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DISC ADAPTER FOR USE IN MULTISTANDARD DRIVE MECHANISM

This invention relates to information storage systems, and, in particular, to adapter mechanisms to allow information to be recovered from a storage medium by a recording or playback device designed for use with either a different type of storage medium or a plurality of types of storage media.

Because of the multiplicity of options for data storage media, data often needs to be transferred from one recording or playback device designed for use with one type of storage medium to another device designed for use with a different type of storage medium. In order to avoid data duplication, adapters have been developed to allow use of different types of storage media within a single device.

One example of such an adapter is the phonograph adapter, which allows a single phonograph player to recover information from phonograph records designed to be played at 33 1/3 revolutions per minute, and from phonograph records designed to be played at 45 revolutions per minute, as well as other rotational speeds.

Another example is a permanent hub adapter used in testing laboratories for adapting a Compact Disc - Read Only Memory (CD-ROM) disc for use with a magneto-optical (MO) spindle. That hub adapter consists of two magnetizable rings and several screws. The CD-ROM disc is placed between the magnetizable rings, and the rings are screwed together through the CD-ROM disc. This hub adapter essentially drilled holes through the CD-ROM disc. Therefore, the adapter was permanently mounted to the disc, and the disc could thereafter not be played in a CD-ROM player.

A further example is a hub adapter designed for commercial or consumer use. The hub adapter consists of a plastic housing, a magnetizable ring, and a connector. The magnetizable ring is mounted within the plastic housing such that the ring may spin relative to the housing. The connector consists of a plurality of plastic tabs extending from the housing in the direction away from the ring. Each plastic tab has a foot at the end remote from the ring. The hub adapter is designed such that two adapters will fit together with the CD-ROM disc in between. The feet of one adapter snap into a recess in the other adapter, creating a permanent connection. Again, the adapter is not removable, and the CD-ROM disc can no longer be played in a CD-ROM player. Furthermore, this design allows slippage of the CD-ROM disc relative to the adapter during rotation.

There are several options for storage media for computer or other data. Among these options are Compact Disc - Read Only Memory (CD-ROM) discs and magneto-optical (MO) discs. Each of these choices presents certain advantages and disadvantages compared to the other.

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Because of these relative advantages and disadvantages, it is often advantageous to store some data on storage media such as CD-ROM discs and other data on storage media such as MO discs. However, this storage option previously had required multiple playback devices. When the amount of data reached levels where a jukebox was needed for data storage, this storage option would require multiple jukeboxes, dramatically increasing cost and space requirements.

The International Organization for Standardization (ISO) sets industry standards for certain aspects of information-bearing media and playback or recording devices for those media, including CD-ROM discs and MO discs. The standards cover such aspects as media shape and size, hub diameter, and clearance between drive mechanisms and media.

Figure 1 is a view of one embodiment of a cartridge.

Figure 2 is a view of one embodiment of a cartridge with the cover removed.

Figure 3 is a top view of a first embodiment of a hub adapter.

Figure 4 is a bottom view of a first embodiment of a hub adapter.

Figure 5 is a view taken along line 5-5 of Figure 3.

Figure 6 is a top view of a second embodiment of a hub adapter.

Figure 7 is a bottom view of a second embodiment of a hub adapter.

Figure 8 is a view taken along line 8-8 of Figure 6.

Figure 9 is a top view of a third embodiment of a hub adapter.

Figure 10 is a bottom view of a third embodiment of a hub adapter.

Figure 11 is a view taken along line 11-11 of Figure 9.

Figure 12 is a top view of a fourth embodiment of a hub adapter.

Figure 13 is a bottom view of a fourth embodiment of a hub adapter.

Figure 14 is a view taken along line 14-14 of Figure 12.

The invention provides for adapting a storage medium for use in a multistandard drive mechanism having a cartridge, an openable cover on the cartridge for insertion and removal of a storage medium, and a door access assembly on the cartridge for providing access to the storage medium by an information recovery apparatus of a drive mechanism.

According to the invention, a cartridge and hub adapter allow playback of a storage medium in a drive mechanism or jukebox designed for playback of a different storage medium, or playback of multiple types of storage media. In the case of adapting a CD-ROM for playback in an MO drive mechanism, the cartridge conforms to the ISO standards for the factors listed above, and the hub adapter adapts a CD-ROM disc to a spindle in an MO disc drive.

