United States Patent [19]

Kruklitis

[11] **3,758,727**

[45] **Sept. 11, 1973**

[54] **MULTIPLE TRANSDUCER MAGNETIC HEAD**

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[73] Assignee: **Burroughs Corporation**, Detroit, Mich.

[22] Filed: **Oct. 22, 1971**

[21] Appl. No.: **191,897**

Related U.S. Application Data

[63] Continuation of Ser. No. 833,909, June 17, 1969, abandoned.

[52] **U.S. Cl.** ..... **179/100.2 C**, 340/174.1 F

[51] **Int. Cl.** **G11b 5/16**, G11b 5/28

[58] **Field of Search** ..... 179/100.2 C; 340/174.1 F; 346/74 MC

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Primary Examiner—James W. Moffitt

Attorney—Paul W. Fish et al.

[57] **ABSTRACT**

A magnetic reproducing head having a plurality of electro-magnetic transducers spaced within the magnetic influence of one another. Magnetic shields are interposed in the space between each transducer to eliminate the cross-coupling of magnetic lines of flux between adjacent transducers within the body of the magnetic head. An eddy current generating member is mounted to eliminate the cross-coupling of magnetic lines of flux externally to the face of the magnetic head.

3 Claims, 8 Drawing Figures

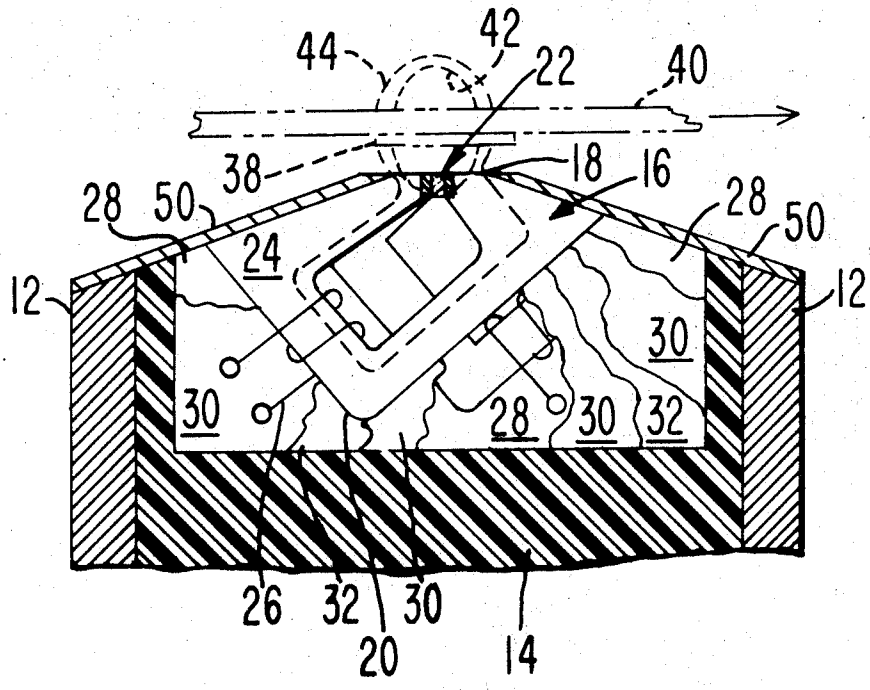


FIG. 1.

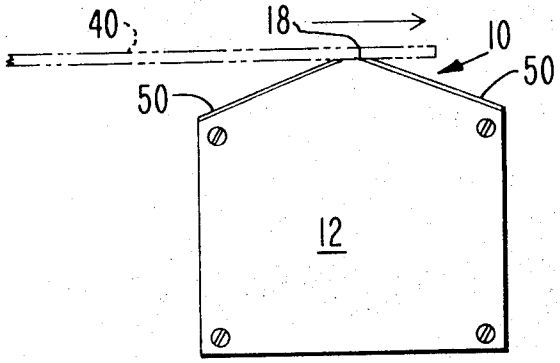


FIG. 2.

