

Nov. 19, 1940.

L. THOMPSON

2,222,342

ELECTROMAGNETIC SOUND RECORDER

Filed Jan. 16, 1939

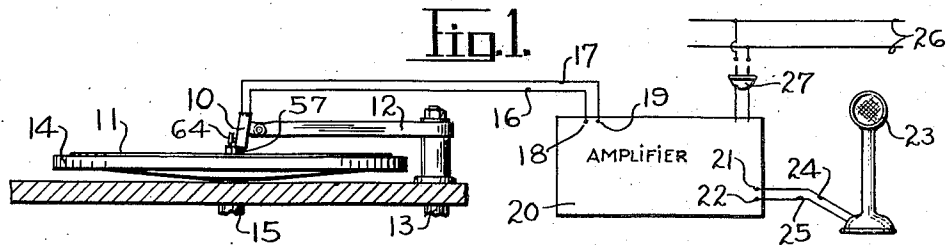


Fig. 2.

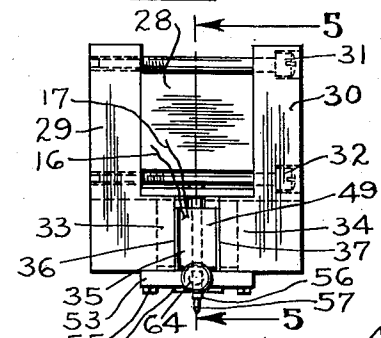


Fig. 3.

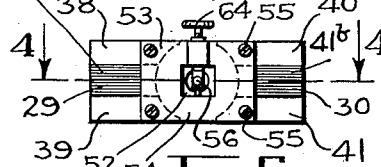


Fig. 5.

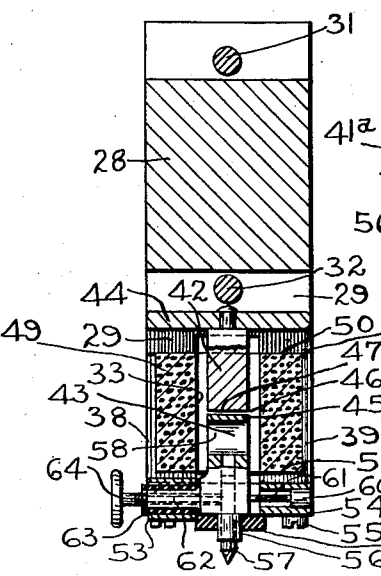


Fig. 4.

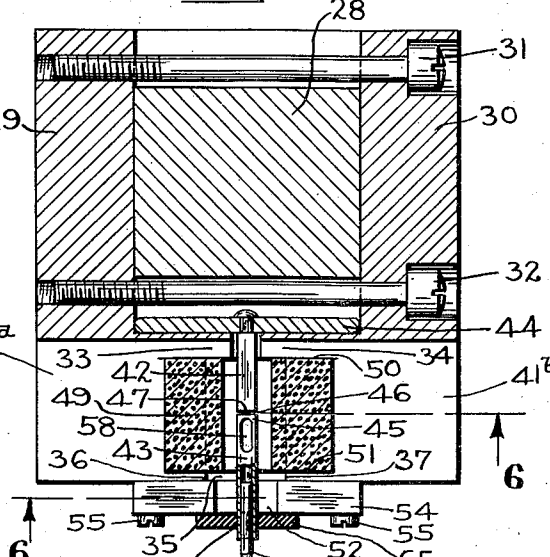


Fig. 6.

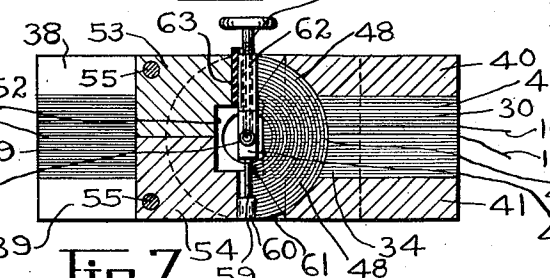
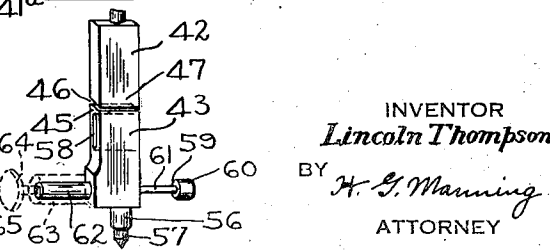


Fig. 7.



