May 30, 1939. R. DALLY 2,160,793

PICKUP

Filed Jan. 21, 1938 3 Sheets-Sheet 1

Fig. 1.

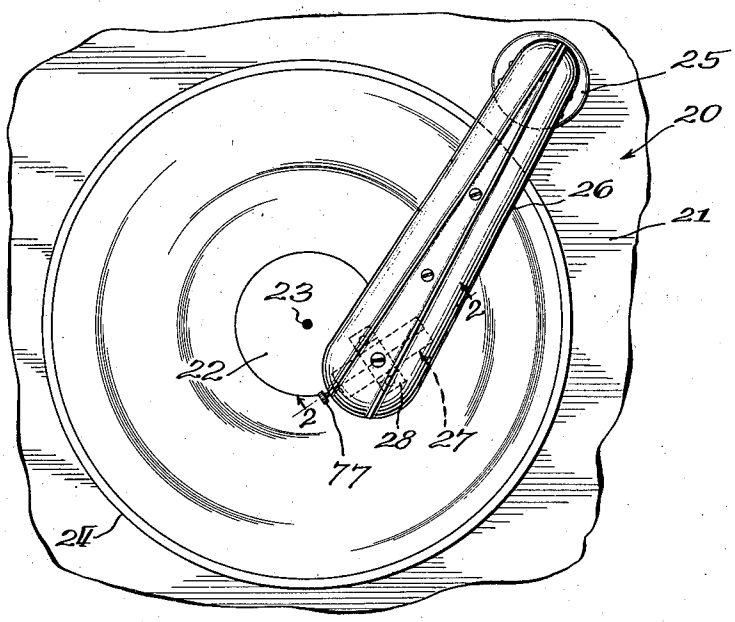


Fig. 2.

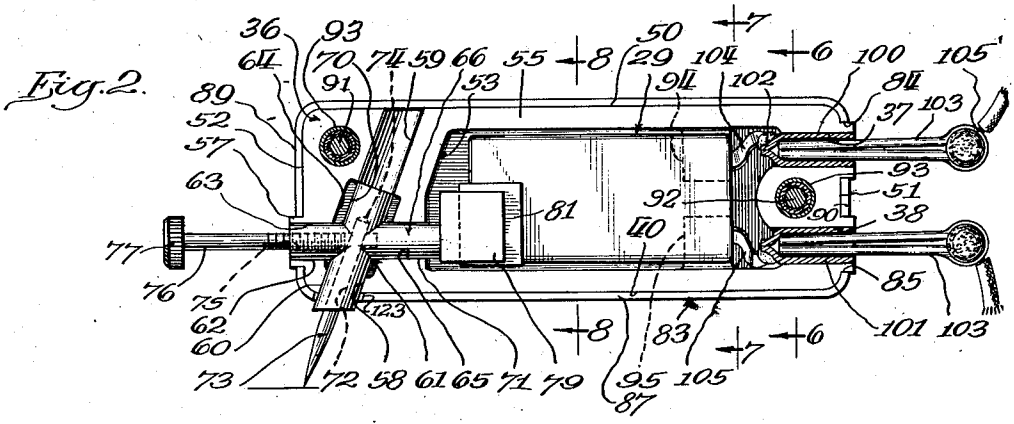
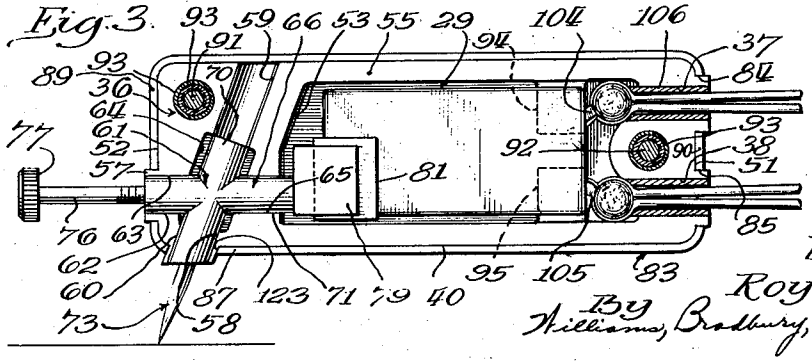


Fig. 3.



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Fig. 11.

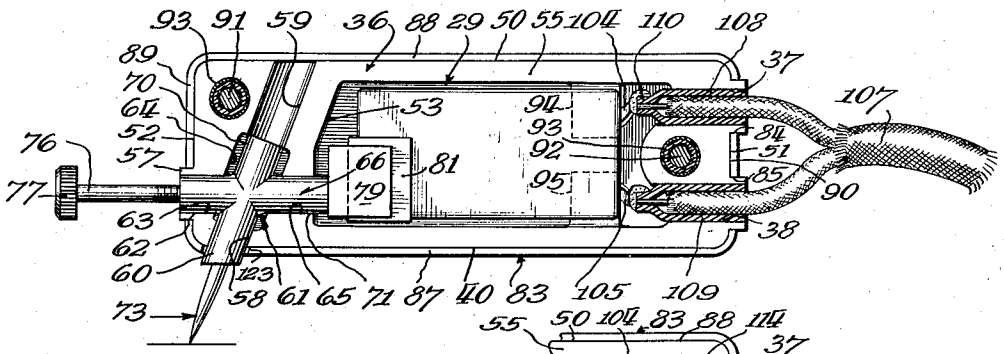


Fig. 12.

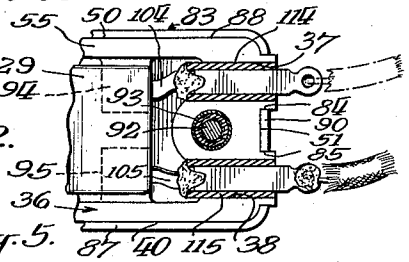


Fig. 5.