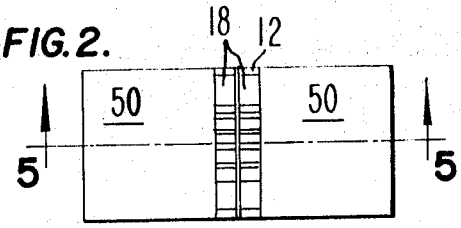


FIG. 3.

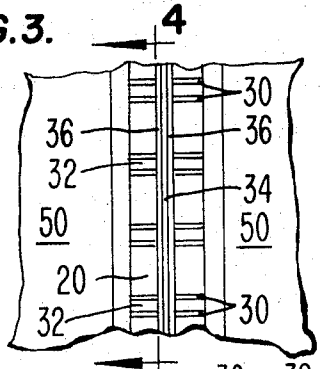


FIG. 5.

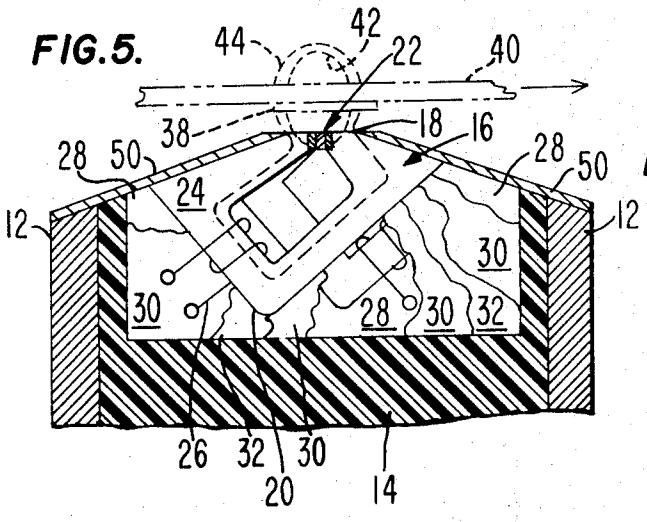


FIG. 4.

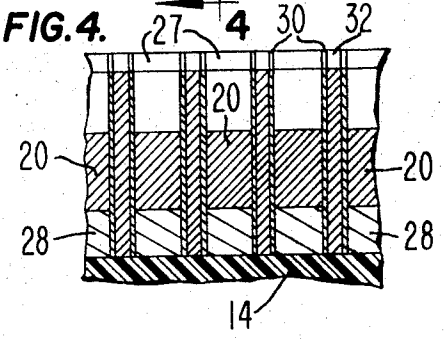


FIG. 6.

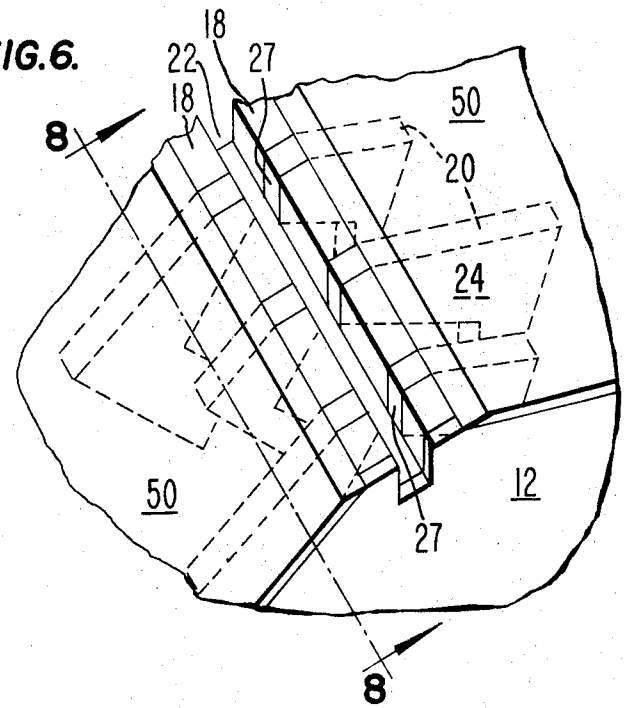


FIG. 7.

