Jan. 23, 1940. R. DALLY 2,187,772

TONE ARM

Original Filed Sept. 24, 1936 2 Sheets-Sheet 1

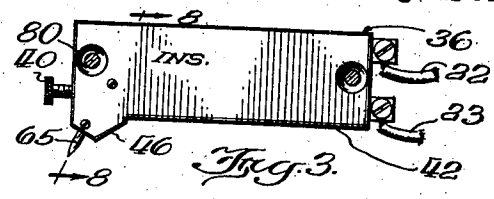


Fig. 3.

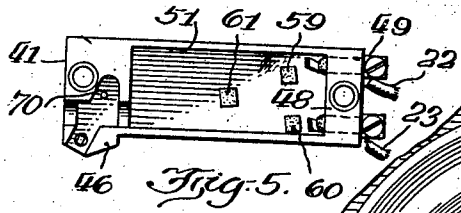


Fig. 5.

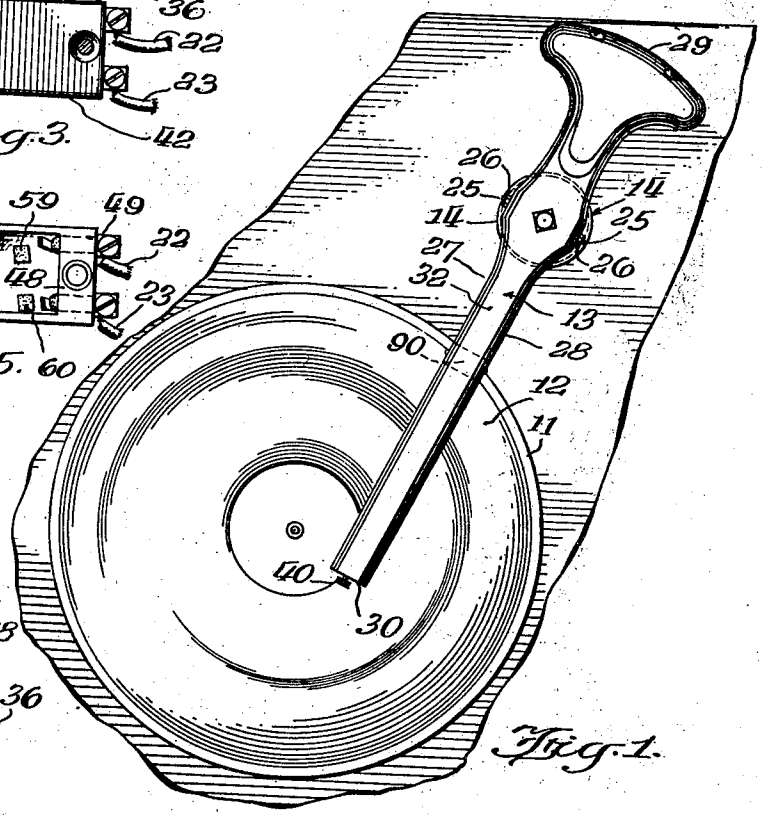
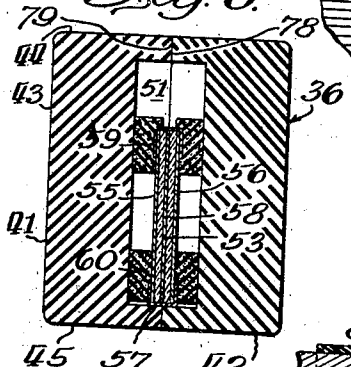


Fig. 1.

Fig. 6.



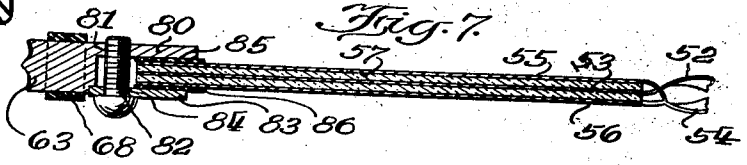


Fig. 7.

