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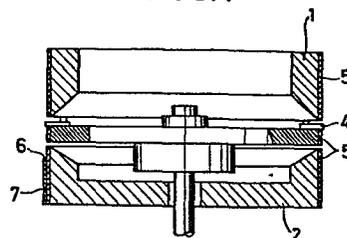
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㉘ **SLIDING MEMBER.**

㉙ A sliding member made with amorphous metallic material on the sliding surface. The sliding member has a small coefficient of friction with magnetic tape by constructing the member in this manner together with high hardness. Accordingly, it can prevent magnetic tape from adhering to the member and thus has excellent running characteristic.

**FIG.1**



## S P E C I F I C A T I O N

## SLIDING MEMBER

## Technical Field

5 The present invention relates to a sliding member and, more particularly, to a sliding member in which a sliding surface is made of an amorphous metallic material. The sliding member of the present invention may be for instance applied to a head drum, a tape guide and the like of a video tape recorder.

## 10 Background Art

In a video tape recorder or the like, a sliding member such as a tape guide or a head drum for guiding magnetic tape must have a small coefficient of friction with magnetic tape and an excellent abrasion  
15 resistance. Aluminum alloys widely adopted as conventional materials for the sliding members such as a head drum, have drawbacks in that they are easy to wear because of their relatively great coefficients of friction and low hardnesses. Therefore, the magnetic  
20 tape adheres to the sliding members made of aluminum alloys and may not run smoothly for this reason, or the magnetic tape causes squeaking. These phenomena are notable especially when the magnetic tape is run under the condition of relatively high temperature and  
25 humidity.

## Disclosure of Invention

In a sliding member of the present invention, the sliding surface is made of an amorphous metallic material, so that the coefficient of friction with  
30 magnetic tape is small; besides the hardness is high, and especially running characteristics of the tape are excellent.

## Brief Description of Drawings

35 Fig. 1 is a sectional view wherein a sliding member of the present invention is applied to a head drum of a video tape recorder.

Fig. 2 is an exploded perspective view wherein a sliding member of the present invention is applied to an AC head of a video tape recorder.

5 Fig. 3 is an exploded perspective view wherein a sliding member of the present invention is applied to a guide pin.

#### Best Mode of Carrying Out the Invention

10 Any amorphous metallic material may be used in the present invention as long as it satisfies the purpose to be accomplished by the sliding member of the present invention. Examples of such an amorphous metallic material may include those materials which contain transition metal elements such as Fe, Co or Ni or metal elements such as Cr in the atomic ratio of about 60 to 15 90%, or those materials which contain metalloids such as P, C, B or Si in the atomic ratio of about 40 to 10%.

20 For the present invention, it suffices that only the sliding surface of the sliding member is made of an amorphous metallic material. However, the overall sliding member may be made of an amorphous metallic material. The method for manufacturing only the sliding surface of the sliding member from an amorphous metallic material is not particularly limited; a 25 conventional method may be adopted. For instance, an amorphous metallic material is formed into a ribbon of a 20 to 30  $\mu$  thickness and the ribbon then adheres to the surface of a sliding member main body, which was made of another material to provide a sliding surface. 30 The amorphous metallic material may be easily formed into a ribbon by a rolling rapid cooling apparatus which is disclosed, for example, in Japanese Patent Application No. 52-22936 (Japanese Laid-Open Patent Application No. 53-106339) or in Japanese Patent Application No. 52-22937 (Japanese Laid-Open Patent 35 Application No. 53-106340). Needless to say, the amorphous metallic material may be easily formed into a

ribbon by the double-roller method, the single-roller method, the liquid rapid cooling method or the like. If the overall sliding member is made of an amorphous metallic material, a sliding member of desired shape may be prepared by the conventional forming. The amorphous metallic materials as described above are easy to work with as compared with ferrite or ceramic and are thus advantageous.

A comparison of coefficients of friction and Vickers Hardness (Hv) between various types of materials and the amorphous metallic material will be shown in the table below:

Table

| Material  | Coefficient of Friction | Vickers Hardness |
|---|-------------------------|------------------|
| Aluminum  | 0.24                    | -                |
| Sendust   | 0.23                    | 500              |
| Ferrite   | 0.16                    | 680              |
| Amorphous metallic material (Fe-Co-Si-B-type) (Surface roughness within $\pm 2 \mu$ ) | 0.12                    | 850              |
| (Surface roughness within $\pm 1 \mu$ )   | 0.16                    | -                |

As may be seen from the above table, the amorphous metallic materials have smaller coefficients of friction and higher hardnesses than those of aluminum, Sendust and ferrite. Furthermore, if the surface roughness is less than about  $\pm 2$  , the amorphous metallic material has an extremely small coefficient of friction. Therefore, the amorphous metallic material

provides a surface of an excellent quality without special finish.

