Jan. 30, 1945. W. J. BROWN ET AL 2,368,198

CONNECTION MEANS

Filed Feb. 11, 1941

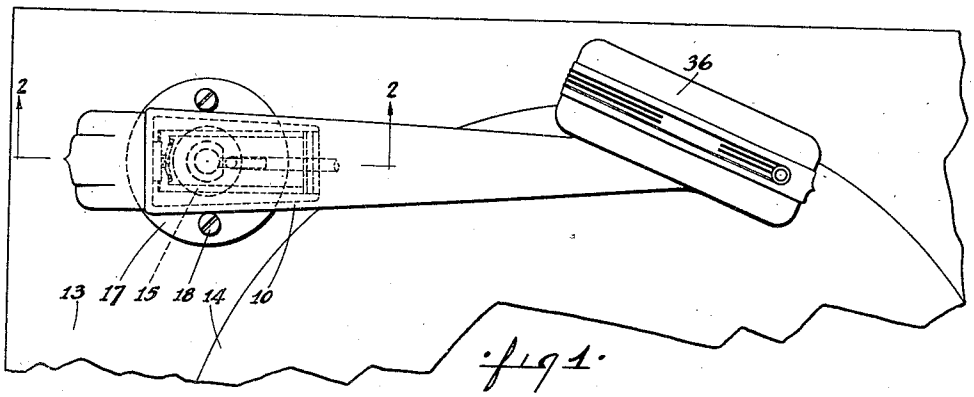


fig 1.

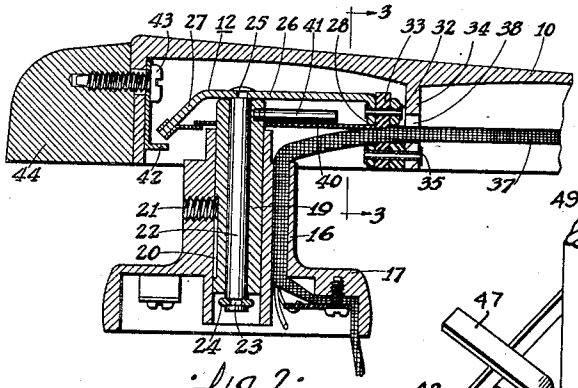


fig 2.

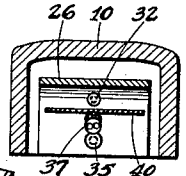


fig 3.

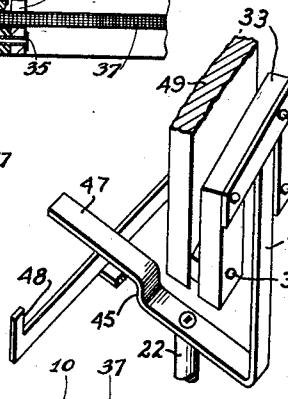


fig 7.

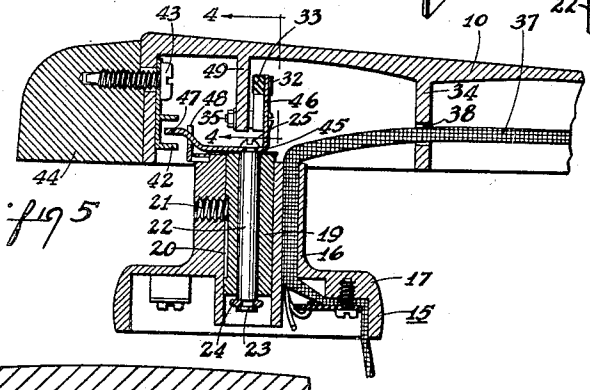


fig 5

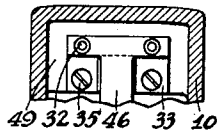


fig 4.

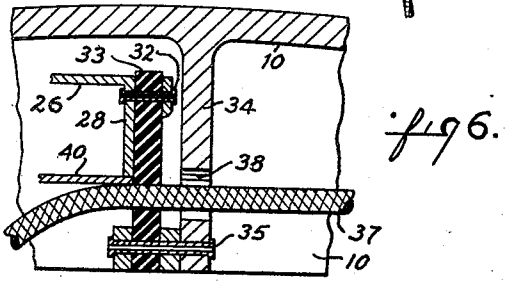


fig 6.

