March 9, 1943. R. DALLY 2,313,126

TONE ARM

Filed Jan. 18, 1941 3 Sheets-Sheet 1

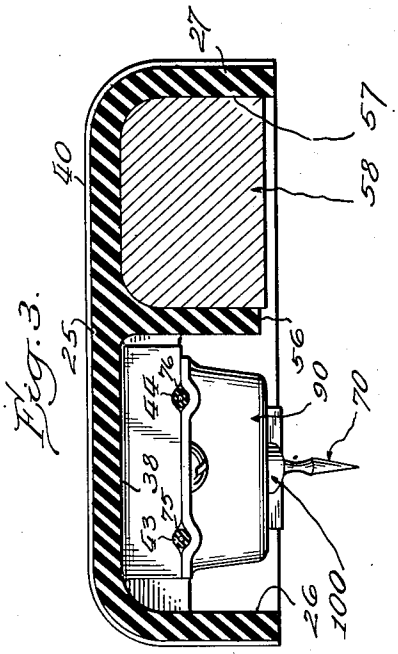


Fig. 3.

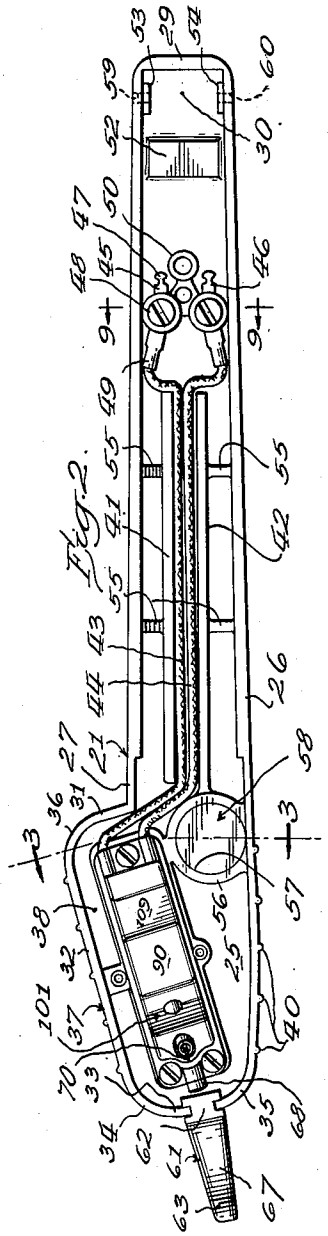


Fig. 2.

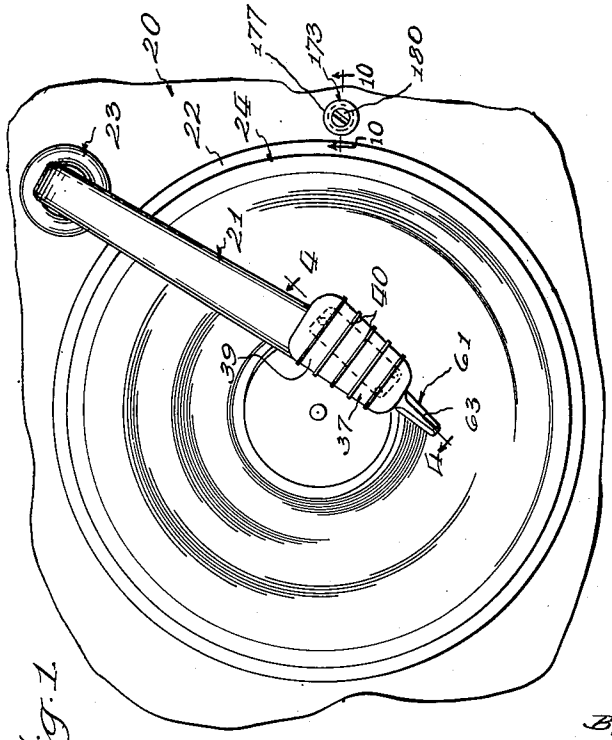


Fig. 1.

