UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

NITTO DENKO CORP.,

Petitioner

Patent No. 8,169,746
Original Issue Date: May 1, 2012
Title: INTEGRATED LEAD SUSPENSION WITH MULTIPLE TRACE CONFIGURATIONS

CORRECTED PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 8,169,746 PURSUANT TO 35 U.S.C. § 312 and 37 C.F.R. § 42.104

Case No. IPR2018-01300

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Exhibit 1017	“Coaxial-Line Discontinuities,” J. R. Whinnery *et al.*, *Proceedings of the I.R.E*, vol. 32, No. 11, November 1944, pp. 695-709.
Exhibit 1018	“Analysis and Design of Head-Preamplifier Connections in Read-Write Channels for Magnetic Rigid-Disk Drives,” Arun Balakrishnan and Christopher M. Carpenter, IEEE Trans. Magn. Vol. 34, No. 1, January 1998 (submitted June 14, 1997.)
Exhibit 1019	“Electric and Magnetic Fields,” by Stephen S. Attwood, John Wiley and Sons, © 1932, 1941, 1949, pp. 422-425.
Exhibit 1020	“Field and waves in communication electronics,” by Simon Ramo et al, John Wiley and Sons, © 1965, 1984, p. 261.

Pursuant to 35 U.S.C. §§ 311-319 and 37 C.F.R. § 42, Petitioner Nitto Denko Corp. ("Nitto" or "Petitioner") respectfully requests *inter partes* review ("IPR") of claims 7-9, 11 and 15 of U.S. Patent No. 8,169,746 ("the '746 patent"). The '746 patent identifies Alexander J. Rice et al. as inventors, was filed April 8, 2008, and issued May 1, 2012. According to U.S. Patent and Trademark Office ("USPTO") assignment records, the '746 patent is currently assigned to Hutchinson Technology Inc. ("HTI" or "Patent Owner"). There is a reasonable likelihood that Petitioner will prevail with respect to at least one claim challenged in this Petition.

The '746 patent relates to a hard drive suspension. A typical suspension includes a supporting arm, a flexible sheet of material known as a "flexure" that includes electrical traces, and a slider that holds a read/write head. The electrical traces connect the read/write head to the circuitry of the hard drive. The '746 patent's suspension uses different configurations of the electrical traces in different regions of the flexure. According to the '746 patent, reductions in the size of suspensions purportedly gave rise to a need for electrical traces with a high bandwidth, low impedance, low stiffness, and a small mechanical footprint. Ex. 1001, 1:33-40. The '746 patent claims a straightforward solution to this recited need. In particular, the electrical traces are provided in two sections. One section uses interleaved or stacked traces, which according to the '746 patent provide high bandwidth and mid-range impedance, suitable for impedance matching to disk drive circuits. *Id*., 5:41-45. The second section uses ground plane traces (i.e. traces backed by an electrically conductive layer), which have relatively low stiffness and a small footprint, and relatively low impedance. *Id*., 5:45-51.

All of the supposed suspension needs purportedly satisfied by the ’746 patent, however, were already well known in the prior art. For instance, the prior art explicitly recognized that the hard drive industry was decreasing the size of suspensions in order to improve hard disk performance. Ex. 1003, 2:4-10. It was also well known that as suspensions became smaller, stiffness became more of an issue. *Id.*, 2:20-23. The prior art further recognized that as the electrical traces were moved closer together, the capacitance in the traces increased, negatively impacting circuit performance. *Id*., 2:46-57. Likewise, it was well known to persons of skill in the art (“POSITA”) that making a flexure smaller, to fit on a smaller suspension, can adversely impact electrical and mechanical performance. *Id*. Thus, the ’746 patent did not identify a previously unknown problem with integrated lead flexures.

The purported solutions that the ’746 patent claims were also known. In particular, the prior art explicitly recognized that undesirable electrical performance can be avoided by including traces with two different layouts, in two different portions of the flexure. *Id*., 3:40-64. Indeed, numerous prior art references disclose hard drive suspensions using the very types of trace layouts required by the ’746 patent’s claims. This petition relies on one such reference: U.S. Patent No. 6,038,102 to Balakrishnan et al. (“Balakrishnan”).

Balakrishnan discloses a hard drive suspension with a flexure very similar to that of the ’746 patent. Just as the ’746 patent requires, Balakrishnan’s flexure includes electrical traces that have different structures in different regions. Specifically, Balakrishnan’s electrical traces use interleaved traces in one region, and ground plane traces in another region, just like the ’746 patent. In view of this disclosure, Balakrishnan anticipates claim 7 and 11 of the ’746 patent. And, Balakrishnan also renders claims 7-9, 11 and 15 of the ’746 patent obvious.

I. <u>Mandatory Notices (37 C.F.R. § 42.8)</u>

A. Real Party-in-Interest (37 C.F.R. § 42.8(b)(1))

Petitioner Nitto and related corporate entities Nitto, Inc., Nitto Denko Fine Circuit Technology (Shenzhen) Co., Ltd., Nitto Denko (HK) Co., Ltd., Nitto Denko Material (Thailand) Co., Ltd., and Mie Nitto Denko Corp. are the real parties-in-interest.

B. Related Matters (37 C.F.R. § 42.8(b)(2))

The ’746 patent is currently at issue in an action pending in the U.S. District Court for the District of Minnesota captioned *Hutchinson Tech. Inc. v. Nitto Denko Corp. et al.*, Case No. 17-cv-01992.

C. Counsel (37 C.F.R. § 42.8(b)(3))

Lead Counsel: Alex V. Chachkes (Reg. No. 41,663)

Back-up Counsel: Donald E. Daybell (Reg. No. 50,877)

Back-up Counsel: K. Patrick Herman (Reg. No. 75,018)

Electronic Service information: A34PTABDocket@orrick.com; D2DPTABDocket@orrick.com; P52PTABDocket@orrick.com

Post and Delivery: Orrick, Herrington, & Sutcliffe LLP, 51 West 52nd Street, New York, NY 10019; Telephone: 212-506-5000 Facsimile: 212-506-5151

II. Requirements for IPR

A. Grounds for Standing

Petitioner certifies that the ’746 patent (Ex. 1001) is available for IPR and that Petitioner is not barred or estopped from requesting this IPR.

B. Identification of Challenge and Relief Requested

Petitioner requests *inter partes* review of and challenges claims 7-9, 11 and 15 of the ’746 patent. Each claim should be found unpatentable and cancelled because the claim recites an integrated lead head suspension flexure that is indistinguishable from the prior art. This petition explains the reasons why the claims are unpatentable, provides details regarding where the various claim limitations can be found in the prior art, and is accompanied by additional explanation and support set forth in the attached Declaration of Dr. Giora Tarnopolsky (Ex 1008, “Tarnopolsky”).

The ’746 patent was filed April 8, 2008 as U.S. application 12/099,523.

Thus, the effective filing date is April 8, 2008. The patentability of the ’746 patent is therefore governed by pre-AIA 35 U.S.C §§ 102/103.

Petitioner relies on the following references, all of which are prior art under pre-AIA 35 U.S.C. § 102(b):

(1) U.S. Patent No. 6,038,102 to Balakrishnan et al., issued March 14, 2000 (“Balakrishnan,” Exhibit 1003);

(2) U.S. Patent No. 5,717,547 to Young, issued February 10, 1998 (“Young”, Exhibit 1004);

(3) U.S. Patent No. 5,737,152 to Balakrishnan et al., issued April 7, 1998 (“Balakrishnan ’152,” Exhibit 1005); and

(4) U.S. Patent Application Publication 2006/0203372 to Yuuki et al., published September 14, 2006 (“Yuuki,” Exhibit 1006).

Petitioner requests that claims 7-9, 11 and 15 be determined unpatentable and cancelled on the following grounds:

Ground 1: Claims 7 and 11 are anticipated by Balakrishnan.

Ground 2: Claims 7 and 11 are obvious over Balakrishnan in view of Young.

Ground 3: Claims 8 and 11 are obvious over Balakrishnan in view of Balakrishnan ’152 and Young.

Ground 4: Claims 9 and 15 are obvious over Balakrishnan in view of

Yuuki.

Ground 5: Claims 9 and 15 are obvious over Balakrishnan in view of Yuuki and further in view of Balakrishnan ’152 or Young

C. Claim Construction

A claim term subject to IPR is given its “broadest reasonable construction in light of the specification.” 37 C.F.R. § 42.100(b). Terms are to be given their plain meaning unless it is inconsistent with the specification. *In re Zletz*, 893 F.2d 319, 321 (Fed. Cir. 1989). Petitioner believes that all terms of the ’746 patent’s claims can be afforded their plain and ordinary meaning, and discusses several terms further below.

1. “Interleaved”

The plain meaning of “interleave” is “to arrange parts of one sequence of things or events so that they alternate with parts of one or more other sequences of things or events and so that each sequence retains its identity.” Ex. 1009 (IEEE Standard Dictionary of Electrical and Electronics Terms, Third Edition, 1984) at 458; Tarnopolsky, ¶64. This plain and ordinary meaning of “interleaved” is not inconsistent with the specification.

The specification of the ’746 patent uses the term “interleaved” many times, but never defines it. See, e.g., Ex. 1001, 1:63-66, 3:23, 3:26-27, 3:31, 3:44, 3:49-50. An embodiment uses interleaved traces where all of the traces are two-terminal traces. *Id*., 3:19-24. However, the specification never limits the term "interleaved" to require that each of the interleaved traces be two-terminal traces. Thus, a POSITA[1] would not understand the '746 patent's claims to be limited to alternating two-terminal traces. Instead, applying the broadest reasonable construction of the term "interleaved traces," the claims embrace any type of alternating traces, including two-terminal, electromagnetically-coupled, or otherwise, and this is taught by Balakrishnan as discussed below. Tarnopolsky, ¶¶63-66.

2. "ground plane trace"

A "ground plane trace" is well known to POSITAs. Such traces are "similar in structure to conventional micro strip conductors" (Ex. 1001, 4:41-44) which have been known since the 1950's. Ex. 1010, at 1645. A "ground plane trace" is

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[1] The ordinarily skilled artisan in the technology field of the '746 patent would have either: (1) a Bachelor's degree in electrical engineering or a similar field and three years of work experience in the disk drive industry, or (2) a Master's degree in electrical engineering or a similar field and one year of work experience in the disk drive industry. One of ordinary skill would be aware of the structure of a hard drive suspension, and the electrical properties of that suspension's traces. Tarnopolsky, ¶¶38-40.

simply a trace that is backed by an electrically conductive layer (i.e. a "ground plane"). Ex. 1001, 4:41-44; Tarnopolsky, ¶67. This electrically conductive layer can be either the underlying spring metal layer or a separate ground plane layer. *Id*., 4:44-52. The spring metal layer can be stainless steel. *Id*., 2:59-60. In the file history, the applicants confirmed that ground plane traces included "traces that extend over portions of the flexure that have a ground plane." Ex. 1002, at 308 (2/16/2012 Amendment, at 10). Applying this broadest reasonable construction, Balakrishnan, Young and Balakrishnan '152 all teach ground plane traces, as discussed below.

III. <u>The '746 Patent</u>

The '746 patent relates generally to a suspension and "flexure" for a hard disk drive. Ex. 1001, 2:48-51. A flexure is a long, thin, flexible multilayered sheet that includes electrical traces—backed by insulation and a spring metal layer—to connect a magnetic read/write head to a preamplifier/driver circuit in the hard drive. *Id*., 2:54-56. The flexure is welded or otherwise mounted to a rigid beam, to form a head suspension assembly. *Id*., 3:4-10. The '746 patent explains that its flexure 10 has a gimbal 14 located at the distal end, where the read/write head is attached. *Id*., 2:50-60. It then has a main body region 12 (mounting region) proximal to the gimbal, where the flexure is mounted onto the rigid beam. *Id*., 3:4-10. Finally, it has a long tail section 15/16 proximal to the main body region and connecting the electrical traces to the preamplifier. *Id.*, 2:50-55; Tarnopolsky, ¶¶27-30.

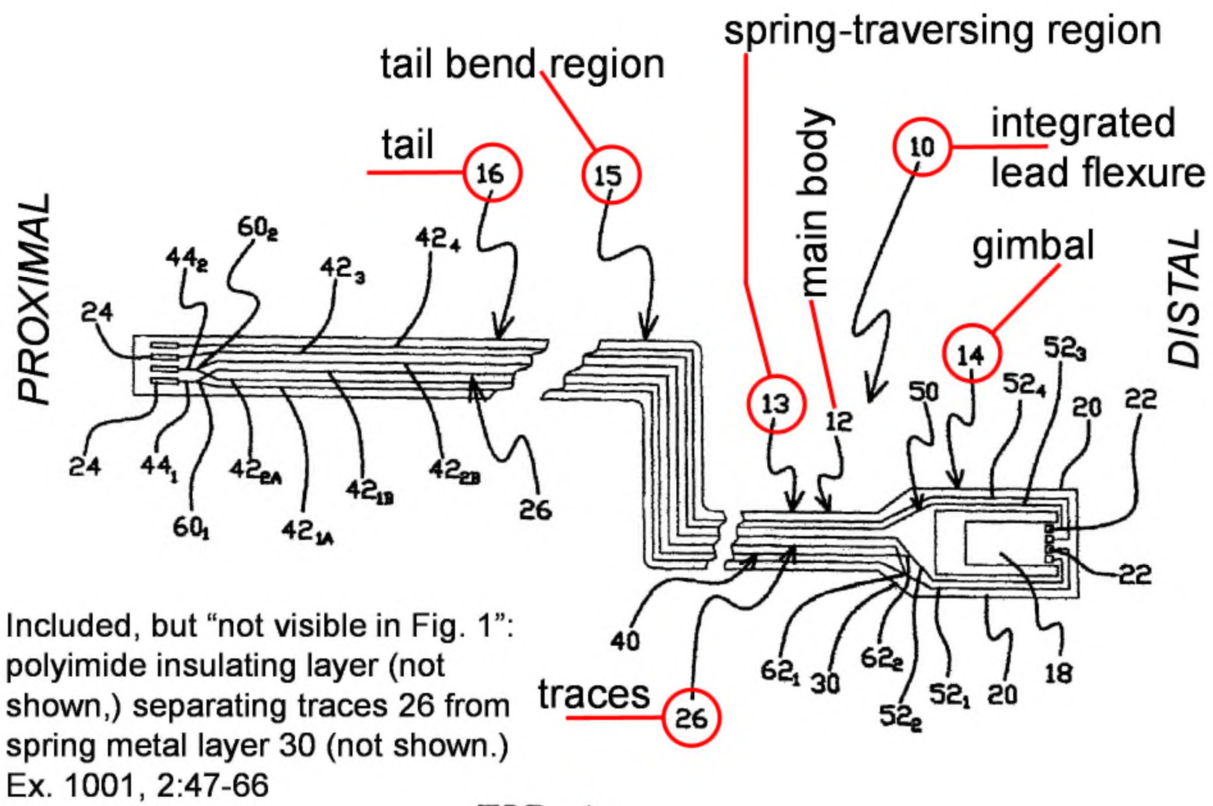


FIG. 1

Ex. 1001, Fig. 1 (annotated)

The ’746 patent uses interleaved or stacked traces 26 in a region of the flexure where improved electrical characteristics are desired, such as on the tail. *Id.,* 5:40-48. It also uses ground plane traces where a smaller mechanical footprint is desired, such as on the gimbal. *Id.* Interleaving traces entails positioning another, different trace between two traces of a signal path. *See, e.g., id.,* 3:22-24. Stacking traces entails layering traces one on top of the other, with an insulating layer between them. *Id.*, 7:8-10. A ground plane trace is simply a trace that is backed by an electrically conductive layer (i.e. a “ground plane”). *Id*., 4:41-44; Tarnopolsky, ¶¶31-32.

The ’746 patent further explains that the preamplifier/driver circuit and the magnetic read/write head have different impedances. As a result, according to the patent, the electrical characteristics of the suspension can be improved by designing the traces to impedance match the driver and the magnetic head. *Id.*, 5:3-13. The ’746 patent states that this impedance matching is done by varying the thickness or width of the traces (Id., 4:64-67) or the thickness of the insulating layer (Id., 5:1), to change the impedance of the traces along their length, from a higher impedance that matches the driver at the proximal end of the traces, to a lower impedance that matches the read/write head, at the distal end of the traces. *Id*., 5:3-13; 5:48-56; Tarnopolsky, ¶¶33-34.

IV. <u>How Challenged Claims are Unpatentable</u>

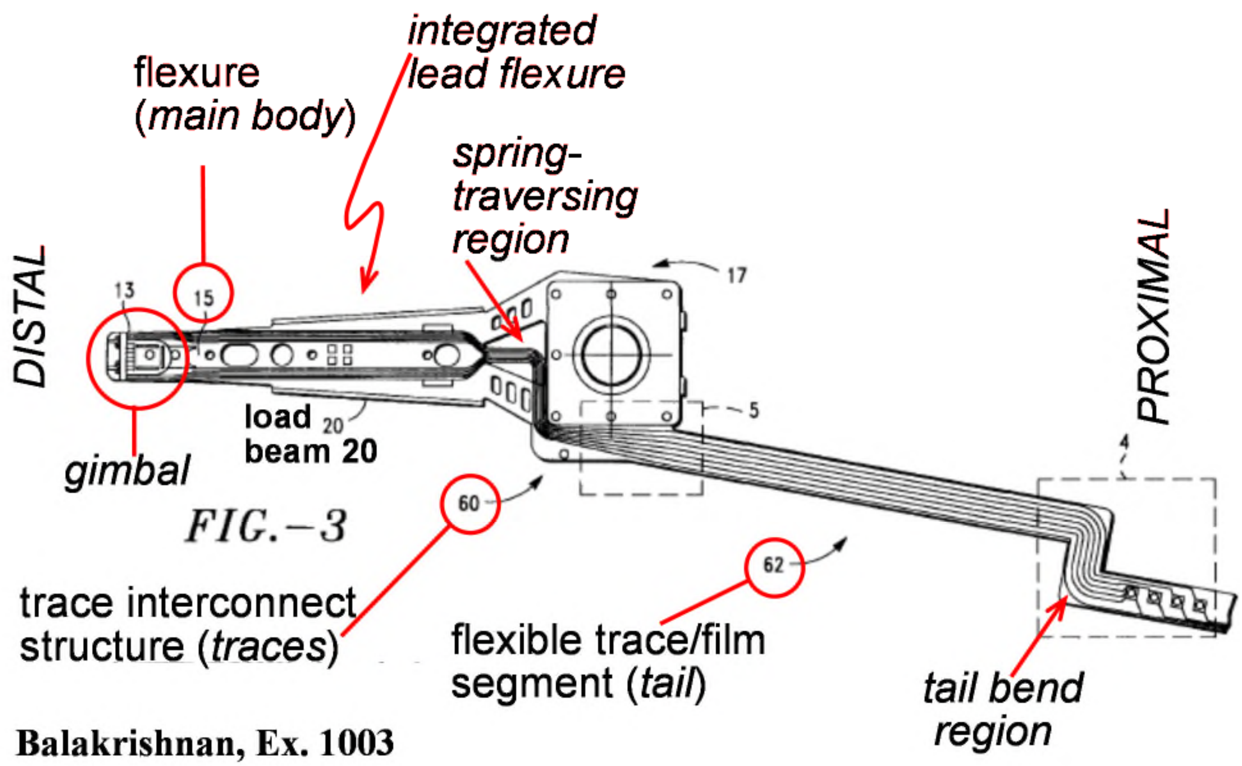
A. Overview of the Prior Art

All of the features required by the claims of the ’746 patent—including the use of electrical traces with two different structural configurations, and the use of impedance matching between a driver circuit and a magnetic head in a hard drive—were known in the prior art as of the patent’s effective filing date. A summary of this prior art follows.

1. Balakrishnan

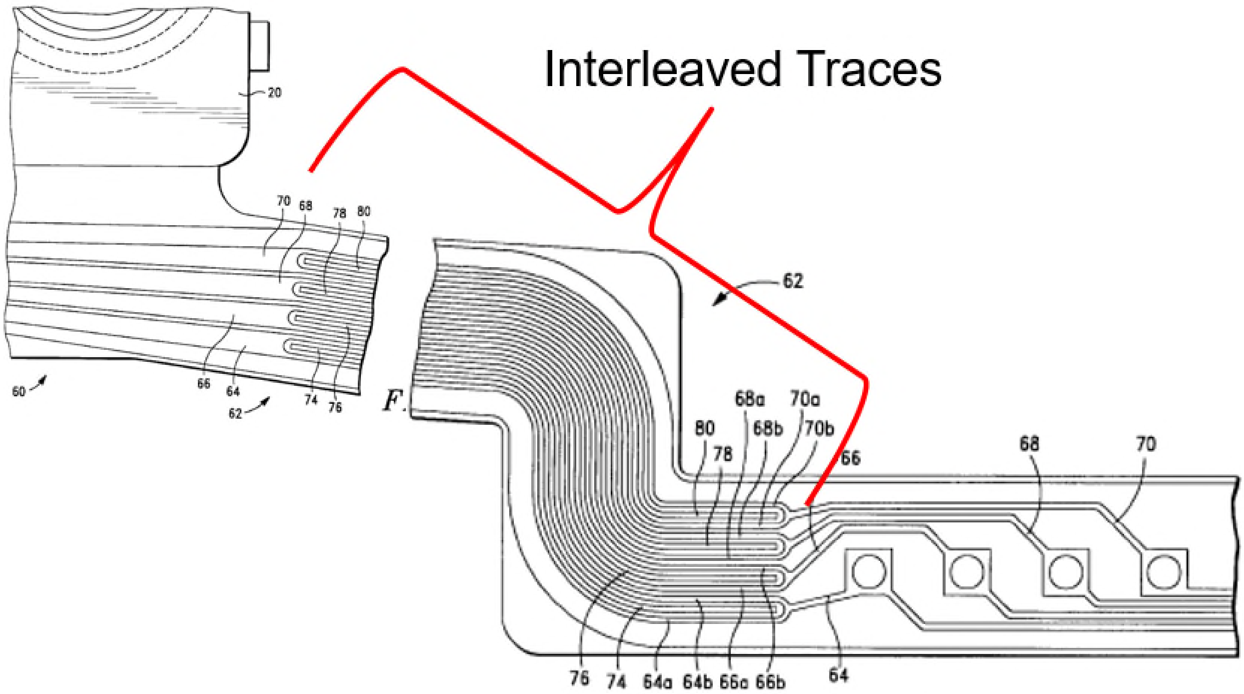
Balakrishnan is identified on the face of the ’746 patent but it was not substantively addressed by the examiner during prosecution, and thus is not subject to Section 325(d). *Zscaler, Inc., v. Symantec Corp.*, IPR2017-01342, 2017 WL 5624702, at *4 (PTAB Nov. 16, 2017) (holding that references which were merely disclosed by the Applicant in an IDS, but which were not substantively discussed by the examiner, were not subject to Section 325(d).)

