(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
31 July 2008 (31.07.2008)

PCT

(10) International Publication Number
WO 2008/089665 A1

(51) International Patent Classification:
G11B 5/48 (2006.01)

(21) International Application Number:
PCT/CN2008/000144

(22) International Filing Date: 21 January 2008 (21.01.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/881,738 22 January 2007 (22.01.2007) US

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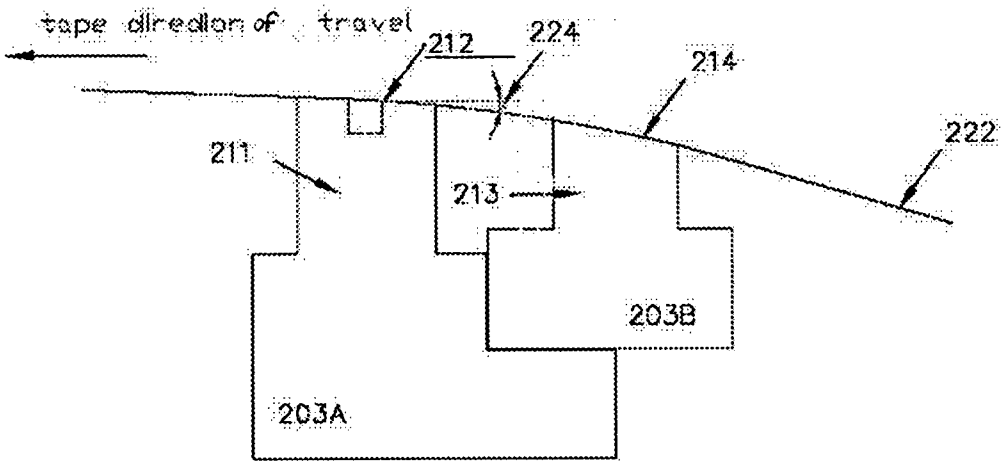
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

(54) **Title:** TAPE HEAD METHOD AND ASSEMBLY UTILIZING SPLIT TAPE STABILIZER DESIGN



(57) **Abstract:** A magnetic tape head assembly with split tape stabilizer element can eliminate the variation of tape wrap angle caused by drive manufacturing and reduce tape wear by reduce tape over-wrap angle on head. The magnetic tape head assembly comprises a recording gap, containing read/write element, and a split tape stabilizer element to support tape before tape passes through recording gap across the width of the head. The split tape stabilizer is aligned with the read/write element along the recording gap and this relationship is fixed by bonding the two components together. A tape head is formed having a first profile and having a stabilizer head interface area. A stabilizer head is formed having a second profile and having a tape head interface area. The tape head assembly and stabilizer head are then bonded by bonding the stabilizer head interface area to the tape head interface area such that the tape head and the stabilizer head have a desired configuration relative to each other and such that a gap is formed between the tape head and the stabilizer head.

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TAPE HEAD METHOD AND ASSEMBLY UTILIZING SPLIT TAPE STABILIZER DESIGN

FIELD OF THE INVENTION

[0001] The present invention relates to magnetic tape read/write heads, and more specifically, to the fabrication of magnetic tape heads designed to maintain contact between a magnetic tape and the tape head when tape wrap angle varies and thereby also varies the head edge pressure on the tape.

BACKGROUND OF THE INVENTION

[0002] As a tape moves over a tape head, an air bearing tends to form under the tape. This air bearing lifts the tape off the head, interfering with the read and write functionality of the tape head. In order to deal with this air bearing interference, tape heads were designed with an over-wrap angle to bleeding out the air before the tape enters the gap.

[0003] The over-wrap angle is a result of the tape wrap angle and the head contour design. The wrap angle (Normally around 5~12 ? is defined by the configuration of the tape drive. Figure 1 illustrates the wrap angle. Tape head 1 has selected contour. Tape 3 forms an angle with a line extending tangentially from the contour of tape head 1 at its edge, thus forming over-wrap angle 5.

[0004] The wrap angle normally varies within certain values, (normally +/-1? due to drive assembly process tolerance. A low tape wrap angle is likely to cause insufficient air bleeding and result in tape lift off from recording gap. A relative large wrap angle will cause large pressure at the edge of the tape head, which will cause tape wear problems in a drive application. The most common method to eliminate the tape wrap angle variation is implement a tape stabilizer element separated but parallel to recording head. An illustration of this is shown in Figure 2. Tape head 101 and stabilizer 103 are fromed from block 103. The tape wrap angle variation will be absorbed by tape stabilizer because the tape passes over the tape stabilizer first before passing over recording element.

