Description

This invention relates to magnetic heads for writing on and reading from magnetic recording media and, more particularly, to thin film magnetic heads.

There are many alternative designs known in the prior art for integrated thin film magnetic heads in which an inductive head is used for writing and a magnetoresistive (MR) element is used for reading. In many of these designs the MR element is located at the air bearing surface (ABS), and a separate write structure is provided, the write gap of which is several microns from the read gap. As a result, should rotary actuators be used, track density can be limited by the misregistration of read and write tracks which varies with angle of the actuator.

It is therefore desirable to provide a design in which the read and write gaps are integrated in such a manner so that they are at the same place on a recording head. Having the MR element at the ABS is undesirable because it subjects electrical elements involved in signal generation to degradation in the event of contact between head and magnetic recording disk while power is applied to the MR element.

Integrated head designs are also known in which the MR element is located away from the ABS. For example, U.S. Patent 4,300,177 shows an integrated head in which the MR element is across a gap in one leg of the yoke (Fig. 1) or in a magnetic path across the yoke (Figs. 2 and 3).

Commonly assigned U.S. Patent 4,698,711 describes a vertical twin-track read/write head in which trite and read operations are integrated into a single pole. Flux is guided to the MR element by using one of the main poles of the write head so that the MR element is in the flux path for a write operation.

Commonly assigned U.S. patent 4,566,050 shows an MR read head for a hand-held magnetic reader in which a magnetic yoke has three legs and the MR element is interposed between two portions of the centre leg of the magnetic yoke. The outer legs of the magnetic yoke are spaced apart a distance so that only one of the outer legs and the centre legs is in position to read a recorded magnetic transition even when the plane of the MR element is skewed with respect to the magnetic transition.

EP-A-0 218 814 discloses an MR read/write head having the features of the first part of claim 1.

The prior art integrated thin film magnetic heads have not been designed with reluctances of various elements chosen so that both the read and write efficiencies are over fifty percent, the problem being that, if the MR element effectively shunts the transducing gap, the reluctance of the MR element must be low for good read efficiency and high for good write efficiency.

According to the present invention, there is provided a thin-film magnetic head for writing data to and reading data from a magnetic medium, the head comprising a magnetic yoke structure having two limbs forming at one end confronting pole pieces having a write gap therebetween, each limb being wound with a coil so that the flux produced in each limb by equally energizing the coils is equal, a flux guide being interposed between said two limbs and extending from the transducing gap so that, when there is equal and opposite flux in the two limbs, there is substantially zero flux in the flux guide, the flux guide having an opening therein; and a magnetoresistive element coupled across the opening, whereby data recorded on a magnetic medium can be sensed by the magneto-resistive element.

In a read operation, the magnetisation is rotated in the MR element in response to magnetic fields being read at the write gap.

During a write operation, very little flux flows through the central leg due to the symmetry of the magnetic yoke so there is minimal disturbance of the read head by the write process. During a read operation, the signal flux in the central leg significantly rotates the magnetisation in the MR element. Since the read and write circuits are essentially independent, each circuit can be designed to have a high efficiency.

An embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawing, wherein:

Fig. 1 is a simplified diagram of a magnetic disk file embodying the present invention;

Fig. 2 is a plan view of a thin film magnetic head embodying the present invention;

Fig. 3 is a section view taking along lines 3-3 of Fig. 2;

Fig. 4 is a section view taken along lines 4-4 of Fig. 2;

Fig. 5 is a view showing an alternate embodiment of the flux guide;

Fig. 6 is a view showing another embodiment of the flux guide;

Fig. 7 is a view showing a further embodiment of the flux guide;

Fig. 8 is a view showing an alternate embodiment of the magnetoresistive element;

Fig. 9 is a plan view of the thin film magnetic head showing an alternate embodiment of the coils;

Fig. 10 is a plan view of the thin film magnetic head showing a further embodiment of the coils;

Fig. 11 is a plan view of an alternate embodiment of the thin film magnetic head embodying the present invention.

The present invention is described as embodied in a magnetic disk file as shown in Fig. 1. At least one rigid rotatable magnetic disk 11 is supported on a spindle and rotated by a disk drive motor (not shown). The magnetic recording media on each disk is in the form of an annular pattern of concentric data tracks d as shown on disk 11.