Balakrishnan teaches a flexure for a hard disk drive. Ex. 1003, 4:50-58. This flexure is secured to a load beam. *Id*., 1:43-45, 4:57-58, 6:60-63, Figs. 2 & 3 (flexure 15 mounted to load beam assembly 20); Tarnopolsky, ¶¶43-44. With reference to Fig. 3, this flexure includes a gimbal, a main body region where the flexure is secured to the load beam, and a tail.



Ex. 1003, Fig. 3 (annotated)

The flexure 15 also includes a trace interconnect array 60. Ex. 1003, 2:25-30, 4:12-20, 6:60-63, 7:32-48, Figs. 2, 3. The trace interconnect array 60 includes two pairs of traces, one pair for the read signal path and one pair for the write signal path. *Id*., 7:53-56. The trace interconnect array is formed on an insulating layer, which in turn is further supported by the flexure or the load beam. *Id*., 4:16-19, 8:44-47. The trace interconnect array includes two portions. The first portion, extending distally from the end of the tail, is the trace/film segment 62. *Id*., 7:15-18; Tarnopolsky, ¶¶53-55. This segment includes four sets of traces, each set having an electromagnetically-coupled "passive" conductor 74, 76, 78, 80 interleaved between two segments (64a, 64b), …, (70a, 70b). These traces are interleaved traces, as shown in Figs. 4 and 5.



Ex. 1003, Figs. 4 & 5 (juxtaposed and annotated)

As shown in Figs. 3-5, these traces extend from the proximal end 17 of the load arm assembly 20, to the preamplifier/write driver 54. *Id*., 7:40-43. Balakrishnan further teaches that these interleaved traces may be extended for virtually the entire distance between the head and the preamplifier, depending on whether or not the size of the trace assembly along the flexure portion is sufficiently wide to allow for use of interleaved connectors. *Id*., 7:43-48.

The second portion, extending distally from the end of the first portion, and connecting to the slider 13, includes four traces formed on the flexure as shown in Figs. 3 and 5.

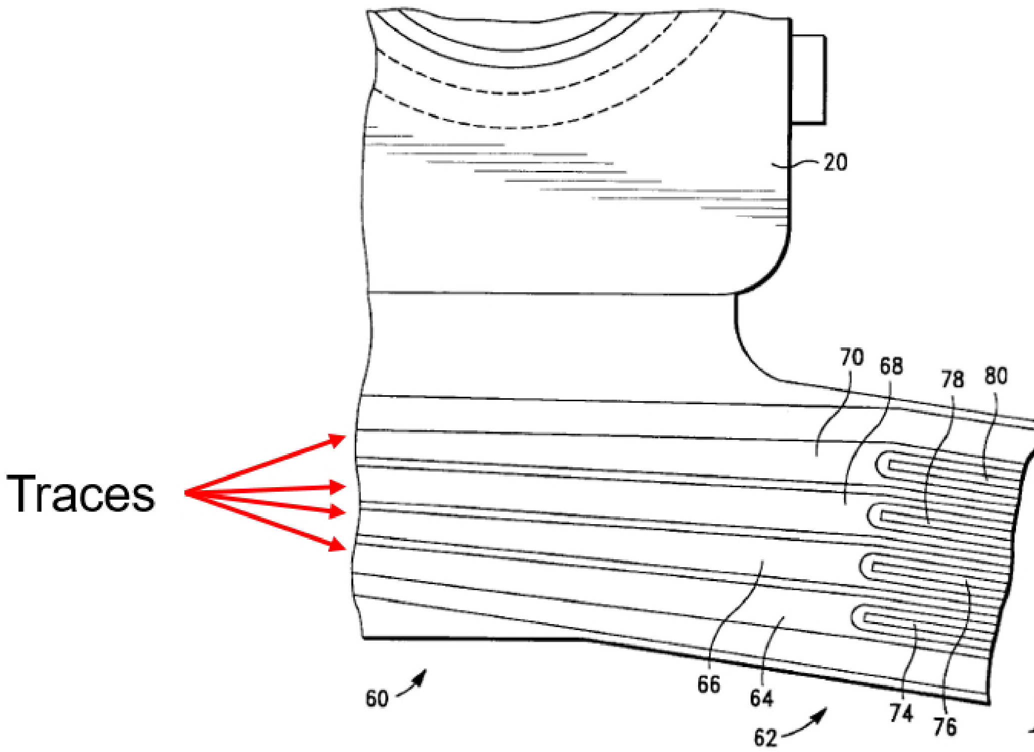


FIG.–5

These traces are ground plane traces, as they are formed on a conductive layer, namely the conductive steel flexure and load beam assembly. *Id.*, 8:44-47, Fig. 3; Tarnopolsky, ¶¶56-58.

Balakrishnan further teaches that its flexure includes four connection pads at the distal end, for connecting the trace transmission lines to the magnetic read/write head 13. *Id.*, Fig. 3; Tarnopolsky, ¶48.

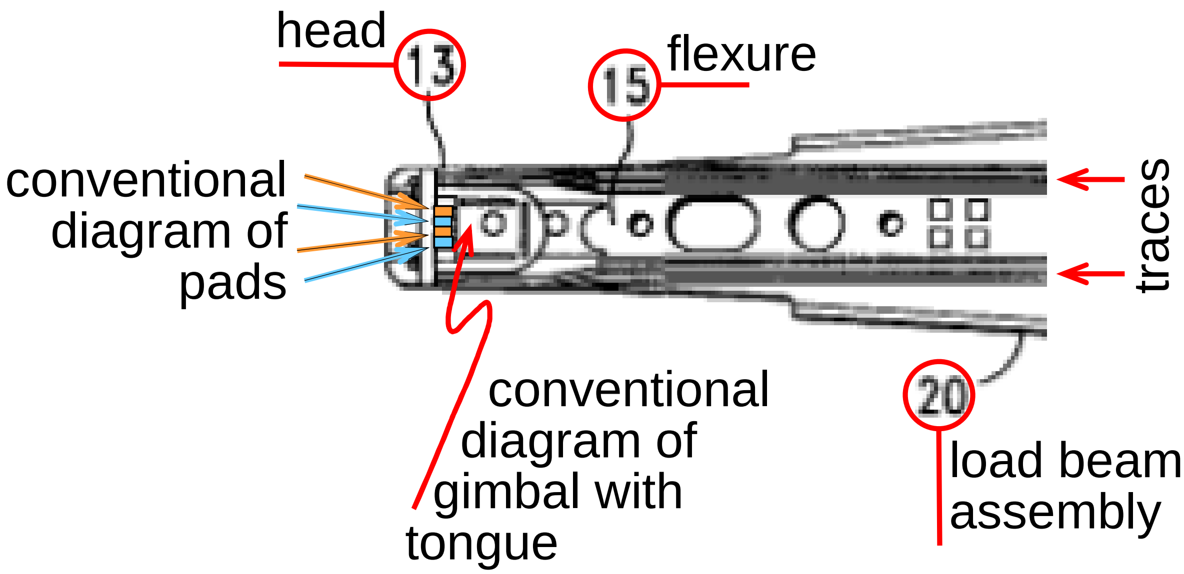


FIG.–3

Ex. 1003, Fig. 3 (excerpted and annotated)

The Williams reference, which Balakrishnan incorporates by reference (*see* Ex. 1003, Balakrishnan at 7:34-40), provides further details of these connection pads. Ex. 1007,[2] 7:4-6, 10:3-6, Fig. 3A; Tarnopolsky, ¶¶83, 87.

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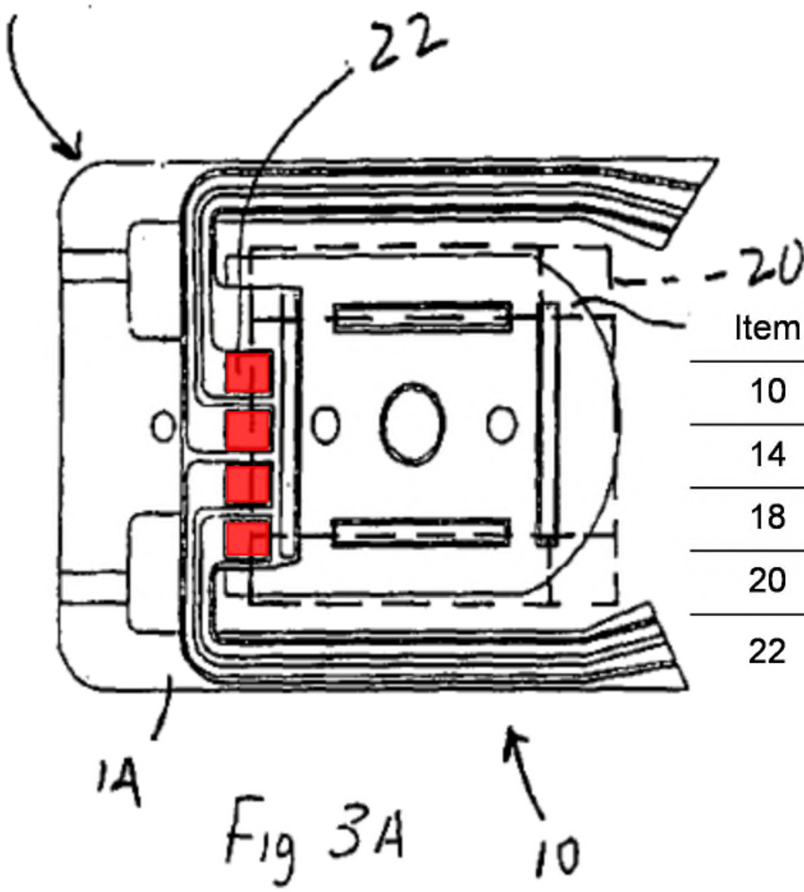
[2] All citations to Williams are to the page:line numbers or the drawings of the as-filed specification, at pp. 7-35, 40-51(drawings) of Ex. 1007.



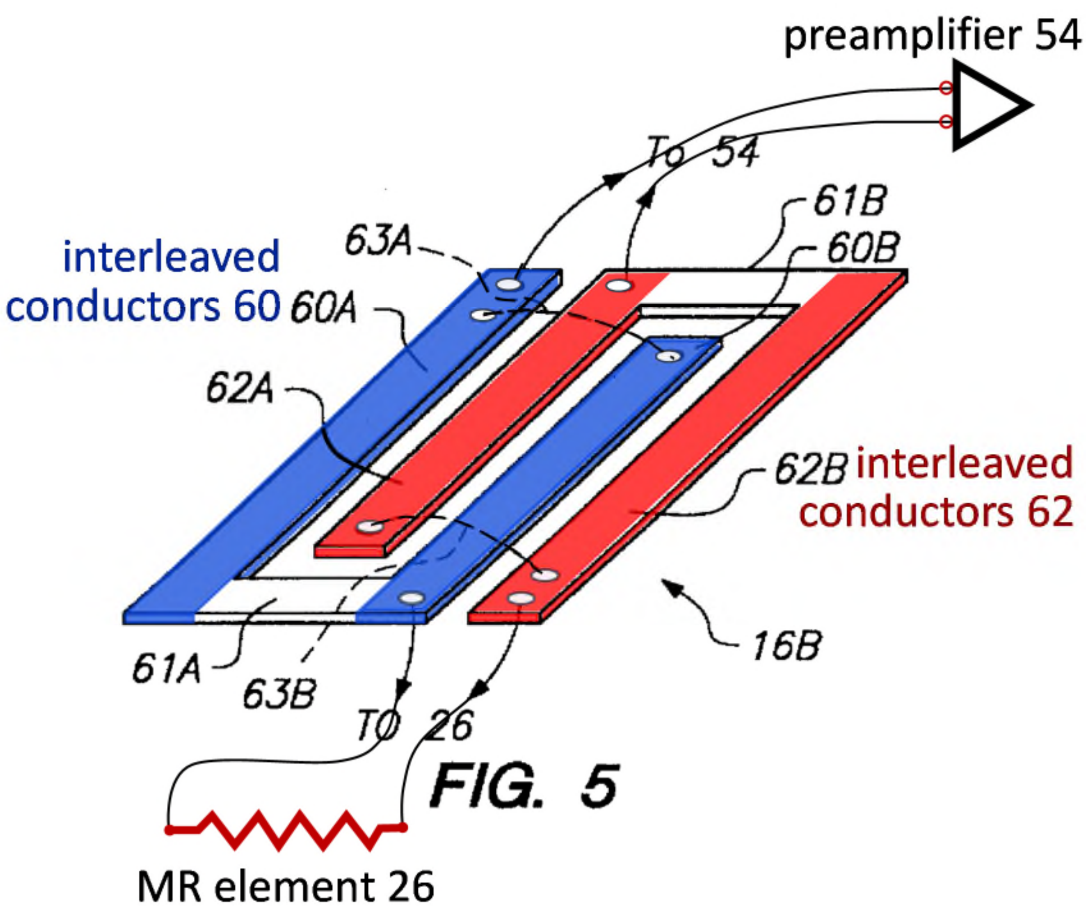
Item	Specification
10	load beam assembly
14	gimbal, flexure
18	distal end
20	head slider (dash)
22	connection pad array for gold-ball bonds to head

Ex. 1007, Fig. 3A (annotated.)

2. Young

Young is identified on the face of the ’746 patent, but was also not substantively addressed by the examiner, and thus is not subject to Section 325(d). *Zscaler, Inc.*, IPR2017-01342, 2017 WL 5624702, at *4.

Young also teaches a flexure for a hard disk drive. Ex. 1004, 5:6-9. This flexure includes an interleaved trace transmission line 16. *Id.*, 5:50-58, Fig. 2. This transmission line 16 includes two pairs of traces 60 and 62, for the read and write signal paths. *Id.*, 5:50-58. The interleaved trace transmission line 16 includes a four-trace interleaved transmission line trace array 16B, on an insulating layer. *Id*., 6:39-41. The trace array includes an interleaved pair of forward signal path conductors 60A-60B (blue), and an interleaved pair of return signal path conductors 62A-62B (red). *Id*., 6:39-47, Fig. 5; *cf. Id.*, 6:16-23.



Ex. 1004, Fig. 5 (annotated)

Trace pair 62A-62B are connected together at the MR element 26 end by a bridging path 63B, and at the preamplifier 54 end by a trace bridge 61B. *Id*., 6:45-47. The bridging paths 63A, 63B can be formed using transverse traces on a separate dielectric layer, connected to the trace array 16B by vias or wires. *Id*., 6:48-51. The traces are electrically connected to the MR element 26 and preamplifier 54. Tarnopolsky, ¶¶74-77.

Young further teaches that its flexure includes four connection pads 22 at the distal end, for connecting the trace transmission lines to the magnetic read/write head (on slider 20). *Id.*, 5:60-65; Tarnopolsky, ¶¶84, 88.

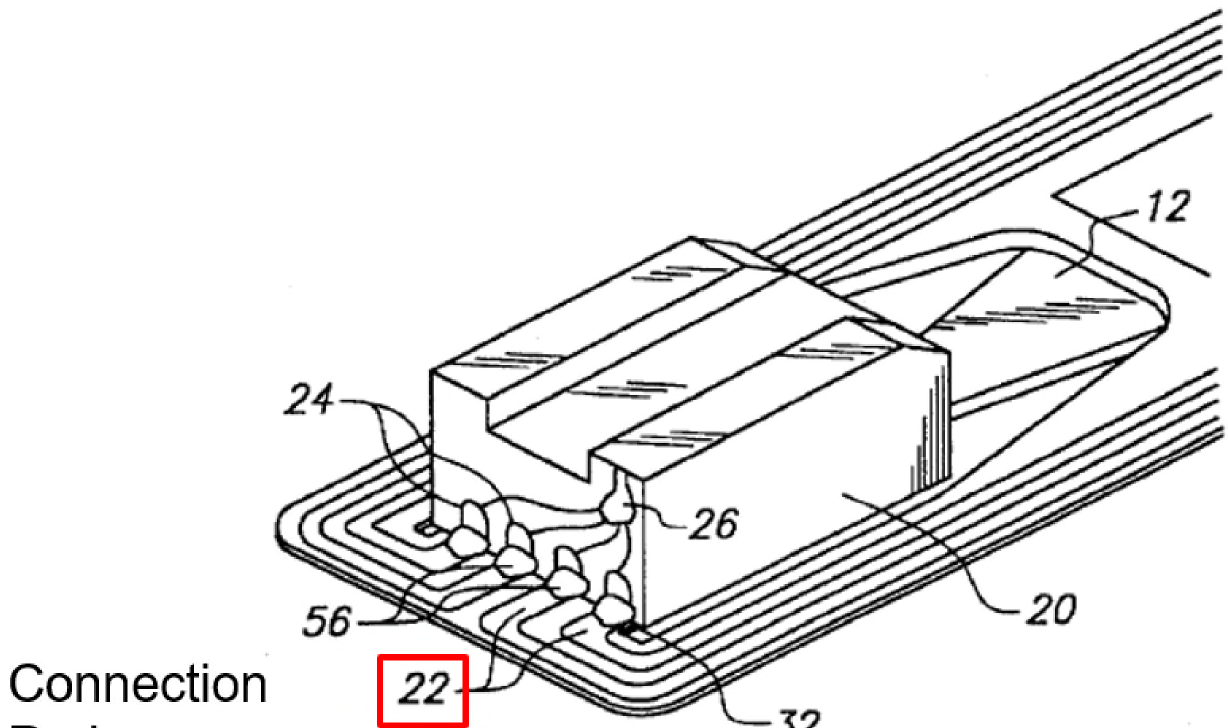


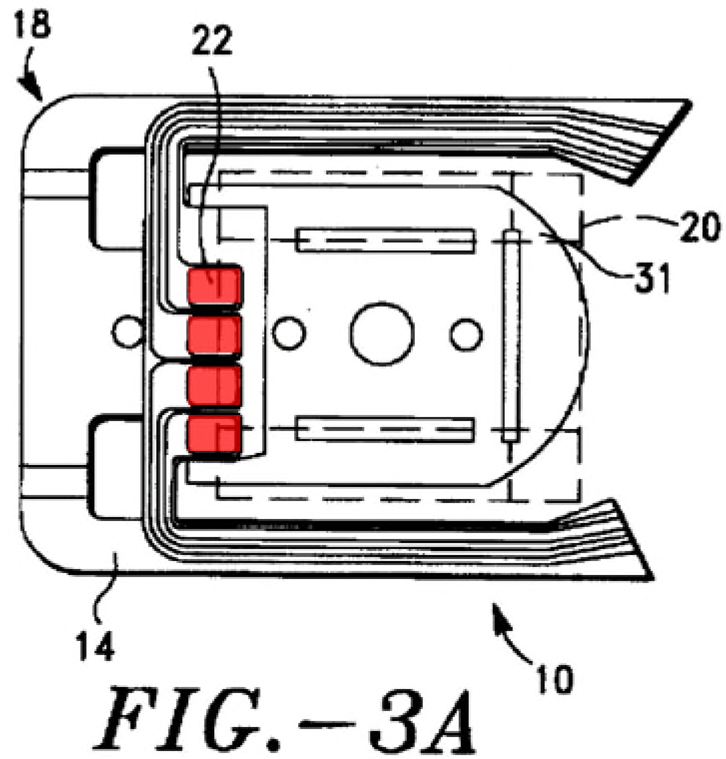
FIG. 3C (PRIOR ART)

Ex. 1004, Fig. 3C (annotated)

3. Balakrishnan ’152

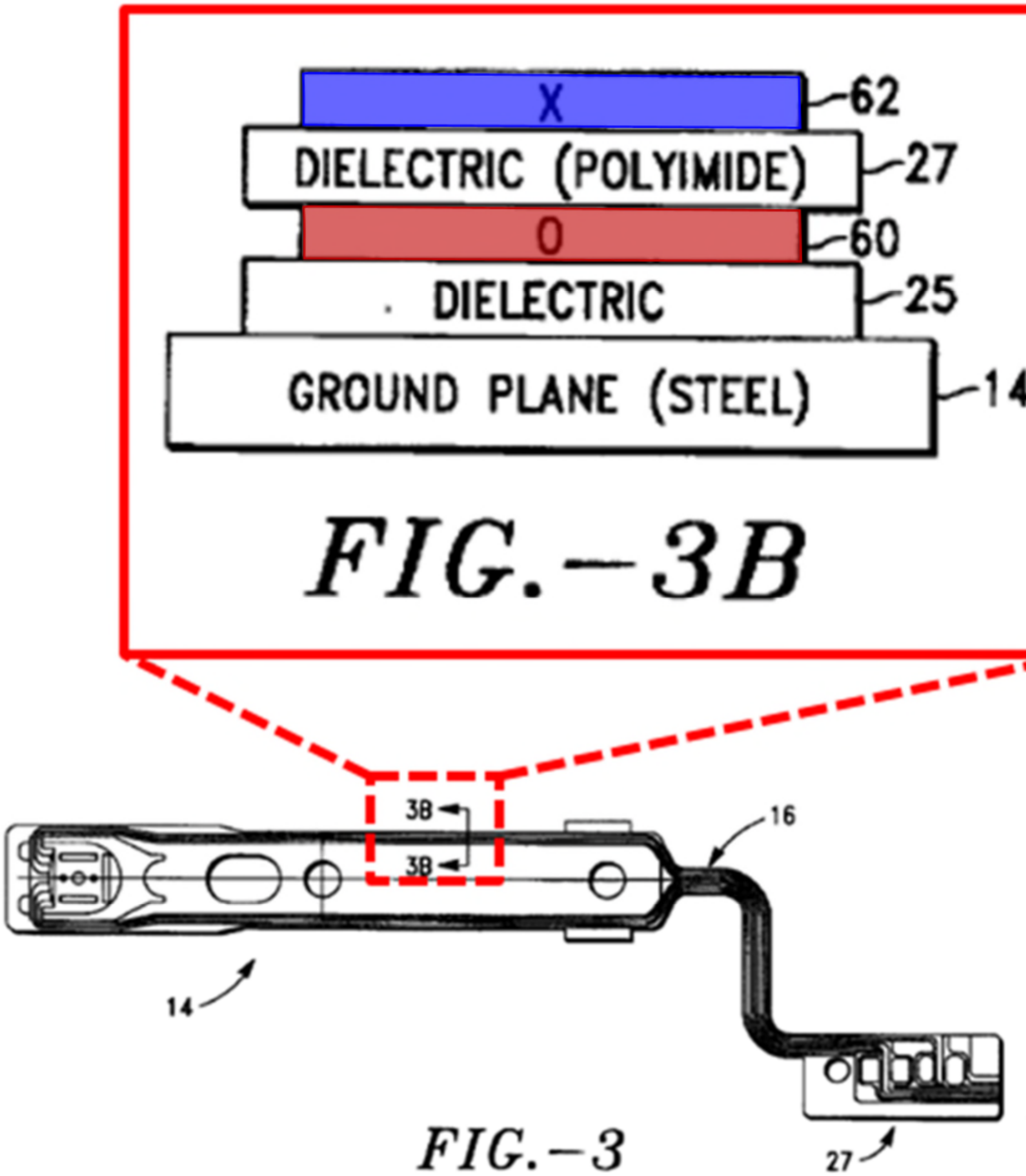
Balakrishnan ’152 is identified on the face of the ’746 patent, but was not substantively addressed by the examiner, and thus is not subject to Section 325(d). *Zscaler, Inc.*, IPR2017-01342, 2017 WL 5624702, at *4.