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CONNECTION MEANS

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Application February 11, 1941, Serial No. 378,463

6 Claims. (Cl. 274—1)

Our invention relates to the art of translating mechanical vibrations to electrical impulses and to translating electrical impulses into mechanical vibrations. More particularly our invention relates to means for supporting a pickup arm for electrical phonographs in such a manner that the twist imparted to the stylus by undulations in the record being played is not materially lost in play in the bearings suspending the arm, but is efficiently used to actuate an electro-mechanical transducer.

Pickup arms for electrical phonographs are designed with two pivots or bearings to allow for movement in two directions. The first or vertical pivot or bearing allows the pickup arm to move horizontally with respect to the record being played and, as the pickup arm stylus follows the grooves of a disc record in toward the center of the record, it causes the entire pickup arm to move about the first pivot. The second or horizontal pivot or bearing is one on which the pickup arm turns or moves in an up and down direction such as when the stylus is taken off of the record or when irregularities in the record or turntable cause the pickup arm to move up and down with respect to the phonograph. In the design and manufacture of these pivots or bearings considerable care must be exercised to keep the amount of bearing play at a minimum. This is particularly true for arms designed for use with laterally cut records which depend for their operation on imparting a torsional vibration to a needle which in turn imparts a vibration to an electro-mechanical transducer. Bearing play in the horizontal and vertical bearings causes a certain amount of the needle vibration to be absorbed by the pickup arm in the form of a torsional vibration about a longitudinal axis parallel to the length of the arm and also in vibration about the vertical axis. These torsional vibrations in the pickup arm reduce the amount of stylus vibration which is transmitted from the undulations in the record to the electro-mechanical transducer and may introduce serious distortion in the wave form at low frequencies. As the frequency of the vibration in the stylus becomes higher and higher the distortion in the wave form introduced by the torsional vibration of the pickup arm becomes less and less due to the inertia of the pickup arm resisting the torsional vibration. The resistance to the torsional vibration in the pickup arm causes a higher percentage of the stylus vibration to pass the electro-mechanical transducer and results in more efficient conversion of mechanical movement to electrical impulse. It is also desirable that the pick-up arm be cushioned to prevent vibration produced by either the record, turntable motor, or any other source external of the stylus on the record from being transmitted to the electro-mechanical transducer through the pickup arm.

It is therefore an object of our invention to provide a connection between a pickup arm and its mounting base which reduces the vibration transmitted to the electro-mechanical transducer from sources external of the stylus on the record.

It is also an object of our invention to provide a resilient connection between a pickup arm and its mounting base which reduces the amount of the torsional vibration of the pickup arm.

A further object of our invention is to provide a resilient device between a pickup arm and its mounting base which prevents excessive torsional vibration of the pickup arm even though there is play in the pivotal bearing means due to manufacturing tolerances, misalinement, and/or wear.

A further object of our invention is to provide a resilient connection between a pickup arm and its base which establishes a hinge about which the pickup arm may be rotated to lift it from the record to inspect or change the stylus and about which the pickup arm may move to allow for variations in height of the record or turntable.

Another object of our invention is to provide a mounting between an arm having an electro-mechanical transducer and an instrument which reduces the amount of vibration transmitted from the instrument to the arm and which resists torsional vibration of the arm.

Another object is to provide a pivot arrangement that will not develop excessive bearing play after continued use.

Another object of our invention is to provide resilient means for replacing the horizontal bearing between an arm and a support for the arm.

A still further object of our invention is to provide a resilient connection between an electro-mechanical transducer and a supporting arm or base which provides a damping action to prevent the undesired transfer of extraneous vibrations therebetween.

Other objects and a fuller understanding of our invention may be had by referring to the following detailed description and claims, taken in conjunction with the following drawing in which;

Figure 1 is a plan view of a pickup arm and part of a support such as a phonograph box.

Figure 2 is a sectional view taken along line 2—2 of Figure 1 and showing our new connection between a pickup arm and a support.

Figure 3 is a sectional view taken along line

3—3 of Figure 2 and showing an end view of the connection between the pickup arm and the support.

Figure 4 is a sectional view somewhat similar to Figure 3 but showing a modified form of connection between the pickup arm and the support.

Figure 5 is a sectional view somewhat similar to Figure 2 but showing a modified form of connection between the pickup arm and the support.

Figure 6 is an enlarged view of the hinge portion shown in Figure 2.

Figure 7 is an enlarged isometric view of the hinge and pivot structure shown in Figure 5.

