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(54) **CONNECTOR WITH ESD PROTECTION**

STECKVERBINDER MIT ESD-SCHUTZ

CONNECTEUR AVEC UNE PROTECTION CONTRE LES DÉCHARGES ÉLECTROSTATIQUES (ESD)

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(56) References cited:
US-A1- 2001 017 771
US-A1- 2004 029 444
US-B1- 6 210 216
US-B1- 6 676 419

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Description

BACKGROUND AND SUMMARY

[0001] This invention relates generally to the use and structure of removable nonvolatile memory devices, particularly those having standardized connectors for interfacing with other electronic systems.

[0002] Electronic circuit cards, including non-volatile memory cards, have been commercially implemented according to a number of well-known standards. Memory cards are used with personal computers, cellular telephones, personal digital assistants (PDAs), digital still cameras, digital movie cameras, portable audio players and other host electronic devices for the storage of large amounts of data. Such cards usually contain a re-programmable non-volatile semiconductor memory cell array along with a controller that controls operation of the memory cell array and interfaces with a host to which the card is connected. Several of the same type of card may be interchanged in a host card slot designed to accept that type of card. However, the development of the many electronic card standards has created different types of cards that are incompatible with each other in various degrees. A card made according to one standard is usually not useable with a host designed to operate with a card of another standard. Memory card standards include PC Card, CompactFlash™ card (CF™ card), SmartMedia™ card, MultiMediaCard (MMC™), Secure Digital (SD) card, a miniSD™ card, Subscriber Identity Module (SIM), Memory Stick™, Memory Stick Duo card and TransFlash™ memory module standards.

[0003] Small, hand-held re-programmable non-volatile memories have also been made to interface with a computer or other type of host through a Universal Serial Bus (USB) connector. These are especially convenient for users who have one or more USB connectors available on the front of their personal computers, particularly if a receptacle slot for one of the above identified memory cards is not present. Such devices are also very useful for transferring data between various host systems that have USB receptacles, including portable devices. Mechanical and electrical details of the USB interface are provided by the "Universal Serial Bus Specification," revision 2.0, dated April 27, 2000. USB connectors generally feature a metal shell surrounding an opening that contains pins, the metal shell connecting to ground when inserted into a USB receptacle. There are several USB flash drive products commercially available from SanDisk Corporation under its trademark "Cruzer®." USB flash drives are typically larger and shaped differently than the memory cards described above.

[0004] Removable memory units (cards, USB flash drives and other units) are generally provided with a standardized connector. In some cases, such connectors are susceptible to damage. A cap may be used to cover such a connector so that it is protected. However, where such covers are separable from the memory unit, they may be lost or damaged easily. One alternative is to provide a connector that retracts into the housing of the memory unit for protection. Examples of such units include Cruzer® Titanium USB flash drives from SanDisk Corporation. In order to provide physical protection, the housing of a flash drive may be made of a metal, such as steel, stainless steel, aluminum, titanium, zinc, a suitable alloy or any other suitable metal.

[0005] A unit with a retractable connector generally has a feature on the outside of its housing that allows a user to manually slide the connector between a retracted position and an extended position. In the retracted position, the connector is contained within the housing and is protected by the housing. In the extended position, the connector extends through an opening in the housing so that it may be plugged into a receptacle. Such an opening is generally made somewhat larger than the connector so that there is some clearance around the connector to allow it to freely extend and retract without significant friction or binding.

[0006] Under normal circumstances, some electrostatic charge can develop on the conductive housing which may lead to Electrostatic Discharge (ESD) issues. ESD is a discharge of transient charge that may develop on a conductive housing or on a body that is in electrical contact with the housing, causing the housing to be at higher electrical potential with respect to ground requiring a ground path to discharge. Hence many electrical/electronic systems are furnished with ESD protection circuits. These circuits prevent an unwanted transient charge that may develop on a conductive housing from jumping onto sensitive components within the memory system and hence prevent the damage or failure of memory devices. One way to design for ESD protection is to provide a ground path to chassis (PC) ground via a metal shell of a connector.