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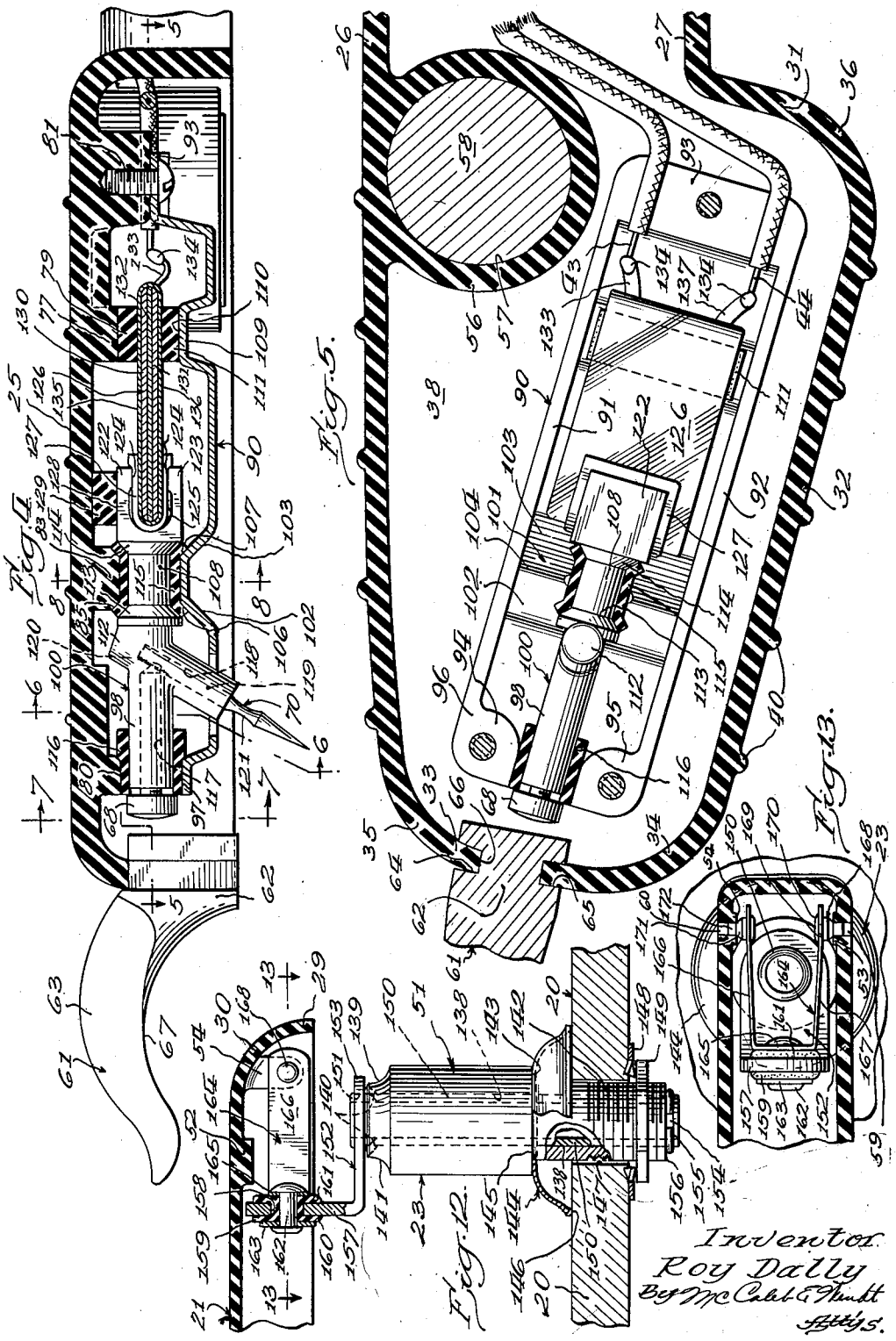


Fig. 4.

Fig. 5.

Fig. 12.

Fig. 13.

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Fig. 6.

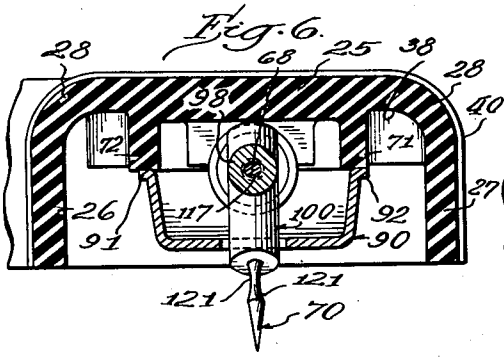


Fig. 7.

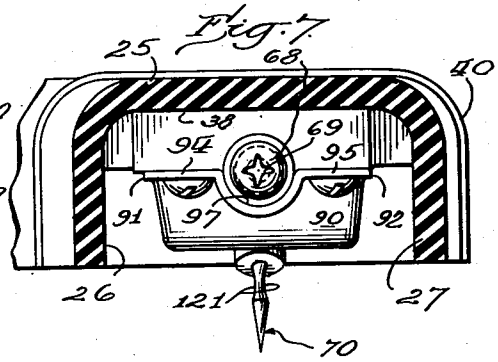


Fig. 8.

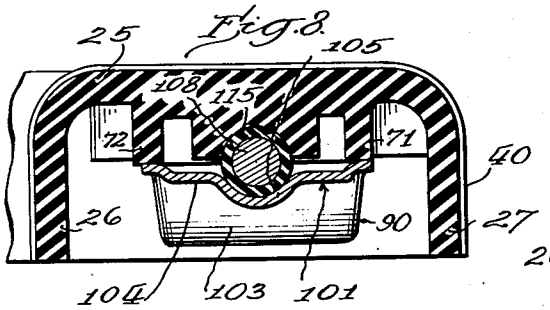


Fig. 9.

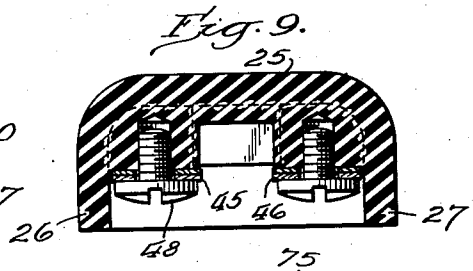


Fig. 11.