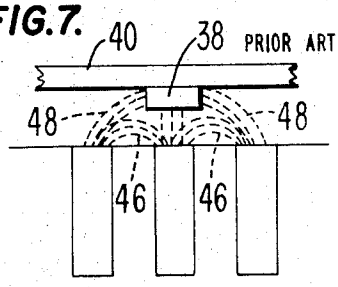
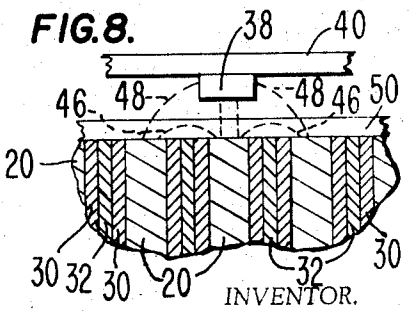


FIG. 8.



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MULTIPLE TRANSDUCER MAGNETIC HEAD

This is a continuation of application Ser. No. 833,909, filed June 17, 1969, and now abandoned.

PRIOR ART

Prior art multiple transducer magnetic heads have required spacing of the electro-magnetic transducers to avoid the cross-coupling of magnetic lines of flux between adjacent transducers. This spacing provides a large reluctance path to the cross-coupling magnetic circuit thereby minimizing the signal from adjacent passive transducers due to magnetic flux coupling from the active transducer. To reduce the spacing between transducers, several types of shields have been used externally to the multiple transducer magnetic head to shield each individual electro-magnetic transducer from cross-coupling lines of magnetic flux external to the head. These external shields increase the reluctance in the magnetic circuit between the transducer and a source of magnetic flux such as an encoded magnetic character thereby reducing the output signal from the transducer.

It is a principal object of this invention to eliminate the cross-coupling lines of flux between adjacent transducers without introducing additional reluctance in the primary magnetic circuit between the electro-magnetic transducer and a source of magnetism such as an encoded magnetic character or member.

It is another object to closely space a plurality of electro-magnetic transducers within a single magnetic head thereby increasing the integrity of the electrical signal derived from the encoded magnetic character.

SUMMARY OF INVENTION

A multiple transducer magnetic head having a plurality of closely spaced parallel electro-magnetic transducers and having a magnetic shield between adjacent electro-magnetic transducers. The front gap of each electro-magnetic transducer is aligned along a single plane extending orthogonal to the broadside of the transducers. An eddy current generating member overlies the several transducers to eliminate the external cross-coupling lines of magnetic flux between adjacent transducers.

DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a plan view of a multiple transducer magnetic head;

FIG. 2 is a front elevation of the head of FIG. 1;

FIG. 3 is an enlarged front elevation view of the gap area of the head of FIG. 1;

FIG. 4 is a fragmentary sectional view taken along line 4—4 of FIG. 3;

FIG. 5 is a fragmentary sectional view taken along line 5—5 of FIG. 2;

FIG. 6 is a fragmentary sectional perspective view of the magnetic head with certain parts omitted for clarity;

FIG. 7 is a diagrammatic view illustrating the objectional flux lines of the prior art;

FIG. 8 is a fragmentary sectional view taken along lines 8—8 of FIG. 6 illustrating the improvement of the present magnetic head.

DETAILED DESCRIPTION

Referring to the drawings there is shown a reproducing or read head **10** comprising in general a casing **12** opened at one end, a body **14** within the casing and a plurality or stack of electro-magnetic transducers **16** mounted on the body and positioned at the open end of the casing. The casing **12** is fabricated from a metallic material and the body is fabricated from a non-metallic, non-magnetic material such as an epoxy. The body **14** functions to support and retain the plurality of electro-magnetic transducers **16** in the casing.