As the disks rotate, the sliders are moved radially in and out so that the heads may access different portions of the disk surface containing the data. Each slider 13 supports one or more read/write head 10 and is attached to an actuator arm 15 by means of a suspension 17. The suspension 17 provides a slight spring force which biases the slider 13 against the disk surface. Each actuator arm 15 is attached to actuator means 19. The actuator means 19 shown schematically in Fig. 1 is a rotary actuator which is operable to move actuator arm 15 in a controlled manner about pivot point 21 as known in the art so that slider 13 and the associated read/write head 10 can be moved to a chosen one of the data tracks on magnetic recording medium 11.

During operation of the disk file, the rotation of the disk generates an air bearing between the slider 13 and the disk surface. The air bearing thus counterbalances the slight spring force of the suspension and supports the slider 13 off the disk surface during operation.

The above description of a typical disk file, and the accompanying illustration of it in Fig. 1 are for representative purposes only. It should be apparent that disk files may contain a large number of disks and actuators, and that each actuator may support a number of sliders.

Referring to Fig. 2 of the drawings, the thin film magnetic head 10, according to the present invention, comprises a first pole 12, a second pole 14 and magnetic yoke 16 which is contiguous with the second pole 14. A pair of coils 18 and 20 are wrapped helically about the magnetic yoke 16 and arranged so that a low reluctance magnetic circuit allows most of the magnetomotive potential applied by the coils 18, 20 to appear between first pole 12 and second pole 14 across a write gap 22. These elements provide a thin film magnetic write head with relatively low flux leakage between the two legs of the magnetic yoke 16 so that writing can be accomplished with high efficiency.

A flux guide 24 is cantered in the gap 22 between first pole 12 and second pole 14 and forms a relatively low reluctance path along the centre of the magnetic yoke 16 between the coils 18, 20 and flux guide 24 extends to the centre of the yoke 16 on the end 26 of the yoke 16 which is opposite the write gap 22. A gap 28 is provided in flux guide 24 at a position remote from write gap 22, and a magnetoresistive (MR) element 30 is positioned across gap 28 so that the signal flux in the flux guide 24 enters MR element 30 and significantly rotates the magnetisation in the MR element 30.

In operation, the thin film magnetic head 10 is positioned closely adjacent to the magnetic recording medium 11 which may comprise a magnetic disk or tape, for example. The separation between the air bearing surface (ABS) 34 of the magnetic head 10 and the magnetic recording medium 11 is maintained by an air bearing formed during relative motion between the magnetic head 10 and the magnetic recording medium 11 to a spacing of a few microinches, for example. The structure of the magnetic head 10 at the ABS 34 (Fig. 3) comprises first pole 12 and second pole 14 separated by the write transducing gap 22. In the embodiment shown, write transducing gap 22 is formed by first and second gap insulation layers 36, 38, the flux guide 24, and a third gap insulation layer 40.

The lower part 24l of flux guide 24 extends from the ABS 34 to gap 28, and the upper part 24u of flux guide 24 extends from gap 28 to the end 26 of magnetic yoke 16. Flux guide parts 24l and 24u are both shown in Fig. 2 as having parallel sides. However, the lower part 24l' (Fig. 5) can be tapered from a width W at gap 28 to a narrower width T at ABS/34 to more easily accommodate narrow track applications. In addition, flux guide parts 24l and 24u are both shown in Figs. 3 and 4 as comprising a single layer of magnetic material. However, flux guide parts 24l and 24u may comprise a laminated structure as shown in Fig. 6. The flux guide parts 24l and 24w comprise alternate thin layers of a ferromagnetic material 23 and a non-magnetic material 25. Flux guide parts 24l and 24w may also comprise a closed flux structure (Fig. 7) in which the ferromagnetic material 27 has edge closures around the non-magnetic material 29. The legs 16r and 16l of the magnetic yoke may also be produced with a laminated or flux closed structure, if desired.

The MR element 30 (Figs. 2 and 3) is normal to flux guide 24 so that the direction of current flow in the MR element is essentially parallel to the ABS 34, and the MR element is separated from flux guide 24 by the second gap insulation layer 38. Electrical conductor leads 42, 44 provide electrical contact to MR element 30, and READ control circuits 46 are coupled across conductor leads 42, 44. Although MR element 30 is shown as comprising a single layer, it is known in the art that the MR layer 30 may comprise other layers as well, such as biasing layers, for example. In addition, the MR element may require more than two conductor leads.

