

March 24, 1936.

A. C. KELLER

2,034,872

PHONOGRAPH REPRODUCER

Filed Oct. 20, 1934

2 Sheets-Sheet 1

FIG. 1

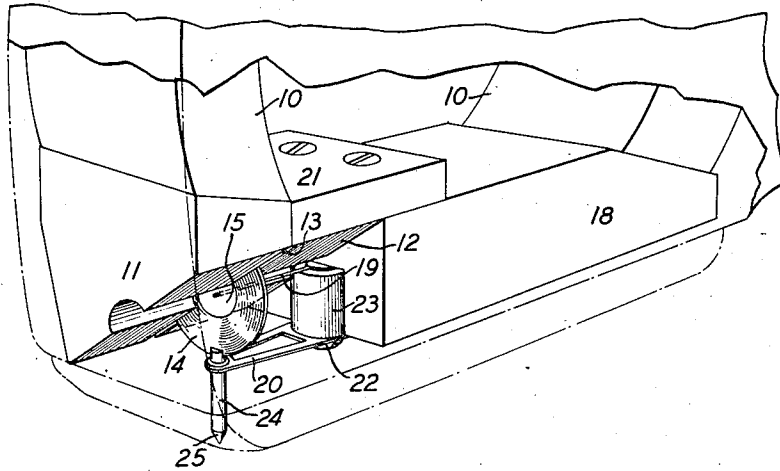


FIG. 2

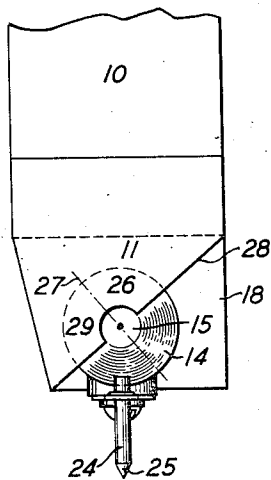
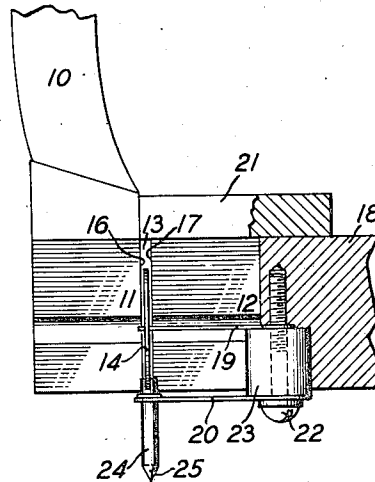


FIG. 3



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FIG. 4

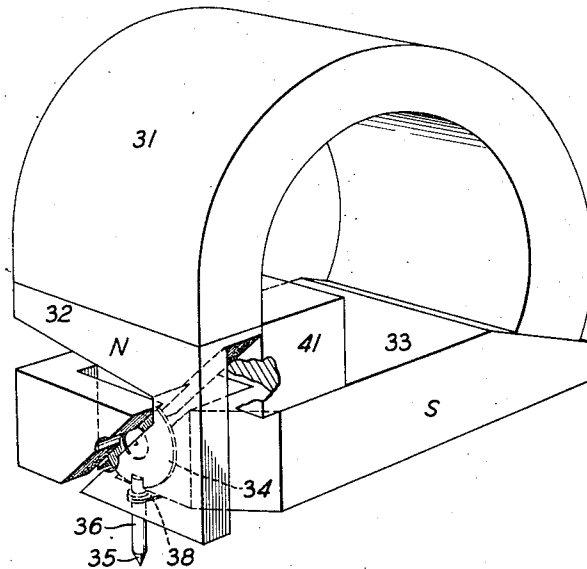


FIG. 5

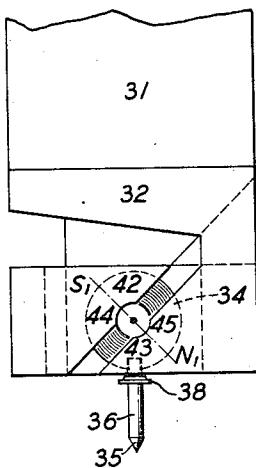


FIG. 6

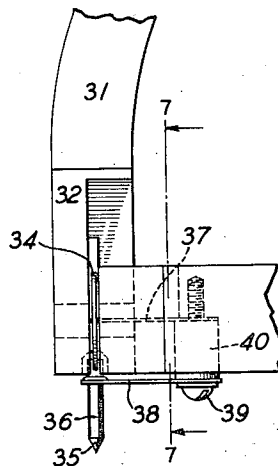
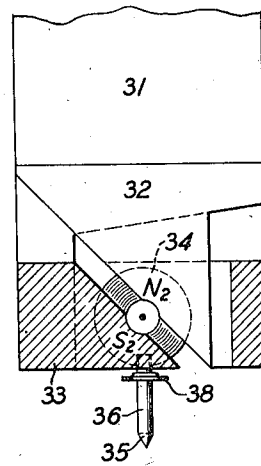