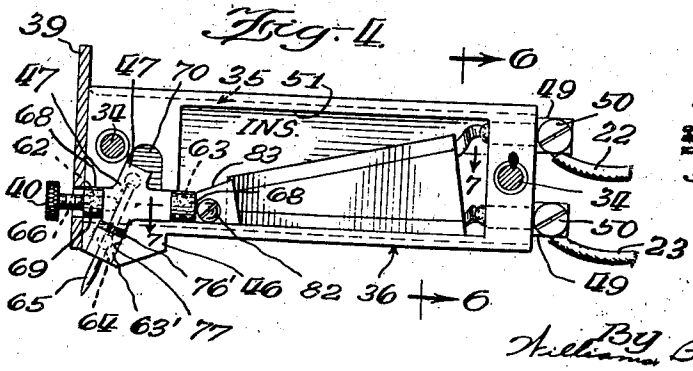


Fig. 4.

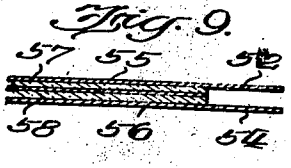


Fig. 9.

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TONE ARM

Original Filed Sept. 24, 1936 2 Sheets-Sheet 2

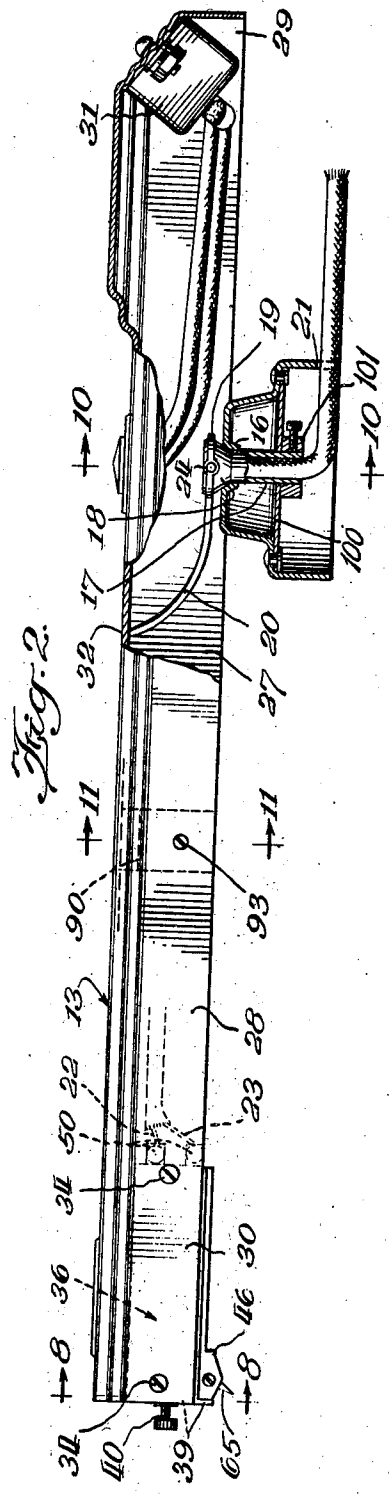


Fig. 2.

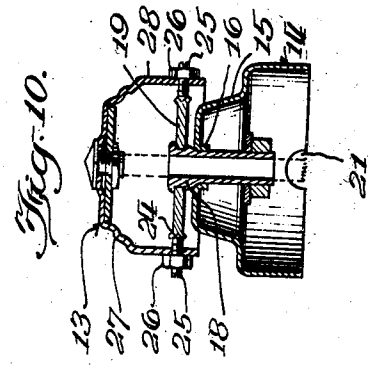


Fig. 10.

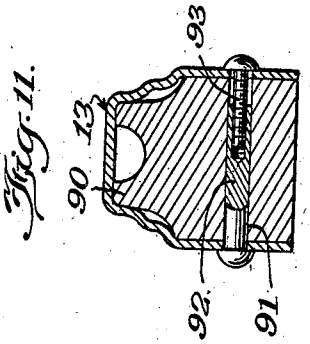


Fig. 11.

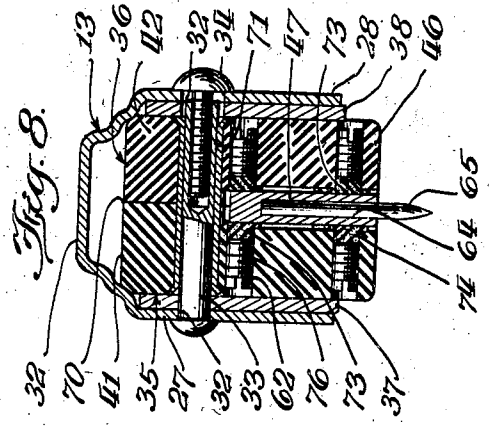


Fig. 8.

