Nov. 25, 1947. M. CAMRAS 2,431,540

MAGNETIC RECORDING HEAD

Filed March 2, 1945

Fig. 1.

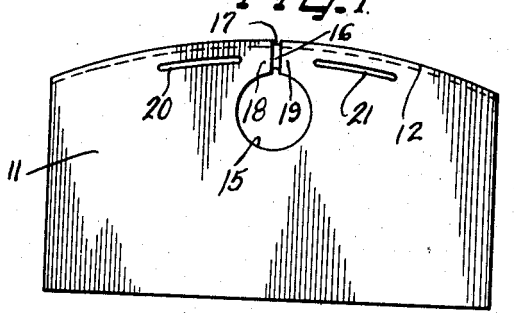


Fig. 2.

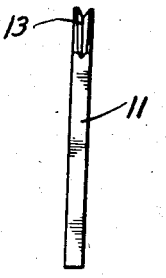


Fig. 3.

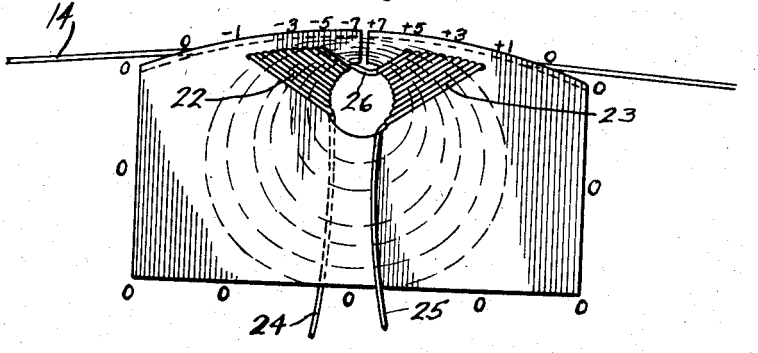
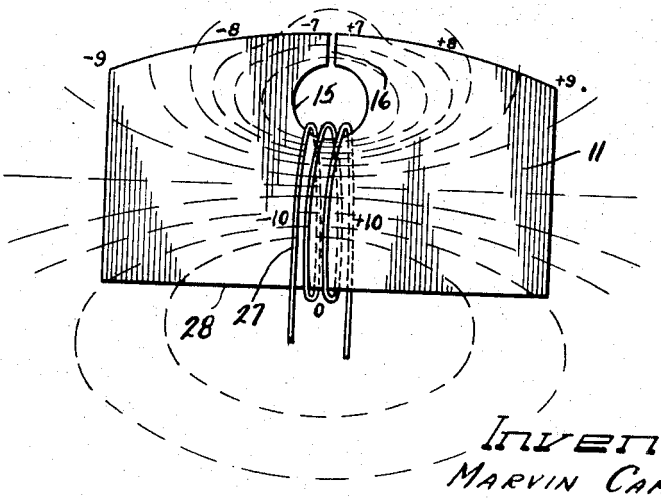


Fig. 4.



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2,431,540

MAGNETIC RECORDING HEAD

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3 Claims. (Cl. 179—100.2)

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This invention relates to a magnetic recording head and more particularly to a head which may be employed to magnetically record fluctuating electric energy on an elongated travelling record medium and to reproduce electrical fluctuations from a previously magnetized record medium.

One of the principal features and objects of the present invention is to provide a novel magnetic recording head which will provide exactly the same high quality of recording and reproduction which is obtained by using a head having the travelling record medium pass directly through the voice coil, but which employs, in this case, only an open slot.

It is one of the objects of the present invention to provide a novel sound head for a magnetic recording and reproducing device of the open slot type.

As the expression "recording head" is used throughout the description and claims of this case, it will be understood that it refers to a head for either making magnetic recordings on a travelling elongated record medium such, for example, as a magnetizable wire; or, for reproducing fluctuating electric energy corresponding to fluctuating energy which has previously been magnetically recorded on the travelling record medium.

A further object of the present invention is to provide a core piece of novel construction for a magnetic recording head.

Another and further object of the present invention is to provide a novel recording head in which the greater part of the recording head is at substantially zero M. M. F.

