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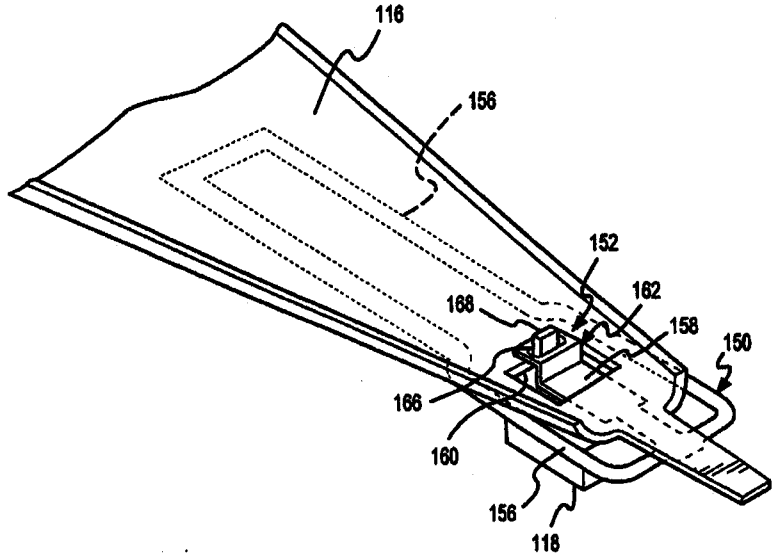
(54) Title: SHOCK LIMITING SUSPENSION FOR A DISC DRIVE



(57) Abstract: A suspension limiter for limiting travel of a read/write transducer gimbal in a disc drive is disclosed that positively engages or interlocks with a feature of the load beam supporting the gimbal, or vice versa, to preclude disengagement of the limiter during an abnormal external shock event. One embodiment has a hook on the load beam that fits within a hole gimbal to interlock the two together. Another embodiment has a hook on the gimbal that fits within a hole in the load beam during a shock event. Another embodiment has tabs on the gimbal that hook over a notch in side fingers extending from the end of the load beam on either side of the gimbal. Another embodiment has a hooked tab on the load beam that extends through an aperture in the gimbal to interlock the gimbal and load beam together during a shock load event. Each of the embodiments prevents catastrophic plastic deformation of the gimbal during such events.

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SHOCK LIMITING SUSPENSION FOR A DISC DRIVE

Field of the Invention

This application relates generally to disc drive data storage devices and more particularly to a shock limiting suspension for a magnetic read/write transducer in a disc drive.

Background of the Invention

Typically a gimbal assembly at one end of an elongated flexure sometimes called a load beam or suspension member supports the head over the data disc in a disc drive. The other end of the flexure or load beam is securely fastened, usually by staking, to a distal end of an actuator arm that is rotatably positioned adjacent the disc or stack of discs in the disc drive. Suspension limiters are used in those disc drives designed to park the read/write transducers or heads off of the discs on a shelf or ramp when the drive is typically either in a power saving mode or deenergized. The suspension limiter functions to help lift the head from the disc during head unload to the ramp and to prevent excessive strain on the gimbal during unload and prevent excessive strain if the drive is subjected to a shock load while the drive is deenergized or in a power save mode and the heads are positioned off of the disc. The end of the flexure carrying the head is suspended by a tab extending from the free end of the flexure into a slot formed in the parking ramp.

The head is supported by a gimbal attached to the load beam that permits the head to pitch, roll and yaw about the pivot point on the gimbal. The gimbal, in turn, is suspended from the load beam. When a shock load is applied to the deenergized drive, the head tends to move away from its supporting gimbal. A shock limiter is typically an extension tab on the gimbal which, when the drive is placed under a predetermined external shock load, engages a portion of the flexure or load beam to prevent excessive movement of the gimbal that would otherwise plastically deform the gimbal. However, if the shock load is substantial, the limiter may be twisted out of engagement with the load beam, and plastic deformation of the gimbal may result. In addition, once the limiter is disengaged, the limiter may interfere with proper orientation of the gimbal when the shock load is removed.

Accordingly there is a need for a shock limiting device in a disc drive that does not disengage the gimbal under any anticipated shock load condition.