Balakrishnan ’152 also teaches a flexure for a hard disk drive. Ex. 1005, 6:56-62. This flexure 14 is attached to a load beam (*id*., 7:25-27) and has a slider 20 with a magnetic read/write head attached to it, via connection pads 22 (red) at the distal end 18 of the flexure 14. *Id*., 7:38-43, Fig. 3C.



Ex. 1005, Fig. 3A (annotated)

The flexure has a stacked trace transmission line 16 formed on it. *Id.*, 8:7-15, Fig. 3B.



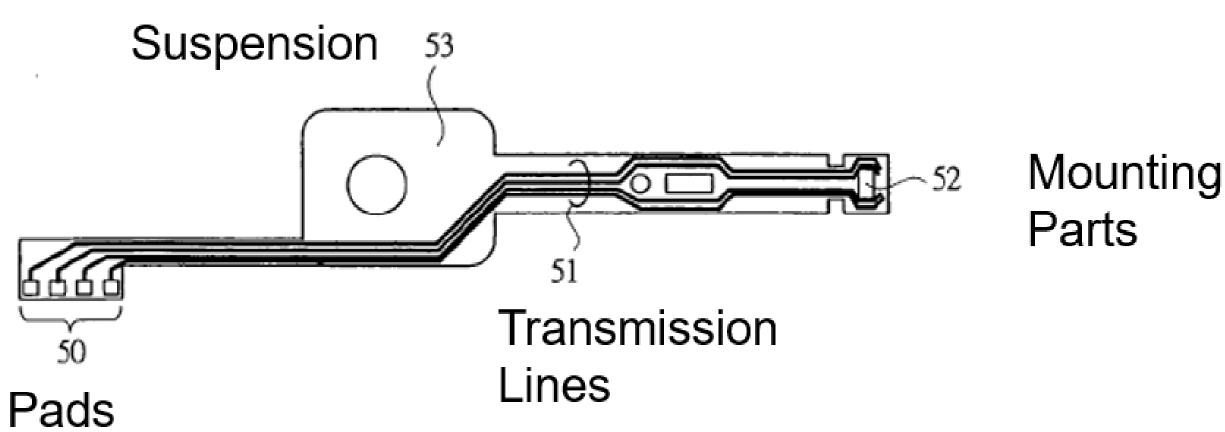
Ex. 1005, Figs. 3 and 3B (juxtaposed and annotated.)

The stacked trace transmission line 16 is made up of an insulating layer 25 on the flexure 14, with a first trace layer 60 (red) on the insulating layer 25, a second insulating layer 27 on the first trace layer 60, and a second trace layer 62 (blue) on the second insulating layer 27. *Id*. The trace layers 60, 62 form a trace pair carrying current between the write element in the magnetic head and a preamplifier 54 located proximal to the proximal end of the load beam. This structure can be replicated for any other signal loops used in the hard drive. *Id*., 10:13-16.

4. Yuuki

Yuuki was not cited during prosecution of the ’746 patent. Yuuki teaches a flexure for a hard disk drive. Ex. 1006, ¶0068, Fig. 5A. Yuuki’s flexure includes transmission lines 51 on the suspension 53, which are connected to pads 50 and magnetic head mounting parts 52 at either end. *Id*. The pads 50 are connected to the read/write IC 10, and the mounting parts 52 are connected to the magnetic head 12. *Id*.

FIG. 5A



Ex. 1006, Fig. 5A (annotated)

The output driver 10a in the read/write IC 10 and the magnetic head 12 have different impedances, *Id*., ¶0077. Yuuki's transmission line is constructed such that the impedance at the driver end of the transmission line should be set to substantially match the impedance of the output driver. *Id*., ¶¶0016, 0054. Furthermore, the impedance at the magnetic head end of the transmission line should be set to substantially match the impedance of the magnetic head. *Id*., ¶0056. According to Yuuki, these impedances are set by varying the widths or thicknesses of the transmission lines, or by varying the thickness of the insulating substrate beneath the transmission lines. *Id*., ¶0072, Fig. 5B; Tarnopolsky, ¶151.

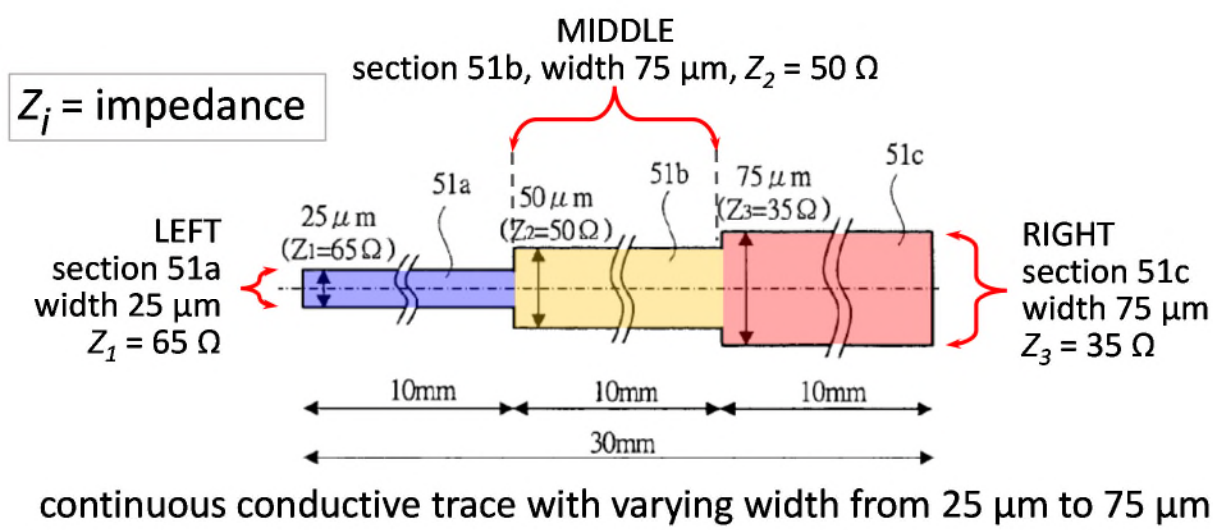


FIG. 5B

Ex. 1006, Fig. 5B (annotated)

For example, Yuuki teaches that the width of the transmission line can be stepped upwards in segments, to progressively reduce the impedance in small steps as the line progresses from the output driver to the magnetic head. *Id*., ¶0073.

Yuuki teaches that any number of segments can be used, as desired, to create a continuous varying impedance that substantially matches the impedances at the output driver and the magnetic head. *Id*., ¶¶0077-78.

B. Ground 1: Claims 7 and 11 are anticipated by Balakrishnan

1. <u>Claim 7</u>

Claim 7 of the ’746 Patent is directed to an integrated lead head suspension flexure, containing electrical traces in two sections, where the traces in one section are interleaved and the traces in the other section are ground plane traces. Balakrishnan teaches such a flexure. Tarnopolsky, ¶¶41-45, 70.

a. “An integrated lead head suspension flexure having a plurality of regions including a tail and a gimbal, including:”

Balakrishnan teaches an integrated lead head suspension flexure. As explained by the ’746 patent, “integrated lead or wireless suspensions and flexures” were well-known in the art. Ex. 1001, 1:12-32 (referencing at least 13 prior art patents disclosing suspensions and flexures). A flexure is a well-known term in the disk drive art, which refers to a sheet of flexible material upon which electrical traces are deposited, to create a conductive signal path from the read/write head of the disk drive to the driver/preamplifier. Ex. 1003, 4:12-16, 4:45-50. An integrated lead flexure is a flexure with the wiring traces formed on the flexure, as opposed to older types of disk drive architectures, which used discrete wires. Ex. 1001, 1:12-14 (equating integrated lead and wireless suspensions); 2:47-66 (describing the flexure having traces formed on a polyimide insulating layer under the traces); Ex. 1003, 2:25-42 (stating that trace interconnect arrays, which are "flat, and are precisely formed printed circuits upon plastic film substrates" were introduced to replace the discrete wire connectors previously used); Tarnopolsky, ¶¶46-47.

Balakrishnan teaches that the flexure includes a flexible insulative polyimide film substrate. Ex. 1003, 4:16-19, 4:51-54; 8:44-47. The electrical trace array is then formed on top of this substrate. *Id.*, 4:16-19; 4:54-57, 8:44-47. A flexible conductive layer, which is welded or otherwise attached to a load beam, is also included underneath portions of the polyimide film layer. *Id.*, 1:43-45; 4:51-53; 8:44-47. The insulative substrate extends along the segment 62, which extends from the end of the load arm 20 to the preamplifier 54. *Id.*, Figs. 2, 3. Thus Balakrishnan teaches the claimed flexure. Tarnopolsky, ¶¶46-47.

With reference to Fig. 3, Balakrishnan's flexure includes a plurality of regions, including at least a tail and a gimbal. According to the '746 patent, the gimbal is the region of the flexure located at the distal end of the flexure where the head/slider assembly is attached. Ex. 1001, 2:50-54; 3:11-13. Balakrishnan discloses the same structure. Ex. 1003, 1:43-45; 6:56-63, Fig. 3. Balakrishnan teaches that "[s]liders are generally mounted to a gimbaled flexure structure attached to the distal end of a suspension's load beam structure." *Id.*, 1:43-45. The gimbal is what allows the slider to "present a 'flying' attitude toward the disk surface and follow its topology." *Id*., 1:48-50; Tarnopolsky, ¶48. As depicted below, Balakrishnan's head 13 is mounted at the end of the flexure 15.

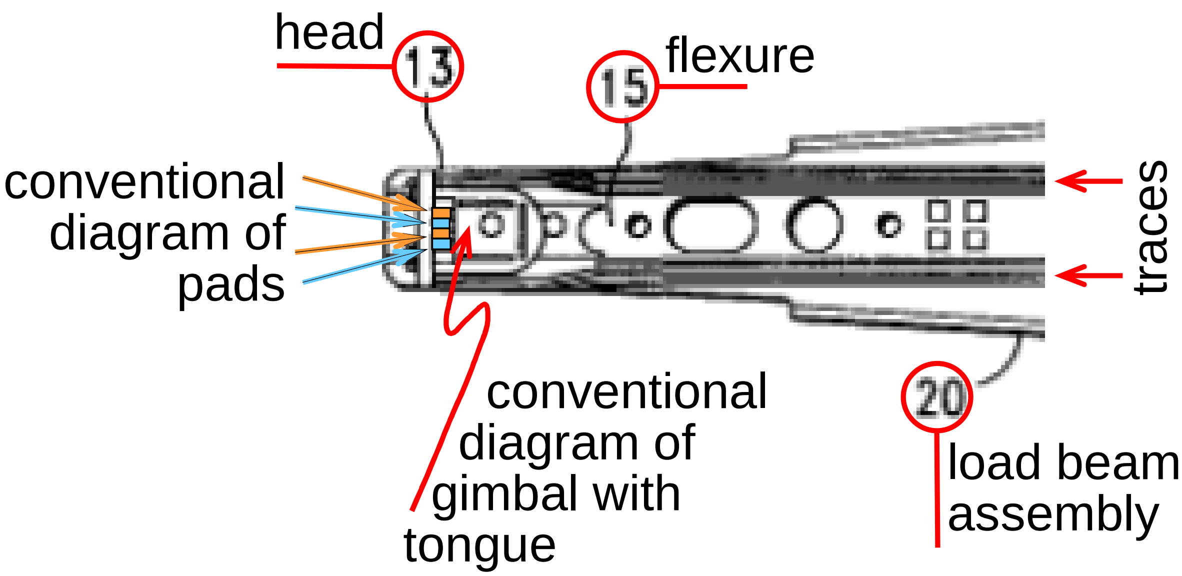
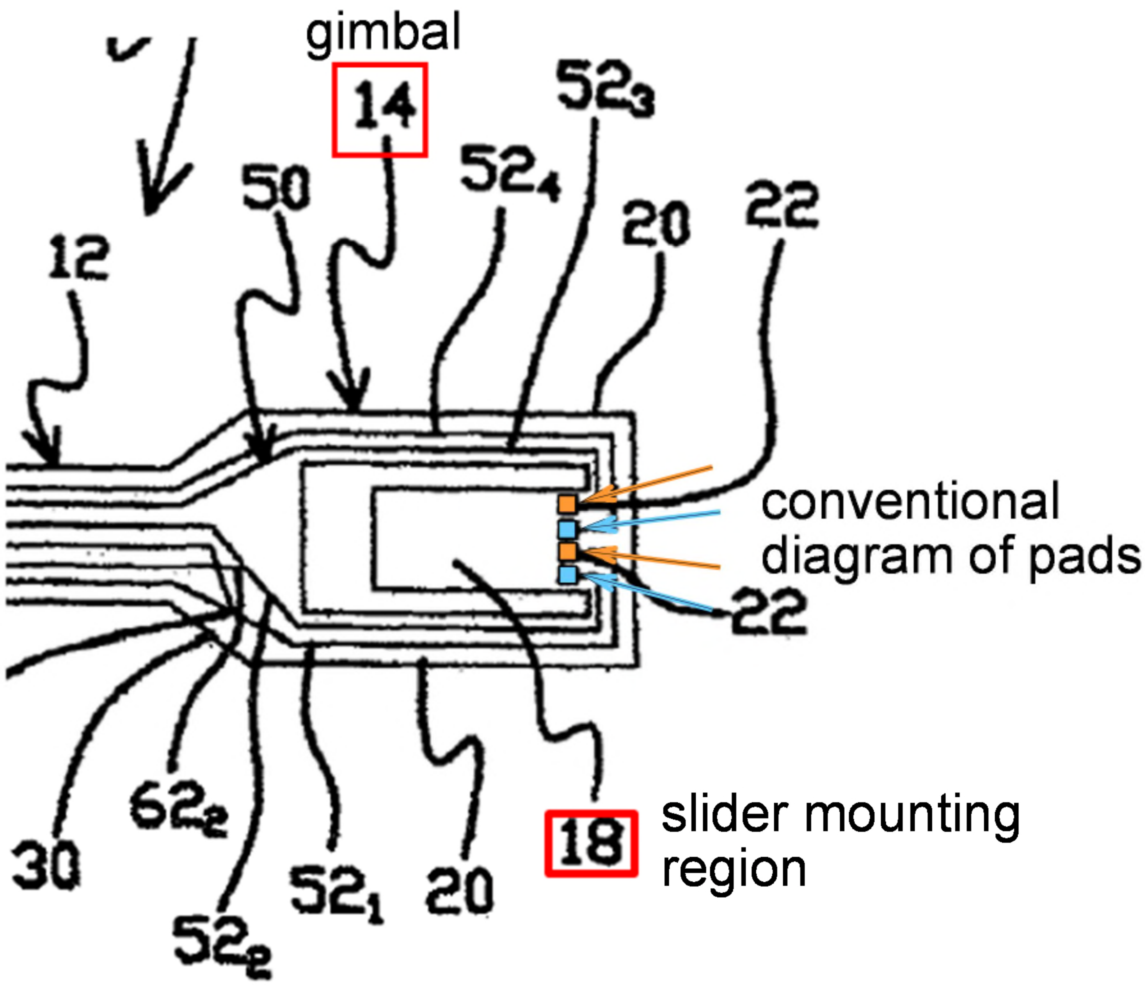


FIG.–3

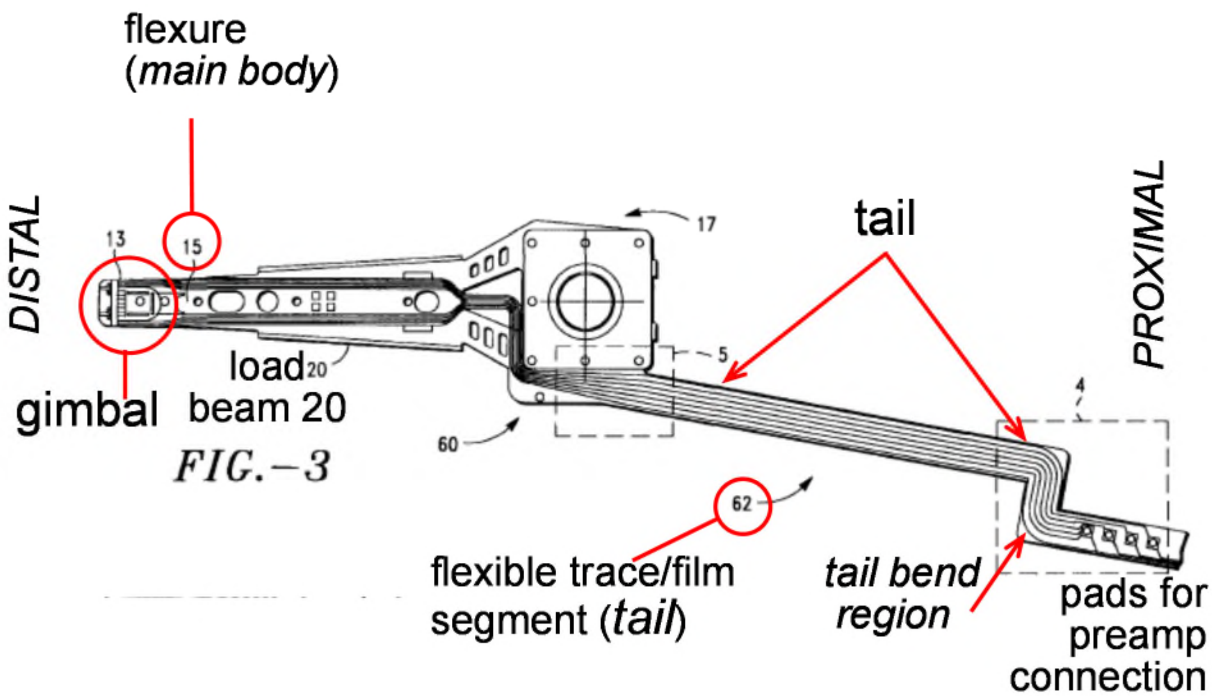
Ex. 1003, Fig. 3 (excerpted and annotated)

This is precisely where the '746 patent teaches that its head/slider is mounted, on slider mounting region 18 at the distal end of flexure 10. Ex. 1001, 3:11-13, Fig. 1 (excerpted below); Tarnopolsky, ¶49.



Ex. 1001, Fig. 1 (excerpted and annotated)

According to the ’746 patent, the tail is the proximal portion of the flexure, which contains the terminal pads to connect the traces to the preamplifier. Ex. 1001, 2:54-56, 3:12-15. Balakrishnan teaches this as well. In Balakrishnan, the segment 62 corresponds to the claimed tail. Ex. 1003, 7:40-43, Figs. 3, 4. Segment 62 extends from the end of the load beam 20 to the preamplifier 54, and includes the terminal pads at the right-hand side of Fig. 3, that connect to the preamplifier 54; Tarnopolsky, ¶51.



Ex. 1003, Fig. 3 (annotated)

This is the same configuration as disclosed by the ’746 patent, which shows its tail 16 extending proximally from the main body region of the flexure (i.e. the mounting region) where the flexure is mounted to the rigid beam. Ex. 1001, 3:6-10, Fig. 1; Tarnopolsky, ¶50.