In the embodiment shown in Fig. 2 the MR element 30 and electrical conductor leads 42 and 44 are arranged so that current flows substantially normal to the flux guide 24 through the MR element 30. This arrangement is suitable for many applications. However, as track widths become narrower, the embodiment shown in Fig. 8 becomes increasingly more desirable. In this embodiment, the MR element 64 is elongated in a direction along the flux guide 24". The electrically conducting leads 66 and 68 are arranged so that the current flow through the MR element 64 is substantially parallel to the flux guide 24". This arrangement provides increased squares of resistance for narrow track applications.

Magnetic yoke 16 is defined as an open yoke since the two legs 16l and 16r are, for most of their length, displaced in the direction which would be the cross track direction when the magnetic head 10 is in use. In a preferred embodiment, the distance between the opposite legs 16l and 16r of the magnetic yoke 16 is more than 100 times the write gap 22 length for a majority of the length of the magnetic yoke 16. Coils 18 and 20 are fabricated helically about the legs 16l and 16r respectively of the magnetic yoke 16.

Each of the coils 18 and 20 are provided with two electrical leads 48, 50 and 52, 54 respectively, and the sense of winding of the coils 18, 20 on legs 16l and 16r magnetic yoke 16 is opposite. By connecting WRITE control circuits 56 across electrical leads 48 and 54 and connecting electrical leads 50 and 52 together, a WRITE current I produces a flux in the direction of arrow 58 in leg 16l of magnetic yoke 16 and produces a flux in the direction of arrow 60 in leg 16r of magnetic yoke 16. This flux provides a substantial magnetomotive potential difference between first pole 12 and second pole 14 which provides an efficient WRITE process. In the WRITE process, to the first order, no WRITE flux flows through the flux guide 24 due to the symmetry of the magnetic yoke 16, so there is minimal disturbance of the read head by the WRITE process. Equivalent operation can be obtained by connecting the two coils together internally as shown in Fig. 9 in which conductor 47 is deposited to connect coils 18 and 20.

In a READ operation, a sense current from READ control circuits 46 is passed through electrical leads 42 and 44 through the MR element 30. The sense current magnitude is selected at a level which provides a bias so that the MR element 30 is biased to a linear part of its resistance vs. magnetic flux characteristics curve. Alternatively, biasing of the MR element 30 may be by means of a current of a chosen low level magnitude in coils 18 and 20. In the embodiment shown in Fig. 10, biasing of the MR element may be produced by means of a current of a chosen low level magnitude in coil 18 and 20. A first current source 49 is connected across terminals 48 and 50, and a second current source 53 is connected across terminals 52 and 54. During a WRITE operation both current sources 49 and 53 produce a current I so that there is no net flux in the central leg of the magnetic yoke. During a READ operation current source 49 produces a current i and current source 53 produces a current -i so that the resulting flux is additive in the centre leg of magnetic yoke 16 where flux guide 24 is located. The level of current i utilised for this biasing technique is sufficiently small that the previously recorded data is not disturbed. Signals produced by resistance variation of the MR element 28 due to data previously recorded on recording medium 11 are sensed by the READ control circuits 46 as is conventionally practised for MR sensing.

An alternate embodiment of the thin film magnetic head is shown in Fig. 11, and this is currently the preferred embodiment. In this embodiment the basic head structure remains the same as the Fig. 2 embodiment. However, the back closure 62 of the magnetic yoke 16' is in the form of an inverted V with easy axis orientation as shown by the arrows in Fig. 11. The easy axis orientation is established by applying a suitable magnetic field in the direction of the arrows during the deposition of the magnetic material which forms the magnetic yoke 16' and the flux guide 24'. The same variations in connections to the coils can be made as described above with respect to the Fig. 2 embodiment.

