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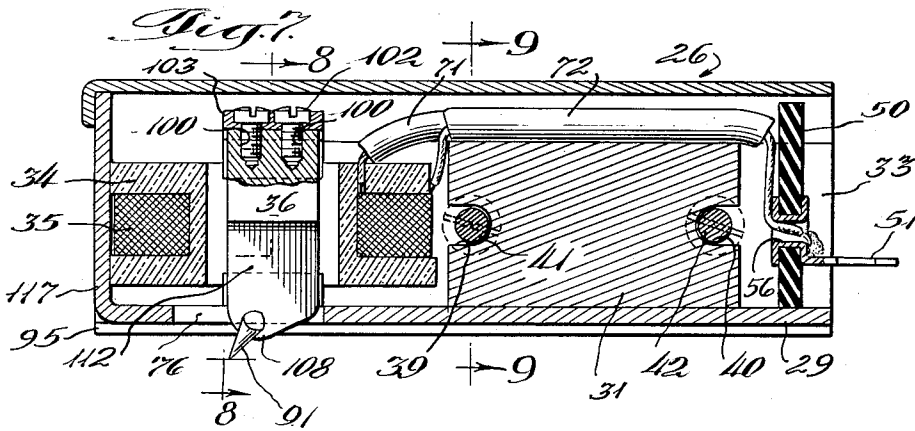
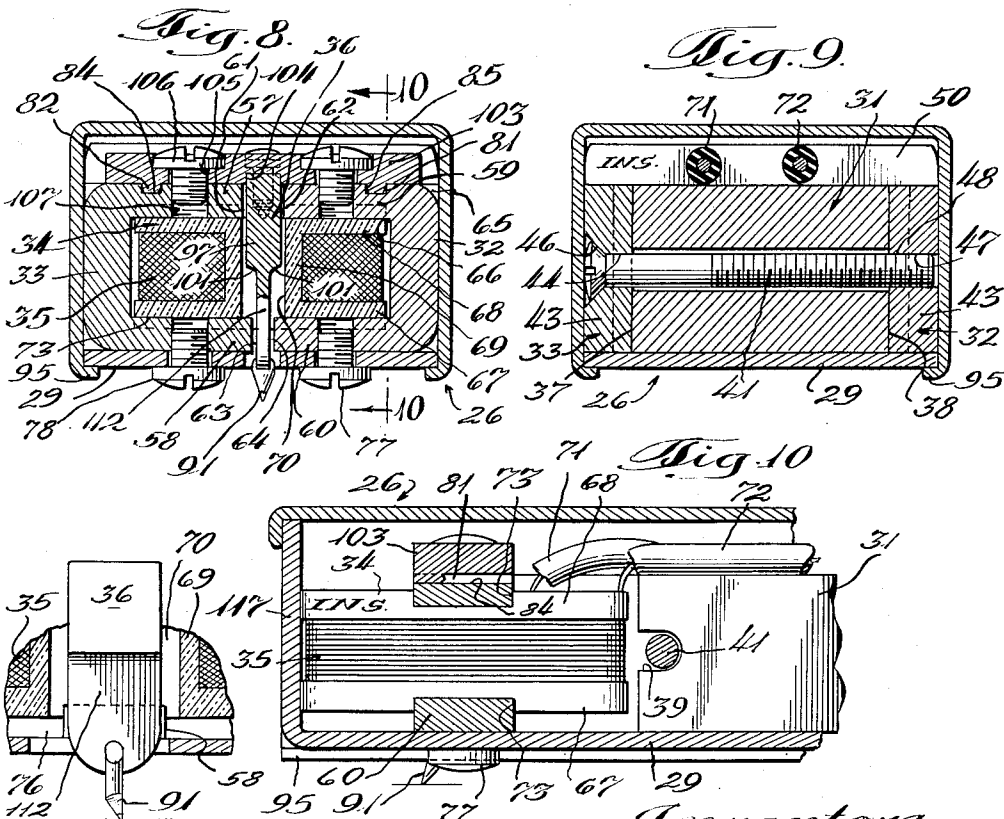
R. DALLY ET AL

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RECORDER

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RECORDER

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The present invention relates to recorders for recording sound or other vibratory effects upon records, such as phonograph records. The invention is equally applicable to recorders of the engraving type which utilize a cutting tool or recorders of the embossing type, the stylus of which does not remove material from the record, but merely displaces it.

