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Karasawa et al.

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(54) **DISK DRIVE SUSPENSION INCLUDING A LOAD BEAM WITH AN ARC-SHAPED TAB, DISK DRIVE, AND DISK DRIVE SUSPENSION MANUFACTURING METHOD**

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G06F 3/06 (2006.01)

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CPC ***G11B 5/4833*** (2013.01); ***G06F 3/0676*** (2013.01); ***G11B 5/4826*** (2013.01); *G11B 2220/2516* (2013.01)

(58) **Field of Classification Search**
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See application file for complete search history.

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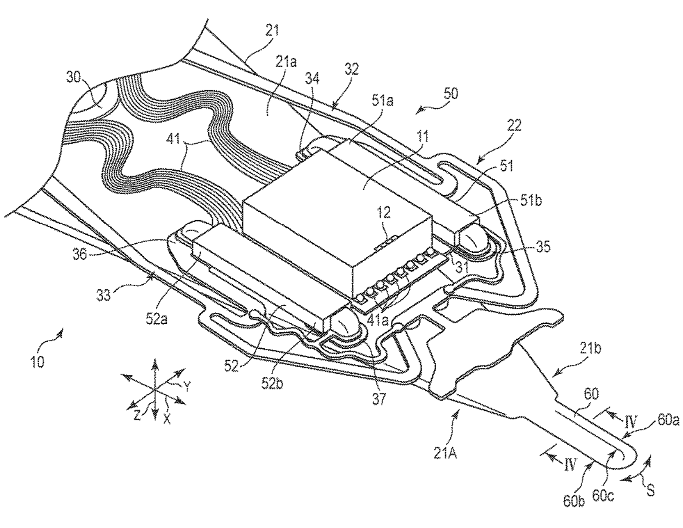
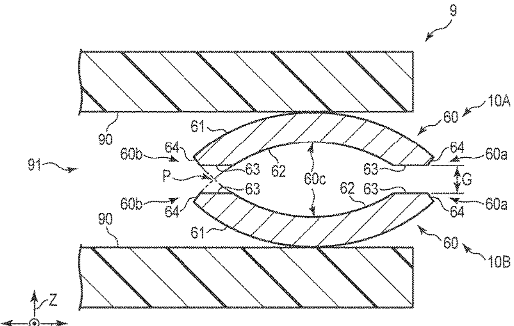
(74) *Attorney, Agent, or Firm* — Holtz, Holtz & Volek PC

(57) **ABSTRACT**

A disk drive suspension of the embodiments includes a load beam, and a flexure including a mounting portion on which a slider is mounted and overlapping with the load beam. The load beam includes a tab further extending than the mounting portion longitudinal direction of the load beam. The tab is shaped in an arc such that a central portion in a lateral direction protrudes with respect to both end portions in the lateral direction, in the load beam. Each of the both end portions includes a flat surface parallel to the lateral direction.

3 Claims, 6 Drawing Sheets





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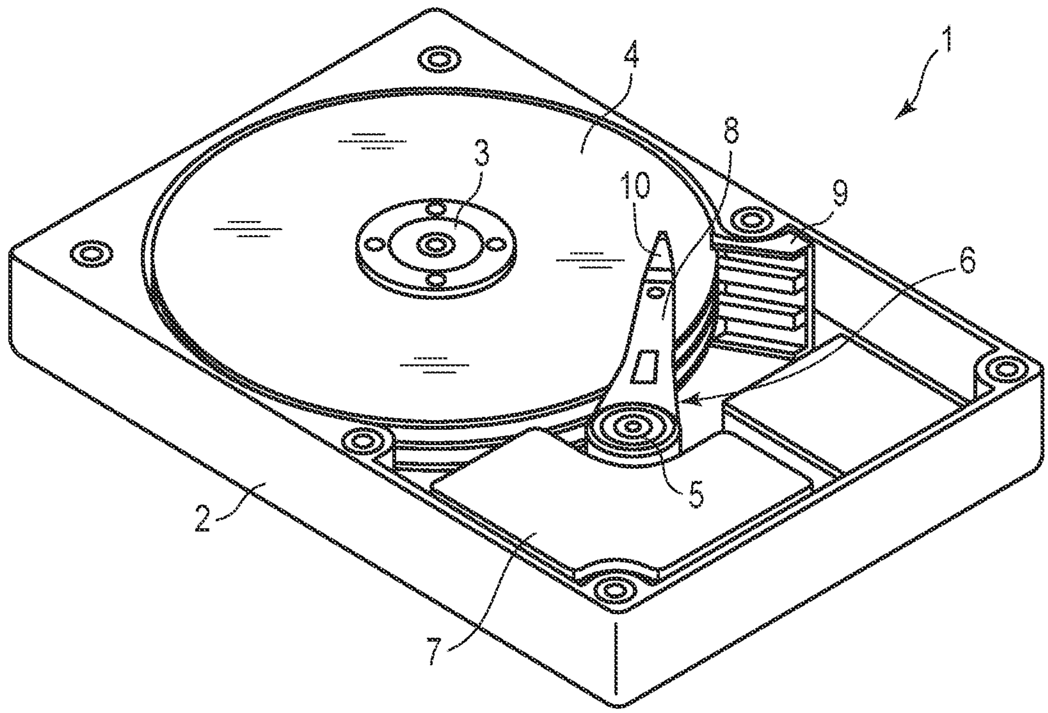
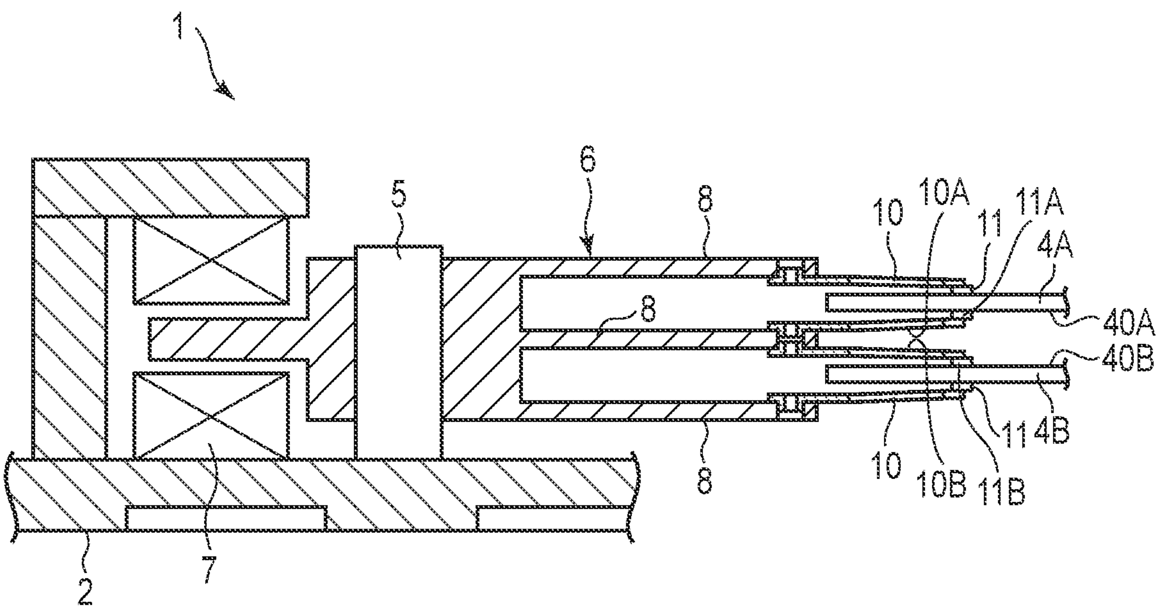


