Dec. 21, 1948. M. CAMRAS 2,456,767

COMBINATION OF MAGNETIC TRANSDUCING AND ERASING HEADS

Filed Nov. 29, 1945 2 Sheets-Sheet 1

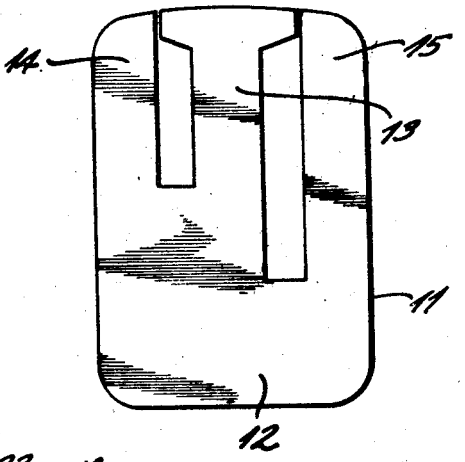

Fig. 1

Fig. 2

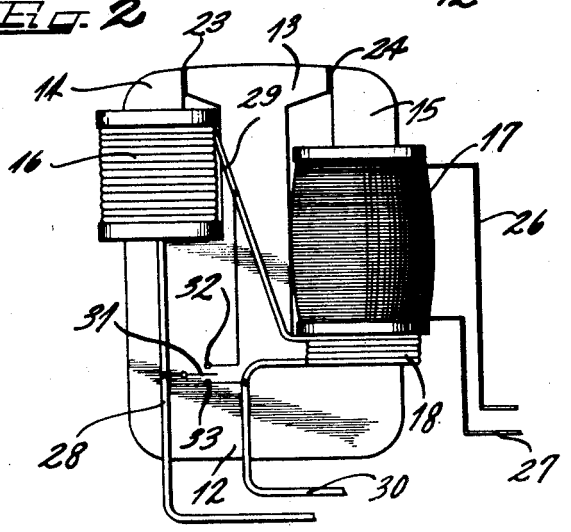

Fig. 3

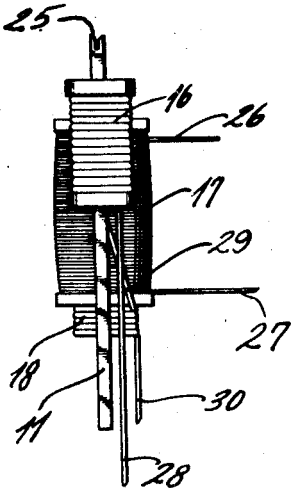

Fig. 4

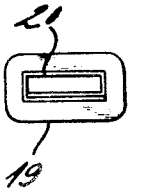

Fig. 5

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COMBINATION OF MAGNETIC TRANSDUCING AND ERASING HEADS

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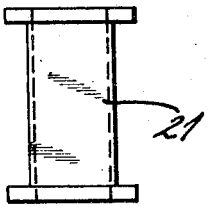