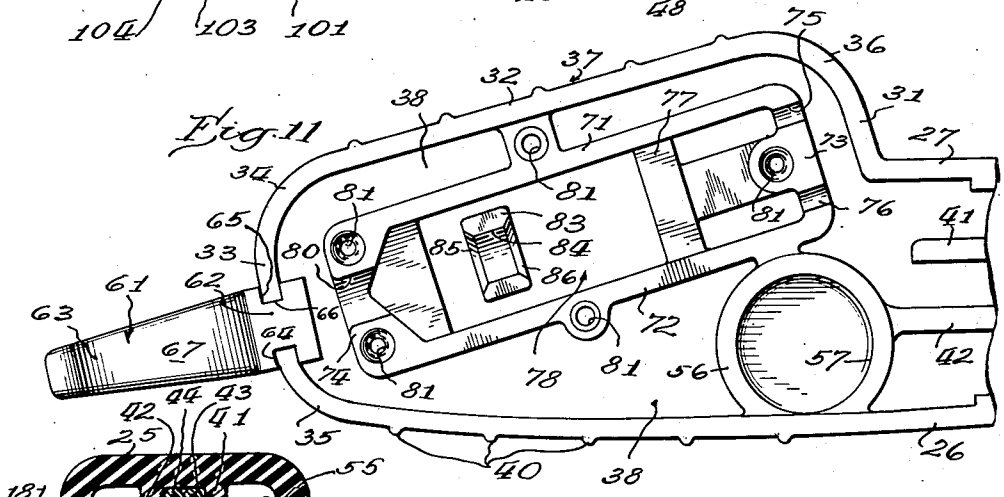
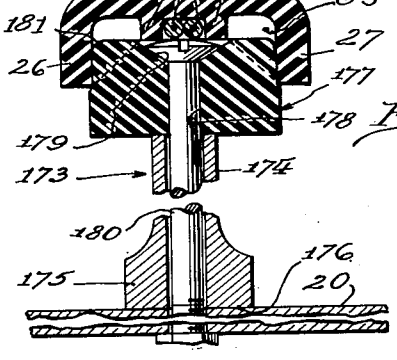


Fig. 10.



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Patented Mar. 9, 1943 2,313,126

UNITED STATES PATENT OFFICE

2,313,126

TONE ARM

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

Application January 18, 1941, Serial No. 374,964

7 Claims. (Cl. 179—100.41)

The present invention relates to tone arms and is particularly concerned with tone arms of the type having a crystal reproducer.

One of the objects of the invention is the provision of an improved tone arm construction in which a number of the parts of the assembly, and in particular parts of the reproducer unit, may be eliminated.

Another object of the invention is the provision of an improved tone arm construction adapted to be used for sound reproducing apparatus of high fidelity and which is adapted to be used with conventional phonographs to give the best reproduction and minimum record wear and to eliminate undesirable frequency responses.

Another object of the invention is the provision of an improved light tone arm and reproducer unit structure in which the characteristics of inertia and weight may be conveniently adjusted to any desired value.

Another object of the invention is the provision of an improved form of tone arm pivotal support by means of which the tone arm may be so mounted that it can be lifted up when installed on the phonograph to such position that the bottom of the pickup can be inspected and the needle most conveniently inserted.

Another object of the invention is the provision of an improved tone arm support having a resilient connection between the tone arm and support so that the tone arm can be removed at any time by merely springing apart the pintle supporting springs which are carried by the tone arm support and by means of which any wear may be taken up so that there is no possibility of rattling.

Another object of the invention is the provision of an improved tone arm and reproducer unit which may be manufactured more economically than the devices of the prior art, which may be assembled with less labor, and which requires a lesser number of parts.

Another object of the invention is the provision of an improved tone arm and reproducer unit which is so constructed that the chuck is protected against axial jars which might otherwise break the crystal.

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 the same parts throughout the several views.

Referring to the drawings accompanying this specification, of which there are three sheets:

Fig. 1 is a top plan view of a tone arm and turntable installation embodying the present invention;

Fig. 2 is a full size bottom plan view of the tone arm removed from its pivotal support;

Fig. 3 is an enlarged sectional view taken on the plane of the line 3—3 of Fig. 2 looking in the direction of the arrows;

Fig. 4 is a fragmentary vertical sectional view taken on the plane of the line 4—4 of Fig. 1 looking in the direction of the arrows;

Fig. 5 is a fragmentary horizontal sectional view taken on the plane of the line 5—5 of Fig. 4 looking in the direction of the arrows;

Fig. 6 is a fragmentary sectional view taken on the plane of the line 6—6 of Fig. 4 looking in the direction of the arrows;

Fig. 7 is a similar view taken on the plane of the line 7—7 of Fig. 4 looking in the direction of the arrows;

Fig. 8 is a similar view taken on the plane of the line 8—8 of Fig. 4 looking in the direction of the arrows;

Fig. 9 is a similar view taken on the plane of the line 9—9 of Fig. 4 looking in the direction of the arrows;

Fig. 10 is a vertical sectional view taken on the plane of the line 10—10 of Fig. 1 looking in the direction of the arrows, showing details of structure of the means for supporting the tone arm in its inoperative position;

Fig. 11 is a fragmentary bottom plan view of the reproducer end of the tone arm showing the details of structure of this part of the arm;

Fig. 12 is a fragmentary vertical sectional view of the opposite end of the tone arm showing the structure of a pivotal support for the tone arm; and

Fig. 13 is a fragmentary horizontal sectional view taken on the plane of the line 13—13 of Fig. 12 looking in the direction of the arrows.