F I G. 1



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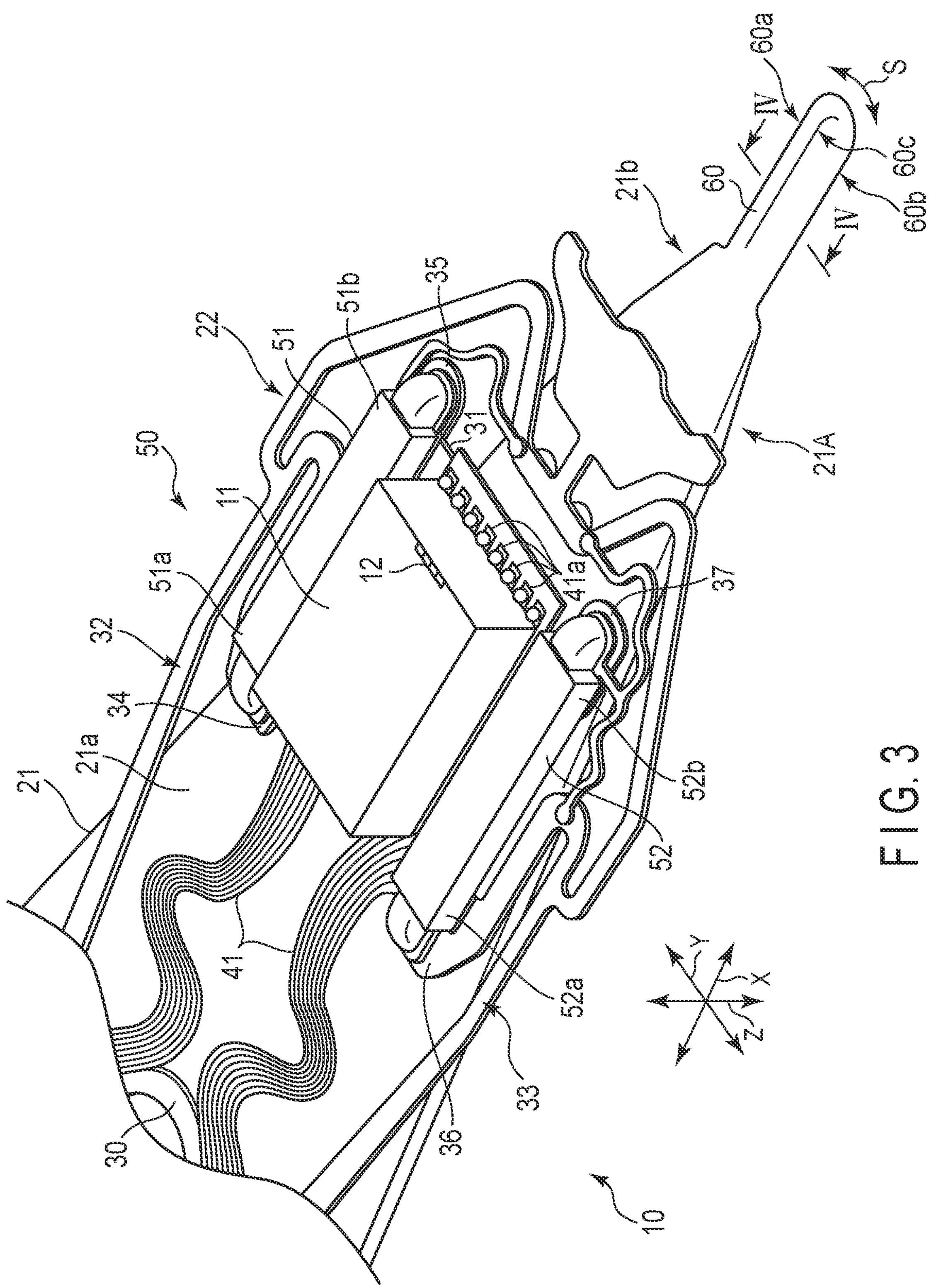

60a
S
IV
60c
21b
60
60b
IV
22
51
51b
35
31
21A
50
11
12
41a
37
51a
32
34
21a
21
52b
52
41
Y
X
Z
52a
33
36
30
10

