May 14, 1968 W. KRIEBEL ET AL 3,383,474

ELECTROMAGNETIC PICKUP WITH EXCHANGEABLE STYLUS ASSEMBLY FOR PHONOGRAPH RECORDS

Filed Dec. 21, 1964 3 Sheets-Sheet 1

PRIOR ART

FIG. 1

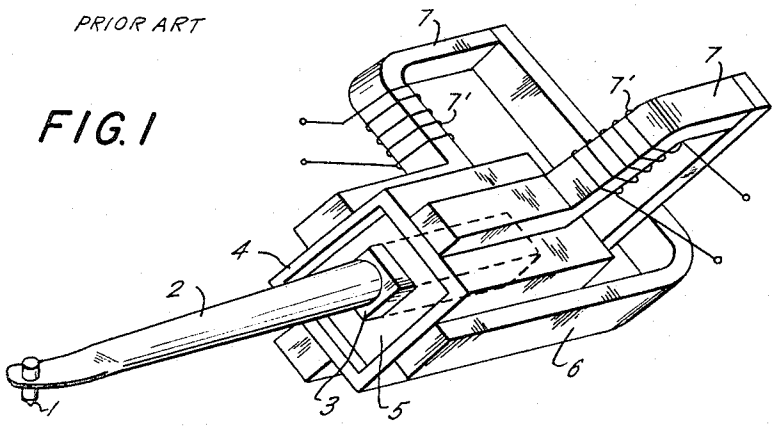


FIG. 7

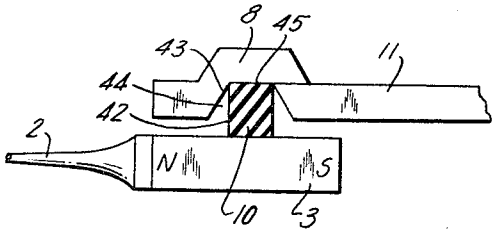
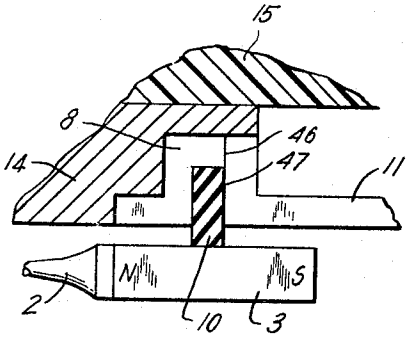