Fig. 6

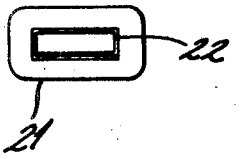

Fig. 7

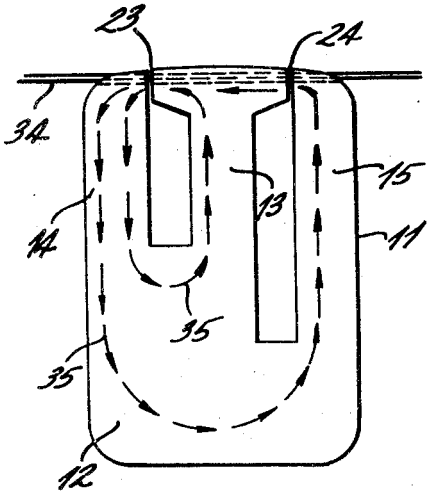

Fig. 8

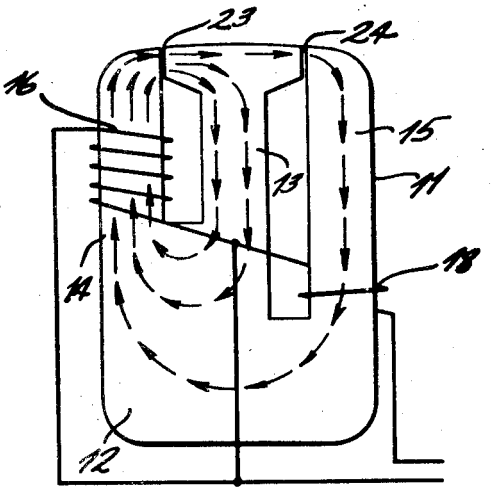

Fig. 9

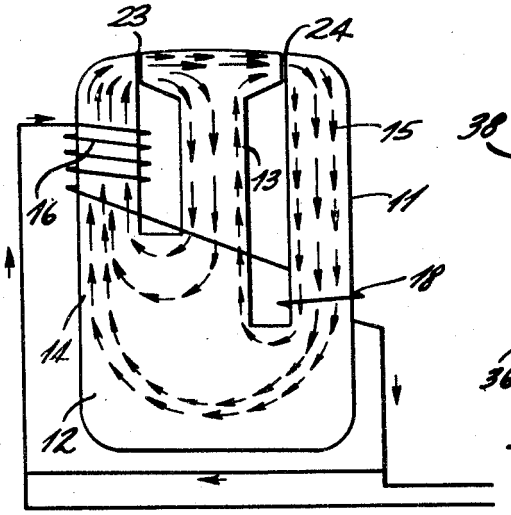

Fig. 10

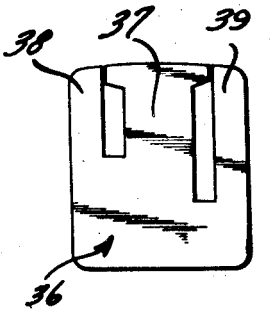

Fig. 11

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Patented Dec. 21, 1948 2,456,767

UNITED STATES PATENT OFFICE

2,456,767

COMBINATION OF MAGNETIC TRANSDUCING AND ERASING HEADS

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Application November 29, 1945, Serial No. 631,682

14 Claims. (Cl. 179—100.2)

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This invention relates to a magnetic recording and reproducing head and more particularly to an electromagnetic transducer head which is especially suited for use with a wire or other elongated recording medium which is longitudinally magnetized.

In magnetic recording and reproducing devices it has been found very desirable to have a head in which a single-core piece comprises the core for the erasing coil, for the signal coil, and for the coil which supplies a high frequency component to the non-magnetic gap associated with the signal coil during the recording operation. It has also been found desirable that such an electromagnetic transducer head should be of the so-called "open slot" type whereby an elongated record medium does not have to be threaded through any of the coils. When magnetic material having a relatively high coercive force is used for the elongated record medium, considerable difficulty has been experienced in the past in properly and adequately erasing the previous history on the record medium. Difficulty has also been experienced during reproduction where a common core structure is used for both the erasing coil and for the signal coil since the stray flux created in the core by the record medium crossing the erase gap sets up an out of phase flux which threads the signal oil. This out of phase flux represents distortion of the voltage induced in the signal coil.

One of the principal features and objects of the present invention is to provide a novel electromagnetic transducer head which overcomes the difficulties previously experienced.

Another object of the present invention is to provide a novel arrangement of erase coil, high frequency coil and signal coil on a single core piece.

Still another object of the present invention is to provide a novel core structure for a magnetic recording and reproducing head.

Still another and further object of the present invention is to provide a novel method and means for recording on and reproducing from an elongated magnetizable record medium.

Still another and further object of the present invention is to provide a novel magnetic recording and reproducing head wherein the erase coil is short circuited during reproduction.

Another and still further object of the present invention is to provide a novel magnetic recording and reproducing head wherein the erase coil and the high frequency coil which are used during a recording operation are connected in series

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and short in whole or in part during reproduction.