[0005] A prior art process for forming such a stabilizer bump is shown in Figures 3-5. Figure 3 shows a monolithic block 103 with embedded transducers 105. A method forming block 103 including embedded transducers 105 can be found in Lam, *et al.*, U.S. Patent No. 6,950,289, which is fully incorporated herein by reference. In Figure 4, the face 107 of block 103 has been ground to provide a desired profile. Next a gap 109 is cut between read/write head 111 and stabilizer 113. The radius of curvature and the center of curvature of this profile formed in Figure 3 are selected for maximum read/write head performance.

[0006] The process of Figures 3-5 forms a tape stabilizer bump that is integrated with recording element bump. However, the difficulty of controlling the dimensions and profile of both the data island 115 (read/write head 111) and the profile of the outrigger island 117 (stabilizer 113) dimension during manufacturing process is high. In the process shown in Figures 3-5, the most economical method uses the same radius and center of curvature for both profile 115 and 117. But in many cases, the tape stabilizer bump and recording element bump are designed with different dimensions and profiles to achieve a optimized head/tape interface. So the process of Figures 3-5 is not cannot achieve a good head/tape interface and process yield. The process must be compromised to form the profile of both the profile of tape stabilizer bump and recording element bump, which does not form the optimized profile of both the profile of tape stabilizer bump and recording element bump. Meanwhile, this process causes high manufacturing costs because of the expensive, high precision equipment required to cut gap 109 in the step of Figure 5. In addition, a high precision cutting blade must be used to prevent chips/cracks along the slotting edge. Even with such expensive equipment, the process of Figure 5 is prone to error, thus reducing the yield of read/write heads due to scrappage.

[0007] Therefore, a head assembly with tape stabilizer bump with easy dimensional and profile control of the read/write head and the stabilizer is desirable. Further, a head assembly process with a low manufacture cost is desirable.

SUMMARY OF THE INVENTION

[0008] The described embodiments of the present invention include a tape head assembly and a method for forming the tape head assembly where a tape head is formed having a first profile and having an stabilizer head interface area. A stabilizer head is formed having a second profile and having a tape head interface area. The tape head assembly and stabilizer head are then bonded by bonding the stabilizer head interface area to the tape head interface area such that the tape head and the stabilizer head have a desired configuration relative to each other and such that a gap is formed between the tape head and the stabilizer head. In one embodiment, the stabilizer head interface area to the tape head interface area are adhesively bonded.

[0009] Using the described method, because the tape head and stabilizer are manufactured separately, it is easy to provide separate profiles for both components. This process individually forms the profile and dimension of recording element bump and tape stabilizer bump. The profile and dimension of tape head and stabilizer can be accurately controlled according to design requirement to achieve optimized head/tape interface. Also with this process there is no need for expensive equipment to form the slot between the tape head and the stabilizer. In addition, to improve the quality by remove the chip/rack in island edge formed during slotting process before final contour formed to reduce tape wear in drive.

SUMMARY OF THE DRAWINGS

[0010] Figure 1 is a side view of a tape head illustrating the concept of a wrap angle;

[0011] Figure 2 is a side view of a prior art tape head and stabilizer combination;

[0012] Figures 3-5 are side view illustrating a prior art process for forming the tape head stabilizer combination of Figure 1;

[0013] Figure 6-8 are side view illustrating a process that is one embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0014] Figure 6 is a side view showing the initial step to a process that is one embodiment of the present invention. Tape head block 203A is formed with read/write transducers 205 using known techniques such as that of U.S. Patent No. 6,950,289. Briefly, conductive coils (write) and magnetically sensitive material such as AMR/GMR element (read) (collectively transducers 205) are formed on a substrate using a suitable technique such as photolithographic techniques. The tape bearing surface is then lapped to provide precise spacing from transducers 205 to the tape bearing surface of the head.

[0015] Stabilizer block 203B is monolithic. Both blocks are formed of a material that has high wear resistance, high strength, is not easily fractured and has good electrical conductivity. One such material is alumina titanium carbide (Al_2O_3/TiC), which is a ceramic material, however, other materials may be advantageously employed.