Wherever possible in the following description, elements which are the same in different figures are represented by the same reference numeral.

Referring to exemplary Figure 1, there is shown one embodiment of a cartridge 1, according to one aspect of the invention. The shape and size of the cartridge 1 conforms to the standards established by the International Organization for Standardization (ISO) for magneto-optical (MO) discs. The cartridge 1 has a cover 2 which opens to allow insertion and removal of a storage medium (not shown), such as a Compact Disc - Read Only Memory (CD-ROM) disc. The cover 2 may be transparent to allow the storage medium to be viewed without being removed from the cartridge 1. The cartridge 1 also includes a door access assembly (not shown), which may comprise a first door 3 and a second door (not shown). The door access assembly (not shown) provides access to the storage medium (not shown) by an information recovery apparatus (not shown) of the drive mechanism (not shown). In the case of an MO drive mechanism, such an information recovery apparatus (not shown) may comprise a primary information recovery apparatus, such as an optical assembly, and a secondary information recovery apparatus, such as a magnetic bias coil. Depending on the orientation of the cartridge 1 with respect to the drive mechanism (not shown), the first door 3 may provide access to the storage medium (not shown) by the primary information recovery apparatus and the second door (not shown) may provide access to the storage medium (not shown) by the secondary information recovery apparatus, or vice versa.

Thus, the door access assembly has a first door on a first side of the cartridge for providing access to the storage medium by a selected one of a primary information recovery apparatus or a secondary information recovery apparatus of the drive mechanism, and a second door on a second side of the cartridge for providing access to the storage medium by the one of the primary information recovery apparatus or the secondary information recovery apparatus of the drive mechanism not selected for access by the first door, wherein the first side and the second side of the cartridge are substantially parallel and are disposed with the storage medium located therebetween.

The cartridge 1 may also include an orientation sensor 4 on one edge of the cartridge 1 for detecting the orientation of the cartridge with respect to the drive mechanism. Because an MO disc bears information on both sides, it may be inserted into the drive mechanism with either side facing up. However, many types of storage media such as CD-ROM discs bear information on only one side, and require that the cartridge 1 be inserted into the drive mechanism right side up. When inserting the cartridge 1 into a drive mechanism, the orientation sensor 4 engages a stop (not shown) within the drive mechanism, thereby preventing upside-down insertion of the cartridge

1 into the drive mechanism. For use with a storage medium bearing information on both sides, the orientation sensor 4 need not be present on the cartridge 1.

Referring to exemplary Figure 2, there is shown the cartridge 1 as shown in exemplary Figure 1 with the cover 2 removed. A CD-ROM disc 5 has been inserted into the cartridge 1 through the open cover 2. The CD-ROM disc 5 has been fitted with a hub adapter (not shown), which adapts the hub of the CD-ROM disc 5 to the spindle of an MO drive mechanism.

Exemplary Figures 3 through 14 show several views of four embodiments of the hub adapter 6. Each of these embodiments contains an annular hub receiving ring, an annular medium receiving body, a hub fastener, and a medium fastener. The annular medium receiving body is connected to the hub receiving body such that the center of the medium receiving body lies along the same line as the center of the hub receiving body. The hub fastener is fixedly mounted to the hub receiving body, and removably secures the hub receiving body to the drive mechanism. The medium fastener is connected to the medium receiving body, and removably secures the storage medium relative to the hub receiving body.

Referring to exemplary Figures 3, 4, and 5, there are shown a top view, a bottom view, and a cross-sectional view of a first embodiment of the hub adapter 6. The hub adapter 6 comprises an annular hub receiving body 7 and an annular medium receiving body 8. The annular medium receiving body 8 may be integral with the annular hub receiving body 7, or may be fixedly mounted by any rigid connection known to one skilled in the art.

In the case of a hub adapter 6 to allow a CD-ROM disc to be played in an MO drive mechanism, the annular hub receiving body 7 has an outer diameter according to the ISO standard established for the outer diameter of the hub of an MO disc. The annular medium receiving body 8 has an outer diameter according to the ISO standard established for the diameter of the center hole of a CD-ROM disc. Both the annular hub receiving body 7 and the annular medium receiving body 8 have an inner diameter according to the ISO standard established for the diameter of the center hole of an MO disc.

