



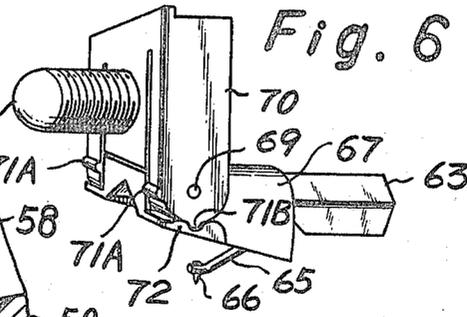
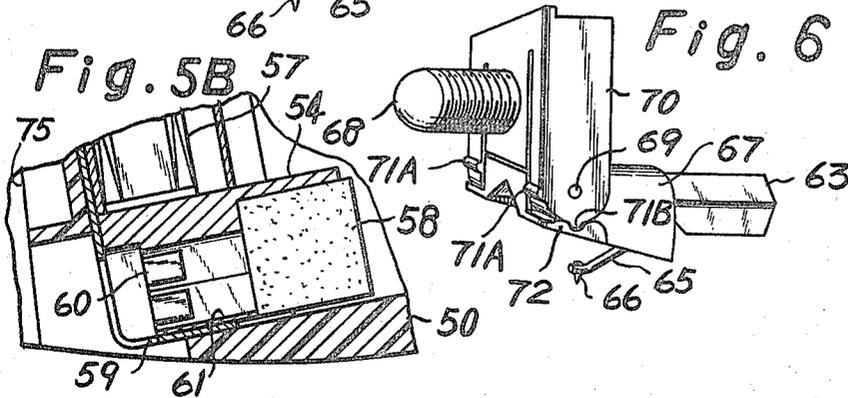
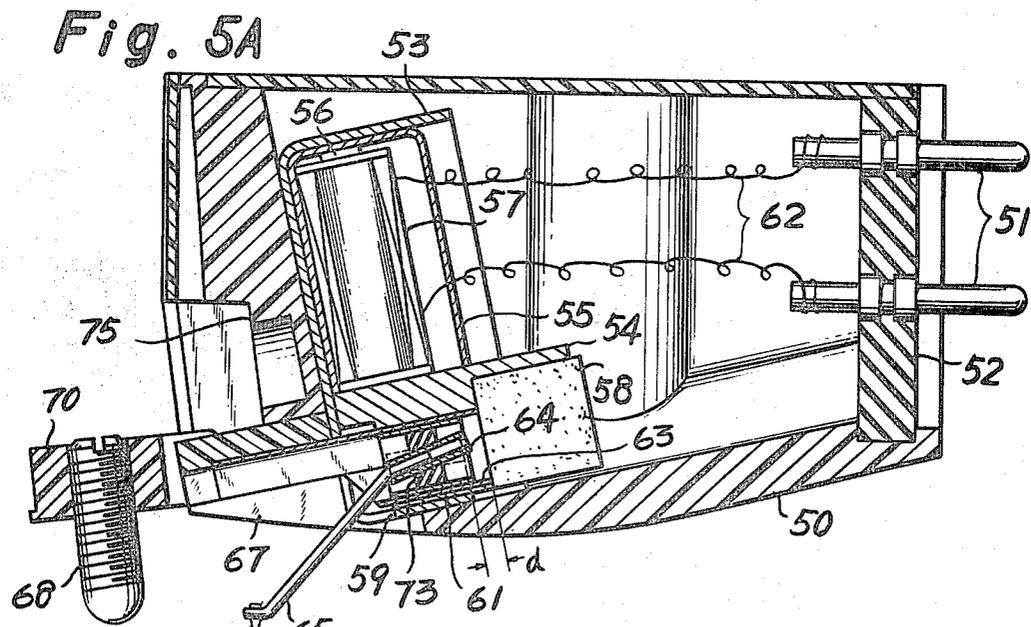
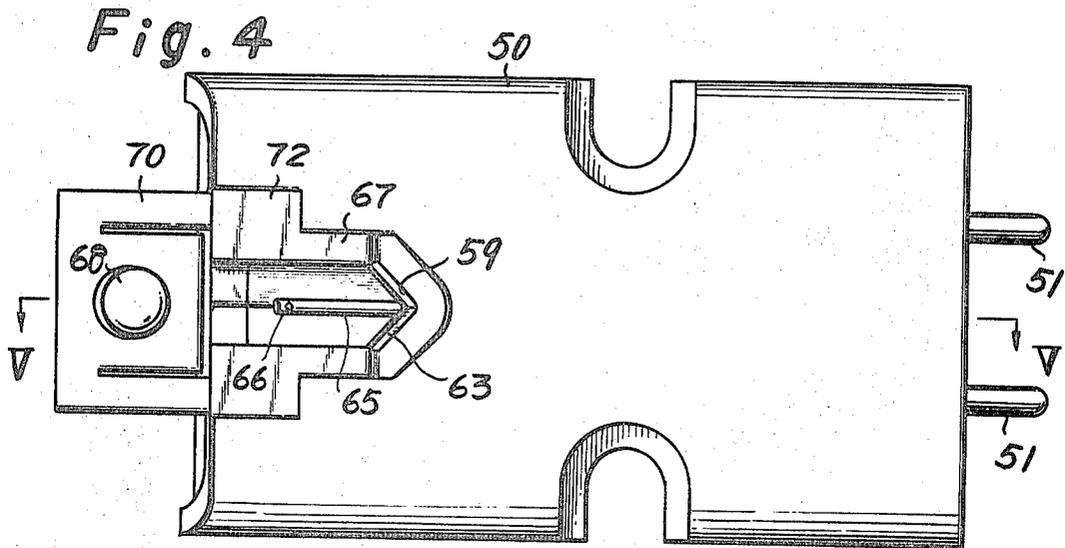
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MAGNETIC PICKUP WITH INDUCING MAGNET AXIALLY  
ALIGNED WITH THE ARMATURE