[0016] As shown in Figure 7, tape head block 203A is machined to form tape head 211 having an optimal profile 212. Similarly, stabilizer block 203B is machined to form stabilizer 213 having profile 214 which is optimal for the stabilizer function. Because blocks 203A and 203 B are separately machined, profile 212 and profile 214 can be different without the need for expensive precision machinery capable of forming different profiles from the same block of material.

[0017] To complete the assembly, tape head block 203A is bonded to stabilizer block 203B. With this embodiment, a precison alignment of the stabilizer 213 relative to the tape head 211 is necessary. On the other hand, this alignment process can be used to compensate for variability in the formation of stabilizer 213 or tape head 211, while providing proper alignment between these two components. For present embodiment, a product specified alignment tool is recommended for the alignment process to ensure that

the distance, angle and relative height are controlled between stablizer 213 and tape head 211.

[0018] The bonding of stabilizer block 203B to tape head block 203A is preferably achieved using a high strength adhesive, such as UV glue. However, many bonding techniques known in the art may be used effectively depending on the materials used. Example alternative techniques are welding and soldering.

[0019] The final assembly 220 is shown in Figure 8. In this assembly, the profiles 212 and 214 of tape head 211 and stabilizer 213, respectively, are optimal for their respective functions. In addition, because stabilizer 213 is specifically aligned at the last step of assembly, the over-wrap angle 224 at the point where the tape 222 moves onto tape head 211 can be precisely controlled. This improves performance by minimizing the air bearing formed on tape head 211 as tape 222 moves across tape head 211.

[0020] Although specific embodiments of the invention are described herein, they are not to be construed as limiting the scope of the invention. Many other embodiments of the invention will become apparent to those skilled in the art in light of the teachings of this application. For example, although the embodiments described herein show the use of alignment tool , many other suitable techniques will be come apparent to those skilled in the art in light of the teaching of this specification. Each of these alternative embodiments and others are considered within the scope of the invention. The scope of the invention is limited only by the claims appended hereto.

WHAT IS CLAIMED IS:

1. A method for forming a tape head assembly comprising:

forming a tape head having a first profile and having an stabilizer head interface area;

forming a stabilizer head having a second profile and having a tape head interface area; and

bonding the stabilizer head interface area to the tape head interface area such that the tape head and the stabilizer head have a desired configuration relative to each other and such that a gap is formed between the tape head and the stabilizer head.

2. A method as in claim 1 wherein the stabilizer head interface area to the tape head interface area are adhesively bonded.

3. A method as in claim 1 wherein the stabilizer head interface area to the tape head interface area are soldered.

4. A method as in claim 1 wherein the stabilizer head interface area to the tape head interface area are welded.

5. A method as in claim 1 wherein the tape head is primarily composed of alumina titanium carbide.

6. A method as in claim 1 wherein the stabilizer head is primarily composed of alumina titanium carbide.

7. A method as in claim 1 wherein the stabilizer head interface includes an alignment feature and the tape head alignment interface includes a complementary alignment feature.

8. A method as in claim 7 wherein the alignment feature is a bump and the complementary alignment feature is a concavity.

9. A method for forming a tape head assembly comprising:

forming a ceramic tape head having a first profile and having an stabilizer head interface area including an alignment feature;

forming a ceramic stabilizer head having a second profile and having a tape head interface area including a complementary alignment feature; and

adhesively bonding the stabilizer head interface area to the tape head interface area such that the tape head and the stabilizer head are aligned according to the alignment feature and the complementary alignment feature.

10. A method as in claim 9 wherein the tape head is primarily composed of alumina titanium carbide.

11. A method as in claim 9 wherein the stabilizer head is primarily composed of alumina titanium carbide.

12. A tape head assembly comprising:

a tape head having a first profile and having an stabilizer head interface area;

a stabilizer head having a second profile and having a tape head interface area; and

wherein the stabilizer head interface area and the tape head interface area are bonded such that the tape head and the stabilizer head have a desired configuration relative to each other and such that a gap is formed between the tape head and the stabilizer head.

13. A tape head assembly claim 12 wherein the stabilizer head interface area to the tape head interface area is adhesively bonded.

14. A tape head assembly as in claim 12 wherein the stabilizer head interface area to the tape head interface area is bonded by soldering.

15. A tape head assembly as in claim 12 wherein the stabilizer head interface area to the tape head interface area are bonded by welding.

16. A tape head assembly as in claim 12 wherein the tape head is primarily composed of alumina titanium carbide.

17. A tape head assembly as in claim 12 wherein the stabilizer head is primarily composed of alumina titanium carbide.

18. A tape head assembly as in claim 12 wherein the stabilizer head interface includes an alignment feature and the tape head alignment interface includes a complementary alignment feature.