The annular hub receiving body 7 includes a hub fastener 9. The hub fastener 9 may comprise an annular magnetizable ring. The dimensions of the hub fastener 9, in the case of a hub adapter 6 to adapt a CD-ROM for playback in an MO drive mechanism, are consistent with the ISO standard established for the magnetizable ring in the hub of an MO disc. The annular medium receiving body 8 has a plurality of ball bearings 10, concentric with the annular medium receiving body 8, extending radially outward from the outer annular surface of the annular medium receiving body 8. The

ball bearings 10 are biased outwardly radially from the center of the annular medium receiving body 8, allowing a storage medium (not shown), such as a CD-ROM disc, to be slid over the ball bearings 10, but to provide resistance against unwanted slippage of the storage medium. In this embodiment, these ball bearings 10 are the medium fastener.

In operation, a storage medium (not shown) is placed concentrically with the annular medium receiving body 8, with an information bearing side of the storage medium toward the annular hub receiving body 7. The ball bearings 10 allow the storage medium to be held in place between the ball bearings 10 and the upper surface 11 of the annular hub receiving body 7. The hub adapter 6, with the storage medium held in place, may be placed on a spindle of a drive mechanism. The spindle of the drive mechanism may have a center pin and an annular magnet. The center pin of the spindle fits into the space defined by the inner diameters of the annular hub receiving body 7 and the annular medium receiving body 8. The hub fastener 9 of the hub adapter 6 fits against the annular magnet of the spindle. The hub fastener 9 and the annular magnet operate to hold the hub adapter 6 in place during rotation and rotational acceleration.

Other embodiments of the hub adapter 6 further comprise an annular connecting body and an annular medium fastening body. The annular connecting body is connected to the medium receiving body at a point remote from the hub receiving body. The annular medium fastening body is connected to the annular connecting body at a point remote from the medium receiving body. The centers of the annular medium fastening body, the annular connecting body, the annular medium receiving body, and the annular hub receiving body lie along the same line.

Referring to exemplary Figures 6, 7, and 8, there are shown a top view, a bottom view, and a cross-sectional view of a second embodiment of the hub adapter. A hub adapter 106 comprises an annular hub receiving body 12, an annular medium receiving body 13, an annular connecting body 14, and an annular fastening body 15. The annular hub receiving body 12 may be integral with the annular medium receiving body 13, or may be fixedly mounted by any rigid connection known to one skilled in the art. Likewise, the annular connecting body 14 may be integral with the annular fastening body 15, or may be fixedly mounted by any rigid connection known to one skilled in the art. A surface of the annular medium receiving body 13 opposite the annular hub receiving body 12 is removably connected to a surface of the annular connecting body 14 opposite the annular fastening body 15.

Each of the annular bodies 12, 13, 14, 15 have substantially the same inner diameter. In the case of a hub adapter 106 to adapt a storage medium for playback with

an MO drive mechanism, this inner diameter is defined according to the ISO standard established for the diameter of the center hole of an MO disc. The outer diameter of the annular medium receiving body 13 is substantially equal to the outer diameter of the annular connecting body 14. This outer diameter is substantially equal to the diameter of the center hole of the storage medium. The annular hub receiving body 12 and the annular fastening body 15 each have an outer diameter larger than the outer diameters of the annular medium receiving body 13 and the annular connecting body 14. In the case of a hub adapter 106 to adapt a storage medium for playback with an MO drive mechanism, the annular hub receiving body 12 has an outer diameter according to the ISO standard established for the outer diameter of the hub of an MO disc. The annular fastening body 15 has an outer diameter larger than the ISO standard established for the inner diameter of the clamping region of the storage medium.

In operation, the annular medium receiving body 13 and the annular connecting body 14 may be separated, and a storage medium placed between them. The annular bodies 13, 14 may then be reconnected. In this position, the centers of each of the annular bodies 12, 13, 14, 15 lie along the same line. Additionally, the center of the storage medium will lie along the same line as the centers of the annular bodies 12, 13, 14, 15. As stated above, the annular medium receiving body 13 and the annular connecting body 14 are removable under sufficient force, but do not allow movement under rotation and rotational acceleration associated with the drive mechanism. Magnets may be used to form this connection, as may any connection known to one skilled in the art.