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## MAGNETIC PICKUP WITH INDUCING MAGNET AXIALLY ALIGNED WITH THE ARMATURE

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9 Claims

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serted into coils, the coils being adapted to generate output signal voltages as the armature which is magnetized by the magnet mechanically oscillates according to variation along the record groove.

This conventional pickup has the disadvantage that as the magnet is provided in parallel to the armature and the cantilever arm and being located forwardly apart from the armature, it has a worse magnetizing efficiency than the magnet for the armature. As a consequence, a relatively large magnet and armature are required and the oscillation mass cannot be sufficiently reduced.

In general, the stylus is subjected to traction produced by the friction between the stylus and the record groove and effective rearwardly of relative advancement of the stylus with respect to the record. Therefore, the cartridge has the shortcoming that the damper for holding the oscillation unit is rearwardly biased and, thus, is deformed resulting in an indefinite oscillation fulcrum point or pivotal point for the unit, which in turn will convert a simple oscillation into complicated one, resulting in a distortion in sound reproduced by virtue of mechanical oscillation caused by variation along the record groove.

### ABSTRACT OF THE DISCLOSURE

A phonograph pickup cartridge having a permanent magnet spaced a predetermined distance from an armature and disposed with the magnetic poles of the magnet being on the extended axis of the armature. The magnet magnetically energizes the armature so that coils of an electromagnetic circuit may generate therein an output signal voltage according to the oscillation of the armature. The magnet also operates to attract the armature so that the traction forces on the armature produced while tracking a record by the friction between a stylus and the record is effectively minimized or is cancelled.

### SUMMARY OF THE INVENTION

The present invention aims to provide a novel and advantageous pickup cartridge in which the above drawbacks have been eliminated.

A primary object of the present invention is to provide a phonograph pickup cartridge which is capable of magnetizing an armature very efficiently and is of a reduced oscillation mass in its stylus assembly and utilizes extremely small stylus pressure.

Another object of the present invention is to provide a phonograph pickup cartridge in which the traction imparted to the stylus during reproduction operation of a record disc is cancelled so that reproduction of sounds is carried out without any distortion.

