Nov. 5, 1946. F. L. MOORE 2,410,607

ELECTRIC RECORDER-REPRODUCER UNIT

Filed March 14, 1944 2 Sheets-Sheet 1

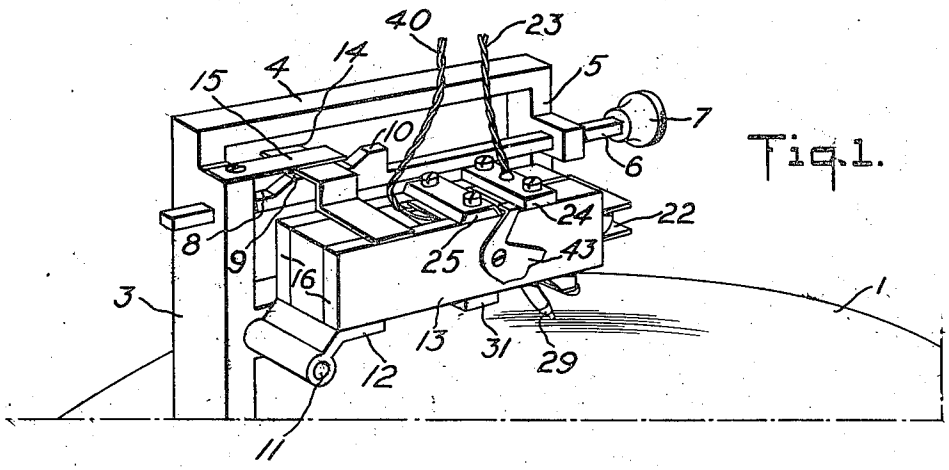
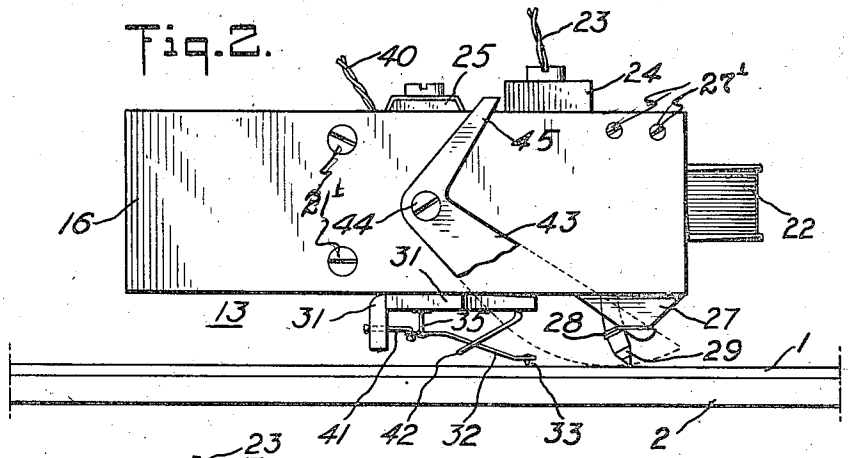


Fig. 1.

Fig. 2.



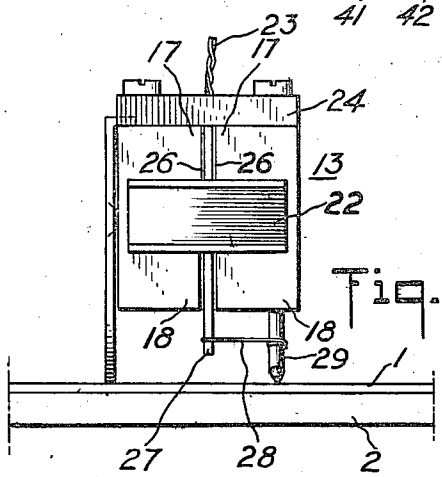


Fig. 3.