The annular hub receiving body 12 has, on a surface opposite the annular medium receiving body 13, a hub fastener 9. The hub fastener 9 may comprise an annular magnetizable ring. The dimensions of the hub fastener 9, in the case of a hub adapter 106 to adapt a CD-ROM for playback in an MO drive mechanism, are consistent with the ISO standard established for the magnetizable ring in the hub of an MO disc. The annular hub receiving body 12 has, on a surface opposing the annular fastening body 15, a lower annular clamping magnet 16. The annular fastening body 15 has, on a surface opposing the annular hub receiving body 12, an upper annular clamping magnet 17. The annular clamping magnets 16, 17 oppose each other, and, in operation, clamp a storage medium in place through magnetic force, to prevent unwanted slippage.

The annular fastening body 15 may have, on a surface opposite from the annular connecting body 14, a second hub fastener (not shown). The second hub fastener (not shown) has the same structure and function as the hub fastener 9. The second hub fastener (not shown) would allow the hub adapter 106 to be inserted into the drive

mechanism upside-down, to allow for playback of storage media with information recorded on both sides, without removing the hub adapter 106 from the storage medium.

Referring to exemplary Figures 9, 10, and 11, there are shown a top view, a bottom view, and a cross-sectional view of a third embodiment of the hub adapter. A hub adapter 206 comprises an annular hub receiving body 18, an annular medium receiving body 19, an annular connecting body 20, and an annular fastening body 21. The annular hub receiving body 18 may be integral with the annular medium receiving body 19, or may be fixedly mounted by any rigid connection known to one skilled in the art. Likewise, the annular connecting body 20 may be integral with the annular fastening body 21, or may be fixedly mounted by any rigid connection known to one skilled in the art.

The inner diameters of the annular hub receiving body 18 and the annular medium receiving body 19 are substantially equal, and, in the case of a hub adapter 206 to adapt a storage medium for playback with an MO drive mechanism, these inner diameters are defined according to the ISO standard established for the diameter of the center hole of an MO disc. The outer diameter of the annular medium receiving body 19 is substantially equal to the diameter of the center hole of the storage medium. The annular hub receiving body 18 has an outer diameter larger than the outer diameter of the annular medium receiving body 19. In the case of a hub adapter 206 to adapt a storage medium for playback with an MO drive mechanism, the annular hub receiving body 12 has an outer diameter according to the ISO standard established for the outer diameter of the hub of an MO disc.

The annular medium receiving body 19 is removably connected to the annular connecting body 20 along the surface defining the outer diameter of the annular medium receiving body 19. This connection is breakable under sufficient force, but does not allow movement under rotation and rotational acceleration associated with the drive mechanism. Magnets may be used to form this connection, as may any connection known to one skilled in the art.

The annular connecting body 20 has an inner diameter substantially equal to the outer diameter of the annular medium receiving body 19. The annular connecting body 20 has an outer diameter larger than the ISO standard established for the inner diameter of the clamping region of the storage medium. The annular fastening body 21 is fixedly mounted to or integral with the annular connecting body 20 on a surface of the annular connecting body 20 which faces the annular hub receiving body 18. The annular fastening body 21 has an outer diameter which may be substantially equal to

the outer diameter of the annular connecting body 20, and an inner diameter which may be larger than the outer diameter of the annular medium receiving ring 19.

In operation, the annular connecting body 20 is removed from the annular medium receiving body 19. A storage medium is then placed concentrically around the annular medium receiving body 19, and the annular connecting body 20 is connected to the annular medium receiving body 19. In this position, the center of the storage medium and the centers of the annular bodies 18, 19, 20, 21 all lie along the same line. The distance between the annular fastening body 21 and the annular hub receiving ring 18, taken normal to the plane of the storage medium, is smaller than the thickness of the storage medium. Therefore, a clamping force between the annular fastening body 21 and the annular hub receiving body 18 is provided to clamp the storage medium in place and to prevent unwanted slippage. The thickness of the annular connecting body 20 is sufficient to withstand the force applied by the annular fastening body 21. Together, the annular fastening body 21 and the annular hub receiving body 18 function as the medium fastener.