One of the objects of the invention is the provision of an improved recording unit which is adapted to be used at extreme temperatures, such as, for example —50 degrees C. to +120 degrees C.

Another object of the invention is the provision of an improved recorder unit which has stable characteristics at all of a relatively wide range of temperatures, such as those which might be encountered in winter in arctic regions and those which might be encountered in the hottest seasons in the tropical zone.

The recorders of the prior art which utilize rubber or other similar resilient material as a support for the armature or for damping material are not suitable for use at extremely cold temperatures because under such conditions the rubber freezes or becomes more rigid so that it is practically solid, and ordinary damping materials would also freeze or become substantially solid.

Under such conditions, knife edges will frost and change their characteristics, due to the collection of moisture, and the recorders of the prior art do not have stable characteristics at the extremes of temperature for which the present invention is adapted.

Another object of the invention is the provision of an improved recorder which records sound with high fidelity and with a minimum amount of distortion or divergence from fidelity, so that the sound may be faithfully reproduced by suitable high fidelity reproduction mechanism.

Another object of the invention is the provision of an improved recorder of the class described, in which there is a better mechanical response for a minimum amount of electrical input than with the devices of the prior art, and in which the performance of the recorder will not vary over a long period of use under the most adverse conditions.

Another object of the invention is the provision of an improved recorder construction which is simple, compact, sturdy, and which has a minimum number of parts so that it may be manufactured at a low cost and so that it may be

placed within the range of a vast number of users.

Another object of the invention is the provision of an improved armature construction which takes the form of a tuned reed having a minimum amount of mass and utilizing a minimum amount of material.

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

Referring to the drawings accompanying the specification,

Fig. 1 is a side elevational view showing a tone arm, turntable, and recorder unit embodying the present invention;

Fig. 2 is a sectional view of the recorder unit, taken along the plane of the line 2—2 of Fig. 4;

Fig. 3 is a vertical sectional view, taken on the plane of the line 3—3 of Fig. 4, looking in the direction of the arrows;

Fig. 4 is an end elevational view of the recorder unit, showing the left end of the unit of Fig. 1;

Fig. 5 is a rear end elevational view of the recorder unit;

Fig. 6 is a fragmentary bottom plan view of that portion of the recorder unit, showing the stylus;

Fig. 7 is a sectional view of the recorder unit, taken on the plane of the line 7—7 of Fig. 2, looking in the direction of the arrows;

Fig. 8 is a vertical sectional view of the recorder unit, taken on the plane of the line 8—8 of Fig. 7, looking in the direction of the arrows;

Fig. 9 is a vertical sectional view, taken on the plane of the line 9—9 of Fig. 7;

Fig. 10 is a vertical sectional view, taken on the plane of the line 10—10 of Fig. 8, looking in the direction of the arrows;

Fig. 11 is a fragmentary sectional view similar to Fig. 10, showing the mode of attachment of the stylus to the armature when the recorder is of the engraving type.

Referring to Fig. 1, 20 indicates a cabinet or other support for a tone arm column 21, which supports a tone arm 22 for pivotal movement on a vertical axis. The support carries a turntable 23 on a turntable shaft 24 for supporting the record 25, and the tone arm 22 has the recorder unit 26 pivotally mounted upon the tone arm by means of the pins or shafts 27.

In other forms of tone arm which are mounted on the column 21 for vertical and horizontal movement, the recorder unit may be fixedly secured to the end of the tone arm.

The recorder unit 26 (Figs. 2 to 4) preferably comprises an outer housing 28, which is formed by a lower supporting plate 29 and a rectangular housing member 30.

The mechanism of the unit preferably comprises a permanent magnet 31 (Fig. 2) in the form of a rectangular block of magnetic material of high coercive force, such as, for example, Alnico, provided with pole pieces 32, 33 (Fig. 2), spool 34, electrical coils 35, and armature 36 (Fig. 8).

The magnet 31 is preferably provided with ground plane surfaces 37, 38 for engaging the pole pieces 32, 33 so that the air gap may be accurately predetermined, and the magnet is preferably formed with grooves 39, 40 (Fig. 7) located in each of its opposite sides for receiving the screw bolts 41, 42.