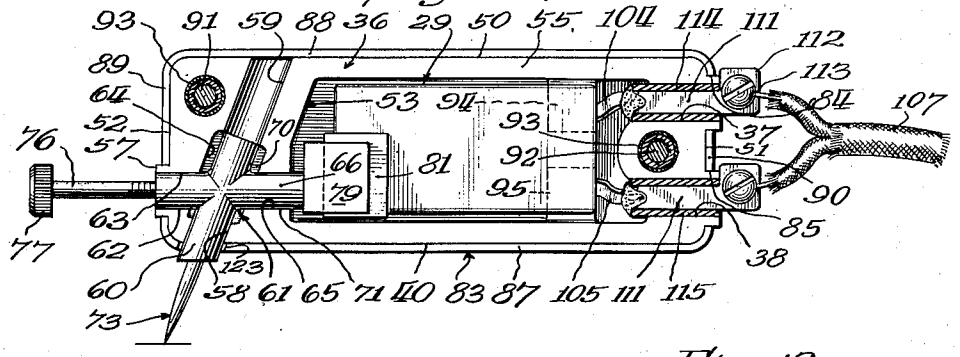


Fig. 6.

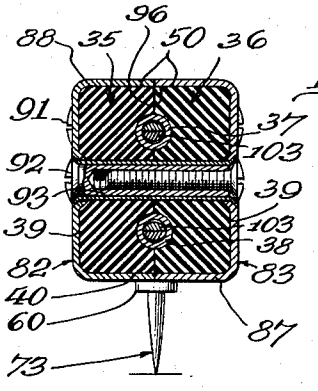
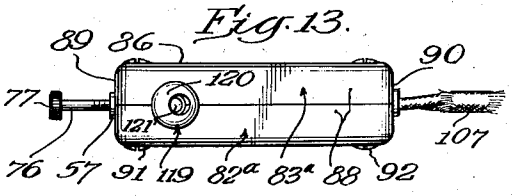


Fig. 13.



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PICKUP

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Fig. 7.

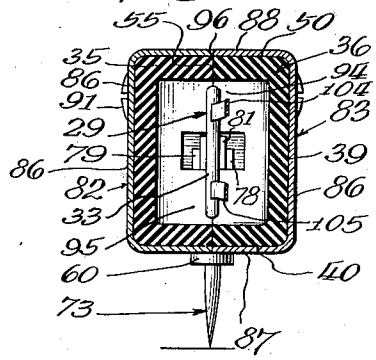


Fig. 8.

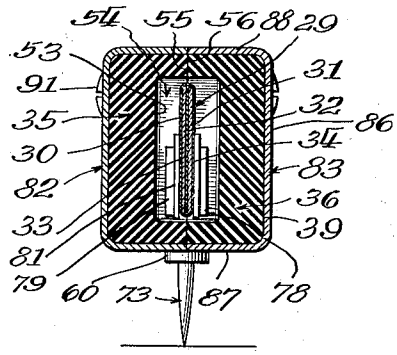


Fig. 9.

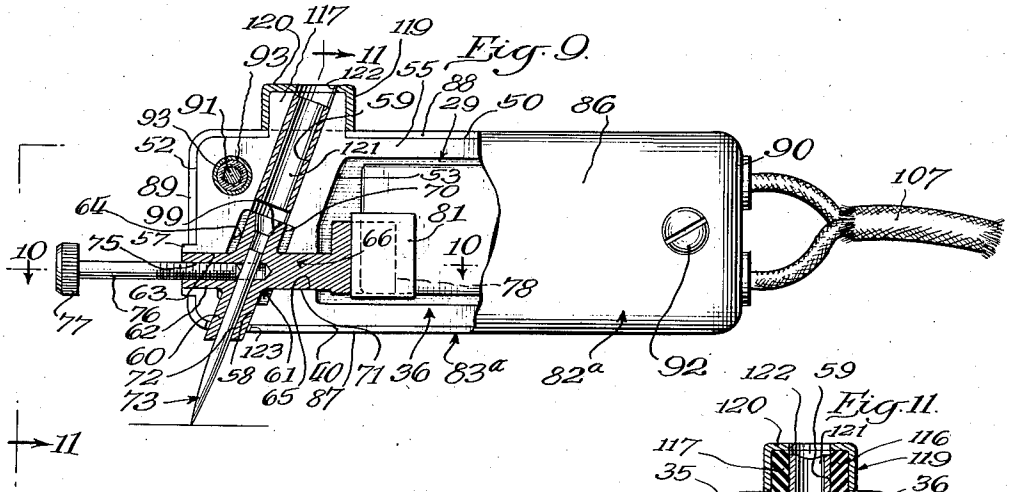


Fig. 10.

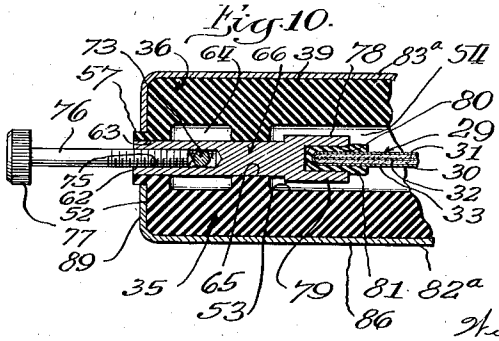
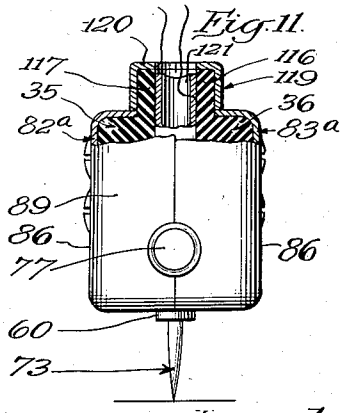


Fig. 11.