At the open end of the casing **12,** the reproducing head **10** is basically truncated or "V"-shaped having a narrow flat surface **18** at the apex of the "V."

Each of the electro-magnetic transducers **16,** in the preferred embodiment there are thirty, comprises a flat laminated loop or ring-shaped core **20** having a single front gap **22** and parallel broadsides **24,** and a flat copper winding **26** wound around one end of the core. The front gap **22** of each transducer core **20** is defined by the ends **27** of each core **20** being positioned in opposed spaced apart relationship to each other. In the drawings, the laminations are not shown for reasons of clarity.

Each transducer **16** is supported by a core supporting member **28** having an aperture therein substantially the same size and shape as in the transducer core. The core supporting member **28** is substantially the same width as the transducer core **20.** Positioned on either side of the transducer core **20** and in contact with both the broadside of the core and the core supporting member **28** are a pair of insulating members **30** of a non-magnetic material such as half hard brass. Adjacent to and in contact with each of the insulating members **30** is a high permeability magnetic shield **32** foil which functions to prevent transformer coupling between adjacent windings **26** thereby serving to eliminate unwanted signals commonly called cross-talk.

In the preferred embodiment the thirty electro-magnetic transducers **16** are positioned with their core broadsides **24** parallel to each other within a space of slightly greater than ½ inch. As previously mentioned, interposed in the space between each transducer are two insulating members **30** with a magnetic shield **32** therebetween. In order to accomplish this packaging density of transducers wherein each transducer is within the magnetic influence or effective flux coupling of the adjacent transducer, the windings **26** are alternately aligned in two spaced-apart rows. The distance between each transducer **16** is substantially less than the width of a transducer core **20.**

The front gap **22** of each transducer is aligned along a plane orthogonal to the broadsides **24** of the cores **20** and centrally positioned along the flat surface **18** of the reproducing head at the open end of the casing. Within the gap length, which is one thousandth of an inch, there is positioned a magnetic shim **34** between a pair of shim insulating members **36.** The shim insulating members **36** are in contact with the loop ends **27** of the core **20.**

The electro-magnetic transducers **16** in the preferred embodiment are responsive to a magnetic field emitting from an encoded magnetic character **38** affixed to a passing document **40.** As illustrated, the lines of magnetic flux emitting from the character **38,** magnetically couple the character to the adjacent transducers with one of the innermost lines **42** of magnetic flux crossing the front gap **22** thereby not generating a current in the winding **26.** One of the outermost lines **44** of magnetic

flux is shown as passing through the transducer core **20** and magnetically coupling with the winding **26** to generate an electric signal therefrom.

In prior art multiple transducer magnetic heads, the center to center distance between adjacent electro-magnetic transducers must be large enough to prevent the cross-coupling lines **46** of magnetic flux from one transducer to an adjacent transducer from inducing an electrical signal in the adjacent transducer. Also, the lines **48** of magnetic flux emitting from an encoded magnetic character **38** which do not magnetically couple with the nearest transducer, must not substantially effect the adjacent transducers. As shown, the magnetic lines of flux from an encoded magnetic character not only couple with the nearest transducer but with each adjacent transducer. Also, the cross-coupling lines **46** of magnetic flux emitting from the middle transducer magnetically couple with each adjacent transducer. As is well known, the magnetic shield **32** in the space between adjacent transducers **16** functions to eliminate the cross-coupling of magnetic flux within the body **14** of the reproducing head **10** but does not shield adjacent transducers from the external cross-coupling lines **46** of magnetic flux.