[0007] Document US-B-6 676 419 discloses a method according to the preamble of claim 1. The present invention is provided for by the method of claim 1 and the unit of claim 7.

[0008] A conductive spring provided between the connector and the housing provides an electrically conductive pathway between the housing and the metal shell of the connector. Thus, the housing and the metal shell are kept at the same potential. When the connector is connected to a receptacle, the metal shell is connected to ground and any charge on the housing is discharged through the conductive spring to the conductive shell. In this way, the memory system is protected from damaging electrostatic discharge. In one example, the conductive spring is formed integrally with the metal shell of the connector.

[0009] Additional aspects, advantages, features and details of various aspects of the present invention are included in the following description of exemplary embodiments thereof, which description should be taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Figure 1 shows a removable flash memory unit having a retractable USB connector according to an embodiment of the present invention.

Figure 2 shows a cross sectional view of the removable flash memory unit of Figure 1 including a slidable PCB to which the connector is mounted.

Figure 3A shows a cross section of the removable flash memory unit of Figure 1 from the side, with the connector in the retracted position, including an electrically conductive spring extending from the connector.

Figure 3B shows a cross section of the removable flash memory unit of Figure 3A with the connector in the extended position.

Figure 4A shows the metal shell of the USB connector of Figure 1 including two springs.

Figure 4B shows a side view of the metal shell of Figure 4A.

Figure 4C shows a top-down view of the metal shell of Figure 4C.

DETAILED DESCRIPTION OF ILLUSTRATED EMBODIMENTS

[0011] Figure 1 shows an example of a removable flash memory unit (flash drive) 100 that has a retractable USB connector 103 extending from a housing 101. Housing 101 is made of a conductive metal in the present example (for example, a Copper alloy or steel). Housing 101 consists of a metal top lid and a metal bottom lid joined together. Other configurations are also possible and a housing may be considered to be conductive even where it includes some insulating components. An opening in housing 101 allows connector 103 to extend from housing 101 so that it can plug into a receptacle. Suitable receptacles according to the USB standard are generally provided on personal computers and other devices.

[0012] Figure 2 shows a cross sectional view of removable flash memory unit 100 along the X-Y plane of Figure 1. USB connector 103 is mounted to a Printed Circuit Board (PCB) 205 at one end. Also mounted to PCB 205 are a controller 202 and a memory 201. Controller 202 and memory 201 form a memory system in the present example. In some cases additional components may be mounted to PCB 205 as part of a memory system. USB connector 103 is connected to controller 202 by electrical conductors (not shown) and controller 202 and flash memory 201 are also connected. Figure 2 shows a volume 207 within housing 101 into which PCB 205 may slide. When PCB 205 slides back to occupy volume 207, connector 103 slides with it so that connector 103 retracts into housing 101.

[0013] Figure 3A shows a vertical cross section (along a plane perpendicular to the x-axis of Figure 1) of a portion of removable flash memory unit 100. Unlike Figures 1 and 2, Figure 3A shows connector 103 in a retracted position within housing 101. Figure 3A shows a spring 310 extending from connector 103 to contact housing 101. Spring 310 is formed of a conductive metal in this example so that an electrically conductive pathway is formed between connector 103 and housing 101, this electrically conductive pathway providing desirable ESD protection. In other examples, a conductive spring may have a different configuration, for example extending from the bottom or sides of a connector, or extending from the housing. In the present example, spring 310 contacts housing 101 when connector 103 is in the retracted position, though in other examples a spring may only make contact with a housing when in the extended position.