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UNITED STATES PATENT OFFICE

2,187,772

TONE ARM

Roy Dally, Racine, Wis., assignor, by mesne assignments, to Webster Electric Company, Racine, Wis., a corporation of Delaware

Original application September 24, 1936, Serial No. 102,303, now Patent No. 2,145,389, dated January 31, 1939. Divided and this application February 27, 1937, Serial No. 128,073

9 Claims. (Cl. 274—23)

The present invention relates to improved tone arms, and is particularly concerned with tone arms of the type adapted to be used with crystal pick-ups. This application is a division of my prior application, Ser. No. 102,303, filed September 24, 1936, entitled "Pick-Ups", now Patent No. 2,145,389, granted January 31, 1939, which now relates to the pick-up unit per se, and the present application relates to the complete tone arm unit.

One of the objects of the present invention is the provision of an improved tone arm assembly which is sturdy, efficient, capable of being used for a long time without necessity for repair, and capable of being manufactured at a low cost.

Another object of the invention is the provision of an improved pick-up arm of the sheet metal type, in which the undesirable vibrations have been damped out and eliminated so as to prevent the effects of resonance occurring in the arm.

Another object is the provision of an improved tone arm structure by means of which most of the parts of the tone arm may be constructed of sheet metal and therefore manufactured by stamping operations so that the tone arm unit may be constructed more economically and brought into the reach of a great number of purchasers.

Other objects and advantages of the invention will be apparent from the following description and the accompanying drawings, in which similar characters of reference indicate similar parts throughout the several views.

Referring to the two sheets of drawings,

Fig. 1 is a top plan view of a fragment of a phonograph equipped with a pick-up and tone arm constructed according to the invention;

Fig. 2 is a side elevational view of the tone arm and pick-up;

Fig. 3 is a side elevational view of the pick-up unit;

Fig. 4 is a side elevational view of parts of the pick-up unit, with one of the covers or clamping members removed, showing the fastening members in section;

Fig. 5 is an elevational view of the inside wall of one of the clamping members, which also forms the pick-up housing;

Fig. 6 is a vertical sectional view through the pick-up unit, taken on the plane of the line 6—6 of Fig. 4;

Fig. 7 is a horizontal sectional view through the pick-up unit, taken on the plane of the line 7—7 of Fig. 4, looking in the direction of the arrows;

Fig. 8 is a vertical sectional view through the pick-up unit, taken on the plane of the line 8—8 of Fig. 2, showing the details of support of the needle;

Fig. 9 is a fragmentary sectional view, similar to the right end of Fig. 7, showing the details of connection for a series connection of the crystal elements;

Fig. 10 is a vertical sectional view through the trunnion for the tone arm, taken on the plane of the line 10—10 of Fig. 2, looking in the direction of the arrows;

Fig. 11 is a transverse sectional view through the tone arm, taken on the axis of the sleeve and screw 92, 93.

Referring to Figs. 1 and 2, 10 indicates in its entirety the phonograph equipped with the usual turntable 11, bearing a record 12 and having a tone arm 13. The tone arm 13 is rotatably and pivotally supported upon a base member 14, which may consist of a substantially cup-shaped sheet metal stamping having an upper cup extension 15.

The upper cup extension is provided with a centrally located bore 16 adapted to rotatably receive a tubular shaft 17 having an upper frusto-conical portion 18, which is extended into a cross piece 19 and riveted therein. The cross piece 19 preferably has an integral, upwardly curved stop arm 20, which is adapted to engage the inside of the tone arm 13 and support the tone arm with its needle elevated when the tone arm is not resting on the record 12.

The tubular shaft 17 is rotatably supported by means of its frusto-conical portion 18 at the top engaging in the frusto-conical flange surrounding the bore 16, and by means of a metal cross piece located below said bore 16 and having an aperture for receiving the tubular member 17, the cross piece being riveted to the cup-shaped member 14. A thrust collar on the lower end of tubular member 17 and secured by a set screw thereto, holds the tubular shaft 17 in its bearings. The cross piece 19 is secured between annular shoulders on the tubular shaft 17 at the upper end thereof, the uppermost annular shoulder being formed by riveting over the end of the tubular shaft 17.