With reference to Figures 1 and 2 our invention comprises a pickup arm indicated generally by the reference character 10, a hollow upstanding shaft 16 for supporting the pickup arm 10, and connection means 12 for connecting the pickup arm 10 to the supporting shaft 16.

The base for the pickup arm 10 comprises a turntable supporting base 13 upon which is turnably mounted a turntable 14. Within the turntable supporting base may be placed such necessary parts for a phonograph as a driving motor, an amplifier, an electromechanical transducer, a loudspeaker, etc. Connected to the turntable supporting base 13 and positioned to one side of the turntable 14 is a vertical bearing support indicated generally by the reference character 15. The vertical bearing support 15 is part of the support for the pickup arm 10 and comprises a hollow upstanding shaft 16 having an enlarged base portion 17 connected to the turntable supporting base 13 by means of the screws 18. Mounted within the hollow portion of the upstanding shaft 16 is an elongated hollow bearing sleeve 19 having a grooved keyway 20. A set screw 21 threadably engages the hollow upstanding shaft 16 and engages the grooved keyway 20 in the hollow sleeve bearing 19 to prevent the hollow sleeve bearing from turning with respect to the upstanding shaft 16 during the rotation of the pickup arm 10 with respect to the base 13. The hollow sleeve bearing permits the adjustment of the height of the pickup arm 10 with respect to the base 13. Rotatably positioned within the hollow sleeve bearing is a bearing shaft 22 which is elongated and extends slightly above and below the ends of the hollow sleeve bearing 19. The portion of the bearing shaft 22 which extends below the hollow sleeve bearing is provided with a circumferential groove 23 within which is positioned a retainer ring 24. The retainer ring may be made of a resilient material such as spring steel and is adapted to prevent the bearing shaft 22 from being withdrawn from the hollow sleeve bearing 19 and at the same time provide a quick and simple means for disassembling the bearing after the hollow upstanding shaft 16 has been removed from the turntable supporting base 13. Connected to the top end of the bearing shaft 22 by means of a rivet or screw 25 is a bracket 26. The bracket 26 may be of any material and shape but as shown it is a flat metal plate having a first end 27 turned downwardly at substantially a 45 degree angle and having a second end 28 turned downwardly at substantially a 90 degree angle. Connected to the second end 28 of the bracket 26 by means of rivets or screws 32 is a resilient suspension member 33. The resilient suspension member 33 is also connected to a flange 34 within and integral with the pickup arm 10 by means of screws or rivets 35. The pickup arm 10 is suspended from the vertical bearing support 15 by means of the resilient suspension member 33 and is adapted to turn in a horizontal plane with respect to the base 13 on the vertical bearing shaft 22 as an axis.

The resilient suspension member 33 may be a thin sheet of spring steel or as shown it may be a piece of material such as rubber, Koroseal, or other such resilient and/or damping material adapted to reduce the vibration which is apt to pass from the base 13 to the pickup arm 10 and cause distortion in the music or speech which the instrument is cutting into a record, or is reproducing from a previously cut record. The point at which the resilient suspension member 33 is connected to the bracket 26 by means of screws 32 is spaced from the point at which the resilient suspension member 33 is connected to the pickup arm 10 by means of screws 35 to establish the resilient material as a hinge between the support 15 and the pickup arm 10. The effective axis of this hinge extends transverse of the pickup arm 10 and substantially parallel to the surface of the turntable 14 thereby providing a transverse axis about which the pickup arm may be rotated with respect to the support to lift the stylus from the disc which is being played or cut on the turntable 14, and to allow for vertical irregularities in the turntable or record. If the resilient suspension member 33 is made of a damping material, we prefer that it have one thin dimension and two relatively thick dimensions, and that it be placed with the relatively thin dimension in a direction which is substantially parallel to the longitudinal axis of the pickup arm 10. To explain the reason for the shape and orientation of the resilient suspension material 33 we will illustrate its function with a record reproducer, although it is to be understood that we are not limiting ourselves to this one particular application as it may be used for many types of arm suspension.

In the design of pickup arms for use in disc record reproducers considerable care must be exercised in the design of the pivot arrangement. This is for the reason that the pickup stylus which is connected to the end of the pickup arm is moved laterally by the undulations in the grooves in a record to cause a force to be applied to an electro-mechanical transducer which is held within the pickup arm head 36. This force moves either a crystal unit in a piezo-electric transducer or a coil or armature in a magnetic transducer to cause an electrical impulse to be produced. The amount of movement of the stylus is of the order of a thousandth of an inch and accordingly it is desirable that as efficient a translation of mechanical movement to electrical impulse be effected as possible.

