is indicated as 11, and whose side portions 12 and 13 respectively lie against the inner surfaces of the carriage side frame portions 6a and 1a. Each of these carriage portions may be provided with horizontally elongated holes or slots 18; inwardly through these slots and into threaded engagement with the cradle side portions 12 and 13 there may be passed shouldered screws 19, the screws and slots forming the support of the cradle to the carriage for forward and rearward sliding therein. The cradle may be completed by a cross-member 14 disposed somewhat behind and above the cross-portion 11 and secured between the cradle side portions 12 and 13 (for example, to upwardly and inwardly extending ears

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12a and 13a formed from 12 and 13), and by a vertically disposed U-shaped bracket 15 extending rearwardly from the central portion of the cross-member 14.

Pivoted to the carriage, and more particularly to the bracket 15 of cradle 10, is a rocker system 20; the pivoting is for rotation of the rocker system in a plane parallel to the path of the carriage 5, and more particularly involves substantially horizontally aligned pivots, for rotation of the system in a substantially vertical side-to-side plane. This rocker system appears in enlarged detail in Figures 3 and 4; its immediately pivoted portion may be a front-and-back extending cylinder 21, from the ends of which extend pivoting rods 22. These rods may rest in central slots 16 extending downwardly from the top edges of the front and back upright portions of the bracket 15, the slots being wider than the diameter of the rods 22 but having bottoms 16a which are V-shaped (see Figure 3) and chamfered (see Figure 4) to provide a linear V-bearing for the pivoting rods 22. The cylinder 21 may be loosely retained against accidental upward dislodgement from the bearings just mentioned, and against more than minute longitudinal play in the bearings, by inverted L-shaped caps 11 screwed to the outer surfaces of the bracket uprights and spacedly overhanging the rods 22.

The rocker system further includes, secure with respect to the cylinder 21, a side-to-side extending cylinder 23, intersecting the cylinder 21 with its axis at right angles to and slightly lower than that of 21 and slightly forward of the longitudinal center of 21; pivoting rods 24, hereinafter further referred to, extending axially from the ends of the cylinder 23; crank-like webs 25 extending downwardly a short distance from the ends of the cylinder 23; and locking rods 26, hereinafter further referred to, extending outwardly from the lower extremities of the webs 25, parallel with the axis of cylinder 23. The entire rocker system is conveniently cast from a suitable material, the pivoting rods 22 and 24 and locking rods 26 being thereafter machined.

The translating device, described more in detail hereinbelow, is pivoted to the rocker system, and more particularly to the pivoting rods 24. The action of the translating device may include reproduction from the record, for which it is illustrated as adjusted in Figure 1. In connection with the reproducing action there is well understood as desirable a material freedom of movement of the reproducing stylus in the direction of carriage travel, and it is that freedom of movement which is provided by the pivoting of the rocker system at 22. The action of the translating device may further include recordation upon the record, for which it is illustrated as adjusted in Figure 7—the re-adjustment for recordation having been effected by sliding the cradle rearwardly within the carriage. In connection with the recording action it is well understood that there may be undesirable that freedom of movement above mentioned as desirable in connection with reproducing, and it is the elimination of that freedom which is the function of the locking rods 26. These are then pressed against respective cam surfaces 90 which are carried by the respective carriage side frame portions 6a and 1a. Conveniently these cam surfaces 90 may comprise the respective lower edges of respective lug portions 91 extending upwardly and forwardly from the rear of the side frame

portions 6a and 1a, respectively. It will of course be understood that when the locking rods 26 are pressed against the cam surfaces 90, the rocker system will be held in a uniquely fixed position about its pivots 22, and its rocking action will be thus eliminated.