INVENTOR
Lincoln Thompson.
BY *H. G. Manning*
ATTORNEY

UNITED STATES PATENT OFFICE

2,222,342

ELECTROMAGNETIC SOUND RECORDER

Lincoln Thompson, Stamford, Conn., assignor to
The SoundScriber Corporation, Stamford,
Conn., a corporation of Connecticut

Application January 16, 1939, Serial No. 251,133

12 Claims. (Cl. 179—100.41)

This invention relates to improvements in phonograph recording, and more particularly to a improved electromagnetic sound recording head in which a stylus carrying armature is pivotally mounted to vibrate within a fixed solenoid which is electrically energized in accordance with the sound vibrations to be recorded.

In previous sound recording heads it has been found that where a relatively large or long stylus-carrying armature was employed, the high inertia of the armature resulted in inaccurate and unfaithful recording. If the armature was shortened to reduce the weight and inertia thereof, the size of the surrounding coil was correspondingly reduced and the energy received by the stylus was insufficient for recording with the high pressures needed to indent hard materials, such as aluminum or other metals.

By means of the present invention the above and other disadvantages have been overcome by providing a sound recording head in which the armature is formed of two alined parts, one of which is held stationary and the other of which is movable, both parts being surrounded by a relatively long energizing coil, whereby a high magnetic flux will be produced and at the same time the undesirable inertia effects of such a long armature will be avoided.

One object of the present invention is to provide a recording head of the above nature in which the stylus carrying section of the armature is provided with a bearing shaft which is resiliently fixed to the body of the head, the other end of said shaft being free to oscillate within a rubber bearing in accordance with the undulating lateral vibrations of the recording stylus.

A further object of this invention is to provide an improved electromagnetic sound recording head of the above nature which will be relatively inexpensive to manufacture, simple in construction, compact, ornamental in appearance, and very efficient and durable in use.

With these and other objects in view, which will appear as the description proceeds, there has been illustrated in the accompanying drawing one form in which the invention may be conveniently embodied in practice.

In the drawing:

Fig. 1 is a schematic view of a sound recording apparatus embodying the invention.

Fig. 2 is a front view of the sound recording head per se.

Fig. 3 is a bottom end view of the same.

Fig. 4 is a sectional view on an enlarged scale

of the recording head taken on the line 4—4 of Fig. 3.

Fig. 5 is an enlarged sectional view of the same taken on the line 5—5 of Fig. 2.

Fig. 6 is a broken enlarged sectional view of the same taken on the line 6—6 of Fig. 4.

Fig. 7 is an enlarged perspective view of the split armature, the lower part of which carries the indenting stylus and is pivotally mounted in the recording head.

Referring now to the drawing wherein like reference numerals designate like parts throughout the several views, the numeral 10 denotes a rectangular casing for the recording head of this invention, said casing being secured to a power driven arm 12 adapted to be slowly swung transversely across a disc record 11, preferably of aluminum. The recording arm 12 is operatively connected in any suitable manner to an electrical motor, not shown, through a shaft 13, said motor preferably also driving a turntable 14, upon which the disc record 11 is disposed through a vertical center shaft 15.

The sound recording head of this invention is particularly adapted to produce a spiral of sound grooves (160 to 200 per inch) upon the rotating flat record disc 11, preferably of thin aluminum, about .006 of an inch in thickness. It will be understood, however, that recordings may also be made on disc records of any other suitable material within the scope of the invention.

The recording head of this invention is of the electromagnetic type, and is connected by a pair of conductors 16 and 17 with the output terminals 18 and 19 of a conventional form of vacuum tube amplifier 20, the input terminals 21 and 22 of which are connected to a microphone 23 of conventional form through conductors 24 and 25. Power is supplied to the amplifier from an A. C. power line 26 through a conventional form of switch plug 27. By means of this apparatus, it will be seen that all sound waves received by the microphone 23 will cause amplified electrical currents to be applied to the recording head for producing indented modulated sound grooves on the surface of the disc record 11.

Recording head

The recording head of this invention includes a permanently magnetized iron block 28 at the upper part of said head, said block 28 being embraced by a pair of opposed L-shaped iron pole pieces 29 and 30 which are securely clamped against said block 28 by means of screws 31 and 32 located in a pair of threaded transverse holes

in said pole pieces. The lower arms 33 and 34 of said pole pieces 29 and 30 are spaced apart and the arms 33 and 34 are slotted at their lower ends to provide side members 40 and 41 between which two sets of laminated iron strips 41a and 41b are located, an air gap 35 being provided between said sets of laminated strips.