If there is play in the vertical and horizontal bearing means on which the pickup arm moves with respect to the support, the pickup arm is apt to vibrate torsionally about its longitudinal axis thereby absorbing some of the stylus displacement which should be translated to the electro-mechanical transducer. The frequency of this torsional vibration is primarily determined by the moment of inertia of the pickup arm about its longitudinal axis and by the stiffness of the entire pickup arm assembly. This resonance is apt to occur at a frequency lying in the lower end of the audible range and cause an objectionable distortion in the wave form. To obviate the result of this resonance we make the horizontal bearing in the form of the resilient suspension member 33, and to prevent twisting in the resilient suspension member 33 we orient

the member to place the relatively thin dimension in a direction substantially parallel to the direction of the longitudinal axis of the pickup arm, and the two relatively thicker dimensions in directions substantially perpendicular to each other and perpendicular to the said longitudinal axis. This places a relatively high section modulus in opposition to the tendency of the pickup arm to vibrate torsionally thereby increasing the stiffness of the whole vibratory system, and places a relatively low section modulus in a position to permit the pickup arm to be raised and lowered with respect to the record being played, and permits a flexibility of vertical motion to accommodate vertical irregularities in turntable or record.

A shielded wire 37 carries the generated electrical impulse along the pickup arm, through a hole 38 in the internal flange 34 in the pickup arm, through a hole in the resilient suspension member 33, and down into the base 13 where it is amplified and sent to a loudspeaker or other suitable converter. To prevent the shielded wire 37 from becoming tangled with the pivots or hinges which connect the pickup arm to the support we provide a diaphragm or guard 40 to prevent the wire from buckling into the wrong place as the pickup arm 10 is moved with respect to the base 13 and to prevent the wire from becoming tangled with a stop 41 which is provided to prevent the pickup arm 10 from turning too far in a horizontal plane. Figure 6 illustrates in enlarged detail the above described construction. The stop 41 is in threaded engagement with the hollow sleeve bearing 19 and as the hollow sleeve bearing is stationary the stop does not move as the pickup arm moves. Accordingly an excessive amount of movement of the pickup arm will cause the side of the pickup arm to engage the stop 41 thereby limiting the horizontal swing. To prevent the pickup arm head from falling on the support and damaging the stylus in case an operator should drop the pickup arm, a lug 42 is connected to the pivot arm by means of a screw 43 and positioned to engage the first end 27 of the bracket 26 to limit the movement of the pickup arm before the stylus hits the base 13. The same screw 43 may be used to connect a counterweight 44 to the pickup arm to balance the weight of the pickup head 36 and reduce the pressure on the stylus point.

The connection between the pickup arm 10 and the bracket 26 is positioned at a distance from the bearing shaft 22. Due to the weight of the pickup arm this establishes a slight force couple which tends to cause the top portion of the bearing shaft 22 to lean toward the stylus and the bottom portion of the bearing shaft to lean away from the stylus. This force is not enough to cause binding between the bearing shaft 22 and the hollow sleeve bearing 19 but is sufficient to "take up" any bearing play or "slop" present to a certain degree in substantially all bearings and particularly apt to be present in low cost bearings, and is sufficient to "take up" bearing play due to wear.

Figure 4 illustrates a modified form of our invention in which the resilient suspension member 33 is substantially U-shaped in plan whereby it may be made larger and have a greater resistance to vibration about the longitudinal axis of the pickup arm yet maintain the relatively low section modulus at a value which will establish the resilient suspension member as a hinge on which the pickup arm is adapted to turn. The U-shaped member is connected to the pickup arm 10 in an inverted position.

Figures 5 and 6 illustrate the use of the U-shaped resilient suspension member 33. A bracket 45 somewhat similar to the bracket 26, is connected to the bearing shaft 22 by means of the screw 25 and is shaped to have a first end 46 turned upwardly at substantially 90 degrees, and have a second end 47 extending rearwardly to engage a bifurcated lug 48 which is connected to the hollow upstanding shaft 16 and is therefore stationary. The second end 47 of the bracket 45 is positioned between the spaced portions of the bifurcated lug 48 to limit the horizontal swing of the pickup arm. The first end 46 of the bracket 45 is connected to the U-shaped resilient suspension member 33 by means of the screw or rivet 32 and the U-shaped member 33 is connected to a web 49 of the pickup arm 10 by means of screws or rivets 35. The pickup arm 10 is therefore suspended from the support 15 by the resilient U-shaped suspension member 33 and the point of suspension is substantially directly above the bearing shaft 22. This construction is advantageous when a very easily moved pivot arm is desired or when the play in the bearing between shaft 22 and the sleeve 19 is not important or is of such a low value that it may be neglected. In conjunction with the second end 47 of the bracket 45, the stop 42 may be used to limit the downward movement of the pickup arm head 36 as was previously described.