Summary of the Invention

Against this backdrop the present invention has been developed. The present invention is a suspension limiter that positively engages or interlocks with a feature of the load beam supporting the gimbal, or vice versa, that in turn supports the read/write transducer to preclude disengagement of the limiter during a shock event. One embodiment of the suspension limiter in accordance with the present invention has a cantilevered arm extending from the gimbal that extends over a portion of the load beam. The distal end of the cantilevered arm has a hook shape and a tip adapted to interlockingly engage an aperture in the portion of the load beam directly beneath the hooked end of the arm. Other embodiments have a hooked tab that interlockingly engages an aperture either in the gimbal or the load beam to interfere with and thus prevent the tab from disengaging the gimbal from the load beam thus limiting the travel of the head and gimbal away from the load beam when excessive shock loads are applied to the drive. These and various other features as well as advantages which characterize the present invention will be apparent from a reading of the following detailed description and a review of the associated drawings.

Brief Description of the Drawings

FIG. 1 is a plan view of a disc drive incorporating a preferred embodiment of the suspension limiter in accordance with the present invention showing the primary internal components.

FIG. 2 is an enlarged perspective view of the distal end of a load beam and transducer head assembly showing a first preferred embodiment of the suspension limiter in accordance with the present invention.

FIG. 3 is an enlarged perspective view of the distal end of the load beam and head assembly showing a second preferred embodiment of the suspension limiter in accordance with the present invention.

FIG. 4 is an enlarged perspective view of the distal end of another load beam and head assembly showing a third suspension limiter in accordance with a third preferred embodiment of the present invention.

FIG. 5 is an enlarged perspective view of the distal end of another load beam and head assembly showing a fourth preferred embodiment of the limiter in accordance with the present invention.

FIG. 6 is an enlarged perspective view of the distal end of another load beam and head assembly showing a fifth preferred embodiment of the suspension limiter in accordance with the present invention.

FIG. 7 is an enlarged perspective view of the distal end of a load beam and head assembly showing a sixth preferred embodiment of the suspension limiter in accordance with the present invention also shown in FIG. 1.

Detailed Description

A disc drive 100 constructed in accordance with one preferred embodiment of the present invention is shown in FIG. 1. The disc drive 100 includes a base 102 to which various components of the disc drive 100 are mounted. A top cover (not shown), cooperates with the baseplate 102 to form an internal, sealed environment for the disc drive in a conventional manner. The components include a spindle motor 106 that rotates one or more discs 108 at a constant high speed. Information is written to and read from tracks on the discs 108 through the use of an actuator assembly 110, which rotates during a seek operation about a bearing shaft assembly 112 positioned adjacent the discs 108. The actuator assembly 110 includes a plurality of actuator arms 114 which extend towards the discs 108, with one or more flexures or load beams 116 extending from each of the actuator arms 114. Mounted at the distal end of each of the flexures 116 is a head 118 that includes an air bearing slider enabling the head 118 to fly in close proximity above the corresponding surface of the associated disc 108.

During a seek operation, the track position of the heads 118 is controlled through the use of a voice coil motor (VCM) 124, which typically includes a coil 126 attached to the actuator assembly 110, as well as one or more permanent magnets 128 which establish a magnetic field in which the coil 126 is immersed. The controlled application of current to the coil 126 causes magnetic interaction between the permanent magnets 128 and the coil 126 so that the coil 126 moves in accordance with the well-known Lorentz relationship. As the coil 126 moves, the

actuator assembly **110** pivots about the bearing shaft assembly **112**, and the heads **118** are caused to move across the surfaces of the discs **108**.

The spindle motor **106** is typically de-energized when the disc drive **100** is not in use for extended periods of time. The heads **118** are moved outward, off of the discs **108** and onto a parking ramp **120** adjacent the outer diameter of the discs **108** when the drive motor is de-energized. The heads **118** are secured on the parking ramps **120** through the use of an actuator latch arrangement, which prevents inadvertent rotation of the actuator assembly **110** when the heads are parked.