The novel features which I believe to be characteristic of my invention are set forth in particularity in the appended claims. My invention itself, however, 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 following description taken in connection with the accompanying drawings, in which:

Figure 1 is an elevational view of the core member of an electromagnetic transducer head embodying the novel teachings and principles of the present invention;

Figure 2 is an elevational view of the core shown in Figure 1 with the erase coil, signal coil and high frequency coil mounted thereon;

Figure 3 is an end view of the assembly shown in Figure 2;

Figure 4 is an elevational view of the erase coil spool;

Figure 5 is a top view of the erase coil spool;

Figure 6 is an elevational view of the signal coil spool;

Figure 7 is a top view of the signal coil spool;

Figure 8 is a diagrammatic illustration of the flux introduced in the core piece shown in Figure 1 due to the passage of a longitudinally magnetized wire across the erase gap;

Figure 9 is a diagrammatic illustration of the counter-flux which tends to be set up in the core piece upon short circuiting of the erase coil alone while leaving the high frequency coil open circuited;

Figure 10 shows the counter-flux which tends to be set up by both the erase coil and the high frequency coil when these two coils are connected in series and short circuited; and

Figure 11 is an elevational view of a modified form of core.

Referring first to Figure 1 of the drawings, there is illustrated therein a core 11 for an electromagnetic transducer head. This core 11 is in the form of a flat plate or stamping having a base portion 12, a central T-shaped leg 13 and two outer legs 14 and 15. The leg 15 is somewhat longer than the leg 14 in order that it may accommodate a signal coil 17 as well as a high frequency coil 18 while the leg 14 only accommodates an erase coil 16. The core 11 may be formed of any suitable magnetic core material having a relatively high initial permeability, a relatively low coercive force and having a saturation level somewhat higher than the record medium with

which the head is to be used. By way of example and not by way of limitation, this material may be that which is commonly known in the trade as "4750 alloy." Further, by way of example and not by way of limitation, this core piece may be approximately .20 inch thick and approximately three-quarters of an inch high.

In Figure 2 of the drawings, the erase coil 16, the signal coil 17 and the high frequency coil 18 are shown mounted on the core. The erase coil 16 is mounted on the leg 14 while the signal coil 17 and the high frequency coil 18 are mounted on the leg 15. While the high frequency coil is shown as being disposed below the signal coil 17, its relative position on the leg 15 may be reversed if desired.

The erase coil 16 may be conveniently wound on a spool 19 such as shown in Figures 4 and 5 of the drawings, the spool 19 having a central opening 20 to enable it to be slipped over the leg 14 in a manner presently to be described. Similarly, the signal coil may be conveniently wound on a spool 21 as may be seen in Figures 6 and 7 of the drawings, the spool 21 having a central opening 22 to enable it to be slipped over the leg 15.

The above referred to structure enables a very economical production of the electromagnetic transducer head since the erase coil 16 and the signal coil 17 may be wound in advance on their respective spools 19 and 21 on any bobbin or spool winding machine. To assemble the coils on the core 11, the legs 14 and 15 are bent out of the plane of the leg 13 sufficient to enable the spools 19 and 21 to be slipped over their respective legs. The legs 14 and 15 are then bent back into position so that they lie in the same planes as the central leg 13 and the gaps are checked and adjusted with a thickness gauge. At this time a drop of solder or other non-magnetic binder is preferably dropped into the gaps 23 and 24. The solder dropped into the gaps 23 and 24 not only serves to hold the legs in a position where their gaps are fixed and determined, but also serves to keep dust and other foreign particles out of the gaps.

The upper edges of the legs 14, 13 and 15 are slotted lengthwise of the edge as at 25 to receive a wire or thread-like record medium.

The high frequency coil 18 is formed by simply winding a few turns of the lead wire to the erase coil 16 around the leg 15 in such a direction as to oppose the stray flux from the erase gap. This is preferably done before the signal coil 17 has been dropped into place.