Referring to Fig. 1, 20 indicates the fixed support for the tonearm 21 and the turntable 22 in the form of the top panel of a phonograph or other housing. The tone arm, which is indicated in its entirety by the numeral 21, includes a pivotal supporting member 23 by means of which the tone arm is mounted for substantially universal movement so that it can be lifted from the record and so that it can progress across the record as its needle follows the groove in the record 24.

The tone arm is preferably of a channeled construction having an upper wall 25 (Fig. 6) and a pair of depending side walls 26 and 27 joined by the partially cylindrical corner por-

tions 28. At its rear or pivotally supported end, it has an end wall 29, closing the end of the channel and joined to the top wall 25 by a partially cylindrical portion 30.

The width of the top wall and of the channeled arm preferably increases somewhat from its rear end toward the free or reproducer end and the channel preferably has an enlargement at its reproducer end, as shown in Fig. 5. At this end the side wall 27 is integrally joined to a side wall portion 31 which extends outward at an angle and is joined to a side wall portion 32 which extends diagonally down toward the other end wall 33 of the channeled arm. The side wall 26 may extend in substantially the same direction throughout its full length to the point where it joins the end wall 33.

All of these side wall portions are joined to their respective end wall or other side wall portions by the curved corner walls 34, 35, 36, as indicated in Fig. 11, and the walls of the enlargement, which is indicated in its entirety by the numeral 37, are preferably slightly deeper than the rest of the tone arm so that the enlargement forms a housing 38 which is of greater depth than that portion of the arm which extends backward from it.

The enlargement 37 may be provided on its side walls and top wall 39 with a plurality of transversely extending reenforcing ribs 40 (Fig. 1) extending from the bottom of each wall up over the top of the arm and down the other side.

The inside of the top wall 25 is preferably formed with a pair of longitudinally extending flanges or ribs 41, 42 (Fig. 2) spaced sufficiently to form a groove which will frictionally retain the conductors 43, 44 leading from the reproducer to the connectors 45, 46. These connectors comprise strips of metal having a head 47 formed at one end and having a body provided with an aperture for receiving a screw bolt 48 which passes through the aperture and is threaded into a lug that is integral with the tone arm.

The other end of each connector, shown at 49, may be of substantially T shape so that its oppositely projecting flanges may be bent about the wire of the insulated conductors 43 or 44 to which they are soldered.

The tone arm may have another integral inwardly projecting cylindrical lug 50 provided with a threaded aperture for receiving a bolt which will clamp to the arm a supporting member for the conductors that will be connected to the connectors 45, 46. This latter conductor will pass along the tone arm and down through the aperture in the supporting post 51 (Fig. 12) to the electrical circuits which are disposed below the supporting table 20.

The tone arm is preferably provided with a plurality of reenforcing ribs, such as the ribs 52 (Fig. 2), 53, 54 and 55, and at its free end the tone arm is preferably provided with an inwardly projecting cylindrical wall 56 forming a tapered cylindrical socket 57 for receiving a metal body 58 preferably of lead or similar material having a predetermined amount of inertia. The lead body 58 is of substantially the same size as the socket 57 and is secured in place by driving it into the socket and spreading it slightly by impact with a tool. It is retained by friction.

The ribs 53, 54 previously mentioned are located at the supported end of the tone arm and they provide the walls 26 and 27 with sufficient body so that bearing apertures 59, 60 may be of greater length. At its free end, the tone arm is preferably provided with a handle 61 and this handle may take the form of a cast metal member having a supporting portion 62 and a finger piece 63.

The supporting portion comprises a body which is formed on its opposite sides with the parallel grooves 64, 65 of substantially rectangular cross-section. These grooves are wide enough to receive the end wall 33 between the walls of the grooves and the end wall is preferably provided with an upwardly extending slot 66 open at the bottom so that the supporting portion 62 of the handle may be slid upward into the slot 66.

The width of the slot is substantially equal to the width of the body portion 62 between the grooves 64 and 65 and the depth of the slot 66 is equal to the depth of the body portion 62 at this point. The slot 66 is tapered and rounded at the top and it receives the body portion 62 with a frictional fit of sufficient tightness so that the handle is retained by the tone arm.

The finger portion 63 extends longitudinally outward from the body portion 62 as shown in Fig. 4 and has its lower part provided with a concave surface 67 for engagement with a finger. Its upper side may have a similar curvature.

In addition to serving as a support for the handle, the groove 66 also provides access to the needle-clamping screw 68 (Fig. 7) which is preferably made of the type having a threaded shank and a head with a cruciform socket 69 that requires a special type of tool which the ordinary user may not have so that he will not tamper with the tone arm.

The tone arm is preferably constructed of cast or molded material. It may be cast of various types of light metals, such as aluminum, or aluminum alloys, but is preferably made of a molded insulating material such as a phenolic condensation compound or some other form of molding powder such as that called "Bakelite."

All of the parts of the tone arm so far described, except the conductors and connectors, handle and weight, are of one integral piece, so that they may be manufactured economically and require no labor in assembly. Such a tone arm made of insulating molded material is very light and when used with the flexible type of needle such as that shown at 70 (Fig. 6), might result in movement or vibration of the complete tone arm by the needle instead of producing the desired effect on the crystal of the reproducer.

Therefore, the relatively light tone arm is provided with the inertia mass previously described and indicated at 58 which has sufficient inertia so that the tone arm has the proper inertia characteristics. This mass also gives the tone arm sufficient weight at its free end and concentrates the weight at the desired point so that the needle will track properly in the record groove.