FIG. **2** shows a greatly enlarged perspective view of the load beam **116** supporting a gimbal **150** that, in turn, supports the transducer or head **118**. The load beam **116** and gimbal **150** incorporates a first preferred embodiment of the suspension limiter **152** in accordance with the invention. The top of the head **118** is fastened to the underside of the gimbal **150** that is in turn fastened to the distal end of the load beam **116**. The gimbal **150** is an elongated spring sheet metal stamping that has an elongated frame portion **156** supporting an inner head support portion **158** canntilevered from the frame portion **156**. The head support portion **158** is typically bonded to the top of the transducer or head **118** as seen in FIG. **2**. The configuration of the gimbal **150** permits the head **118** a substantial range of freedom of movement about the mounting point so that the head **118** can pitch, roll, and yaw about the attachment point in order to accurately follow the surface contours of the disc during drive operation.

The load beam **116** is an elongated sheet metal body that has a cutout **160** adjacent the distal end of the load beam **116**. The gimbal **150** is in turn an elongated sheet metal stamping that has a bent tab **162** having an L shape extending from a rear end of the inner head support portion **158**. This tab **162** has a catch hole **164** in its long leg **166**. The load beam **116** has a hook shaped tab **168** that extends upward from the cutout **160**. This tab **168** projects through the catch hole **164** in the long leg **166** of the bent tab **162** so that when and if the disc drive **100** is subjected to a substantial external shock event, the gimbal **150** will flex downward until the long leg **166** of the tab **162** hits the load beam **116**. This limits the deflection of the gimbal **150**. If the shock load is strong enough, the applied forces may deflect the tab **162** sufficiently to cause the tab **162** to try to slip off and disengage from the

load beam **116**. However, the bent up hook tab **168** projecting through the catch hole **164** interlocks with the long leg **166** to stop any further movement of the tab **162**. The hook tab **168** thus prevents deformation of the tab **162** and dislodgement of the tab **162** from the load beam **116**. This configuration essentially positively latches the gimbal **150** to the load beam **116** during such events and, in turn, prevents undesirable deformation of the gimbal **150** that would otherwise catastrophically prevent the head **118** from being repositioned onto the disc **108** when the drive **100** is reenergized.

FIG. **3** illustrates another preferred embodiment of a suspension limiter **201** in accordance with the present invention. A portion of the distal end of a load beam **200** is shown in perspective in FIG. **3** as viewed from the disc surface. The load beam **200** has a cut out **202** forming a hook **204** that is bent upward at a right angle to the surface plane of the load beam **200**. The load beam **200** has one end of an elongated gimbal **206** laser welded to the load beam **200**. The other end of the gimbal has a head mounting plate portion **208** to which a transducer head **210** is fastened. The head mounting plate portion **208** has a catch hole **212** through a rear end of the head mounting plate portion **208**. The catch hole **212** is vertically aligned with a downwardly extending hook tip **214** which is sized to fit into the catch hole **212**.

The hook **204**, catch hole **212**, and the hook tip **214** make up the suspension limiter in this embodiment. When a shock load is applied to the disc drive in which this embodiment is used, in a downward direction, as seen in FIG. **3**, the head **210** initially moves upward, pulling the gimbal 208 upward such that the hook tip **214** of the hook **204** extends into the catch hole **212** in the head mounting plate portion **208** and limiting the upward travel of the gimbal **206** with respect to the load beam **200** thereby preventing any plastic deformation of the gimbal **206** and the engagement of the hook tip **214** in the catch hole **212** prevents the potential disengagement of the hook **204** from the mounting plate portion **208**.

FIG. **4** illustrates another preferred embodiment of a suspension limiter **301** in accordance with the present invention. This embodiment is very similar to the second embodiment discussed immediately above. A portion of the distal end of a load beam **300** is shown again in perspective in FIG. **4** as viewed from the disc

surface. The load beam 300 has a cut out 302 forming a tab hook 304 that is bent upward from the surface plane of the load beam 300. In this embodiment, however, the hook 304 is not at a right angle to the surface plane of the load beam 300 as in hook 204. Instead, the tab hook 304 has a tab portion that extends in a plane parallel to the surface plane of the load beam 300. The load beam 300 has one end of an elongated gimbal 306 laser welded to the load beam 300. The other end of the gimbal 306 has a head mounting plate portion 308 to which a transducer head 310 is fastened. The head mounting plate portion 308 has an elongated catch hole 312 through a rear end of the head mounting plate portion 308. The elongated catch hole 312 is vertically aligned with a downwardly bent tab hook tip 314 which is sized to fit into the catch hole 312.

