

Oct. 19, 1943.

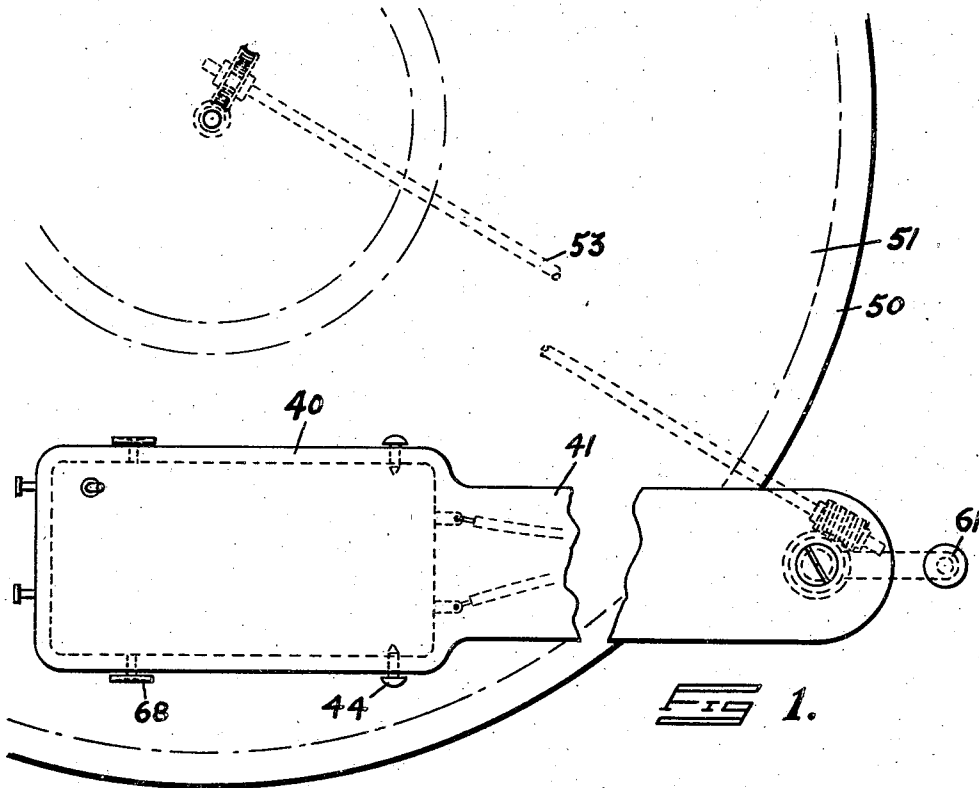
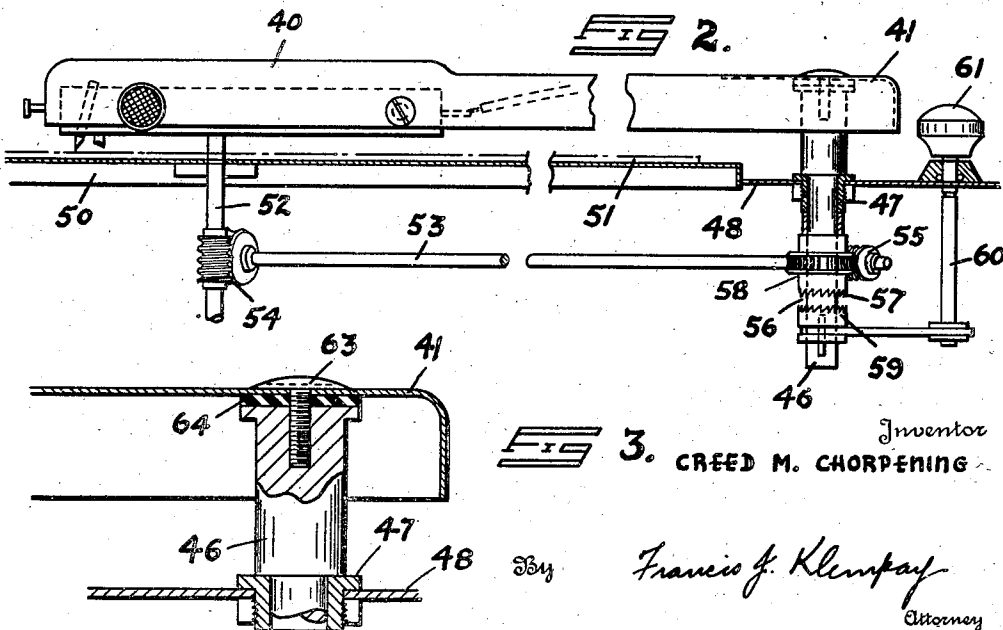
C. M. CHORPENING