The base 14 may be secured to the top of the phonograph by means of screws or other convenient fastening means, and it is conveniently provided with a groove 21 in its side wall for passage of the electric conductors 22, 23 provided with the pick-up. The base 14 supports the frusto-conical portion 18 of the shaft 17 for rotation on a vertical axis, thereby adapting the tone arm to move to different positions radially with respect to the record 12.

The cross piece 19 is preferably provided in its ends with the stamped, frusto-conical sockets 24, each of which is adapted to receive the conical end of a screw bolt 25 held in place by a lock nut 26. The cross piece 19 comprises a resilient bronze leaf which is sprung sufficiently to place a slight spring pressure on the conical bearings, the faces of which are kept constantly engaged by the

leaf. This eliminates entirely any tendency toward chattering in the bearing when vibration is applied to the tone arm, and wear is automatically compensated for by the tendency of the cross piece 19 to take up any wear. The tubular member 17 is rotatably supported at its lower end by the cross piece 100 (Fig. 2) and retained in its bearings by the collar 101.

Screw bolts 25 are threaded into the side walls 27, 28 of the tone arm 13 and are so adjusted that they engage in the frusto-conical sockets 24 of the cross piece 19, thus rotatably supporting the tone arm 13 on the cross piece 19. This permits the tone arm to be lifted from the record so as to remove the needle from the record, and at the beginning or end of the playing of a piece. It also permits the tone arm to follow the irregularities in the record so that the needle may rise or fall as required when the record rotates.

The tone arm 13 preferably comprises a stamped sheet metal member which is inherently resilient, which may be provided with the side walls 27, 28 and an end wall 29, the opposite end being open at 30 until closed by the insertion of the pick-up unit. The tone arm 13 is pivotally supported on the cross piece 19 by the screws 25 at a point which is closer to the end 29 than the end 30.

The end portion 29 of the tone arm is suitably enlarged to provide space for a frequency adjusting unit 31. This unit 31 comprises an electrical filter unit having one or more resistance coils in connection with a condenser intended to be used to adjust the frequency response of the pick-up to any desired degree.

The tone arm is preferably used with an additional amount of resistance required to make the shunt resistance load between pick-up and tube grid circuit not less than 500,000 ohms.

The side walls 27, 28 and end walls 29 are joined by a top wall 32, and thereby form an arm of substantially U-shaped cross-section, except for certain ornamental configurations made for the purpose of improving its appearance.

The side walls 27, 28 are provided with apertures 32, which are aligned with each other and which are adapted to receive the threaded sleeves 33 and the screw bolts 34 which pass through these walls, through a metal stirrup 35, and through the pick-up unit 36, to secure the pick-up unit to the tone arm. The metal stirrup 35 comprises a sheet metal member having two legs 37, 38, which embrace the sides of the pick-up unit 36, and a wider yoke 39, which substantially covers the end of the pick-up unit, and which is provided with an aperture for passing the needle securing screw 40.

The pickup unit 36, with its enclosing sheet metal stirrup 35, is a substantial fit between the side flanges 27 and 28 of the channelled tone arm, wherein it is secured by threaded members as described.

The pick-up unit 36 preferably has its housing made of two identical halves 41, 42 of molded insulating material, such as "Bakelite" or other phenolic condensation compound, or die cast metals. The half housing members are provided with the flat or plane side walls 43, top 44, and back 45, which are substantially rectangular in shape, but it is provided at the needle end with a downward extension 46 adapted to house the needle chuck 47 and the screw 40.

While the halves of the housing are identical in shape, they differ in the fact that the half portion 41 preferably has embedded in its end 48 a pair of longitudinally projecting connector strips 49. These connector strips comprise strips of metal embedded in the "Bakelite" and have at their outer ends threaded bores for receiving the screw bolts 50, which clamp the conductors 22, 23 to the connector strips 49.