[0014] Figure 3B shows a portion of flash memory unit 100 in the same view as Figure 3A, but with connector 103 in the extended position where it protrudes from housing 101. Spring 310 is shown contacting housing 101 along edge 320. As connector 103 slides forward, spring 310 may be depressed by edge 320 and deformed. Spring 310 deforms elastically so that when connector 103 is returned to its retracted state, spring 310 returns to its previous position. As spring 310 deforms it presses against edge 320 to form a low-resistance, metal-to-metal contact with housing 101. Thus, in the extended position, connector 103 is connected to housing 101 by an electrically conductive, low-resistance pathway. Also, in the retracted position and at all positions between extended and retracted positions, spring 310 maintains a connection between connector 103 and housing 101. This provides a pathway for electrostatic discharge that has a lower resistance than a pathway through electronic components within housing 101. Any static charge that may have built up on housing 101 is discharged directly from housing 101 to connector 103 when connector 103 is inserted in a receptacle. When flash memory unit 100 is in use, with connector 103 in a receptacle, the metal shell of connector 103 is connected to chassis ground. Thus, if a person who has an electrostatic charge on their body touches housing 101, the electrostatic charge discharges from housing 101 to connector 103 without passing through electronic components within housing 101. Spring 310 provides an alternative route for electrostatic discharge so that instead of discharging through components within housing 101, current passes directly to connector 103 by a low-resistance pathway. In the present example, spring 310 maintains an electrically conductive, low-resistance pathway at all times, when connector 103 is in the extended position, in the retracted position and at all intermediate positions.

[0015] In the example illustrated, connector 103 is mounted to PCB 205 so that connector 103 is not separately movable from PCB 205. However, in other embodiments, USB connector may be moved independently of some or all the components of the memory system and may not always be mounted to a PCB. The present invention is not limited to connectors that are mounted to a PCB.

[0016] A spring may be provided on either housing 101 or on connector 103. Alternatively, an additional structure may be added that includes a spring to provide a conductive pathway For a USB connector, the metal shell of the connector generally provides a pathway to ground when the connector is connected to a receptacle. This metal shell is generally formed of a sheet of metal that wraps around a central opening that contains pins for data transmission. In the present example, spring 310 is formed integrally with the metal shell of connector 103. That is, spring 310 is formed from the same metal sheet that forms the metal shell of connector 103.

[0017] Figure 4A shows metal shell 430 of connector 103 prior to installation in housing 101. Figure 4A shows spring 310 and spring 432 extending from metal shell 430 (spring 432 is not visible in earlier figures). Spring 310 and spring 432 both serve the same purpose. Different numbers of springs may be used in different examples. In some cases, one spring may be sufficient while in other cases, two, three or more springs may be used. Springs may be located on any side of metal shell 430. Figure 4A shows spring 310 formed from metal shell 430. Spring 310 is a strip of metal from metal shell 430 that is elongated longitudinally (along the Y-direction of Figure 1). Spring 310 remains attached to the remainder of metal shell 430 at one end. The other end is bent up from metal shell 430 so that it extends above the upper surface of metal shell 430. Thus, even where an opening in a housing provides clearance for a standard sized connector, spring 310 extends sufficiently to bridge the gap and maintain an electrically conductive pathway. Spring 310 deforms elastically so that it maintains good contact with housing 101 throughout repeated operation, and does not interfere with movement of connector 103. A spring may be formed in any suitable shape and may be straight or curved. Forming a spring integrally with a metal shell of a connector provides a simple, reliable structure that creates an electrically conductive, low-resistance pathway between the connector and the housing.

[0018] Figure 4B shows a side view of metal shell 430. Spring 310 is shown extending 0.75mm above the upper surface of metal shell 430. This extends sufficiently to bridge the gap between metal shell 430 and housing 101. However, a spring may be formed to extend a different amount for a different housing and the dimensions of the present figures are exemplary only.

[0019] Figure 4C shows a top-down view of metal shell 430. Springs 310, 432 are shown extending longitudinally 6.75millimeters and having a width of 1.0millimeter. Other dimensions may also be used. For example, a single spring having a width of more than one millimeter (1mm) may also be used and may provide sufficiently low resistance.

[0020] In other examples, similar springs may be added to connectors other than USB connectors to provide good connection to a housing or other conductive component which moves with respect to the connector. Examples include connectors provided in various types of memory card and other electronic devices. The present invention is not limited to USB connectors but may also be used with connectors according to different standards. For example, FireWire connectors may be similarly provided with springs where appropriate.