The tab hook 304, catch hole 312, and the tab hook tip 314 make up the interlocking suspension limiter in this embodiment. When a shock load is applied to the disc drive in which this embodiment is used, in a downward direction, as seen in FIG. 4, the head 310 again initially moves relatively upward, away from the load beam 300, pulling the gimbal 308 upward such that the hook tip 314 of the hook 304 extends into the catch hole 312 in the head mounting plate portion 308 and limiting the upward travel of the gimbal 306 with respect to the load beam 300 thereby preventing any plastic deformation of the gimbal 306. The interlocking engagement of the hook tip 314 in the catch hole 312 prevents the potential disengagement of the tab hook 304 from the mounting plate portion 308 of the gimbal 306 during the event.

Another embodiment of a suspension limiter 401 in accordance with the invention is shown in FIG. 5. In this figure, the distal end of a load beam 400 is shown in a perspective top view toward a disc 108. The load beam 400 in this embodiment does not have a cut out forming a hook. Instead, the distal end of the load beam 400 widens into a reverse tapered end 402 that covers the side rails 404 of an elongated gimbal 406, which in turn supports a transducer head 407.

A pair of fingers 408 is formed by downward bends at opposite corners of the end 402. One finger 408 extends alongside each of the rails 404 of the gimbal 406. Each of the fingers 408 has a notch 410 cut into its upper edge. Each of the side rails 404 of the gimbal 406 has an outwardly projecting and downwardly

hooked wing tab **412** that projects laterally outward directly over the notch **410** in the adjacent finger **408**.

In this embodiment, the load beam **400** will be supported on a ramp (not shown) when parked that engages a portion of the load beam behind the head **407**. During normal drive operation, there is no interaction between the fingers **408** and the gimbal **406**. When the actuator assembly is parked on the ramp, there is also no interaction normally between the fingers **408** and the gimbal **406**. However, if an external shock load is applied to the drive, the head **407** may tend to move away from the load beam **400**, e.g., downward in FIG. **5**, causing the side rails **404** of the gimbal **406** to follow. The side fingers **408** limit the downward movement of the gimbal **406**. The hooked tabs **410** interlockingly engage the fingers **408** in the notches **410** to prevent the tabs **410** from being dislodged from the fingers 408 during excessive shock load events.

Another embodiment of a suspension limiter **501** in accordance with the invention is shown in FIG. **6**. This embodiment is very similar to that shown in FIG. **5** except for the limiter configuration. Again, the distal end of a load beam **500** widens into a reverse tapered end **502** that covers the side rails **504** of an elongated gimbal **506**, which in turn supports a transducer head **507**. A pair of fingers **508** is formed by downward bends at opposite corners of the end **502**. One finger **508** extends alongside each of the rails **504** of the gimbal **506**. Each of the fingers **508** has a tab **510** that extends upward from its upper edge. Each of the side rails **504** of the gimbal **506** has an outwardly projecting flat tab **512** that extends laterally outward directly over the tab **510** in the adjacent finger **508**. The flat tab **512** has an aperture **514** therethrough that is sized to receive the tab **512**.

The load beam **500** will be supported on a ramp (not shown) when parked that engages a portion of the load beam behind the head **507**. Again, during normal drive operation, there is no interaction between the fingers **508** and the gimbal **506**. When the actuator assembly is parked on the ramp, there is also no interaction normally between the fingers **508** and the gimbal **506**. However, if an external shock load is applied to the drive, the head **507** may tend to move away from the load beam **500**, e.g., downward in FIG. **6**, causing the side rails **504** of the gimbal **506** to follow. The side fingers **508** limit the downward movement of the gimbal

506 by engaging the tabs 512. The tabs 512 are prevented from disengaging the fingers 508 under excessive shock loadings by the vertical tabs 510 entering the apertures 514 and interlocking the tabs together during the event. Thus the engagements of the tabs 510 in the apertures 514 prevent the tabs 512 from being dislodged from the fingers 508 during excessive shock load events.