Two-part armature

In order to vibrate the recording stylus to produce an undulatory spiral sound track upon the record 11, provision is made of a two-part armature comprising an upper stationary portion 42 and a lower movable portion 43, both of which are disposed in the air gap between the spaced extremities 36 and 37 of the pole pieces 29 and 30. The upper armature portion 42 is fixed to a transverse plate 44 of non-magnetic material, such as brass, which plate 44 in turn is seated upon the upper surfaces of the pole piece arms 33 and 34 above the air gap 35. The movable lower armature portion 43 is spaced at its upper end 45 by a narrow air gap 46 from the lower end 47 of the stationary armature portion 42. The air gap 46 is so small that only a slight impedance is offered to the flow of magnetic flux between the two parts of the armature. The slight loss of power introduced by said gap is more than made up by the fact that a larger and more efficient coil may be employed than was possible with conventional types of recording heads of this general type.

To support a hollow electromagnetic wire coil or solenoid 49 around the armature sections 42 and 43, the arms 36 and 37 of the pole pieces are provided with concave segments 48 which form arcuate seats for said solenoid coil 49. The coil 49 is electrically connected with the amplifier 20 by conductors 16 and 17.

The movable lower armature portion 43 is extended below the arms 33 and 34 of the pole pieces 29 and 30 and passes through a square opening 52 enclosed by a frame consisting of a pair of U-shaped plates 53 and 54 secured to the side members 40 and 41, as by screws 55. The plates 53 and 54 are made of non-magnetic metal, such as brass. The lower movable armature portion 43 is positioned between the plates 53 and 54 midway in the opening 52 and has a hollow vertical stem 56 depending below the plates 53 and 54, which stem is adapted to receive a pointed recording stylus 57. The upper end of the armature portion 43 has an elongated vertical slot 58 formed therein to reduce the weight and inertia thereof.

The movable armature portion 43 is secured to the plate 54 by a resilient torsion stud 59 having a head 60 which is soldered or otherwise fixed in a suitable socket in said plate 54. Between the head 60 and the armature portion 43, the stud 59 is reduced in diameter to form a resilient spring section 61, the torsion of which is adapted to rapidly restore the stylus 57, after deflection by the magnetic forces set up in the coil 49, to its central position.

On the opposite side of the movable armature 43 from the torsion stud 59, provision is made of a hollow stem 62 which is surrounded by a soft rubber sleeve 63 mounted in the plate 53. The stem 62 is interiorly threaded to receive a headed stylus-clamping set screw 64.

In order to dampen resonant vibrations of the movable armature portion 43, provision is made of a sheet of soft rubber 65 cemented or otherwise

secured to the bottom of the plates 53, and tightly and resiliently embracing the stylus-holding stem 56.

For a more detailed disclosure of the feed mechanism for driving the recording arm, reference should be made to my Patent No. 2,133,596; the disc record of aluminum is more fully disclosed in my copending application, Serial No. 245,944, filed December 15, 1938; and a dictating machine with which the cutting head may be employed is disclosed in my copending application, Serial No. 248,690, filed December 31, 1938.

Operation

In the operation of this invention, sound waves received by the microphone 23 are converted in the usual manner into variable electrical impulses which pass into the amplifier 20 through the conductors 24 and 25, and after amplification therein, pass out through the conductors 16 and 17 to the solenoid coil 49. These amplified electrical impulses serve to energize the coil 49 and produce a pulsating magnetic flux of high intensity which passes through both of the armature portions 42 and 43. The movable portion 43 of the armature is thus caused to vibrate and oscillate the stylus 57 laterally with relatively high power, whereupon modulated sound grooves may be indented in the surface of the metal disc 11 engaged by said stylus 57.

The relatively short and light weight armature portion 43 has low moment of inertia characteristics whereby the sound grooves formed by the stylus 57 in the disc 11 will faithfully represent the sound impulses received by the microphone 23, and said impulses may be later reproduced in exceptionally clear and articulate manner over a high range of wave lengths.

By reason of the relatively stiff resilient mounting for the movable armature portion 43, the stylus will be held centrally in the air gap 35. This construction is very rigid and durable and is capable of withstanding relatively heavy stresses and strains incident to the indenting of sound grooves on discs made of hard materials, such as aluminum.

While there has been disclosed in this specification one form in which the invention may be embodied, it is to be understood that this form is shown for the purpose of illustration only, and that the invention is not to be limited to the specific disclosure, but may be modified and embodied in various other forms without departing from its spirit. In short, the invention includes all the modifications and embodiments coming within the scope of the following claims.

Having thus fully described the invention, what is claimed as new, and for which it is desired to secure Letters Patent, is:

1. In a phonograph recording head, a U-shaped magnet having a space between the legs thereof, an armature comprising a pair of vertically aligned stationary and movable portions slightly spaced apart at their adjacent ends and extending through said space, an electromagnetic coil embracing both portions of said armature, and means to produce electromagnetic impulses in said coil corresponding to the sound to be recorded.