FIG. 3

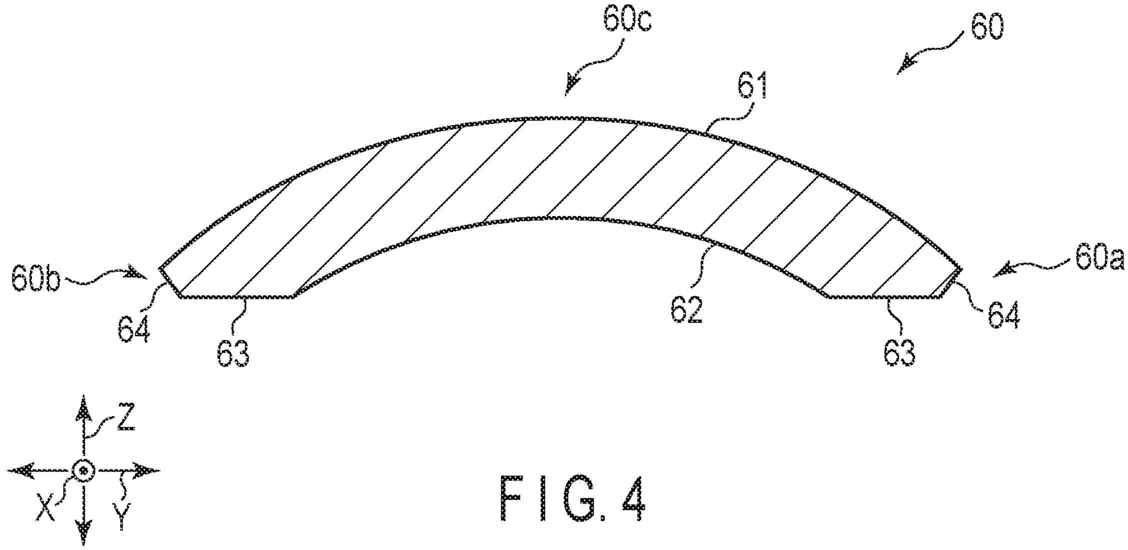

60c
60
61
60b
60a
64
62
64
63
63
Z
X
Y

FIG. 4

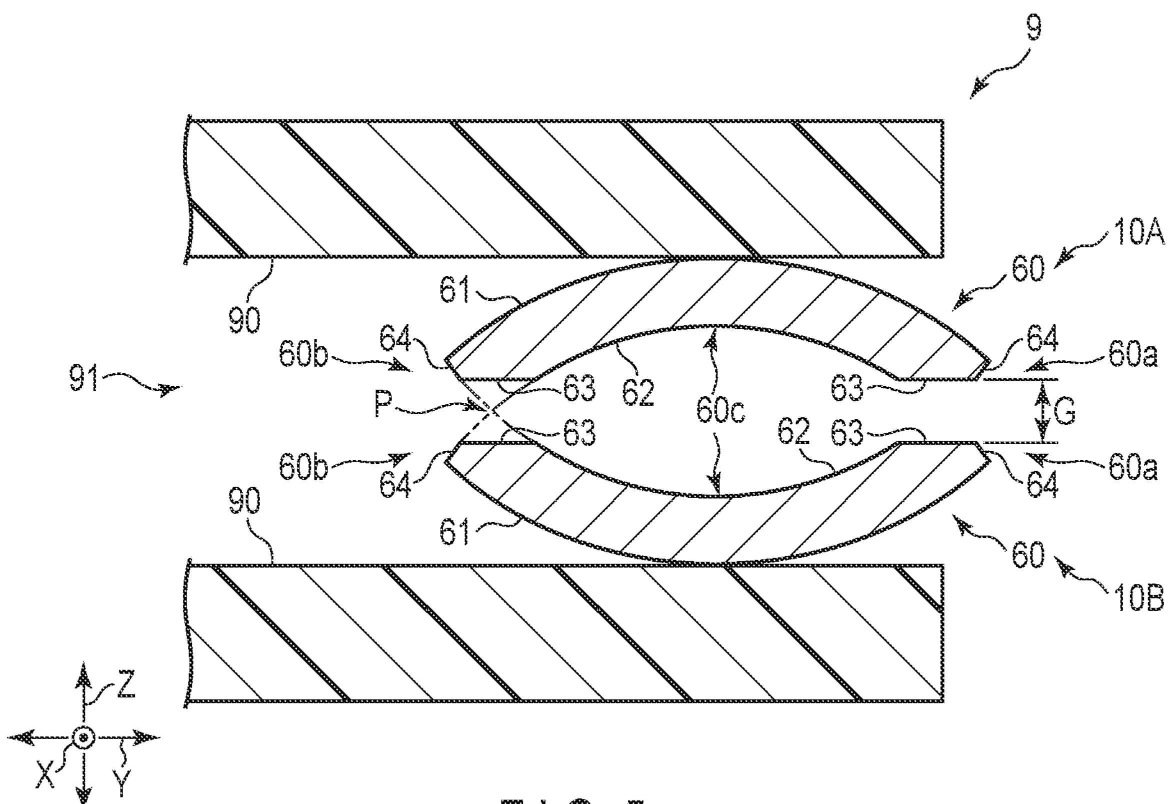
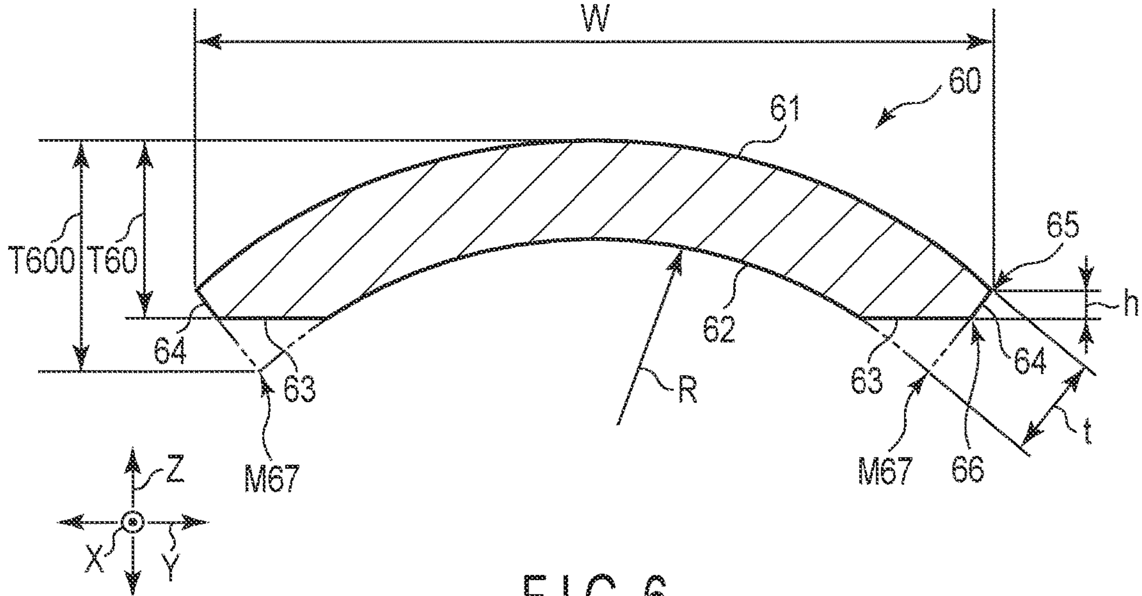
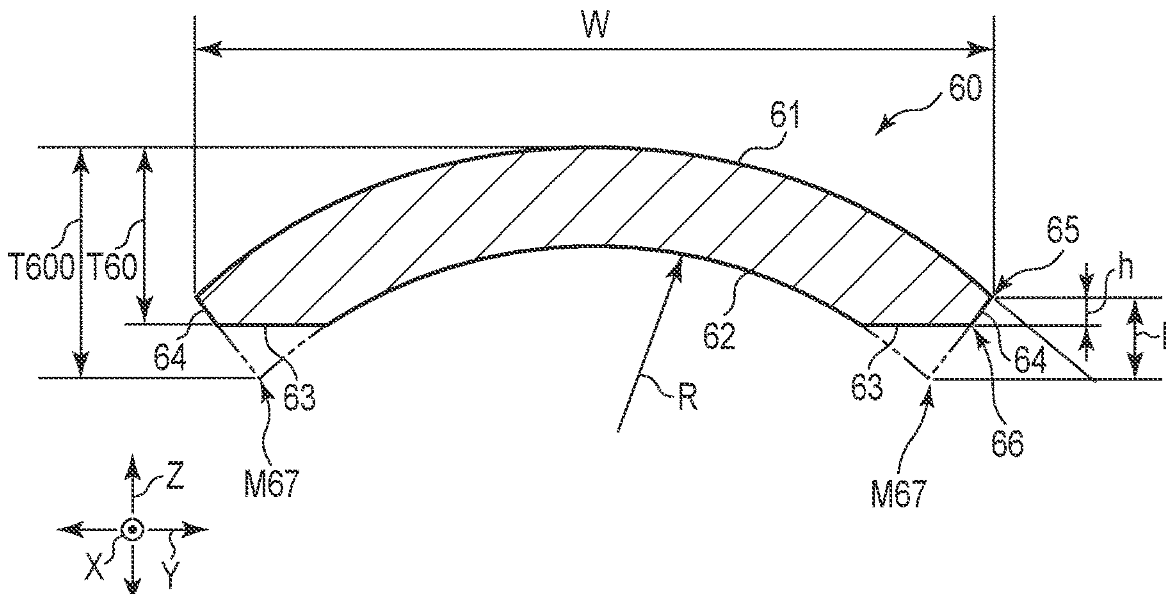

9
10A
60
61
90
64
64
60b
60a
91
63
62
63
P
60c
G
63
62
63
60b
60a
64
64
90
61
60
10B
Z
X
Y

FIG. 5



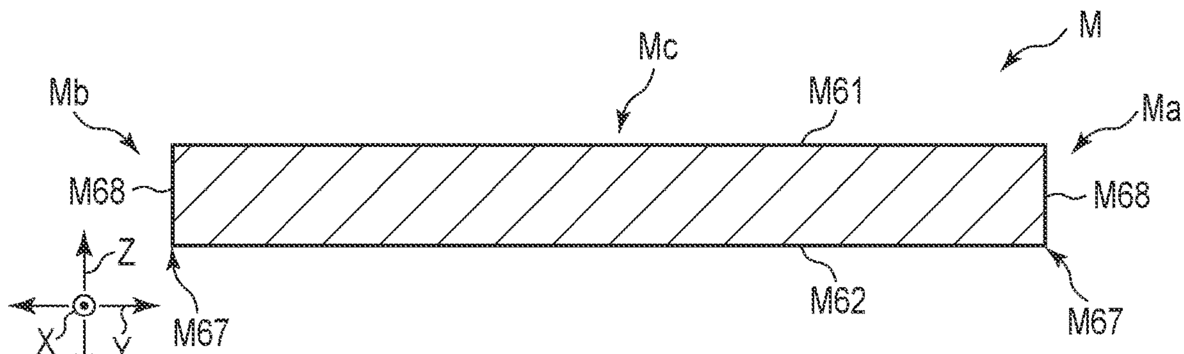
W
60
61
65
T600
T60
h
64
62
64
63
63
R
t
M67
M67
66
Z
X
Y