Another and still further object of the present invention is to provide a recording head having the electric recording or pick-up coil wound thereon in a novel manner.

Still another and further object of the present invention is to provide a novel method and means for magnetizing a traveling elongated record medium and for reproducing electric energy from a previously magnetized record medium.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, both as to its organization, manner of construction and method of operation, together with further objects and advantages thereof, may best be understood by reference to the accompanying drawing, in which:

Figure 1 is a front elevational view of the core member of a recording head embodying the novel teachings of the present invention;

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Figure 2 is an end view of the core member shown in Figure 1;

Figure 3 shows the recording head, including the core piece, as shown in Figures 1 and 2, together with the coil wound in place thereon, and in addition diagrammatically shows the flux pattern of the field set up by current flowing in the coil; and

Figure 4 is a view similar to Figure 3 showing a prior art type of recording head together with a diagrammatic illustration of the flux pattern set up by the voice coil thereof.

Referring first to Figures 1 to 3 of the drawing, I have illustrated thereby one embodiment of the present invention. This embodiment of the present invention shows a core piece 11, as shown in Figures 1 and 2 of the drawing, which is formed of a single flat piece of magnetizable material. The material may be of any suitable composition having high magnetic permeability and low magnetic retentivity. By way of example and not by way of limitation, this core piece 11 may be .020 in. in thickness, approximately ¾ in. long, and approximately ½ in. in height. The top edge is slightly curved as at 12 to provide a crown. This crowned edge 12 is grooved lengthwise as at 13 for receiving and confining a traveling elongated record medium such, for example, as a wire 14 (see Figure 3).

A relatively large hole 15 is cut or punched in the center of the core member 11 near the crowned edge 12, and in addition a slot 16 is cut between the hole 15 and the upper crowned edge 12 of the core 11. This slot 16 preferably is very narrow, such for example, as .002 in. If desired the slot may be filled with non-magnetizable material such, for example, as silver solder 17, in order to maintain the spacing between the opposite sides of the slot at a uniform distance apart.

The metal of the core member 11 on the opposite sides of the slot 16 provides pole portions 18 and 19 when a magnetizing coil is wound on the core member 11 in a manner presently to be described.

In addition to the hole 15, two long narrow slots disposed substantially parallel to the crowned edge 12 are provided at 20 and 21. These slots are placed as close to the edge 12 as is possible without causing the slots 20 and 21 to interfere or merge with the groove 13. The ends of the slots 20 and 21 adjacent the pole pieces 18 and 19 are spaced a substantial distance back from the pole tips for a reason which will hereinafter be explained. After the core member 11 is cut or punched in the manner described in

connection with above description of Figures 1 and 2, a coil is wound therearound as shown in Figure 3. This coil is in the form of a continuous coil wound first through the slot **20** and the hole **15** and then through the slot **21** and the hole **15**. The direction of winding of the coil through the slot **21** is the same as the direction of winding through the slot **20**. This provides two coil portions **22** and **23**, the outer ends **24** and **25** of which are arranged to be connected to the magnetic recorder apparatus. The inner ends of the coil portions **22** and **23** are connected by the integral portion **26**. In effect, the coil portions **22** and **23** are what would result from taking a single helically wound coil and breaking it open slightly in the middle. If, for example, at an instant of time when the current is flowing up through the conductor **24** and down through the conductor **25**, the left-hand end of the coil portion **22** will be a south pole and the right-hand end thereof will be a north pole. Furthermore, the left-hand end of the coil portion **23** will be a south pole, and the right-hand end of the coil portion **23** will be a north pole. We thus see that there is a very strong concentration of flux across the gap **16** since the two inner ends of the coil portions **22** and **23** are of opposite polarity. Due to the fact that there is a large amount of magnetizable material below the coil portions **22** and **23**, the return flux path is predominantly concentrated in that region. A small amount of flux path returns above the top portion of the coil portions **22** and **23** adjacent the groove **13**. Since there is only a very small amount of metal here due to the fact that the slots **20** and **21** were close to the top edge of the core member **11**, it will be readily appreciated that the flux carried in this region is very small.