The translating device 30 with which I have illustrated my invention is of electro-mechanical nature, for the translation of electric oscillations (representing sound, for example) into mechanical vibrations and/or vice versa. Its active portion is a translating unit 31, which is preferably in the form of a piezo-electric bending unit of the so-called "bi-morph" type, such for example as in general disclosed in U. S. Patent No. 1,802,782 to Sawyer. In such a unit two or more thin piezo-electric crystals are secured together face-to-face, with suitable intermediate and outside metal foil electrodes electrically interconnected, in an arrangement such that upon the application of voltage to the electrodes one or more of the crystals will contract longitudinally and another one or more will expand longitudinally, to result in a transverse bending of the unit—and, conversely, upon transverse bending of the unit there will be developed on the several electrodes potentials which are caused by the electrode interconnection to aid each other. The unit 31 which I have particularly illustrated is of trapezoidal plan shape, and comprises four crystals secured together. Fine coiled conductors, seen in Figure 6 as 29, may serve to connect the translating unit 31 with electrical work circuits (not shown) for supplying oscillations to or receiving them from that unit.

The full assembly of the translating device 30 appears in vertical, principally cross-sectional view in Figure 1, while Figures 5 and 6 are respectively front and cross-sectional views of the device with the front casing and the clamping plate omitted. The main frame of the translating device is indicated as 32; this may be a casting of suitable metal. It may comprise an upper plate portion 33; a lower plate portion 34 continuing downwardly from 33 but slightly thicker (i. e., extending more forwardly), centrally apertured as at 34a; a heel portion 35 extending downwardly from 34 but still thicker; a forwardly extending rim or flange 36 beginning at an intermediate point on one side of the lower plate portion 34, running upwardly along that side of 34 and of 33, extending above the upper end of 33, curving in a "nose" 36a, and returning along the other side of 33 and 34 to terminate horizontally opposite its point of beginning; and partial inward extensions 37 of rim 36 across the top part of the front face of 33. The downwardly directed ends 36b of the rim 36 are provided with upwardly extending slots 38 which fit freely over the pivot rods 24 above described; these slots terminate in bearings 39 of relatively hard metal inset into the rim 36, in which bearings the top surface of the slot is V-shaped (see Figure 4) and chamfered (see Figure 3) to provide a linear V-bearing for the translating device on the pivoting rods 24. The translating device may be loosely retained against accidental upward dislodgement from the pivot rods 24, and against more than minute play longitudinally of those rods, by L-shaped caps 40 screwed to the outer surfaces of the terminal rim portions and spacedly hooking below the rods 24.

Against the front surface of the rim 36 and of its inward extensions 37 there is held a clamping plate 41, as by screws 42 passing through clear-

ance holes in the upper plate portion 33 and the extensions 37 into threaded engagement with the clamping plate. This plate may extend from the nose 36a of the rim 36 to a little below the top of the lower plate portion 34; along the bottom part of its inner or rearward surface this plate may be slightly thickened in an inward direction to form a jaw 41b. Between this jaw and the top part 34b of the front surface of the lower plate portion 34, acting as a cooperating jaw, there is cemented the base or wide-end portion of the bending unit 31; thin electrical insulating pieces, such as of "fish-paper," are interposed between the jaws and unit to insulate the latter. The unit 31 extends upwardly between the clamping plate 41 and the upper plate portion 33 to have its upper or narrow-end extremity slightly above the top of 33.

This unit end is of course intended to vibrate relative to the rest of the translating device; it is desirable, however, that its vibration be somewhat damped, in order to suppress an exaggeration of response in the frequency region of resonance of the effective compliance of the unit 31 with the effective mass of the unit and of components carried thereby. This damping may readily be provided by placing in front of and behind the unit, between the rim extensions 37, damping pieces 43; these, with the unit between them, are clamped between the clamping plate 41 and the upper plate portion 33. In areal configuration these damping pieces may be trapezoidal, to fit between the extensions 37 whose inner surfaces may be angled for parallelism with the sides of the unit 31; in thickness these pieces may be dimensioned to result in a desired degree of compression thereof upon assembly of the device. Effective pieces 43 may be made of the resilient damping material currently available under the trade name of "Neoprene"; for still more effective damping action, when desired, they may be provided with transverse holes and these holes filled with inserts 44 of highly viscous and little resilient material, such as that currently available under the trade name of "Viscoloid."

In front of the clamping plate 41, and held thereto by suitable screws, there may be assembled a casing 65, the space between clamping plate and casing being appropriate for the inclusion, when desired, of one or more damped vibration absorbers such for example as those disclosed in my co-pending application Serial No. 149,861, filed June 23, 1937. Such absorbers are not shown herein, as they form no part of the present invention.