2,332,204

APPARATUS FOR RECORDING AND REPRODUCING SOUND

Filed June 11, 1940

2 Sheets-Sheet 1



Oct. 19, 1943.

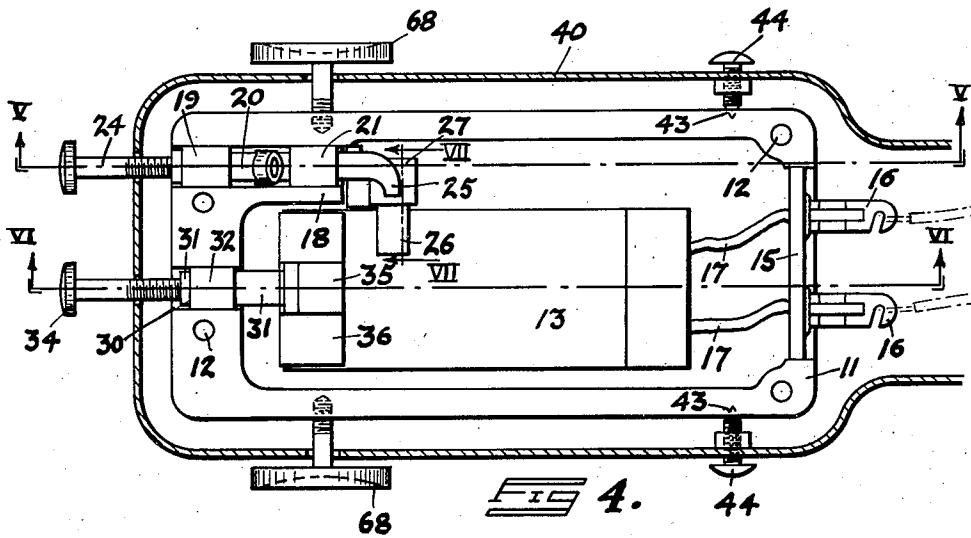
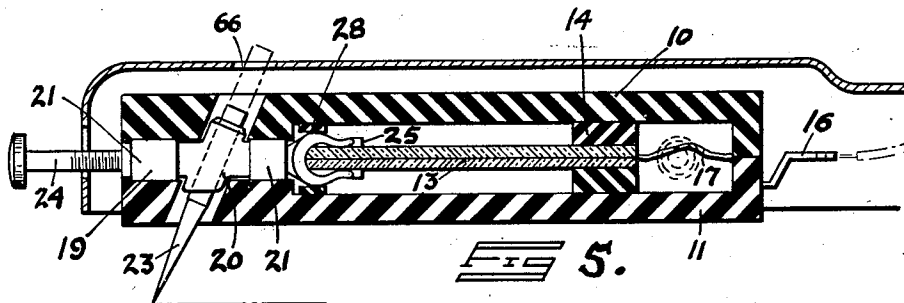
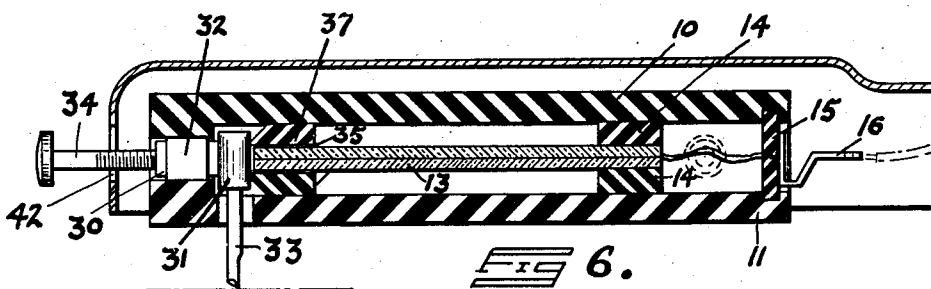
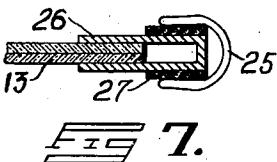
C. M. CHORPENING