FIG. 6

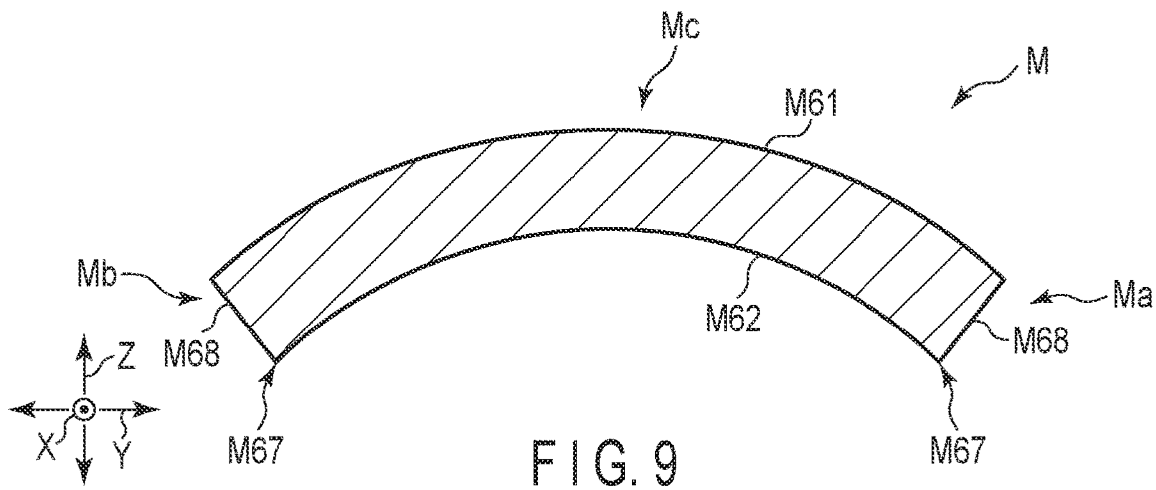


W
60
61
65
T600
T60
h
H
64
62
64
63
63
R
66
M67
M67
Z
X
Y

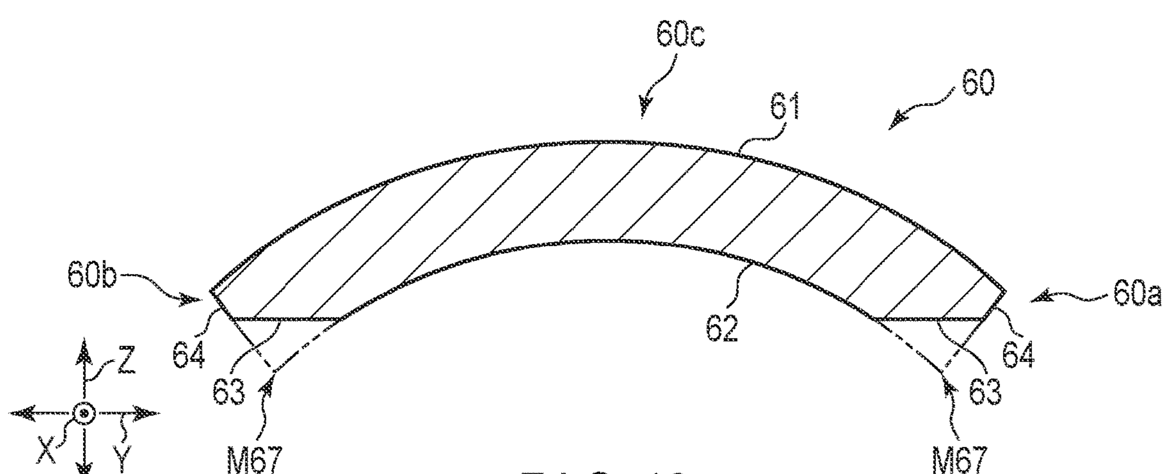
FIG. 7



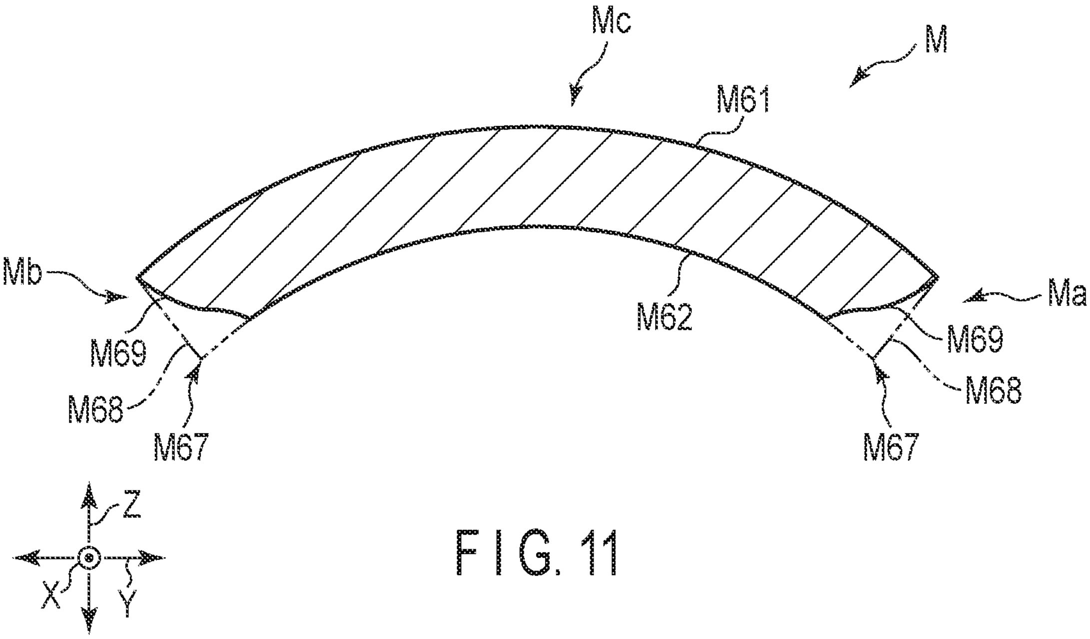
F I G. 8



F I G. 9

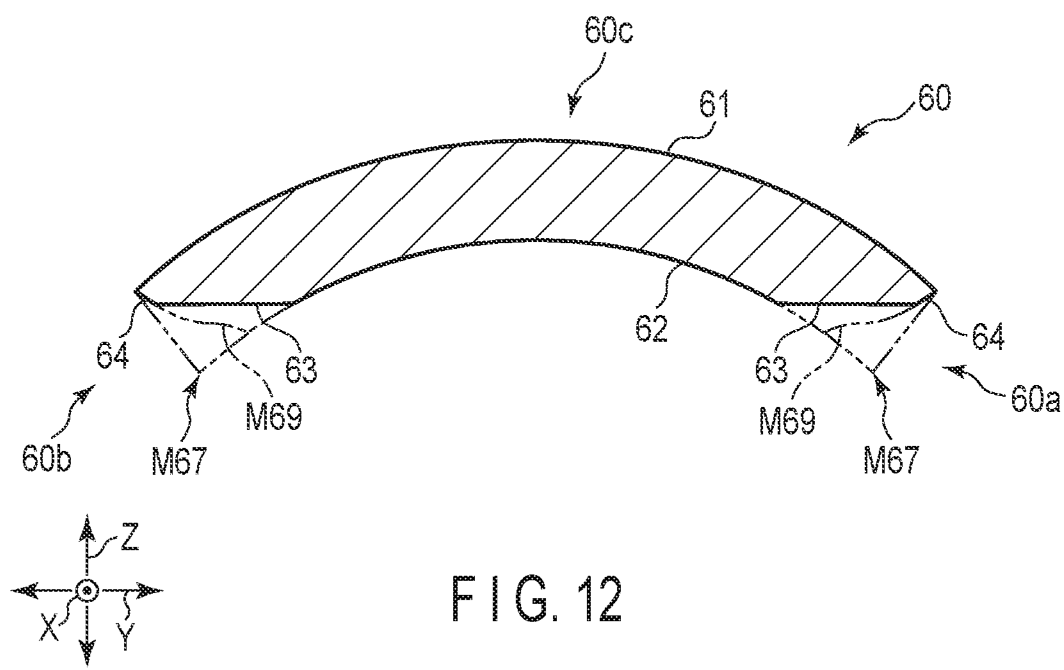


F I G. 10



Mc
M
M61
Mb
Ma
M62
M69
M69
M68
M68
M67
M67
Z
X
Y

FIG. 11



60c
60
61
64
62
64
63
63
60a
M69
M69
60b
M67
M67
Z
X
Y

FIG. 12

DISK DRIVE SUSPENSION INCLUDING A LOAD BEAM WITH AN ARC-SHAPED TAB, DISK DRIVE, AND DISK DRIVE SUSPENSION MANUFACTURING METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based upon and claims the benefit of priority from prior Japanese Patent Application No. 2021-162717, filed Oct. 1, 2021, the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a disk drive suspension used for hard disk drives or the like, a disk drive and a disk drive suspension manufacturing method.

2. Description of the Related Art

A hard disk drive (HDD) is used in an information processing apparatus such as a personal computer. The hard disk drive includes a magnetic disk which rotates about a spindle, a carriage which turns about a pivot, and the like. The carriage includes an actuator arm, and turns in a disk track width direction about the pivot by a positioning motor such as a voice coil motor.

A disk drive suspension (hereinafter simply referred to as a suspension) is attached to the actuator arm. Toe suspension includes a load beam, a flexure overlapping with the load beam, and the like. A slider which constitutes a magnetic head is provided on a gimbal portion formed near a distal end of the flexure. Elements (transducers) for access such as read or write of the data are provided at the slider. A head gimbal assembly is constituted by the load beam, the flexure, the slider, and the like.