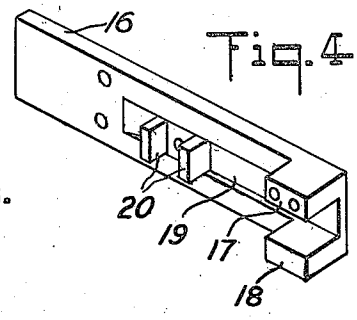


Fig. 4.

INVENTOR
FRANK L. MOORE
BY Darby & Darby
ATTORNEY

Nov. 5, 1946. F. L. MOORE 2,410,607

ELECTRIC RECORDER-REPRODUCER UNIT

Filed March 14, 1944 2 Sheets-Sheet 2

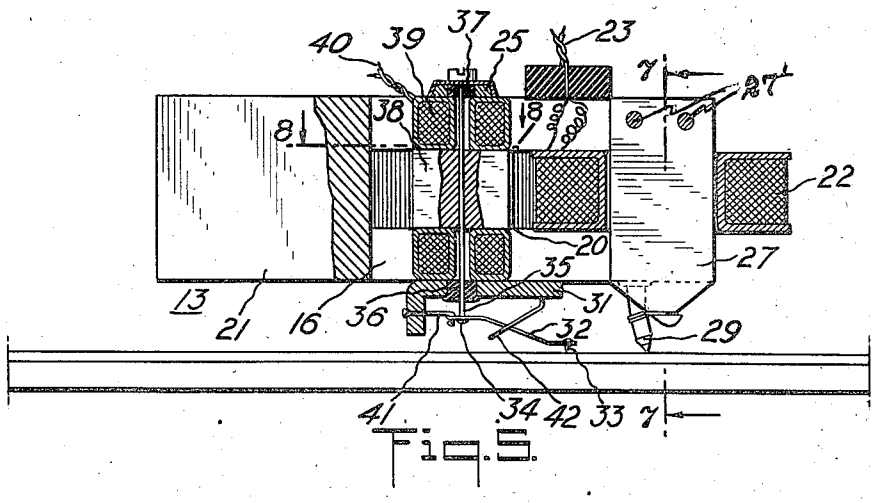


Fig. 5.

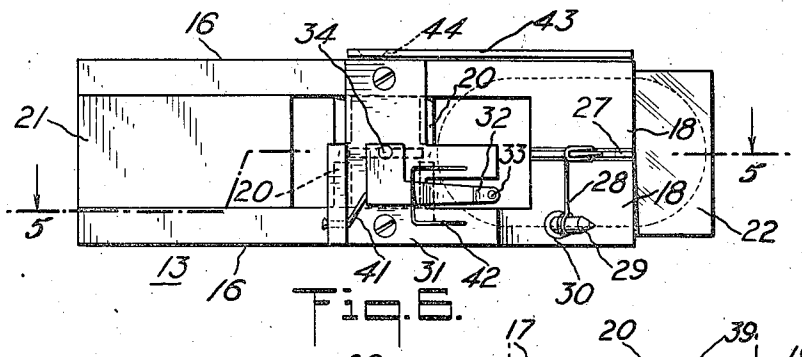


Fig. 6.

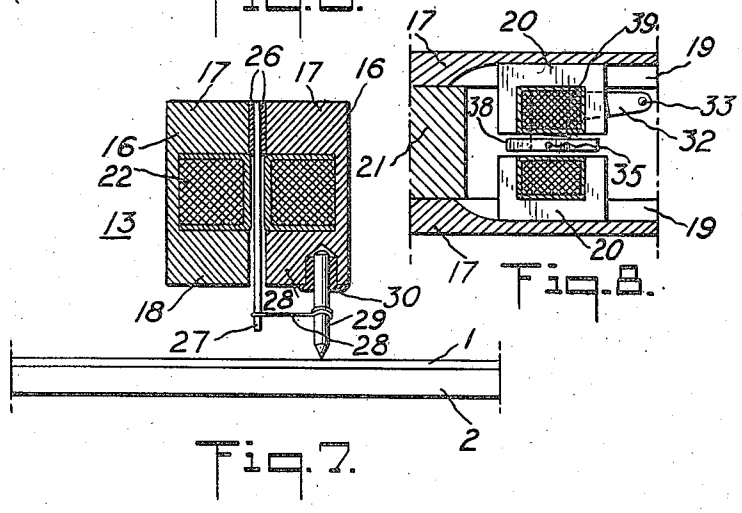


Fig. 8.