2,332,204

APPARATUS FOR RECORDING AND REPRODUCING SOUND

Filed June 11, 1940

2 Sheets-Sheet 2



Inventor
CREED M. CHORPENING

By

Francis J. Klemm

Attorney

UNITED STATES PATENT OFFICE

2,332,204

APPARATUS FOR RECORDING AND
REPRODUCING SOUND

Creed M. Chorpening, Youngstown, Ohio, assign-
or to The Astatic Corporation, Youngstown,
Ohio, a corporation of Ohio

Application June 11, 1940, Serial No. 339,861

12 Claims. (Cl. 179—100.41)

This invention relates to apparatus for recording and reproducing sound and more particularly to a unitary device which is selectively operable to convert electrical impulses coming from a sound detecting device, as a microphone, into mechanical pulsations and to imprint such latter pulsations onto a permanent record, such as a rotatable disk, or to detect the undulations of the record and convert the same into electrical impulses for operating a sound emitting device, as a speaker for example. The invention seeks to simplify the design and construction of apparatus employed for sound recording and reproducing and has particular application to a combinational unit having the two stated functions. Accordingly, the primary object of the invention is the provision of an apparatus for recording and reproducing sound which is simpler in design and more economical to construct than arrangements heretofore devised for the combined purposes.

A further object of the invention is the provision of an apparatus for recording and reproducing sound which is operative to accomplish its combined functions while requiring less manipulative effort on the part of the user, whereby its range of usefulness is materially enhanced.

Another object of the invention is the provision of a translating unit which is operative to convert mechanical pulsations into electrical pulsations or vice versa, whereby the same unit may be employed either as a sound recording or a sound reproducing instrument but which nevertheless may be readily constructed at very low cost.

A more specific object of the invention is the provision of an arrangement whereby a single translating element, as a piezo-electric crystal, may be utilized alternatively to record or reproduce sound on or from a conventional record, as a rotating disk for example.

Yet another object of the invention is the provision of a unitary translating cartridge which may be employed either for recording or reproducing, which may readily be operatively mounted on a stylus carrying arm of simple and economical construction, and which is at all times in condition for either use.

These and other objects and advantages of the invention will become apparent from a consideration of the following detailed specification and the accompanying drawings wherein there is specifically disclosed a preferred embodiment of the invention.

In the drawings:

Figure 1 is a plan view of an apparatus con-

structed in accordance with the principles of the invention;

Figure 2 is a side view of the apparatus of Figure 1, some of the parts being shown in section;

Figure 3 is a sectional view of a detail of the apparatus of Figures 1 and 2;

Figure 4 is a plan view of the combined recording and reproducing unit of the invention, the view being taken with the top half of the cartridge casing removed;

Figures 5 and 6 are sectional views of the unit of Figure 4 taken along the lines V—V and VI—VI, respectively, of Figure 4; and

Fig. 7 is a sectional view along the line VII—VII of Fig. 4.