In order to overcome the increase in the recording density of the disks, the head gimbal assembly needs to be further downsized, and the slider needs to be positioned more precisely relative to the recording surface of the disks. Furthermore, since the demand for improvement of recording capacity of the hard disk drive for improvement of recording density is strong, the number of magnetic disks that the hard disk drive comprises has increased (so-called multi-disking).

In order to increase the number of magnetic disks, it is necessary not only to make magnetic disks thinner, but also to make the distance between magnetic disks short. When the interval between the magnetic disks is made shorter, suspensions facing each other between the magnetic disks are more likely to contact each other. For this reason, thinner suspensions are required.

For example, JP 2020-129423 A discloses a disk drive in which the number of magnetic disks installed as recording media can be increased. Even in the suspension provided in the disk drive disclosed in JP 2020-129423 A, however, when the number of magnetic disks is increased, tabs at the distal ends of the suspensions facing each other may contact each other.

BRIEF SUMMARY OF THE INVENTION

An object of the present invention is to provide a disk drive suspension, a disk drive, and a disk drive suspension manufacturing method, capable of corresponding to increase in number of magnetic disks.

According to one embodiment, a disk drive suspension comprises a load beam, and a flexure including a mounting portion on which a slider is mounted and overlapping with the load beam. The load beam includes a tab further extending than the mounting portion in a longitudinal direction of the load beam. The tab is shaped in an arc such that a central portion in a lateral direction protrudes with respect to both end portions in the lateral direction, in the load beam. Each of the both end portions includes a flat surface parallel to the lateral direction.

The tab may have an arc-shaped first surface located on a side of the flexure and an arc-shaped second surface on a side opposite to the first surface, in a thickness direction of the load beam intersecting the longitudinal direction and the lateral direction. Each of the flat surfaces may be connected to the second surface. Each of the both end portions may further have a connecting surface connecting the first surface to the flat surface.

Each of the both end portions may further include a first edge at which the first surface and the connecting surface are connected, and a second edge at which the flat surface and the connecting surface are connected. A distance from the first edge to the second edge in the thickness direction may be less than or equal to a half of a thickness between the first surface and the second surface.

According to another embodiment, a disk drive suspension manufacturing method is a method of manufacturing a disk drive suspension comprising a load beam including a tab. The method comprises a curving a metal plate such that a central portion in a lateral direction protrudes with respect to both end portions in the lateral direction, in the tab, and a flattening surfaces parallel to the lateral direction, on the both end portions.

The metal plate has a third surface formed in an arc shape in the curving, a fourth surface on a side opposite to the third surface, which is formed in an arc shape in the curving, a fifth surface connecting the third surface to the fourth surface, and an edge to which the fourth surface and the fifth surface are connected. The edge may be flatted in the flattening.

According to yet another embodiment, a disk drive comprises a first disk, a second disk spaced apart from and opposed to the first disk, a first suspension performing data read from or data write to the first disk, a second suspension performing data read from of data write to the second disk, and a ramp including an interval and being provided on an outer peripheral side of the first disk and the second disk. Each of the first suspension and the second suspension comprises a load beam, and a flexure including a mounting portion on which a slider is mounted and overlapping with the load beam. The load beam includes a tab further extending than the mounting portion in a longitudinal direction of the load beam. The tab is shaped in an arc such that a central portion in a lateral direction protrudes with respect to both end portions in the lateral direction, in the load beam. Each of the both end portions includes a flat surface parallel to the lateral direction. The first suspension and the second suspension are located in the interval in a state in which the flat surfaces are spaced apart from each other and opposed to each other, when the mounting portion retreats from each of the first and disk and the second disk.

The disk drive suspension, the disk drive, and the disk drive suspension manufacturing method, can correspond to increase in the number of magnetic disks.

Additional objects and advantages of the invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and obtained by means of the instrumentalities and combinations particularly pointed out hereinafter.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention, and together with the general description given above and the detailed description of the embodiments given below, serve to explain the principles of the invention.

FIG. **1** is a schematic perspective view showing an example of a disk drive.

FIG. **2** is a schematic cross-sectional view showing a part of the disk drive.

FIG. **3** is a schematic perspective view showing a part of a distal side of a suspension as seen from a slider side.

FIG. **4** is a cross-sectional view showing a tab taken along line IV-IV of FIG. **3**.

FIG. **5** is a view showing a relationship between the tab and the ramp when the suspension is retracted into the ramp.

FIG. **6** is a view showing an example of a thickness of the tab in the thickness direction.

FIG. **7** is a view showing another example of the thickness of the tab in the thickness direction.

FIG. **8** is a view showing an example of a method of manufacturing a tab.

FIG. **9** is a view showing an example of a method of manufacturing a tab.

FIG. **10** is a view showing an example of a method of manufacturing a tab.

FIG. **11** is a view showing another example of the method of manufacturing the tab.

FIG. **12** is a view showing another example of the method of manufacturing the tab.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** is a schematic perspective view showing an example of a disk drive (HDD) **1**. The disk drive **1** comprises a casing **2**, a plurality of magnetic disks **4** (hereinafter simply referred to as disks **4** rotatable about a spindle **3**, a carriage **6** which can turn about a pivot **5**, a positioning motor (voice coil motor) **7** for driving the carriage **6**, and a ramp **9** provided on the casing **2**. The ramp **9** is provided on an outer circumference side of the disks **4**. The casing **2** is sealed by a lid (not shown).

FIG. **2** is a schematic cross-sectional view showing a part of the disk drive **1**. As shown in FIG. **1** and FIG. **2**, a plurality of arms (carriage arms) **8** are provided on the carriage **6**. A suspension **10** is mounted on a distal end portion of each arm **8**. A slider **11**, which constitutes the magnetic head, is, provided on the distal end portion of each suspensions **10**.

When each disk **4** rotates at a high speed, air flows in between the disk **4** and the slider **11** and an air bearing is thereby formed. When the carriage **6** is turned by the positioning motor **7**, the suspension **10** moves radially relative to the disk **4**, such that the slider **11** moves to a desired track of the disk **4**.

When the disk **4** is stopped, the suspension **10** retreats toward the ramp **9** shown in FIG. **1**. When the disk **4** is driven, the suspension **10**, which has retreated to the ramp **9**, moves from the ramp **9** toward the disk **4**.

As shown in FIG. **2**, the disks **4** include a first disk **4**A and a second disk **4**B. The first disk **4**A is opposed and spaced apart from the second disk **4**B. From the other viewpoint, the first disk **4**A faces the second disk **4**B in the thickness direction of the casing **2**. The first disk **4**A has a face **40**A and the second disk **4**B has a face **40**B opposed to the face **40**A.

The plurality of suspensions **10** provided at the disk drive **1** includes a first suspension **10**A and a second suspension **10**B. The first suspension **10**A and the second suspension **10**B are located between the first disk **4**A and the second disk **4**B. The first suspension **10**A faces the second suspension **10**B in the thickness direction of the casing **2**.

The first suspension **10**A includes a slider **11**A that reads data from or writes data to the face **40**A side of the first disk **4**A. The second suspension **10**B includes a slider **11**B that reads data from or writes data to the face **40**B side of the second disk **4**B. The plurality of disks **4** are not limited to two disks, but may be three or more disks. The quantity of suspensions **10** is changed arbitrarily in accordance with the number of disks **4**.

FIG. **3** is a schematic perspective view showing a part of a distal side of the suspension **10** as seen from the slider **11** side. The suspension **10** comprises a base plate (not shown) fixed to the arm **8** of the carriage **6** (shown in FIG. **1** and FIG. **2**), a load beam **21**, and a flexure **22** overlapping with the load beam **21**. The flexure **22** is arranged along the load beam **21**. The flexure **22** is secured to the load beam **21** by laser spot welding or other means.

Both the load beam **21** and the flexure **22** extend in the longitudinal direction of the suspension **10**. In the following descriptions, the longitudinal direction of the suspension **10**, the load beam **21** and the flexure **22** is referred to as a longitudinal direction X, and a direction (width direction) orthogonal to the longitudinal direction X is referred to as a lateral direction Y of the suspension **10**, the load beam **21**, the flexure **22**, and the like.