A further object of the invention is to provide a small stylus pressure pickup cartridge which is provided with means for readily indicating as to whether or not the stylus pressure is a predetermined value when adjusting the stylus pressure so that the damper for holding the armature is not deformed or distorted and is in its neutral position.

A still further object of the present invention is to provide a pickup cartridge of the kind that has a reduced number of turns in the coils and a reduced magnetic inertia, and is able to take an increased compliance and to reproduce a better quality of sound free from any distortion and utilizes a readily replaceable stylus assembly.

Other objects and features of the present invention will be made apparent from the description which will be made hereunder with reference to the accompanying drawings in which:

### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of a major part of an embodiment of the pickup cartridge of the present invention with parts shown in longitudinal section;

FIG. 2 is a perspective view of the cartridge shown in FIG. 1;

FIG. 3 is a longitudinal side view of another embodiment of the cartridge;

### BACKGROUND OF THE INVENTION

#### Field of the invention

This invention relates to a pickup cartridge, and more particularly to an electromagnetic phonograph pickup cartridge for use with stereophonic record discs.

### DESCRIPTION OF THE PRIOR ART

A conventional stereophonic pickup cartridge of moving magnet type is arranged so that a cantilever arm having at one end a stylus is provided at the other end with a magnet, the magnet being supported by a rubber damper within a space defined by two pairs of pole pieces. The conventional device of this kind utilizes the principle that oscillation of the stylus produced by variation along the record groove is transmitted mechanically to the magnet for oscillating it to produce changes in the magnet fluxes within the pole pieces, so that an output signal voltage is generated in the coils. This conventional moving magnet type cartridge has the drawback that the cartridge inherently has a larger oscillating mass than the stylus and has poor practical efficiency. An attempt has been made to eliminate this drawback by replacing the damper with a damper of softer rubber so as to make the compliance greater. The use of the softer damper has resulted in unstable central support of the magnet. A use of a magnet of larger capacity will result in reproduction of wave distortion in operation due to magnetic inertia as well as in generation of unbalanced output voltages in the right and the left channel coils.

There is an induced magnet type pickup cartridge having a magnet which is disposed substantially in parallel and laterally aligned relationship to an armature somewhat spaced from the pole faces of the pole pieces in-

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FIG. 4 is a bottom view of still another embodiment of the cartridge according to the present invention;

FIG. 5A is a longitudinal side view taken along the line of V—V of FIG. 4 and FIG. 5B is a longitudinal side view of a major part of a cartridge housing shown in FIG. 5A;

FIG. 6 is a perspective view of the stylus assembly utilized in the cartridge of the embodiment shown in FIGS. 4 and 5; and

FIGS. 7, 8 and 9 are side views of the cartridge of the embodiment shown in FIGS. 4 and 5 with a part being broken away in the respective figures, illustrating positions of the cartridge in stylus pressure adjusting operation.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

The embodiment shown in FIGS. 1 and 2 is a stereophonic pickup cartridge of induced magnet type. As will be seen in these figures, there are four pole pieces 10, 11, 12, and 13 disposed such that they are angularly spaced from one another by 90 degrees, each of the pole pieces having its opposite ends turned at right angles from the major portion thereof. The pole pieces 10 to 13 are provided with coils 14, 15, 16 and 17 wound around the pole pieces, respectively. The coils 14 and 16 around the pole pieces 10 and 12, respectively, are connected together in series so that the induced voltages in the coils are added together. The coils 15 and 17 around the facing pole pieces 11 and 13 are also series-connected for the same reason. As an example, the coils 14 and 16 have lead wires 18 and 19 extending outwardly therefrom, respectively, and both coils 14 and 16 are connected by a lead wire 20, as shown in FIG. 1. A tubular holder 21 of square configuration in section is secured to the turned end faces of the respective pole pieces 10 to 13. The holder 21 has a permanent magnet 22 mounted thereon adjacent the rear end of the holder so that the magnetic poles are on an extension of the axis of the holder. There is provided a cantilever arm 23 having a stylus 24 mounted thereon at the forward end thereof and an armature 25 of ferromagnetic material such as pure iron or permalloy. Within the holder 21 is positioned a recess damper 26 of rubber in contact with the outer or forward end of the magnet 22. The rear or inner end of the armature 25 is received in the recess of the damper 26, so that the rear end face of the armature is spaced from the magnet 22 by the damper 26. The magnet 22 is provided rearwardly of the armature 25, appreciably spaced therefrom, and is on the line of the axis thereof. This arrangement can magnetize the armature 25 very efficiently. Thus the armature 25 can be small enough and the oscillation mass of stylus may be tolerably small. The reproduction characteristic in the high frequency range is especially excellent.