Referring first to Figures 4, 5 and 6 of the drawings, the combined recording and translating unit of the invention is constructed in cartridge form and includes a casing having upper and lower sections 10 and 11, respectively, which are provided with suitable registering apertures 12 to receive bolts or rivets, not shown, to hold the two sections in rigid assembled relation. The casing sections 10 and 11 may be constructed in any known manner but are preferably molded of resinous plastic material or die cast from soft metal. A piezo-electric element 13, preferably a pair of superimposed Rochelle salt crystals hereinafter termed the crystal, is mounted within the casing being clamped at one end thereof between the two clamping pads 14. The pads 14 are preferably of medium hard rubber and as such provide a fairly rigid anchor for the fixed end of the crystal. Extending transversely across one end of the casing sections 10 and 11 and partially received in grooves or recesses incorporated therein is the fibre strip 15 to which are attached the terminal connectors 16. Conductors 17 connect the terminal 16 with the respective crystal sections.

The mating casing sections 10 and 11 are each provided with an inwardly directed boss 18 extending from a corner of the end opposite the terminal end of the cartridge. A semi-cylindrical groove 19 is provided in each of the bosses 18 to provide a cylindrical bore when the casing sections are assembled. Positioned within the bore is a chuck 20 journaled in spaced soft rubber sleeves 21. In accordance with the usual practice the chuck 20 is provided with an inclined transverse bore to receive the reproducing needle or stylus 23 and a threaded longitudinal bore to receive the needle clamping screw 24. The end of the chuck opposite the screw 24 is provided with a curved and bifurcated end 25. A metal

clamp 26 is fitted over the side edge of the crystal 13 adjacent the end opposite the fixed end of the crystal and is suitably insulated therefrom. Clamp 26 extends outwardly from the side of the crystal and its outer end is encased in a pad 27. The bifurcations of the end 25 of the chuck 20 fit closely on either face of the clamp 26 with the pad 27 therebetween. Suitable damping pads 28 are provided between the chuck 20 and the casing.

A cylindrical bore 30 is provided in the end of the casing opposite the terminal end thereof with its axis substantially coincident with the principal axis of the crystal. A chuck 31 is journaled in the bore 30, a soft rubber bushing 32 being provided therein, and is provided with a vertically extending bore to receive the record cutting stylus 33. Chuck 31 is provided with a threaded bore to receive the stylus clamping screw 34. The inner end of the chuck 31 is bifurcated, as at 35, to fit over the end of the crystal 13. Damping pads 37 are positioned between the bifurcations 35 and the inner surfaces of the casing sections. It should be noted that the cutting stylus holder or chuck is closely coupled to the crystal element for the proper transmission of movement to the cutting stylus and that the reproducing stylus holder is more loosely coupled to the crystal element to provide the proper low needle impedance for satisfactorily reproducing the record. The recording stylus holder is severely damped by the pads 37 and, if desired, limit screws or other adjustable device may be provided to limit the amplitude of oscillation of the recording stylus. It should be further understood that the above described recording and reproducing unit is at all times available for use either as a recording unit or a reproducing unit, depending on which holder and stylus are applied to the record.

It should be apparent that many changes may be made in the construction of the above described recording and reproducing translator assembly, as for example the use of other specific constructions for transmitting the vibrations from and to the crystal, the use of crystals of other types than the torque type shown, and the use of separate crystals housed in the cartridge casing for recording and reproducing, but it should be understood that the latter modification would mitigate certain of the advantages attained by the use of the preferred illustrated embodiment of the invention. It is further specifically contemplated that instead of employing the reproducing stylus chuck 20, which is substantially a rigid member, and providing the loose coupling by the pad 27 a yieldable torque wire may be provided for the mechanical connection between the crystal and the stylus. The reproducing stylus may be either of the replaceable type or of a permanent type employing a jeweled point.