The amorphous metallic material has magnetization lower than that of ferrite or the like and has  
5 electrification lower than that of ceramic.

As has been described above, the amorphous metallic material is particularly suitable for a material to make up the sliding surface of the sliding member.

10 The present invention will further be described with reference to the accompanying drawings.

A head drum of a video tape recorder shown in Fig. 1 is of three-layered structure including an upper stationary cylinder 1, a lower stationary cylinder 2  
15 and a rotary head cylinder 3. A pair of magnetic heads 4 are mounted on the rotary head cylinder. An amorphous metallic material layer 5 is formed on the tape sliding surface of each cylinder. Referring to Fig. 1, the material layer is formed by having a ribbon  
20 of an amorphous metallic material adhere to that part of the main body which will become the tape sliding surface.

Although a lead 6 for guiding magnetic tape is mounted on the lower stationary cylinder 2, this lead  
25 may be formed by having the other amorphous metallic material layer 7 adhere to the outer surface of the amorphous metallic material layer 5 so that the upper end of the layer 7 may serve as a lead. If the amorphous metallic material is made into a ribbon whose  
30 shape has a lead, another method to form a lead may be offered by having such ribbon adhere to the main body of the sliding member. In order to form a ribbon of such a shape with a rolling rapid cooling apparatus as described above, a step corresponding to the lead is  
35 formed on a cooling roller for rapidly cooling a melted amorphous metallic material, and the amorphous metallic material is rapidly cooled thereon.

According to the present invention, the amorphous metallic material layer may be formed on that part of the member which will be brought into sliding contact with magnetic tape and need not therefore be formed on the entire surfaces of the cylinders. If the sliding part or part of the sliding member alone is made of an amorphous metallic material, the rest of the member may be made of a conventional material such as a hard plastic or an aluminum alloy.

Fig. 2 shows an AC head (audio/control head) of a video tape recorder to which a sliding member of the present invention is applied. Magnetic heads 10 and 11 for recording audio and control signals respectively are mounted on the upper and lower side edges of the AC head. An amorphous metallic material layer 12 adheres to the sliding part between the magnetic heads.

Fig. 3 shows a guide pin to which a sliding member of the present invention is applied. In this guide pin, an amorphous metallic material layer 15 adheres to the tape sliding surface.

#### Industrial Applicability

Since that part of the sliding member of the present invention which corresponds to the sliding surface is made of an amorphous metallic material, the coefficient of friction between the sliding surface and magnetic tape is small and the sliding surface has a high hardness. Therefore, adhesion of the magnetic tape to the sliding member may be prevented and excellent running characteristics of the magnetic tape may be guaranteed. The amorphous metallic material is easy to work with and is effective to lower the manufacturing cost of the member.

Claims

1. A sliding member characterized in that a sliding surface is made of an amorphous metallic material.

5           2. A sliding member according to claim 1, characterized in that the amorphous metallic material is a metal element and a metalloid element.

10           3. A sliding member according to claim 2, characterized in that the metal element is transition metal elements such as Fe, Co and Ni, or Cr or the like.

            4. A sliding member according to claim 2, characterized in that the metalloid element is P, C, B Si, or the like.

15           5. A sliding member according to any one of claims 2 to 4, characterized in that the metal element is contained in an atomic ratio of about 60% to about 90% and the metalloid element is contained in an atomic ratio of about 40% to about 10%.

20           6. A sliding member according to any one of claims 1 to 5, characterized in that the amorphous metallic material is of Fe-Co-Si-B type.

