

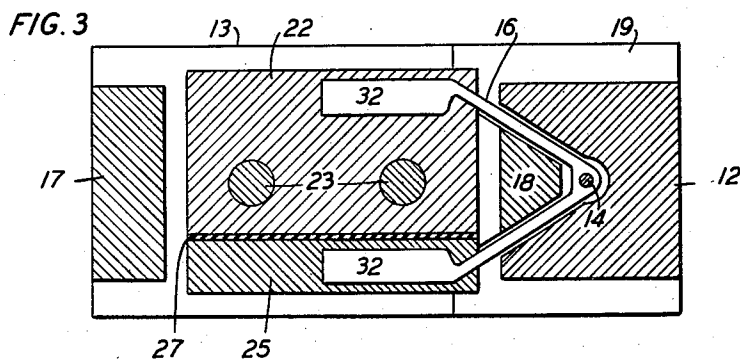
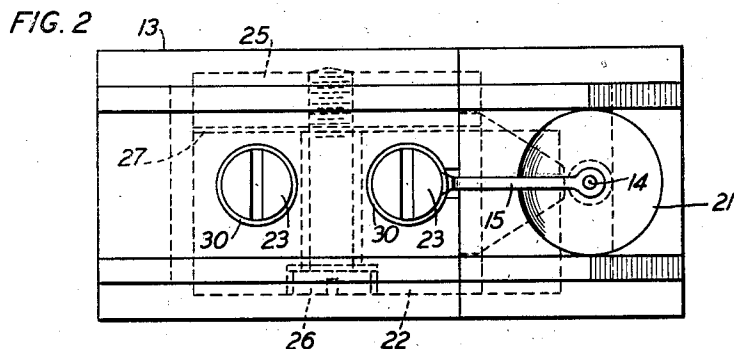
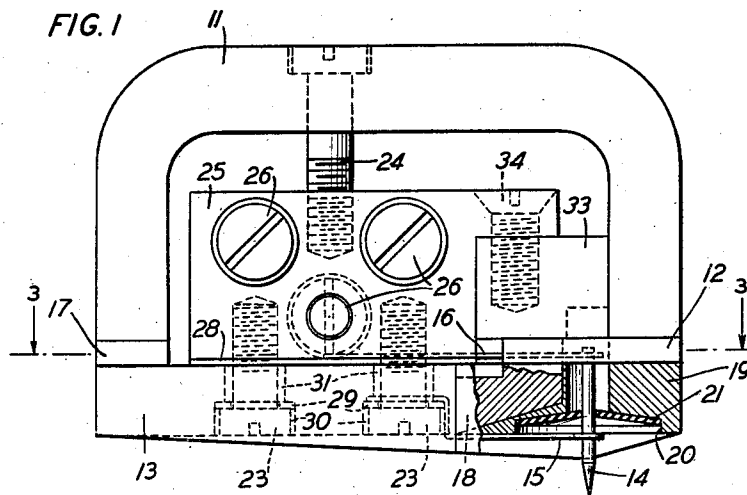
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PHONOGRAPH REPRODUCER

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PHONOGRAPH REPRODUCER

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9 Claims. (Cl. 179-100.41)

This invention relates to phonograph reproducers and the object of the invention is a high quality reproducer of the hill and dale type which is capable of faithfully reproducing an original recording without injury to the grooves.

It is often very desirable to playback an original recording immediately after cutting to determine whether it is satisfactory or whether another record must be made. Original recordings are usually made in soft materials such as wax, which can not withstand the high pressures required to vibrate reproducers of the types ordinarily used on commercial pressings. If the pressure required is greatly in excess of the strength of the recording material, the stylus cuts into the groove and the record is then useless for processing purposes. But even when the pressure is reduced to a point where it causes no serious permanent deformation of the groove, it is found with the structures of the prior art that a temporary deformation, due to the resiliency of the material, occurs during reproduction. This causes a distortion in the wave form reproduced which is particularly noticeable for the higher frequencies. In either case the use of such a playback fails to give a true indication of the quality of the recording. It has been proposed heretofore to build reproducers for playback purposes with very small mechanical impedance at the needlepoint so that they will be operable by forces which the groove contours can withstand. In general, however, it has been found very difficult to reduce the mass and stiffness of the known types of reproducer moving system sufficiently to avoid both of the above kinds of groove deformation and at the same time to obtain a practical mechanical structure which is satisfactory in other respects. For good results with the usual recording waxes it is found that the stylus pressure should not be in excess of 5 grams and, from the standpoint of temporary deformation, it is preferably much less.