To the upper end of the unit 31 is secured a stylus holder 50 in which may be held both a recording stylus 51 and a reproducing stylus 52, adapted to be selectively engaged with the record by movement of the cradle within the carriage, as already noted. The requirements for the couplings of these two styli to the unit 31 are quite dissimilar: The recording stylus 51 should be substantially rigidly coupled to the unit; whereas the reproducing stylus 52 should be coupled to the unit through a compliance which is large relative to the compliance of the recorded record, in order that record wear may be properly minimized, and which also is desirably provided with some damping in order that resonance effects involving that compliance shall not attain to undue amplitudes. According to my invention I am able to provide in an integral, one-piece stylus holder 50 the most desirable coupling for each stylus. This I do by forming the holder of

compliant material, preferably characterized by some considerable internal damping; by holding the recording stylus 51 in the holder close to the region of contact of the holder with the unit 31; and by holding the reproducing stylus 52 in the holder relatively remote from that region—preferably near the end of a relatively thin extending portion of the holder, wherein the compliant nature of the holder material has an opportunity to manifest itself.

While I intend no unnecessary limitation thereto, I have found very effective for the stylus holder 50 the moldable plastic material currently available under the trade name "Tenite." This I have molded into a form which may be described as comprising a cap portion 50a adapted to fit about and be cemented to the upper end of the unit 31; a boss portion 50b extending rearwardly from the cap portion at least as far as the rear face of the translating device frame 32, and adapted to have the recording stylus 51 cemented therein; a thin trapezoidally-planned portion 50c extending upwardly from the rear part of the cap portion in a plane parallel to the unit 31; a boss 50d at the convergent upper end of the extending portion 50c, adapted to have the reproducing stylus cemented therein; and preferably two thin web portions 50e on respective sides of the holder, at right angles to the extending portion 50c, bridging the immediate angle formed between the latter portion and the cap portion 50a and serving to overcome any tendencies to undue weakness at this point. It will be understood, of course, that in this structure the extending portion 50c, and particularly its region above the webs 50e, provides the substantially compliant coupling of the reproducing stylus 52 to the unit 31 (the value of this compliance being adjusted as desired by a choice of thickness of this portion and extent of the webs); that the compliance is inherently damped by virtue of the appreciable internal damping of the selected material; and that the boss 50b and cap portion 50a, by virtue of their immediacy and thickness, provide the substantially rigid coupling of the recording stylus 51 to the unit 31.

The construction of the stylus holder so described results, in the precedingly described structure, in the reproducing stylus being displaced appreciably above the recording stylus, the recording stylus extending preferably very slightly, and the reproducing stylus still a little more, rearwardly of the rear face of the translating device frame 32. If the parts are arranged, as shown, so that when the translating device 30 is very approximately in a vertical plane the recording stylus is very approximately at the elevation of the record axis, then with the translating device 30 extending downwardly from the stylus in a vertical plane (or in the slightly counter-clockwise-from-vertical plane illustrated in Figure 7), the engagement of a stylus with the record will be of the recording stylus 51. By sliding of the cradle forwardly in the carriage (by means not necessary herein to show) to the position illustrated in Figure 1, the translating device is permitted to rotate about the pivot rods 24 upwardly in its upper part to the slightly inclined-from-vertical position shown in that figure, so that the engagement of a stylus with the record will be of the reproducing stylus 52.

It may be a rearward bias of the upper part of the translating device 30 which, in the absence of counteracting means, causes stylus engagement with the record. This bias is provided by

the arrangement of the center of gravity of the device, this center being accordingly fixed within the device at a small distance behind the pivot rods 24—the distance depending on the stylus-biasing forces desired. Vertically it is desirable that the center of gravity be approximately at the elevation of those pivot rods under most conditions. To fix the center of gravity there may be appropriately included in the translating device 30—for example, secured to the rear surface of the heel 35 and connected if desired through webs 56 with the rear surface of the lower plate portion 34—a weight 55 of heavy metal such as brass. The weight 55 and/or the heel 35, as needed, may be provided with set screws, the screws being adjustable in respective different directions; such screws are shown as 57 and 58, serving respectively to adjust the center of gravity forward-and-backward and up-and-down.