The signal coil 17 has its opposite ends connected through conductors 26 and 27 to the main circuit of the magnetic recorder and reproducer (not shown).

The lower end of the erase coil 16 is connected through a conductor 28 to one side of a suitable source of high frequency electric energy. The other side of the erase coil 16 has a conductor 29 which is the end of the coil 16 which leads over the leg 15 and is wrapped therearound to form the high frequency coil 18. From there it extends as a conductor 30 to the other side of the source of high frequency electric energy. This high frequency electric energy may have a frequency which varies through wide limits without departing from the spirit and scope of the present invention. By way of example and not by way of limitation, the frequency of this source may be of the general order of magnitude of twenty to fifty kilocycles per second.

As diagrammatically shown in Figure 2 of the drawings, a switch 31 is preferably provided for either short circuiting the erase coil 16 itself by closing the switch against a contact 32 which is connected to the conductor 29 or else closing the switch against a contact 33 which is connected to the conductor 30 leading from the high frequency coil 18. When the switch 31 is closed against the contact 32, the erase coil 16 is short circuited while the high frequency coil 18 is open circuited (assuming that the high frequency source is also disconnected). When the switch 31 is closed against the contact 33, the erase coil 16 and the high frequency coil 18 are connected in series and short circuited. This switch 31 is preferably closed for a reason which will now be explained whenever the electromagnetic transducer head is being used for reproduction, while it is left open when the erase coil 16 and the high frequency coil 18 are being energized from the high frequency source and the signal coil 17 is being employed to record signals on a traveling record medium passing through the slot 25 in the top edge of the core 11.

The reason why it is desirable to short circuit either the erase coil alone or the erase coil and the high frequency coil when the head is being used for reproduction will be apparent from an inspection of the flux diagrams in Figures 8, 9 and 10 of the drawings. If there were no coils on the head and a longitudinally magnetized wire 34 were to pass from left to right as viewed in Figure 8 of the drawings, flux would be set up in the core piece 11 when the magnetized portion of the wire crosses the erase gap 23. Flux would also be set up when the magnetized portion of the wire 34 crosses the reproducing gap 24. The flux which is produced by the wire crossing the erase gap 23 is undesirable since the portion thereof which threads the reproducing gap is out of phase with the flux set up therein by the portion of wire which is crossing the reproducing gap at the time the other portion of the wire is crossing the erase gap.

In Figure 8 of the drawings, the flux set up in the core piece 11 by virtue of the wire passing across the gap 23 is indicated by the flux arrows 35. One flux path for the stray flux is, of course, through the leg 14, the center leg 13 and the base portion 12. Another flux path for this stray flux is through the two outer legs 14 and 15 and the base portion 12. It is this stray flux which flows through the outer leg 15 and hence across the gap 24 which causes distortion in the reproduction.

By short circuiting the erase coil, a counter-M. M. F. may be established which tends to balance out the stray field flux since it is in the opposite direction when it crosses the gap 24. This counter-flux which counter-M. M. F. tends to set up and which results from the short circuiting of the erase coil 16 alone by closing the switch 31 against the contact 32 is illustrated in Figure 9 of the drawings.

If the counter-M. M. F. produced by the erase coil 16 is not strong enough to overcome the stray flux, the high frequency coil may be included in the shorted circuit so that the counter-M. M. F. established by it when the two coils are short circuited will be in aiding relation to the counter-M. M. F. produced by the erase coil 16, with both in opposition to the stray flux tending to cross the gap 24.

In the above description reference has been made to the fact that in the embodiment illustrated in Figure 2 the contact 33 is connected to conductor 30. If the current flowing through the

shorted circuit of the erase coil and the high frequency coil, which was induced therein by flux threading the erase coil, establishes an M. M. F. in flowing through the high frequency coil which is greater than that necessary to offset the stray flux in the signal gap coming from the erase gap, the contact 33 may be tapped in at a suitable intermediate point on the high frequency coil which point includes just a sufficient amount of the high frequency coil in the shorted circuit to create an M. M. F. which counterbalances the stray field which tends to produce stray flux in the signal magnetic circuit.