Grooves 39 and 40 may have flat side walls and half cylindrical end portions, and are preferably slightly larger than the screw bolts to permit of some lateral and longitudinal adjustment. The Alnico of which the magnets are made is preferably cast in bars having oppositely disposed grooves 39 and 40, and the bars are cut off to length and provided with the accurately ground plane surfaces 37 and 38.

The pole pieces 32, 33 are similar in construction, but are oppositely located right hand and left hand members. They may be constructed of any suitable metal, such as cold rolled steel or soft iron, and may either be cast or made of sheet metal. Each pole piece has a rectangular body portion 43, which may be of the same width as the thickness of the magnet block 31.

The body portion 43 of each pole piece has a pair of spaced through bores 44, 45, 46, and 47, one of which is countersunk for receiving the screw bolts 41, 42 and the heads thereof.

The apertures 47 in the pole piece 32, for example, may be threaded to receive the threaded end 48 of the screw bolts 41, 42, and by means of these screw bolts the two pole pieces are frictionally clamped on the magnet block 31.

The apertures 44, 45, and 47, 47 are suitably spaced from each other so that the screw bolts are located in the grooves 39 and 40 in the magnet block 31 with a slight amount of clearance between the bolts and the walls of the grooves for adjustment.

Each pole piece is preferably provided at its rear end (Fig. 2) with a groove 49 of rectangular cross-section slightly spaced from the end and adapted slidably to receive the rear wall 50, comprising a sheet of insulating fiber for supporting the connectors 51, 52. The fiber sheet is slightly deeper than the width of the pole piece bodies 43, and is provided with laterally projecting ears 53, 54, which effect a complete closure of that end of the housing in the assembly, as shown in Fig. 5.

The connectors 51, 52 may be similar in construction, and each may consist of a short strip of sheet metal, having a T-shaped end portion 55 for engagement with a conductor, the strip being secured to the fiber end wall 50 by a tubular rivet 56.

At its opposite end each pole piece 32 or 33 is preferably formed with a pair of inwardly extending parallel flanges 57, 58, 59, 60, which serve as the pole pieces proper, and which when assembled with the armature 36 and the magnet 31 provide an equal air gap clearance at 61, 62 at the fixed end of the armature 36, and also at

63, 64, which indicate the air gaps at the movable end of the armature 36.

The pole piece flanges 57, 58, 59, 60 are substantially rectangular in shape, the two upper flanges 57 and 59 being longer than the lower flanges 58 and 60 in order to provide the same air gap at 63, 64 on each side of the thin portion of the armature 36 as is provided on each side of the relatively thick portion of the armature 36 adjacent the pole piece flanges 60, 61.

When the pole pieces are formed of sheet metal, the outer corners at 65, between the body flange and the pole piece flanges, will be rounded; but the inner corners 66 will be ground or otherwise cut out to substantially rectangular form so as not to interfere with the seating of the spool 34, which is to be placed between them.

The spool 34 consists of an insulating spool which is preferably made of initially plastic moldable material, and it has a pair of parallel end flanges 67, 68 (Fig. 8) carried by a central tubular portion 69. The tubular portion 69 has a through aperture 70 of substantially rectangular shape for passing the armature 36 with a suitable clearance so that the armature is not engaged in any way by the spool.

The spool 34 carries the insulated coils of conducting wire 35, preferably of enameled wire, since a greater efficiency may be attained in some cases by such wire. The coils 35 may consist of a great number of turns of fine wire or a few turns of relatively heavy wire, since the impedance and the conductivity of the coil may be made any desired amount to suit the recorder for different purposes.

The ends of the coil 35 terminate in conductors 71, 72 (Fig. 2), which are connected to the connectors 51, 52 by means of a drop of solder in the tubular rivet. The upper spool flange 68 (Fig. 10) and the lower spool-flange 67 are preferably provided with a relatively shallow groove 73, which extends diametrically across the upper and lower faces of these flanges respectively, for receiving the pole piece flanges 57, 58, 59, 60.

In some embodiments of the invention only the upper face of the spool may be provided with a groove 73; or in others only the lower face of the spool.

The cross section of this shallow groove 73 is substantially rectangular and complementary to the shape of the pole piece flanges 57, 59 so that the pole pieces must be slid laterally on the spool 34, and the spool fits inside the pole piece flanges 57—60 when the pole piece flanges 57, 59 are in the groove 73.

Thus the spool 34 and the coil which it carries are positively anchored with respect to the pole pieces, which is of particular importance in a recorder where there is a reaction against the coils when force is exerted on the armature and stylus.