Referring to Fig. 11, this is a bottom plan view of the free end of the molded tone arm channel which is provided with integral formations suitable for the support of the crystal and other elements of the reproducer which forms a part of the tone arm. In this case one of the clamping members or housing members for the reproducer forms an integral part of the tone arm.

The reproducer housing is preferably of a type somewhat similar to that disclosed in my prior application Serial No. 338,519 filed June 3, 1940, for Crystal pick-up units. One of the half-housing members disclosed in that application is pref-

erably employed with the tone arm structure in this embodiment of the invention.

Thus, the chamber 38 of the tone arm is preferably provided with a pair of inwardly projecting parallel ribs or walls 71, 72 which project from the top wall of the enlargement 37 into the chamber 38. These walls join with the end wall portions 73, 74, forming a half of a substantially rectangular housing. The end wall 73 is provided with a pair of half cylindrical grooves 75, 76 adapted to pass the insulated conductors 43, 44 and to clamp the insulated portion of these conductors in such manner that it will be held in fixed position.

Spaced inwardly of the end wall 73 there is a transversely extending rib 77 in the reproducer chamber 78 having an upper plane surface which is located below the upper surface of walls 71 and 72 when the walls are viewed as seen in Fig. 11 in the inverted position. The rib 77 serves to support a resilient block 79 which may be made of soft resilient rubber or printer's roll composition or other material of similar resilient characteristics.

Referring again to Fig. 11, the end wall 74 is provided with a transversely extending half cylindrical groove 80 for passing a portion of the chuck which has the threaded bore for receiving the clamping screw 68. The walls 71—74 of that portion of the reproducer housing which is integral with the tone arm are preferably suitably enlarged at the points where the threaded bores 81 are located, as these threaded bores are used in connection with the screws for clamping the other half housing to the tone arm.

The molded tone arm also has inside the crystal chamber 78 an inwardly extending integral bearing lug 83 which may be of substantially rectangular external outline but which is provided with a half cylindrical groove 84 and with frusto conical tapered portions 85, 86 leading to the groove 84.

Referring now to Fig. 4, 90 indicates in its entirety the other half-housing member which cooperates with the walls of chamber 78 in the tone arm to complete the chamber for the crystal of the reproducer. This half-housing member 90 is in fact practically similar to the construction of one of the half-housing members of my prior application above mentioned and it may comprise a metal stamping made of suitable sheet metal such as aluminum or an aluminum alloy.

This half-housing member is provided with a border flange, the side portions of which are shown in Fig. 6 at 91 and 92 as relatively narrow flanges, and the end portions of which are shown in Fig. 4 at 93 and in Fig. 7 at 94, 95. The housing member 90 comprises a sheet metal member which is recessed inside the border flanges 91—95 and it thus forms a part of the chamber within which the crystal and chuck of the reproducer are housed. Its border flanges 91—95 are adapted to engage the flat or plane surface indicated at 96 on the side and end walls 71—74 of the chamber 78 in the tone arm enlargement 37 to form a substantially closed housing.

Certain of these border flange portions, however, are provided with recesses as follows: Referring to Fig. 7 between the border flange portions 94, 95 there is a partially cylindrical pressed groove 97 which registers with the partially cylindrical groove 80 of Fig. 11 to form a cylindrical bore for receiving one of the trunnions 98 of the chuck which is indicated in its entirety by the numeral 100.

The sheet metal half-housing member 90 is also formed with an inwardly pressed formation 101 between its ends and at the right of the chuck 100 (Fig. 5), this formation comprising a pair of diagonally extending surfaces 102, 103, joined at a ridge 104. The diagonal surfaces 102, 103 and ridge 104 are deformed as indicated in Fig. 8 where this formation 101 is provided with a partially cylindrical groove 105 in the ridge 101.

The result is a cylindrical groove which is provided at both of its ends with frusto-conical portions indicated at 106, 107, in Fig. 4; that is, a groove and surfaces substantially like those indicated at 84, 85, 86 in Fig. 11.

When the two housing portions 78 and 90 are placed together, these grooves 84 register and form a cylindrical bearing supporting bore for the right-hand trunnion 108 of the chuck 100. The sheet metal half-housing 90 is also provided with an inwardly extending rib 109 (Fig. 4) having a plane upper surface 110 which may extend fully across the half-housing 90. This surface is intended to support a resilient block 111 similar to that previously described for clamping the crystal members in fixed position in the housing as shown in Fig. 4.

The size of the blocks 79, 111 and the ridges 109 and 77 relative to the thickness of the crystals and the space in the housing are such that the blocks 79, 111 are compressed and the crystals resiliently clamped by the housings when the parts are assembled as shown in Fig. 4. To secure the housings together, the sheet metal member 90 is provided with apertures registering with the apertures 81 at the ends of the housing 78 and screws pass through apertures in the half-housing 90 and are threaded into the bores 81 to secure these two housing members together.

The chuck 100 comprises a cast metal member which may be made of any suitable metal such as die cast metal having a cylindrical trunnion 98 on one side of its central body 112 and another trunnion 108 on the other side of the central body 112. These bearing portions are aligned, being generated on the same axis and the trunnion 108 is preferably bordered by the frusto-conical thrust surfaces 113, 114.