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Patented May 30, 1939

2,160,793

UNITED STATES PATENT OFFICE

2,160,793

PICKUP

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

Application January 21, 1938, Serial No. 186,049

25 Claims. (Cl. 179—100.41)

The present invention relates to crystal pick-up units for sound reproduction, such as are utilized in phonographs of the type utilizing a loud speaker or translating the record of sound from a disc record into electrical energy.

One of the objects of the invention is the provision of an improved crystal pick-up unit in which the crystal is wholly protected against the ingress of moisture and adapted to be maintained in good condition in spite of external moisture or other deleterious conditions.

Another object of the invention is the provision of an improved pick-up unit which is adapted to be manufactured more cheaply by virtue of the fact that it embodies less parts and involves less work in its assembly, and has no loose sleeves or resilient supporting blocks, such as are used in the devices of the prior art.

Another object of the invention is the provision of an improved resilient supporting housing for crystal pick-up units in which the resilient supporting parts are adapted to be utilized at high efficiency for a longer period of time, by virtue of the fact that the present integral rubber housing does not age as fast as the small resilient or rubber blocks or sleeves which are used in the devices of the prior art.

Another object of the invention is the provision of an improved crystal pick-up in which there is less mechanical noise produced by the pick-up than in the devices of the prior art because most of the mechanical noise is absorbed or damped out by the structure of the present pick-up.

Another object is the provision of an improved crystal pick-up in which high fidelity reproduction can be secured, or with which any desired voltage cut-off at a predetermined frequency can be secured within a predetermined range, by means of slight changes in the structure of the pick-up.

Another object is the provision of an improved crystal pick-up unit which is protected not only against moisture, but which is protected and shielded electromagnetically and electrostatically by means of an external metal housing.

Another object is the provision of an improved metal housing or shield for crystal pick-ups of the class described, which is adapted to clamp the integral water-tight sleeves, but which may be provided with such a clearance between the chuck and the shield that it will positively stop any excessive motion of the chuck and prevent the breaking of the crystal by forces applied to the chuck.

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 three sheets of drawings:

Fig. 1 is a fragmentary top plan view of a phonograph, showing the turntable and tone arm equipped with the present pick-up;

Fig. 2 is an enlarged vertical sectional view of the pick-up, taken on the plane of the line 2—2 of Fig. 1, showing the details of structure of the pick-up in double size, the pick-up being equipped with female connector sleeves;

Fig. 3 is a similar vertical sectional view of the same pick-up when equipped with male connector members;

Fig. 4 is a similar view of the pick-up when equipped with lead wires directly connected by means of sleeves to the pick-up;

Fig. 5 is a view of the pick-up, similar to Fig. 4, when equipped with screw type connectors;

Fig. 6 is a sectional view taken on the plane of the line 6—6 of Fig. 2, looking in the direction of the arrows, showing details of construction of the pick-up;

Fig. 7 is a vertical sectional view taken on the plane of the line 7—7 of Fig. 2, looking in the direction of the arrows, showing further details;

Fig. 8 is a vertical sectional view taken on the plane of the line 8—8 of Fig. 2, looking in the direction of the arrows, showing details of construction of the crystal;

Fig. 9 is a side elevational view of a modified form of pick-up, in partial section, on a plane passing through the axis of the pick-up chuck, showing an upper needle feed type of pick-up;

Fig. 10 is a horizontal sectional view, taken on the plane of the line 10—10 of Fig. 9, looking in the direction of the arrows, and showing details of construction of the chuck;

Fig. 11 is an end elevational view of the pick-up unit of Fig. 9, in partial section, at the plane of the needle feed axis, showing further details of construction;

Fig. 12 is a fragmentary view, showing a connector similar in structure to Fig. 5, but adapted for a soldered connection to a wire;

Fig. 13 is a top plan view of the pick-up unit of Fig. 9.

Referring to Fig. 1, 20 indicates in its entirety a phonograph which is provided with a support 21 for rotatably supporting a turntable 22 rotatably mounted on a shaft 23 for carrying the disc record 24. The support 21 carries the base 25 of

the tone arm, upon which the tone arm 26 is mounted for pivotal movement in a vertical plane and pivotal movement in a horizontal plane.

The tone arm 26 carries suitable conductors or leads which extend from the pick-up unit 27, which is the type embodying the present invention.

The pick-up unit 27 may be secured in place by a U-shaped stirrup 28 of metal or fiber, which embraces the pick-up and has its attaching flanges secured to the tone arm 26 by screws or other convenient fastening means.

Referring now to Figs. 2, 6, 7, and 8, these are views which illustrate the preferred construction of the pick-up. The pick-up comprises an elongated crystalline piezo-electric unit, indicated in its entirety by the numeral 29, which is particularly constructed to generate an electromotive force when the crystal unit 29 is subjected to twisting or torsion.

Referring to Fig. 8, such a crystal unit comprises the flat plates 30, 31 of suitable crystals, such as Rochelle salts, which in the present case are substantially rectangular in form, for the purpose of increasing the electrical capacity of the crystal unit. The crystal units 30 and 31 are separated by metal foil 32 and are covered on the outside with an additional coating of metal foil 33, 34, which coatings serve to collect any electric charge generated from all parts of the surface of the crystals.

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. For further disclosure of the structure of the crystal elements, reference is had to my prior application, Serial No. 102,303, filed September 24, 1936, for Pick-ups.

The leads extending from the metal foils 32—34 may be connected in series or parallel, depending upon the results desired, and any number of crystal plates may be used, as disclosed in my prior application.

In order that the crystal unit may be adapted to generate electromotive forces upon torsion, the crystals have their faces cut parallel to the *b* and *c* axes of the Rochelle salt crystal, from which they are formed, and their parallel end edges parallel to one of said axes.