Where in the above described embodiment of the invention I have diagrammatically illustrated a switch as being the means for shorting the erase coil and the high frequency component coil, it is to be understood that this is merely a diagrammatic example of any convenient method for providing a low impedance path for the circuit of the erase coil and the high frequency coil. It will, of course, be understood by those skilled in the art that the low impedance path might be provided by the high frequency circuit itself, since most high frequency output circuits have a very low impedance path to low frequency signals, although they have a high impedance to high frequency energy of the magnitude which is employed for the high frequency component of the electromagnetic transducer head.

In Figure 11 of the drawing I have illustrated a modified form of core for an electromagnetic transducer head. It has been found that a core of this particular character reduces the stray pick-up, although it is somewhat larger in size than the compact arrangement illustrated in Figure 1 of the drawings. More particularly, a core 36 is illustrated having a relatively wide T-shaped center leg 37 and a pair of side legs 38 and 39. Side legs 38 and 39 are similar to the side legs 14 and 15 of Figure 1 of the drawings while the center leg 37 is similar to leg 13 of Figure 1 of the drawings but is much wider. It has been found that by using a relatively wide center leg as compared with the side legs, short circuiting of the erase coil alone is usually sufficient to substantially eliminate the undesirable stray flux from the erase gap.

From the above description, it will be apparent that I have provided an extremely efficient magnetic recording and reproducing head which is very easy to manufacture and which may be produced at low cost.

While I have shown and described certain particular embodiments of my invention, it will of course be understood that I do not wish to be limited thereto, since many modifications and changes 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 core of paramagnetic material for a magnectic transducer head having a base portion, a central generally T-shaped leg rising from said base, a substantially straight second leg and a substantially straight third leg rising from said base on either side of said central leg and disposed in such a manner that their extremities are slightly spaced from the T-shaped head of said central leg to provide non-magnetic gaps therewith, all of said legs lying in a single plane.

2. A core of paramagnetic material for a magnetic transducer head having a base portion, a central generally T-shaped leg rising from said base, a substantially straight second leg and a substantially straight third leg rising from said base on either side of said central leg, said third leg being longer than said second leg, said second and third legs terminating opposite the T-shaped extremity of said central leg and in closely spaced relationship thereto, thereby to provide a pair of non-magnetic gaps therewith, all of said legs lying in a single plane.

3. A magnetic recorder and reproducer comprising a paramagnetic core having a pair of non-magnetic gaps therein through which a traveling record medium is arranged to pass, a signal coil associated with one of said gaps, a magnetic signal erasing coil associated with the other of said gaps, and means for selectively short-circuiting said erasing coil.

4. A magnetic recorder and reproducer comprising a paramagnetic core having a pair of non-magnetic gaps therein through which a traveling record medium is arranged to pass, a signal coil associated with one of said gaps and a magnetic signal erasing coil associated with the other of said gaps, and the erasing coil circuit being substantially short circuited during reproduction.

5. An electromagnetic tranducer comprising a paramagnetic core having a pair of non-magnetic gaps therein through which a traveling record medium is arranged to pass, a signal coil associated with one of said gaps, a high frequency component coil associated with the same one of said gaps, an erasing coil associated with the other of said gaps, and means for selectively short-circuiting said erasing coil and said high frequency component coil.

6. An electromagnetic transducer comprising a paramagnetic core having a pair of non-magnetic gaps therein through which a traveling record medium is arranged to pass, a signal coil associated with one of said gaps, a high frequency component coil associated with the same one of said gaps, an erasing coil associated with the other of said gaps, and means for selectively short-circuiting said erasing coil and a portion of said high frequency component coil.

7. An electromagnetic transducer comprising a paramagnetic core having a pair of non-magnetic gaps therein through which a traveling record medium is arranged to pass. an electric signal coil associated with one of said gaps, a magnetic signal erasing coil associated with the other of said gaps, a high frequency component coil connected in series with said erasing coil and associated with the same gap as said signal coil, and means for short-circuiting the serially connected erasing coil and high frequency coil.