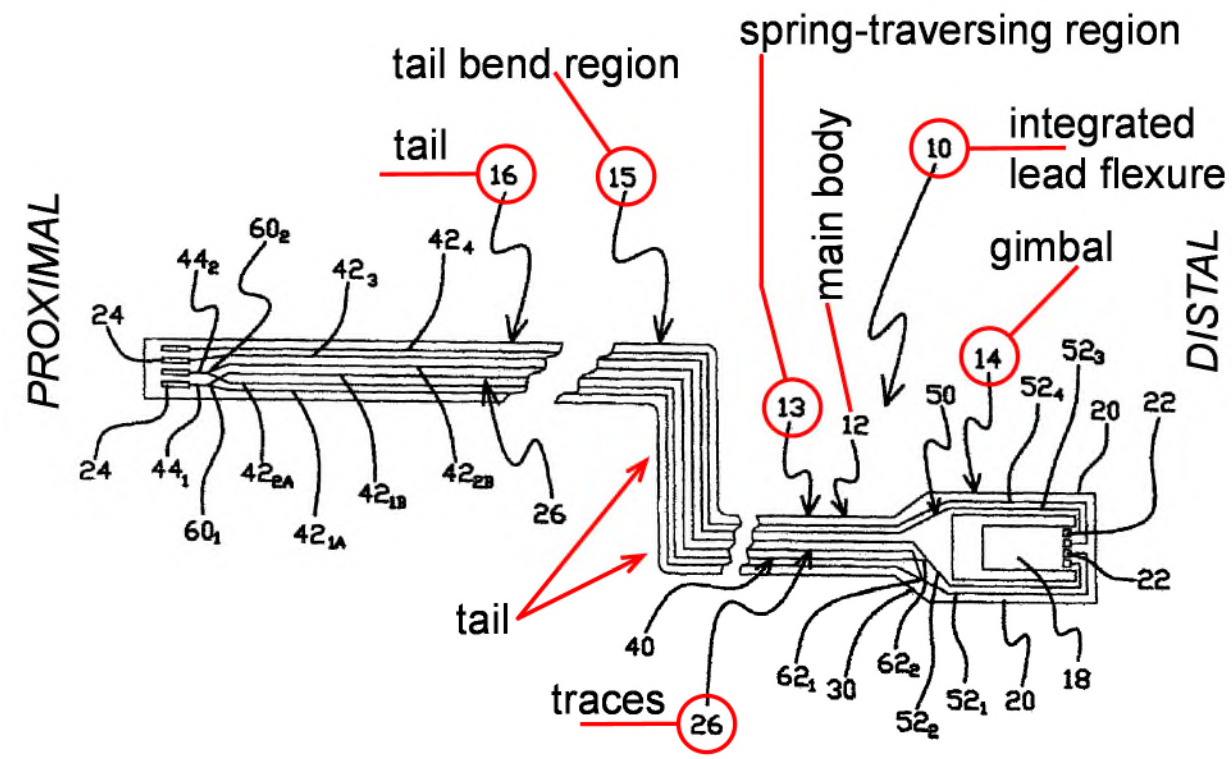


FIG. 1

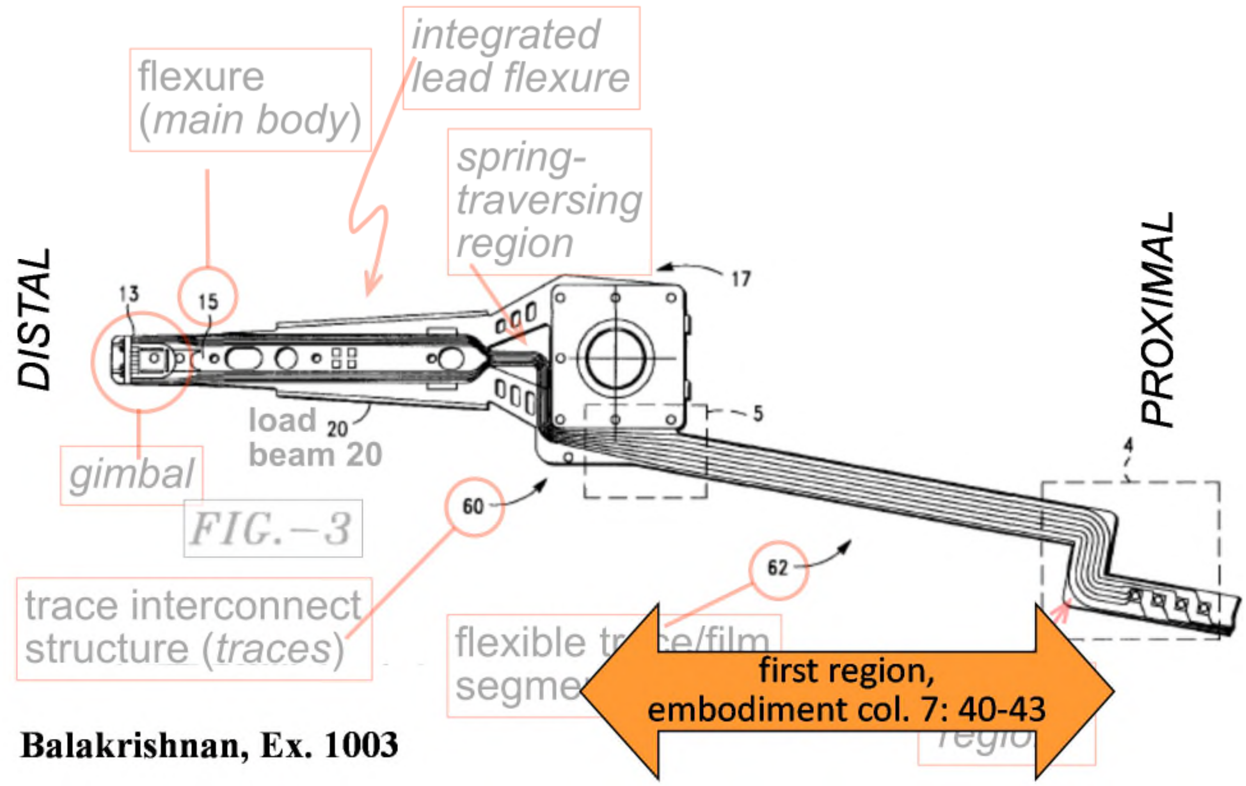
Ex. 1001, Fig. 1 (annotated)

Therefore, Balakrishnan discloses the claimed flexure, including the gimbal and tail regions.

b. **"First trace sections having a first structural configuration on a first region of the flexure"**

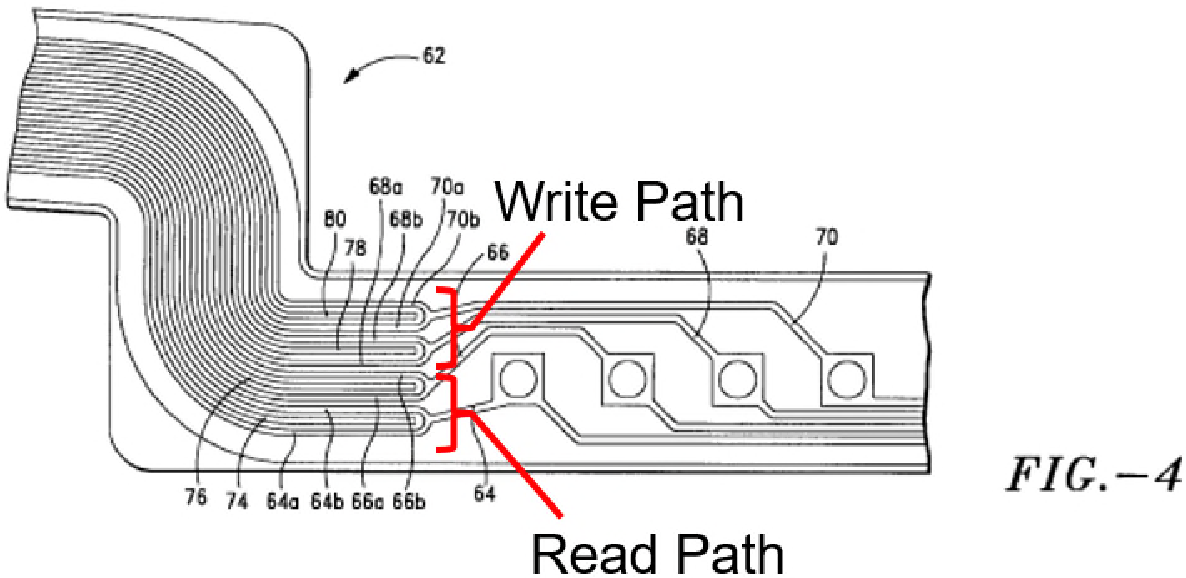
Balakrishnan teaches this limitation. This limitation merely requires that the flexure have a "first region", and that this "first region" include "first trace sections" that have a "first structural configuration."

The first region in Balakrishnan is the trace/film segment 62, which is depicted in Fig. 3 as extending from the end of the load arm 20 to the right-hand side of the figure. Ex. 1003, 7:40-43; Tarnopolsky, ¶¶53-55.



Ex. 1003, Fig. 3 (annotated)

As shown in further detail in Fig. 4, this region includes two conductive path pairs (first trace sections), a read path pair including conductors 64 and 66, and a write path pair including conductors 68 and 70. These path pairs are interleaved as discussed in further detail in Section IV.B.1.e below. The path pairs are divided into segments 64a-64b, 66a-66b, 68a-68b, and 70a-70b, each with a conductor trace 74, 76, 78, 80 interleaved respectively therebetween. Ex. 1003, 7:53-67; Tarnopolsky, ¶55.



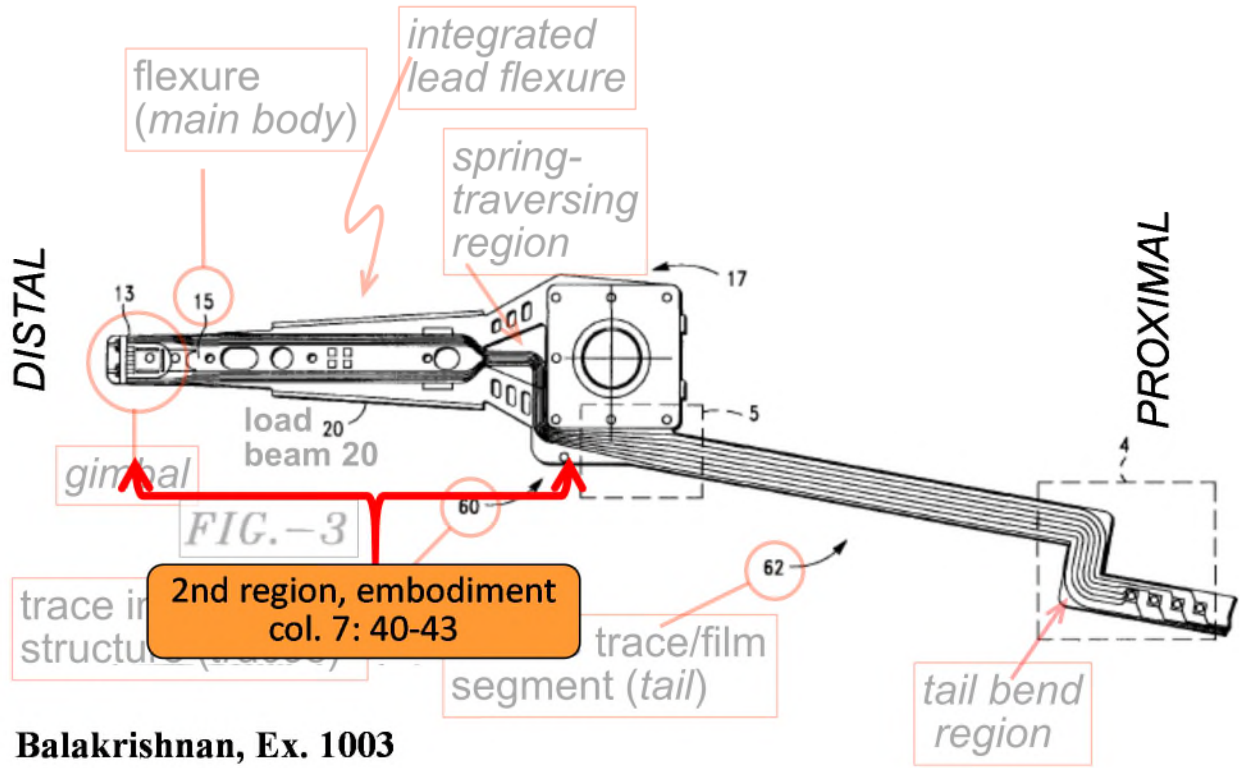
Ex. 1003, Fig. 4 (annotated)

This interleaved structure is the claimed "first structural configuration."

c. **"Second trace sections having a second structural configuration different than the first configuration on a second region of the flexure"**

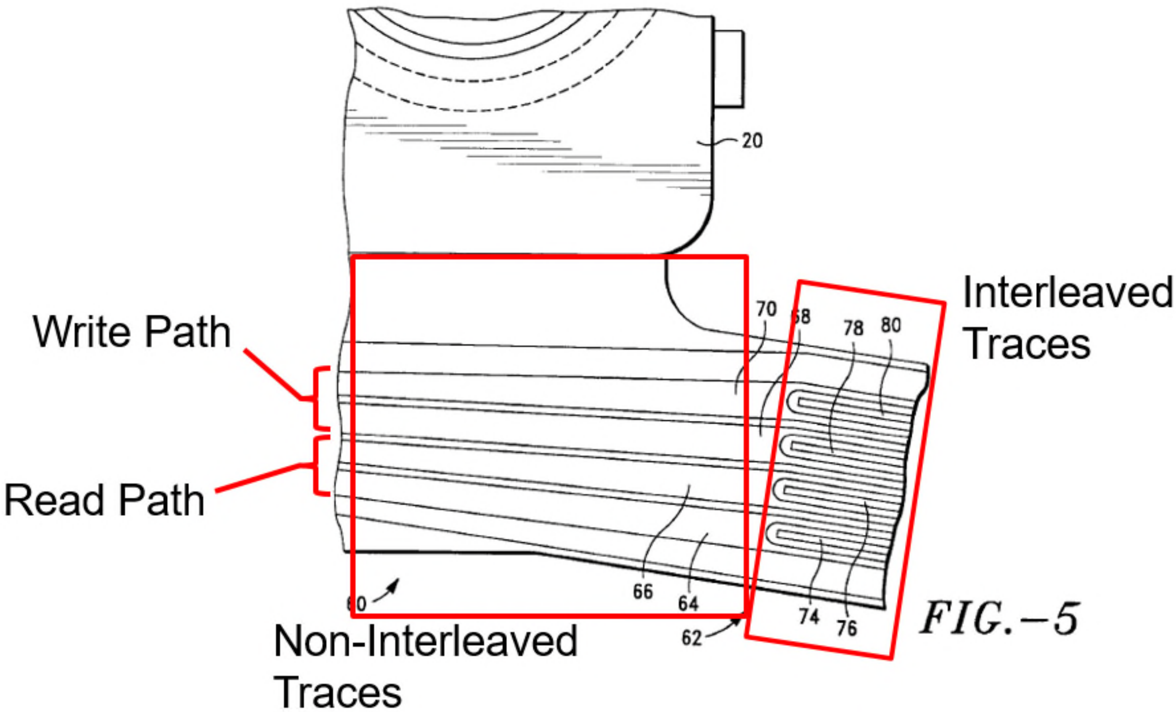
Balakrishnan teaches this limitation. This limitation merely requires that the flexure have a "second region", and that this "second region" include "second trace sections" that have a "second structural configuration," where the second configuration is different from the first configuration.

The second region in Balakrishnan is the portion of the interconnect structure 60 which is on the flexure 15 shown in Fig. 3, extending to the end of the trace/film segment 62 that contains the interleaved traces. Ex. 1003, 7:40-43; Tarnopolsky, ¶56.



Ex. 1003, Fig. 3 (annotated)

As shown in further detail in Fig. 5, this region also includes two conductive path pairs (second trace sections), a read path pair including conductors 64 and 66, and a write path pair including conductors 68 and 70. The conductors 64, 66, 68 and 70 are not interleaved in the second region. Ex. 1003, Fig. 5; Tarnopolsky, ¶57.

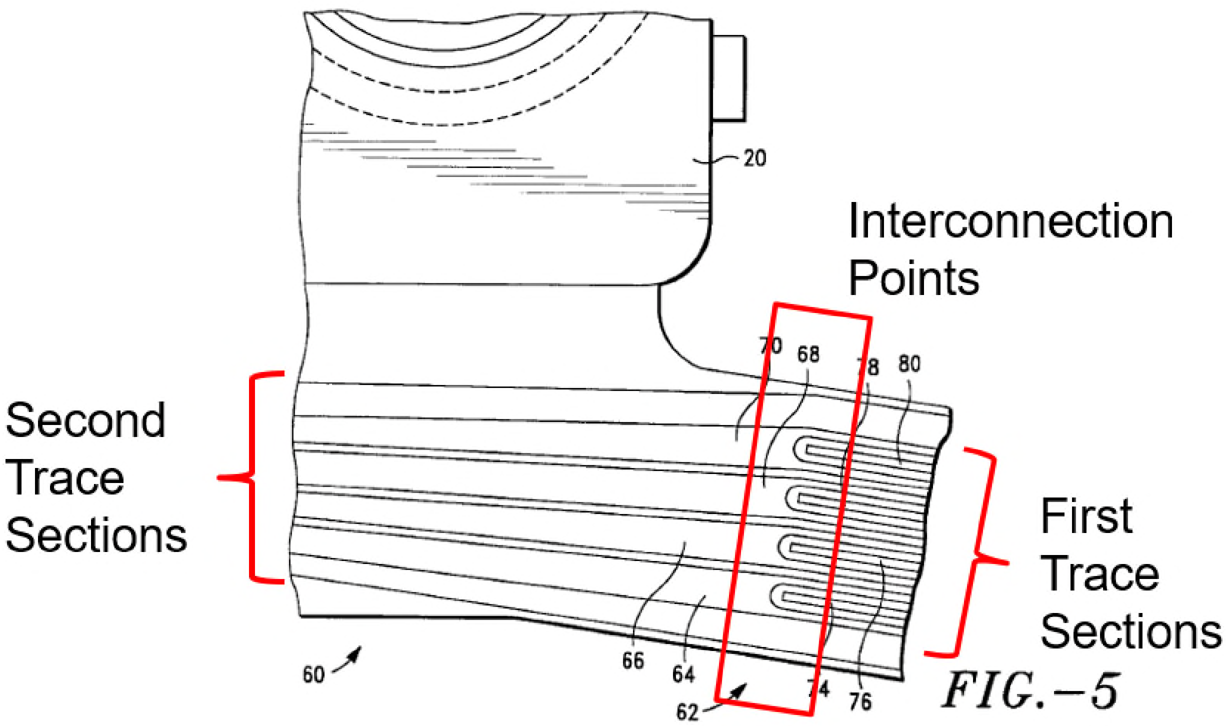


Ex. 1003, Fig. 5 (annotated)

As discussed in further detail in Section IV.B.1.f below, the conductors that run atop the flexure 15 have a non-interleaved, ground plane structure, which is the claimed "second structural configuration." Because the non-interleaved traces are not interleaved, they have a different structure than the interleaved traces. Tarnopolsky, ¶58.

d. **"The second trace sections electrically connected to the first trace sections"**

Balakrishnan teaches this limitation. Balakrishnan teaches that the trace conductor array "connect[s] the read/write head/slider assembly in a head-disk assembly … to read/write circuitry within the head-disk assembly." Ex. 1003, 4:12-16; 4:34-40. This is shown in Fig. 2, where interconnect structure 60 is shown as connecting the head 13 to the preamplifier 54. *Id*., Fig. 2; 6:56-63, 7:14-18. Thus, all of the sections of the interconnect structure 60 are electrically connected to each other, in order for signals to be sent between the head 13 and the preamplifier 54; Tarnopolsky, ¶59.



Ex. 1003, Fig. 5 (annotated)

As shown in detail in Fig. 5, the interconnect structure 60 includes the interleaved first trace sections, at the right-hand side of Fig. 5. The interconnect structure 60 also includes the non-interleaved second trace sections, at the left-hand side of Fig. 5. For each trace 64, 66, 68, 70, the interleaved section is directly electrically connected at the interconnection points to the non-interleaved section. Ex. 1003, Fig. 5, 7:53-61; Tarnopolsky, ¶60.

e. **"Wherein the first trace sections include interleaved traces"**

Balakrishnan teaches this limitation. Ex. 1003, 3:65-4:6 ("outside conductors divide a unidirectional current flow and an interleaved passive conductive trace repels resultant flux.") As discussed above, the first trace sections in Balakrishnan are the interleaved sections in segment 62, which are in the first region. *Supra*, section IV.B.1.b; Tarnopolsky, ¶61. Figs. 4 and 5 depict the first region, including the two ends of the segment 62, showing the details of the interleaved trace sections.

