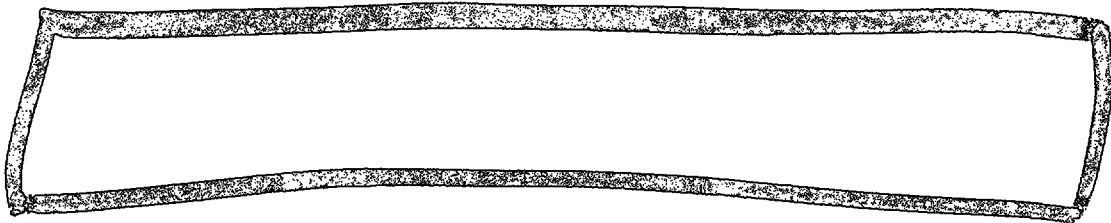


inductive magnetic conversion element and an MR element are shorted from each other by a substance with a resistance of 10^3 to $10^9 \Omega \text{ cm}$ and at least one electrode is connected between a pair of terminals that are connected to the MR element. However, in this prior art, a substance with a resistance of 10^3 to $10^9 \Omega \text{ cm}$ is required to short the inductive magnetic conversion element from the MR element and, furthermore, a diode, which is essentially not required to achieve the functions of the MR element, must be connected.

In addition, Japanese Unexamined Patent Publication (KOKAI) No. 141636/1995 discloses a technology whereby, in a structure in which a flexible printed board is employed as a lead conductor for the MR element, two terminals that are connected to the MR element are shorted during the manufacturing and assembly processes and the flexible printed board is cut prior to the characteristics measurement following the assembly work, to open the shorted area. However, this prior art may be adopted only when a flexible printed board is employed, and the technology does not take into consideration the possibility of using a twisted pair wire for the lead wire, which is often the case in this type of thin film magnetic head. Moreover, the flexible printed board must be cut using a special cutting tool. Furthermore, if a flexible printed board is employed, a probe must be used when connecting a characteristics measuring device.



US Patent No. 5,465,186 (IBM) discloses various arrangements for removing protective short circuits. In some of these arrangements special steps or tools such as laser ablation, chemical etching or ion milling are required. Alternatively, various tear off portions carrying the short circuit are provided with the intention that the short circuit can be manually removed. However, in this disclosure the tear off portions are separate from the connectors which are used to make external electrical connections to the magnetic head or slider.

DISCLOSURE OF THE INVENTION

It is an object of the present invention to provide a magnetic head apparatus in which breakdown caused by electrostatic discharge of an MR element can be prevented without requiring any additional parts such as diodes whilst employing twisted pair wire. In particular, a protective short circuit is provided which can be cut or opened manually without using a special cutting tool. The short circuit is incorporated in a connector which, without further modification, can be inserted into a characteristics measuring device after the cutting or opening of the short circuit is performed.

In order to achieve the objects described above, the magnetic head apparatus according to the preferred embodiments of the present invention includes a magnetic head, a head support device, a lead wire and a terminal board. The magnetic head is provided with a slider and one or more magnetic conversion elements mounted on the slider. At least one of the magnetic conversion elements is a read element which utilizes the magnetoresistance effect. The head support device supports the magnetic head. The lead wire is

are electrically shorted by a shorting portion 56 at a rearward position that is distanced from the connecting areas 54 and 55 over a distance. The wires 31 and 32 leading from the MR element 12 are connected to the terminal conductors 52 and 53 respectively. The wires 41 and 42 of the lead wire 4 led from the magnetic conversion element 13 are connected to the terminal conductors 62 and 63 respectively. The terminal conductors 62 and 63 are separated from the terminal conductors 52 and 53 by gaps G3 and G4 respectively. Grooves or perforations 57 for facilitating the cutting operation are provided between the shorting portion 56 and the connecting areas (54, 55) and (64, 65).

It will be obvious to a person skilled in the field to which the invention pertains that effects and advantages similar to those explained in reference to Figs 1 to 9 are achieved when one of the terminal boards shown in Figs 10 to 13 is employed.

As has been explained, according to the present invention, the following advantage is achieved:

A magnetic head apparatus is provided having a connector that can be directly inserted without further modification into a characteristics measuring device following a manual cutting operation for opening the circuit in which no special tool is provided.

CLAIMS

1. A magnetic head apparatus comprising:

a magnetic head having a slider and one or more magnetic conversion elements positioned at said slider, at least one of said magnetic conversion elements being a read element utilizing a magnetoresistance effect;

a head support device configured to support said magnetic head;

a lead having a pair of lead wires, one end of each of said pair of lead wires being connected to said read element;

a terminal board having a pair of terminal conductors on a hard substrate, said pair of terminal conductors ~~being shaped to mate with an external electric circuit, and~~ each having a first end and a second end, said second end having a connecting area that connects to respective other ends of said pair of lead wires, said pair of terminal conductors being electrically shorted to each other at a shorting portion located in an inclusive range between said connecting area and said first end; and

said hard substrate being provided with at least one of a groove and perforations to facilitate cutting in an area between said shorting portion and said connecting area ~~thereby open said electrical short, and said terminal conductors after cutting being receivable by said external electric circuit without further modification.~~

2. A magnetic head apparatus according to claim 1 wherein said external electric circuit is a characteristics measuring device.

3. A magnetic head apparatus according to claim 1 or 2, wherein:

said hard substrate includes said groove; and

said groove is V-shaped.

4. A magnetic head apparatus according to claim 1 or 2, wherein:

said hard substrate includes said perforation, said perforation comprising laterally aligned holes.

5. A magnetic head apparatus according to any of claims 1-4 wherein:

said magnetic head includes a write magnetic conversion element.

6 A magnetic head apparatus according to any of claims 1-5 wherein:

said head support device, with one end thereof in a lengthwise direction constituting a fixed end and another end thereof constituting a free end, is provided with a flexible supporting portion toward said free end and said flexible supporting portion is mounted at said head support device of said slider.



MAGNETIC HEAD APPARATUS

ABSTRACT

The present invention is directed to prevention of breakdown caused by electrostatic discharge in an MR element.

An MR element constitutes a read element. A head support device 2 supports a magnetic head 1. A lead wire 3 is constituted with at least a pair of lead wires 31 and 32 and each of the pair of lead wires 31 and 32 is connected to the read element at one end. A terminal board 5 is provided with at least one pair of terminal conductors 52 and 53 on top of a hard substrate 51. The pair of terminal conductors 52 and 53 are provided with connecting areas 54 and 55 respectively on the same side, to which one end of which are connected the other ends of the lead wires 31 and 32 respectively. The pair of terminal conductors 52 and 53 are electrically shorted from each other by a shorting portion 56 at a rearward position which is away from the connecting areas 54 and 55 over a distance.

Fig. 1