FIG. 8



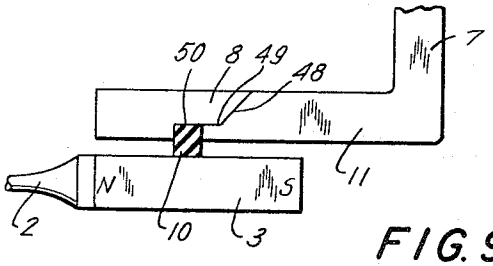


FIG. 9

FIG. 2

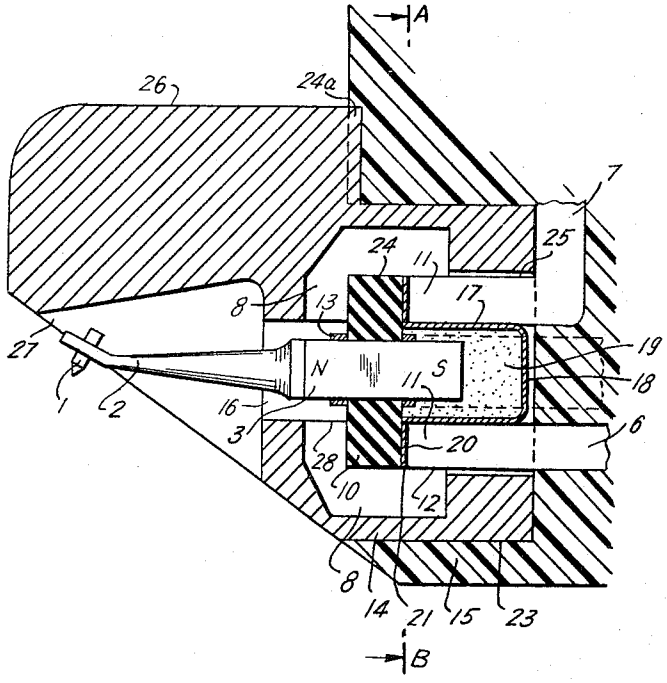

A
26
24a
7
24
11
25
17
8
13
19
27
N
S
18
1
2
16
3
20
6
28
10
12
8
14
21
15
23
B

FIG. 3

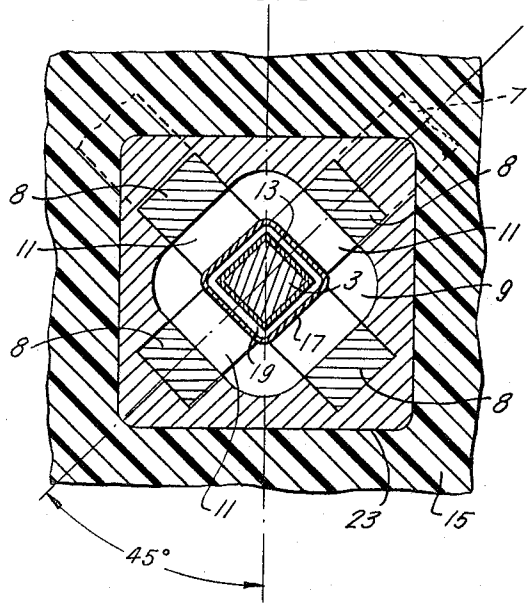

7
8
8
13
11
11
3
9
17
8
19
8
11
23
15
45°

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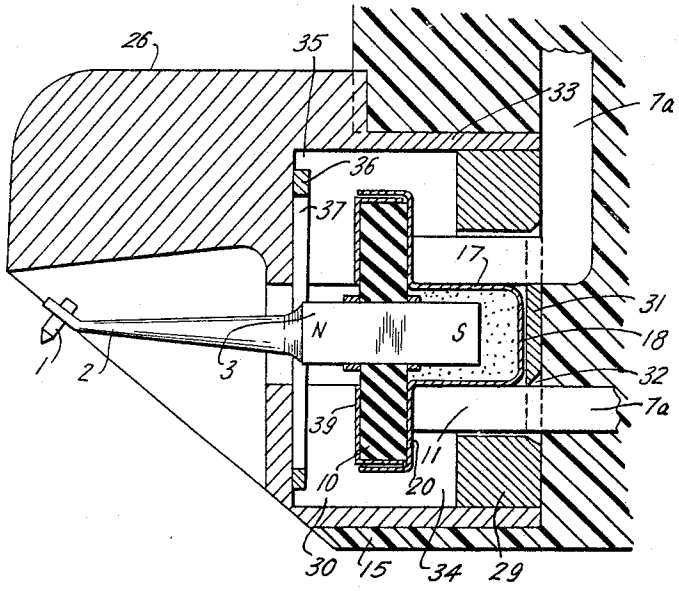
FIG. 4



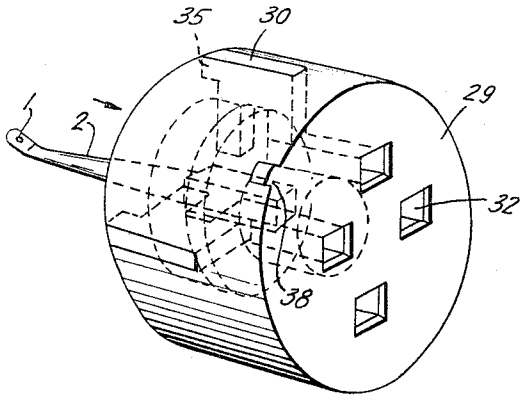


FIG. 5

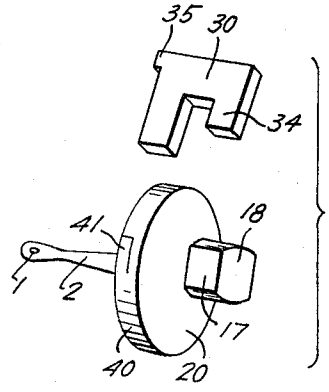


FIG. 6

United States Patent Office 3,383,474 Patented May 14, 1968

3,383,474

ELECTROMAGNETIC PICKUP WITH EXCHANGEABLE STYLUS ASSEMBLY FOR PHONOGRAPH RECORDS

Walter Kriebel, Kiel, and Gustav Maas, Eutin, Germany, assignors to Electroacustic Gesellschaft mit beschrankter Haftung, Kiel, Germany, a corporation of Germany

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Claims priority, application Germany, Dec. 23, 1963, E 26,098
22 Claims. (Cl. 179—100.41)

ABSTRACT OF THE DISCLOSURE

The magnetic circuit of an electromagnetic pickup for phonograph records has at least one pair of pole shoes spaced from each other to form a pole gap. An armature is positioned in the gap extending in length substantially parallel to and spaced from the pole shoes and has a length which is less than that of any of the pole shoes. Each of the pole shoes is subdivided into a fixed portion and a removable end portion at the gap and the removable end portion of each engages the corresponding fixed portion and protrudes therefrom. An exchangeable assembly comprises an armature and a stylus carrier secured to the armature and extending colinearly therewith. Each of the removable pole shoe portions is part of the exchangeable assembly and forms, when engaging one of the respective fixed portions and conjointly therewith, an intermediate space between the removable end portion and the corresponding fixed portion laterally of and extending to and opening on the armature. Two opposite ones of the spaces have conjointly with the pole gap a larger width than the pole gap only. An elastic bearing member surrounds the armature and is mounted in the spaces.

Our invention relates to electromagnetic pickups for reproduction of monophonic or stereophonic phontograph records. More particularly, the invention concerns itself with pickups whose stylus carrier is fastened to a magnetizable or permanent-magnetic armature which is vibratorily mounted between pole shoes of a magnet system equipped with coil means for generating or varying electric voltages in accordance with the undulations of the record grooves engaged by the stylus. Pickups of this kind are known, for example, from U.S. Patents 3,077,521 and 3,077,522.

For optimal reproduction quality, the tracking force and the equivalent mass at the stylus tip should be minimal and the compliance should be as high as feasible. This requires minimizing the counteracting inertia moments and return forces of the pickup system, and thus leads to extremely small geometric dimensions, for example, elastic bearings having a thickness of but a few tenths of one millimeter. The resulting difficulties in construction and assembly work are aggravated by the requirement that the stylus member be easily exchangeable without jeopardizing the high quality of reproduction achieved by the extremely small dimensions and very low weight. If exchanging the stylus member is too difficult, it is usually neglected, thus defeating all other expedients toward high-quality reproduction because the worn stylus tip is no longer capable of following fine details of the recordings and causes permanent damage to the record grooves.

It is therefore an object of our invention to facilitate the manufacture and especially the assembly of those parts in an electromagnetic photograph pickup that are responsible for high-quality reproduction, and to satisfy the mutually contradictory requirements toward further improvement of reproduction quality, on the one hand, and

greater ease of exchangeability of the stylus assembly by laymen, on the other hand.