With the crystalline plates thus oriented, the unit which they constitute flexes in torsion about its longitudinal axis, when the plates are subjected to electrostatic fields caused by electromotive forces applied to their electrodes, and vice versa, and when the unit is so flexed in torsion electromotive forces are generated at its electrodes. Piezo-electric units of this character are now well known, and are further described in United States Letters Patent No. 1,803,275 issued to Charles B. Sawyer, and now owned by the Brush Development Company, from which such crystal units may be purchased.

The present crystal units are further enclosed in a water-impervious coating comprising two coatings of asphalt lacquer extending over all of the metallic foil protecting the crystals from access of moisture, such as might be due to condensation within the housing, further to be described.

The housing and support for the crystal unit 29 preferably comprises a pair of resilient, flexible rubber members 35, 36, which are similar in shape and construction and practically identical, except that one member is left hand and the other is right hand. Each of these half housing members is provided with half cylindrical grooves so that when the halves are assembled the housing has a pair of apertures 37, 38 for leads.

Each of these housing members is substantially rectangular in elevation, and is provided with a flat side surface 39, bottom surface 40, top surface 50, and end surfaces 51, 52, all of which surfaces are substantially rectangular.

Each of the half housing members 35, 36 is also provided with a centrally located cavity 53, which may be substantially rectangular in elevation, as shown in Fig. 2, except for the upper left corner, which is cut off parallel to the needle well. The two cavities 53 of the two housing members 35, 36 form a crystal chamber 54 when the two housing members are placed together with the two flat surfaces 55, 56 engaging each other.

The housing members 35, 36 are provided with flat surfaces 55, 56, which surround the border of the housing members so that the two housing members may be placed flatly together and the edges thereof may be sealed to provide a moisture-tight enclosure. Exceptions to this flat surface are at the chuck sleeve 57, the chuck groove 58, and the needle well 59, as well as grooves 37, 38. Grooves 37, 38 may also have half tubular members protruding therefrom to insulate the connectors from the metal housing.

Thus, at the point 58, each of the half housings is provided with a half cylindrical groove extending diagonally downwardly to the left in Fig. 2, for receiving the cylindrical portion 60 of the chuck 61.

The groove 59, shown in Fig. 2, is utilized when the half housing members 35, 36 are used on the top needle feed type of pick-up, shown in Fig. 9.

At the point 57, each of the half housings is provided with a semi-cylindrical, longitudinally projecting formation 57, like a half sleeve, which surrounds the chuck bearing 62 and provides a moisture-tight engagement between the chuck trunnion and the housing members.

When the two housing members are placed together, the members 57 make a cylindrical sleeve, and the housing members are provided with a half cylindrical groove 63, so that the grooves 63 form a bearing for the chuck trunnion 62. The grooves 58 likewise clamp the cylindrical part 60 of the chuck and may be used to effect a damping of the chuck by the resilient engagement of the rubber parts on that part of the chuck.

The two housing members 35, 36 are also each provided with a chamber 64 communicating with the grooves 63, 58, and 59, for receiving the main part of the chuck 61. Another half cylindrical groove 65 in each of the housing members communicates with the recess 53, so that when the housing members are placed together, the latter grooves 65 embrace the cylindrical chuck trunnion 66, which extends from the chamber 64 into the chamber 54.

If desired, a sleeve similar to the sleeve 57 may be extended from the groove 58 surrounding the lower cylindrical portion of the chuck 60, as shown in Fig. 3. The chuck 61 comprises a cast metal member, which may be made of various metals, such as aluminum, "Dow" metal, or magnesium, or zinc alloys. Such materials may be used for the purpose of securing high fidelity reproduction up to the frequency of resonance which, for example, is about 5,000 cycles per second for zinc, 6,000 cycles per second for alu-

minum, and 7,500 cycles per second for "Dow" metal. Any desired voltage cut-off at predetermined frequency can be secured by changing the materials of which the chuck and the housing halves are constructed or by changing the clamping connection between the crystal unit and the chuck.

The chuck is a cruciform member formed by four outwardly projecting cylindrical portions **62**, **60**, **70**, and **71**. The cylindrical extensions **62** and **71** are in alignment with each other and comprise the trunnions for the chuck. The cylindrical portions **60** and **70** are in alignment with each other and comprise the needle-supporting portion of the chuck, but the portions **60** and **70** extend diagonally downwardly and toward the left, in Fig. 2, so as to hold the needle at an angle, to cause the needle to track more easily.

The cylindrical portions **70** and **60** of the chuck are provided with a cylindrical bore **72** of such size as to slidably receive the needle **73**, and in the embodiment of Fig. 2 this bore terminates at the point **74**, and the needle abuts against the end of the bore.

The trunnion **62** is also provided with a bore **75**, which is threaded to receive the threaded end of a needle screw **76**, having a knurled head **77**. The needle screw **76** bears against the needle **73** and clamps it in place, as the bore **75** intersects with the bore **72**.

The cylindrical portion **71** of the chuck, that is, the inner trunnion, is provided with a clamping extension, shown best in Fig. 10, and comprising a pair of substantially parallel, rectangular plates **78**, **79**, which are integral with the trunnion, and have a groove **80** between them. The crystal unit **29** has a strip of rubber or other resilient material **81**, folded in U-shape about its edge and placed in the groove **80**. The two flanges **78** and **79** are then clamped against the rubber **81**, clamping the crystal unit **29** and securing the chuck to the crystal unit.

The resilient characteristics of this connection may be varied by varying the resilient material **81**, which is used by varying the thickness of the plates **78**, **79** or the material of the chuck, that is, the stiffness of the clamping member, and by the amount of force which is applied in bending the plates **78**, **79** into clamping engagement with the rubber **81** and crystal unit **29**. This connection provides a resilient damping connection between the crystal unit **29** and the chuck **61**.

It should be noted that the housing halves **35**, **36** and the rubber pad **81** may be made of resilient, flexible rubber or other similar resilient material.