In accordance with the preferred embodiment of the invention, the cartridge housing the translating element and supporting the styluses is pivotally mounted in the outer end 40 of a pivotally mounted arm 41. Arm 41, which may be either a molded, cast or stamped article, is ordinarily provided with a top wall and side walls and an open bottom. End 40 is enlarged somewhat as shown to accommodate the cartridge and is provided in its outer end wall with a pair of vertically elongated apertures 42 to accommodate the stylus holding means 24 and 34. The side walls of the cartridge may be pro-

vided with conical indentations 43 adjacent the terminal end of the cartridge and conically tipped screws 44 are screw threaded through the side walls of the arm end 40 with their inner ends received in the indentations 43, thus providing a pivotal support for the terminal end of the cartridge. The vertical length of the apertures 42 allow limited pivotal movement of the cartridge about the pivot points 43. The center point and stylus end of the cartridge are, of course, biased to downward position by reason of the eccentric disposition of the pivot points 43 and it is possible, by so selecting the weight of the cartridge and the position of the points 43 longitudinally along the cartridge, to determine the downward force exerted on either of the styluses when the styluses support their end of the cartridge.

Arm 41 is carried by a revoluble post 46 which is journaled in a suitable bushing 47 carried by the top panel 48 of a record reproducing machine. Such machine will also include a turntable 50 for supporting a record disk 51 and in accordance with the usual practice the turntable is in turn supported and rotated by a vertical shaft 52.

In recording it is essential that the cutting stylus be moved across the face of the record at a constant rate and that the record be rotated at uniform speed. Shaft 52 is therefore driven at constant speed by any suitable mechanism, not shown, and the arm 41 is coupled to the turntable for movement in synchronism therewith by the shaft 53 coupled with the shaft 52 by the worm reduction gears 54 and with the post 46 by means of the worm reduction gears 55 and a clutch 56. The latter may include teeth 57 on one end of a worm wheel 58, which is normally freely rotatable on the post 46, and mating teeth on a collar 59, which is feathered on the shaft 46. Collar 59 is moved along the shaft 46 and into and out of engagement with the teeth 57 by an arm 60 which extends up through the panel 48 and is provided at its outer end with a manually engageable knob 61. It should be obvious that as the knob 61 is moved to upper position the gear 58 will be coupled with the collar 59 and the post 46 rotated along with the turntable 50 but at greatly reduced speed.

Arm 41 is attached to the upper end of the post 46 by the flat head screw 63 which passes through an aperture in the upper wall of the arm and is screw-threaded into the post 46. A washer 64 of suitable friction material is interposed between the upper end surface of the post 46 and the arm 41 to provide in effect a friction clutch between the arm and the post. Any suitable expedient may be relied on to accomplish this function and in the apparatus specifically disclosed the shank of the screw 63 reaches the bottom of the bore in the post 46 and is screwed tightly thereagainst. The amount of friction provided is therefore determined by the thickness and character of the washer 64.

In accordance with the preferred embodiment of the invention the bore in the cartridge casing to receive the reproducing stylus extends entirely through the casing and an aligned aperture 66 is provided in the upper wall of the arm end 40 to enable the stylus 23 to be moved to retracted position as shown in dotted lines in Figure 5.

During the normal use of the apparatus of the invention both styluses will be retained in their respective holders with the reproducing stylus 23 extending downwardly below the cutting end

of the stylus 33, as indicated in Figure 2 of the drawings. With the knob 61 depressed, as illustrated in Figure 2, the arm 41 is free to rotate at will and in this condition of the parts the apparatus may be employed for reproducing a record placed on the turntable, regardless of whether or not the record was cut by the particular machine in question. Needle pressure is applied to the reproducing needle 23 by the unbalanced weight of the translator cartridge, as explained above, and to aid in lifting the needle above the face of the record flat headed screws 68, which are screw-threadedly received in the side walls of the cartridge and extend out through vertically elongated apertures in the side wall of the arm, may be provided. The screws 68 have cut and knurled outer surfaces and may conveniently be gripped between the thumb and forefinger of the operator.