The width of the spool flanges 68 between the pole piece bodies 43 is such that the flanges 68 fit between the pole pieces when they are secured to the magnet block 31, anchoring the spool against lateral movement as well as longitudinal movement.

The magnet and spool assembly thus far described is preferably carried by the bottom plate 29, which is constructed of nonmagnetic material, such as brass, aluminum, or some other suitable material.

This bottom plate may consist of a rectangular sheet of such metal, which is formed at its

forward end with the upwardly extending flange 117, forming the end wall of the housing.

Adjacent this end the bottom plate 29 is provided with an elongated aperture 76, having parallel sides and rounded ends; and the aperture 76 preferably extends, as shown in Fig. 6, toward the left, beyond the pole piece flanges 58 and 60 so that the stylus 91 may clear these pole piece flanges to permit its being lifted out of the pole piece assembly, as the stylus itself may thus be made, if necessary, slightly wider than the total air gap.

If it were not for the clearance at the left end of the aperture 76 in Fig. 6, the stylus, when thicker than the total air gap between the flanges 58 and 60, would have to be removed through the bottom of the housing, whereas with the present structure it may be lifted out of the top of the housing.

The bottom plate 29 may be secured to the magnet and pole piece assembly by means of screw bolts 77, 78 (Fig. 6), which pass through this bottom plate and are threaded into the lower pole piece flanges 58 and 60, as shown in Fig. 8.

This secures the pole piece flanges 58, 60 in accurate predetermined spaced relation to each other so as to determine the accuracy of the air gaps at 63, 64.

The armature 36 is preferably of the reed type, having at least a lower portion 112 which is relatively thin like a reed and adapted to vibrate at a predetermined frequency due to its resilient characteristics.

At the points 101 the thickness of the armature is increased, providing a body portion 97, which may be of uniform thickness from the points 101 to the upper end.

The armature body 97 may be of substantially rectangular shape in cross-section and elevation, and it is provided at its upper end with a pair of centrally located screw bores 100 for receiving the screw bolts 102, which secure the armature 36 to a cross bar 103. The cross bar 103 has a transverse groove 104 of rectangular section adapted to receive the armature body 97, which is secured to this groove by the screw bolts 102.

In order to secure the pole pieces in accurately spaced position the cross bar 103 is preferably formed with a pair of depending ribs 81, 82, which are adapted to fit into the complementary grooves 84, 85 formed in the upper pole piece flanges 57, 59.

The armature supporting bar 103 also has countersunk apertures 105 for receiving the screw bolts 106 and the heads thereof, and the screw bolts are threaded into the threaded bores 107.

There is a clearance around the screw bolts 106 in the bores 105, and it is the ribs 82 and grooves 84, 85, which have an accurate fit, that determine the spacing of the pole piece flanges 57, 59, the parts being held in fixed position by the screw bolts. This structure has the additional advantage that, if desired, the complete armature assembly, comprising the armature 36 and the supporting bar 103, may be removed; or, if desired, only the armature 36 may be removed by loosening the screw bolts which hold it.

In some embodiments of the invention the bottom plate 29 and the lower pole piece flanges 58, 60 may also be provided with grooves and ribs 81, 82, 84, 85; but the accurate spacing may be accomplished by the use of these elements only on the upper or the lower side of the pole pieces.

The shape of the end portion 112 of the stylus is shown in Fig. 7 for the embossing type of recorder, in which the stylus is secured at an angle. In this embodiment of the invention the end portion 112 of the armature tapers toward the point 108 adjacent the front side of the armature, and the stylus 91 comprises a suitably pointed member, preferably of an alloy of the platinum group, which is welded on the end of the rib portion 112 with its point extending at a predetermined angle of from twenty-eight to thirty degrees, for example.

In the embodiment of Fig. 11, where the recorder is of the cutting or engraving type, the stylus 91 is vertical, or nearly vertical, and it may be located centrally of the rib portion 112. The armature 36 may be made of any suitable nonferrous or magnetic metal, such as cold rolled steel; and in some embodiments of the invention a suitable non-metallic stylus, such as a sapphire, could be attached by means of a holder of metal which is welded to the reed.

The armature assembly is so proportioned and constructed that it will be tuned to vibrate at any desired resonant frequency, such as, for example, 5,000 cycles per second; but most of the movement takes place at the free end of the armature.