The temperatures at which these pick-ups operate are between 70 and 130 degrees F., and between these temperatures there are substantially no changes in the damping qualities of resilient and flexible rubber so that this material is of great advantage, unlike solidified oil, or "Viscaloid".

It should be noted that all of the grooves **58**, **63**, **59**, **65**, **37**, **38** may be made slightly smaller than the metal members which they embrace so as to cause these grooves to come into resilient and fluid-tight engagement with the metal members engaged thereby, and the two rubber housing members **35**, **36** may be made slightly larger than the metal housings **82**, **83**, which enclose them.

The metal housing members **82**, **83** comprise box-like metal members, preferably made of pressed metal, each one being identical with the other, except that one is left hand and the other right hand, and each has grooves which register to form connector holes **84**, **85** in the housing. These connector holes register with the bores **37**, **38** in the corresponding rubber half housing.

Each metal housing member **82** or **83** has a flat body portion (Fig. 7) **86**, a flat bottom portion **87**, a flat top portion **88**, and flat end portions **89** and **90**.

The metal housings are provided with apertures for passing the sleeve **57**, and the sleeve **89**, and apertures are also provided through the metal housing **82**, **83** and the rubber half housing **35**, **36** for passing a pair of securing members **91**, **92** in the form of bolts. The two half housings **35**, **36** may be secured together by tubular rivets **93**, the rivets having apertures of sufficient size to pass the bolts **91**, **92**. Any other convenient form of fastening means may be utilized, if desired.

The two half housing members **35**, **36** are secured together by means of rubber cement so that the rubber housing completely surrounds the crystal unit and is moisture-proof.

The metal housing members **82**, **83** are preferably made of soft iron, which not only provides the crystal pick-up with an electrostatic shield, but also an electromagnetic shield. Other metals may be employed for these metal housings **82**, **83**, but unless magnetic metal is employed, the metal housing would only constitute an electrostatic shield.

The half housing members **35** and **36** are also provided with clamping formations **94**, **95**, within the recesses **53**, and at the end opposite to the chuck **61**, for the purpose of clamping the adjacent end portions of the crystal unit **29**. The resilient clamping formations **94**, **95** comprise rectangular projections in the chamber **54**, located at each of the right corners of the crystal unit **29**, in Fig. 2, and they project outwardly in the recesses **53** sufficiently so that when the two halves **35**, **36** are brought together, these members **94**, **95** resiliently clamp and engage the crystal unit **29**. Thus, the right end of the crystal unit **29** is held against movement by the clamping members **94**, **95**, and this clamping by means of the rubber half housings **35**, **36** is reinforced by the metal housings **82**, **83**. The amount of clamping or resilient engagement, and thus the resilient characteristics of the support, may be varied by varying the depth of these clamping formations **94**, **95**.

The clearance **123** between the cylindrical part **60** of the chuck and metal housings **82**, **83**, determines permissible amount of movement of the chuck.

The thickness of the housing halves **35**, **36** from the flat surface **39** (Fig. 7) to the edge **55** may be varied to change the clamping action on the crystal unit and other parts. Thus the edge **55** of rubber preferably projects slightly above the edge **96** of the metal housing **83** when the rubber housing is removed with its metal housing, so that the rubber will be compressed when the parts are put together.

Referring to Fig. 2, one form of connector for the pick-up is shown in this figure. In this embodiment a pair of metal sleeves **100**, **101**, such as brass or copper, are provided, which fit in the grooves **37**, **38**, with a fluid-tight fit. These sleeves are identical, and therefore only one need be described in detail. Each sleeve has its inner end (Fig. 2) pinched together at **102** to effect a substantial closure, after which the sleeve has that end dipped in solder, and it may then be used as a female connector, if desired.

In order to make a male connector, a small

cotterpin 103 may have its shank inserted into the sleeve 100 and soldered in place by dipping the sleeve and cotterpin into solder. The sleeve with its cotterpin is then inserted in the groove 37, and the leads 104, 105 from the crystal unit are soldered to the inner ends of the sleeves. The eyes of the cotterpin are very conveniently usable for insertion of wires 105', which are held in place by means of a drop of solder.

Referring to Fig. 3, in this embodiment the sleeve 106 has a cotter-pin inserted into it, with the eye located on the inner end of the sleeve. The sleeve is pinched about the cotter-pin and inserted in molten solder so as to close the inner end of the sleeve, leaving the eye of the cotter-pin open, and the leads 104, 105 from the crystal unit are then inserted in the eyes of the cotter-pin and soldered in place by means of a drop of solder. The projecting shanks of the cotter-pins thus serve as a male connector for insertion into a jack.

Referring to Fig. 4, in this embodiment the end of a two-wire cable 107 has each of its wires stripped and one wire inserted in each of the tubes 108, 109. The inner ends of the tubes are again pinched at 110 into engagement with the stripped wires, and the tube ends and wires are dipped in solder, to seal the ends of the tubes and attach the wires more securely. Thereafter, the tubes may be placed in the grooves 37, 38 and the leads 104, 105 from the crystal unit may be soldered to the inner ends 110 of the tubes. This provides a direct connection to the wires of the cable.

Referring to Fig. 5, in this embodiment the end of each tube is closed by dipping in solder, the solder engaging the end of a small metal strip 111, which has a laterally turned flange 112 provided with a threaded aperture for receiving a clamping screw 113. The crystal unit leads 104, 105 may then be soldered to the ends of the tubes 114, 115, and by this structure the crystal unit is provided with a standard type of threaded connector.

Referring to Figs. 9, 10 and 11, this is another embodiment, in which the needle well is provided with a top feed. In this embodiment the two half housing members of rubber 35 and 36 are provided with an upward tubular extension which is formed by two half sleeve portions 116, 117 surrounding and registering with the needle well 59.