When the stylus 24 traces a stereophonic record groove carrying stereophonic information on the opposing side walls of the groove, the armature 25 which is being magnetically energized by the magnet 22 is oscillated in accordance with the modulation in the groove. Assuming that the armature 25 is moved toward the pole piece 10, there is produced an increase in the magnetic flux passing through the pole piece 10 and a decrease in the magnetic flux passing through the pole piece 12 which is positioned diametrically opposite to the pole piece 10. At this time, the magnetic flux passing through the pole pieces 11 and 13 are reduced to some extent, but this reduction in magnetic flux is taken up by the coils 15 and 17 and, thus, no output voltage is generated. Therefore, an output signal voltage is obtained from the coils 14 and 16. In the case where the armature 25 is moved in the opposite direction, the coil circuit operates in the reversed manner. Thus, the device is operable to faithfully reproduce the information recorded on the stereophonic

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groove in whatever direction, i.e., in vertical or horizontal or in what ever direction the oscillation may be.

When the stylus is in contact with a groove in a rotating record to reproduce information carried by the groove, the stylus is subjected to traction forces (arrow A) which are effective rearwardly of the relative advancement of the stylus with respect to the record due to the friction between the stylus and the groove to thereby pull the cantilever arm 23 and the armature 25 resulting in distortion thereof. With the cartridge according to the present invention, however, the rear end of the armature 25 is pulled or attracted by the magnet 22 in the direction opposite to that of said traction forces and, thus, the traction forces on the stylus, cantilever arm and the armature are mainly offset or cancelled by the attraction of the magnet 22. Therefore, the cantilever arm 23 and the armature 25 may be oscillated without being subjected to any distortion and may have their definite fulcrum or pivotal point for the oscillation, affording highly faithful and superior reproduction.

FIG. 3 illustrates a cartridge of another embodiment of the present invention. The cartridge includes a housing 30 having fixed to the rear end thereof a terminal plate 32 on which are mounted four pins 31. The cartridge also includes a cantilever arm 33 having a stylus 34 on the forward end and an armature 35 of ferromagnetic material on the other end. The armature is supported by a damper 36 of rubber at substantially the intermediate portion of the armature. A permanent magnet 37 is mounted within the housing 30 so that the magnetic poles of the magnet 37 is on an extension of the axis of the armature 35 and so that the magnet is somewhat spaced apart from the rear end face of the armature. There are provided two pairs of pole pieces 38, parallel to but spaced from the armature 35. Yokes 39 and 40 and coils 41 and 42 extending therearound, respectively, are provided in such a manner that the axes of the yokes and the coils are perpendicular to the axis of the armature 35. On picking up modulation along the record groove, the stylus 34 and the cantilever arm 33 are mechanically oscillated. This oscillation is transmitted to the armature 35. In response to the oscillation of the armature 35, variations are produced in the magnetic fluxes passing through the yokes 39 and 40. Output signal voltages are generated in the coils 41 and 42 and are led out of the coils.