The annular hub receiving body 18 has, on the surface opposite the annular medium receiving ring 19 and the storage medium, a hub fastener 9. The hub fastener 9 may comprise an annular magnetizable ring. The dimensions of the hub fastener 9, in the case of a hub adapter 206 to adapt a CD-ROM for playback in an MO drive mechanism, are consistent with the ISO standard established for the magnetizable ring in the hub of an MO disc. Similarly, the annular connecting body 20 may have, on the surface opposite the annular fastening ring 21 and the storage medium, a second hub fastener (not shown). The second hub fastener (not shown) has the same structure and function as the hub fastener 9. The second hub fastener (not shown) would allow the hub adapter 206 to be inserted into the drive mechanism upside-down, to allow for playback of storage media with information recorded on both sides, without removing the hub adapter 206 from the storage medium.

Referring to exemplary Figures 12, 13, and 14, there are shown a top view, a bottom view, and a cross-sectional view of a fourth embodiment of the hub adapter. A hub adapter 306 comprises an annular hub receiving body 22, an annular medium receiving body 23, an annular connecting body 24, and an annular fastening body 25. The annular hub receiving body 22 may be integral with the annular medium receiving body 23, or may be fixedly mounted by any rigid connection known to one skilled in the art. Likewise, the annular connecting body 24 may be integral with the annular fastening body 25, or may be fixedly mounted by any rigid connection known to one skilled in the art. A surface of the annular medium receiving body 23 opposite the

annular hub receiving body 22 is removably connected to a surface of the annular connecting body 24 opposite the annular fastening body 25.

Each of the annular bodies 22, 23, 24, 25 have substantially the same inner diameter. In the case of a hub adapter 306 to adapt a storage medium for playback with an MO drive mechanism, this inner diameter is defined according to the ISO standard established for the diameter of the center hole of an MO disc. The outer diameter of the annular medium receiving body 23 is substantially equal to the outer diameter of the annular connecting body 24. This outer diameter is substantially equal to the diameter of the center hole of the storage medium. The annular hub receiving body 22 and the annular fastening body 25 each have an outer diameter larger than the outer diameters of the annular medium receiving body 23 and the annular connecting body 24. In the case of a hub adapter 306 to adapt a storage medium for playback with an MO drive mechanism, the annular hub receiving body 22 has an outer diameter according to the ISO standard established for the outer diameter of the hub of an MO disc. The annular fastening body 25 has an outer diameter larger than the ISO standard established for the inner diameter of the clamping region of the storage medium.

In operation, the annular medium receiving body 23 and the annular connecting body 24 may be separated, and a storage medium placed between them. The annular bodies 23, 24 may then be reconnected. In this position, the centers of each of the annular bodies 22, 23, 24, 25 lie along the same line. Additionally, the center of the storage medium will lie along the same line as the centers of the annular bodies 22, 23, 24, 25. As stated above, the annular medium receiving body 23 and the annular connecting body 24 are removable under sufficient force, but do not allow movement under rotation and rotational acceleration associated with the drive mechanism. Magnets may be used to form this connection, as may any connection known to one skilled in the art.

The distance between the annular fastening body 25 and the annular hub receiving ring 22, taken normal to the plane of the storage medium, is smaller than the thickness of the storage medium. Therefore, a clamping force between the annular fastening body 25 and the annular hub receiving body 22 is provided to clamp the storage medium in place and to prevent unwanted slippage. The thickness of the annular fastening body 25 is sufficient to withstand this clamping force. Together, the annular fastening body 25 and the annular hub receiving body 22 function as the medium fastener. The medium fastener can have an annular upper fastening ring fixedly mounted to a surface of the medium fastening body opposing the hub receiving body, and an annular lower fastening ring fixedly mounted to a surface of the hub receiving body, wherein the lower fastening ring opposes the upper fastening ring and

is magnetically attracted to the upper fastening ring. According to the invention there may be an annular hub receiving body mounted to a surface of the cartridge, wherein the hub receiving body may rotate about a line normal to the surface, and an annular medium receiving body connected to the hub receiving body wherein the center of the medium receiving body lies along the same line as the center of the hub receiving body, a hub fastener fixedly mounted to the hub receiving body, for removably securing the hub receiving body to a drive mechanism, and a medium fastener connected to the medium receiving body, for removably securing a storage medium relative to the hub receiving body.