Thus, a tubular sleeve 115 of live resilient material, such as rubber, may be placed on the trunnion 108, also covering the frusto-conical surfaces 113, 114, and the assembly, including the sleeve, will be of a suitable shape to be complementary to the aperture formed by the grooves 84 and 105 and the frusto-conical surfaces 85, 86 and 106, 107 in the half-housing members.

Here again the live rubber sleeve 115 is slightly larger than the space which it is to occupy so that it is compressed when the housings are fastened together.

Thus, the chuck 100 is resiliently supported for rotation or movement on the trunnion 108, and its axial movement is resisted by the thrust bearings 113, 114 and frusto-conical surfaces 85, 86, 106, 107.

The trunnion 98 may be substantially cylindrical and it is provided with a live resilient rubber sleeve 116 which engages the cylindrical grooves 80 and 97 in the housings and prevents metal-to-metal contact between the chuck and the housing at this point.

This sleeve is also initially compressed when the housings are secured together, as will be evident from the fact that the compressed portion is smaller at the left-hand end of the sleeve in Fig. 5. The trunnion 98 is provided with an ax-

ially extending bore 117 which is threaded to receive the threaded shank of the clamping screw 68. This screw shank is long enough to extend through the bore 117 into engagement with a needle 70 which is mounted in a communicating bore 118 in the body 112.

The main body 112 of the chuck 100 may comprise a substantially cylindrical diagonally outward and downwardly extending portion 112 having the bore 118 which is open at the bottom and which communicates with the bore 117 at the top.

The needle 70 is preferably of the type having a cylindrical upper shank 119 which has a flattened surface 120 for engagement with the shank of the bolt 68. The needle has this surface in order that it may be disposed in proper rotative position as it also has a pair of concave depressions 121 at the opposite sides of the needle between its point and the cylindrical shank 119 in the bore 118.

These concave depressions 121 give the needle an intermediate resilient portion which flexes or bends more easily in a plane passing through the axis of the needle and extending at right angles to the tangent to the groove of the record.

It will be noted in Fig. 5 that the housing half which is integral with the tone arm is disposed at an angle to the major axis of the tone arm and this is for the purpose of bringing the needle into proper position for approximate tangential tracking with respect to the spiral grooves of the record.

The chuck 100 has at its end opposite to the trunnion 98, a substantially U-shaped formation comprising the two flanges 122, 123. These flanges have the plane clamping surfaces 124 and are provided with a clearance at 125 over the rest of the surface between the flanges 122 and 123.

The flanges 122 and 123 are adapted to clamp the crystal assembly 126 but a U-shaped live resilient rubber sheet 127 is interposed between the clamping surfaces 124 and the crystal assembly 126. This provides the clamping members 122 and 123 with a live resilient surface for engaging the crystal assembly 126 and the rubber 127 is likewise compressed by pinching the flanges 122 and 123 together with a suitable tool after the crystal assembly is between these flanges.

The uppermost flange 122 also has its upper plane surface 128 engaging a live rubber block 129 which engages the top wall 25 of the tone arm. This block 129 may consist of live resilient rubber or printer's roll composition or other suitable resilient material and it is included for the purpose of giving the chuck and crystal assembly and tone arm the desired resilient and frequency characteristics.

The crystal assembly 126 may comprise a pair of suitable crystals such as Rochelle salts adapted to generate an electromotive force when subjected to torsion. The crystal assembly may consist of a pair of crystals 130, 131 separated by a layer of metal foil 132 which is connected to one of the conductors, such as conductor 43, by a foil strip 133 and a drop of solder 134.

The two crystals 130 are connected over all by a covering of foil, the upper layer of which is indicated at 135 and the lower layer at 136, both layers being insulated from the centrally located foil 132 by the crystals 130 and 131, and the outer layer may extend over both edges and sides completely enclosing the crystals and protecting them from moisture.

As the crystal members in this pickup are disposed in a plane parallel to the plane of the record, they will of course be cut appropriately with respect to the axes of the crystal from which they are made, so that the twisting action of the chuck under the influence of the needle will generate electromotive forces that are collected by means of the foil 132, 135, 136, and carried to the conductors 43 and 44 by the strips of foil 133, 137.

The units may be provided with conductors 43, 44 which lead to connectors 45, 46 or with conductors of any desired length extending the full length of the tone arm and down through the support 51.

Referring to Figs. 12 and 13, the rear end of the tone arm is supported upon the column 51 which comprises a tubular member having a through bore 138 having its upper end formed with a relatively narrow thrust surface 139. This narrow thrust surface is provided by making the end portion 140 of the bore 138 frusto-conical and by providing a taper 141 at the upper outer surface of the cylindrical column 51.

At its lower end this column has a reduced threaded portion 142 and there is an annular shoulder 143 which engages a stamped sheet metal collar 144. The collar 144 has a centrally located bore 145 for passing the reduced threaded portion 142 and it comprises a flange which extends downwardly and radially so that its lower and outer edge 146 is adapted to rest on the phonograph table 20.

Provision is made for securing this column 51 to the table 20 by providing the table 20 with a bore 147 for passing the reduced portion 142. A spring washer 148 and nut 149 are threaded on the lower end 142 of the column 51 to clamp the table 20 between collar 144 and nut 149.