Other screws 59 have been shown in the heel 35; these serve to adjust the center of gravity of the translating device from side to side, to establish a desired normal or mean position for it and the rocker system in the arc of free movement which they jointly have about the pivot rods 22 under conditions appropriate for reproduction, as abovementioned.

At times it will be desirable to remove both styli from contact with the record. Accordingly there may be provided a pin 49 extending upwardly from the nose 36a of the translating device frame, and means for moving this pin forwardly when desired. This means may include a generally vertical arm 82 whose upper portion is folded over and provided with an aperture 83, of relatively large dimensions, surrounding the pin 49. When either stylus is to be in contact with the record the arm 82 will be placed in such a position that the pin 49 is free of the sides of aperture 83. The arm 82 may, however, be moved (by means not herein necessary to show) for a sufficient distance forwardly to move the pin 49 sufficiently to carry both styli dependably out of contact with the record.

While I have illustrated and described my invention in terms of a preferred embodiment thereof, it will be understood that I intend no unnecessary limitations by virtue of the details of that embodiment, as there will be readily suggested to those skilled in the art various modifications, many of them wide, which may still lie within the true spirit and proper scope of the invention. In many of the appended claims I undertake to express that scope broadly, subject however to such proper limitations as the state of the art may impose. Claims are made herein, however, only to the stylus holder, the stylus assembly, and the combination thereof with the translating unit—claims to other novel features disclosed herein having been made in the abovementioned co-pending application Serial No. 187,388, of which this application is a division.

I claim:

1. In a phonograph, the combination of a translating unit; an integral stylus holder comprising a relatively rigid portion connected to said unit and a relatively compliant portion extending from said rigid portion; a recording stylus held in said rigid portion; and a reproducing stylus held at a part of said compliant portion remote from said rigid portion.

2. In a phonograph, the combination of a translating unit; a stylus holder comprising a relatively rigid portion secured to and carried by said unit and a relatively compliant portion extending from said rigid portion; a recording stylus held in said rigid portion; and a reproducing stylus held at a part of said compliant portion remote from said rigid portion.

3. In a phonograph, the combination of a translating unit; a stylus holder comprising a relatively reinforced portion connected to said unit and a relatively compliant portion extending from said reinforced portion; a recording stylus held in said reinforced portion; and a reproducing stylus held at a part of said compliant portion remote from said reinforced portion.

4. In a phonograph, the combination of a translating unit; a stylus holder comprising a relatively rigid portion including a cap fitting about and secured to an extremity of said unit, and a relatively compliant portion extending from said rigid portion; a recording stylus held in said rigid portion; and a reproducing stylus held at a part of said compliant portion remote from said rigid portion.

5. The combination according to claim 1, wherein said holder is formed of a material whose compliance is characterized by appreciable internal damping.

6. The combination according to claim 1, wherein said holder is formed of a moldable plastic material whose compliance is characterized by appreciable internal damping.

7. A stylus assembly for a phonograph which includes a stylus-cooperating translating unit, said assembly comprising an integral stylus holder having a relatively rigid portion adapted for connection to said unit, and a relatively compliant portion extending from said rigid portion; a recording stylus held in said rigid portion; and a reproducing stylus held at a part of said compliant portion remote from said rigid portion.

8. A stylus assembly for a phonograph which includes a stylus-cooperating translating unit, said assembly comprising a stylus holder having a relatively reinforced portion adapted for connection to said unit, and a relatively compliant portion extending from said reinforced portion; a recording stylus held in said reinforced portion; and a reproducing stylus held at a part of said compliant portion remote from said reinforced portion.

9. An integral stylus holder adapted to connect recording and reproducing styli with the translating unit of a phonograph, said holder comprising a relatively rigid portion adapted for connection with said unit and having means for holding a recording stylus; a relatively compliant portion extending from said rigid portion; and means, carried by said compliant portion remote from said rigid portion, for holding a reproducing stylus.

10. A stylus holder adapted to connect recording and reproducing styli with the translating unit of a phonograph, said holder comprising a relatively reinforced portion adapted for connection with said unit and having means for holding a recording stylus; a relatively compliant portion extending from said rigid portion; and means, carried by said compliant portion remote from said reinforced portion, for holding a reproducing stylus.

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