A still further preferred embodiment of a suspension limiter 601 in accordance with the present invention is shown in FIG. 7. This embodiment of the interlocking suspension limiter 601 of the present invention is similar to that shown in FIG. 3 except that the suspension limiting hooked tab is formed in the gimbal rather than the load beam. A distal end of a load beam 600 is shown in FIG. 7. The load beam 600 is a sheet metal body that has a parking tip 602 at its distal end that extends into a parking groove 604 in the parking ramp 120 when the drive 100 is deenergized as shown in FIG. 1. An elongated gimbal 606 supports a transducer head 608 beneath the load beam 600. The load beam 600 has a pair of spaced cutouts 610 and 612 above the gimbal 606 defining a web portion 614 of the load beam therebetween. The gimbal 606 is a sheet metal body that has a pair of side rails 616 and a central cantilevered head support portion 618 beneath the web portion 614 of the load beam 600. The head 608 is attached to the underside of the head suport portion 618. The head support portion 618 has an upwardly bent suspension limiter hook 620 formed at its rear end. This bent hook extends up through the cutout 610 and over the web portion 614 and has a downwardly projecting tip 622. The web portion 614 has an aperture 624 directly beneath the tip 622 sized to receive the tip 622 in a shock event as in the previously described embodiments. The engagement of the tip 622 in the aperture 624 again interlockingly prevents the hook 620 from disengaging the web 614 during excessive shock events. The aperture may not necessarily be directly beneath the tip 622. The aperture may be positioned offset from a direct alignment such that during such a shock event, the limiter hook 622 does not need to insert immediately directly into the aperture 624, but may slide along the surface of the web portion 614 and into the aperture 624 and catch during elastic deformation in the event. This offset configuration between the limiter and the feature engaged during the shock event may be incorporated as well into the other embodiments described above. The offset

arrangemnt helps maintain a close gap between the limiter **620** and the mating feature such as aperture **624**, which is desirable during the ramp unload process during power save or power down.

In summary, the present invention may be viewed as a suspension limiter (such as **151, 201, 301, 401, 501,** or **601**) for a load beam and head support assembly in a disc drive (such as **100**) wherein a transducer head (such as **118, 210, 310, 407, 507** or **608**) is supported by a gimbal (such as **156, 206, 306, 406, 506,** or **606**) fastened to a distal end of a load beam (such as **116, 200, 300, 400, 500,** or **600**). The suspension limiter includes a limiting member (such as **162, 204, 304, 412, 512,** or **620**) formed on one of the load beam (such as **116, 200, 300, 400, 500** or **600**) or the gimbal (such as **156, 206, 306, 406, 506,** or **606**) and a feature (such as **168, 212, 312, 410, 510,** or **624**) on the other of the load beam or the gimbal wherein the limiting member **162, 204, 304, 412, 512,** or **620**) and the feature (such as **168, 212, 312, 410, 510,** or **624**) interlockingly engage to prevent disengagement of the limiting member and feature during the shock event. More specifically, the feature may include an aperture (such as **166, 212, 312, 514,** or **624**) in one of the load beam or gimbal and the limiting member may have a tip (such as **214, 314, 510** or **622**) positioned to enter the aperture (such as **212, 312, 514,** or **624**) to prevent disengagement during a shock event. The gimbal may have a curved hook shaped tab (such as **412**) projecting over a notch (such as **410**) in an elongated finger (such as **408**) projecting from the load beam (such as **400**) wherein the tab (such as **412**) engages the notch (such as **410**) to prevent disengagement of the tab (such as **412**) from the finger (such as **408**) during a shock event.

The interlocking feature may alternatively be on the load beam (such as **168,** or **624**) and the limiting member (such as **162**) may extend from a cantilevered head support portion (such as **158**) of the gimbal (such as **156**) directly over the feature (such as **168**) on the load beam (such as **116**). The feature may be an aperture (such as **624**) through the load beam (such as **600**) sized and positioned to receive a downwardly extending tip (such as **622**) of a hook shaped limiting member (such as **620**) during a shock event. The limiter feature may be on the gimbal (such as **202, 312, 412,** and **514**) and the limiting member may be an elongated member (such as **204, 304, 408,** and **508**) extending from the load beam (**200, 300, 400,** or **500**). The

limiting member may have a hook shape (such as **204** or **304**) for engaging a tab portion of the gimbal (such as **208** or **308**) and interlockingly fitting into an aperture (such as **212** or **312**) in the tab portion (such as **208** or **308**) during a shock event.