[0021] Although the various aspects of the present invention have been described with respect to exemplary embodiments and variations thereof, it will be understood that the invention is entitled to protection within the full scope of the appended claims.

Claims

1. A method of forming a removable nonvolatile memory (100) comprising:

   forming a memory system on a printed circuit board (205) the memory system including an array of nonvolatile memory cells (201) and a memory controller (202);
   attaching a connector (103) to the printed circuit board (205), **characterised in that** the connector (103) has a spring (310) that extends from the connector (103); and further **characterised by**
   locating the printed circuit board (205) within an electrically conductive housing (101) such that the spring (310) contacts the electrically conductive housing (101).

2. The method of claim 1 wherein the printed circuit board (205) has a range of movement within the electrically conductive housing (101), the range of movement extending from a first position in which the connector (103) is within the housing (101) and a second position in which the connector (103) is at least partially outside the housing (101).

3. The method of claim 2 wherein the spring (310) maintains contact with the electrically conductive housing (101) in the first position, the second position and at intermediate positions between the first position and the second position.

4. The method of claim 1, 2 or 3 wherein the connector (103) is a Universal Serial Bus connector.

5. The method of claim 4 wherein the Universal Serial Bus connector includes a metal shell (430) and the

spring (310) is integral with the metal shell (430).

6. The method of any one of the preceding claims wherein the connector (103) has at least one additional spring (432) that extends from the connector (103).

7. A removable nonvolatile memory unit (100) comprising:

an array of nonvolatile memory cells (201) on a semiconductor substrate;
characterised in that the unit (100) further comprises:

an electrically conductive housing (101) that extends about the semiconductor substrate;
a connector (103) having a plurality of pins, the connector (103) in communication with the array of nonvolatile memory cells (201), the connector (103) retracting into the housing (101) in a first position and extending from the housing (101) in a second position;
a spring (310) forming an electrically conductive pathway, the electrically conductive pathway electrically connecting the housing (101) and a portion of the connector (103).

8. The removable nonvolatile memory unit (100) of claim 7 wherein the connector (103) is a Universal Serial Bus connector.

9. The removable nonvolatile memory unit (100) of claim 7 or 8 wherein the portion of the connector (103) is a metal shell (430) and the spring (310) is integral with the metal shell (430).

10. The removable nonvolatile memory unit (100) of claim 7, 8 or 9 wherein the array of nonvolatile memory cells (201) form a flash memory array.

11. The removable nonvolatile memory unit (100) of any one of claims 7 to 10 wherein the semiconductor substrate and the connector (103) are mounted to a printed circuit board (205).

Patentansprüche

1. Verfahren zum Ausbilden eines entfernbaren, nichtflüchtigen Speichers (100), das beinhaltet:

Ausbilden eines Speichersystems auf einer Leiterplatte (205), wobei das Speichersystem ein Array nichtflüchtiger Speicherzellen (201) und einen Speichercontroller bzw. eine Speichersteuereinrichtung (202) beinhaltet;
Anbringen eines Verbinders (103) an der Leiterplatte (205), **dadurch gekennzeichnet, dass** der Verbinder (103) eine Feder (310) aufweist, die sich von dem Verbinder (103) erstreckt; und ferner **gekennzeichnet durch**
Anordnen der Leiterplatte (205) in einem elektrisch leitenden Gehäuse (101), so dass die Feder (310) das elektrisch leitende Gehäuse (101) kontaktiert.

2. Verfahren nach Anspruch 1, bei dem die Leiterplatte (205) einen Bewegungsumfang in dem elektrisch leitenden Gehäuse (101) aufweist, wobei der Bewegungsumfang sich von einer ersten Position, in welcher der Verbinder (103) sich in dem Gehäuse (101) befindet, und einer zweiten Position, in welcher der Verbinder (103) sich wenigstens teilweise außerhalb des Gehäuses (101) befindet, erstreckt.