The arrangement of the pickup cartridge of the instant embodiment provides functional advantages similar to those obtainable from the construction of the preceding embodiment. In other words the magnet 37 is provided rearwardly of armature 35 appreciably spaced from the armature on the extended axis thereof so that it can very efficiently magnetize the armature 35 and, even if the armature 35 together with the stylus 34 and the cantilever arm 33 is subjected to traction forces effective rearwardly of the relative advancement of the stylus with respect to the record, such traction forces are effectively cancelled by the attraction of the magnet 37 on the armature 35. The cantilever arm 33 and the armature 35, therefore, are in no way distorted permitting in reproduction of high fidelity and excellence in sound quality.

The pickup of the instant embodiment has a further advantage that the material and the configuration of the magnet used may be selected freely to some extent, as compared with a pickup of the conventional type wherein the magnet is adapted to be directly oscillated, so that it is possible to generate an appropriate output voltage as well as to reduce the number of turns of the coils. Furthermore, the attraction force of the magnet 37 is effective to stabilize the intermediate support of the armature 35, which makes it possible to form the damper 36 from a soft rubber to thereby increase compliance greater. This also serves to prolong the effective lives of the record groove and the stylus.

FIGS. 4 to 6 illustrate still another embodiment of the cartridge according to the present invention. The cartridge includes a housing 50 moulded from a plastic material. The housing has secured on the rear end thereof a terminal plate 52 provided with four pins 51. Within the housing 50 is contained an electromagnetic circuit means which is received in an outer shield 53 in the housing and comprises pole yokes 56 and coils 57 bounded by and disposed above a coil block 54 and housed in an inner shield 55. A permanent magnet 58 is fixedly mounted at a rearward position of a space defined between a lower portion of the outer shield 53 and the coil block 54. The outer shield 53 is provided with an opening 59 for a stylus assembly which will be described hereinafter. Four pole pieces 60 are fixed in a hole 61 into which the stylus assembly is inserted. Each of the coils 57 has lead wire 62 respectively extending therefrom and secured by soldering to the pins 51 at the inner ends thereof.

The stylus assembly consists of a stylus guard 63 so shaped and dimensioned as to be fitted into the hole 61, an armature 64 supported by a damper 73 disposed within the guard 63, a stylus 66 provided on the forward end of a cantilever arm 65 whose rear end is secured to the armature 64 and, a guard holder 67 for holding the guard 63 and a projection 68 for use with a stylus pressure adjustment gauge. The armature 64 is supported at substantially its intermediate portion by the damper 73 and is in tilted relationship with respect to the guard 63 as shown in FIG. 5A when the stylus pressure against the record is zero (0). In this position of the armature 64, the damper 73 is deformed and distorted. The projection 68 is adjustably provided in a bridge 70 which is pivotally mounted on the holder 67 by means of an axle 69. The bridge 70 is provided at the rotary end thereof with a pair of small projections 71A and 71B which are adapted to engage a stop 72 on the holder 67 for click-stopping the bridge 70 in essentially horizontal or vertical position.

The armature 64 is so positioned that the rear end face thereof is offset inwardly from the rear end of the guard 63 by a distance  $d$ , so that, when the stylus assembly is fitted and loaded into the cartridge housing the guard 63 is inserted into the hole 61 until the rear end of the guard engages the magnet 58 and is stopped by the latter which will assure that the stylus assembly is mounted in the housing with the armature rear end being spaced from the magnet 58 by the predetermined distance  $d$ . The magnet 58 is essentially on the extended axis of the armature when tracking so that it can very efficiently magnetize the armature 64. The pickup can perform its function with the small construction of the armature 64 allowing the armature to be minimized in size thereby keeping the oscillation mass of stylus small while the frequency reproduction is much better. As the magnet 58 is fixed on the cartridge, the stylus assembly only, as shown in FIG. 6, can be replaced when the stylus is to be replaced which makes replacement very economical. The armature 64 together with the stylus 66 and the cantilever arm 65 are subjected to traction forces effective rearwardly of the advancement of the stylus relative to the record, the cantilever arm 65 and the armature 64 are not distorted since the armature 64 is under the attraction of the magnet 58. This is effective to provide a sound reproduction which is highly faithful to the original sound and is of excellent fidelity.