In the present invention the impedance of the moving system is reduced to a new order of magnitude by simplifying the structure, omitting some of the usual component parts and making the parts used of very low mass and stiffness. More specifically the stylus is mounted directly upon two parallel supporting members fixed at one end to permit the stylus to vibrate vertically. One (or both) of these members is disposed in the gaps of a magnetic circuit and constitutes a dynamic generating element as well as a stylus support.

In the preferred embodiment, the supporting members are stamped out of thin sheet material, the upper one being V-shaped to provide sufficient space for a central pole piece. The lower member is used only as a stylus support and is

of somewhat lower lateral stiffness to facilitate the tracking of the stylus point in the groove. A reproducer of this type is capable of uniform response over the high quality music range and can be operated with a record pressure of 2 grams or less. A thin washer of rubber or other suitable material around the stylus protects the magnetic gap from dirt and adds a little stabilizing damping to the system.

These and other features of the invention will be more clearly understood from the following detailed specification and the drawing in which:

Fig. 1 is a side view of a reproducer according to this invention;

Fig. 2 is a bottom view of the reproducer; and

Fig. 3 is a section taken as indicated to show particularly the combination stylus support and generating element.

The reproducer consists essentially of a permanent magnet 11, pole pieces 12 and 13, a stylus 14, and stylus supporting members 15 and 16, the latter of which is also the generating element as will be more fully explained.

The pole piece 13 has an upwardly extending portion 17, the face of which is ground flat to make good contact with one of the poles of the magnet, and an L-shaped portion 18 at its other end terminating in a V-shaped pole face (Fig. 3) and forming the central pole piece between the arms of the stylus support 16. The non-magnetic member 19 has a recess 20 into which is fitted the rubber washer 21 for preventing dust and other foreign matter from collecting in the air gap. Dust is prevented from entering the gap from above by a block 33 of rubber or other suitable material held in place by a screw 34. The member 19 is soldered to the end portion 18 of the pole piece 13 and supports the pole piece 12 which is in contact with the other pole of the magnet 11 and has a V-shaped pole face opposite the pole face of member 18 as shown in Fig. 3.

This assembly is secured by set screws 23, 23 and the magnet by set screw 24 to the brass block 22. The brass block 25 is secured to block 22 by set screws 26 but insulated therefrom by a sheet of insulating material 27 and a similar sheet 28 insulates both blocks from the pole face 13. The screws 23 are suitably insulated from the pole piece 13 by flat washers 29 and tubular washers 30, 31 and screws 26 are similarly insulated from the block 25 as shown in Fig. 2.

The member 16 has broad end pieces 32 which are clamped between the insulating sheet 28 and the blocks 22 and 25, respectively. From Fig. 2 it is evident that these blocks project beyond the magnet on either side and they are therefore well adapted to serve as plug contacts for mechanically and electrically connecting the reproducer to the supporting arm, in addition to their function of a framework on which the rest of the repro-

ducer is assembled. The stylus 14 is preferably of sapphire or other suitable permanent stylus material and therefore insulates the member 16 from the member 15 and the pole piece 13. The member 15 is held in place by one of the screws 23 as shown and is preferably in the form of a single arm of relatively low lateral stiffness as compared with the member 16 so that the point of the stylus may more readily follow the groove.

The moving system comprising the members 15 and 16 and the stylus 14 should be proportioned in accordance with the general theory of reproducer design set forth in a copending application of A. C. Keller, Serial No. 402,123 filed October 24, 1929, in which it is shown that the fundamental requirement for good tracking is that the force exerted by the stylus on the record shall never be less than the product of the vibratory velocity of the stylus and the mechanical impedance of the moving system. In equation form this may be written:

$$F = SQ \geq VZ$$

where

S is the effective stiffness of the system in dynes per centimeter

Q is the initial displacement of the moving system in centimeters produced when the reproducer is placed on the record

V is the maximum vibratory velocity of the system in centimeters per second, and

Z is the impedance of the system in mechanical ohms, all of which are referred to the stylus point.