Although we have described our invention with a certain degree of particularity, it is to be understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

We claim:

1. In a sound reproducing system, pickup arm means, a support for said pickup arm means, said support including a vertical sleeve bearing and rotatable shaft means adapted to turn within said sleeve bearing, an arm connected to said rotatable shaft and extending away therefrom, resilient means connected to said arm and connected to said pickup arm means for suspending said pickup arm means from said rotatable shaft and positioned away from the said rotatable shaft to establish a force couple on said rotatable shaft means with respect to said sleeve bearing thereby reducing bearing play between said sleeve bearing and said rotatable shaft means, said resilient means having a portion free from contact with either said pickup arm or said arm and providing for vertical rotation of said pickup arm with respect to said support.

2. In a sound reproducing system, pickup arm means including an electro-mechanical transducer having a stylus and for use with a phonograph record, a support for said pickup arm means, said support including a rotatable shaft and a bracket attached to said shaft and rotatable therewith, resilient means comprised of flexible damping material having a high section modulus in a first direction and a low section modulus in a second direction, means connecting said resilient means to said pickup arm means and means connecting said resilient means to said support, said resilient means suspending said pickup arm from said support and being oriented to resist torsional vibration of said pickup arm

introduced into said pickup arm by said stylus and to resist rotation of said pickup arm with respect to said support in a first direction, and to place the low section modulus of said resilient means in a direction to establish said resilient means as a flexible hinge about which said pickup arm is adapted to pivot in a second direction for vertical movement with respect to said phonograph record, said rotatable shaft establishing an axis about which said pickup arm is adapted to rotate, said resilient means establishing a hinge about which said pickup arm may move with respect to said support, terminal means connected to said electro-mechanical transducer and extending into said support, said resilient means having a hole therein through which said terminal means extend, and said bracket having a guide to guide said terminal means as said terminal means extend through said resilent means.

3. In a support for a phonograph pickup arm having a top side and two downwardly extending sides connected to said top side and defining a hollow arm, a rigid web connected to at least one of the sides of said pickup arm and extending downwardly in the hollow between said two downwardly extending sides, flexible suspension means having a first and a second end portion with a central portion located therebetween, means for connecting the first end of said flexible suspension means to the lower end of said web, supporting means including a rotatable member, an arm connected to said rotatable member and extending away therefrom, means for connecting the second end of said flexible suspension means to a portion of said arm which is located away from said rotatable member, said second end of said flexible suspension means being positioned substantially directly above said first end of said flexible suspension means and within said hollow arm, and said central portion of said flexible suspension means providing for vertical rotation of said pickup arm with respect to said supporting means.

4. In a support for a phonograph pickup arm having a top side and two downwardly extending sides connected to said top side and defining a hollow arm, a rigid web connected inside the hollow portion of said arm to one of the sides thereof and extending downwardly, flexible suspension means having a first and a second end portion with a central portion located therebetween, means for connecting the first end of said flexible suspension means to the lower end of said web, supporting means including a rotatable member, an arm connected to said rotatable member and extending away therefrom, means for connecting the second end of said flexible suspension means to a portion of said arm which is located away from said rotatable member, said second end of said flexible suspension means being positioned substantially directly above said first end of said flexible suspension means and within said hollow arm, and said central portion of said flexible suspension means being spaced from contact with said pickup arm with respect to said supporting means.

5. A device as set forth in claim 4 in which said arm connected to said rotatable member extends upwardly; and said connections between said flexible suspension means and said arm, and between said flexible suspension means and said web are in a line substantially directly above said rotatable member.

6. A device as set forth in claim 4 in which said arm connected to said rotatable member extends outwardly away from said rotatable member; and said connection between said flexible suspension means and said arm, and between said flexible suspension means and said web are located away from the axis of said rotatable member whereby a force-couple is established on said rotatable means for reducing bearing play.

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