The cylindrical bore 138 in the column 51 rotatably supports a tubular metal member 150, the upper end of which is expanded into tight frictional engagement in a bore 151 in a metal bracket 152. The bracket 152 has a horizontal flange portion 153 with an aperture having a tight fit with the upper end of the tube 150 and the flange 153 serves as a thrust bearing for the upper end of the tube 150 against the thrust bearing surface 139.

A very light spring washer of the wavy type is preferably interposed between flange 153 and thrust bearing surface 139 to prevent any rattling. The lower end of the tube 150 is provided with a half cylindrical groove 154 extending completely around the tube and adapted to receive a round spring wire 155 which is bent to substantially circular form and which exerts a clamping action that retains it in the groove 154.

The spring wire 155 projects beyond the outer surface of the tube 150 and engages the end 156 of the column 51 as a thrust bearing to keep the tube 150 in the column.

The bracket 152, as well as the tube 150, may be constructed of light metal such as aluminum, or an aluminum alloy, and it is also provided with a vertically extending flange 157. This flange is at right angles to the flange 153 and it is provided with a through bore 158 at the top for receiving the rubber grommet 159 which is located in the bore and which has flanges 160, 161 on both sides of the bracket 152.

The inner cylindrical portion of the grommet also insulates the body of a rivet 162 from the bracket and this rivet is provided on the left side (Fig. 12) of the bracket 152 with a metal washer

163. The rivet 162 carries a U-shaped spring trunnion supporting member 164. Rivet 162 passes through the grommet 159 and through an aperture in the spring 164 in such manner that the spring 164 is tightly secured to the bracket 152 but there is no metal-to-metal contact between the bracket 152 and the spring 164.

The spring 164 comprises a strip of spring steel bent to substantially U shape and having its yoke 165 provided with the aperture for receiving the rivet 162. The two legs 166, 167 of this spring extend in the same general direction but may diverge slightly as shown in Fig. 13 and at their ends they are provided with apertures for receiving the riveted studs 168 which are similar in shape but oppositely disposed.

Each stud 168 has an annular shoulder 169 which engages one side of the spring 167 and has a riveted portion 170 on the other side of the spring. The main body of each stud is enlarged and it is provided with a frusto-conical portion 171 and a reduced cylindrical portion 172.

This reduced cylindrical portion 172 fits in the bearing apertures 59 and 60 of the tone arm while the frusto-conical portion 171 bears against the end portion of the apertures 59 or 60 and under the resilient compression of the spring arms 166, 167, any wear which occurs in the bearing is taken up and rattling is positively prevented.

The tone arm is thus pivotally supported on the post 51 at an axis which is disposed very close to the rear wall 29 and the flange 157 is of sufficient length so that as the tone arm pivots upward, the rear wall 29 may pivot down into the space which appears between the tone arm in Fig. 12 and the flange 153.

Referring now to Figs. 1 and 10, the tone arm is preferably provided with an auxiliary support for holding it and protecting the needle and reproducer against damage when it is not being used on a record. This support is indicated in Fig. 1 at 173. This support preferably comprises a tubular metal column 174 having an enlarged bottom portion 175 provided with a flat lower surface 176 which engages the table 20.

The upper end of the smaller portion of the tube 174 may be engaged by a cylindrical rubber block 177 of such diameter that it has to be compressed when it is inserted between the depending flanges 26 and 27 of the tone arm. This rubber member 177 preferably has its upper corners rounded at 181 so as to give the block a kind of taper which will permit it to be compressed as it slides in between the flanges 26 and 27.

The rubber block has it central bore 178 tapered at 179 to receive the head of a screw bolt 180 which passes through the rubber cushion 177 and the column 174 and secures the rubber to the column and the column to the table 20 by means of a nut on its lower threaded end, the bolt passing through the table.

The size of the rubber member 177 is such that when the tone arm is pushed on it as shown in Fig. 10, the tone arm is retained against removal by friction, but it may be pulled off by application of a predetermined vertical force whenever it is desired to lift the tone arm and place it on a record.

The tone arm may be removed from the column 51 at any time by compressing the spring legs 167, 166, sufficiently to remove the trunnions 172 from their bearings 59 and 60. The tone arm is insulated by the rubber at 159 from needle noise or other undesirable noises which might be transmitted to the tone arm by the column.

The characteristics of the tone arm and reproducer are greatly improved over the devices of the prior art. There is less needle wear due to the lightness of the tone arm, and the inertia characteristics of the tone arm may be adjusted to any desired value.

By locating the handle 62 and the weight 58 near the free end of the tone arm, its mass is concentrated near the crystal pickup unit and made most effective, and the tone arm may be made much lighter than if the same mass were distributed throughout the full length of the tone arm.

The present tone arm may be manufactured at a very low cost because of the reduction in the number of its parts, and it may be assembled more quickly than the devices of the prior art in which the reproducer is a separate unit before it is placed in the tone arm. The crystals are protected against moisture by being completely enclosed in tin foil and they are protected against breakage by the thrust bearing arrangement which is located just behind the needle.

A thin resilient needle may be employed and the operator is deterred from tampering with it because of the fact that the needle clamping screw is concealed by the handle and a special clamping screw is used for which a special tool should be employed.