The connector strips 49 project into an element chamber 51, where they have extensions that are soldered to leads 52 suitably connected to the foil which is associated with the crystal elements. When the crystal elements are connected in parallel, as exemplified in Fig. 7, one lead 52 may be brought out from the central foil 53, or from any number of alternate, centrally located foils, and the other lead 54 may be connected to the two outer foils 55, or to the alternate series of foils, if a larger number of crystal elements and foils are used. When the elements are to be connected in series, one lead 52 is connected to the outermost of the foils 55, and the other lead 54 is connected to the outermost of the foils 56 associated with the crystal elements.

The crystal elements 57, 58 comprise flat plates of suitable crystals, such as Rochelle salts, and in the present case the strips are preferably trapezoidal in form, as shown in Fig. 4. The crystal elements 57, 58 are separated by the metal foil 53, which serves to collect any electric charge generated, from all parts of the surface of the crystals, and on each of the outer surfaces of the crystal elements 57, 58 there are the foil coverings 55 and 56. The foils and crystal elements are cemented together by suitable cement, such as, for example, melted Rochelle salts, thereby forming a unit which may be installed in the pick-up as such.

The housing halves 41, 42 are provided with the substantially rectangular depressions 51, forming the chamber 51 when the two halves are placed together as shown in Figs. 6 or 8. Each of the halves has projecting into the chamber a plurality of lugs 59, 60, 61 and adapted to serve as clamping jaws for engaging the sides of the crystal unit to clamp it in position in the pick-up. These lugs 59—61 may consist of small blocks of rubber cemented to the interior walls of the chamber 51 and thick enough so that the resilient rubber blocks 59—61 are suitably compressed to clamp the crystal unit in place when the halves 41, 42 are secured together as shown in Fig. 6.

Any number of such resilient rubber blocks may be used, two of them being preferably located at the extreme right ends of the broadest part of the crystal element so as to secure that end of the element against rotation.

The additional rubber block 61 disposed near the middle of the element also serves to clamp it, but, being made of rubber, does not prevent transmission of torque from one end of the element to the other. The left ends of the housing parts 41, 42 are each formed with half of the sockets necessary to house the armature 47.

The needle chuck 47 comprises a metal member which may be made of die cast metal having a pair of cylindrical trunnions 62, 63, which are aligned with each other and are carried by a body having a downwardly and outwardly extending needle supporting portion 63'. The needle supporting portion 63' may be substantially rectangular or round in section, and is provided at its lower end with an axially extending bore 64 adapted to receive the needle 65.

The trunnion 62 may have a threaded bore 66 communicating with the needle bore 64 and

threaded to receive the securing screw 40 which engages the needle and clamps it in the bore 63. Each of the trunnions 62, 63 is provided with a resilient rubber bearing sleeve 68 which is held on the trunnion by its own tension, being a closed rubber band tensioned about the cylindrical surface. The rubber bearing members 68 are adapted to be received in the hemi-cylindrical grooves 69 which are formed in the housing halves 41, 42, and which provide bores for receiving the rubber sleeves 68 when the housing halves are secured together.

The sockets 70 in each half 41, 42 surrounding the armature body 47 provide a clearance around this body so that it may rotate on the trunnions 62, 63, and each side of the armature is preferably engaged above and below the trunnions by resilient rubber blocks 71 to 74. These rubber blocks may be slidably received in the threaded bores 75 and engaged by the threaded members 76 so that they can be driven into resilient engagement with the armature 47 to regulate the resilient pressure under which this member moves.

The housing may be sealed against moisture by an additional resilient rubber band or ring 76' which surrounds the body 47 in the bore 77 and effects a water-tight and hermetic seal at this point. One of the most important purposes of the rubber sleeve 76' is to automatically center the needle chuck 63 in the cavity in such manner that it cannot strike the housing during normal operation. The rubber sleeve 68 seals the housing at the trunnion 62, and suitable cement or a gasket may be applied, if desired, between the opposing surfaces 78, 79 of the halves 41, 42 of the housing.

The trunnion 63 has a flat attaching flange 80 projecting axially therefrom and provided with a threaded bore 81 for receiving a screw bolt 82. A clamping plate 83 has a bore 84 for receiving the screw bolt 82, and its plate is driven into clamping relation with the crystal element by means of screw bolt 82. Rubber sheets 85, 86 are interposed between the flange 80 and the crystal element and between the flange 83 and the crystal element, insulating the foil from the needle and providing a resilient gripping action for the clamping members 80, 83. The left and smaller end of the crystal element is, therefore, secured to rotate with the trunnions 62, 63 of the needle chuck.