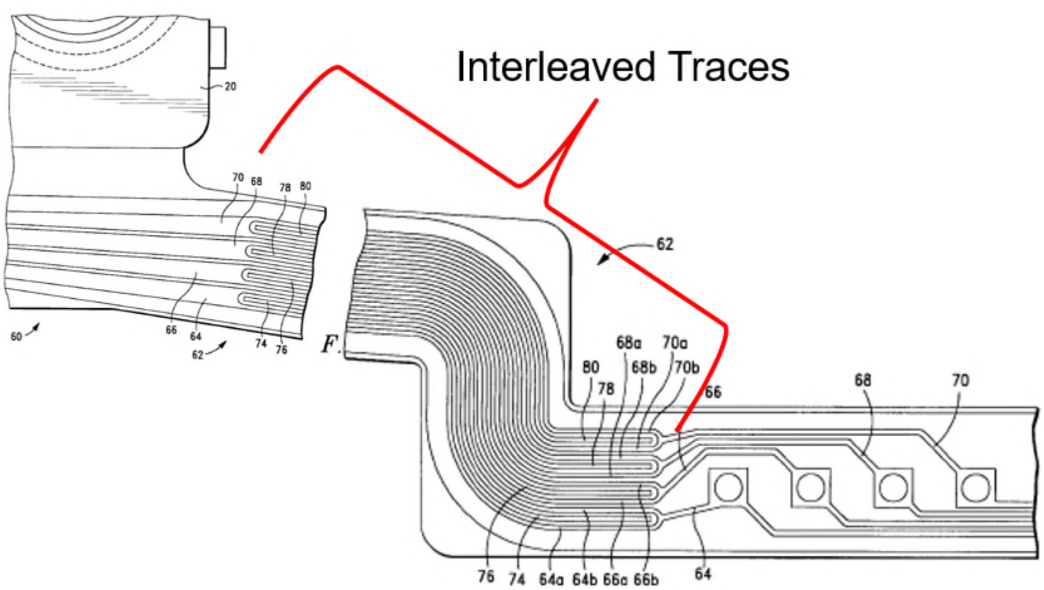


FIG.—4

Ex. 1003, Figs. 4 & 5 (juxtaposed and annotated)

The trace sections in segment 62 are interleaved, with electromagnetically-coupled conductive traces interleaved between each pair of two-terminal traces for the read and write paths. Ex. 1003, 7:53-67, Fig. 4; Tarnopolsky, ¶62. Thus, in the first trace section, trace 64 is split into trace segments 64a and 64b, trace 66 is split into segments 66a and 66b, trace 68 is split into segments 68a and 68b, and trace 70 is split into segments 70a and 70b. Ex. 1003, 7:58-61. Each segment pair has an interleaved trace 74, 76, 78, 80 respectively. *Id*., 7:62-67.

The plain meaning of "interleaved" merely requires alternating trace types. *Supra*, section II.C.1. The interleaved traces disclosed in Balakrishnan are plainly arranged in an alternating pattern. For example, trace 64 alternates between trace 64a, then trace 74, and then back to trace 64b. Ex. 1003, 7:64. Therefore, the interleaved traces disclosed in Balakrishnan satisfy the plain meaning of "interleaved" under the broadest reasonable construction. Tarnopolsky, ¶¶63-66.

f. **"The second trace sections include ground plane traces"**

Balakrishnan teaches this limitation. Balakrishnan teaches that the portion of the interconnect structure 60 in its "second region"—which is the region that includes the gimbal—is part of a multi-layer flexure 15, that includes the ground plane, as well as the traces of the interconnect structure. Ex. 1003, Figs. 2-3, 6:60-63, 7:43-48, 8:38-47; Tarnopolsky, ¶68. As seen in Fig. 3, the ground plane traces of the interconnect structure 60 extend along the flexure 15, from the head 13 until they reach the proximal end of the load beam 20, where they pass over an air gap, then run along the side of the proximal end 17 of load beam 20, and then transition into trace/film segment 62 (which contains the interleaved traces).

Balakrishnan teaches that "[t]his flexure includes a generally planar conductive member extending to proximity of the read/write head/slider assembly." *Id.*, 4:50-58. This flexure 15 is part of load beam assembly 20. *Id.*, 6:60-63. This flexure can be formed of, for example, stainless steel. *Id.*, 8:44-47; *see also* Ex. 1007, 9:28-31 ("the flexure 14 is formed of thin stainless steel") (incorporated by Ex. 1003, 7:34-40). Thus, Balakrishnan teaches the same ground plane layer as used in the '746 patent, namely a stainless steel conductive layer arranged beneath the electrically conductive traces. Ex. 1001, 2:60; Tarnopolsky, ¶69.

2. <u>Claim 11</u>

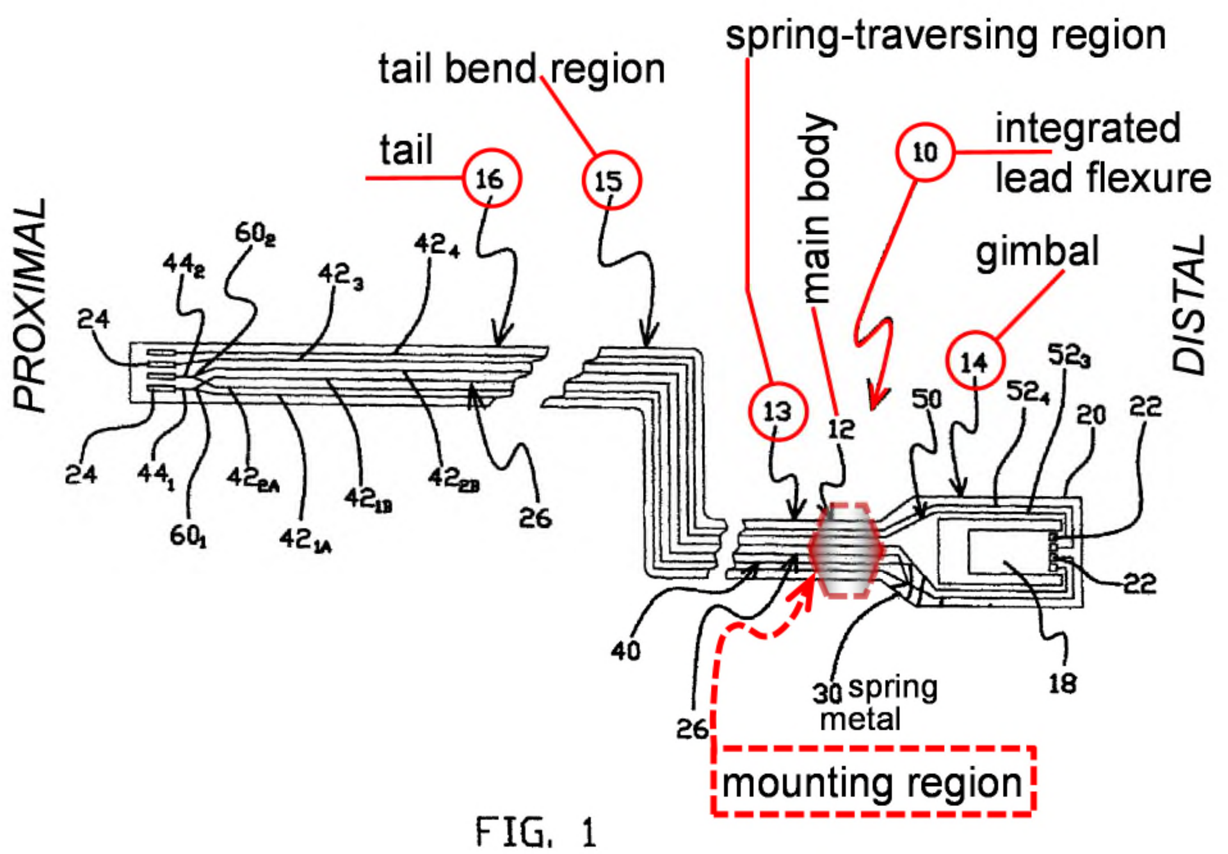
Claim 11 of the '746 Patent is directed to an integrated lead head suspension flexure, containing electrical traces in two sections, where the traces in each of the two sections have different structural configurations, either interleaved, stacked or ground plane traces. As with claim 7, Balakrishnan teaches such a flexure, specifically one that uses interleaved traces in one section and ground plane traces in the other section. Tarnopolsky, ¶¶78-79.

a. **"An integrated lead head suspension flexure"**

Balakrishnan teaches this limitation. *Supra*, section IV.B.1.a; Tarnopolsky, ¶80.

b. **"A mounting region"**

Balakrishnan teaches this limitation. The '746 patent teaches that its flexure 10 is welded or otherwise mounted to a rigid beam (i.e. a load beam) at the main body region 12 of the flexure 10. Ex. 1001, 3:6-10. The main body region 12 is located between the gimbal and the tail. *Id.*, 2:50-52, 3:6-10, Fig. 1.

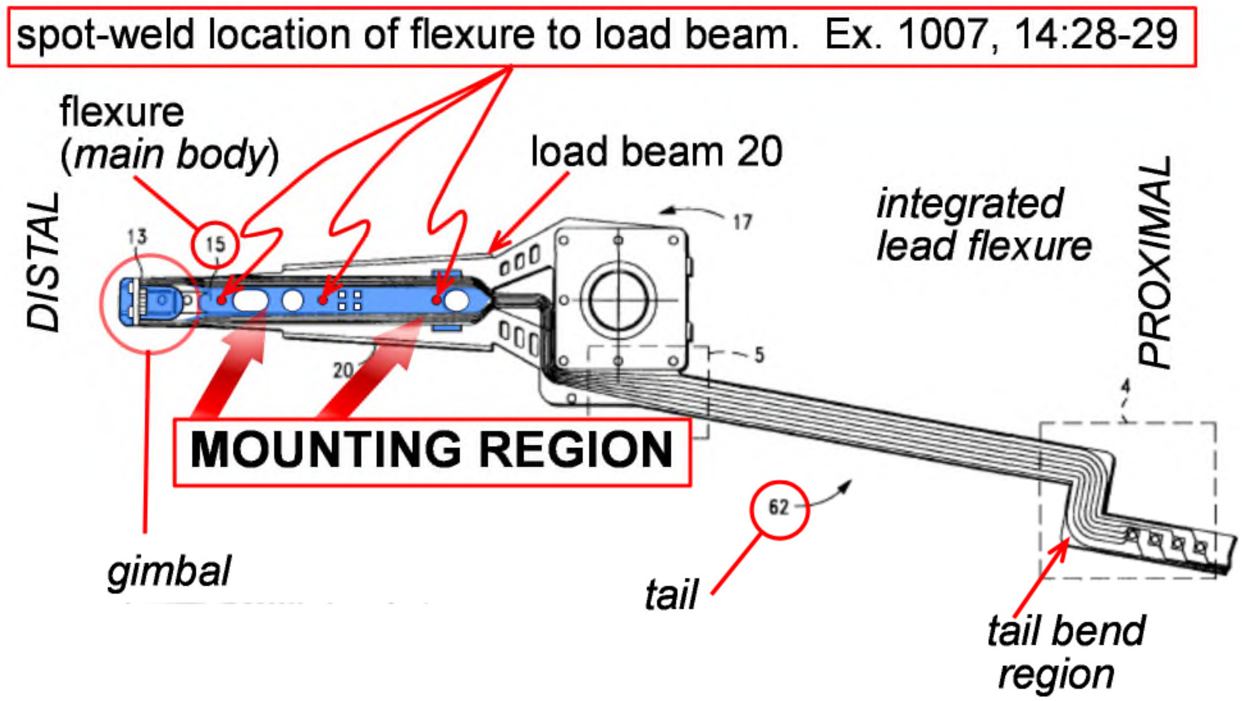


Ex. 1001, Fig. 1 (annotated)

Claim 11 recites that the claimed mounting region is between the gimbal and the tail (the gimbal extends distally from the mounting region, the tail extends proximally from same). This is the same configuration as the main body region 12 shown in Fig. 1 of the ’746 Patent and discussed in the above-cited passages. Thus, the claimed mounting region corresponds to the disclosed main body region where the flexure is mounted to a rigid beam. Tarnopolsky, ¶81.

Balakrishnan teaches that a “flexure structure [is] attached to the distal end of a suspension’s load beam structure.” Ex. 1003, 1:42-44. Balakrishnan further discloses, in Fig. 2, “the load beam assembly 20 which includes at a distal end 19 a head 13 supported by a flexure 15 and the trace interconnect array 60.” *Id.*, 6:60-64, Fig. 2. Fig. 2 depicts the flexure 15 on which the trace interconnect array 60 is formed, and shows that the flexure 15 is mounted to the load arm 20 between the gimbal/head and the tail, at the mounting region as claimed. Balakrishnan further teaches, via its incorporation of Williams, that the flexure is spot-welded to the load beam. Ex. 1007 at 20 (application 14:28-29), Fig. 2 (“flexure 14 may be conventionally spot-welded to load beam 12’ at locations 13, for example.”)

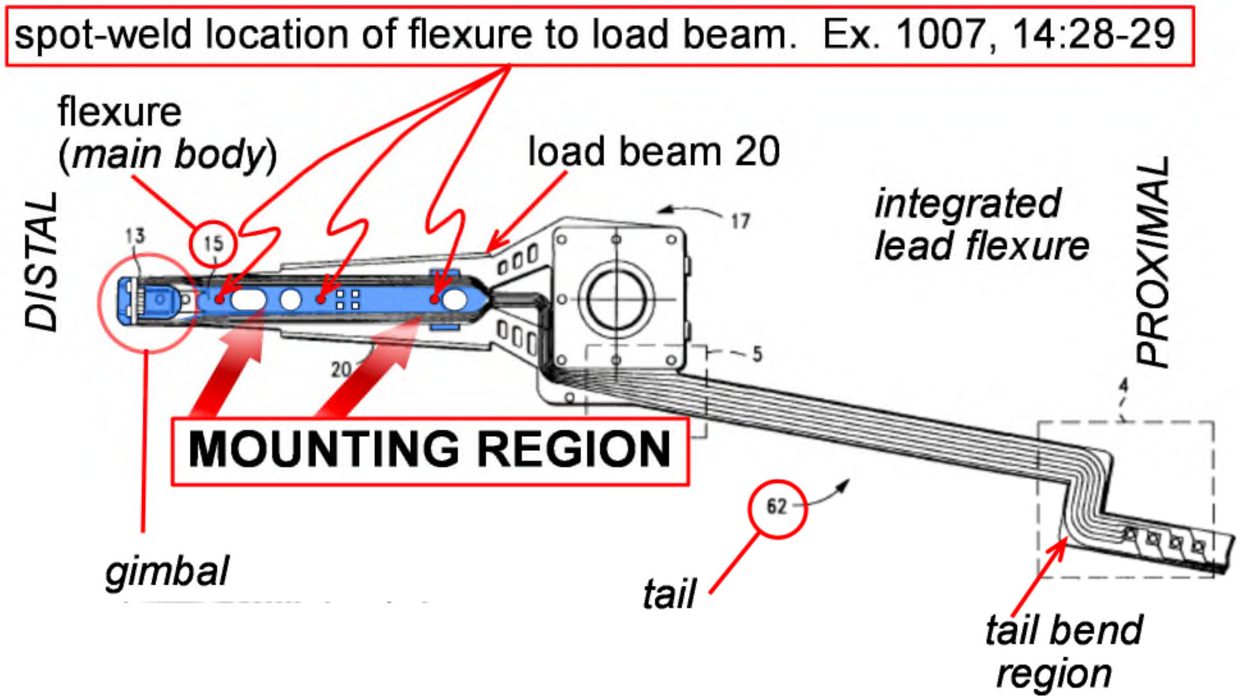
A comparison of the flexures disclosed in the ’746 patent and Balakrishnan shows that they are both mounted to the load arm at the same location.



Ex. 1003, Fig. 3 (annotated) – mounting region is the region of flexure 15 that is located proximal to the head 13, and lies over load beam 20.

c. A gimbal extending distally from the mounting region and having bond pads

Balakrishnan discloses a gimbal extending distally from the mounting region. As discussed in Section IV.B.1.a above, in the ’746 patent the gimbal is the region of the flexure located at the distal end of the flexure, where the head/slider assembly is attached. Balakrishnan teaches the same gimbal structure. Tarnopolsky, ¶82. Balakrishnan teaches that the gimbal is the portion of the flexure that is located at the distal end of the suspension’s load beam structure, stating that “[s]liders are generally mounted to a gimbaled flexure structure attached to the distal end of a suspension's load beam structure." Ex. 1003, 1:43-45. As seen in Fig. 3, the gimbal is located distal to the mounting region.



Ex. 1003, Fig. 3 (annotated)

Balakrishnan teaches that the traces are connected to the head on the gimbal. Balakrishnan recites that "a trace conductor array is provided for connecting a read/write head/slider assembly in a head-disk assembly … to read/write circuitry within the head-disk assembly of a hard disk drive." Ex. 1003, 4:12-16. In this array, "two of the conductors are for electrically connecting a read element of the head to a preamplifier circuit, and two of the conductors are for connecting a write element of the head to a write driver circuit." *Id*., 4:37-40.

Balakrishnan further discloses the use of bond pads to make these connections. Tarnopolsky, ¶83. As shown in Fig. 3, Balakrishnan teaches a head region 13, located at the distal end of the flexure 15 portion of the load beam assembly 20.

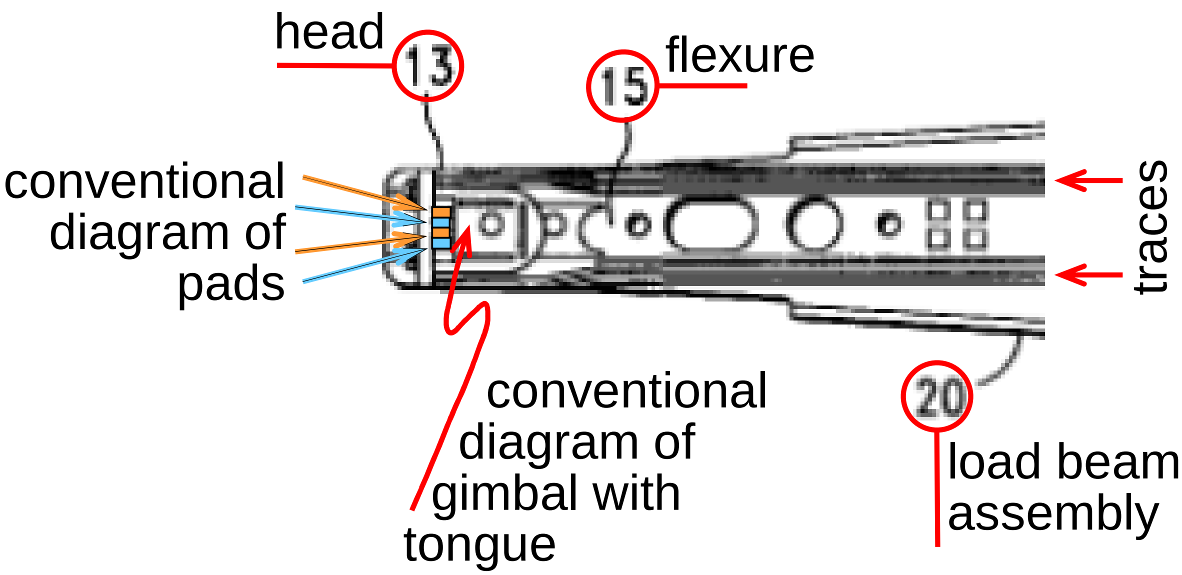
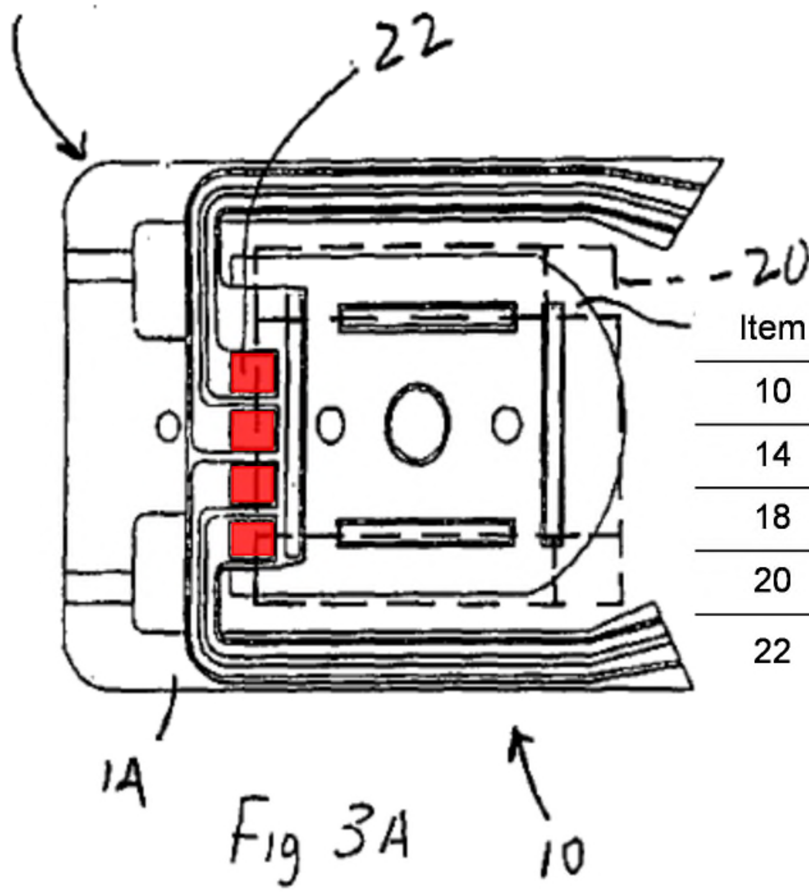


FIG.–3

Ex. 1003, Fig. 3 (excerpted and annotated)

The head 13 includes a gimbal with a tongue for mounting the slider. Tarnopolsky ¶48. There are four pads as well, which provide the contacts for connecting the flexure 15 to the slider. Ex. 1003, 4:12-16; Tarnopolsky ¶48. Further details of Balakrishnan's load beam structure, including the head slider, are shown in the incorporated Williams reference, Ex. 1007.