The thin film magnetic head 10 is fabricated by the use of suitable deposition and patterning techniques that are known in the art. The bottom layer of the coils is deposited first. This is followed by a layer of insulation, either dielectric material such as alumina or hard baked resist. This layer electrically insulates the coils from the yoke structure. The part of the magnetic yoke which comprises first pole 12 and extends to the straight leg 16r is deposited next, followed by the deposition of an insulator layer 70 to provide a planar surface for the deposition of the other head components. The flux guide 24, the MR layer 30, and the electrical leads are deposited, along with the appropriate insulating layers prior to the deposition of the remainder of the magnetic yoke. The insulating layers include hard baked resist to insulate the coils 18, 20 and a mound 72 or non-magnetic spacer member (Fig. 4) to define the zero throat position. Suitably patterned dielectric, insulating material such as alumina may also be used.

The remainder of the magnetic yoke 16 is then deposited and this includes the second pole 14 and a contiguous structure which comprises leg 16l, back closure 26, and leg 16r which is deposited directly contacting the previously deposited layer of magnetic material which extends to first pole 12. After the deposition of suitable insulating material, vias are opened to the bottom coil layer so that the top coil layer can be deposited to provide electrical contact with the bottom coil layer and produce a coil 18 helically wrapped about leg 16l of the magnetic yoke and coil 20 helically wrapped about leg 16r of the magnetic yoke.

There has been described an integrated inductive write/magnetoresistive read thin film magnetic head comprising: an open magnetic yoke having outside legs and a central leg, said outer legs being overlapped at one end to form confronting pole pieces having a transducing gap between said pole pieces, said central leg having an opening and being positioned between said pole pieces at said one end and joined with said outer legs at the other end to produce a symmetrical yoke structure; a magnetoresistive element

coupled across said opening in said central leg; and a winding on each of said outside legs wound in a direction so that flux produced by equally energizing said windings is equal and in opposite directions in each of said outside legs.

Claims

1. A thin film magnetic head for writing data to and reading data from a magnetic medium, the head comprising a magnetic yoke structure having two limbs (16l, 16u) forming at one end confronting pole pieces (12, 14) having a write gap (22) therebetween, each limb being wound with a coil (18, 20) so that the flux produced in each limb by equally energising the coils is equal, a flux guide (24) being interposed between said two limbs ; and characterised by :
said flux guide (24) extending from the transducing gap so that, when there is equal and opposite flux in the two limbs, there is substantially zero flux in the flux guide, the flux guide having an opening therein; and a magnetoresistive element (30, 64) coupled across the opening, whereby data recorded on a magnetic medium can be sensed by the magneto-resistive element.

2. A thin film magnetic head as claimed in Claim 1 wherein said magnetoresistive element (30, 64) is elongated in a direction substantially normal to said flux guide.

3. A thin film magnetic head as claimed in Claim 1 wherein said magnetoresistive element (30, 64) is elongated in a direction substantially parallel to said flux guide.

4. A thin film magnetic head as claimed in any preceding claim wherein said magnetic yoke has a back closure at a position opposite to said write gap.

5. A thin film magnetic head as claimed in Claim 4 wherein said back closure is in the shape of an inverted V.

6. A thin film magnetic head as claimed in any preceding claim wherein said magnetic yoke structure is oriented with an easy axis in a direction substantially normal to said flux guide.

7. A thin film magnetic head as claimed in Claim 1 wherein said limbs are spaced apart a distance at least 100 times the write gap length.

8. A thin film magnetic head as claimed in any preceding claim wherein said flux guide has a laminated structure having alternate layers of a ferromagnetic material separated by layers of nonmagnetic material.

9. A thin film magnetic head as claimed in any of Claims 1 to 7 wherein said flux guide comprises a ferromagnetic material which is enclosed on all sides by nonmagnetic material.

10. A magnetic recording system comprising:
a magnetic recording medium (11) having a plurality of tracks for the recording of data;
a thin film magnetic head (10) as claimed in any preceding claim maintained in a closely spaced position relative to said magnetic recording medium during relative movement between said magnetic head and said magnetic recording member;
actuator means connected to said magnetic head for moving said head to selected tracks on said medium;
means operable in response to a write cycle to produce a current signal of a predetermined level in each of the coils so that the resulting flux in said magnetic yoke is additive at said write gap between said pole pieces so that a magnetic pattern, representative of data, is recorded on said magnetic recording medium in an area adjacent said write gap; and
means operable in response to a read cycle to rotate the magnetisation in said magnetoresistive element in response to previously recorded magnetic fields being read at said write gap.