To this end, and in accordance with a feature of our invention, each pole shoe of the electromagnetic system is subidivided into a fixed portion and a removable end portion, both forming jointly a member of at least one pair of poles with an intermediate pole gap in which the armature is vibratorily mounted; and the removable pole-shoe portions, as well as the armature and its bearing member, constitute part of the exchangeable assembly, thus being removable from and attachable to, the fixed portion of the electromagnetic system together with the stylus system. When the exchangeable assembly is attached, the removable pole-shoe portions are seated on the respective fixed pole-shoe portions and form around the armature a cavity whose width is larger than that of the field gap. The elastic bearing member, such as a rubber grommet, is seated in this cavity and is firmly joined with the armature.

As a result, assembling and exchanging the stylus system is considerably facilitated and various further improvements in reproduction quality are afforded. Especially the critical dimensions of the armature bearing may be given an easily manipulatable order of magnitude of a few millimeters, in contrast to the conventional, difficile dimensions of a few tenths of one millimeter. Nevertheless, the oscillating parts of the pickup system may retain the necessary small dimensions. Indeed, by virtue of the invention, the dimensions of these other components may be further reduced for further improved reproduction quality. Furthermore, the air gap between pole shoe and armature is no longer determined by the slightest geometric dimensions of the elastic bearing member required for sufficient elasticity, but may now be chosen independently of the desired elasticity and only in accordance with the required or optimal armature travel, even in cases where the particular design of the pickup requires mounting the elastic bearing member within the air gap. This, in turn, affords obtaining a higher signal voltage and thereby a more favorable signal-to-noise ratio, or it permits further reducing the size of the armature, both also contributing to better reproduction qualities.

According to another, preferred feature of our invention, the exchangeable portions of the pole shoes are rigidly joined mechanically but magnetically isolated from each other so as to form a mechanical unit which contains a cavity, merging with the above-mentioned pole-shoe cavities to form a single large hollow space. The elastic bearing member is additionally or exclusively mounted and supported in this common hollow space within the exchangeable unit.

By virtue of the invention, the elastic bearing member may be given a more readily manipulatable and exchangeable shape as compared with the minute grommets heretofore used as best suitable. The movable pole-shoe portions and the elastic bearing member can be more readily and more accurately mounted, and they reliably retain during exchange the accurate positions required for optimal cooperation with the fixed pole-shoe portions and the armature. This also secures and reliably preserves an accurately defined working position of the armature relative to the pole shoes.

According to still another feature of the invention, the elastic bearing member is predominantly braced against the wall portions of the cavity space which are most remote from the armature. This permits giving the bearing a low elastic return force yet a handy shape which facilitates assembling.

The above-mentioned and further objects, advantages and features of our invention, said features being set forth with particularity in the claims annexed hereto, will be

apparent from, and will be described in, the following with reference to embodiments of pickups according to the invention illustrated by way of example in the accompanying drawings, wherein:

FIG. 1 shows schematically and in perspective a known pickup for the purpose of explanation with reference to the embodiments of the invention shown in the other illustrations.

FIG. 2 is a longitudinal section through part of a pickup according to the invention.

FIG. 3 is a cross section along the line A–B of FIG. 2, but rotated 45° to make the pickup suitable for stereophonic recordings.

FIG. 4 shows in section another embodiment according to the invention.

FIG. 5 is a perspective view of a mounting unit which forms part of the pickup shown in FIG. 4.

FIG. 6 shows perspectively and in exploded fashion a detail of FIGS. 4 and 5.

FIGS. 7, 8 and 9 show three additional embodiments differing with respect to the spearation between the pole-shoe portions and the formation of an intermediate space seating the elastic bearing member.

While the embodiments of the invention described hereinafter will be explained with reference to the known and commercially available pickup system whose essential parts are shown in FIG. 1, it should be understood that the invention is not limited thereto.

The pickup according to FIG. 1 has a stylus tip **1** of sapphire or diamond mounted on a carrier **2** of non-magnetic metal such as aluminum, which is rigidly fastened to a prismatic and longitudinally magnetized armature **3** of permanent-magnet material. The parts **1**, **2** and **3** thus form a stylus system which is vibratorily mounted within a non-magnetic sleeve **4**. The interspace between armature and sleeve is largely filled with elastic material **5**, such as a sleeve or grommet of synthetic rubber, by virtue of which the armature **3** can pivot toward all sides relative to the sleeve **4**. The sleeve **4** is exchangeably positioned between pole shoes **6**. Illustrated are four such pole shoes of which each two opposite ones form a pair appertaining to a magnetic circuit and 90° displaced from the other pair. The magnetic circuits **7** carry respective windings **7'** in which voltages are induced when the armature **3** performs pivotal oscillations, being deflected by the stylus tip **1** travelling in a record groove. The axis of the tip **1** must be directed at an angle of 45° relative to the gap direction of each pole-shoe pair for reproducing stereophonic recordings.

The operation of the pickup involves the known dynamoelectric principle. When the stylus tip **1** is deflected by the undulations of a record groove, the resulting pivotal movements of the armature **3** in the sleeve **4** vary the magnetic flux acting upon the two coils **7'**. The corresponding voltages thus induced in the coils correspond to the two component recordings along the lateral walls of the groove and, upon amplification, are supplied to separate amplifiers and loudspeakers in the conventional manner.

This general principle of an electromagnetic pick-up may also be embodied in numerous other designs to which the present invention is applicable. It appears preferable, however, to first explain the invention with reference to the particular type of pickup exemplified by FIG. 1.