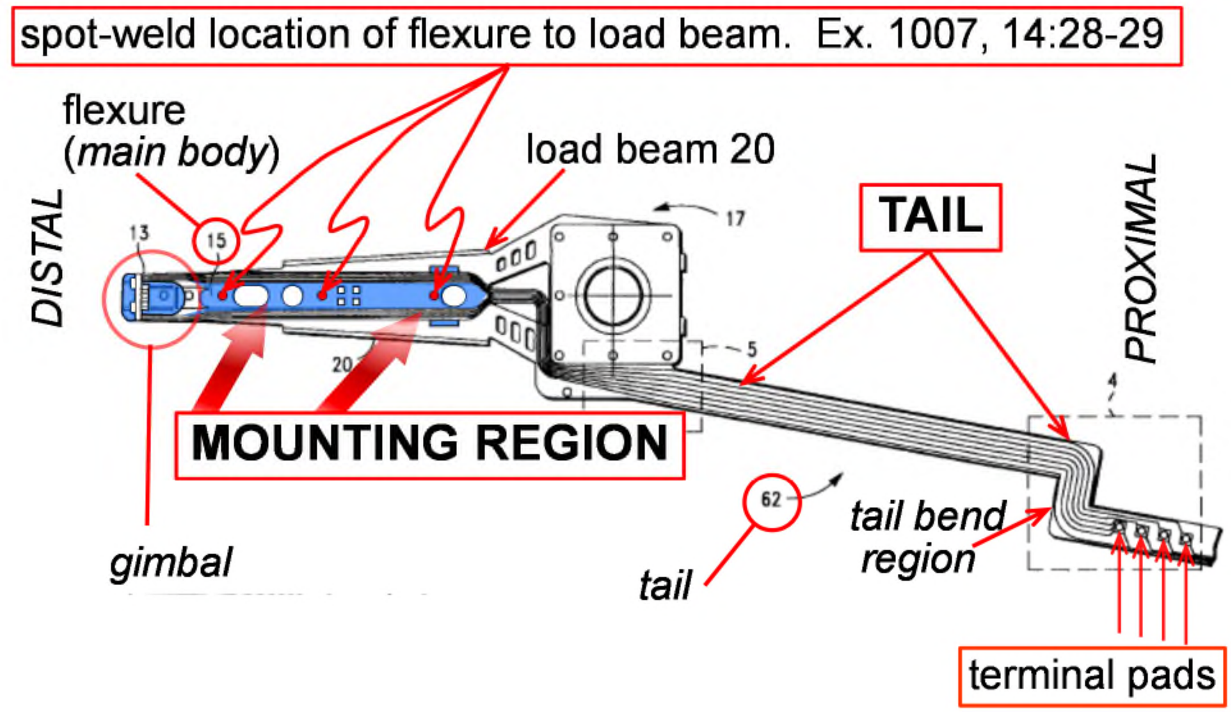
Item	Specification
10	load beam assembly
14	gimbal, flexure
18	distal end
20	head slider (dash)
22	connection pad array for gold-ball bonds to head

Ex. 1007, Fig. 3A (annotated)

Further, Williams, which Balakrishnan incorporates by reference, additionally teaches that the load beam assembly 10 includes a gimbal 14 and connection pad array 22 (red), which is configured as shown in Fig. 3A, to include four pads. Ex. 1007, 9:34-10:1. These pads are used to connect the traces to the head/slider body 20, via gold ball bonds 56. Ex. 1007, 10:3-7. Thus, Balakrishnan (with the incorporation of Williams) teaches this limitation. Tarnopolsky, ¶¶83-86.

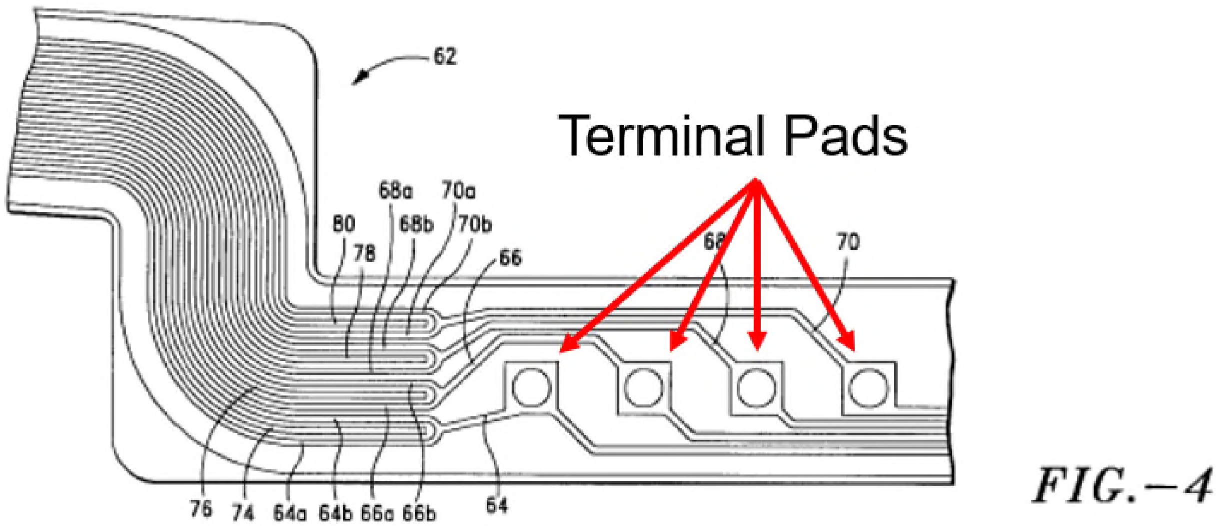
d. **A tail extending proximally from the mounting region and having terminal pads**

Balakrishnan teaches this limitation. As discussed in Section IV.B.1.a above, in the ’746 patent the tail 16 is the region located at the proximal end of the flexure. This region extends proximally from the main body region 12 (i.e. in the opposite direction of the distally-extending gimbal) as shown in Fig. 1 of the ’746 patent. Ex. 1001, Fig. 1. Balakrishnan teaches the same structure, specifically segment 62. *Supra*, section IV.B.1.a. Segment 62 carries the interleaved conductor traces from the load beam 20 all the way to the preamplifier 54. Ex. 1003, 7:40-43. With reference to Figs. 3 and 4, the tail is the portion of the trace interconnect structure 60 extending proximally from the point where the flexure is secured to the load beam, and including the trace/film segment 62. *Id.*, 4:57-58; 7:15-18; 7:40-49; Tarnopolsky ¶89.



Ex. 1003, Fig. 3 (annotated)

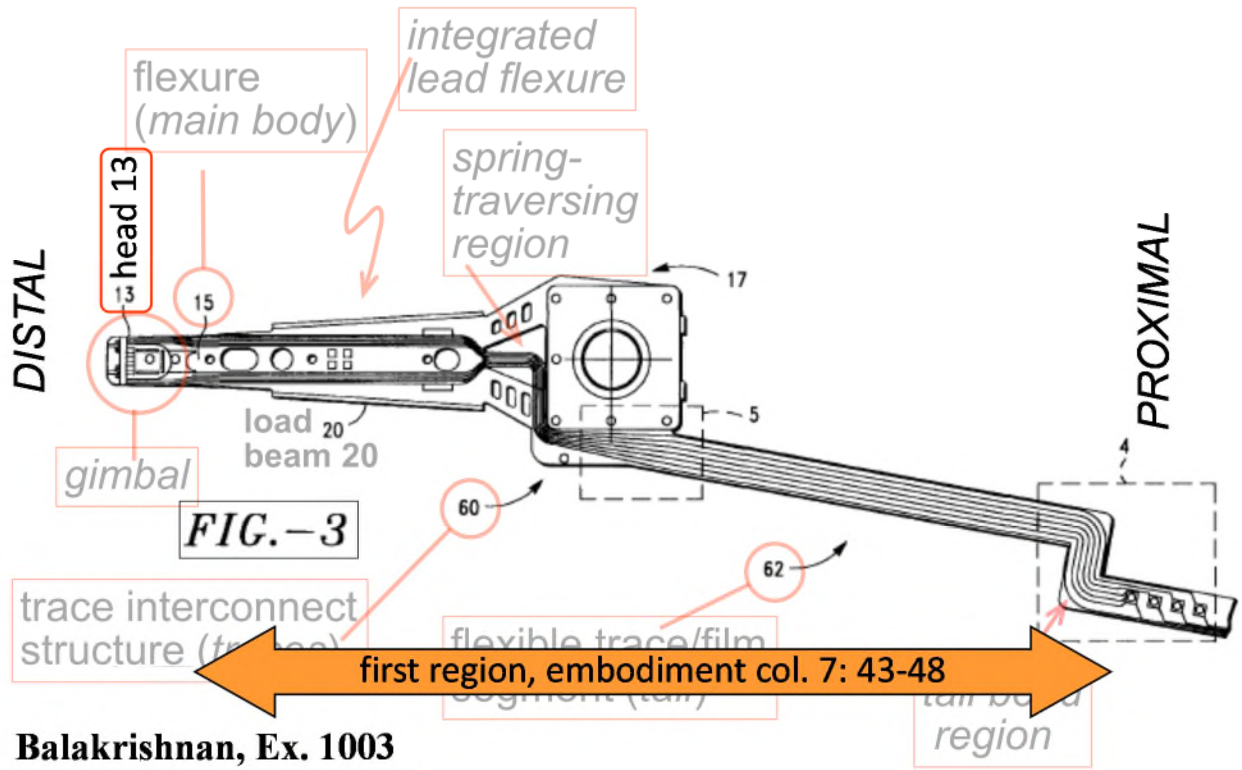
This tail includes four terminal pads that connect the trace/film segment 62 to the preamplifier 54, as shown in Figs. 3 and 4. *Id.*, 7:14-24, Fig. 4. These four terminal pads are the square structures located in the center-right of Fig. 4. Tarnopolsky ¶90.



Ex. 1003, Fig. 4 (annotated)

e. **First trace sections having a first structural configuration electrically connected to the terminal pads and extending over at least a portion of the tail**

Balakrishnan teaches this limitation. Tarnopolsky, ¶91. As discussed above in Section IV.B.1.b, the first trace sections in Balakrishnan are the interleaved sections (first structural configuration) of segment 62. As shown in Fig. 4, these interleaved sections are electrically connected to the four terminal pads. Ex. 1003, Fig. 4; Tarnopolsky, ¶90. This is how the traces connect to the preamplifier 54, to connect the "read preamplifier/write driver circuit to read and write elements of the magnetic recording head 12 [sic:13]." *Id*., 7:14-24, 7:40-43.



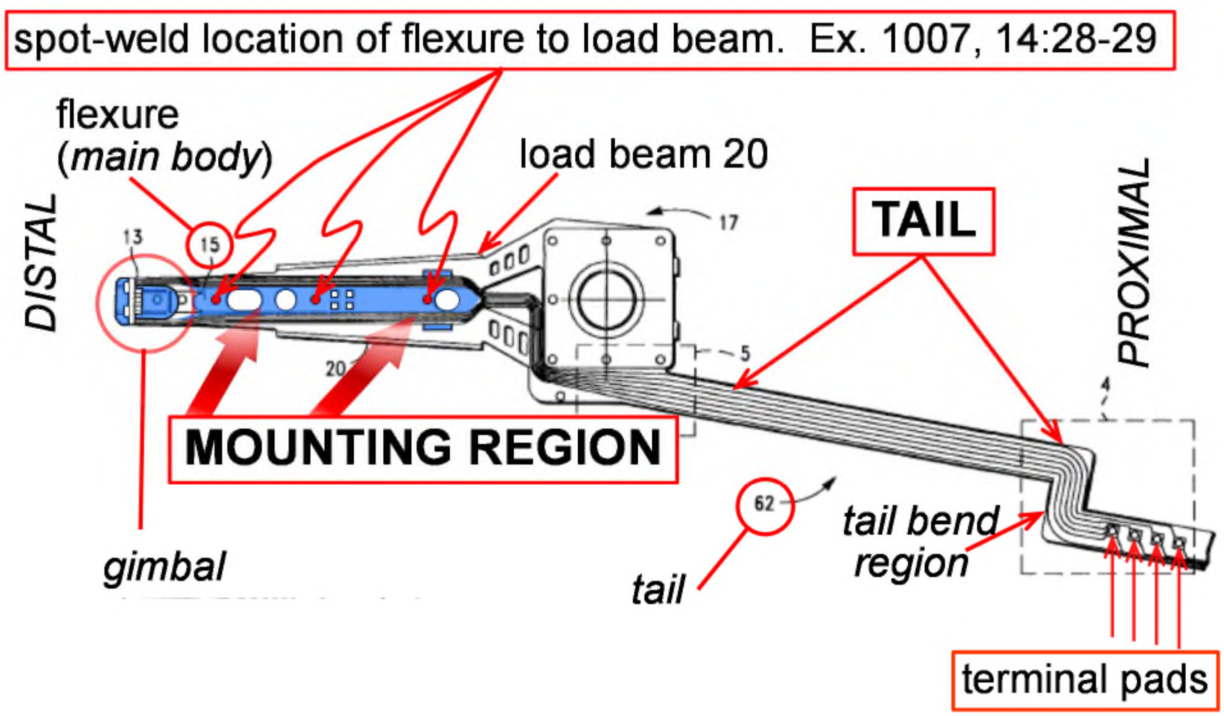
Ex. 1003, Fig. 3 (annotated)

The interleaved traces in segment 62 extend over nearly the entire tail section, extending at least from the end of the load arm 20 all the way through to the end of the tail section, where short non-interleaved traces 64, 66, 68, 70 connect to the terminal pads as shown in Figs. 3 and 4. Ex. 1003, 7:40-48, Figs. 3, 4.

f. **Wherein the first trace sections extend over substantially all of the tail and mounting region**

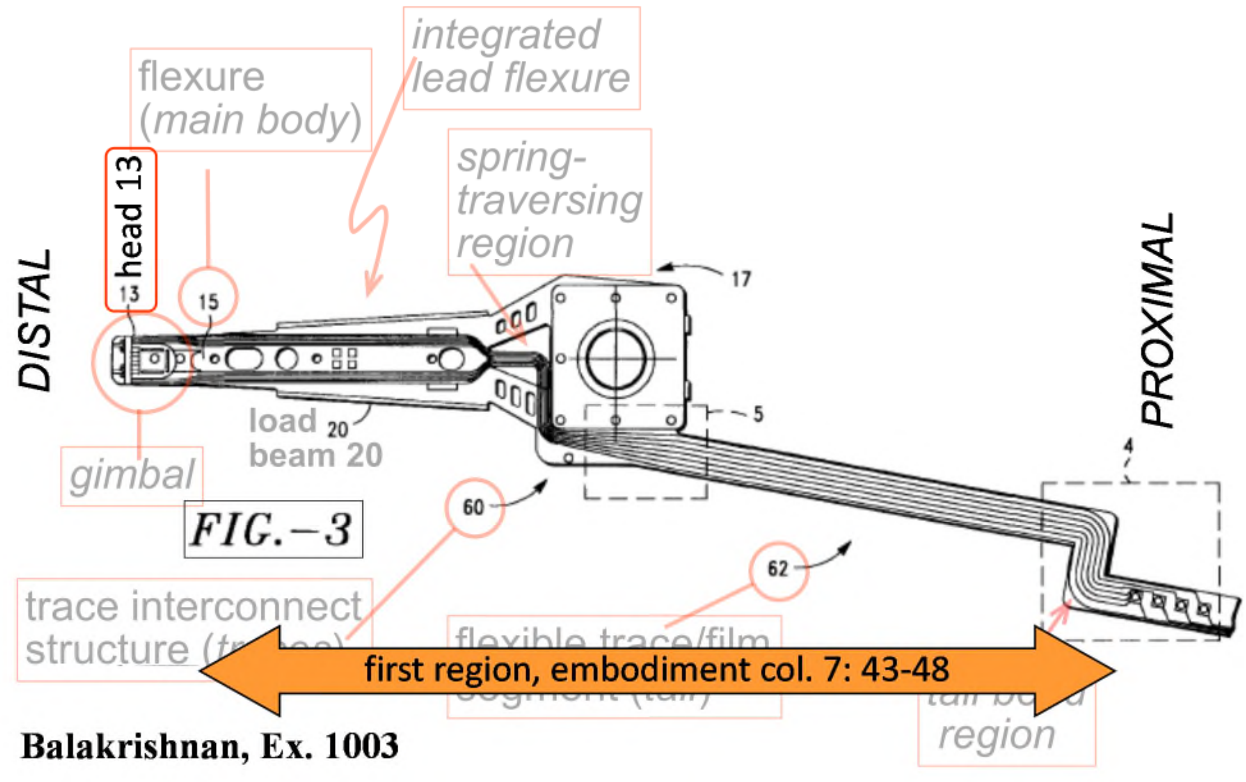
Balakrishnan teaches this limitation. As discussed in Section IV.B.2.e above, the first trace sections shown in Fig. 4 extend over all of the tail portion, other than where the terminal pads are located, and where the short non-interleaved traces 64, 66, 68, 70 connect to the terminal pads. Thus the interleaved portions cover substantially all of the tail. Tarnopolsky, ¶¶54, 81, 89.

Balakrishnan also teaches that the interleaved traces cover substantially all of the mounting region. Balakrishnan teaches that the interleaved conductor traces "may extend for virtually the entire distance between the head 13"—which is located on the gimbal—and the preamplifier 54." Ex. 1003, 7:43-45. This includes the mounting region. Tarnopolsky, ¶¶54, 81, 89.



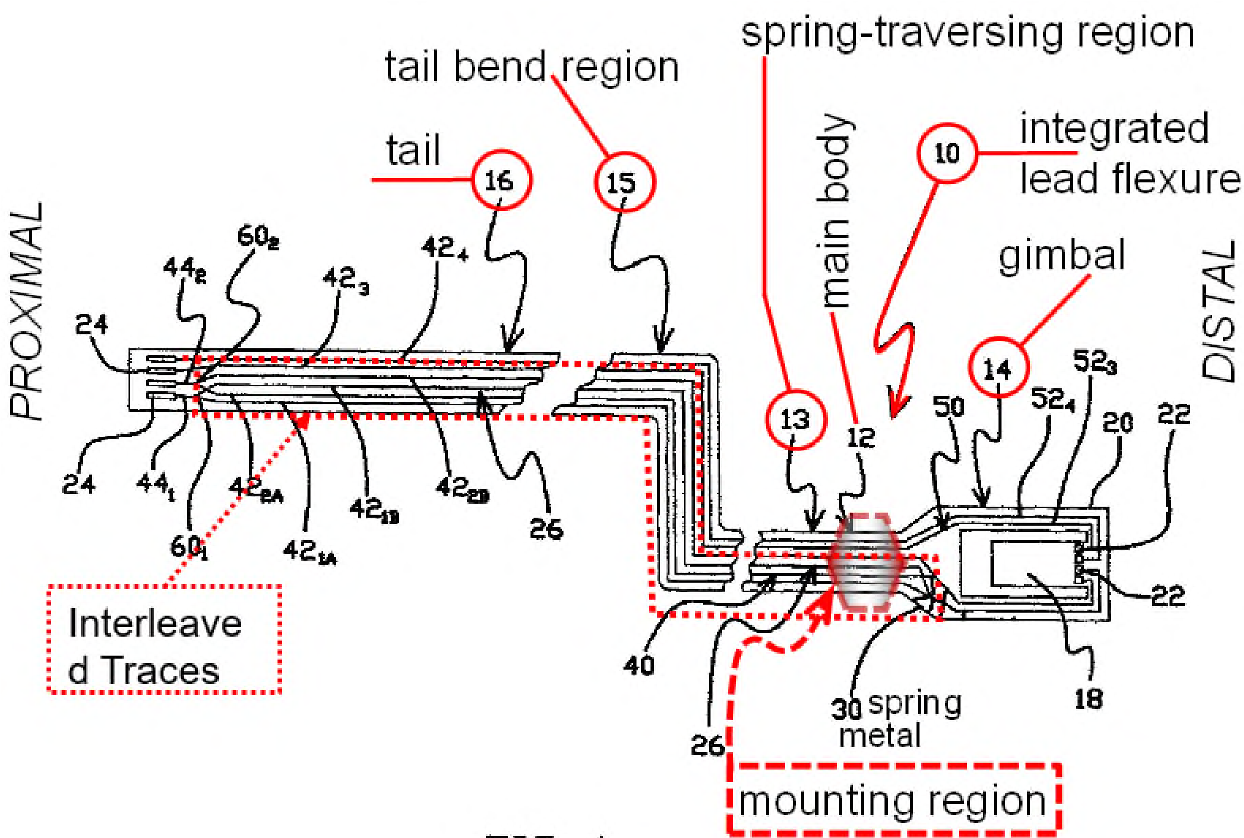
Ex. 1003, Fig. 3(annotated)

As discussed above, the mounting region is the region where the interconnect structure 60 and the flexure 15 are mounted to the load arm 20. *Supra*, section IV.B.2.b. The conductor traces of the interconnect structure 60 extend across this entire region. Thus, when these traces are interleaved in the mounting region, Balakrishnan teaches this limitation.



Ex. 1003, Fig. 3(annotated)

This is the same as what is disclosed in the ’746 patent.

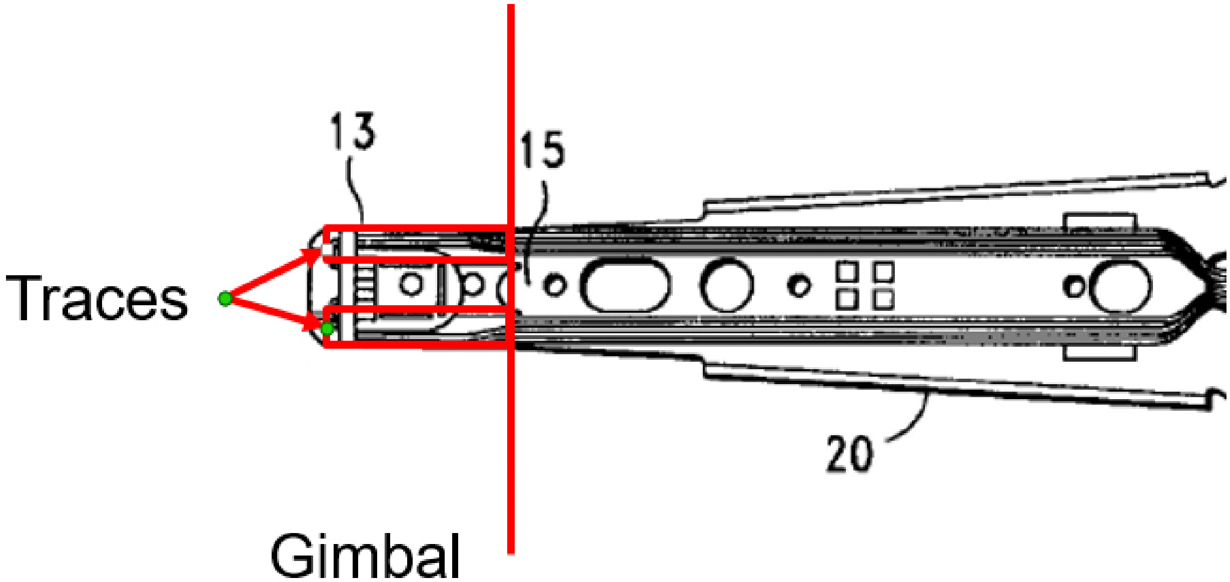


Ex. 1001, Fig. 1 (annotated)

According to Fig. 1 of the '746 patent, the interleaved portions of the traces 42_{1a}, 42_{1b}, 42_{2a} and 42_{2b} extend across the tail portion except for where the pads 24 are located, and where short non-interleaved segments 44_1, 44_2 are located. Ex. 1001, 3:26-29. These interleaved portions extend across the entire main body region 12, which as discussed above (Section IV.B.2.b) is where the '746 patent's flexure is mounted to the load beam. Indeed, because only two of the four traces between the gimbal and the tail are interleaved (the other two are single traces, *Id.*, 3:22-24), the interleaved traces of Balakrishnan actually cover more of the tail and mounting regions than do those of the ’746 patent.