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 desired to secure by Letters Patent of the United States, is:

1. In a crystal reproducing member, the combination of a tone arm having a recess formed in its free end and having a half-housing formed in said recess for enclosing a crystal unit and a chunk, a second half-housing member adapted to engage the housing formed in said tone arm, means for securing said housing members together, a crystal unit carried by said housing members, and a needle chuck movably mounted between said housing members and engaging said crystal unit, said tone arm being constructed of molded insulating material and said other half-housing member being a stamped sheet metal member.

2. In a crystal reproducing member, the combination of a tone arm having a recess formed in its free end and having a half-housing formed in said recess for enclosing a crystal unit and a chuck, a second half-housing member adapted to engage the housing formed in said tone arm, means for securing said housing members together, a crystal unit carried by said housing members, and a needle chuck movably mounted between said housing members and engaging said crystal unit, said tone arm being constructed of molded insulating material and said other half-housing member being a stamped sheet metal member, and said means for securing comprising threaded screw bolts passing through apertures in said sheet metal member and threaded into threaded bores in said tone arm.

3. In a reproducer unit the combination of a housing member of a molded phenolic condensation compound formed with projecting side flanges defining the walls of the housing, said side flanges being provided with threaded bores, end flanges

on said housing, one of said end flanges having an enlarged aperture for clearance around the chuck and the other of said end flanges having grooves formed therein for partial reception of rubber-covered conductors and said latter end flange having a threaded bore, said housing being formed on its interior with a raised surface for engaging a crystal and having spaced from said surface a projecting lug provided with a half cylindrical bearing surface and with tapered thrust surfaces on both sides, a metal housing member comprising a stamped sheet metal member formed with an outwardly projecting border flange adapted to engage the side walls of the first-mentioned housing, said lateral member having a pressed formation for engaging the crystal and another pressed formation provided with thrust surfaces and a half cylindrical bearing surface, a crystal clamped between said housing members and a chuck engaging said crystal and having a trunnion, said trunnion having thrust surfaces at its ends and a resilient covering for said trunnion and thrust surfaces whereby the trunnion and thrust surfaces may be clamped between the housing members to secure it for a limited universal movement.

4. In a reproducer unit the combination of a housing member of a molded phenolic condensation compound formed with projecting side flanges defining the walls of the housing, said side flanges being provided with threaded bores, end flanges on said housing, one of said end flanges having an enlarged aperture for clearance around the chuck and the other of said end flanges having grooves formed therein for partial reception of rubber-covered conductors and said latter end flange having a threaded bore, said housing being formed on its interior with a raised surface for engaging a crystal and having spaced from said surface a projecting lug provided with a half cylindrical bearing surface and with tapered thrust surfaces on both sides, a metal housing member comprising a stamped sheet metal member formed with an outwardly projecting border flange adapted to engage the side walls of the first-mentioned housing, said lateral member having a pressed formation for engaging the crystal and another pressed formation provided with thrust surfaces and a half cylindrical bearing surface, a crystal clamped between said housing members and a chuck engaging said crystal and having a trunnion, said trunnion having thrust surfaces at its ends and a resilient covering for said trunnion and thrust surfaces whereby the trunnion and thrust surfaces may be clamped between the housing members to secure it for a limited universal movement, and threaded members passing through said sheet metal member and threaded into said insulating housing to clamp the chuck, the crystal and the conductors between said housing members.

5. In a combined tone arm and reproducer unit, the combination of a tone arm of molded material having a housing formed in its free end for housing part of a crystal and chuck assembly, a complementary housing member adapted to be combined with the tone arm to complete the enclosure of the crystal and chuck assembly, said housings having half-cylindrical grooves formed at the rear end thereof whereby substantially cylindrical apertures are formed when the housing is assembled, and conductors for effecting connections with said crystal unit comprising insulated electrical conductors covered with live resilient material, the insulation of said conductors being of slightly larger size than said cylindrical apertures whereby the conductors may be clamped between the parts of the housing to anchor them to the housing.

6. In a combined tone arm and reproducer unit, the combination of a tone arm of molded material having a housing formed in its free end for housing part of a crystal and chuck assembly, a complementary housing member adapted to be combined with the tone arm to complete the enclosure of the crystal and chuck assembly, said housings having half-cylindrical grooves formed at the rear end thereof whereby substantially cylindrical apertures are formed when the housing is assembled, and conductors for effecting connections with said crystal unit comprising insulated electrical conductors covered with live resilient material, the insulation of said conductors being of slightly larger size than said cylindrical apertures whereby the conductors may be clamped between the parts of the housing to anchor them to the housing, said tone arm being formed on its lower side with a pair of parallel ribs between which said conductors may be compressed and retained by frictional engagement therewith.

7. In a combined tone arm and reproducer unit, the combination of a tone arm of molded material having a housing formed in its free end for housing part of a crystal and chuck assembly, a complementary housing member adapted to be combined with the tone arm to complete the enclosure of the crystal and chuck assembly, said housings having half-cylindrical grooves formed at the rear end thereof whereby substantially cylindrical apertures are formed when the housing is assembled, and conductors for effecting connections with said crystal unit comprising insulated electrical conductors covered with live resilient material, the insulation of said conductors being of slightly larger size than said cylindrical apertures whereby the conductors may be clamped between the parts of the housing to anchor them to the housing, said tone arm being formed on its lower side with a pair of parallel ribs between which said conductors may be compressed and retained by frictional engagement therewith, and electrical connectors carried by the other ends of said conductors and secured to the lower end of said tone arm.

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