Fig. 7.

INVENTOR
FRANK L. MOORE
BY Darby & Darby
ATTORNEY

Patented Nov. 5, 1946 2,410,607

UNITED STATES PATENT OFFICE

2,410,607

ELECTRIC RECORDER-REPRODUCER UNIT

Frank L. Moore, Flushing, N. Y., assignor to The Gray Manufacturing Company, Hartford, Conn., a corporation of Connecticut

Application March 14, 1944, Serial No. 526,390

16 Claims. (Cl. 179—100.41)

1

This invention relates to a combination magnetic recording and reproducing unit for impressing sound records on and reproducing them from record blanks.

The combination unit herein disclosed has been devised:

1. To obtain full advantage of the inherent simplification which results in the use of a single unit for both recording and reproducing sound without making the usual sacrifices necessary in such a unit.

2. To provide a combination unit which can be laterally positioned with respect to the surface of the record in the same manner during reproduction as is used for recording.

3. To provide a combination unit which will operate at maximum efficiency for both recording and reproducing without adjustment or alteration in its impedance characteristic.

4. To provide a combination unit which may be held rigid in a vertical relation to the record surface during reproduction.

5. To provide a combination unit so constructed as to permit three-position operation, the lowest of which is recording with the reproducer stylus riding on the record, the second of which is reproducing, with the recording stylus off the record, and the third of which both styli are off the record permitting its displacement and removal.

6. To provide a combination unit which constitutes a novel structure of recorder armature and stylus coupling, together with a method of stylus damping, that will permit removal and replacement of the recorder stylus.

7. To provide a combination unit which incorporates a novel reproducer stylus damping and centering method.

The other and more detailed objects of the invention will be apparent from the following description of one embodiment thereof as illustrated in the attached drawings.

In the accompanying drawings,

Figure 1 is a perspective view of the combination unit of this invention and its mounting;

Figure 2 is a side elevational view thereof with a portion of the styli guard broken away;

Figure 3 is an end elevational view of the unit;

Figure 4 is a perspective view of one of the magnetic poles of the unit;

Figure 5 is a cross-sectional view taken on the line 5—5 of Figure 6;

Figure 6 is a bottom plan view of the unit;

Figure 7 is a cross-sectional view taken on the line 7—7 of Figure 5; and

2

Figure 8 is a cross-sectional view taken on the line 8—8 of Figure 5.

In the art of electrically recording and reproducing sound through the use of sound records, tapes and cylinders it is customary to provide two separate translation units, one, a recording unit for actuating a recording stylus in accordance with an electrical signal to form a modulated groove on the record, and two, a reproducing unit to be actuated by a reproducing stylus in contact with the groove so as to reproduce electrical signals in accordance with the modulations of the groove.

It is not new to the art to provide a combination unit for serving the dual purpose of recording and reproducing; however, units of this kind often fail to correctly simplify the machine in which they are used due to the fact that they require relatively complicated mechanisms for positioning them relative to the surface of the record. In addition, in order to serve their dual purpose, a sacrifice in frequency response and efficiency in either one or both of their functions is usually made. The combination unit herein disclosed is so designed as to eliminate these limitations.