3. Verfahren nach Anspruch 2, wobei die Feder (310) in der ersten Position, der zweiten Position, und in Zwischenpositionen zwischen der ersten Position und der zweiten Position einen Kontakt mit dem elektrisch leitenden Gehäuse (101) hält.

4. Verfahren nach Anspruch 1, 2 oder 3, bei dem der Verbinder (103) ein Universal Serial Bus-Verbinder bzw. USB-Verbinder ist.

5. Verfahren nach Anspruch 4, bei dem der USB-Verbinder eine Metallschale (430) aufweist, und wobei die Feder (310) in die Metallschale (430) integriert ist.

6. Verfahren nach einem der vorstehenden Ansprüche, bei dem der Verbinder (103) wenigstens eine zusätzliche Feder (432) aufweist, die sich von dem Verbinder (103) erstreckt.

7. Entfernbare nichtflüchtige Speichereinheit (100) mit:

einem Array nichtflüchtiger Speicherzellen (201) auf einem Halbleitersubstrat;
dadurch gekennzeichnet, dass die Einheit (100) ferner aufweist:

ein elektrisch leitendes Gehäuse (101), das sich um das Halbleitersubstrat erstreckt;
einen Verbinder (103) mit einer Anzahl von Pins, wobei der Verbinder (103) in Kommunikation mit dem Array nichtflüchtiger Speicherzellen (201) steht, wobei sich der Verbinder (103) in einer ersten Position in das Gehäuse (101) zurückzieht und sich in einer zweiten Position aus dem Gehäuse (101) erstreckt;
eine Feder (310), die einen elektrisch leitenden Pfad bildet, wobei der elektrisch lei-

tende Pfad das Gehäuse (101) und einen Teil des Verbinders (103) elektrisch verbindet.

8. Entfernbare nichtflüchtige Speichereinheit (100) nach Anspruch 7, bei der der Verbinder (103) ein Universal Serial Bus-Verbinder bzw. USB-Verbinder ist.

9. Entfernbare nichtflüchtige Speichereinheit (100) nach Anspruch 7 oder 8, bei der der Abschnitt des Verbinders (103) eine Metallschale (430) ist, und die Feder (310) in der Metallschale (430) integriert ist.

10. Entfernbare nichtflüchtige Speichereinheit (100) nach Anspruch 7, 8 oder 9, bei der das Array nichtflüchtiger Speicherzellen (201) ein Flash-Speicherarray bildet.

11. Entfernbare nichtflüchtige Speichereinheit (100) nach einem der Ansprüche 7 bis 10, bei der das Halbleitersubstrat und der Verbinder (103) auf einer Leiterplatte (205) angebracht sind.

Revendications

1. Procédé de formation d'une mémoire non volatile amovible (100) comprenant les étapes consistant à :

former un système de mémoire sur une carte de circuit imprimé (205), le système de mémoire comprenant un réseau de cellules de mémoire non volatiles (201) et un contrôleur de mémoire (202) ;
fixer un connecteur (103) à la carte de circuit imprimé (205), **caractérisé en ce que** le connecteur (103) comporte un ressort (310) qui s'étend depuis le connecteur (103) ; et **caractérisé en outre par**
le positionnement de la carte de circuit imprimé (205) dans un logement électriquement conducteur (101) de sorte que le ressort (310) soit en contact avec le logement électriquement conducteur (101).

2. Procédé selon la revendication 1, dans lequel la carte de circuit imprimé (205) a une plage de mouvement dans le logement électriquement conducteur (101), la plage de mouvement s'étendant depuis une première position dans laquelle le connecteur (103) est dans le logement (101) à une deuxième position dans laquelle le connecteur (103) est au moins partiellement à l'extérieur du logement (101).

3. Procédé selon la revendication 2, dans lequel le ressort (310) maintient le contact avec le logement électriquement conducteur (101) dans la première position, dans la deuxième position et à des positions intermédiaires entre la première position et la deuxième position.