In some embodiments of the invention the reed or armature 36 can be riveted or welded to the supporting top plate or bar 103. This bar, however, must be made of nonmagnetic material, such as, for example, brass or aluminum; otherwise it would short circuit the flux, which would pass through the bar, rather than through the air gap.

The box-like portion of the housing 30 may consist of a piece of nonmagnetic sheet metal like the bottom plate 29, and which has a top flange 92 and a pair of depending side flanges 93, 94 at right angles to the top flange and fitting on the edges of the bottom plate 29.

The side flanges 93 carry inwardly extending guide flanges 95, which fit under the bottom plate, and the size of the housing member 30 is such that it may be slid endwise on the recorder assembly with the flanges 95 under the bottom plate.

The left end of the housing is thus closed by the end plate 117, and the right end is closed by the insulating plate 50. The housing and the pole piece members are preferably provided with a pair of oppositely located apertures 96 for receiving pins or other members by means of which the housing is pivoted on the tone arm at 22.

As the present armature is mounted without any knife edges or without being secured in resilient material, such as rubber, there is no possibility of the movement of the armature being hampered by the knife edges frosting or by a rubber mounting becoming solid at low temperatures. The characteristics of the present recorder are substantially stable throughout a wide range of temperatures, from very high temperatures to very low temperatures; and thus the present recorder is adapted to be used under the most adverse conditions.

Its armature and stylus may be removed as a unit and replaced whenever necessary; and when such a replacement is made, there is no danger of the spacing at the air gap becoming deranged.

While we have illustrated a preferred embodiment of our invention, many modifications may be made without departing from the spirit of the invention, and we do not wish to be limited to

the precise details of construction set forth, but desire to avail ourselves of all changes within the scope of the appended claims.

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

1. In a recording unit for recording sound and the like, the combination of a permanent magnet of high coercive force comprising a body of magnetic material having plane oppositely disposed faces, a pair of pole piece members, each pole piece member having a plane body portion adapted to engage said faces, securing means passing through the pole piece members for securing the said pole piece members to the said magnetic body by frictional clamping action, an armature carried by said pole piece members and adapted to vibrate between the opposed pole faces thereof, said armature comprising a reed-like member having a stylus carried by its free end, and said reed-like member being carried by a supporting bar of non-magnetic material, threaded means for securing said supporting bar to said pole pieces, and shoulder means carried by said pole pieces and by said bar for determining the spacing of said armature from the pole faces.
2. In a recording unit for recording sound and the like, the combination of a permanent magnet of high coercive force comprising a body of magnetic material having plane oppositely disposed faces, a pair of pole piece members, each pole piece member having a plane body portion adapted to engage said faces, securing means passing through said pole piece members for securing said pole piece members to said magnetic body by frictional clamping action, and an armature carried by said pole piece members and adapted to vibrate between opposed pole faces thereof, said armature being fixedly carried by a supporting bar and said bar being fixedly secured to said pole piece members, said armature comprising a reed-like member having a stylus carried by its free end.
3. In a recording unit for recording sound and the like, the combination of a permanent magnet of high coercive force comprising a body of magnetic material having plane oppositely disposed faces, a pair of pole piece members, each pole piece member having a plane body portion adapted to engage said faces, said magnetic body having oppositely disposed grooves, securing means located in said grooves and passing through said pole piece members for securing said pole piece members to said magnetic body by frictional clamping action, and an armature carried by said pole piece members and adapted to vibrate between opposed pole faces thereof, said armature being fixedly carried by a supporting bar and said bar being fixedly secured to said pole piece members, said armature comprising a reed-like member having a stylus carried by its free end.
4. In a recording unit for recording sound and the like, the combination of a permanent magnet of high coercive force comprising a body of magnetic material having plane oppositely disposed faces, a pair of pole piece members, each pole piece member having a plane body portion adapted to engage said faces, said magnetic body having oppositely disposed grooves, securing means located in said grooves and passing through said pole piece members for securing said pole piece members to said magnetic body by frictional clamping action, and an armature carried by said pole piece members and adapted to vibrate between opposed pole faces thereof, said armature

being fixedly carried by a supporting bar and said bar being fixedly secured to said pole piece members, said pole piece members and said bar having complementary ribs and grooves on opposite sides of said armature for locating the faces of the pole pieces in predetermined spaced relation to the armature.