For conveying a realization of the slight dimensions required of the elastic bearing member **5**, it should be considered that FIG. 1 is shown on a greatly enlarged scale. The difficulties of mounting the elastic bearing member will be apparent if one takes into account that the bearing has a thickness of only $\frac{4}{10}$ mm. At the same time, this bearing member must be soft but, when being assembled with the relatively long sleeve **4**, must not suffer the slightest deformation or be subjected to tension and assume a precisely defined position. Meeting these requirements ao a greater or lesser extent requires extreme skill and a considerable amount of time. It is thus one of the more specific objects of the present invention to minimize these shortcomings, aside from affording additional advantages mentioned hereinafter.

Referring now to FIGS. 2 and 3, it will be noted that according to the invention a portion **8** of the pole shoes, denoted by **6** in FIG. 1, is designed as a separate piece and is seated upon the remaining, fixed pole-shoe portion **11** so as to protrude beyond the fixed portion. This results in forming intermediate spaces **9** (FIG. 3) in which the annular bearing member **10** of synthetic rubber or the like elastomeric material is located. Denoted by **12** in FIG. 2 is one of the separating faces upon which the adjacent removable pole-shoe portion **8** is closely but slidably seated. The remainder of the magnetic circuits **7** may correspond to those shown in FIG. 1. It will be noted that the cavity formed by the spaces **9** has a considerably larger width or diameter than corresponds to the width of the effective pole gap between the pole shoes. Accordingly, the width of the elastic bearing member **10** located in the cavity is also much larger than the width of the pole gap.

The elastic bearing member **10** is seated upon the armature **3** to adhere thereto by friction and is fixed in position by rings **13** which are either elastic or cemented to the armature **3**. Consequently the bearing member **10** need be subjected to only little stress for sufficient frictional seating. If desired, the bearing member **10** may also be cemented or vulcanized upon the armature **3**. The periphery of the elastic bearing member **10** abuts against the walls of the cavity **9** to permit pivoting motion of the armature **3** toward all sides under the slight return force of the elastic bearing which nevertheless is sufficiently large and accessible for convenient handling during assembling work.

The pickup may be made and assembled as follows. The four pole-shoe portions **8** are first joined with each other by a supporting structure **14** of synthetic plastic, aluminum or other non-magnetic material to jointly form a single rigid unit. In this manner, the pole-shoe portions **8** are fixed in their positions relative to each other. It is preferable to thus rigidly fasten the removable pole-shoe portions by injection molding or embedding them into a body of casting or potting resin shaped as a plug-type structure. The synthetic plastic may be transparent so that the interior remains visible to facilitate the subsequent mounting of the bearing member **10**.

The elastic bearing member **10** is preferably seated upon the armature **3** outside of the structure **14** just described. The locality of the bearing member **10** is approximately at the gravity center of the vibratory system composed of parts **1** to **3**, in which position the bearing member **10** is then fixed to the armature, for example by means of the above-mentioned rings **13**. Thereafter, the entire system of parts **1** to **3** with the bearing member **10** seated thereupon, is inserted from the right (FIG. 2) into the hollow cavity **9** (FIG. 3). At this time, the structure **14** with the removable pole-shoe portions **8** is still separate from the housing **15** of the pickup in which the main portion of the magnetic circuits **7** with the fixed pole-shoe portions **11** is mounted.

The cavity **9** forms a generally quadrangular cup space with rounded edges whose cross section is apparent from FIG. 3. Of course, the cross section of this cup space may be given a circular or any other desired shape. As the stylus system **1** to **3** together with the bearing member **10** is being inserted, it is moved to the position shown in FIG. 2. This assembling procedure is readily observable because the cavity **9** remains visible from the right and the stage at which the bearing member **10** just reaches the cup bottom of the cavity and hence the position shown in FIG. 2, can be observed through the opening **16** through which the stylus carrier **2** emerges. If the structure **14** consists of transparent plastic, the assembling work can be additionally checked by inspection through the transparent wall.

It will be apparent that the large dimensions of the bearing member **10** permit reliable handling and inserting it in such a manner that it will not become compressed or otherwise deformed. This virtually eliminates the danger of impairing the extremely small reproduction quality by electricity-distorting deformations of the bearing member as are apt to occur, on account of its extremely small dimensions, in a pickup according to FIG. 1. As a result, the production of a large number of pickups having uniformly optimal qualities is greatly facilitated.

After the elastic bearing member **10** is inserted into the cavity **9**, further fixing of the bearing member is not necessary, as a rule, because the member is kept in position by the above-mentioned frictional connection with the armature. This is aided by the fact that the weights of the individual parts are very small so that minute pressures of the bearing member against the walls of the hollow space **9** will suffice to secure a sufficient frictional seating. During operation of the pickup, the front faces of the fixed pole-shoe portions **11** confine the elastic bearing member **10** and thus also contribute to securing it in the correct position. As mentioned, however, the bearing member may be additionally fastened to the armature by cementing, elastic rings or the like.

As further shown in FIG. 2, a cup-shaped sleeve **17** of non-magnetic material has its open side abut against the elastic bearing member **10**, the other side **18** of the sleeve being closed. The cup-shaped sleeve receives a portion of the armature **3** and is filled with a damping medium **19**, such as silicone grease, which surrounds the enclosed portion of the armature. The sleeve **17** is further shown to have its opening surrounded by an outwardly directed flange **20** at which the sleeve is firmly connected with the pole-shoe portions **8**, thus forming part of the exchangeable assembly unit.