4. Procédé selon la revendication 1, 2 ou 3, dans lequel le connecteur (103) est un connecteur USB (Universal Serial Bus).

5. Procédé selon la revendication 4, dans lequel le connecteur USB comprend une enveloppe métallique (430) et le ressort (310) est d'un seul tenant avec l'enveloppe métallique (430).

6. Procédé selon l'une quelconque des revendications précédentes, dans lequel le connecteur (103) comporte au moins un ressort (432) supplémentaire qui s'étend depuis le connecteur (103).

7. Unité de mémoire non volatile amovible (100) comprenant :

un réseau de cellules de mémoire non volatiles (201) sur un substrat semi-conducteur ;
caractérisée en ce que l'unité (100) comprend en outre :

un logement électriquement conducteur (101) qui s'étend autour du substrat semi-conducteur ;
un connecteur (103) comportant une pluralité de broches, le connecteur (103) étant en communication avec le réseau de cellules de mémoire non volatiles (201), le connecteur (103) se rétractant dans le logement (101) dans une première position et s'étendant depuis le logement (101) dans une deuxième position ;
un ressort (310) formant un trajet électriquement conducteur, le trajet électriquement conducteur connectant électriquement le logement (101) et une partie du connecteur (103).

8. Unité de mémoire non volatile amovible (100) selon la revendication 7, dans laquelle le connecteur (103) est un connecteur USB.

9. Unité de mémoire non volatile amovible (100) selon la revendication 7 ou 8, dans laquelle la partie du connecteur (103) est une enveloppe métallique (430) et le ressort (310) est d'un seul tenant avec l'enveloppe métallique (430).

10. Unité de mémoire non volatile amovible (100) selon la revendication 7, 8 ou 9, dans laquelle le réseau de cellules de mémoire non volatiles (201) forme un réseau (matrice) de mémoire flash.

11. Unité de mémoire non volatile amovible (100) selon l'une quelconque des revendications 7 à 10, dans laquelle le substrat semi-conducteur et le connecteur (103) sont montés sur une carte de circuit imprimé (205).