Patentansprüche

1. Ein Dünnschichtmagnetkopf zum Schreiben/Lesen von Daten auf/von einem magnetischen Medium, wobei der Kopf eine magnetische Jochstruktur aufweist, mit zwei Schenkeln (16l, 16u), die an einem Ende einander gegenüberliegende Polstücke (12, 14) bilden, mit einem dazwischenliegenden Schreibspalt (22), wobei jeder Schenkel mit einer Spule (18, 20) umwickelt ist, so daß der in jedem Schenkel durch gleichmäßiges Erregen der Spulen erzeugte Fluß gleich ist, wobei zwischen den genannten beiden Schenkeln ein Flußpfad (24) angeordnet ist; und gekennzeichnet dadurch,
daß der genannte Flußpfad (24) von dem Wandlerspalt aus verläuft, so daß, wenn in den beiden Schenkeln ein gleicher und entgegengesetzter Fluß vorhanden ist, in dem Flußpfad im wesentlichen ein Null-Fluß vorhanden ist, wobei der Flußpfad über eine Öffnung verfügt; und ein magnetoresistives Element (30, 64), das über die Öffnung gekoppelt ist, wodurch auf einem ma-

coupled across said opening in said central leg; and a winding on each of said outside legs wound in a direction so that flux produced by equally energizing said windings is equal and in opposite directions in each of said outside legs.

Claims

1. A thin film magnetic head for writing data to and reading data from a magnetic medium, the head comprising a magnetic yoke structure having two limbs (16l, 16u) forming at one end confronting pole pieces (12, 14) having a write gap (22) therebetween, each limb being wound with a coil (18, 20) so that the flux produced in each limb by equally energising the coils is equal, a flux guide (24) being interposed between said two limbs ; and characterised by :
said flux guide (24) extending from the transducing gap so that, when there is equal and opposite flux in the two limbs, there is substantially zero flux in the flux guide, the flux guide having an opening therein; and a magnetoresistive element (30, 64) coupled across the opening, whereby data recorded on a magnetic medium can be sensed by the magneto-resistive element.

2. A thin film magnetic head as claimed in Claim 1 wherein said magnetoresistive element (30, 64) is elongated in a direction substantially normal to said flux guide.

3. A thin film magnetic head as claimed in Claim 1 wherein said magnetoresistive element (30, 64) is elongated in a direction substantially parallel to said flux guide.

4. A thin film magnetic head as claimed in any preceding claim wherein said magnetic yoke has a back closure at a position opposite to said write gap.

5. A thin film magnetic head as claimed in Claim 4 wherein said back closure is in the shape of an inverted V.

6. A thin film magnetic head as claimed in any preceding claim wherein said magnetic yoke structure is oriented with an easy axis in a direction substantially normal to said flux guide.

7. A thin film magnetic head as claimed in Claim 1 wherein said limbs are spaced apart a distance at least 100 times the write gap length.

8. A thin film magnetic head as claimed in any preceding claim wherein said flux guide has a laminated structure having alternate layers of a ferromagnetic material separated by layers of nonmagnetic material.

9. A thin film magnetic head as claimed in any of Claims 1 to 7 wherein said flux guide comprises a ferromagnetic material which is enclosed on all sides by nonmagnetic material.

10. A magnetic recording system comprising:
a magnetic recording medium (11) having a plurality of tracks for the recording of data;
a thin film magnetic head (10) as claimed in any preceding claim maintained in a closely spaced position relative to said magnetic recording medium during relative movement between said magnetic head and said magnetic recording member;
actuator means connected to said magnetic head for moving said head to selected tracks on said medium;
means operable in response to a write cycle to produce a current signal of a predetermined level in each of the coils so that the resulting flux in said magnetic yoke is additive at said write gap between said pole pieces so that a magnetic pattern, representative of data, is recorded on said magnetic recording medium in an area adjacent said write gap; and
means operable in response to a read cycle to rotate the magnetisation in said magnetoresistive element in response to previously recorded magnetic fields being read at said write gap.