This affords several further advantages. In the first place, the elastic bearing member **10** is positionally fixed by the flange **20**. The flange **20** engages for example a groove **21** of the removable pole-shoe portions **8** and/or of the unit **14** and, on the other hand, is in lateral engagement with the elastic bearing member **10**. As a result, the elastic bearing member **10** is confined on both sides and consequently need have no more than touching or guiding engagement at its outer periphery with the, for example, cylindrical circumference of the hollow space **9**, without being required to exert pressure upon the armature to effect frictional seating. Another advantage is the fact that the right-hand end of the armature **3** is protected. The armature can neither be touched nor damaged during assembling, shipping or exchanging of the assembly unit. These advantages are obtained even if the cup-shaped sleeve **17** is not filled with a damping medium **19**. The provision of this medium, however, improves the reproduction quality by securing a periodic oscillation of the system **1** to **3**. A similar damping effect may be achieved, at least partially, by the elastic bearing member itself. However, providing for separate damping with the aid of a medium as shown at **19** makes it unnecessary to select the dimensions or the material of the elastic bearing member with a view to obtaining any damping effect.

The assembly unit on structure **14** is joined with the pickup housing **15** by plugging the unit into an outwardly open recess **23** of the housing. This recess may be given various shapes, for example a predominantly square cross section as shown in FIG. 3, although a circular cross section is likewise applicable, for example. It is preferable to provide the unit **14** with guiding parts, such as a guiding nose **24***a* or the like, which are spaced farther away from the armature **3** than the pole-shoe portions **8** and which determine the position of the exchangeable assembly unit relative to the housing **15** of the pickup. By such means, the exchangeable unit is constrainedly guided to its correct position and, when fully inserted, is fixed in this position relative to the housing of the pickup.

When the exchangeable unit is being plugged into the pickup housing, the removable pole-shoe portions **8** fit snugly over the fixed pole-shoe portions **11** along which they slide to the proper position shown in FIG. 2. The mutually sliding pole-shoe faces are denoted by **24** and **25**. The mutual engagement may be such that when the removable assembly unit is being plugged into proper position, the pole-shoe portions **8**, as they advance along the fixed pole-shoe portions, will slightly press upon the latter and thus improve the magnetic engagement. It is preferable, therefore, to make the legs of the magnetic circuits **7**, or parts thereof, somewhat resilient, for example in the leg portions adjacent to the pole shoes. This affords a particularly intimate mechanical and magnetical junction of the exchangeable pole-shoe portions with the fixed pole-shoe portions. In addition, the sleeve **17** likewise may be made resilient so that it abuts with resilient force against the pole-shoe portions **11**. This may be done, for example, by having the cylindrical shape of the sleeve bulge somewhat outwardly so that when the sleeve is being pressed together by the pole-shoe portions **11**, the sleeve will be elastically deformed to the illustrated straight-cylindrical shape.

The magnetic circuit structures **7** may be mounted in any desired manner in the housing **15** of the pickup. It is particularly simple to embed these magnetic components, including such accessories as the coils and their terminals, in casting or potting resin which coalesces with the material of the pickup housing or is filled into a recess provided for this purpose in the housing.

It is further preferable to provide the supporting structure **14** of the exchangeable assembly unit with a grip **26** or a protective cover **27** for the stylus carrier **2**, or both, as is the case with the embodiment illustrated in FIG. 2. The grip or handle **26** as well as the protective hood **27** above the stylus carrier may consist of a single piece with the mounting structure **14** or may be mechanically connected thereto. This results in a large and handy unit, despite the fact that the reproductively active components proper have minute dimensions. The entire assembly unit can be easily and rapidly exchanged by a layman. In addition, the invention combines the advantages afforded by a sleeve as shown at **4** in FIG. 1 with the possibilities of improving the reproduction heretofore afforded only with pickups whose stylus assembly is not exchangeable. This will be understood from the following.

It will be recognized from FIG. 1 that the wall thickness of the sleeve **4** in a pickup of the known type occupies an essential share of the narrow air gap. It is of advantage to keep the air gap narrow but to preserve the dessired ease of exchangeability. With the known type of pickup, however, an attempt at reducing the air gap is limited not only by the required wall thickness of the sleeve but also by the fact that the elastic bearing member **5** must have a minimum thickness in order to permit large-scale assembling and secure the desired mobility and compliance of the stylus point **1**.

By comparison with FIG. 2 it will be recognized that by virtue of the invention these limitations are largely eliminated. The air gap can be kept very narrow because the wall thickness of the sleeve **17** is not troublesome as it does not affect the size of the bearing member **10** and since the armature movements are very small. The reduction of the gap width has the consequence that the available output voltage is higher than heretofore. Furthermore, any spurious fields, for example from the drive motor of the phonograph, can have only a greatly reduced interfering influence. Both effects improve the signal-to-noise ratio of the pickup. If desired, this improvement may also be utilized for reducing the dimensions of the armature. This, in turn, affords reducing the tracking force and improving the vertical and lateral compliance,

thus imposing less wear upon the record discs and making finer details of the recordings audible for an increased number of repetitions.

Although in the foregoing the novel features and advantages of the invention have been described in comparison with the known pickup shown in FIG. 1, the invention is not limited to systems of this particular kind. For example, it may be applied equally well to variable-reluctance pickups in which a permanent magnet is associated with the stationary portion of the magnetic circuit or circuits and the vibratorily mounted armature consists of magnetically soft material. The invention is further not limited to the reproduction of stereophonic recordings. For examp'e, the pickup portion shown in FIG. 2 having a single magnetic circuit may serve for reproducing only one component of a magnetic component or for reproducing a monaural recording. For the purpose of more lucid illustration, the stylus point **1** is shown to have its axis in the plane of illustration in which the armature **3** is pivotally movable. This design would be suitable for the reproduction of depth recordings. If the magnetic system is turned 90°, the system would be suitable for reproduction of lateral recordings. If the system comprises two magnetic circuits 90° displaced from each other according to FIG. 1, the pickup is suitable for two-component recordings such as stereophonic records. Since it is not customary to use depth and lateral components for such purposes but to have the two component recordings located on the respective two lateral walls of the record groove, the stylus axis for stereophonic recordings of the latter kind must be 45° displaced from each of the axes of mutual spacing between the two poles of each magnetic circuit, this being shown in FIG. 3.