The adjusting clamp, comprising the shoulder 80, screw 82, clamp 83, and rubber sections 84 and 85, comprise a means for varying the voltage output of the pick-up without disturbing the frequency response. The motion of the needle point and needle chuck up to the clamp is constant, depending upon the frequency being reproduced. The torque developed by the clamp as a result of this motion also depends upon the frequencies being reproduced, but when applied through rubber to the crystal elements the torque applied to the crystal element may be varied over a large degree by varying the pressure applied to the clamp and rubber by the screw 82. The greater the pressure applied, the greater the voltage output will be, due to the added stress induced in the crystal element, and one of the most important features of the invention is the arrangement whereby the voltage output may be adjusted without disturbing the frequency response.

The flanges 80—83 may be made trapezoidal in shape, increasing in size toward the right end, as shown in Fig. 4, to clamp across the full width of that end of the crystal element. The two halves 41, 42 of the housing are preferably secured together by tubular rivets 80, which are adapted to pass the securing screws 33, 34 which extend through the side walls 27, 28 of the tone arm and through the pick-up to secure it in place.

The present pick-up is adapted to be used with records of the type having a groove which causes the needle 65 to move laterally in response to the contour of the groove to reproduce sound. When the needle 65 vibrates in a lateral direction about the axis of the trunnions 62, 63, the needle chuck has a rotative movement which tends to twist the crystal element, since the opposite end of the crystal element is held in fixed position. The torque produced in the crystal element produces a condition of strain which generates an electromotive force, the amount of the electromotive force depending upon the amount of torque, which depends upon the amplitude of vibration of the needle at any time. The present pick-up is, therefore, adapted to produce an electromotive force which, when amplified, reproduces sound recorded upon the record, and it may be used with any suitable amplifying circuit, such as that of a radio receiver.

Referring to Fig. 11, this is a cross-section, taken through a damping block 90, which is shown in dotted lines in Fig. 1. The channeled arm 13 is preferably provided with a lead block 90, which is a substantial fit between the flanges of the channel. This block has an aperture 91 for passing the screw sleeve 92 and screw bolt 93, the heads of these members engaging the outside of the flanges of the tone arm and drawing them into close engagement with the lead block 90.

The block may have a groove at the top for holding conductors in proper place. The purpose of this lead block or plug is to damp out the resonance which occurs in the arm, and it is found that the most satisfactory material is lead, due to its very inert nature.

Materials other than lead have not proved satisfactory for the reason that they do not have a satisfactory damping action. The free edges of the channeled tone arm are tightly clamped in engagement with the lead plug by means of making the aperture 91 an over-sized hole.

The pick-up is adapted to be used for a long period of time without deterioration because of its improved structure and because of the crystal being sealed against access to moisture, not only by the coverings of foil, but by the sealing of the housing with the rubber bearings and gaskets. It is found that a pick-up operating upon the torque principle reproduces sounds faithfully and efficiently and that the present pick-up may be constructed at a low cost which places it within the means of a large number of purchasers.

While I have illustrated a preferred embodiment of my invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States, is:

1. In a tone arm, the combination of a pick-up element with a resilient sheet metal tone arm for supporting said pick-up element, said tone arm having a natural period of resonance and a block of inert material clamped to said tone arm for

damping out the vibrations in said tone arm due to its natural period of resonance.

2. In a tone arm, the combination of a pick-up element with a resilient sheet metal tone arm for supporting said pick-up element, said tone arm having a natural period of resonance and a block of inert material clamped to said tone arm for damping out the vibrations in said tone arm due to its natural period of resonance, said tone arm having oppositely disposed flanges, and said block comprising a lead member fitting between said flanges, which are clamped in close engagement with said block.

3. In a tone arm, the combination of a supporting stool having a resilient cross piece carried thereby, said cross piece having oppositely disposed conical depressions therein, a tone arm comprising a resilient sheet metal member having oppositely disposed flanges adjacent the opposite edges of said cross piece, and a pair of screw members carried by said tone arm, each screw member having a conical end engaging in said conical depressions, said screw members being adjusted to place a predetermined tension in their associated parts to prevent rattling and automatically compensate for wear.