2. In a phonograph recording head, a loop-shaped magnet having a space in the magnetic circuit thereof, an armature passing through said space, an electromagnetic coil surrounding said armature, said armature comprising a pair of

aligned stationary and movable portions, both of which are embraced by said coil, means to resiliently mount said movable armature portion, and means to produce electromagnetic vibrations in said coil corresponding to the sound to be recorded.

3. In a phonograph recording head, a magnetic circuit including an open space, an electromagnetic coil in said space responsive to the sound vibrations, a stylus-carrying armature embraced by said coil, said armature being split intermediate its ends to provide two separated portions, both of which are surrounded by said coil.

4. A stylus oscillating armature for a phonograph recording head comprising a fixed portion, a movable portion located below and spaced from said fixed portion to provide an intermediate air gap, and an electromagnetic coil embracing both of said portions to impress a pulsating flux upon said armature responsive to the sound to be recorded, whereby said movable portion will cut a modulated groove in a sound record.

5. In a phonograph recording head, a magnetic circuit including an open space, an electromagnetic coil, a fixed armature and a stylus-holding armature extending through said space, both armatures being embraced by said coil, said movable armature having a torsion stud extending from one side thereof and secured to said head.

6. In a phonograph recording head, a stylus-holding armature of magnetic material, means responsive to the sound to be recorded for impressing a vibrating electromagnetic field upon said armature, said armature being split into two separated sections, one fixed to said head and the other movable therein, whereby the moment of inertia of the stylus carrying section will be reduced to permit high power faithful sound recording thereby, the fixed section of said armature being surrounded by said field.

7. In a phonograph recording head, a frame including a U-shaped magnet having an air gap between the pole pieces thereof, an electromagnetic coil responsive to the vibrating impulses of the sound to be recorded located within said air gap, a vibrating armature having a rigid upper portion extending into the upper part of said air gap and being fixed to said frame, and a movable lower portion extending into the lower part of said air gap in alignment with said upper portion and leaving a small air gap therebetween, means to support said movable armature portion including a resilient torsion stud connected to said frame and extending from one side of said movable portion, a stem extending from the other side of said movable armature portion in alignment with said stud, a pair of plates extending between said pole pieces, said stud being fixed in one of said plates, a yieldable resilient sleeve in the other of said plates, said stem being freely journaled in said sleeve, said coil embracing both of said armature portions to produce a powerful magnetic alternating flux therein.

8. In a device for indenting sound grooves in a disc record, a frame, a U-shaped magnetic circuit having a magnetic air gap between the legs thereof, an electromagnetic coil responsive to vibrating impulses of the sound to be recorded, a vibrating armature portion extending into said air gap, and means to resiliently mount said armature portion including a resilient torsion stud connected to one side of said armature portion and having a head fixedly secured in a stationary part of said frame, a stem extending from the other side of said armature portion, and a sleeve of yieldable resilient material secured to said frame for freely embracing said stem.

9. In a device for indenting sound grooves in a disc record, a frame, a U-shaped magnetic circuit having a magnetic air gap between the legs thereof, an electromagnetic coil responsive to vibrating impulses of the sound to be recorded, a vibrating armature portion extending into said air gap, and means to resiliently mount said armature portion including a resilient torsion stud connected to one side of said armature portion and fixedly secured in a stationary part of said frame, a stem extending from the other side of said armature portion, and a sleeve of yieldable resilient material secured to said frame for freely embracing said stem.

10. In a device for indenting sound grooves in a rotating metallic record, a head adapted to be carried by a driven swinging recording arm, said head carrying a U-shaped magnet having an air gap between the pole pieces thereof, an electromagnetic coil located within said air gap and being responsive to the vibrating impulses of the sound to be recorded, a two-part armature of magnetic material embraced by said coil, the parts of said armature being separated by a narrow air gap, the upper part of said armature being fixed rigidly to said head, the lower part of said armature being capable of vibration in response to the pulsating magnetic flux passing through both parts of said armature.

11. In a phonograph recording head, a magnetic circuit including an air gap, an electromagnetic coil in said air gap responsive to the vibrating impulses of the sound to be recorded, an armature embraced by said coil, said armature having a torsion stud on one side fixedly secured to said head, and also having a stem on its other side aligned with said stud and journaled for free oscillation in said head.

12. In a phonograph recording head, a magnetic circuit including an air gap, an electromagnetic coil in said air gap responsive to the vibrating impulses of the sound to be recorded, an armature embraced by said coil, said armature having a torsion stud on one side fixedly secured to said head, and also having a stem on its other side aligned with said stud and journaled for free oscillation in a soft rubber bearing in said head.

LINCOLN THOMPSON.