Patentansprüche

1. Ein Dünnschichtmagnetkopf zum Schreiben/Lesen von Daten auf/von einem magnetischen Medium, wobei der Kopf eine magnetische Jochstruktur aufweist, mit zwei Schenkeln (16l, 16u), die an einem Ende einander gegenüberliegende Polstücke (12, 14) bilden, mit einem dazwischenliegenden Schreibspalt (22), wobei jeder Schenkel mit einer Spule (18, 20) umwickelt ist, so daß der in jedem Schenkel durch gleichmäßiges Erregen der Spulen erzeugte Fluß gleich ist, wobei zwischen den genannten beiden Schenkeln ein Flußpfad (24) angeordnet ist; und gekennzeichnet dadurch,
daß der genannte Flußpfad (24) von dem Wandlerspalt aus verläuft, so daß, wenn in den beiden Schenkeln ein gleicher und entgegengesetzter Fluß vorhanden ist, in dem Flußpfad im wesentlichen ein Null-Fluß vorhanden ist, wobei der Flußpfad über eine Öffnung verfügt; und ein magnetoresistives Element (30, 64), das über die Öffnung gekoppelt ist, wodurch auf einem ma-

* C L M S *

gnetischen Medium aufgezeichnete Daten von dem magnetoresistiven Element gelesen werden können.

2. Ein Dünnschichtmagnetkopf nach Anspruch 1, bei dem das genannte magnetoresistive Element (30, 64) in einer Richtung verlängert ist, die im wesentlichen senkrecht zu dem genannten Flußpfad liegt.

3. Ein Dünnschichtmagnetkopf nach Anspruch 1, bei dem das genannte magnetoresistive Element (30, 64) in einer Richtung verlängert ist, die im wesentlich parallel zu dem genannten Flußpfad verläuft.

4. Ein Dünnschichtmagnetkopf nach jedem der vorangehenden Ansprüche, bei dem das genannte magnetische Joch in einer Position, die dem genannten Schreibspalt gegenüberliegt, einen hinteren Schluß aufweist.

5. Ein Dünnschichtmagnetkopf nach Anspruch 4, bei dem der genannte hintere Schluß die Form eines umgekehrten V hat.

6. Ein Dünnschichtmagnetkopf nach jedem vorangehenden Anspruch, bei dem die genannte magnetische Jochstruktur in einer Vorzugsrichtung ausgerichtet ist, die im wesentlichen senkrecht zu dem genannten Flußpfad verläuft.

7. Ein Dünnschichtmagnetkopf nach Anspruch 1, bei dem die genannten Schenkel einen Abstand voneinander aufweisen, der mindestens das 100-fache der Schreibspaltlänge beträgt.

8. Ein Dünnschichtmagnetkopf nach jedem vorangehenden Anspruch, bei dem der genannte Flußpfad eine Schichtstruktur aufweist, mit abwechselnden Schichten aus einem ferromagnetischen Material, getrennt durch Schichten aus einem nichtmagnetischen Material.

9. Ein Dünnschichtmagnetkopf nach jedem der Ansprüche 1 bis 7, bei dem der genannte Flußpfad ein ferromagnetisches Material umfaßt, welches auf allen Seiten von nichtmagnetischem Material umschlossen ist.

10. Ein magnetisches Aufzeichnungssystem, das folgendes umfaßt:
ein magnetisches Aufzeichnungsmedium (11) mit einer Vielzahl von Spuren zum Aufzeichnen von Daten;
einen Dünnschichtmagnetkopf (10) nach jedem vorangehenden Anspruch, der, bezogen auf das genannte magnetische Aufzeichnungsmedium bei einer relativen Bewegung zwischen dem genannten Magnetkopf und dem genannten magnetischen Aufzeichnungselement in einem engen Abstand gehalten wird;
Stellantriebsmittel, die mit dem genannten Magnetkopf verbunden sind, zum Bewegen des genannten Magnetkopfes zu ausgewählten Spuren auf dem genannten Medium;
Mittel, die in Antwort auf einen Schreibzyklus ein Stromsignal eines vorbestimmten Pegels in jeder der Spulen erzeugen, so daß der resultierende Fluß in dem genannten magnetischen Joch an dem genannten Schreibspalt zwischen den genannten Polstücken additiv ist, so daß ein magnetisches Muster, das die Daten darstellt, auf dem genannten magnetischen Aufzeichnungsmedium in einem Bereich aufgezeichnet wird, der an den genannten Schreibspalt angrenzt; und
Mittel, die in Antwort auf einen Lesezyklus die Magnetisierung in dem genannten magnetoresistiven Element in Antwort auf zuvor aufgezeichnete Magnetfelder, die an dem genannten Schreibspalt gelesen werden, drehen.