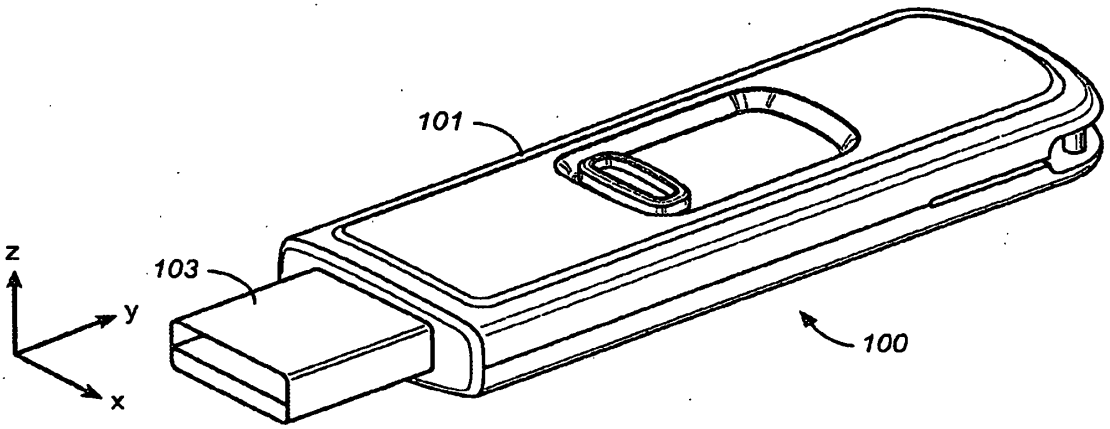
101
103
z
y
x
100

FIG. 1

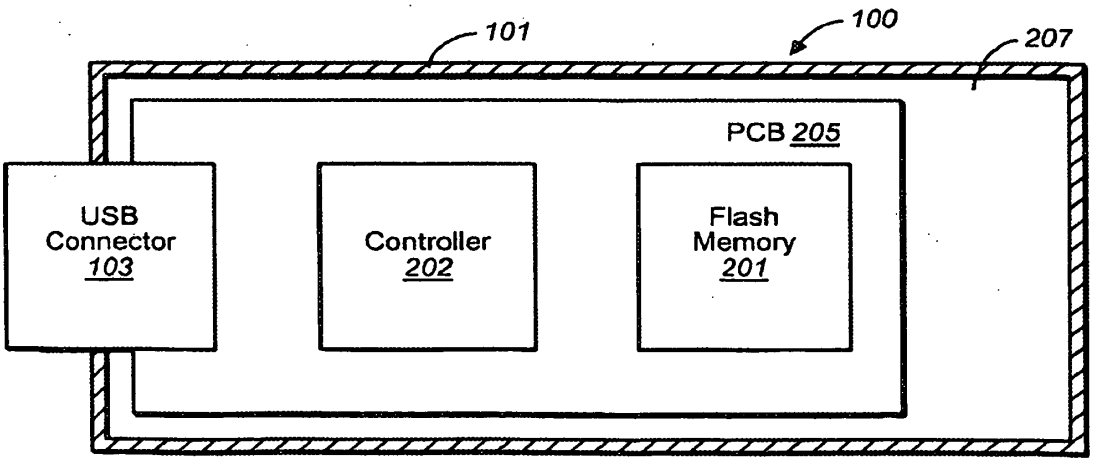
101
100
207
PCB 205
USB Connector 103
Controller 202
Flash Memory 201