8. An electromagnetic transducer comprising a paramagnetic core having a pair of non-magnetic gaps therein through which a traveling record medium is arranged to pass, an electric signal coil associated with one of said gaps, a magnetic signal erasing coil associated with the other of said gaps, a high frequency component coil connected in series with said erasing coil and associated with the same gap as said signal coil, said high frequency component coil being wound in the opposite direction from the direction of winding of said erasing coil, and means for effectively short circuiting said erasing coil and at least a portion of said high frequency coil.

9. An electromagnetic transducer comprising a paramagnetic core having a pair of non-magnetic gaps therein through which a traveling record medium is arranged to pass, an electric signal

coil associated with one of said gaps, a magnetic signal erasing coil associated with the other of said gaps, a high frequency component coil connected in series with said erasing coil and associated with the same gap as said signal coil, and means for selectively short-circuiting said erasing coil only.

10. An electromagnetic transducer comprising a paramagnetic core having a pair of non-magnetic gaps therein through which a traveling record medium is arranged to pass, an electric signal coil associated with one of said gaps, a magnetic signal erasing coil associated with the other of said gaps, a high frequency component coil connected in series with said erasing coil and associated with the same gap as said signal coil, said high frequency component coil being wound in the opposite direction from the direction of winding of said erasing coil, and means for effectively short-circuiting said erasing coil.

11. An electromagnetic transducer head for transducing signal energy between a traveling magnetic record medium and an electric circuit comprising a core plate of relatively thin paramagnetic material having a base portion of three upstanding legs all disposed in substantially the same plane, the center leg of the three having a T-shaped extremity and the other legs, one on either side of said center leg, being substantially straight, the extremities of said side legs being disposed in slightly spaced relationship with the ends of the T-shaped extremity of said center leg to provide non-magnetic gaps therebetween, a magnetic erasing coil on one of said side legs, an electric signal coil and a high frequency component coil on the other of said side legs, said high frequency biasing coil being serially connected with said erase coil.

12. An electromagnetic transducer head for transducing signal energy between a traveling magnetic record medium and an electric circuit comprising a core plate of relatively thin paramagnetic material having a base portion of three upstanding legs all disposed in substantially the same plane, the center leg of the three having a T-shaped extremity and the other legs, one on either side of said center leg, being substantially straight, the extremities of said side legs being disposed in slightly spaced relationship with the ends of the T-shaped extremity of said center leg to provide non-magnetic gaps therebetween, a magnetic erasing coil on one of said side legs, an electric signal coil and a high frequency component coil on the other of said side legs, said high frequency biasing coil being serially connected with said erase coil, said side leg on which said transducer coil and said high frequency biasing coil is mounted being substantially longer than said side leg upon which said erase coil is mounted.

13. An electromagnetic transducer head for transducing signal energy between a traveling magnetic record medium and an electric circuit comprising a core plate of relatively thin paramagnetic material having a base portion of three upstanding legs all disposed in substantially the same plane, the center leg of the three having a T-shaped extremity and the other legs, one on either side of said center leg, being substantially straight, the extremities of said legs being disposed in slightly spaced relationship with the ends of the T-shaped extremity of said center leg to provide non-magnetic gaps therebetween, a magnetic erasing coil on one of said side legs, an electric signal coil and a high frequency component coil on the other of said side legs, said high frequency biasing coil being serially connected with said erase coil, said center leg being substantially wider than said side legs, whereby stray flux in signal gap during reproduction is reduced to a minimum.

14. A core of paramagnetic material for a magnetic transducer head having a base portion, a central generally T-shaped leg rising from said base, a substantially straight second leg and a substantially straight third leg rising from said base on either side of said central leg and disposed in such a manner that their extremities are slightly spaced from the T-shaped head of said central leg to provide non-magnetic gaps therewith, said center leg being substantially wider than said side legs, all of said legs lying in a single plane.

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