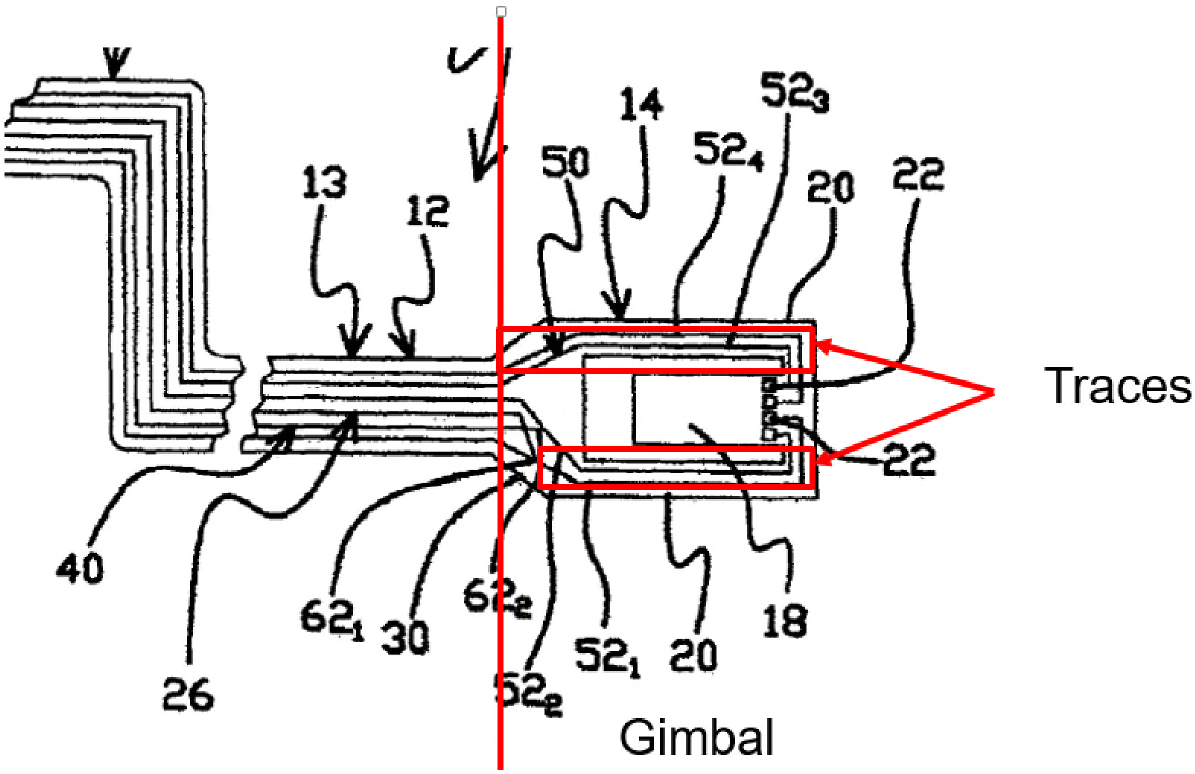
g. Second trace sections having a second structural configuration different than the first structural configuration electrically connected to the bond pads and extending over at least a portion of the gimbal, wherein the second trace sections extend over substantially all of the gimbal

As discussed above in Section IV.B.1.c, the second trace sections in Balakrishnan are the non-interleaved, ground plane sections of interconnect structure 60 on flexure 15 (second structural configuration). These non-interleaved sections are electrically connected to the head, because the second trace sections are part of the signal pathway between the recording head and the preamplifier/write driver 54. Ex. 1003, 4:34-40; 7:18-24, Fig. 3. This is how the traces connect to the head 13, to connect “[the] read preamplifier/write driver circuit to read and write elements of the magnetic recording head 12 [sic:13]”. *Id*., 7:14-24, 7:40-43. As discussed in section IV.B.2.c above, the second trace sections are connected to the connection pad array 22 shown in the incorporated Williams reference.



Ex. 1003, Fig. 3 (excerpted and annotated)

As shown in Fig. 3, the non-interleaved traces in interconnect structure 60 (red boxes) extend over nearly the entire gimbal section (left of the vertical red line), other than the place where the slider is attached. Ex. 1003, Figs. 2, 3, 6:60-63; Tarnopolsky, ¶92. This is the same as what is disclosed in the ’746 patent.



Ex. 1001, Fig. 1 (excerpted and annotated)

According to Fig. 1 of the ’746 patent, the non-interleaved portions of the traces 50 (52_1,52_2, 52_3, 52_4) extend across all of the gimbal portion except for the slider mounting portion 18, where the read/write head is mounted. Ex. 1001, Fig. 1, 3:24-26, 3:36-38.

h. **Transition structures electrically connecting the first trace sections to the second trace sections, wherein the transition structures directly electrically connect the first and second trace sections**

Balakrishnan teaches this limitation. As disclosed in the ’746 patent, a transition structure can be as simple as a single trace branching into two parallel traces, to make space for an interleaved trace to be placed between them. This is shown, for example, by transition structure 62_2 below.

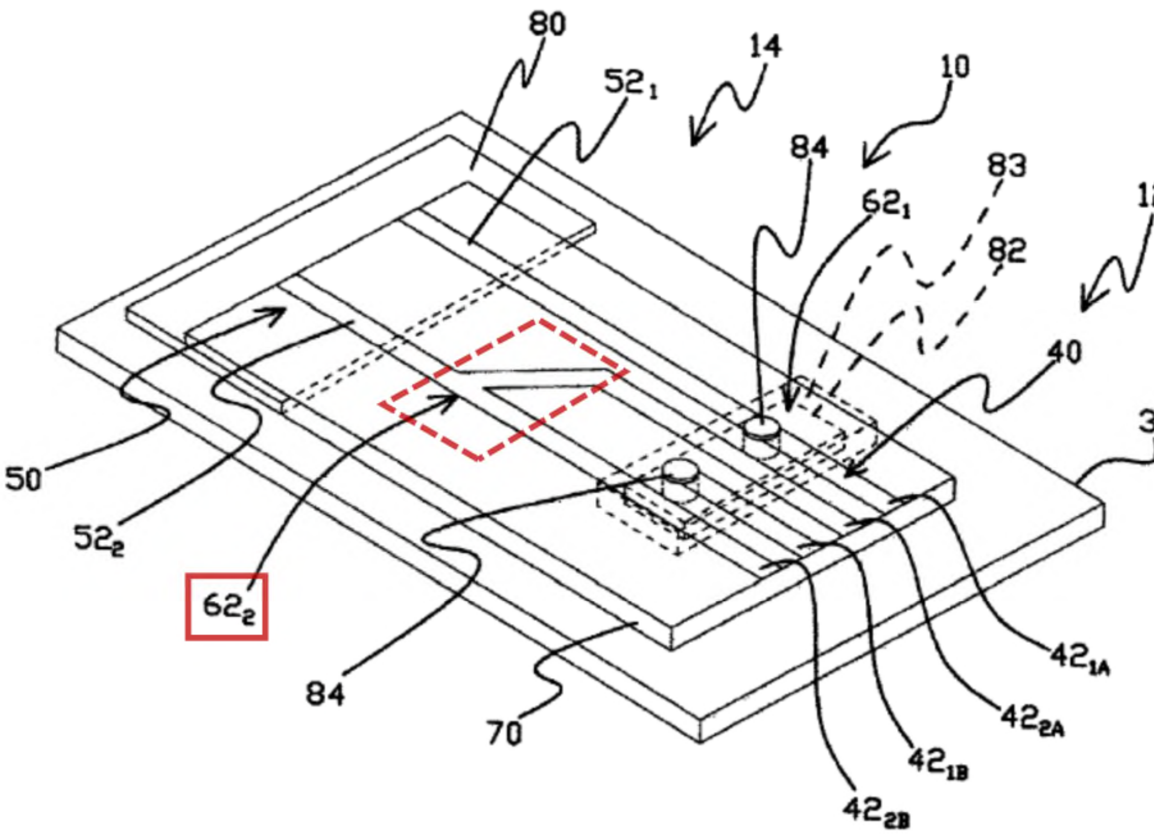
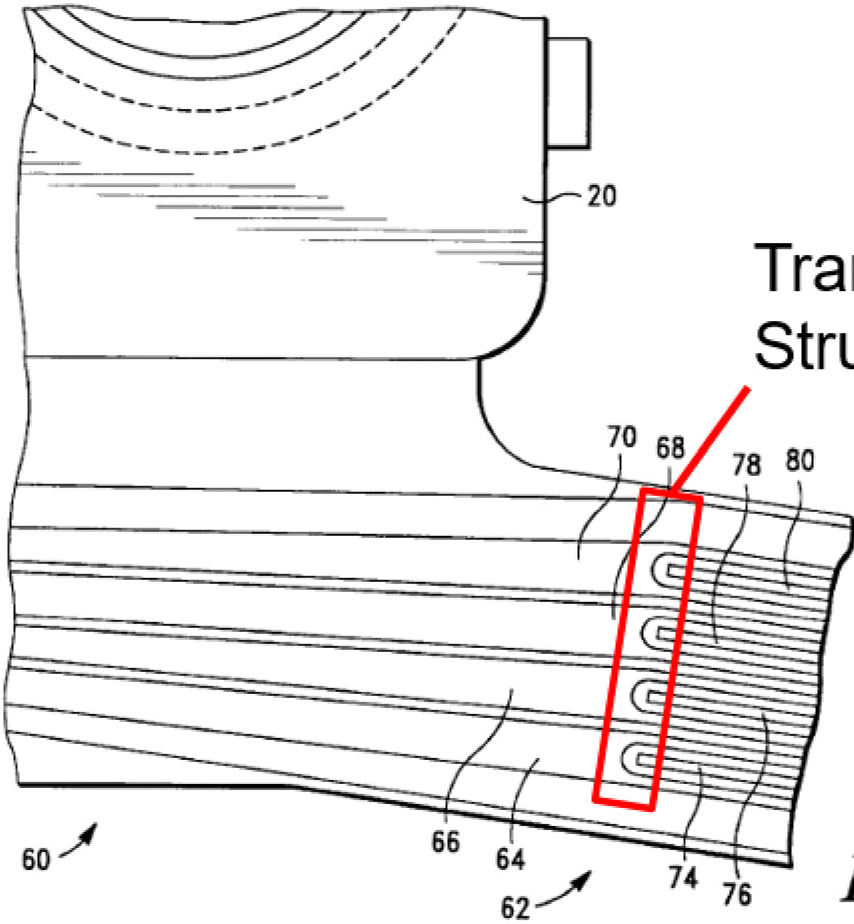


FIG. 4

Ex. 1001, Fig. 4 (annotated)

As the '746 patent states, "transition structure 62_2 is an intersection of the interleaved traces 42_{2A} and 42_{2B}." *Id.*, 4:53-54. This intersection allows the interleaved trace 42_{1B} to be placed between the traces 42_{2A} and 42_{2B}. Balakrishnan teaches the exact same transition structures. Tarnopolsky, ¶¶93-95.



Ex. 1003, Fig. 5 (annotated)

As shown in detail in Fig. 5 of Balakrishnan, the interconnect structure 60 includes the interleaved first trace sections, at the right-hand side of Fig. 5. The interconnect structure 60 also includes the non-interleaved second trace sections, at the left-hand side of Fig. 5. For each trace 64, 66, 68, 70, the trace branches into two traces with an interleaved trace between it, and the interleaved section is directly electrically connected to the non-interleaved section. Ex. 1003, Fig. 5, 7:53-61; Tarnopolsky, ¶96.

i. **Wherein the first trace sections have a first structural configuration from the set including interleaved traces, stacked traces and ground plane traces**

Balakrishnan teaches interleaved traces. *Supra,* sections IV.B.1.b and IV.B.1.e; Tarnopolsky, ¶99.

j. **The second trace sections have a second structural configuration from the set including interleaved traces, stacked traces and ground plane traces.**

Balakrishnan teaches ground plane traces. *Supra,* section IV.B.1.f; Tarnopolsky, ¶101.

C. Ground 2: Claims 7 and 11 are obvious over Balakrishnan in view of Young.

Claims 7 and 11 of the ’746 Patent are directed to an integrated lead head suspension flexure, containing electrical traces in two sections, where the traces in one section are interleaved and the traces in the other section are ground plane traces. Balakrishnan in view of Young renders claims 7 and 11 obvious. Balakrishnan teaches the claimed flexure, with electromagnetically-coupled, conductive, interleaved traces. Young teaches interleaved traces that are all also two-terminal traces. Tarnopolsky, ¶¶71-74, 97-100.

1. <u>Claim 7</u>

a. **“An integrated lead head suspension flexure having a plurality of regions including a tail and a gimbal, including:”**

Balakrishnan teaches this limitation. *Supra,* section IV.B.1.a,

b. **"First trace sections having a first structural configuration on a first region of the flexure"**

Balakrishnan teaches this limitation. *Supra,* section IV.B.1.b,

c. **"Second trace sections having a second structural configuration different than the first configuration on a second region of the flexure"**

Balakrishnan teaches this limitation. *Supra,* section IV.B.1.c.

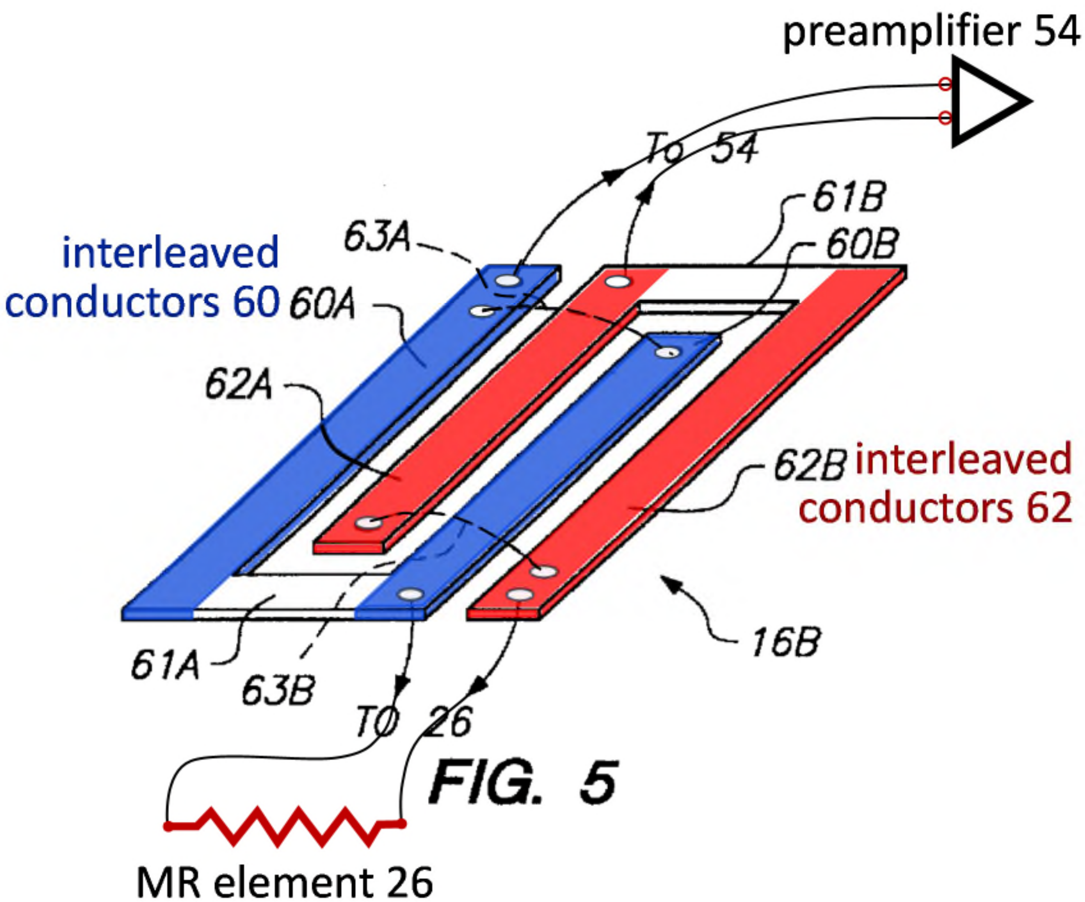
d. **"The second trace sections electrically connected to the first trace sections"**

Balakrishnan teaches this limitation. *Supra,* section IV.B.1.d.

e. **"Wherein the first trace sections include interleaved traces"**

As discussed above, Balakrishnan teaches this limitation. *Supra,* section IV.B.1.e. In the event that the Board determines that the term "interleaved traces" is limited to requiring that all of the interleaved traces must be two terminal traces, then Balakrishnan does not teach such traces. However, Balakrishnan in view of Young renders this limitation obvious. Tarnopolsky, ¶¶73-74. In particular, Young teaches "[a]n integrated transmission line array of multiple interleaved trace conductors symmetrically formed in a single plane for electrically interconnecting a read element or a write element of a dual element read/write head to a preamplifier circuit in a disk drive." Ex. 1004, Abstract.

Young teaches the use of interleaved two-terminal traces. *Id.*, 6:39-47, Fig. 5; Tarnopolsky, ¶¶75-77.



Ex. 1004, Fig. 5 (annotated)

The interleaved traces include trace pairs 60A-60B (blue), and 62A-62B (red). Each trace pair is electrically connected to the magneto-resistive (MR) read/write element 26 at the head end of Young's load beam assembly 10, and to the preamplifier 54 at the other end of the load beam assembly 10. *Id*., 6:39-47, 6:22-23 (discussing the connections for traces 60, 62 of interconnect structure 16A of Fig. 4), 5:52-58 (same for traces 60, 62 of interconnect structure 16 of Fig. 2.). Trace pair 60A-60B are connected together at the MR element 26 end (i.e. the distal end) by a bridge 61A, and at the preamplifier 54 end (i.e. the proximal end) by a bridging path 63A. *Id*., 6:43-45. Trace pair 62A-62-B are connected together at the MR element 26 end by a bridging path 63B, and at the preamplifier 54 end by a trace bridge 61B. *Id*., 6:45-47. The bridging paths 63A, 63B can be formed using transverse traces on a separate dielectric layer, connected to the trace array 16B by vias or wires. *Id*., 6:48-51. These bridging paths and bridges provide the electrical connections between the first and second trace sections, where Young's interleaved trace array is used in Balakrishnan's suspension flexure. Tarnopolsky ¶76-77. Thus, Young supplies the specific teaching of an interleaved trace array where all of the traces are active traces carrying signals to or from the read/write head.

f. **"The second trace sections include ground plane traces"**

Balakrishnan teaches this limitation. *Supra*, section IV.B.1.f.

2. <u>Claim 11</u>

a. **"An integrated lead head suspension flexure"**

Balakrishnan teaches this limitation. *Supra*, section IV.B.2.a.

b. **"A mounting region"**

Balakrishnan teaches this limitation. *Supra*, section IV.B.2.b.

c. **A gimbal extending distally from the mounting region and having bond pads**

Balakrishnan discloses a gimbal extending distally from the mounting region and having bond pads. *Supra*, section IV.B.2.c. Young also teaches the use of bond pads to connect traces to the read/write head.