The removable pole-shoe portions **8** may be joined with the supporting structure **14** by first embedding these pole-shoe portions in the unfinished state within the nonmagnetic material, for example aluminum, which is to form a block-shaped supporting structure. During casting of the embedding material the pole-shoe portions **8** are held in the proper positions relative to each other and as required for subsequent cooperation with the armature **3** and the fixed pole-shoe portions **11**. The resulting solid block is thereafter machined so that the pole-shoe portions **8** obtain at their respective ends the correct junction faces **12** for engagement with the fixed pole-shoe portions and at their other ends the correct pole faces **28** relative to the armature **3**. In this manner, a highly accurate position of the pole-shoe portions **8** and **11** as well as a satisfactory stability is achieved together with extremely few specimen differences in large-quantity production.

The embodiment illustrated in FIGS. 4, 5 and 6 differs from the pickup according to FIGS. 2 and 3 mainly in that the supporting structure for the removable pole-shoe portions is designed as an entity in which the removable pole-shoe portions are positioned, and which constitutes a sub-assembly inserted into a recess of a plug portion of the exchangeable armature-stylus assembly. This affords more freedom in the design of the hollow space and the removable pole-shoe portions. For example, the size of the elastic bearing member **10** can be still further increased in this manner. Thus, a comparison of FIG. 4 with FIG. 2 shows that the diameter of the rang-shaped elastic bearing member **10** in FIG. 4 is still larger than that of the corresponding member in FIG. 2.

A further improvement is obtained by providing the removable unit with means for the constrained guidance of the fixed pole-shoe portions when the removable assembly is being plugged into the pickup housing, thus further facilitating an exchange of the removable assembly by laymen.

The supporting structure **29** of the subassembly shown in FIGS. 4 and 5 has a generally cylindrical shape and is hollow. The interior is open at one side **37** for mounting the armature **3**. The bottom **31** is provided with openings **32** shaped in accordance with the cross section of the fixed pole-shoe portions to provide for constrained guidance of these portions **11**. The peripheral surface of the structure **29** has radially directed slots for inserting the removable pole-shoe portions **30**. This facilitates assembling the armature bearing as well as the armature and also protects the armature in the assembled condition.

A tubular member **33** forming an integral piece of material with the handle or grip **26** is positioned over the cylindrical supporting unit **29**. A radially extending nose **38** of unit **29** engages a longitudinal groove (not illustrated) of the tubular part **33** to secure both in the proper position and against relative rotation. This is advisable if both parts have a circular cross section. If the cross section differs from the circular shape, a mutual positioning engagement is not necessary but often advantageous. The handle structure **26** facilitates exchanging the entire assembly and also protects the stylus carrier **2**, aside from firmly holding the pole-shoe portions **30** in their respective slots.

The illustrated pole-shoe portions **30** have approximately the shape of a U of which one leg **34** enters into snug contact with the adjacent fixed pole-shoe portion **11**. This affords providing the pickup with the above-mentioned bearing member **10** of very large diameter, because the bearing member may be mounted in the bight space between the legs of the U-shaped pole-shoe portions **30**.

It is further preferable to make the leg **34** shorter by the thickness of the fixed pole-shoe portion **11** than the other leg of the U-shaped pole-shoe portion **30**. With such a design, the plugged-in pole-shoe portion **30** is supported upon the end of the fixed pole-shoe portion **11**. The other side of the removable pole-shoe portion **30** is supported by having a nose **35** resting upon an annular shoulder **36** of the supporting structure **29**. As a consequence, the full opening **37** of the hollow pot-shaped unit **29** remains available for mounting the stylus system **1** to **3** including the elastic bearing member **10**, while nevertheless preserving an accurate positioning of the pole-shoe portions **30**.

Similar to the embodiment of FIG. 2, the pickup shown in FIG. 4 comprises a sleeve **17** adjacent to the elastic bearing member **10**. However, the sleeve **17** according to FIG. 4 has a radial flange **20** engaged by a cover **39**. The flange and the cover jointly enclose the bearing member **10** on all sides, thus fully protecting the bearing member. FIG. 6 shows the stylus system including the thus encapsulated armature and bearing member.

The cup portion of the sleeve **17** is inserted into a bore of the supporting unit **29** in the direction of the arrow indicated in FIG. 5. When thereafter the pole-shoe portions **30** are being inserted in radial direction through the slots, the structure **29** then being held fast, for example manually, the flange **20** and the cover **39** afford an additional guidance for the pole-shoe portions **30** which may be positioned like clamps over the flange and cover on sleeve **17**, so that the assembling work reuires no particular skill. Furthermore, the flange **20** and the cover **39** may have some resilience so as to yield during assembling. For this purpose the flange **20** and the cover **39** may be given a somewhat bulging shape. Then each pole-shoe portion **30**, when being inserted into the unit **29**, presses the flange **20** and the cover **39** to the respective planar shapes. Another way of providing for resiliency is to cut a slit into the cylindrical margin of the flange **20** to produce a resilient tongue **41** according to FIG. 6. Still another or additional way is to position a broad rubber ring upon the peripheral outer surface of the unit **29**.