When separate units are used for recording and reproduction, the recording unit as a rule is either guided laterally across the surface of the record to properly space the grooves on the record, or is held rigid while the record is moved radially to accomplish the same result. In either case, a mechanical means, usually in the form of a feed screw is required to properly space the grooves being formed by the recorder stylus. In the case of the reproducing unit it is customary to leave the unit free laterally by mounting it on a pivoted arm and allowing it to swing over the surface of the record, the entire unit and arm being guided by the groove as it is contacted by the stylus of the unit. Thus it is evident that the functions of recording and reproduction, whether accomplished by two separate units or a single combination unit, normally require two methods of lateral control: the recording unit being guided by a mechanical means; the reproducer unit being guided solely by the recorded groove as it is contacted by the reproducing stylus. The combination unit shown in the drawings is so constructed as to operate in the same manner during reproduction as is used for recording, its lateral control being determined by means other than the recorded groove, that is by whatever means are used to control the recorder. Thus an important simplification is achieved.

It is also important to note that not only is a simplification achieved but by controlling the position of the reproducer laterally by means other than the groove itself, its lateral stability will not be limited to the relatively small stabilizing force obtained from the sides of the record groove. Furthermore, the unit shown in the drawings is so constructed as to operate rigid in a vertical relation to the surface of the record during reproduction; therefore it will not be subject to the usual troubles which occur when common types of reproducers, operating with the stylus pressure derived by weight or spring methods, are used. That is tilting, motion, or vibration of any kind will not cause the reproducer stylus to be bounced out of the groove. Thus, a very valuable practical advantage of the assembly of this invention is that it adapts any reproducing apparatus to mobile operation.

The combination unit shown in the drawings is provided with separate styli armatures and coils for recording and reproduction, and therefore no adjustments are required between recording and reproduction in order to obtain ideal impedance characteristics for both functions. However, since the unit utilizes a single magnet and a common magnetic circuit for both the recording section and the reproducing section, the basic advantage of the combination is retained.

Through the separate use of styli and armatures, the unit lends itself to simple three position operation. It is a characteristic of the unit that the reproducer section is so arranged as to permit the reproducer styli to ride on the surface of the record during recording.

By mounting the recorder stylus in a semi-flexible bushing at one end and coupling the opposite or "point" end to the recorder armature by means of a clasp connection, simple and effective damping of the armature is achieved and by releasing the clasp the stylus may be easily removed and replaced.

Through the use of a damping material coupled at a point near the axis of vibration of the reproducer armature, a less critical type of damping for the reproducer is obtained since the stylus operates at a relatively large distance from the axis of the armature. In addition, a non-critical centering effect is obtained.

From the above discussion it is believed that the general, as well as the more specific objects of this invention will be apparent, and the description of a physical embodiment of these features will now be given.

The device of the invention is illustrated in the drawings in connection with a type of sound recording and reproducing machine in which the recording and reproducing unit is relatively fixed and the record, either with or without a support is moved radially with respect to the unit during recording and reproducing. One known type of machine with which the subject matter of this invention may be used is disclosed in the greatest detail in United States Patent No. 2,296,870, granted September 29, 1942, to B. A. Proctor et al. for sound recording and reproducing. In that machine a thin flexible record is employed in such a manner that a turntable as such is not used, although a turntable support for the record is illustrated herein.

The record 1, or any material suitable for the purpose, is shown mounted upon a support or turntable 2 which may be caused to revolve on an axis which moves radially with respect to the unit by mechanism well known but not herein disclosed. Fixedly supported adjacent the record is a standard 3 having a horizontal extension 4 at its upper end terminating in a short vertical extension 5. A horizontal slidable rod provided with a handle 7 is mounted in the yoke 6 formed and provided with projections to form three camming surfaces, 8, 9 and 10 at different vertical elevations. Pivotally mounted on the post 11 attached to the standard 3 by means of an arm 12 is the recording and reproducing unit 13. This unit has attached to its upper face a rigid bracket 14 positioned to engage the camming surfaces 8, 9 and 10 respectively, depending upon the position of the rod 6. Bearing on the top surface of the bracket 14 is a leaf spring 15 attached to the standard 3 by means of a screw, as shown.