The limiting member may include an elongated finger (such as **408** or **508**) extending from the distal end (such as **402** or **502**) of the load beam (such as **400** or **500**) along side the gimbal (such as **406** or **506**). The feature may be a downwardly curved tab (such as **412**) laterally extending from the gimbal (such as **406**) over a complementary notch (such as **410**) formed in the elongated finger (such as **408**) beneath the tab (such as **412**). Alternatively, the limiting member may further have another elongated finger (such as **408**) extending along side the gimbal (such as **406**) and the gimbal (such as **406**) would have another downwardly curved tab (such as **412**) laterally extending from the gimbal (such as **406**) over another complementary notch (such as **410**) formed in the another elongated finger (such as **408**) beneath the another tab (such as **412**).

The limiter (such as **501**) has a limiting member that comprises a pair of elongated fingers (such as **508**) extending from the distal end (such as **502**) of the load beam (such as **500**) along opposite sides of the gimbal (such as **506**). The gimbal has a pair of laterally extending tabs (such as **512**) each extending over one of the elongated fingers (such as **508**). Each tab (such as **512**) has an aperture (such as **514**) therethrough. The interlocking feature is a vertical tab (such as **510**) projecting upward from each of the fingers (such as **508**) toward the aperture (such as **514**) in the tab (such as **512**) immediately above. When the drive (such as **100**) is subjected to a shock load, the vertical tab (such as **510**) interlockingly engages the aperture (such as **514**) in the gimbal tab (such as **512**) immediately above to prevent disengagement of the tabs.

Stated another way, the present invention may be viewed as an actuator assembly (such as **110**) for use in a disc drive (such as **100**) to move a transducer (such as **118, 210, 310, 407, 507,** or **608**) over a rotating disc (such as **108**). The assembly has an actuator arm (such as **114**) carrying a load beam (such as **116**) supporting a gimbal (such as **156**) at a distal end thereof. The gimbal suspends a transducer (such as **118, 210, 310, 407, 507,** or **608**) and the assembly has a suspension limiter (such as **152, 201, 301, 401, 501,** or **601**) for limiting movement

of the gimbal (such as **156, 206, 306, 406, 506,** or **606**) to prevent deformation of the gimbal during an excessive shock event. The suspension limiter (such as **152, 201, 301, 401, 501,** or **601**) includes a limiting member (such as **168, 204, 304, 408, 508,** or **620**) formed on one of the load beam or the gimbal and a feature (such as **166, 212, 312, 410, 514,** or **624**) on the other of the load beam (such as **116, 200, 300, 400, 500,** or **600**) or the gimbal (such as **156, 204, 304, 408, 508,** or **606**) wherein the limiting member and the feature interlockingly engage to prevent disengagement of the limiting member and feature during the shock event.

The feature may include an aperture (such as **166, 212, 312, 514,** or **624**) in one of the load beam or gimbal and the limiting member may have a tip (such as **168, 214, 314, 510,** or **622**) positioned to enter the aperture (such as **166, 212, 312, 514,** or **624**) to prevent disengagement during a shock event. The gimbal (such as has **406**) may have a curved hook shaped tab (such as **412**) projecting over a notch (such as **410**) in an elongated finger (such as **408**) projecting from the load beam (such as **400**). The tab engages the notch to prevent disengagement of the tab from the finger during a shock event. Alternatively, the feature (such as **168** or **624**) may be on the load beam (such as **116** or **600**) and the limiting member (such as **162** or **620**) extends from a cantilevered head support portion (such as **158** or **618**) of the gimbal (such as **156** or **606**) directly over the feature on the load beam. The feature may be an aperture (such as **624**) through the load beam (such as **600**) sized and positioned to receive a downwardly extending tip (such as **622**) of a hook shaped limiting member (such as **620**). Alternatively, the feature may be on the gimbal (such as **166, 212, 312,** or **514**) and the limiting member is an elongated member (such as **168, 204, 304,** or **510**) extending from the load beam (such as **116, 200, 300,** or **508**). The limiting member may have a hook shape (such as **168**) for engaging a tab portion (such as **162**) of the gimbal (such as **156**) and interlockingly fitting into an aperture (such as **166**) in the tab portion during a shock event.