19. A tape head assembly as in claim 18 wherein the alignment feature is a bump and the complementary alignment feature is a concavity.

20. A tape head assembly comprising:

a ceramic tape head having a first profile and having an stabilizer head interface area including an alignment feature;

a ceramic stabilizer head having a second profile and having a tape head interface area including a complementary alignment feature; and

wherein the stabilizer head interface area and the tape head interface area are adhesively bonded such that the tape head and the stabilizer head are aligned according to the alignment feature and the complementary alignment feature.

21. A tape head assembly in claim 20 wherein the tape head is primarily composed of alumina titanium carbide.

22. A tape head assembly as in claim 20 wherein the stabilizer head is primarily composed of alumina titanium carbide.

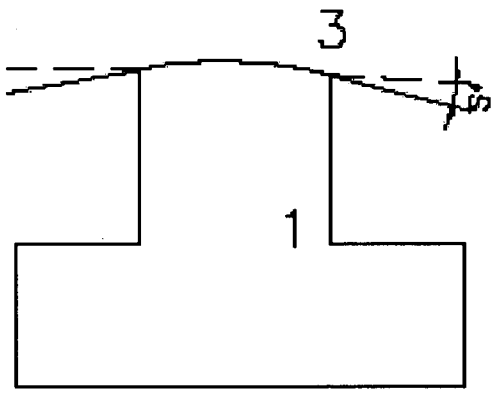

Fig 1

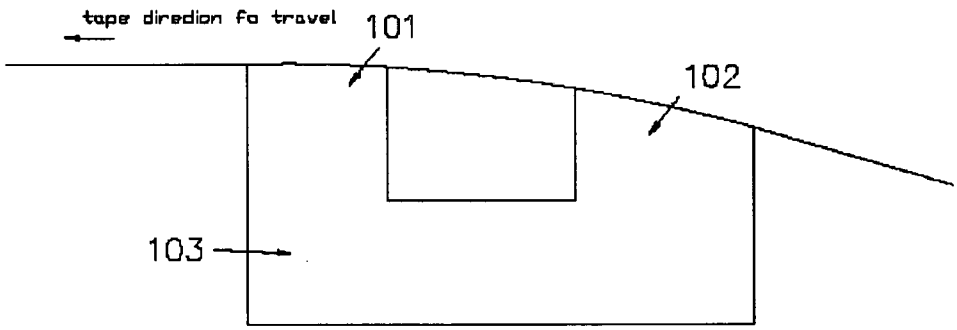

Fig 2 Prior Art

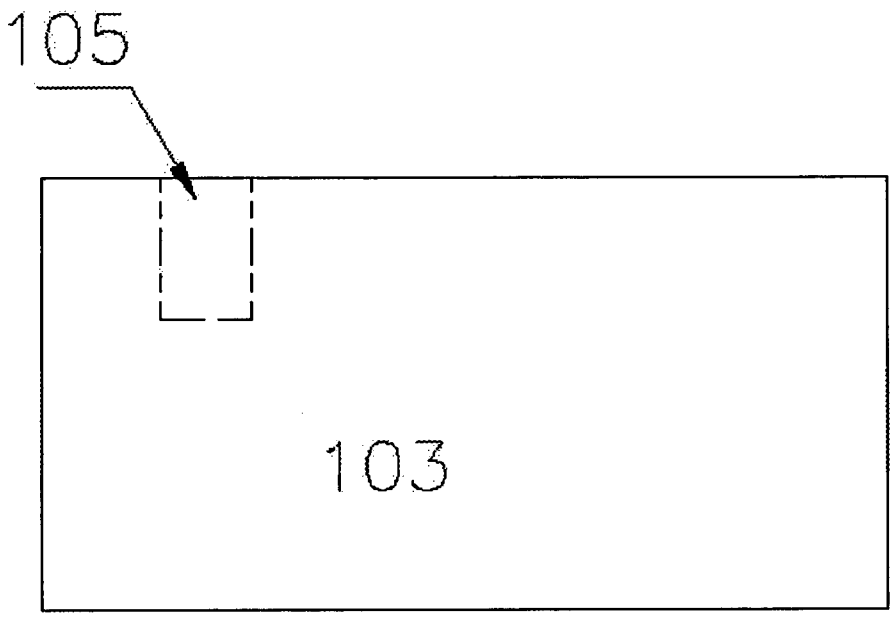

Fig 3 Prior Art

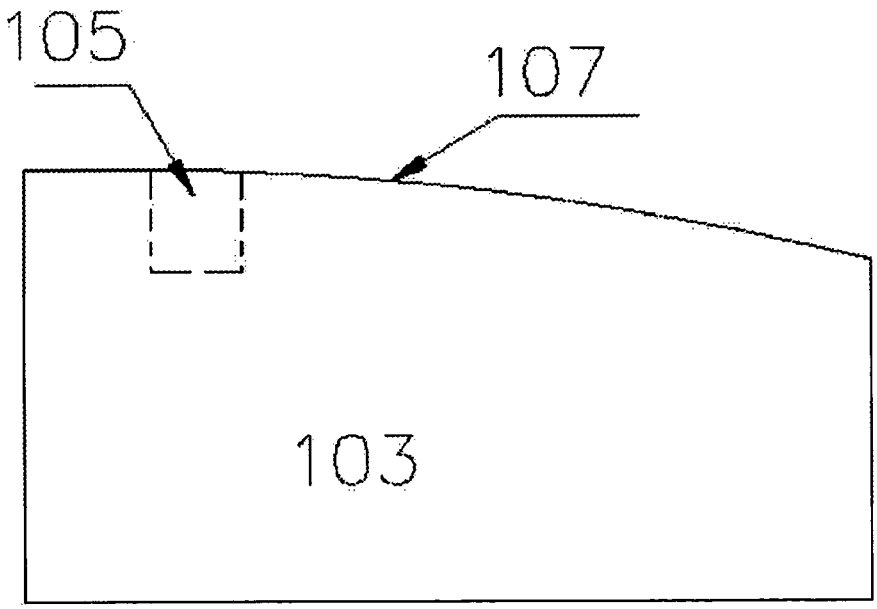

Fig 4 Prior Art

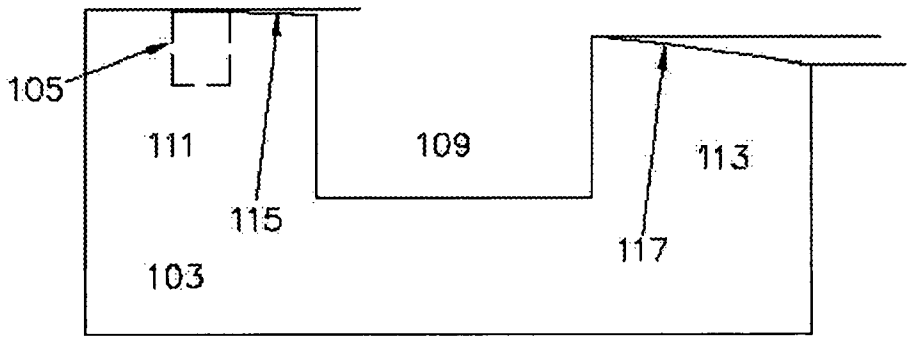

Fig 5 Prior Art

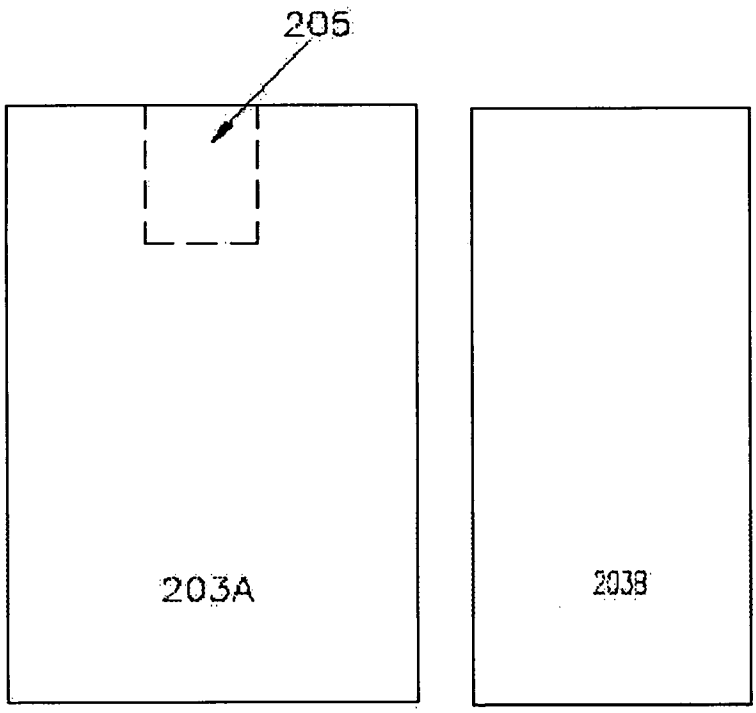

Fig 6

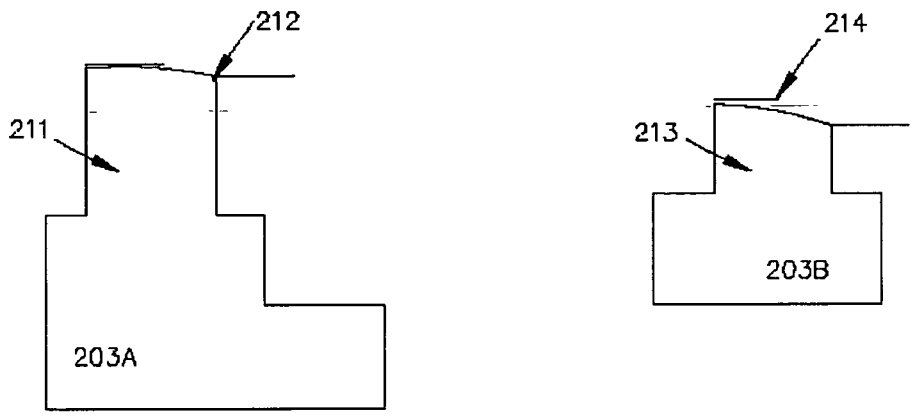
212
211
203A
214
213
203B

Fig 7

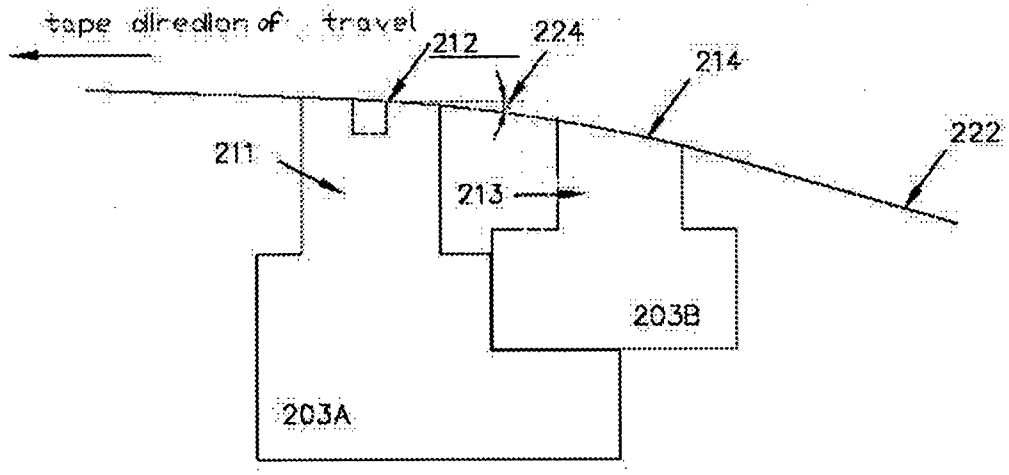
tape direction of travel
212
224
214
222
211
213
203B
203A

Fig 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2008/000144

A. CLASSIFICATION OF SUBJECT MATTER

IPC: G11B5/48 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G11B5/+;G11B15/+;G11B23/+

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used): WPI EPODOC PAJ CNPAT CNKI: magnetic+ tape+ read/write head+ wrap+ angle+ air+ bearing stabiliz+ gap+ bond+/weld+/solder+/adhesive+ individual+/separate+/ alone+/ single+/ respective+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2005/0168874 A1 (Biskeborn et al.) 4 Aug. 2005 (4.8.2005) The whole document	1-22
PA	CN 1920955 A (INT BUSINESS MACHINES CORP) 28 Feb. 2007 (28.2.2007) The whole document	1-22
A	US 6018444 A (BECK et al.) 25 Jan. 2000(25.1.2000) The whole document	1-22

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 Apr. 2008(11.4.2008)	**30 Apr. 2008 (30.04.2008)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer BIAN,Xishuang Telephone No. (86-10)62414221

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2008/000144

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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International application No.
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