5. In a recording unit for recording sound and the like, the combination of a permanent magnet of high coercive force comprising a body of magnetic material having plane oppositely disposed faces, a pair of pole piece members, each pole piece member having a plane body portion adapted to engage said faces, said magnetic body having oppositely disposed grooves, securing means located in said grooves and passing through said pole piece members for securing said pole piece members to said magnetic body by frictional clamping action, and an armature carried by said pole piece members and adapted to vibrate between opposed pole faces thereof, said armature being fixedly carried by a supporting bar and said bar being fixedly secured to said pole piece members, said pole piece members and said bar having complementary ribs and grooves on opposite sides of said armature for locating the faces of the pole pieces in predetermined spaced relation to the armature, and threaded means for securing said bar to said pole piece members.

6. In a recorder assembly the combination of a block of magnetic material of high coercive force with a pair of pole piece members and threaded means for clamping said pole piece members frictionally on said block, said pole piece members having upper and lower pole flanges extending toward each other and provided with pole faces, an armature comprising a reed of magnetic material fixedly mounted at one of its ends on said pole piece members, and an insulated energizing coil carried by said pole piece members and surrounding said armature.

7. In a recorder assembly the combination of a block of magnetic material of high coercive force with a pair of pole piece members and threaded means for clamping said pole piece members frictionally on said block, said pole piece members having upper and lower pole flanges extending toward each other and provided with pole faces, an armature comprising a reed of magnetic material fixedly mounted at one of its ends on said pole piece members, and an insulated energizing coil carried by said pole piece members and surrounding said armature, said coil being carried by a spool, said spool fitting between said pole piece flanges.

8. In a recorder assembly the combination of a block of magnetic material of high coercive force with a pair of pole piece members and threaded means for clamping said pole piece members frictionally on said block, said pole piece members having upper and lower pole flanges extending toward each other and provided with pole faces, an armature comprising a reed of magnetic material fixedly mounted at one of its ends on said pole piece members, and an insulated energizing coil carried by said pole piece members and surrounding said armature, said coil being carried by a spool, said spool fitting between said pole piece flanges, and said spool being provided with grooves for receiving predetermined of said pole piece flanges to anchor the spool in place.

9. In a magnetic sound apparatus, the combination of a magnetic structure including a source of magneto motive force and a pair of

substantially parallel legs, provided with substantially U-shaped pole pieces extending toward each other and resiliently supported by said legs, with an energizing coil supported between said pole pieces, an armature located between said pole pieces and projecting therefrom at its free end, said armature having a stylus at its free end and a non-magnetic bridge member supporting said armature between said pole pieces, with its supported end in fixed position, said bridge member and the adjacent parts of said pole pieces being provided with apertures for receiving through bolts threaded into the pole pieces and provided with a clearance surrounding said bolts in said bridge member, said pole pieces and bridge member being provided with complementary transversely extending grooves and ridges for definitely determining the position of the pole pieces and the extent of the air gap between said armature and each pole piece, said ridges and grooves being forced into engagement with each other and secured by said through bolts against release.

10. In a recorder assembly the combination of a block of magnetic material of high coercive force with a pair of pole piece members and threaded means for clamping said pole piece members frictionally on said block, said pole piece members having upper and lower pole flanges extending toward each other and provided with pole faces, an armature comprising a reed of magnetic material fixedly mounted at one of its ends on said pole piece members, and an insulated energizing coil carried by said pole piece members and surrounding said armature, said armature being carried by a supporting member of non-magnetic material carried by the pole piece members, said pole piece members and non-magnetic member being provided with a groove and complementary rib on each side of the armature whereby the armature is accurately spaced from the pole piece faces.

11. In a recorder assembly the combination of a block of magnetic material of high coercive force with a pair of pole piece members and threaded means for clamping said pole piece members frictionally on said block, said pole piece members having upper and lower pole flanges extending toward each other and provided with pole faces, an armature comprising a reed of magnetic material fixedly mounted at one of its ends on said pole piece members, and an insulated energizing coil carried by said pole piece members and surrounding said armature, said armature having a stylus welded to its free end and extending beyond the pole pieces.