In another embodiment, the limiting member is an elongated finger (such as **408**) extending from the distal end (such as **402**) of the load beam (such as **400**) along side the gimbal (such as **406**) and the feature is a downwardly curved tab (such as **412**) laterally extending from the gimbal over a complementary notch (such as **410**) formed in the elongated finger beneath the tab. Further, the limiting member

may comprisee a pair of elongated fingers (408) extending from the distal end (such as 402) of the load beam (such as 400) along opposite sides of the gimbal (406).

The gimbal (such as 506) may alternatively have a pair of laterally extending tabs (such as 512) each extending over one of the elongated fingers (such as 508), each tab (such as 512) having an aperture (such as 514) therethrough. In this embodiment, the feature is a vertical tab (such as 510) projecting upward from each of the fingers (such as 508) toward the aperture (such as 514) in the tab immediately above whereby when the drive (such as 100) is subjected to a shock load, the vertical tab (such as 510) interlockingly engages the aperture (such as 514) in the gimbal tab (such as 512) immediately above to prevent disengagement of the tabs (such as 512).

It will be clear that the present invention is well adapted to attain the ends and advantages mentioned as well as those inherent therein. While a presently preferred embodiment has been described for purposes of this disclosure, various changes and modifications may be made which are well within the scope of the present invention. For example, many other different hook and aperture shapes may be envisioned than have been described above. The tip 622 of the hook 620 may have a square or pointed shape rather than the curved tip as shown in FIG. 7. The feature that is interlockingly engaged by the tip 622 of the hook 620 may be a ridge or upwardly bent tab along the rear of the web 618 rather than an aperture 624. Numerous other changes may be made which will readily suggest themselves to those skilled in the art and which are encompassed in the spirit of the invention disclosed and as defined in the appended claims.

What is claimed is:

1. A suspension limiter for a load beam and head support assembly in a disc drive wherein a transducer head is supported by a gimbal fastened to a distal end of a load beam, the suspension limiter comprising:

A limiting member formed on one of the load beam or the gimbal and an engagement feature on the other of the load beam or the gimbal; and

means for interlockingly engaging the limiting member and the feature to prevent disengagement of the limiting member and feature during a shock event.

2. A suspension limiter for a disc drive wherein a transducer head is supported by a gimbal fastened to a distal end of a load beam, the suspension limiter comprising:

a limiting member formed on one of the load beam or the gimbal; and

a feature on the other of the load beam or the gimbal for contacting the limiting member during a shock event, wherein one of the limiting member and the feature includes an aperture that securely engages a vertical protrusion on the other of the limiting member and the feature to prevent disengagement of the limiting member and the feature during a shock event.

3. The suspension limiter according to claim 2 wherein the feature is on the gimbal and the limiting member is on the load beam.

4. The suspension limiter according to claim 3 wherein the gimbal includes a head mounting portion that extends above an opening defined in the load beam, and wherein:

the feature includes the aperture formed in the head mounting portion of the gimbal; and

the limiting member comprises a hook formed from a segment of the load

beam, the hook extending through the opening defined in the load beam and including a tip positioned above the aperture for securely engaging the aperture during a shock event.

5. The suspension limiter according to claim 4 wherein the hook includes:

a first segment extending from one side of the opening defined in the load beam, the first segment bent at a right angle to extend vertically above a plane of the load beam; and

a second segment extending parallel to the plane of the load beam, wherein the hook tip is defined at an end of the second segment so that the hook tip is positioned over the aperture in the absence of a shock event.

6. The suspension limiter according to claim 4 wherein the hook comprises an arm extending from one end of the opening defined in the load beam, the arm bent at an angle to a plane of the load beam so that the hook tip is positioned over the aperture in the absence of a shock event.

7. The suspension limiter according to claim 2 wherein the feature is on the load beam and the limiting member is on the gimbal.

8. The suspension limiter according to claim 7 wherein:

the feature includes the aperture formed on the load beam; and

the limiting member comprises a hook extending from a head mounting portion of the gimbal upward through an opening defined in the load beam, the hook including a tip positioned for securely engaging the aperture during a shock event.

9. The suspension limiter according to claim 7 wherein:

the feature comprises a vertical tab extending from the load beam; and

the limiting member comprises a horizontal tab extending from the

gimbal, the horizontal tab defining the aperture for securely engaging the vertical tab during a shock event.