In order to compare the difference between a coil wound in the manner above described with an open slot type recorder head of the prior art, such a prior art construction has been illustrated in Figure 4 of the drawing. More particularly, the core member **11** and the prior art structure have a magnetizing and pick-up coil **27** wound through the central hole **15** and over the bottom edge **28** of the core member **11**. Let us now compare the difference. Assuming that the magnetizing field force at one end of the coil **27** is plus ten and that the other end is minus ten, we then find that the field at the upper left-hand corner of the core member may be minus nine and at the upper right-hand corner plus nine units of field force. Across the gap **16**, we have minus seven units at one pole and plus seven at the other pole. Due to the fact that there is a difference of M. M. F. at the opposite corners of the core member, there is a large leakage field as shown by the flux lines in Figure 4. This field is spaced around the core member **11** and introduces distortion into the wire when a recording is made.

In Figure 3 of the drawings, let us assume that the units of M. M. F. are the same at the pole tips **18** and **19**. That is to say, there is minus seven at one side and plus seven at the opposite side of the gap **16**. Due to the fact that the greatest part of the return path is through the metal itself forming the core member **11**, a condition exists where substantially the entire bottom and end edges of the core member **11** are all at zero magnetic potential. This is true even of the upper corners of the core member **11**. The most important thing is that the greatest magnetic potential is right at the air gap and that it

rapidly decreases along the upper edges in opposite direction as distinct from the prior art open slot type of recording head wherein the magnetic potential increases (in a postive or negative direction) as you move away from the air gap along the upper edge of the core member. The result of the construction shown in Figure 3 is that substantially the same result and the same effect is obtained as though the wire were passed directly through the center of the magnetizing coil. This latter type of arrangement has the great advantage of giving a much higher fidelity but has the disadvantage of not being able to readily insert and remove the wire from the recording head. The construction described herein has the advantages of both prior art types of heads and neither of the disadvantages of the prior art types of heads. Namely, it has the advantage of giving a high fidelity of a closed type head and yet at the same time has the advantage of providing an open slot head in which the wire may be introduced and removed even though the ends of the wire are confined.

The impedance of the recording head may be varied by varying the number of turns of wire in the coil portions **22** and **23** and the windings may be in the form of a single layer or a plurality of layers depending upon the impedance desired.

While I have shown a particular embodiment of my invention, it will, of course, be understood that I do not wish to be limited thereto, since many modifications may be made, and I, therefore, contemplate by the appended claims to cover all such modifications as fall within the true spirit and scope of my invention.

I claim as my invention:

1. A magnetic recording head comprising a plate of relatively high magnetic permeability and relatively low magnetic retentivity, a groove extending along one edge of said plate for receiving and guiding a traveling record medium, said plate having a non-magnetic gap therein extending inwardly from said one edge, said plate having a pair of slots in close proximity to said one edge on opposite sides of said gap, said plate having at least one additional opening therein, and a magnetizing coil wound through said slots and said additional opening.

2. A magnetic recording head comprising a plate of relatively high magnetic permeability and relatively low magnetic retentivity, a groove extending along one edge of said plate for receiving and guiding a traveling record medium, said plate having a non-magnetic gap therein extending inwardly from said one edge, said plate having a pair of slots in close proximity to said one edge on opposite sides of said gap, said plate having at least one additional opening therein, and a magnetizing coil wound through said slots and said additional opening, the coil being wound the same way on both sides of said gap, whereby the adjacent ends of the coil portions on opposite sides of said gap are of opposite magnetic polarity.

3. A magnetic recording and reproducing head comprising a core member of relatively high magnetic permeability and relatively low magnetic retentivity, means for guiding a traveling record medium over a predetermined path, at least three apertures in said core member, the first and second of said apertures being located in close proximity to said path of travel of said record medium, said core member having a non-magnetic gap between said first and second apertures, and a recording and reproducing coil wound partly

through the first and partly through the second of said apertures and the additional apertures.

MARVIN CAMRAS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,351,007	Camras	June 13, 1944

FOREIGN PATENTS

Number	Country	Date
357,378	Great Britain	Sept. 14, 1931
805,434	France	Nov. 19, 1946