To condition the apparatus for recording and cutting purposes it is only necessary to retract the reproducing stylus 23 thereby allowing the cutting stylus 33 to engage the face of the record and to elevate the knob 61 whereby the arm 51 will be geared to the turntable and be moved across the face of the record as the record rotates. The friction disc 64 enables the arm 41 to be moved in opposition to the gearing to enable the cutting stylus to be accurately positioned adjacent the outer marginal edge of the record in beginning the record regardless of the oriented position of the gear 58.

It should be understood that the apparatus of this invention is equally operable for recording on pregrooved record blanks and this may be accomplished by retracting the reproducing stylus as explained above and disengaging the clutch 56, in which case the arm 41 will be freely moved inwardly in accordance with the decreasing diameters of the convolutions of the groove. It should also be apparent that, if the apparatus is employed to play back a record which has previously been cut by the same apparatus, the clutch 56 need not be disengaged as the driven travel of the reproducing stylus and the inward travel of the record groove is necessarily coincident.

An important advantage of the stylus arrangement of the preferred embodiment of the invention is that the cutting stylus may, if desired, be permanently attached to its holder in properly oriented position by the manufacturer, thereby insuring the proper functioning of the apparatus.

The above specifically described embodiment of the invention should be considered as illustrative only as obviously many changes may be made therein without departing from the spirit or scope of the invention. It should be especially understood that the particular form of the arm and the method in which the same is geared to the record turntable is not per se any part of the invention but is pertinent only insofar as it is combined with the novel recording and reproducing unit of the invention. This unit comprising a cartridge may, of course, be used in conjunction with other forms of record blanks, such as cylinders, and in conjunction with ancillary apparatus other than that specifically described above and may itself be modified in many respects as suggested above, for example. Reference should therefore be had to the appended claims in determining the scope of the invention.

What I claim is:

1. A combined sound recording and reproducing unit comprising in combination a turntable

for supporting and rotating a record disk, an arm mounted for pivotal movement about an axis parallel with the axis of rotation of said turntable and positioned outside of the marginal edge of the turntable, means to move said arm about said first mentioned axis in synchronism with the rotation of said turntable, means to render said first mentioned means inoperative whereby said arm is freely rotatable, a support pivotally mounted on said arm adjacent the free end thereof for movement about an axis parallel with the plane of said record, said support being eccentrically mounted whereby the outer end thereof will be urged toward the plane of said record, a piezo-electric translating element carried by said support, a record cutting stylus closely coupled with said element and extending downwardly from the outer end of said support toward said record, a holder loosely coupled with said element and adapted to detachably receive a record reproducing stylus, and means to limit the pivotal movement of said support relative to said arm.

2. A combined sound recording and reproducing unit comprising in combination a turntable for supporting and rotating a record disk, an arm mounted for pivotal movement about a vertical axis positioned outside of the outer periphery of said turntable, means to move said arm about said axis and across the face of said turntable in synchronism with the rotation of said turntable, means to render said first mentioned means inoperative whereby said arm is freely rotatable, a support pivotally mounted on said arm adjacent the free end thereof for movement about a horizontal axis, said support being eccentrically mounted whereby the outer end thereof will be urged toward the plane of said record, an electro-mechanical translating element carried by said support, a holder closely coupled with said element and adapted to receive a record cutting stylus, a second holder loosely coupled with said element and adapted to receive a record reproducing stylus, said last two mentioned means being carried by said support adjacent the outer end thereof.