A direction intersecting (for example, orthogonal to) the longitudinal direction X and the lateral direction Y is referred to as a thickness direction of the suspension **10**, the load beam **21**, the flexure **22**, and the like. In addition, a sway direction S is defined as indicated by an arc-shaped arrow near the distal end of the load beam **21**.

For example, elements **12** that can convert magnetic signals and electrical signals, such as MR elements, are provided at the distal end portion of the slider **11** constituting the magnetic head. Access such as data write, data read, or the like on the disks **4** is performed by the elements **12**. A head gimbal assembly is composed of the slider **11**, the load beam **21**, the flexure **22**, and the like.

The load beam **21** has a face **21***a*. The flexure **22** is arranged on the face **21***a*. The flexure **22** overlaps with a body **21**A of the load beam **21**. The flexure **22** includes a metal base **30** formed of a thin stainless steel plate and a wiring portion **41** arranged along the metal base **30**. A part of the wiring portion **41** is electrically connected to the elements **12** of the slider **11** via a terminal **41***a* for the slider **11**.

The thickness of the metal base **30** is smaller than the thickness of the load beam **21**. The thickness of the metal base **30** is desirably from 12 to 25 μm, for example, 20 μm. The thickness of the load beam **21** is, for example, 30 μm.

The flexure **22** includes a tongue **31**, a first outrigger **32**, and a second outrigger **33**. The slider **11** is mounted on the tongue **31**. The tongue **31** is an example of a mounting portion on which the slider **11** is mounted.

The first outrigger **32** and the second outrigger **33** are arranged on both sides of the tongue **31** in the lateral direction Y. The first outrigger **32** and the second outrigger **33** are shaped to expand to both sides of the tongue **31** in the lateral direction Y. Each of the tongue **31**, the first outrigger **32**, and the second outrigger **33** is a part of the metal base **30** and, for example, its outline is formed by etching.

A dimple (not shown) protruding toward the tongue **31** is formed near the distal end of the body **21**A of the load beam **21**. The distal end of the dimple is in contact with the tongue **31**. The tongue **31** can pivot about the distal end of the dimple to make a desired gimbal motion. A gimbal portion **50** is composed of the tongue **31**, the first outrigger **32**, the second outrigger **33**, the dimple, and the like.

A first micro actuator element **51** and a second micro actuator element **52** are mounted on the gimbal portion **50**. The micro actuator elements **51** and **52** have a function of rotating the tongue **31** in the sway direction S.

The micro actuator elements **51** and **52** are arranged on both sides of the slider **11** in the lateral direction Y. The micro actuator elements **51** and **52** are formed of a piezoelectric material such as lead zirconate titanate (PZT) or the like.

Both ends **51***a* and **51***b* of the first micro actuator element **51** are fixed to actuator support portions **34** and **35** of the tongue **31**, respectively, by a conductive adhesive or the like. Both ends **52***a* and **52***b* of the second micro actuator element **52** are fixed to actuator support portions **36** and **37** of the tongue **31**, respectively, by a conductive adhesive or the like.

The body **21**A of the load beam **21** includes a distal end portion **21***b* which is located on a side opposite to one end connected to the baseplate. A tab **60** extending from the distal end portion **21***b* in the longitudinal direction X is formed on the load beam **21**. When the disks **4** are stopped, the tab **60** are guided such that the suspension **10** moves to a retreating position.

The tab **60** is formed integrally with the body **21**A of the load beam **21**. As shown in FIG. **3**, the tab **60** has an elongated shape extending in the longitudinal direction X. The tab **60** further extends than the tongue **31** in the longitudinal direction X.

The tab **60** includes an end portion **60***a*, an end portion **60***b* on a side opposite to the end portion **60***a*, a central portion **60***c* in the lateral direction Y. The central portion **60***c* is located between the end portion **60***a* and the end portion **60***b* in the lateral direction Y. The end portion **60***a* and the end portion **60***b* may be hereinafter referred to as "both end portions **60***a* and **60***b*".

FIG. **4** is a cross-sectional view showing the tab **60** as taken along line IV-IV of FIG. **3**. The tab **60** is formed in a shape of an arc curved toward the flexure **22** side in the thickness direction Z. The tab **60** "curved toward the flexure **22** side" means that the tab **60** is curved to protrude in a direction (upward direction in FIG. **4**) from a face opposite to the face **21***a* of the load beam **21** toward the face **21***a*, in the thickness direction Z. More specifically, as shown in FIG. **4**, the tab **60** has a curved shape such that the central portion **60***c* further protrudes than the both ends **60***a* and **60***b*.

The tab **60** has an arc-shaped surface **61** (first surface), and an arc-shaped surface **62** (second surface) on a side opposite to the surface **61**. Each of the end portions **60***a* and **60***b* has a flat surface **63** connected to the surface **62** and a connecting surface **64** connecting the surface **61** with the flat surface **63**. The surface **61** is located on the flexure **22** side (i.e., the same side as the face **21***a* of the body **21**A of the load beam **21**) in the thickness direction Z. The tab **60** is curved from the surface **62** to the surface **61** in the thickness direction Z. The centers of curvature of the surfaces **61** and **62** are located on the surface **62** side in the thickness direction Z.

The flat surfaces **63** are formed at both ends **60***a* and **60***b* of the tab **60** along the longitudinal direction X. For example, the flat surface **63** is formed entirely from a proximal end to a distal end of the tab **60** connected to the body **21**A. As shown in FIG. **4**, the flat surface **63** is a surface parallel to the lateral direction Y. In this case, "parallel to the lateral direction Y" also implies being slightly inclined with respect to the lateral direction Y. Furthermore, the flat surfaces **63** may be surfaces parallel to the longitudinal direction X.

A distance between the flat surface **63** and the surface **61** in the thickness direction Z at the both ends **60***a* and **60***b* is shorter at a position moving away from the central portion **60***c* in the lateral direction Y. The connecting surfaces **64** are formed at the both ends **60***a* and **60***b* of the tab **60** along the longitudinal direction X. In the example shown in FIG. **4**, the connecting surface **64** is a surface inclined with respect to the flat surface **63**. From the other viewpoint, the flat surface **63** is connected to the surface **61** via the connecting surface **64**.

FIG. **5** is a view showing a relationship between the tab **60** and the ramp **9** when the suspension **10** retreats into the ramp **9**. FIG. **5** shows a part of a cross section of the tab **60** and the ramp **9** as seen from the distal end side of the tab **60**. FIG. **5** shows, for example, a state in which the tongue **31** on which the slider **11** is mounted retreats from each of the first disk **4**A, and the second disk **4**B.

In the example shown in FIG. **5**, the ramp **9** has two support surfaces **90** and a gap **91** formed between the two support surfaces **90**. The ramp **9** is formed of, for example, a synthetic resin. The tab **60** of the first suspension **10**A and the tab **60** of the second suspension **10**B are each located in the gap **91**.

The tabs **60** are supported on the support surfaces **90**, respectively, in the gap **91**. The surfaces **61** are in contact with the support surfaces **90**, respectively, at the central portions **60***c* of the tabs **60**. The surface **62** and the flat surfaces **63** of the first suspension **10**A are spaced apart and opposed to the face surface **62** and the flat surfaces **63** of the second suspension **10**B in the thickness direction Z. In this case, the flat surfaces **63** are closest to each other.

As shown in FIG. **5**, the flat surfaces **63** are parallel to each other. A gap G is formed between the flat surfaces **63**. From the other viewpoint, the flat surfaces **63** of the first suspension **10**A are not in contact with the flat surfaces **63** of the second suspension **10**B.

Shapes of the ends **60***b* of the tabs **60** of the suspensions **10**A and **10**B in a case where the flat surfaces **63** and the connecting surfaces **64** are not formed are represented by broken lines. When the flat surfaces **63** are not formed, for example, the tabs **60** may contact each other at a position indicated by an arrow P in FIG. **5**.

FIG. **6** is a view showing an example of a thickness T**60** of the tab **60** in the thickness direction Z. As shown in FIG. **6**, the end portions **60***a* and **60***b* further include an edge **65** (first edge) at which the surface **61** and the connecting surface **64** are connected, and an edge **66** (second edge) at which the flat surface **63** and the connecting surface **64** are connected.