The use of the projection 68 for the stylus pressure adjusting gauge is seen in conjunction with FIGS. 7 to 9. While the initial position that the stylus assembly is mounted in the cartridge housing, the bridge 70 is brought into horizontal position to make the projection 68 vertical as shown in FIG. 7. In this position, the stylus pressure against the record 74 is zero (0) and the damper is, not being in its neutral position, deformed. The stylus pressure is progressively increased until the forward end of the projection 68 reaches the surface of the record

74 as shown in FIG. 8. The projection 68 is preliminarily adjusted in length so that the stylus pressure is of optimum value when the pickup cartridge is in its position shown in FIG. 8. In this position, the axis of the armature 64 is parallel with the guard 63 and is coincident with the axis of the magnetic pole of the magnet 58. The damper 73 is, thus, not deformed and is in its neutral position, assuring that the armature 64 is precisely oscillated according to mechanical oscillation of the stylus 66. After completing the operation for increasing the stylus pressure, the bridge 70 is turned upwardly about the axle 69 into a recess 75 in the housing 50. Reproduction operation of the record 74 is then carried out in this state.

While the present invention has been described with reference to a few particular embodiments, it is to be understood that these embodiments are only for illustrative purpose and the present invention may have various modifications and changes without departing from the spirit and the scope of the invention as defined by the appended claims.

What is claimed is:

1. A phonograph pickup cartridge comprising an electromagnetic circuit including coils and pole pieces operatively disposed in a cartridge housing; a replaceable stylus assembly including a cantilever arm, a stylus at the forward end of said arm, an armature mounted on the rear end of said arm, a tubular guard member surrounding said armature, and a damper positioned between said armature and guard member to movably mount said armature, arm and stylus therein; and a permanent magnet mounted in said housing substantially on the extended longitudinal axis of said armature when the stylus is in operable condition, said magnet being spaced from said rear end of the armature by a predetermined amount so as to effectively magnetically energize said armature.

2. A phonograph pickup cartridge as claimed in claim 1 wherein said rear end of the armature is spaced a predetermined amount from the rear end of said guard member and when said replaceable stylus assembly is in position in the housing said rear end of the guard member abuts the front of said magnet thereby spacing said rear end of the armature by the predetermined amount therefrom.

3. A phonograph pickup cartridge as claimed in claim 1 wherein said coils have axes substantially perpendicular to said armature axis, and lines extending the coil axes respectively pass through said pole pieces.

4. A phonograph pickup cartridge as claimed in claim 1 wherein said damper also surrounds said rear end of the armature and is positioned between said rear end and said magnet, the dimension of damper rearward the armature determining the spacing.

5. A phonograph pickup cartridge as claimed in claim 1 wherein the magnetic axis of said permanent magnet is substantially on the extended longitudinal axis of said armature.

6. A phonograph pickup cartridge as claimed in claim 1 in which said electromagnetic circuit means comprises two pairs of pole pieces disposed in opposite relation and having at their end turned portions connected to said said guard member; and a coil wound around each said pole piece; said permanent magnet being fixed within the space enclosed and defined by said pole pieces, and said armature also being disposed within said space with a clearance between said armature and each of the end faces of said turned portions of the pole pieces.

7. A phonograph pickup cartridge as claimed in claim 1 in which the axes of said coils are substantially perpendicular to the axis of said armature; and said permanent magnet and said armature are external the space between said coils.

8. A phonograph pickup cartridge as claimed in claim 1 wherein said stylus assembly further includes a stylus pressure projection mounted on said guard member and

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rotatable to a first position essentially perpendicular to the record to be played and a second position essentially parallel to the record, the projection being of an adjustable predetermined length, the lower end of which projection is adapted to contact the record when it is in said first position when a desired pressure is exerted on said stylus.

9. A phonograph pickup cartridge as claimed in claim 8 wherein said damper is deformed by said armature when there is no stylus pressure, and when the desired pressure is exerted on the stylus so that the lower end of the projection contacts the record, said damper is in an undeformed state and said extended longitudinal axis of the armature is essentially coincident with the magnetic axis of said magnet.

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