4. In a tone arm for electric pick-ups, the combination of a pick-up with a channelled tone arm, said pick-up being carried by one end of said tone arm inside the channel thereof, and means for pivotally and rotatably supporting said tone arm adjacent the other end thereof, and a damping block of lead carried by said tone arm within the channel thereof and engaging the walls of said channel, said damping block being secured to said walls for the purpose of damping out objectionable resonant frequencies in said tone arm.

5. In a tone arm, the combination of a supporting stool having a resilient cross piece carried thereby, said cross piece having oppositely disposed conical depressions therein, a tone arm comprising a resilient sheet metal member having oppositely disposed flanges adjacent the opposite edges of said cross piece, and a pair of screw members carried by said tone arm, each screw member having a conical end engaging in said conical depressions, said screw members being adjusted to place a predetermined tension in their associated parts to prevent rattling and automatically compensate for wear, said cross piece having a forwardly and upwardly extending arm adapted to engage a part of said tone arm to effect a support of said tone arm with the needle out of engagement of parts located below the level of a record.

6. In a tone arm, the combination of a supporting stool having a resilient cross piece carried thereby, said cross piece having oppositely disposed conical depressions therein, a tone arm comprising a resilient sheet metal member having oppositely disposed flanges adjacent the opposite edges of said cross piece, and a pair of screw members carried by said tone arm, each screw member having a conical end engaging in said conical depressions, said screw members being adjusted to place a predetermined tension in their associated parts to prevent rattling and automatically compensate for wear, said cross piece having a forwardly and upwardly extending arm adapted to engage a part of said tone arm to effect a support of said tone arm with the needle out of engagement of parts located below the level of a record, said cross piece being carried by a tubular metal member having oppositely disposed shoulders engaging the sides of said cross piece, and being rotatably mounted in said stool.

7. In a tone arm, the combination of a supporting stool having a resilient cross piece carried thereby, said cross piece having oppositely disposed conical depressions therein, a tone arm comprising a resilient sheet metal member having oppositely disposed flanges adjacent the opposite edges of said cross piece, and a pair of screw members carried by said tone arm, each screw member having a conical end engaging in said conical depressions, said screw members being adjusted to place a predetermined tension in their associated parts to prevent rattling and automatically compensate for wear, said cross piece having a forwardly and upwardly extending arm adapted to engage a part of said tone arm to effect a support of said tone arm with the needle out of engagement of parts located below the level of a record, said cross piece being carried by a tubular metal member having oppositely disposed shoulders engaging the sides of said cross piece, and being rotatably mounted in said stool, said stool comprising an inverted sheet metal cup having an annular shoulder intermediate its open end and closed end, and having a bearing formed in its closed end, said annular shoulder supporting a cross piece provided with an auxiliary bearing.

8. In a tone arm, the combination of a supporting stool having a resilient cross piece carried thereby, said cross piece having oppositely disposed conical depressions therein, a tone arm comprising a resilient sheet metal member having oppositely disposed flanges adjacent the opposite edges of said cross piece, and a pair of screw members carried by said tone arm, each screw member having a conical end engaging in said conical depressions, said screw members being adjusted to place a predetermined tension in their associated parts to prevent rattling and automatically compensate for wear, said cross piece having a forwardly and upwardly extending arm adapted to engage a part of said tone arm to effect a support of said tone arm with the needle out of engagement of parts located below the level of a record, said cross piece being carried by a tubular metal member having oppositely disposed shoulders engaging the sides of said cross piece, and being rotatably mounted in said stool, said stool comprising an inverted sheet metal cup having an annular shoulder intermediate its open end and closed end, and having a bearing formed in its closed end, said annular shoulder supporting a cross piece provided with an auxiliary bearing, said bearing in said closed end having a frusto-conical bore at its upper end and said tubular member having a complementary frusto-conical formation whereby wear between the parts may be taken up.

9. In a tone arm, the combination of a pickup element with a resilient sheet metal tone arm having a pair of parallel side flanges joined by a top flange, the said parallel flanges having undesirable natural resonance characteristics, and a block of lead interposed between the said parallel walls of said tone arm, said walls being clamped against said block, whereby the lead is adapted to absorb and damp out the said undesirable resonance characteristics which are due to the natural period of resonance of said tone arm.

ROY DALLY.