FIG. 7



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PHONOGRAPH REPRODUCER

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Application October 20, 1934, Serial No. 749,155

7 Claims. (Cl. 179—100.41)

This invention relates to phonograph reproducers and more particularly to those of the universal type.

The object of the invention is a reproducer capable of high quality reproduction from either hill-and-dale or lateral cut records without requiring any attention on the part of the operator as to which type of record is being used.

According to the invention, the generating element, preferably a very thin coil of the pancake type, is mounted vertically on the stylus holder with about one-half of the coil projecting into a short gap in the magnetic circuit of the device. This assembly is supported by vertically spaced cantilever springs, the upper spring being free to deflect either vertically or laterally and the lower spring intermediate the coil and the stylus being free both vertically and torsionally, but relatively rigid in a lateral sense. When the stylus is vibrated vertically both springs deflect vertically and the upper portion of the coil turns act as the generating element, but when lateral forces are applied to the stylus the lower spring is deflected torsionally and the lateral portion of the coil turns in the gap become the generating element.

In an alternate construction, according to the invention, the magnetic structure is of the cross-pole type and so arranged that substantially one-half of each coil turn is active for either type of reproduction.

Due to the compact design of the moving system the mechanical impedance of these reproducers may be kept very low so that good tracking is obtained at low stylus pressures. Moreover, the pancake coil can be made very thin and the air-gap very short and leakage flux relatively low so that particularly when a cross-pole magnetic structure is used the advantages of low stylus pressure are obtained with very little, if any, sacrifice in efficiency as compared with reproducers of other types.

Fig. 1 of the drawings is a perspective view of a reproducer according to the invention;

Figs. 2 and 3 are front and side views respectively of the reproducer of Fig. 1;

Fig. 4 is a perspective view of an alternative construction according to the invention in which a cross-pole magnetic circuit is used;

Figs. 5 and 6 are front and side views respectively of the reproducer of Fig. 4; and

Fig. 7 is a sectional view taken as indicated in Fig. 6.

Referring now to Figs. 1, 2 and 3, the magnetic system of the reproducer consists of a permanent magnet 10 of which only the end portions are

shown and pole-pieces 11 and 12 which define a substantially triangular gap 13 for the coil 14. The coil is spirally wound on a central core member 15 and suitably impregnated to make it rigid enough to hold its shape without external support. In this way, the coil can be made very thin so that the gap 13 may be very short and the flux density in the gap very high. The pole-pieces are preferably slotted opposite the core 15 of the coil to confine the flux to the active portions of the coil and the efficiency of the device may, of course, be further increased by shaping the pole faces 16 and 17 to the contour of the coil so that the path of lowest reluctance is through the coil.

The pole-piece 12 is preferably made by cutting away a portion of the bottom piece 18 to form the necessary triangular pole face 17 and at the same time provide vibrating clearance for the coil supporting springs 19 and 20. The pole-pieces 11 and 12 are conveniently held in their proper relative positions by a brass or other non-magnetic spacing piece 21 and the coil supporting springs 19 and 20 are secured to the bottom piece 18 by a screw 22 and a spacing washer 23. The upper spring 19 should be free to deflect both vertically and laterally and in the construction shown it consists of a single strand of fine steel wire secured to the center of the core 15 of the coil. The lower spring 20 should be free to deflect both vertically and torsionally but not laterally and these requirements are met by a V-shaped spring of wire or of thin sheet material with the center portion stamped out as shown. This spring is preferably connected to a lightweight tubular member 24 which connects the stylus 25 to the coil.