To achieve closer spacing of the electro-magnetic transducers **16** and to substantially eliminate external cross-coupling lines **46** of magnetic flux as previously mentioned, the outer surfaces of the reproducing head **10** adjacent to the front gap **22** area have each been covered by a layer of electrically conductive material serving as an eddy current generating member **50.** This member **50,** which in the preferred embodiment is a copper plate, overlies and is in an abutting relationship with edge portions of each of the transducer cores **20** facing outwardly of the body **14.** The eddy current generating member **50,** in the preferred embodiment, does not extend across the flat portion **18** of the reproducing head **10** so as to not introduce additional reluctance in the magnetic circuit between encoded magnetic character **38** and the electro-magnetic transducers **16.**

Equating the diagrammatic representations of FIGS. **7** and **8** with the perspective of FIG. **6,** the diagrammatic view of FIG. **8** represents a sectional view taken through the eddy current generating member **50.**

The eddy current generating member **50** is a very low resistivity, less than 2.5 microhms-centimeter, non-magnetic metallic material. Copper, which has a resistivity of 1.682 microhm-centimer was selected in the preferred embodiment over gold or silver for reasons of economy. All three metals are classified as diamagnetic materials wherein an applied magnetic field such as from the cross-coupling lines **46** of magnetic flux, is slightly reduced due to the alternation of the atomic electron orbits produced by the field. When diamagnetic materials are placed in a magnetic field, they tend to orientate themselves in the direction of the field, with their magnetism opposing that of the field. Therefore, the cross-coupling lines **46** of flux generate an eddy current within the eddy current generating member **50** which in turn generates a magnetic field in opposition to the field of the cross-coupling lines of magnetic flux.

The eddy current generating member **50** overlies the edge portions of the electro-magnetic transducer cores **20** and may extend to the casing **12** where it is secured by any bonding means such as electrolytic plating.

The eddy current generating member **50** also functions to prevent external electro-magnetic signals from adversely effecting the electro-magnetic transducers **16** within the reproducing head **10.** Adverse effects are the generation of electrical signals from the transducer winding **26** from spurious signals external to the reproducing head **10.** These spurious signals are frequently the cause of electrical noise on the electro-magnetic transducer signal lines.

There has been shown and described a multiple transducer reproducing head **10** having an eddy current generating member **50** overlying the exposed ends of the electro-magnetic transducer cores **20.** The eddy current generating member **50** eliminates the cross-coupling lines **46** of magnetic flux between adjacent transducers **16** and thereby achieves a closer spacing between the center lines of the electro-magnetic transducers **16.**

What is claimed is:

1. In a low frequency multiple channel magnetic transducing head for reading magnetic inked characters comprising a stack of similar closely spaced apart thin flat magnetic transducing core elements each forming a closed magnetic circuit except for the provision of a front gap and so mounted by non-magnetic material to exhibit a general truncated formation including a pair of sloping walls coverging toward one another but terminating short of convergence to form a narrow flat surface therebetween and to locate the gaps in the core elements in the flat surface in alignment with one another for sensing magnetic inked characters on a record medium relatively movable closely past the head, the improvement comprising:

magnetic means disposed along said aligned gaps to decrease the reluctance of said gaps,

non-magnetic means insulating said magnetic means from said sloping walls, and

a thin layer of electrically conductive material contactually overlying each of said pair of sloping walls formed by the stack of magnetic core elements and covering substantially the surface area of each of the sloping walls, said electrically conductive layers terminating flush with the plane of the flat surface leaving exposed the aligned front gaps of the magnetic core elements, said electrically conductive layers responding to cross-coupling lines of magnetic flux between adjacent magnetic core elements of the stack and passing through the conductive layer for generating eddy currents in the layers which in turn generate magnetic flux lines operating in opposition to said cross-coupling lines of magnetic flux thereby substantially reducing interchannel crosstalk.

2. In a low frequency multiple channel magnetic transducing head according to claim **1** wherein said electrically conductive layers approach the plane of the flat surface in a taper of decreasing material thickness so that the extremity of the taper terminates at the plane of the surface.

3. In a low frequency multiple channel magnetic transducing head according to claim **1** wherein said electrically conductive layers are composed of diamagnetic material having a resisitivity less than 2.5 microhms-centimeter.

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