In addition to the tracking requirement, the impedance must be kept very low so that the reproducer will operate at very low record pressures. This is attained by making the stylus and its supporting members very light in weight and the stiffness of the members as low as possible from a tracking standpoint. It has been found, for example, that very good results are obtained with a structure having a total effective mass of 1.5 milligrams and an effective stiffness of $.35 \times 10^{-6}$ dynes per centimeter.

From the standpoint of efficiency it may be desirable to form the member 16 from round wire of bronze or other suitable material of about 4 mils diameter so that the length of the air gap can be a minimum. Such a structure, however, is difficult to assemble accurately and hence thin flat material of relatively greater width than depth such as 6 mils $\times$ 4 mils is sometimes preferable. With either the wire or flat material so proportioned that the moving system has constants of the order of those given above, the reproducer will track satisfactorily with a pressure of 2 grams or less and may be used to play back original soft waxes repeatedly without appreciably affecting the quality of the record.

The operation of the reproducer will be readily understood from the foregoing description of the structure. When suitably supported on a reproducer arm as by spring clips contacting the sides of blocks 22 and 25, and properly counterweighted the stylus will exert a pressure on the record of the order of 2 grams and members 15 and 16 will be deflected to provide the necessary restoring force to maintain contact with the groove. The undulations of a hill and dale groove will vibrate the stylus vertically and member 16 will cut the flux passing between the pole piece 12 and the end portion 18 of the pole piece 13. The member 16 is therefore effectively a coil comprising a partial turn and the electro-

motive forces generated in the two portions of the member are additive.

While the invention has been described with reference to a single embodiment it will be understood that various changes may be made within the scope of the following claims.

What is claimed is:

1. In a phonograph reproducer the combination with a frame and a magnetic circuit mounted on the frame and having an air gap, of a stylus and a supporting member therefor disposed in the gap connected directly to the stylus and the frame and constituting the generating element of the reproducer.

2. In a phonograph reproducer the combination with a frame and a magnetic circuit having a central pole piece and a gap on either side of the pole piece, of a stylus and spaced parallel members of low mass and stiffness fixed at one end to the frame and connected directly to the stylus, one of said members being located in the gap and constituting the generating element of the reproducer.

3. In a playback reproducer for reproducing original recordings the combination with a frame and a magnetic circuit mounted on the frame and having an air gap, of a moving system comprising a stylus and a combined stylus supporting and generating element disposed in the air gap and connecting the stylus to the frame, the effective needlepoint mass of the system being of the order of 1.5 milligrams and the effective needlepoint stiffness being of the order of $.35 \times 10^{-6}$ dynes per centimeter.

4. In a phonograph reproducer a combination stylus support and dynamic generating element comprising a V-shaped member adapted to be fixed at one end to the reproducer structure and to be vibrated by a stylus secured to the other end.

5. A low impedance moving system for phonograph reproducers comprising a stylus, a lower supporting member for the stylus and an upper supporting member comprising a partial turn dynamic generating element.

6. In a phonograph reproducer a non-magnetic framework comprising two portions insulated from each other, a magnet and pole pieces forming a V-shaped gap secured to the framework, a stylus and supporting means therefor comprising a generating element in the gap connected to the portions of the framework.

7. In a phonograph reproducer, a frame, a magnetic system having a gap mounted on the frame and a moving system comprising a stylus and upper and lower supporting elements therefor, the lower element being of relatively low lateral stiffness and the upper element being of relatively high lateral stiffness disposed in the gap and constituting the generating element of the reproducer.

8. A playback reproducer comprising a frame, a magnet extension having a gap mounted on the frame, and a moving system comprising a stylus, a lower supporting element and a partial turn coil supported by the frame disposed in the gap and connected directly to the stylus.

9. In a phonograph reproducer the combination with a magnetic circuit having an air gap, a stylus and a combined stylus support and generating element disposed in the gap, of resilient material surrounding the stylus for excluding dust from the gap and damping the vibrations of the stylus.