As represented by a broken line in FIG. **6**, an intersection at which extensions of the surface **62** and the connecting surface **64** cross is referred to as edge M**67**. In a case where the flat surface **63** is not formed, the tab **60** has the edge M**67**. The edge M**67** is in contact with a position indicated by the arrow P in FIG. **5**.

A distance from the edge **65** to the edge **66** in the thickness direction Z is referred to as a distance h. The distance h can also be referred to as a protrusion height of the edge **66** relative to the edge **65**. A thickness between the surfaces **61** and **62** is referred to as a thickness t. A distance between the edges **65** of the end portions **60***a* and **60***b* in the lateral direction Y is referred to as a distance W, and a radius of curvature of the surface **62** is referred to as a radius of curvature R. The distance h is desirably, for example, less than or equal to a half of the thickness t ($t/2 \geq 1$).

By setting the distance h as described above, as shown in FIG. **6**, a thickness T**60** of the tab **60** in the thickness direction Z can be made smaller than a thickness T**600** of the tab **60** in a case where the flat surfaces **63** are not formed. Furthermore, the length of the flat surface **63** in the lateral direction Y can be increased by reducing the thickness T**60** of the tab **60** in the thickness direction Z. By increasing the length of the flat surface **63** in the lateral direction Y, the area of the flat surface **63** in the longitudinal direction X and the lateral direction Y can be increased.

FIG. **7** is a view showing another example of the thickness T**60** of the tab **60** in the thickness direction Z. A distance H from the edge **65** to the edge M**67** in the thickness direction Z is referred to as a distance H. The distance h is desirably, for example, less than or equal to a half of the distance H ($H/2 \geq h$).

By making the distance h less than or equal to a half of the distance H, the thickness T**60** of the tab **60** can be further reduced. Furthermore, by reducing the thickness T**60** of the tab **60** in the thickness direction Z, the length of the flat surface **63** in the lateral direction Y can be made longer.

In the examples shown in FIG. **6** and FIG. **7**, for example, the thickness t is 0.030 mm, the distance W is 0.250 mm, the radius of curvature R is 0.160 mm, the distance H is 0.023 mm, and the distance h is 0.008 mm. Each dimension is not limited to the above examples.

Next, a method of manufacturing the suspension **10** comprising the load beam **21** including the tab **60** will be described. An outline of the metal plate in a flat state, which is the material of the load beam **21**, is trimmed to a predetermined shape in advance. The load beam **21** can be molded from the metal plate by pressing the metal plate trimmed using a die set.

The tab **60** of the load beam **21** is formed into a curved shape, for example, by coining using a die set. A method of manufacturing the tab **60**, of the method of manufacturing the suspension **10**, will be mainly described below.

FIG. **8** to FIG. **10** are views showing an example of the method of manufacturing the tab **60**. In FIG. **8** and the following figures, a cross-section of a portion of a metal plate M where the tab **60** is formed is shown. The longitudinal direction, the lateral direction, and the thickness direction of the metal plate M correspond to the longitudinal direction X, the lateral direction Y, and the thickness direction Z of the load beam **21**. The thickness t described with reference to FIG. **6** corresponds to the thickness of the metal plate M.

As shown in FIG. **8**, the metal plate M has a surface M**61**, which is the surface **61**, a surface M**62**, which is the surface **62**, surfaces M**68** (third surfaces), which connect the surface M**61** with the surface M**62**, and edges M**67** to which the surface M**62** and the surface M**68** are connected. The edges M**67** correspond to the edges M**67** described with reference to FIG. **6** and FIG. **7**.

The metal plate M includes an end portion Ma, an end portion Mb on a side opposite to the end portion Ma, and a central portion Mc in the lateral direction Y. The central portion Mc is located between the end portion Ma and the end portion Mb in the lateral direction Y. The end portion Ma and the end portion Mb may be hereinafter referred to as "both end portions Ma and Mb". The end portion Ma corresponds to the end portion **60***a*, the end portion Mb corresponds to the end portion **60***b*, and the central portion Mc corresponds to the central portion **60***c*.

The method of manufacturing the tab **60** includes a curving process and a flattening process. In the curving process, for example, the metal plate M is formed into an arc shape by coining the metal plate M using a die set. As shown in FIG. **9**, the metal plate M is curved by the curving process such that the central portion Mc protrudes with respect to the both end portions Ma and Mb.

In the flattening process, for example, the edges M**67** are crushed and flattened by pressing the edges M**67** toward the surface M**61** in the thickness direction Z, using a die set, and the flat surfaces **63** are thereby formed as shown in FIG. **10**. Crushing a part of the metal plate M is hereinafter referred to as "crushing process". At the both end portions Ma and Mb, for example, the crushing process of the edges M**67** is performed simultaneously. The flat surfaces **63** are formed to have, for example, a predetermined surface property.

The flat surfaces **63** are formed along the longitudinal direction X at the both end portions Ma and Mb of the metal plate M. As shown in FIG. **10**, the edges M**67** are crushed such that the flat surfaces **63** are parallel to the lateral direction Y. Furthermore, the flat surfaces **63** may be surfaces parallel to the longitudinal direction X.

When the flat surfaces **63** are formed, the connecting surfaces **64** are also formed. The connecting surfaces **64** are parts of the surfaces M**68**. In the flattening process, the edges M**67** are crushed such that the connecting surfaces **64** are formed. The connecting surfaces **64** are, for example, surfaces inclined with respect to the flat surfaces **63**.

The tab **60** is formed from the metal plate M by the above-described manufacturing method. The flattening process may be performed before the curving process, after the curving process, or simultaneously with the curving process. After that, the flexure **22** is made to overlap with a predetermined position along the load beam **21**.

FIG. **11** and FIG. **12** are views showing another example of the method of manufacturing the tab **60**.

For example, the edges M**67** and the surfaces M**62** and M**68** near the edges M**67** are inclined by an etching process, prior to the curving process. From the other viewpoint, the edges M**67** are dropped by the etching process. For example, the etching process is performed when the metal plate is trimmed by etching to a predetermined outline of the load beam **21**.

Surfaces M**69** to connect the surfaces M**61** and M**62** are formed on the metal plate M by the etching process. For example, the surfaces M**69** have curved surfaces. The etching process is included in a part of the flattening process.

In the curving process, the metal plate M having the surfaces M**69** is formed in an arc shape, as shown in FIG. **11**. In the flattening process, for example, parts of the surfaces M**69** are crushed and flattened by pressing the surfaces M**69** using a die set, and the flat surfaces **63** are thereby formed as shown in FIG. **12**.

At the both end portions Ma and Mb, for example, the crushing process of the surfaces M**69** is performed simultaneously. The flat surfaces **63** are formed to have, for example, a smoother surface property than the surfaces

M69. As shown in FIG. **12**, the surfaces M69 are crushed such that the flat surfaces **63** are parallel to the lateral direction Y. Furthermore, the flat surfaces **63** may be surfaces parallel to the longitudinal direction X.

When the flat surfaces **63** are formed, the connecting surfaces **64** are also formed. The connecting surfaces **64** are parts of the surfaces M**69**. In the flattening process, the surfaces M**69** are crushed such that the connecting surfaces **64** are formed. The surfaces M**69** may be formed by performing the etching process after the curving process. As described with reference to FIG. **8** to FIG. **10**, the crushing process of the surfaces M**69** may be performed before the curving process, after the curving process, or simultaneously with the curving process.

The tab **60** of the load beam **21** in the suspension **10** configured as described above has the flat surfaces **63**. The thickness T**60** of the tab **60** in the thickness direction Z is smaller than the thickness T**600** of the tab **60** in a case where the flat surfaces **63** are not formed. Thus, the tabs **60** can hardly be brought into contact with each other, and the distance between the disks **4** and the distance between the support surfaces **90** of the ramp **9** can be made shorter. From the other viewpoint, the tabs **60** are less likely to contact each other even when the interval is smaller than before.

For example, more disks **4** can be provided for the same casing **2** by reducing the interval between the disks **4**. Thus, the suspension **10** of the embodiments can accommodate an increase in the number of disks.