The two metal housing members 82, 83 have been indicated by the numerals 82*a* and 83*a* in this embodiment, and a separate tubular cap 119 is provided for surrounding the sleeve members 116, 117, and cemented thereto or soldered to the metal housing.

The tubular cap 119 has an inwardly extending flange 120 for engaging the ends of the sleeved formations of rubber 116, 117. There is an aperture 122 in the top of the metal housing which registers with the needle well 59.

The tapered bore 99, Fig. 9, in the top needle feed type of chuck facilitates the entry of the needle.

The metal sleeve 121 fits in the bore 59 where it is held by cement and it is resiliently gripped by the rubber. Sleeve 121 stops short of the chuck, but it provides a smooth anti-friction path for the needle passing into the chuck. The needle might otherwise stick due to its engagement with rubber if sleeve 121 were not provided.

The operation of this pick-up is as follows: When the needle 73 moves along the groove of the record, by virtue of the rotation of the record, the groove causes the needle 73 to vibrate in a lateral direction, producing torsional vibrations of the cast metal chuck 61. These rotative vibrations or oscillations are transmitted by means of the clamping member 79 and resilient pad 61, to the crystal unit 29, causing a torsion or twisting of the crystal unit, due to the fact that the opposite end is held by the blocks or rubber projections 94, 95. The twisting of the crystal unit, of course, produces an electromotive force, which varies with the vibration of the needle 73, as the crystal is one which is constructed to produce electromotive force on twisting.

Referring to the chuck trunnions 71, 62 in the rubber apertures or grooves 65, 63, the device may work in either of two ways: The trunnions may be cemented to the rubber supporting device 35, 36 at the grooves 65, 63, or so tightly clamped that the rubber in the grooves tends to move with the trunnions, in which case there would be no sliding of the trunnions in the bearings formed by the grooves 65, 63. In other embodiments the trunnions 62, 71 may slide in the rubber bearings provided by the grooves 63, 65, or the result may be a combination of sliding movement of the trunnions in the bearings, with some motion of the adjacent portions of the rubber with the trunnions. The cast metal chuck 61, however, is made of metal of such characteristics that there is practically no resilient action in the chuck, as the cast metal ordinarily employed is not resilient, but must be strong enough to transmit the torsional vibrations without flexibility, since such metal is not flexible as compared with springs or steel wires.

It will thus be observed that I have invented an improved pick-up unit which is cheaper to make because the assembly of small parts, such as rubber blocks, rubber sleeves, etc., has been eliminated.

The present casing is moisture-proof and, as there are no loose sleeves or blocks to be put in place, it may be constructed at a much lower cost than the devices of the prior art. As all of the rubber parts are integral with the halves of the supporting housing, they do not age as fast as the relatively small rubber blocks or sleeves, which age more quickly than larger rubber parts. The mechanical noise incidental to the operation of a pick-up is decreased because it is absorbed and damped out.

The present pick-up may be constructed for any desired pick-up cut-off or no voltage frequency within a predetermined range, and the metal housing is adapted to provide electromagnetic and electrostatic shielding. The crystal is adequately protected against breakage, even when excessive force is applied to the needle or projecting screw, and the present pick-up is adapted to give high fidelity reproduction for a long period of time.

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 pick-up unit for phonographs or the like, the combination of a crystal adapted to generate an electromotive force upon deformation, with a pair of housing members formed of flexible, resilient material, and provided with a crystal chamber enclosing said crystal and protecting said crystal against humidity, said crystal chamber having means for clamping the crystal in the housing formed integrally with the housing.

2. In a pick-up unit for phonographs or the like, the combination of a crystal adapted to generate an electromotive force upon deformation, with a pair of housing members formed of flexible, resilient material, and provided with a crystal chamber enclosing said crystal and protecting said crystal from humidity, said crystal chamber having means for clamping the crystal in the housing formed integrally with the housing, and a chuck for supporting a needle, said chuck being mounted for pivotal movement and having a moving part thereof secured to that end of the crystal opposite from its support in the housing.

3. In a pick-up unit for phonographs or the like, the combination of a crystal adapted to generate an electromotive force upon deformation, with a pair of housing members formed of flexible, resilient material, and provided with a crystal chamber enclosing said crystal and protecting said crystal from humidity, said crystal chamber having means for clamping the crystal in the housing formed integrally with the housing, and a chuck for supporting a needle, said chuck being mounted for pivotal movement and having a moving part thereof secured to that end of the crystal opposite from its support in the housing, and resilient means interposed between the chuck and the crystal unit.

4. In a pick-up unit for phonographs or the like, the combination of a crystal adapted to generate an electromotive force upon deformation, with a pair of housing members formed of flexible, resilient material, and provided with a crystal chamber enclosing said crystal and protecting said crystal from humidity, said crystal chamber having means for clamping the crystal in the housing formed integrally with the housing, and a chuck for supporting a needle, said chuck being mounted for pivotal movement and having a moving part thereof secured to that end of the crystal opposite from its support in the housing, the two halves of said housing being constructed of rubber, and means for clamping the rubber halves of said housing together.

5. In a pick-up unit for phonographs or the like, the combination of a crystal adapted to generate an electromotive force upon deformation, with a pair of housing members formed of flexible, resilient material, and provided with a crystal chamber enclosing said crystal and protecting said crystal from humidity, said crystal chamber having means for clamping the crystal in the housing formed integrally with the housing, and a chuck for supporting a needle, said chuck being mounted for movement and having a moving part thereof secured to that end of the crystal opposite from its support in the housing, said chuck being mounted for rotative oscillation on an axis extending along the longest dimension of the crystal.