Pickups according to the invention may be modified in various respects. Thus the embodiments shown in FIGS. 7, 8 and 9 exemplify different other ways of separating the removable pole-shoe portions from the remaining fixed portions and giving the removable portions

respectively different shapes, the pickup in each case being assumed to correspond otherwise to the one shown in FIG. 1, for example.

The embodiment illustrated in FIGS. 2 and 3 may be looked upon as being characterized by the fact that the hollow space for accommodating the flexible bearing member for the armature is formed by the inner lateral faces of the removable and angularly shaped pole-shoe portions **8**, on the one hand, and the front faces of the remaining, fixed pole-shoe portions **11**, on the other hand. As shown, the elastic bearing member **10** may rest on all sides against the peripheral wall of the hollow space thus constituted. However, the invention also contemplates pickup designs in which the bearing member abuts only against those wall portions of the hollow space that are most remote from the armature **3**. For example, the bearing member **10** may be made somewhat narrower in width than the hollow space so that air gaps remain along both lateral walls. The same purpose is served by a pickup in which the shape of the hollow space departs from that of the bearing member so that the bearing member is braced essentially only against the wall most remote from the armature in the hollow space.

The embodiment shown in FIG. 7 is of the latter type. That is, a gap space **44** is left between the lateral sides **42** of the elastic bearing member **10** and those wall components **43** of the hollow space that face the bearing member. While the hollow space as well as the elastic bearing may be given various shapes, they are shown in FIG. 7 to leave a wedge-shaped interspace **44**. This requires giving the walls of the hollow space and consequently the respective surface areas of the pole-shoe portions an inclined direction as compared with that shown in FIG. 2. However, the same result is also obtainable by giving the lateral sides **42** of the bearing member **10** an inclined position, resulting in an outwardly tapering cross section of the bearing member. By virtue of such features, the bearing member **10** abuts only against the wall portions **45** most remote from the armature **3**. This results in a higher degree of softness and consequently a very slight return force of the bearing member even if its dimensions are relatively small.

Various modifications are also applicable with respect to the shape and arrangement of the planes of separation between the removable and fixed pole-shoe portions. Thus, according to FIG. 8, the separation surface **46** lies flush with the adjacent lateral side of the flexible bearing member **10**. This further improves the accessibility of the bearing member during assembling and facilitates checking the member for proper seating.

FIG. 9 exemplifies another way of shaping the removable pole-shoe portions as well as a different shape and arrangement of the separation surface. While in the embodiments so far described the separation face extends either perpendicularly to the plugging direction of the exchangeable armature-stylus assembly or parallel to that direction, the separation surface in the pickup according to FIG. 9 extends in part at a different angle, for example 45°, to the just-mentioned directions. This portion of the separating face is denoted by **48**, a residual portion **49** extending in the plugging direction of the exchangeable assembly.

It will be noted that in an embodiment of the type shown in FIG. 9, the possibility of giving the elastic bearing member **10** a larger diameter than corresponds to the width of the gap between the pole shoes is much more limited than with embodiments according to FIGS. 2 to 8. On the other hand, a pickup according to FIG. 9 may be obtained from the components of a known pickup according to FIG. 1 simply by providing the originally undivided pole shoe with a recess **50** (FIG. 9) for receiving the elastic bearing member **10**, and separating the pole-shoe portion **8** in the illustrated manner from the rest of the pole shoe. This permits a manufacturer of the original pickups to employ a large number of already available parts in the production of improved pickups according to the invention.

It will be apparent from the variety of embodiments illustrated and described herein, that the invention affords numerous modifications. For example, combinations of the different features described in the foregoing with reference to respectively different embodiments are readily applicable in a single pickup. Thus individual arrangements and designs of the separation faces may be combined with different shapes of the pole-shoe portions. Among these is a design in which the removable pole-shoe portions **8** are straight and the fixed pole-shoe portions **11** are curved or angular, thus constituting essentially an inversion of such pole-shoe portions **8** and **11** as shown in FIG. 2. To those skilled in the art, it will be obvious therefore that our invention may be given embodiments other than particularly described herein, without departing from the essential features of our invention and within the scope of the claims annexed hereto.

We claim:

1. An electromagnetic pickup for phonograph records, comprising a magnetic circuit provided with coil means and having at least one pair of pole shoes spaced from each other to form a pole gap and a vibratory armature in said gap, said armature extending in length substantially parallel to and spaced from said pole shoes and having a length which is less than that of any of said pole shoes, each of said pole shoes being subdivided into a fixed portion and a removable end portion at said gap, said removable end portion engaging said fixed portion and protruding therefrom, an exchangeable assembly comprising said armature and a stylus carrier secured to said armature with a stylus mounted on said carrier, said armature and said stylus carrier extending colinearly, each of said removable pole shoe portions being part of said exchangeable assembly and forming, when engaging one of said respective fixed portions and conjointly therewith, an intermediate space between the removable end portion and the corresponding fixed portion laterally of and extending to and opening on said armature, two opposite ones of said spaces having conjointly with said pole gap a larger width than said pole gap only, and an elastic bearing member surrounding said armature and joined therewith, said member being mounted in said space.

2. A pickup as claimed in claim **1**, wherein said exchangeable assembly comprises a structure of non-magnetic material fixedly interconnecting said pole-shoe end portions and forming a cavity which includes said intermediate spaces.

3. A pickup as claimed in claim **1**, wherein said exchangeable assembly comprises a structure of non-magnetic material fixedly interconnecting said pole-shoe end portions and forming a cavity which includes said intermediate spaces, said elastic bearing member being located in said cavity and having a shape departing from that of said cavity to form annular interstices on the respective axial sides of said bearing member, said bearing member being in pressure contact with said cavity substantially only at the perimetric surface.