3. A combined sound recording and reproducing unit comprising in combination a turntable for supporting and rotating a record disk, an arm mounted for pivotal movement about a vertical axis positioned outside of the periphery of said turntable, a support pivotally mounted on said arm adjacent the free end thereof for movement about a horizontal axis, said support being eccentrically mounted whereby the outer end thereof will be urged toward the plane of the record disk, a piezo-electric crystal carried by said support, a holder for a record cutting stylus carried by the outer end of said support and rigidly connected with said crystal, and a holder for a record reproducing stylus carried by the outer end of said support and resiliently connected with said crystal.

4. A combined sound recording and reproducing unit comprising in combination means to support and rotate a record blank, an arm adapted to move across the face of said blank, means to move said arm in accordance with the rotation of said record blank, a support pivotally mounted on said arm adjacent the free end thereof, said support being eccentrically mounted whereby the outer end thereof will be urged toward the face of the record, a piezo-electric translating element carried by said support, a

holder for a record cutting stylus carried by the outer end of said support and closely coupled with said element, and a holder for a record reproducing stylus carried by the outer end of said support and loosely coupled with said element.

5. Apparatus for recording and reproducing sound comprising in combination a supporting arm adapted to sweep across a record face, a support eccentrically pivoted on said arm, a translating element operative to convert electrical impulses into mechanical impulses and vice versa carried by said support, a holder for a record cutting stylus carried by the normally unsupported end of said support and closely coupled with said element, and a holder for a record reproducing stylus carried by the same end of said support and loosely coupled with said element.

6. Apparatus for recording and reproducing sound comprising in combination a housing, a translating element operative to convert electrical impulses into mechanical impulses and vice versa in said housing, a holder for a record cutting stylus carried by said housing and closely coupled with said element, and a holder for a record reproducing stylus carried by said housing and loosely coupled with said element.

7. Apparatus according to claim 6 but in which said element is of the piezo-electric torque type, the axis of rotation of said first mentioned holder being substantially coincident with the axis of twist of said element.

8. A combined sound recording and reproducing unit comprising a piezo-electric crystal of the torque responsive type, means to clamp said crystal along one of its ends, a member clamped to the other end of said crystal and being substantially coincident with the axis of twist of said crystal, a record cutting stylus operatively connected with said member, a second member clamped along a side edge of said crystal, a reproducing stylus, and means operatively connecting said reproducing stylus and said second member.

9. A combined sound recording and reproducing unit comprising in combination, a casing having mating upper and lower sections each pro-

vided with a pair of spaced parallel semi-cylindrical grooves extending throughout the thickness of one end wall and in the meeting base thereof whereby a pair of spaced parallel bores are provided when said sections are assembled, a piezo-electric crystal in said casing and clamped along one of its ends between said sections, said crystal being of the torque responsive type and having its axis of twist substantially coincident with the principal axis of one of said bores, a cutting stylus holder journaled in the said one of said bores and having a bifurcated end to clamp over the adjacent edge of said crystal, a reproducing stylus holder journaled in the other of said bores and provided with a curved and bifurcated inner end, a bifurcated member received over a side edge of said crystal and projecting within the bifurcations of the curved end of said holder, and a pad of cushioning material between said second mentioned bifurcations on the inner end of said holder.

10. A combined sound recording and reproducing apparatus comprising in combination a piezo-electric element operative to convert electrical impulses into mechanical impulses and vice versa, said element having a fixed portion and movable portions, a record cutting stylus holder rigidly connected with a movable portion of said element, and a record reproducing stylus holder resiliently connected with a movable portion of said element.

11. A combined sound recording and reproducing apparatus comprising in combination a translating element operative to convert electrical impulses into mechanical impulses and vice versa, said element having a fixed portion and movably portions, a record cutting stylus holder rigidly connected with a movable portion of said element, and a record reproducing stylus holder resiliently connected with a movable portion of said element.

12. Apparatus according to claim 10 further characterized in that said element is of the torque type, the axis of rotation of said first mentioned holder being substantially coincident with the axis of twist of said element, said second mentioned holder being connected to said element at its side edge.

CREED M. CHORPENING.