The annular hub receiving body 22 has, on a surface opposite the annular medium receiving body 23, a hub fastener 9. The hub fastener 9 may comprise an annular magnetizable ring. The dimensions of the hub fastener 9, in the case of a hub adapter 306 to adapt a CD-ROM for playback in an MO drive mechanism, are consistent with the ISO standard established for the magnetizable ring in the hub of an MO disc.

The annular fastening body 25 may have, on a surface opposite from the annular connecting body 24, a second hub fastener (not shown). The second hub fastener (not shown) has the same structure and function as the hub fastener 9. The second hub fastener (not shown) would allow the hub adapter 306 to be inserted into the drive mechanism upside-down, to allow for playback of storage media with information recorded on both sides, without removing the hub adapter 306 from the storage medium.

With any of the embodiments of the hub adapter described above, the hub fastener 9 may comprise the entire lower surface of the annular hub receiving body 7, 12, 18, 22. In addition, the second hub fastener may comprise the entire upper surface of the annular fastening body 15, 25 or the annular connecting body 20. Additionally, any of the embodiments of the hub adapter may be rotatably mounted to the interior of the cartridge 1. Furthermore, in the embodiments of the hub adapter comprising more than one integral piece, either of the integral pieces may be rotatably mounted to the interior of the cartridge 1.

It will be obvious to one skilled in the art that adjustments may be required in the mechanical or optical features of the drive. These adjustments would allow a single optical assembly to determine which type of media is in the drive, and set parameters such as working position of the carriage assembly, expected track width, expected track pitch, and size of media. This determination may be made by trial and error by the drive, or there may be a switch on the cartridge 1 which alerts the drive that a storage medium which requires adaptation, such as a CD-ROM disc, is being inserted. In the latter case, an assembly to recognize the switch must then be added to the drive

mechanism. The structure and operation of such a switch and assembly would be obvious to one skilled in the art.

It will be obvious to one skilled in the art that modifications to the above description of the invention may be made without departing from the spirit and scope of the invention. The scope of the invention, therefore, is indicated by the appended claims rather than the above description.

**Claims:**

1. An apparatus for adapting a storage medium for use in a multistandard drive mechanism comprising:
an annular hub receiving body (7) ;
an annular medium receiving body (8) connected to said hub receiving body (7) wherein the center of said medium receiving body (8) lies along the same line as the center of said hub receiving body (7);
a hub fastener (9) fixedly mounted to said hub receiving body (7) , for removably securing said hub receiving body (7) to a drive mechanism; and
a medium fastener connected to said medium receiving body (8), for removably securing a storage medium (5) relative to said hub receiving body (7).

2. An apparatus for adapting a storage medium (5) for use in a multistandard drive mechanism comprising:
an annular hub receiving body (7);
an annular medium receiving body (8) connected to said hub receiving body (7) wherein the center of said medium receiving body (8) lies along the same line as the center of said hub receiving body (7);
a hub fastener (9) fixedly mounted to said hub receiving body (7), for removably securing said hub receiving body (7) to a drive mechanism;
a medium fastener connected to said medium receiving body (8), for removably securing a storage medium (5) relative to said hub receiving body (7);
an annular connecting body (14) connected to said medium receiving body (8) at a point remote from said hub receiving body (7), wherein the centers of said connecting body (14) , said medium receiving body, and said hub receiving body (7) lie along a line; and
an annular medium fastening body (15) connected to said connecting body (14) at a point remote from said medium receiving body (8), wherein the centers of said medium fastening body (15) , said connecting body (8) ; said medium receiving body (8), and said hub receiving body (7) lie along a line..

3. An apparatus as defined in claim 2, wherein:
said hub receiving body (7) is integral with said medium receiving body;
said connecting body (14) has a diameter substantially equal to the diameter of said medium receiving body (8);



said medium fastening body (15) has an inner diameter substantially equal to the inner diameter of said medium receiving body (8) and an outer diameter larger than the outer diameter of said medium receiving body (8);

said medium fastening body (15) is integral with said connecting body (14) at a surface of said connecting body (14) remote from said medium receiving body (8), wherein said medium fastening body (15) and said hub receiving body (7) together provide a clamping force on the storage medium (5) placed therebetween concentrically with said medium receiving body (8); and

said medium fastener comprises said medium fastening body (15).

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