6. In a pick-up unit for phonographs or the like, the combination of a crystal adapted to generate an electromotive force upon deformation, with a pair of housing members formed of flexible, resilient material, and provided with a crystal chamber enclosing said crystal and protecting said crystal from humidity, said crystal chamber having means for clamping the crystal in the housing formed integrally with the housing, and a chuck for supporting a needle, said chuck being mounted for pivotal movement and having a moving part thereof secured to that end of the crystal opposite from its support in the housing, and a supporting and enclosing metal housing surrounding the resilient housing to provide an electrostatic shield for the crystal.

7. In a pick-up unit for phonographs or the like, the combination of a crystal adapted to generate an electromotive force upon deformation, with a pair of housing members formed of flexible, resilient material, and provided with a crystal chamber enclosing said crystal and protecting said crystal from humidity, said crystal chamber having means for clamping the crystal in the housing formed integrally with the housing, and a chuck for supporting a needle, said chuck being mounted for pivotal movement and having a moving part thereof secured to that end of the crystal opposite from its support in the housing, and a supporting and enclosing metal housing surrounding the resilient housing to provide an electrostatic shield for the crystal, said metal housing being constructed of electromagnetic metal for the purpose of providing a magnetic shield for the crystal unit.

8. In a pick-up unit for phonographs or the like, the combination of a crystal adapted to generate an electromotive force upon deformation, with a pair of housing members formed of flexible, resilient material, and provided with a crystal chamber enclosing said crystal and protecting said crystal from humidity, said crystal chamber having means for clamping the crystal in the housing formed integrally with the housing, and a chuck for supporting a needle, said chuck being mounted for pivotal movement and having a moving part thereof secured to that end of the crystal opposite from its support in the housing, said resilient housing having an aperture for fitting the projecting screw-supporting portion of the chuck to provide a moisture-tight joint about the latter part.

9. In a pick-up unit for phonographs or the like, the combination of a crystal adapted to generate an electromotive force upon deformation, with a pair of housing members formed of flexible, resilient material, and provided with a crystal chamber enclosing said crystal and protecting said crystal from humidity, said crystal chamber having means for clamping the crystal in the housing formed integrally with the housing, and a chuck for supporting a needle, said chuck being mounted for pivotal movement and having a moving part thereof secured to that end of the crystal opposite from its support in the housing, and said housing having a portion fitting the needle-supporting portion of the chuck to provide a fluid-tight joint about that part of the chuck.

10. In a pick-up unit for phonographs or the like, the combination of a crystal adapted to generate an electromotive force upon deformation, with a pair of housing members formed of flexible, resilient material, and provided with a crystal chamber enclosing said crystal and protecting said crystal from humidity, said crystal chamber having means for clamping the crystal in the housing formed integrally with the hous-

ing, and a chuck for supporting a needle, said chuck being mounted for pivotal movement and having a moving part thereof secured to that end of the crystal opposite from its support in the housing, said housing being formed of two similar half portions, and means for clamping said half portions together to clamp the crystal.

11. In a pick-up unit for phonographs or the like, the combination of a crystal adapted to generate an electromotive force upon deformation, with a pair of housing members formed of flexible, resilient material, and provided with a crystal chamber enclosing said crystal and protecting said crystal from humidity, said crystal chamber having means for clamping the crystal in the housing formed integrally with the housing, and a chuck for supporting a needle, said chuck being mounted for pivotal movement and having a moving part thereof secured to that end of the crystal opposite from its support in the housing, and a metal housing surrounding the resilient housing, said metal housing having an aperture for passing the needle-supporting portion of the chuck, and said metal housing limiting the motion of the chuck in the resilient housing.

12. In a pick-up unit for phonographs or the like, the combination of a crystal adapted to generate an electromotive force upon deformation, with a pair of housing members formed of flexible, resilient material, and provided with a crystal chamber, said crystal chamber having means for clamping the crystal in the housing formed integrally with the housing, and a chuck for supporting a needle, said chuck being mounted for movement and having a moving part thereof secured to that end of the crystal opposite from its support in the housing, said chuck being provided with a needle well extending through the same, and said housing having an aperture at the top for the top feed of the needle well with needles.

13. In a pick-up unit, the combination of a support with a crystal unit mounted to be fixedly supported at one end, a chuck connected to the other end of the crystal unit and mounted for pivotal movement responsive to the track on a record, said crystal unit having leads, and said housing comprising a resilient, flexible member with a connector sleeve mounted in said resilient, flexible member, and means for securing said connector sleeve to the leads from said crystal unit.

14. In a pick-up unit, the combination of a support with a crystal unit mounted to be fixedly supported at one end, a chuck connected to the other end of the crystal unit and mounted for movement responsive to the track on a record, said crystal unit having leads, and said housing comprising a resilient, flexible member with a connector sleeve mounted in said resilient, flexible member, and means for securing said connector sleeve to the leads from said crystal unit, said crystal unit being provided with male connector members comprising the outwardly projecting shanks of cotter-pins carried by said sleeves.

15. In a pick-up unit, the combination of a support with a crystal unit mounted to be fixedly supported at one end, a chuck connected to the other end of the crystal unit and mounted for movement responsive to the track on a record, said crystal unit having leads, and said housing comprising a resilient, flexible member with a connector sleeve mounted in said resilient, flexible member, and means for securing said connector sleeve to the leads from said crystal unit, said crystal unit being provided with electrical means comprising cotter-pins having their shank ends secured in said sleeves, the eyes of said cotter-pins being used for electrical connection.

16. In a pick-up unit, the combination of a support with a crystal unit mounted to be fixedly supported at one end, a chuck connected to the other end of the crystal unit and mounted for movement responsive to the track on a record, said crystal unit having leads, and said housing comprising a resilient, flexible member with a connector sleeve mounted in said resilient, flexible member, and means for securing said connector sleeve to the leads from said crystal unit, said crystal unit being adapted to be connected to the insulated conductors of a cable, the ends of the cable conductors being stripped and being secured to the inner ends of said tubes, the insulated ends of the conductors extending into said tubes.