Revendications

1. Tête magnétique à film mince pour écrire des données sur un milieu magnétique et pour lire des données à partir de celui-ci, la tête comprenant une structure de bobine magnétique comportant deux branches (16l, 16u) formant à une extrémité des pièces polaires en vis-à-vis (12, 14) ayant un entrefer (22) entre elles, chaque branche étant enroulée par un bobinage (18, 20) de telle sorte que le flux produit dans chaque branche en excitant également les bobines est égal à un guide de flux (24) interposé entre lesdites deux branches; et caractérisée par le fait que ledit guide de flux (24) s'étend depuis l'entrefer de transduction de telle sorte que, lorsqu'il y a un flux égal et opposé dans les deux branches, il y a un flux sensiblement nul dans le guide de flux, le guide de flux ayant une ouverture dans celui-ci; et un élément magnétorésistif (30, 64) couplé sur l'ouverture, grâce à quoi les données enregistrées sur un support magnétique peuvent être détectées par l'élément magnétorésistif.

2. Tête magnétique à film mince selon la revendication 1 dans laquelle ledit élément magnétorésistif (30, 64) a une forme allongée dans une direction sensiblement normale audit guide de flux.

3. Tête magnétique à film mince selon la revendication 1, dans laquelle ledit élément magnétorésistif (30, 64) a une forme allongée dans une direction sensiblement parallèle audit guide de flux.

* C L M S *

4. Tête magnétique à film mince selon l'une quelconque des revendications précédentes dans laquelle ladite bobine magnétique a une fermeture arrière opposée audit entrefer d'écriture.

5. Tête magnétique à film mince selon la revendication 4, dans laquelle ladite fermeture arrière a la forme d'un V inversé.

6. Tête magnétique à film mince selon l'une quelconque des revendications précédentes dans laquelle ladite structure de bobine magnétique est orientée avec un axe facile dans une direction sensiblement normale audit guide de flux.

7. Tête magnétique à film mince selon la revendication 1 dans laquelle lesdites branches sont espacées d'une distance d'au moins 100 fois la longueur de l'entrefer d'écriture.

8. Tête magnétique à film mince selon l'une quelconque des revendications précédentes dans laquelle ledit guide de flux a une structure en couches comportant des couches alternées d'un matériau ferromagnétique séparées par des couches de matériau non magnétique.

9. Tête magnétique à film mince selon l'une quelconque des revendications 1 à 7 dans laquelle ledit guide de flux comporte un matériau ferromagnétique qui est entouré sur tous les côtés par un matériau non magnétique.

10. Système d'enregistrement magnétique comprenant:

un support d'enregistrement magnétique (1) ayant une pluralité de pistes pour l'enregistrement de données;

une tête magnétique à film mince (10) selon l'une quelconque des revendications précédentes maintenue dans une position étroitement espacée par rapport audit support d'enregistrement magnétique au cours d'un déplacement relatif entre ladite tête magnétique et ledit élément d'enregistrement magnétique;

un moyen d'actionnement connecté à ladite tête magnétique pour déplacer ladite tête sur des pistes sélectionnées sur ledit support;

un moyen pouvant fonctionner en réponse à un cycle d'écriture pour produire un signal de courant d'un niveau prédéterminé dans chacune des bobines de telle sorte que le flux résultant dans ladite bobine magnétique s'ajoute dans ledit entrefer d'écriture entre lesdites pièces polaires de telle sorte qu'une configuration magnétique, représentative de données, est enregistrée sur ledit support d'enregistrement magnétique dans une zone adjacente audit entrefer d'écriture; et

un moyen pouvant fonctionner en réponse à un cycle de lecture pour faire tourner l'aimantation dans ledit élément magnétorésistif en réponse à des champs magnétiques enregistrés au préalable en cours de lecture au niveau dudit entrefer d'écriture.