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FIG. 1

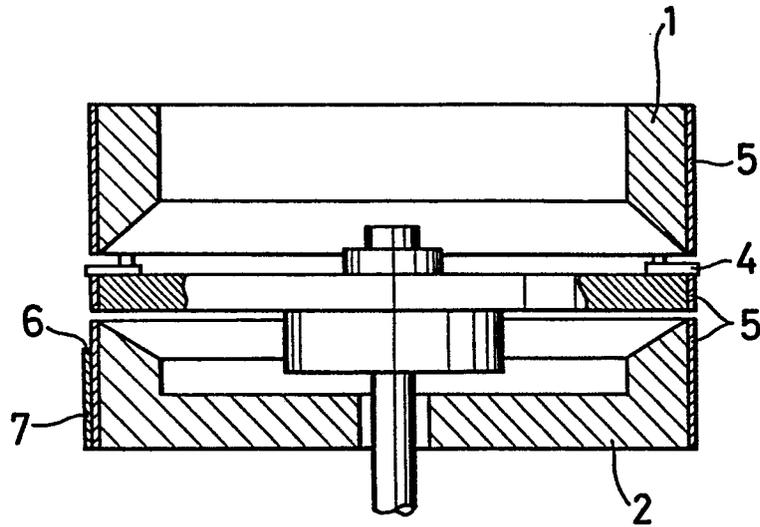


FIG. 2

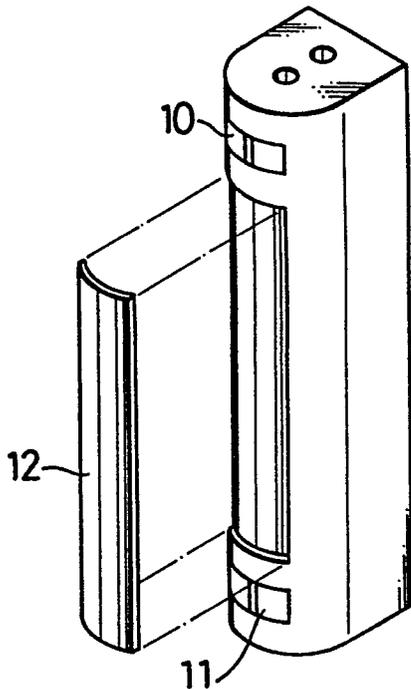
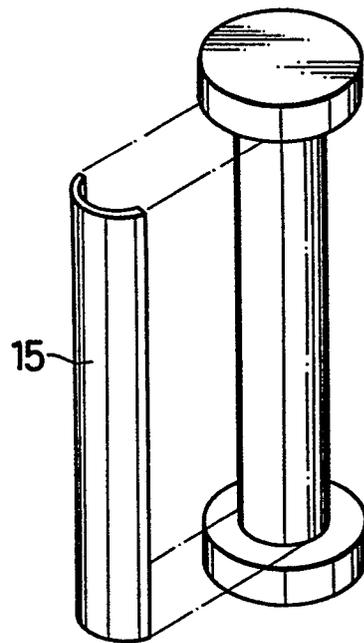