4. A pickup as claimed in claim **1**, wherein said pole-shoe end portions have angular shape, and said intermediate spaces are formed by the inner lateral faces of said end portions and the respective adjacent front faces of said fixed pole-shoe portions.

5. A pickup as claimed in claim **1**, wherein said pole-shoe end portions have substantially L-shape and have the inner side of one of the L-legs slidingly engageable with one of said respective fixed portions on the lateral side facing away from said gap, said intermediate space being located between said inner side of said L-leg and the adjacent end face of said fixed portion.

6. A pickup as claimer in claim **1**, wherein said bearing members has the shape of an annular flat disc, and the

plane of division between said fixed and removable pole-shoe portions is flush with one flat side of said disc.

7. A pickup as claimed in claim 1, wherein said fixed and removable pole-shoe portions have conjointly the shape of a straight bar, said intermediate space forming a lateral recess in one side of said bar shape, and the division between said fixed and removable portions extending from the opposite side of said bar shape into said recess.

8. A pickup as claimed in claim 1, wherein said fixed pole-shoe portions of said magnetic circuit are resiliently displaceable toward each other.

9. A pickup as claimed in claim 1, wherein said removable pole-shoe portions have lateral inner faces slidably engageable in the inserting direction of said exchangeable assembly with lateral outer faces of said respective fixed pole-shoe portions.

10. A pickup as claimed in claim 1, wherein said bearing member has a substantially annular shape and an outer periphery in radial pressure engagement with said pole-shoe end portions.

11. A pickup as claimed in claim 10, wherein said bearing member and said cavity are in mutual pressure engagement at substantially only the cavity wall portions most remote from said armature.

12. A pickup as claimed in claim 1, wherein said removable pole-shoe portions have substantially U-shape, one leg of the U-shape being engageable with one of said respective fixed pole-shoe portions, and said intermediate space is located in the bight of said U-shape.

13. A pickup as claimed in claim 12, wherein said one leg is shorter than the other by the thickness of said fixed pole-shoe portion and engages said fixed portion on the lateral side of the latter facing away from said pole gap.

14. An electromagnetic pickup for phonograph records, comprising a housing having an exteriorly accessible recess, magnetic circuit means mounted in said housing and having fixed spaced-apart pole-shoe portions protruding into said recess, an exchangeable armature-stylus assembly having a rigid supporting structure, pole-shoe end portions fixedly mounted in said structure in mutually spaced relation and insertable into said recess for engagement with said respective fixed pole-shoe portions, said structure having between the end portions of said pole-shoe portions mounted in said housing and the end portions of said pole-shoe portions mounted in said structure a cavity whose width is larger than the spacing between said pole-shoe portions, an annular bearing member of elastomeric material seated in said cavity, a magnetic armature coaxially joined with said bearing member and extending axially away therefrom in opposite directions between said fixed pole-shoe portions and between said end portions respectively, said armature extending in length substantially parallel to and spaced from said pole shoes and having a length which is less than that of any of said pole shoes, said cavity extending to and opening on said armature, and stylus means fastened to said armature and extending colinearly therewith, said assembly being insertable and removable as a whole relative to said housing.

15. A pickup as claimed in claim 14, wherein said supporting structure of said exchangeable assembly consists of synthetic plastic and forms a plug removably insertable into said recess of said housing.

16. A pickup as claimed in claim 14, wherein said supporting structure comprises an integral handle portion to be gripped manually for exchanging said assembly, and said structure has an integral protective hood portion which covers said stylus means from above.

17. A pickup as claimed in claim 14, wherein said assembly comprises an enclosure having a tubular plug portion insertable into said recess, said supporting structure being disposed in said plug portion and having radial slots into which said respective pole-shoe end portions are inserted, said slots being adjacent to the inner surface of said tubular portion so that said end portions are held in said slots by said tubular portion.

18. A pickup as claimed in claim 17, wherein said supporting structure forms a cylindrical cup, said slots extending through the cylindrical wall of said cup, the bottom of said cup having holes to be traversed by said fixed pole-shoe portions, and said stylus means extending out of the cup opening of said structure.

19. An electromagnetic pickup for phonograph records, comprising

a magnetic circuit provided with coil means and having at least one pair of pole shoes spaced from each other to form a pole gap and a vibratory armature in said gap, each of said pole shoes being subdivided into a fixed portion and a removable end portion engaging said fixed portion and protruding therefrom;

a cup-shaped sleeve of non-magnetic material having a transverse flange extending about the cup opening, said sleeve forming an envelope around said armature and being filled with damping medium;

an exchangeable assembly comprising said armature and a stylus carrier secured to said armature with a stylus mounted on said carrier, each of said removable pole-shoe portions being part of said exchangeable assembly and forming, when engaging one of said respective fixed portions and conjointly therewith, an intermediate space laterally of said armature, two opposite ones of said spaces having conjointly a larger with than said pole gap; and

an elastic bearing member surrounding said armature and joined therewith, said member being mounted in said spaces, the flange of said cup-shaped sleeve being adjacent to one side of said bearing member and attached to said assembly.

20. A pickup as claimed in claim 19, wherein the flange of said sleeve is fastened to said pole-shoe end portions.

21. A pickup as claimed in claim 19, further comprising a non-magnetic cover disposed on the other side of said bearing member, said flange and said cover forming together a capsule enclosing said bearing member.

22. A pickup as claimed in claim 21, wherein said flange and cover are of elastically deformable sheet material to act as radially compressible springs.

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BERNARD KONICK, *Primary Examiner.*

L. H. HILL, R. F. CARDILLO, *Assistant Examiners.*