In order to place the unit in recording position it is only necessary to pull the knob 7 outwardly until the bracket 14 rests on the lowest elevation 8 when the recording stylus 29 will contact the record to form a record which will result in a groove in which the reproducer stylus 33 will ride over the surface of the record. When the knob is pushed inwardly so that the bracket 14 rides on the middle elevation 9 the recording stylus 29 will be lifted off the record but the reproducing stylus 33 will remain in contact with it. When the knob is pushed all the way in so that bracket 14 rides on the highest elevation 10 both the recording and reproducing styli will be out of engagement with the record.

It is to be noted that during recording the device may be made to operate in either of two ways, depending upon the strength of the leaf spring 15. If this spring is made sufficiently heavy the unit will, for the purposes of this invention, be locked in vertical relation to the surface of the record. Although this is not a common method of operation it has certain advantages which are fully explained in my copending application Serial No. 495,527, filed July 20, 1943, for Method and apparatus for applying recording stylus pressure. If the leaf spring 15 is not made sufficiently heavy to lock the unit in a vertical sense during recording then recording will be in accordance with the more common method wherein the recording stylus pressure is obtained by means of a light spring, in this case spring 15, and the weight of the unit so that it may have vertical movement during recording.

It is apparent from the construction illustrated in Figure 1 that the unit is mounted rigid laterally in all three positions discussed above. It is further to be noted that the vertical positioning of the unit as described above is accomplished by a simplified arrangement not as far as I know obtainable with other types of combination units.

The unit comprises a pair of magnetizable pole pieces 16, each constructed as illustrated in Figure 4 to provide a pair of poles 17 and 18 which in assembled relation are respectively opposed to each other to form an operating air gap as clearly illustrated in Figure 3. When so assembled the opposite ends of the magnetizable pole pieces 16 are held in spaced relation by means of a permanent magnet 21. The parts are clamped in this relation by means of screws which include the brass screws 21', see Figure 2. The magnet 21 may be held in position by means of dowel pins, not shown. The poled ends of the magnetizable pole pieces 16 are also clamped together by means of screws 27' and have clamped between them a magnetizable armature 27 which is out of physical contact with the member 16 by reason of the non-magnetic shims 26, see

Figures 3 and 7, which may be made of some suitable material such as phosphor bronze or rubber. The screws 27' are of non-magnetic material.

Mounted in the rectangular space formed by the opposed pairs of poles 17 and 18 is the recording winding 22 through which the soft iron armature 27 extends in the form of a cantilever, as clearly illustrated in Figure 7. The current supply leads for this winding are shown at 23 passing through a block 24 of insulating material extending across the members 16 at the top and secured thereto by screws, as shown.

A bearing supporting member 25 of non-magnetic material such as brass also extends between these members adjacent the block 24 and is secured thereto by means of screws, as shown. At the bottom of the members and extending between them is a non-magnetic support 31 which is attached thereto by means of screws. It will be seen, therefore, that the parts are very well interconnected to form a strong permanent construction in which the various parts are held in assembled relation.

Returning to Figure 4, it will be seen that the inner face of each magnetic member 16 is provided with a rectangular groove 19 in which the reproducer pole pieces 20 in the form of rectangular U-shaped members of magnetizable material are mounted. These are attached in place by means of screws. Mounted in the space formed by the members 20 when in assembled relation, as is clear from Figure 8, is the reproducing winding 39 provided with leads 40. In the space between the poles formed by the members 20 is the reproducer armature 38 which is journaled on a vertical axis by means of a shaft 35 journaled in the bearing 36 in the support 31 of the bearing 37 in the support 25, as clearly shown in Figure 5. The space between members 20 provides a relatively wider air gap than is usually employed in reproducer units to permit of greater lateral freedom of the armature 38 and attached parts. The bearings 36 and 37 are preferably of some non-magnetic material such as rubber, for example. Thus the armature 38 may rotate between the poles of the members 20 on a vertical axis.