FIG. 2

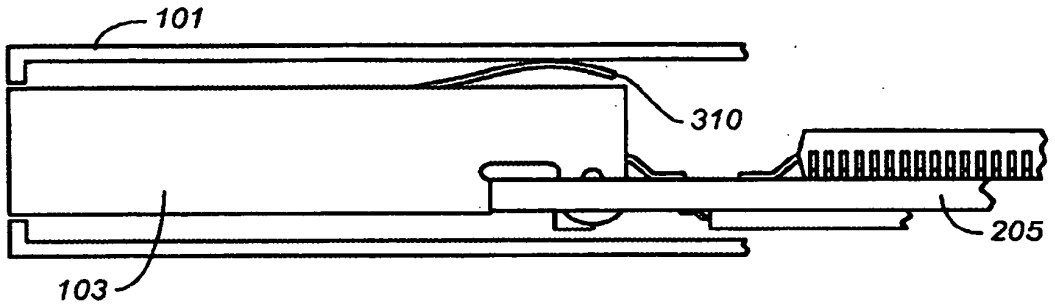

FIG. 3A

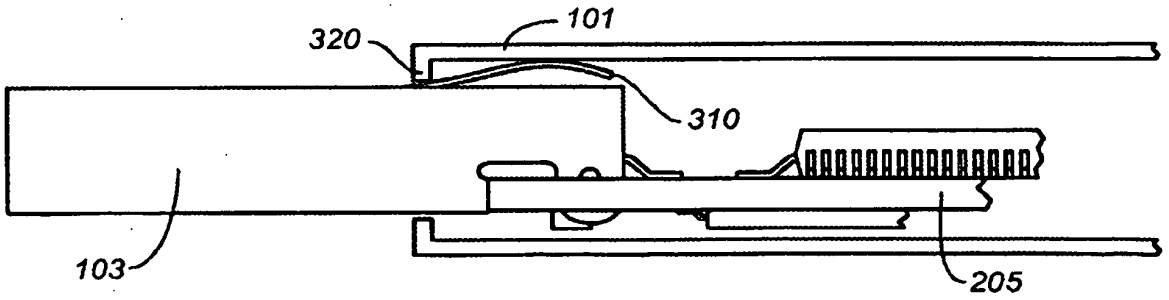

FIG. 3B

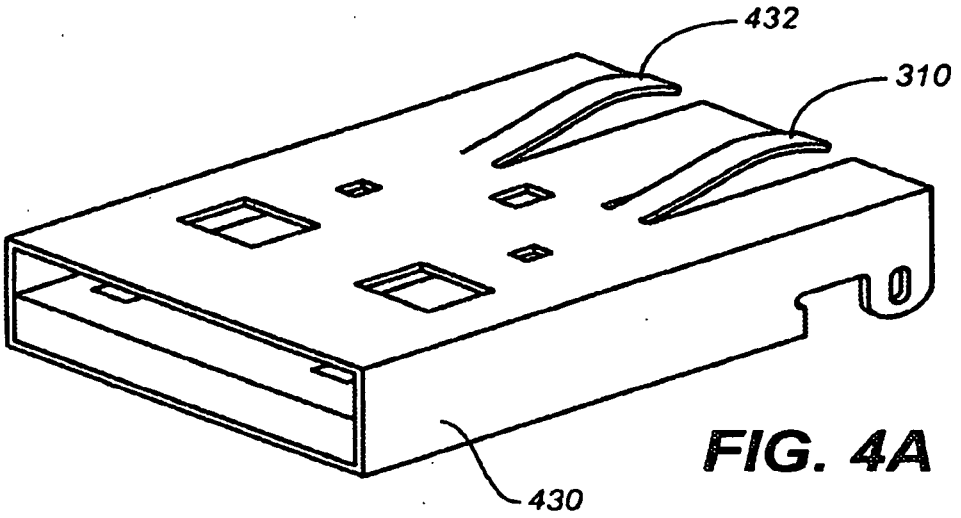

FIG. 4A

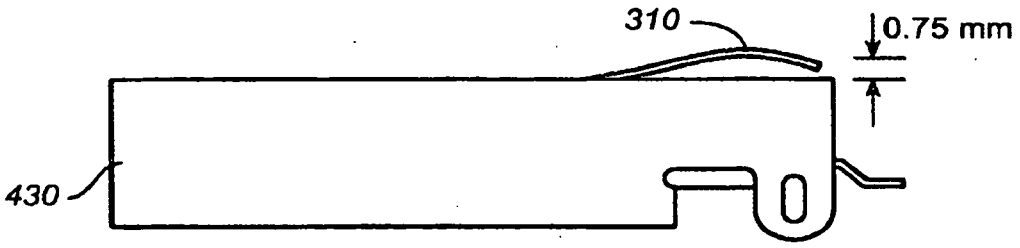

FIG. 4B

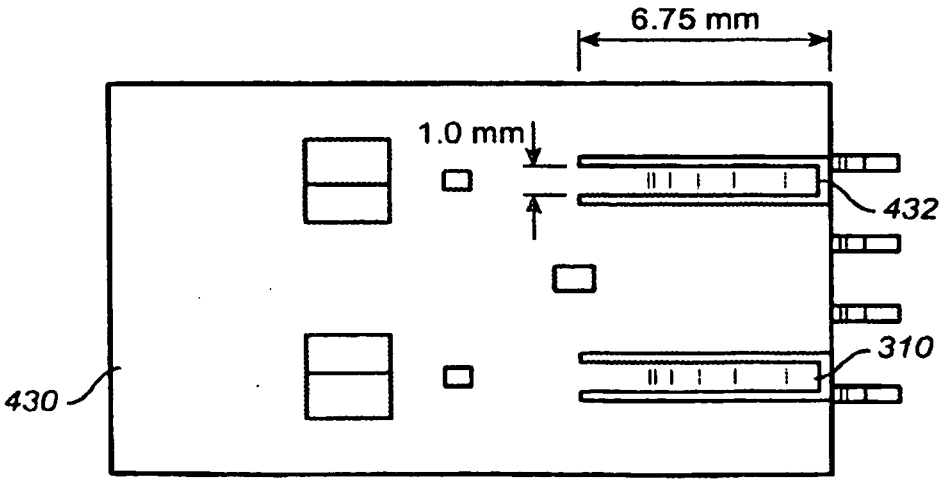

FIG. 4C

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 6676419 B **[0007]**