FIG. 3



INTERNATIONAL SEARCH REPORT

0067230

International Application No PCT/JP81/00366

|  |  |                                     |  |   |  |  |  |                                      |  |  |
|--|--|-------------------------------------|--|---|--|--|--|--------------------------------------|--|--|
| <b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>3</sup>  |  |                                     |  |   |  |  |  |                                      |  |  |
| According to International Patent Classification (IPC) or to both National Classification and IPC  |  |                                     |  |   |  |  |  |                                      |  |  |
| Int. Cl. <sup>3</sup> C22C 19/00, C22C 27/06, C22C 38/00, G11B 15/60, H01F 1/14  |  |                                     |  |   |  |  |  |                                      |  |  |
| <b>II. FIELDS SEARCHED</b>   |  |                                     |  |   |  |  |  |                                      |  |  |
| Minimum Documentation Searched <sup>4</sup>  |  |                                     |  |   |  |  |  |                                      |  |  |
| Classification System  | Classification Symbols   |                                     |  |   |  |  |  |                                      |  |  |
| I P C  | C22C 19/00, C22C 27/06, C22C 38/00, G11B 15/60, H01F 1/14  |                                     |  |   |  |  |  |                                      |  |  |
| Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>5</sup>   |  |                                     |  |   |  |  |  |                                      |  |  |
| <b>III. DOCUMENTS CONSIDERED TO BE RELEVANT</b> <sup>14</sup>  |  |                                     |  |   |  |  |  |                                      |  |  |
| Category <sup>6</sup>  | Citation of Document, <sup>16</sup> with indication, where appropriate, of the relevant passages <sup>17</sup>   | Relevant to Claim No. <sup>18</sup> |  |   |  |  |  |                                      |  |  |
| X  | JP,A, 51-73923 (The Research Institute for Iron Steel and other Metal, Tohoku University) 26, June, 1976 (26.06.76), Page 7, lower left column, lines 7 to 15  | 1 - 6                               |  |   |  |  |  |                                      |  |  |
| X  | JP,A, 52-114421 (The Research Institute for Iron Steel and other Metal, Tohoku University) 26, September, 1977 (26.09.77), Pages 1 to 3, Fig. 5  | 1 - 6                               |  |   |  |  |  |                                      |  |  |
| X  | JP,A, 53-47321 (The Research Institute for Iron Steel and other Metal, Tohoku University, TDK Electronics Co., Ltd.) 27, April, 1978 (27.04.78) Page 7, Table 1, Fig. 5                                    | 1 - 6                               |  |   |  |  |  |                                      |  |  |
| Y  | JP,A, 52-105525 (Allied Chemical Corp.) 5, September, 1977 (05.09.77), Page 6, lower right column lines 6 to 7 & US,A, 4038073 & DE, A1, 2708151 & FR, A1, 2343055   | 1 - 6                               |  |   |  |  |  |                                      |  |  |
| Y  | JP,A, 53-102219 (TDK Electronics Co., Ltd.) 6, September, 1978 (06.09.78), Page 1, Page 6, upper right column, lines 1 to 5  | 1 - 6                               |  |   |  |  |  |                                      |  |  |
| Y  | JP,A, 53-103924 (TDK Electronics Co., Ltd.) 9, September, 1978 (09.09.78), Page 7, lower left column, lines 13 to 16 & DE,A1, 2806052  | 1 - 6                               |  |   |  |  |  |                                      |  |  |
| <p>* Special categories of cited documents: <sup>15</sup></p> <table border="0"> <tr> <td>"A" document defining the general state of the art</td> <td>"P" document published prior to the international filing date but on or after the priority date claimed</td> </tr> <tr> <td>"E" earlier document but published on or after the international filing date</td> <td>"T" later document published on or 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</td> </tr> <tr> <td>"L" document cited for special reason other than those referred to in the other categories</td> <td>"X" document of particular relevance</td> </tr> <tr> <td>"O" document referring to an oral disclosure, use, exhibition or other means</td> <td></td> </tr> </table> |  |                                     | "A" document defining the general state of the art | "P" document published prior to the international filing date but on or after the priority date claimed | "E" earlier document but published on or after the international filing date | "T" later document published on or 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 | "L" document cited for special reason other than those referred to in the other categories | "X" document of particular relevance | "O" document referring to an oral disclosure, use, exhibition or other means |  |
| "A" document defining the general state of the art   | "P" document published prior to the international filing date but on or after the priority date claimed  |                                     |  |   |  |  |  |                                      |  |  |
| "E" earlier document but published on or after the international filing date   | "T" later document published on or 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 |                                     |  |   |  |  |  |                                      |  |  |
| "L" document cited for special reason other than those referred to in the other categories   | "X" document of particular relevance   |                                     |  |   |  |  |  |                                      |  |  |
| "O" document referring to an oral disclosure, use, exhibition or other means   |  |                                     |  |   |  |  |  |                                      |  |  |
| <b>IV. CERTIFICATION</b>   |  |                                     |  |   |  |  |  |                                      |  |  |
| Date of the Actual Completion of the International Search <sup>19</sup>  | Date of Mailing of this International Search Report <sup>20</sup>  |                                     |  |   |  |  |  |                                      |  |  |
| February 22, 1982 (22.02.82)   | March 1, 1982 (01.03.82)   |                                     |  |   |  |  |  |                                      |  |  |
| International Searching Authority <sup>1</sup>   | Signature of Authorized Officer <sup>20</sup>  |                                     |  |   |  |  |  |                                      |  |  |
| Japanese Patent Office   |  |                                     |  |   |  |  |  |                                      |  |  |

## FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

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

"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

V.  OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE <sup>10</sup>

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1.  Claim numbers \_\_\_\_\_, because they relate to subject matter <sup>12</sup> not required to be searched by this Authority, namely:

2.  Claim numbers \_\_\_\_\_, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out <sup>13</sup>, specifically:

VI.  OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING <sup>11</sup>

This International Searching Authority found multiple inventions in this international application as follows:

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3.  No required additional search fees were timely paid by the applicant. Consequently, this International search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

## Remark on Protest

The additional search fees were accompanied by applicant's protest.

No protest accompanied the payment of additional search fees.