Secured to the lower end 34 of the shaft 35 is a spring arm 32 to the free end of which is attached the reproducing stylus 33. As is clear from Figure 6, this spring arm 32 is of L-shaped formation and is attached to the end 34 of the shaft 35 near the end of the short arm thereof. At the opposite corner this arm is provided with a damping device 41 of some suitable flexible material, as for example a stressed rubber band which is anchored in the adjacent extension of the support 34. A U-shaped guard 42 in the form of a wire is attached to the end surface of the support 31 and extends around the spring arm 32, as is clear from Figures 5 and 6.

The recording stylus 29 is anchored in one of the members 16, as shown in Figure 7, by means of a resilient mounting bush 30 made of rubber, for example, so that it is capable of transverse movement. The stylus is driven from the armature 27 by means of a clasp 28 illustrated in the form of a wire attached to the lower end of the armature 27 and snapped around the stylus 29.

Pivotally mounted on the outside of the unit at 44 is a bellcrank lever 43 of such shape and size as to form a protective guard for the styli without interfering with the operation of the unit. The other arm 45 of the bellcrank is provided with a right angle extension, as is clear from Figure 1, which overlies the top of the unit and limits the downward movement of the guard when the unit is in raised position.

While the operation of the device will now be apparent to those skilled in the art, a brief description thereof will be included for purposes of completeness. Assuming that the device is to be used for recording, the signals to be recorded in the form of electrical currents are applied to the magnetizing winding 22 through the leads 23. These signal currents having alternating characteristics will alternately polarize the armature 27 to cause it to vibrate in the field between the poles 17 and 18 created by the permanent magnet 21. The recording stylus 29 being rigidly connected to the armature 27 by means of the clasp 28 undergoes similar movements to form a record groove in the record blank 1. It will be recalled that the upper end of the armature 27 is anchored between the shims 26. Thus by means of well known principles of magnetic repulsion and attraction the armature 27 will be vibrated by and in accordance with the signal currents to produce a physically modulated record representative of the original sounds comprising the signal.

With regard to the reproducer unit it will be seen that the coil 39 lies in a uniform magnetic field between the poles of the members 20. When the reproducing stylus 33 is being vibrated by the modulations of the record groove the magnetizable armature 38 will be vibrated in a rotational sense in that field to vary the flux distribution thereof, and hence induce a current in the windings 39 representative of the recorded signal. The armature 38 will rotate on the axis of the shaft 35 through small angles due to the transverse movements of the arm 32 to cause this result. The reproducer armature 38 is of the balanced armature type, as will be apparent to those skilled in the art.

Due to the flexibility of the spring arm 32 it will be capable of rising and falling in accordance with any variations which occur in the distance between the body of the unit and the surface of the record as it passes beneath the unit then permitting the unit to be rigidly held in a vertical direction as previously explained. In addition the spring arm 32 is capable of relatively free lateral movement by reason of its mounting on the rotatable shaft 35, thus permitting the body of the unit to be held rigid laterally or to be guided by means other than the groove itself, so that any eccentricities in the record groove being "tracked" by the reproducer stylus will not cause it to leave the groove. This is an important feature of the construction illustrated and adapts the unit for either type of relative movement with regard to the record, that is movement caused by the tracking of the stylus in the groove, or movement caused by external means for moving the unit laterally in the case where that type of operation is employed.

Another feature of this invention is present in the reproducer portion of the unit in the provision of the flexible damping connection 41 in the manner disclosed. The spring arm 32 is rigidly connected to the shaft 35 and is resisted in its rotational movements by means of the damping means 41 connected thereto at one end and anchored in the support 31 at its other end. This type of damping construction is particularly simple and effective since it works at a point closer to the reproducer pivot, that is the pivot of shaft 35, than does the stylus which is at the

outer end of the relatively longer flexible arm **32**. It serves the purpose of keeping the reproducer armature spaced between the reproducer poles and thus keeps the reproducer stylus mounting spring **32** from coming in contact with the protective guide **42**.