10. The suspension limiter according to claim 9 wherein the horizontal tab extends vertically upward from a head mounting portion of the gimbal through an opening defined in the load beam, the horizontal tab contacting a surface of the load beam during a shock event, and the vertical tab extending through the aperture defined in the horizontal tab to prevent the horizontal tab from being pulled through the opening defined in the load beam during a shock event.

11. The suspension limiter according to claim 9 wherein:

the feature includes two elongated fingers extending along opposite sides of the gimbal, each elongated finger including a vertical tab extending upward toward the gimbal; and

the limiting member includes two horizontal tabs extending outward from opposite sides of the gimbal, each horizontal tab contacting a corresponding one of the elongated fingers during a shock event, and each horizontal tab defining an aperture positioned over the vertical tab of the corresponding elongated finger for securely engaging the vertical tab to prevent disengagement of the horizontal tab and the elongated finger during a shock event.

12. A disc drive having an actuator assembly for moving a transducer over a rotating disc, the actuator assembly comprising:

an actuator arm carrying a load beam supporting a gimbal at a distal end thereof, wherein the transducer is suspended from the gimbal; and

a suspension limiter for limiting movement of the gimbal relative to the load beam during a shock event to prevent deformation of the gimbal, wherein the suspension limiter comprises:

a limiting member formed on one of the load beam or the gimbal; and

a feature on the other of the load beam or the gimbal for contacting the limiting member during a shock event, wherein one of the limiting member and the feature includes an aperture that securely engages a vertical protrusion on the other of the limiting member and the feature to prevent disengagement of the limiting member and the feature during a shock event.

13. The disc drive according to claim 12 wherein the feature is on the gimbal and the limiting member is on the load beam.

14. The disc drive according to claim 13 wherein the gimbal includes a head mounting portion that extends above an opening defined in the load beam, and wherein:

the feature includes the aperture formed in the head mounting portion of the gimbal; and

the limiting member comprises a hook formed from a segment of the load beam, the hook extending through the opening defined in the load beam and including a tip positioned above the aperture for securely engaging the aperture during a shock event.

15. The disc drive according to claim 14 wherein the hook includes:

a first segment extending from one side of the opening defined in the load beam, the first segment bent at a right angle to extend vertically above a plane of the load beam; and

a second segment extending parallel to the plane of the load beam, wherein the hook tip is defined at an end of the second segment so that the hook tip is positioned over the aperture in the absence of a shock event.

16. The disc drive according to claim 14 wherein the hook comprises an arm extending from one end of the opening defined in the load beam, the arm bent at an angle to a plane of the load beam so that the hook tip is positioned over the aperture in the absence of a shock event.

17. The disc drive according to claim 12 wherein the feature is on the load beam and the limiting member is on the gimbal.

18. The disc drive according to claim 17 wherein:

the feature includes the aperture formed on the load beam; and

the limiting member comprises a hook extending from a head mounting portion of the gimbal upward through an opening defined in the load beam, the hook including a tip positioned for securely engaging the aperture during a shock event.

19. The disc drive according to claim 17 wherein:

the feature comprises a vertical tab extending from the load beam; and

the limiting member comprises a horizontal tab extending from the gimbal, the horizontal tab defining the aperture for securely engaging the vertical tab during a shock event.

20. The disc drive according to claim 19 wherein the horizontal tab extends vertically upward from a head mounting portion of the gimbal through an opening defined in the load beam, the horizontal tab contacting a surface of the load beam during a shock event, and the vertical tab extending through the aperture defined in the horizontal tab to prevent the horizontal tab from being pulled through the opening defined in the load beam during a shock event.

21. The disc drive according to claim 19 wherein:

the feature includes two elongated fingers extending along

opposite sides of the gimbal, each elongated finger including a vertical tab extending upward toward the gimbal; and

the limiting member includes two horizontal tabs extending outward from opposite sides of the gimbal, each horizontal tab contacting a corresponding one of the elongated fingers during a shock event, and each horizontal tab defining an aperture positioned over the vertical tab of the corresponding elongated finger for securely engaging the vertical tab to prevent disengagement of the horizontal tab and the elongated finger during a shock event.