The flat surfaces **63** of the tab **60** are connected to the surfaces **62**, respectively, at the both end portions **60***a* and **60***b*. As a result, when the suspension **10** retreats to the ramp **9**, the flat surfaces **63** of the tabs **60** can be spaced apart and opposed in the gap **91** of the ramp **9**.

For example, when the tabs **60** do not have flat surfaces **63** as represented by broken lines in FIG. **5**, the both end portions **60***a* and **60***b* may contact each other the gap **91**. When the tabs **60** have the flat surfaces **63**, the flat surfaces **63** can be spaced apart and opposed to each other even in the cap between the support surfaces **90** in which the both end portions **60***a* and **60***b* (in particular, edges M**67**) are in contact with each other. From the other viewpoint, the interval between the support surfaces **90** can be made further smaller.

For example, when the disk drive **1** receives an external shock, the tabs **60** of the suspension **10** may contact each other. When the tabs **60** have the flat surfaces **63**, the flat surfaces **63** contact each other. When the flat surfaces **63** contact each other, particles such as dust are less likely to be generated at the contact as compared with a case where, for example, the edges M**67** contact each other.

As a result, damage to the disk **4** caused by particles can be suppressed and occurrence of access failures such as data read from or data write to the disks **4** by means of the slider **11** can be prevented.

Since the flat surfaces **63** are the surfaces parallel to the lateral direction Y, the flat surfaces **63** are parallel to each other as shown in FIG. **5**. For this reason, the flat surfaces **63** are easily brought into surface contact with each other, and particles are less likely to be generated. From the other viewpoint, the edges of the tabs **60** are less like likely to contact each other.

The tab **60** has the connecting surface **64** that connects the flat surface **63** to the surface **61**. For this reason, the edge **65** is less likely to be a sharp edge the edge formed in a case where the flat surface **63** and surface **61** are connected directly to each other.

For example, the thickness T**60** of the tab **60** can be made smaller by making the distance h less than or equal to a half of the thickness t. If the thickness T**60** of the tab **60** becomes smaller, the interval between the disks **4** and the interval between the support surfaces **90** of the ramp **9** can be made further smaller. For example, if the interval between the disks **4** can be reduced, a further increase in the number of disks can be accommodated.

According to the method of manufacturing the suspension **10** of the embodiments configured as described above, the tab **60** having the flat surfaces **63** can be obtained. More specifically, the flat surface **63** parallel to the lateral direction Y can be formed at the both end portions **60***a* and **60***b* of the tab **60**, by the flattening process.

Since the flat surfaces **63** are formed by the crushing process using a die set, the flat surfaces **63** with higher dimensional accuracy can be obtained on the tab **60** as compared with chemical etching. For this reason, when the tab **60** is located in the gap **91** of the ramp **9**, the interval (clearance) between the flat surfaces **63** can be sufficiently secured.

Furthermore, when the flat surfaces **63** contact, generation of particles can be further suppressed by forming the flat surfaces **63** with the smooth surface properties. By performing the flattening process simultaneously with the curving process, the flat surfaces **63** can be formed on the tab **60** without increasing the manufacturing process. When the flattening process is performed before the curving process, the edges M**67** can be crushed by the die set against the metal plate M in a flat state, and the flat surfaces **63** can be thereby easily formed.

In the flattening process, the flat surfaces **63** may be formed by crushing the edges M**67** of the metal plate M in the crushing process or the flat surfaces **63** may be formed by forming the surfaces M**69** in the etching process and then performing the crushing process.

The thickness T**60** of the tab **60** can be made smaller by forming the surfaces M**69** in the etching process and then crushing the surfaces M**69**. By forming the surfaces M**69** by the etching process, the amount of crushing of the metal plate M in the crushing process of the metal plate M is smaller than that in the crushing process in a case where the surfaces M**69** are not formed.

The burden on the die set can be suppressed by reducing the amount of crushing of the metal plate M by the die set. As a result, an interval for maintenance of the die set can be made wider and the burden on the operator can be reduced.

According to the disk drive **1** comprising the suspension **10** of the embodiments, the disk drive **1** with an increased number of disks **4** can be obtained since the thickness T**60** of the suspension **10** is small. In addition to the above, various suitable advantages can be obtained in the embodiments.

According to the embodiments, the suspension **10** that can accommodate an increase in the number of disks **4**, the disk drive **1** comprising the suspension **10**, and the method of manufacturing the suspension **10** can be provided.

In implementing the inventions disclosed in the above embodiments, the specific configuration of each element constituting the suspension for the disc drive, including the specific configuration such as shapes of the load beam and flexure, can be modified in various manners. The connecting surface **64** may be, for example, a curved surface connecting the flat surface **63** to the surface **61**.

In the flattening process in the method of manufacturing the tab **60**, for example, the flat surfaces **63** may be formed by dropping the edges M**67** by laser light. As another example in the flattening process, the flat surfaces **63** may be formed by flattening parts of the surfaces M**69** formed by the etching process shown in FIG. **11** by laser light. The laser irradiation may be performed before or after the curving process. The flat surfaces **63** that are less likely to generate particles can be formed by forming the flat surfaces **63** by laser light.

Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention is its broader aspects is not limited to the specific details and representative embodiments shown and described herein. Accordingly, various modifications may be made without departing from the spirit or scope of the general inventive concept as defined by the appended claims and their equivalents.

What is claimed is:

1. A disk drive suspension comprising:

a load beam; and

a flexure including a mounting portion on which a slider is mounted, and overlapping with the load beam,

wherein:

the load beam includes a tab extending further than the mounting portion in a longitudinal direction of the load beam,

the tab is shaped in an arc such that a central portion in a lateral direction protrudes with respect to both end portions in the lateral direction,

the tab has an arc-shaped first surface located on a side of the flexure and an arc-shaped second surface on a side opposite to the first surface, in a thickness direction of the load beam intersecting the longitudinal direction and the lateral direction,

each of the end portions of the tab includes:

a flat surface parallel to the lateral direction and connected to the second surface,

a connecting surface connecting the first surface to the flat surface,

a first edge at which the first surface and the connecting surface are connected, and

a second edge at which the flat surface and the connecting surface are connected, and

a distance from the first edge to the second edge in the thickness direction is less than or equal to a half of a thickness between the first surface and the second surface.

2. A method of manufacturing a disk drive suspension comprising a load beam including a tab, the method comprising:

curving a metal plate such that a central portion in a lateral direction protrudes with respect to both end portions in the lateral direction, in the tab; and

flattening surfaces parallel to the lateral direction, on the end portions,

wherein the metal plate has a first surface formed in an arc shape in the curving, a second surface on a side opposite to the first surface, which is formed in an arc shape in the curving, third surfaces connecting the first surface to the second surface, and edges to which the second surface and the third surfaces are connected, and

wherein the edges are flattened in the flattening.

3. A disk drive comprising:

a first disk;

a second disk spaced apart from and opposed to the first disk;

a first suspension to perform data read from or data write to the first disk;

a second suspension to perform data read from or data write to the second disk; and

a ramp including a gap and being provided on an outer peripheral side of the first disk and the second disk,

wherein:

each of the first suspension and the second suspension comprises a load beam and a flexure including a mounting portion on which a slider is mounted and overlapping with the load beam,

the load beam includes a tab extending further than the mounting portion in a longitudinal direction of the load beam,

the tab is shaped in an arc such that a central portion in a lateral direction protrudes with respect to both end portions in the lateral direction,

the tab has an arc-shaped first surface located on a side of the flexure and an arc-shaped second surface on a side opposite to the first surface, in a thickness direction of the load beam intersecting the longitudinal direction and the lateral direction,

each of the end portions of the tab includes:

a flat surface parallel to the lateral direction and connected to the second surface,

a connecting surface connecting the first surface to the flat surface,

a first edge at which the first surface and the connecting surface are connected, and

a second edge at which the flat surface and the connecting surface are connected, and

a distance from the first edge to the second edge in the thickness direction is less than or equal to a half of a thickness between the first surface and the second surface, and

the first suspension and the second suspension are located in the gap of the ramp in a state in which the flat surfaces of the end portions of the tabs thereof are spaced apart from each other and opposed to each other, when the mounting portion of the flexure of the first suspension and the mounting portion of the flexure of the second suspension retreat from each of the first disk and the second disk.

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