12. In a recorder assembly the combination of a block of magnetic material of high coercive force with a pair of pole piece members and threaded means for clamping said pole piece members frictionally on said block, said pole piece members having upper and lower pole flanges extending toward each other and provided with pole faces, an armature comprising a reed of magnetic material fixedly mounted at one of its ends on said pole piece members, and an insulated energizing coil carried by said pole piece members and surrounding said armature, said coil being carried by a spool, said spool fitting between said pole piece flanges, said spool having an enlarged aperture to provide clearance at one side of said pole piece members for passage of said stylus whereby the armature and its supporting member may be removed as a unit from the opposite side.

13. In a magnetic sound apparatus, the combination of a magnetic structure including a source of magneto motive force and a pair of substantially parallel legs, provided with substantially U-shaped pole pieces extending toward each other and resiliently supported by said legs, with an energizing coil supported between said pole pieces, an armature located between said pole pieces and projecting therefrom at its free end, said armature having a stylus at its free end and a non-magnetic bridge member supporting said armature between said pole pieces, with its supported end in fixed position, said bridge member and the adjacent parts of said pole pieces being provided with apertures for receiving through bolts threaded into the pole pieces and provided with a clearance surrounding said bolts in said bridge member, said pole pieces and bridge member being provided with complementary transversely extending grooves and ridges for definitely determining the position of the pole pieces and the extent of the air gap between said armature and each pole piece, said ridges and grooves being forced into engagement with each other and secured by said through bolts against release, said armature comprising a member of magnetic metal having that portion which is fixedly secured to the bridge piece of substantial thickness and being reduced in thickness from its free end to a point inside the said coil to form a thin reed-like portion at its free end for resonant vibratory motion.

14. In a magnetic sound apparatus, the combination of a block of magnetic material forming a permanent magnet with a pair of pole piece members and threaded means for clamping said pole piece members against said permanent magnet, said pole piece members having pole flanges extending toward each other and the pole flanges on each pole piece member being spaced from each other, and an armature fixedly secured to said pole piece members and adapted to vibrate between said pole flanges, said armature being carried by a non-magnetic metal member secured to a pole piece flange on each pole piece member, said non-magnetic member and the adjacent pole piece flanges being provided with engaging shoulders on each side of the armature for predetermined air gap spacing between the armature and the pole piece flanges.

15. In a magnetic sound apparatus, the combination of a block of magnetic material forming a permanent magnet with a pair of pole piece members and threaded means for clamping said pole piece members against said permanent magnet, said pole piece members having pole flanges extending toward each other and the pole flanges on each pole piece member being spaced from each other, an armature fixedly secured to said pole piece members and adapted to vibrate between said pole flanges, said armature being carried by a non-magnetic metal member secured to a pole piece flange on each pole piece member, said non-magnetic member and the adjacent pole piece flanges being provided with engaging shoulders on each side of the armature for predetermined air gap spacing between the armature and the pole piece flanges, and a housing comprising a non-magnetic metal plate secured to one side of said apparatus and having an aperture for passage of the armature, and a box-like metal member of non-magnetic material slidably mounted on said plate and adapted to cover its sides and top.

16. In a magnetic sound apparatus, the combination of a block of magnetic material forming a permanent magnet with a pair of pole piece members and threaded members for clamping said pole piece members against said permanent magnet, said pole piece members having pole flanges extending toward each other and the pole flanges on each pole piece member being spaced from each other, an armature fixedly secured to said pole piece members and adapted to vibrate between said pole flanges, said armature being carried by a non-magnetic metal member secured to a pole piece flange on each pole piece member, said non-magnetic member and the adjacent pole piece flanges being provided with engaging shoulders on each side of the armature for predetermined air gap spacing between the armature and the pole piece flanges, a housing comprising a non-magnetic metal plate secured to one side of said apparatus and having an aperture for passage of the armature, a box-like metal member of non-magnetic material slidably mounted on said plate and

adapted to cover its sides and top, and an end closure comprising a plate of insulating material carrying connectors for said apparatus, said insulating plate being slidably mounted in slots in said pole piece members.

17. An armature structure for recorders, comprising a bridge member formed with a transversely extending groove of rectangular cross section, and an armature of magnetic material having a fixed end portion of substantially rectangular cross section fitting in said groove, threaded means for securing said armature in said groove, said armature being of substantially rectangular shape in elevation, and being reduced in thickness intermediate its ends, forming a free end portion of thin reed-like shape which is symmetrically curved at its free end and provided with a stylus welded centrally of said free end.

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