When the reproducer is used on hill-and-dale records the springs 19 and 20 will both deflect vertically to permit the coils to vibrate vertically with the stylus and the top quarter 26 of the coil as defined by the dotted line 27 and the side 28 of the pole-pieces 11 will be effective to generate currents representing the sounds recorded on the record. When the reproducer is used on lateral cut records the spring 20 being relatively stiff laterally will deflect torsionally to form a pivot so that the upper spring 19 will deflect laterally and the coil will vibrate laterally in the gap. In this case the top quarter of the coil is ineffective but the lateral quarter 29 will generate currents representing the sounds recorded on the lateral record. It is therefore apparent that this reproducer may be used indiscriminately on either type of record.

In the alternate construction of Figs. 4 to 7 a cross-pole magnetic structure is used to increase

the proportion of active conductor in the coil. The magnet 31 has two pole-pieces 32 and 33 each of which has two active pole faces on opposite sides of the coil 34 so disposed that the flux traverses the two halves of the coil in opposite directions as indicated by the polarity markings S₁, N₁ and S₂, N₂ in Figs. 5 and 7. In order to keep the leakage flux low, the spacing between the north and south poles on the same side of the coil must be large as compared with the working gap in which the coil is disposed and for the purposes of illustration the spacings have been shown larger than required in actual practice since the working gaps cannot be clearly shown in their true proportion.

The moving system comprising the coil 34, the stylus 35 and the connecting tube 36 is supported by the springs 37 and 38 which are secured to the pole-piece 33 by the screw 39 and the spacer 40 in a manner similar to the construction already described. The pole-pieces 32 and 33 are held in position by the non-magnetic spacer 41 as shown in Fig. 4 but this spacer is omitted in Figs. 5 to 7 in order to show the magnetic structure more clearly.

From the description already given of the structure of Fig. 1 it will be clear that the portion of the coil between the pole-pieces S₁ and N₂ will be operative as in the structure of Fig. 1 to generate currents in accordance with either lateral or vertical stylus vibrations. When the coil is vibrated vertically the top quarter 42 is active and at the same time the bottom quarter 43 of the coil is cutting the flux between the poles N₁ and S₂ which is flowing in the direction opposite to the flux between S₁ and N₂ so that the currents are in aiding relationship in the coil turns. Similarly, when the coil is vibrating laterally so that the side quarter 44 is active, the other side 45 will also be active to generate currents in additive relationship to those generated in the quarter 44 since the fluxes at the two sides of the coil are in opposite directions. In this structure, therefore, substantially one-half of the coil is active when the reproducer is operating on either type of record and a correspondingly higher efficiency can be obtained.

What is claimed is:

1. In a universal reproducer, a moving system comprising a flat spirally wound coil, a stylus and a stylus arm connecting the stylus to the coil, a magnetic circuit including a gap, and spring supporting means for the system constraining the coil to vibrate in the gap in one generating mode

for vertical vibrations of the stylus and in another generating mode for lateral vibrations of the stylus.

2. A universal reproducer comprising a magnetic circuit including a short air-gap, a stylus, a stylus arm, a flat spirally wound coil on the arm, and means for supporting the coil for both vertical and lateral vibrations in the air-gap comprising an upper spring free to deflect both vertically and laterally and a lower spring relatively rigid in a lateral sense, but free to deflect vertically for vertical vibrations of the stylus and torsionally to form a fulcrum for the arm when the stylus is vibrated laterally.

3. A moving system for phonograph reproducers comprising a flat spirally wound coil, a stylus, a connecting member between the stylus and the coil, and vertically and torsionally resilient mounting means comprising an upper spring support secured to the center of the coil and a lower spring support secured to the member for holding the coil in operative relation to a magnetic circuit.

4. A moving system for reproducers comprising a flat spirally wound coil, a stylus, a connecting member between the stylus and the coil, an upper supporting spring secured to the center of the coil and a lower supporting spring free to deflect both vertically and torsionally, but not laterally secured to the member intermediate the coil and the stylus.

5. In a universal reproducer, a moving system comprising a flat coil, a stylus and a connecting member between the stylus and the coil, a cross-pole magnetic structure defining a plurality of gaps and a plurality of springs supporting the coil for lateral and vertical vibrations in said gaps.

6. In a phonograph reproducer, a magnetic circuit including two pole-pieces defining a gap, a spirally wound coil, a stylus for driving the coil and spaced springs differing in lateral stiffness supporting the coil for vertical and lateral vibrations with substantially one-half of the coil extending into the gap.

7. In a phonograph reproducer, a spirally wound coil, a stylus for driving the coil, means for supporting the coil for both vertical and lateral vibrations and means for producing magnetic fluxes parallel to the axis of the coil but in opposite directions in diagonally opposite halves of the coil.

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