17. In a pick-up unit, the combination of a support with a crystal unit mounted to be fixedly supported at one end, a chuck connected to the other end of the crystal unit and mounted for movement responsive to the track on a record, said crystal unit having leads, and said housing comprising a resilient, flexible member with a connector sleeve mounted in said resilient, flexible member, and means for securing said connector sleeve to the leads from said crystal unit, said sleeves being provided with metal connector members secured therein and provided with threaded bores and screw members at their outer ends for the attachment of wires.

18. In a crystal unit, the combination of a pair of half housing members formed of soft, resilient and flexible rubber, with a chuck mounted for pivotal movement in said housing members, said chuck having a pair of aligned trunnions and a downwardly extending needle-supporting portion provided with a well, said housing halves being formed with grooves registering with and receiving the trunnions and downwardly extending portion thereof, whereby the chuck is clamped in the housing to form a moisture-tight joint between the chuck and the housing, permitting movement of the chuck.

19. In a crystal pick-up, the combination of a pair of resilient flexible housing members having a crystal chamber for enclosing a crystal unit, said housing members having a pair of outwardly extending grooves communicating with said crystal chamber and forming bores when the two housing members are secured together, with a crystal unit in said crystal chamber, and comprising a piezo electric crystal and conducting members on the opposite sides thereof, with a pair of tubular connectors for said unit, comprising a pair of sleeves, each sleeve being disposed in one of the apertures formed by said grooves, said sleeves being connected to said leads.

20. In a crystal pick-up, the combination of a pair of resilient, flexible housing members having a crystal chamber for enclosing a crystal unit, said housing members having a pair of outwardly extending grooves communicating with said crystal chamber and forming bores when the two housing members are secured together, with a crystal unit in said crystal chamber, and comprising a piezo electric crystal and conducting members on the opposite sides thereof, with a pair of tubular connectors for said unit, com-

prising a pair of sleeves, each sleeve being disposed in one of the apertures formed by said grooves, said sleeves being connected to said leads, the inner ends of said sleeves being pinched together to engage the bared end of an insulated conductor located in each of said sleeves, and said bared end and pinched end being soldered together in such manner as to effect a closure of that end of said sleeve.

21. In a crystal pick-up, the combination of a pair of resilient, flexible housing members having a crystal chamber for enclosing a crystal unit, said housing members having a pair of outwardly extending grooves communicating with said crystal chamber and forming bores when the two housing members are secured together, with a crystal unit in said crystal chamber, and comprising a piezo electric crystal and conducting members on the opposite sides thereof, with a pair of tubular connectors for said unit, comprising a pair of sleeves, each sleeve being disposed in one of the apertures formed by said grooves, said sleeves being connected to said leads, and a metallic strip located in said sleeve and soldered at the inner end of said sleeve in such manner as to effect a complete closure of the inner end of said sleeve.

22. In a crystal pick-up, the combination of a pair of resilient, flexible housing members having a crystal chamber for enclosing a crystal unit, said housing members having a pair of outwardly extending grooves communicating with said crystal chamber and forming bores when the two housing members are secured together, with a crystal unit in said crystal chamber, and comprising a piezo electric crystal and conducting members on the opposite sides thereof, with a pair of tubular connectors for said unit, comprising a pair of electric sleeves, each sleeve being disposed in one of the apertures formed by said grooves, said sleeves being connected to said leads, the inner ends of said sleeves being pinched together to engage the bared end of an insulated conductor located in each of said sleeves, and said bared end and pinched end being soldered together in such manner as to effect a closure of that end of said sleeve, and a metallic strip located in said sleeve and soldered at the inner end of said sleeve in such manner as to effect a complete closure of the inner end of said sleeve, said metallic strip being formed with an apertured end for engagement with external conductors.

23. In a crystal pick-up, the combination of a pair of resilient, flexible housing members having a crystal chamber for enclosing a crystal unit, said housing members having a pair of outwardly extending grooves communicating with said crystal chamber and forming bores when the two housing members are secured together, with a crystal unit in said crystal chamber, and comprising a piezo electric crystal and conducting members on the opposite sides thereof, with a pair of tubular connectors for said unit, comprising a pair of sleeves, each sleeve being disposed in one of the apertures formed by said grooves, said sleeves being connected to said leads, and a metallic strip located in said sleeve and soldered at the inner end of said sleeve in such manner as to effect a complete closure of the inner end of said sleeve, said strip being provided at its external end with threaded bores, and threaded members for engaging said external conductors.

24. In a crystal pick-up, the combination of a pair of resilient flexible housing members having a crystal chamber for enclosing a crystal unit, said housing members having a pair of outwardly extending grooves communicating with said crystal chamber and forming bores when the two housing members are secured together, with a crystal unit in said crystal chamber, and comprising a piezo electric crystal and conducting members on the opposite sides thereof, with a pair of tubular connectors for said unit, comprising a pair of sleeves, each sleeve being disposed in one of the apertures formed by said grooves, said sleeves being connected to said leads, said tubular connectors having their inner ends pinched together and sealed against moisture by soldering, and a cotterpin projecting from the opposite ends of said tubular members, the eye of said cotterpin forming a connector for engagement with external conductors.

25. In a crystal pick-up, the combination of a pair of resilient flexible housing members having a crystal chamber for enclosing a crystal unit, said housing members having a pair of outwardly extending grooves communicating with said crystal chamber and forming bores when the two housing members are secured together, with a crystal unit in said crystal chamber, and comprising a piezo electric crystal and conducting members on the opposite sides thereof, with a pair of tubular connectors for said unit, comprising a pair of sleeves, each sleeve being disposed in one of the apertures formed by said grooves, said sleeves being connected to said leads, said tubular connectors having cotterpins arranged therein, with the eyes of said cotterpins located inwardly of said connectors, whereby the eyes may be utilized for connection with the leads from said crystal member.

ROY DALLY.