The guard **43** is useful in protecting the styli against damage when placing a record in or removing it from the machine, as well as protecting them from injury from other objects. When the unit is in either recording or reproducing position the lower edge of the guide **43** rides on the surface of the record. When both styli are raised from the record in order to remove or replace it, the guide drops down into protecting position limited by the extension on the arm **45**, so that in moving a record into place it cannot be moved directly against the styli.

From the above description it will be apparent to those skilled in the art that the principles and features comprising the novel subject matter of this invention are capable of embodiment in other physical arrangements. I do not, therefore, desire to be limited to the structure herein disclosed for purposes of illustration, but rather by the claims granted me when construed in accordance with established principles of claim interpretation.

What is claimed is:

1. A combined recording and reproducing unit comprising a magnetized housing forming reproducing and recording poles respectively separated by air gaps, armatures movably supported in said air gaps respectively, a recording winding for one of said armatures, and a reproducing winding for the other of said armatures, a longitudinally rigid recording stylus connecting to one of said armatures, a flexible support connected to the other of said armatures and extending at right angles to said recording stylus and a reproducing stylus attached to the end of said support.

2. In the combination of claim 1, said recording armature comprising a cantilever and said reproducing armature being rotatably supported.

3. In the combination of claim 1, said reproducing armature being rotatably mounted so that said support rotates therewith and a damping device interconnecting said support with said unit, a lever arm shorter than the lever arm at the end of which the reproducing stylus is mounted.

4. In the combination of claim 1, said recording stylus being anchored at one end in a flexible mounting on said housing.

5. In the combination of claim 1, said recording stylus extending at right angles to said housing and the support for said reproducing stylus extending parallel to said housing and at right angles to said recording stylus.

6. In the combination of claim 1, the support for said reproducing stylus being rotatable in a plane at right angles to said recording stylus.

7. In the combination of claim 1, the support

for said reproducing stylus being rotatable in a plane at right angles to said recording stylus, and damping means for said support.

8. In the combination of claim 1, said styli lying below said housing and a guard therefor pivotally mounted on the side of said housing.

9. In a sound recording-reproducing unit of the type described, the combination including a support, a combination recording and reproducing unit mounted on said support for pivotal movement in a vertical plane and including recording and reproducing styli extending below said unit, a bracket attached to said unit, and a positioning member mounted on said support for positioning said unit on its pivotal support in any one of three positions in said vertical plane.

10. In a sound recording-reproducing unit of the type described, the combination including a support, a combination recording and reproducing unit mounted on said support for pivotal movement in a vertical plane and including recording and reproducing styli extending below said unit, a bracket attached to said unit, a positioning member mounted on said support for positioning said unit on its pivotal support in any one of three positions in said vertical plane, and a spring anchored on said support bearing on said unit in opposition to said positioning means.

11. In the combination of claim 10, said pivotal support being transversely rigid.

12. In a recording and reproducing unit the combination comprising a magnetized housing provided with poles forming a pair of air gaps, windings and armatures associated with said poles respectively, a transversely movable recording stylus mounted on said housing and connected to one of said armatures, and a transversely and vertically movable reproducing stylus connected to the other of said armatures and lying adjacent said recording stylus.

13. In the combination of claim 12, said recording stylus being mounted in a flexible bushing in said housing.

14. In the combination of claim 12, said reproducing stylus being mounted at the end of a flexible spring arm.

15. In the combination of claim 12, said reproducing stylus being mounted at the end of a flexible spring arm, and damping means for resisting transverse movement of said arm.

16. In a sound reproducing unit for use with a record having a laterally displaced groove, the combination including a magnetized housing forming poles separated by air gaps, a support for said housing which holds the unit rigid laterally, a vibrating system comprising an armature movably supported in said air gaps and a stylus rigidly fastened thereto, and means providing relatively free lateral movement of said vibrating system with respect to said housing, whereby the stylus will remain in the record groove in spite of any eccentricities in the groove and in spite of the lateral rigidity of the unit.

FRANK L. MOORE.