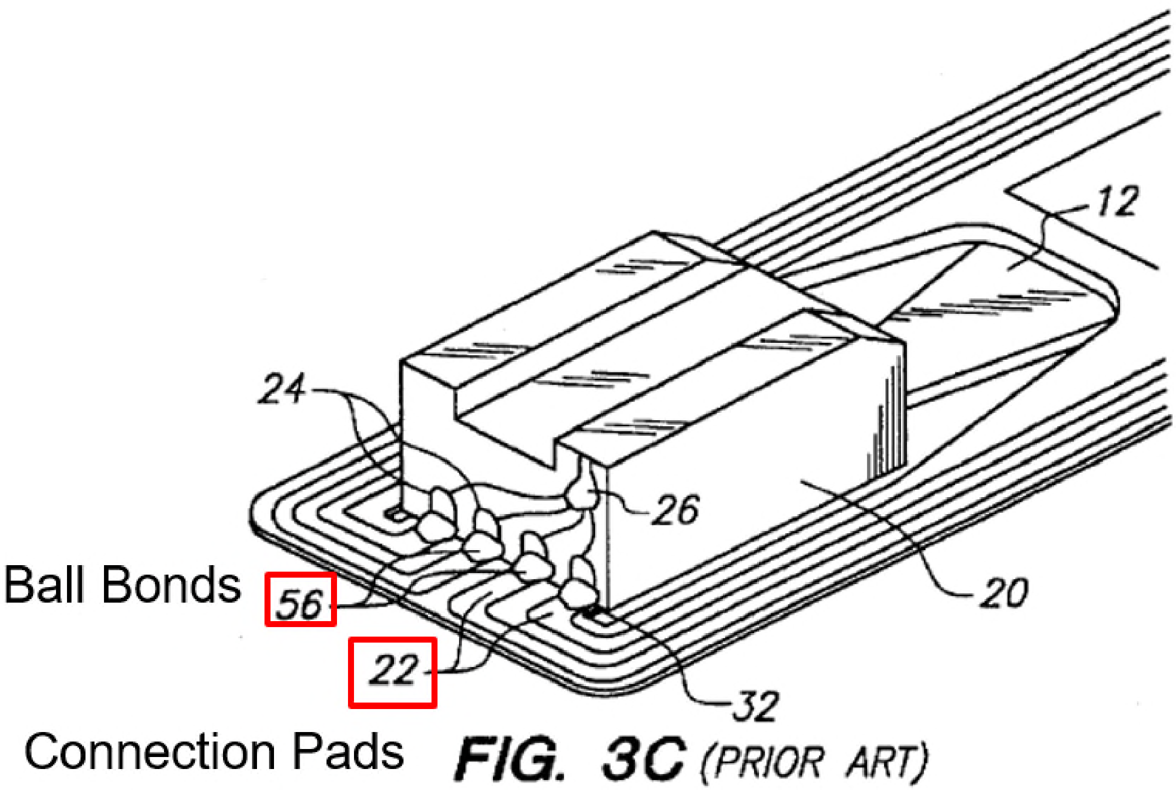


FIG. 3C (PRIOR ART)

Ex. 1004, Fig. 3C (annotated)

With reference to Fig. 3C, Young teaches that the electrical connections between the traces in the trace array on the flexure and the slider 20 include connection pads 22 (i.e. bond pads). These "connection pads 22 at the distal end 18 are provided for connection by e.g. ultrasonically-welded gold ball bonds 56 to four aligned connection pads 24 of a dual-element (four conductor) thin film magneto-resistive read/write structure 26." Ex. 1004, 5:60-65. Thus, Balakrishnan in view of Young teaches this limitation. Tarnopolsky, ¶¶87-88.

d. **A tail extending proximally from the mounting region and having terminal pads**

Balakrishnan teaches this limitation. *Supra*, section IV.B.2.d.

e. **First trace sections having a first structural configuration electrically connected to the terminal pads and extending over at least a portion of the tail**

Balakrishnan teaches this limitation. *Supra,* section IV.B.2.e.

f. **Wherein the first trace sections extend over substantially all of the tail and mounting region**

Balakrishnan teaches this limitation. *Supra,* section IV.B.2.f.

g. **Second trace sections having a second structural configuration different than the first structural configuration electrically connected to the bond pads and extending over at least a portion of the gimbal, wherein the second trace sections extend over substantially all of the gimbal**

As discussed above in Section IV.B.2.g, the second trace sections in Balakrishnan are the non-interleaved, ground plane sections of interconnect structure 60 on flexure 15 (second structural configuration), that extend over all of the gimbal portion, other than the portion where the head 13 is attached, and connect to the bond pads. This is the same configuration as used in the '746 Patent. Ex. 1001, 3:24-26, 3:36-38. In combination with Young, these trace sections would be connected to the slider in the head region 13 via Young's bond pads 22. *Supra*, section IV.C.2.c, Tarnopolsky, ¶¶87-88.

h. Transition structures electrically connecting the first trace sections to the second trace sections, wherein the transition structures directly electrically connect the first and second trace sections

Balakrishnan (*supra*, section IV.B.2.h) and Young teach this limitation. As explained above, Balakrishnan teaches a "transition structure[]" for "connecting" "first trace section[]" of interleaved traces to "second trace section[]" of ground plane traces. (*Supra*, section IV.B.2.h.) One of ordinary skill in the art would recognize that a similar transition structure would be used with Young's interleaved traces. In particular, Young teaches transition structures for connecting its interleaved trace pairs 60A-60B and 62A-62B to the non-interleaved traces at either end of the interleaved section. Trace pair 60A-60B are connected together at the MR element 26 end (i.e. the head end) by a bridge 61A, and at the preamplifier 54 end by a bridging path 63A. Ex. 1004, 6:43-45. Trace pair 62A-62B are connected together at the MR element 26 end by a bridging path 63B, and at the preamplifier 54 end by a trace bridge 61B. *Id*., 6:45-47. The bridging paths 63A, 63B can be formed using transverse traces on a separate dielectric layer, connected to the trace array 16B by vias or wires. *Id*., 6:48-51. These bridging paths and bridges allow for the direct electrical connections between the first and second trace sections, where Young's interleaved trace array is used in Balakrishnan's flexure. Tarnopolsky ¶¶97-98, 100.

i. Wherein the first trace sections have a first structural configuration from the set including interleaved traces, stacked traces and ground plane traces

Balakrishnan teaches that the first trace sections have an interleaved trace configuration. *Supra*, sections IV.B.1.b and IV.B.1.e. Young further teaches these interleaved traces are all two-terminal traces. *Supra*, IV.C.1.e. In a combination of Balakrishnan with Young, Young's interleaved traces would connect to Balakrishnan's non-interleaved traces (64, 66, 68, 70) at the same points as indicated in Balakrishnan. Tarnopolsky , ¶¶99-100.

j. The second trace sections have a second structural configuration from the set including interleaved traces, stacked traces and ground plane traces.

Balakrishnan teaches that the second trace sections are ground plane traces. *Supra*, section IV.B.1.f.

3. It Would Have Been Obvious To Combine the Teachings of Balakrishnan and Young

As of the '746 Patent's filing date, it would have been obvious to a POSITA to modify Balakrishnan to include Young's interleaved traces, transition structures and bond pads, to arrive, with a reasonable expectation of success, at the subject matter of claims 7 and 11. Tarnopolsky, ¶¶102-110.

A POSITA would have known of Balakrishnan and Young and been strongly motived to consider both references, since Balakrishnan cites to and incorporates Young by reference. Tarnopolsky, ¶¶105, 109. Indeed, Balakrishnan and Young both teach the same physical device (an interconnect array in a flexure for a hard drive), and share the same object of improving said array. Thus, these references are in the same field of endeavor as the ’746 patent. Tarnopolsky, ¶¶102-103.

A POSITA would have further been aware that both Balakrishnan and Young address the desirability of tuning the electrical characteristics of the array. Ex. 1003, 4:1-6; Ex. 1004, 2:49-58. Balakrishnan teaches that there are different ways to accomplish this improvement, including using interleaved trace conductor arrays or stacked trace conductor arrays. Ex. 1003, 3:11-38. Indeed, Balakrishnan expressly identifies Young as a known solution to the problem of improving the electrical characteristics of a trace conductor array in a hard drive. *Id.*

Balakrishnan further teaches that it is desireable to interleave the traces further along the flexure in the distal direction towards the head. Ex. 1003, 7:40-48. Because all of the conductors in Young are two-terminal, the interconnect trace array can be made narrower, and thus interleaving can fit on the narrower portions of the flexure. Tarnopolsky ¶106. A POSITA would appreciate that this savings in space would, in appropriate circumstances, justify any tradeoff in increased capacitance and manufacturing complexity. Tarnopolsky, ¶107. Furthermore, a POSITA would have considered swapping Balakrishnan's interleaved array for Young's array to be a routine design choice. *Id.*

Using Young's active interleaved trace conductor array and transition structures in place of Balakrishnan's passive trace conductor array would have been successful. Tarnopolsky ¶¶71, 78, 106, 109-110. First, Balakrishnan expressly teaches that Young's array is suitable to reduce inductance in a hard disk flexure. Ex. 1003, 3:11-25. Second, Young also teaches that its array reduces both impedance and inductance. Ex. 1004, 7:7-15. Third, both Balakrishnan and Young teach that an interleaved section of a trace conductor array can easily be electrically connected in between the other elements of the current path. Tarnopolsky, ¶¶96, 97, 106, 108. Balakrishnan teaches the use of transition structures to connect a non-interleaved (i.e. ground plane) section to the interleaved section. Ex. 1003, Figs. 4 & 5. Young also teaches the use of transition structures, including simple trace intersections as well as bridges, vias or wires, to connect its interleaved section to the non-interleaved portions of the current path, including the ground plane traces shown in Fig. 3C of Young. Ex. 1004, 6:39-53, Fig. 5.

Finally, a POSITA reviewing Balakrishnan would have recognized that Balakrishnan's trace conductor array was connected to the read/write head, because Balakrishnan expressly teaches this. Ex. 1003, 4:12-16; 6:60-63. A

POSITA would have further recognized that Young expressly teaches that the trace conductor array electrical connection to the read/write head can be made using, among other structures, connection pads and gold ball bonds (i.e. bond pads). Indeed, both of these teachings are contained with the four corners of Balakrishnan, since the entirety of Young is incorporated by reference into Balakrishnan. Ex. 1003, 3:16-21. Thus, it would have been quite straightforward for a POSITA to implement the connection taught by Balakrishnan between the trace conductor array and the read/write head, using the connection pads and gold ball bonds taught by Young. Tarnopolsky, ¶¶87-88. There would have been every expectation that this would be successful, since Young and Balakrishnan are both connecting the exact same types of components together. Tarnopolsky ¶¶109-110, 181.

D. Ground 3: Claims 8 and 11 are obvious over Balakrishnan in view of Balakrishnan ’152 and Young

1. <u>Claim 8</u>

Claim 8 of the ’746 Patent is identical to claim 7, except that it recites “wherein the first trace sections include stacked traces” (instead of interleaved traces). As discussed above, Balakrishnan teaches such a flexure, except that Balakrishnan uses interleaved traces, not stacked traces. Balakrishnan ’152 teaches the use of stacked traces in a flexure for a disk drive. Ex. 1005, 8:7-27, Figs. 3, 3B. Young teaches the use of transverse traces formed on a separate dielectric layer and vias for transitioning a superior trace to an inferior (e.g. ground-plane) traces. Ex. 1004, 6:48-51, Fig. 5; Tarnopolsky, ¶122. Thus it would have been obvious to replace Balakrishnan's interleaved traces with Balakrishnan '152's stacked traces and Young's transition structures. Tarnopolsky, ¶111.

a. **"An integrated lead head suspension flexure having a plurality of regions including a tail and a gimbal, including:"**

Balakrishnan teaches this limitation. *Supra*, section IV.B.1.a.

b. **"First trace sections having a first structural configuration on a first region of the flexure"**

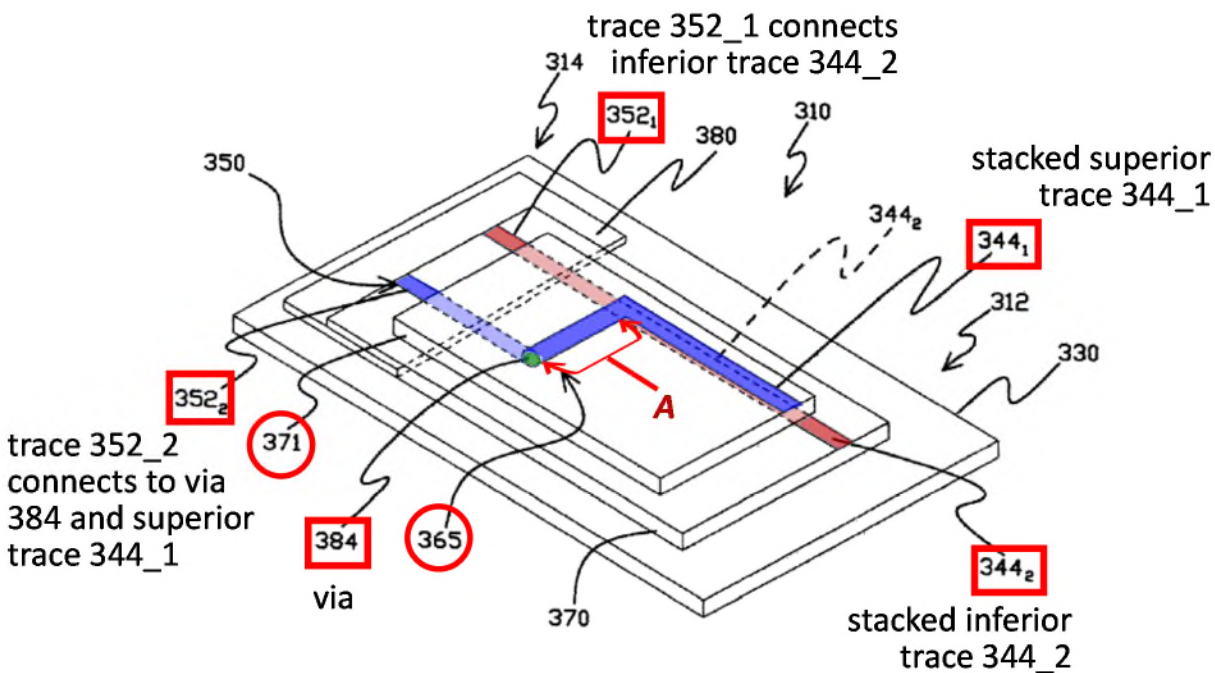
Balakrishnan in view of Balakrishnan '152 renders this limitation obvious. *Supra*, section IV.B.1.b (Balakrishnan's teachings). As discussed in further detail below (Section IV.D.1.e), it would have been obvious to replace the interleaved traces of Balakrishnan with the stacked traces of Balakrishnan '152. This stacked structure is the claimed "first structural configuration."

c. **"Second trace sections having a second structural configuration different than the first configuration on a second region of the flexure"**

Balakrishnan teaches this limitation. *Supra*, section IV.B.1.c.

d. **"The second trace sections electrically connected to the first trace sections"**

As discussed in Section IV.B.1.d above, Balakrishnan teaches that the second trace sections are electrically connected to the first trace sections. In the combination of Balakrishnan in view of Balakrishnan '152 and Young, where the interleaved first trace sections are replaced with stacked first trace sections, for each trace 64, 66, 68, 70, the stacked superior traces would be directly connected to the ground plane traces, using Young's transverse traces and vias. Tarnopolsky, ¶122. Young teaches that a superior trace (e.g. the transverse trace) is connected to an inferior trace (e.g. the ground plane trace) using a via. Ex. 1004, 6:48-51, Fig. 5; Tarnopolsky, ¶¶97, 122. Young's teachings correspond directly to one of the embodiments of a "transition structure" in the '746 patent, for stacked traces:



Ex. 1001 FIG. 9

Ex. 1001, Fig. 9 (annotated).

The correspondence of Young's disclosure and the '746 patent appears in the table below.

'746 patent Ex. 1001, 9:27-44	Young Ex 1004, 6:47-51

transition structure 365	"second bridging path" (6:47)
insulating layer 371	"separate dielectric layer" (6:49)
conductive via 384 extending through the insulating layer 371[3]	"connected … by vias" (6:50)
element annotated "*A*"	"transverse trace[s] formed on a separate dielectric layer" (6:48:49)

Thus Balakrishnan in view of Balakrishnan '152 and Young teaches this limitation.

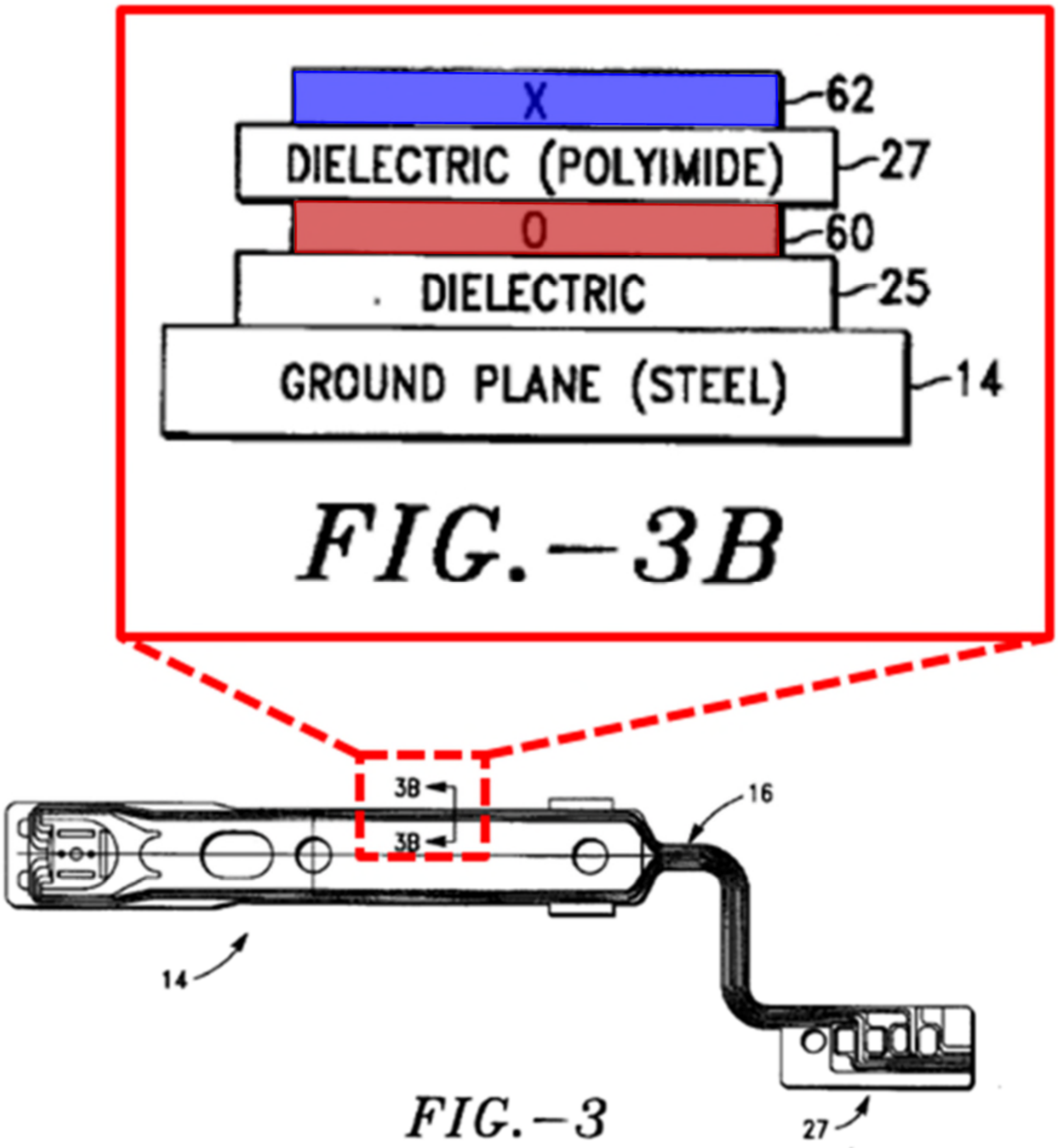
e. **"Wherein the first trace sections include stacked traces"**

Balakrishnan in view of Balakrishnan '152 renders this limitation obvious. Balakrishnan teaches that the first trace sections, as discussed above in section IV.B.1.b, include interleaved traces. Ex. 1003, 3:65-4:6. As discussed above, the first trace sections in Balakrishnan are the sections in segment 62. *See supra,* Section IV.B.1.b. Figs. 4 and 5 depict the two ends of the segment 62, showing the details of the interleaved and non-interleaved trace sections. Tarnopolsky, ¶116.

While Balakrishnan teaches that stacked traces can be used in a hard drive flexure (Ex. 1003, 3:30-38), the traces depicted in Balakrishnan's preferred embodiments do not use stacked traces. However, Balakrishnan '152 teaches the

[3] There is an error in the '746 patent at 9:42. The element number is 371, not 370.

use of stacked traces. Tarnopolsky, ¶117. In particular, Balakrishnan ’152 teaches a hard disk drive with a load beam assembly 10 that includes a flexure 14 having a trace interconnect array 16. Ex. 1005, 6:55-62, Fig. 1. This trace interconnect array 16 includes a portion that uses a stacked structure. As shown in Figs. 3 and 3B, the trace interconnect array 16 at the section in Fig. 3 marked by the cut line 3B-3B includes a stacked structure.



Ex. 1005, Figs. 3 and 3B (juxtaposed and annotated)

Fig. 3B shows a pair of conductive traces 60 (red) and 62 (blue), which in this example are the trace pair for the write element in the head structure. Ex. 1005, 8:20-22. The stacked structure includes an insulating polyimide layer 25 on the ground plane 14, a first trace 60 on the polyimide layer, a second polyimide layer 27 on the first trace 60, and a second trace 62 on the second polyimide layer 27. *Id*., 8:10-15. These traces 60, 62 are the stacked traces. Tarnopolsky, ¶¶118-119.

Balakrishnan ’152 further teaches that the stacked structure of Fig. 3B can be improved using the structure of Fig. 8, and that this structure can be used for both the read path and the write path, if desired. Ex. 1005, 9:52-58 (teaching that Balakrishnan ’152’s stacked structures can be used for either the read or the write path), 10:13-16 (teaching that the trace connector array of Fig. 8 can be replicated in any desired number of service loop paths). Thus, Balakrishnan ’152’s stacked traces would be used in the first trace sections in the first region, as claimed. Tarnopolsky ¶¶115, 121, 123.

f. **“The second trace sections include ground plane traces”**

As discussed in Section IV.B.1.f above, Balakrishnan teaches that the second trace sections include ground plane traces. Combining Balakrishnan with Balakrishnan ’152 would not affect the presence of the ground plane traces located at least at the distal end of the flexure. Tarnopolsky ¶¶115, 136. Thus Balakrishnan in view of Balakrishnan ’152 teaches this limitation.

2. **Claim 11**

Claim 11 of the ’746 Patent is directed to an integrated lead head suspension flexure, containing electrical traces in two sections, where the traces in each of the two sections have different structural configurations, either interleaved, stacked or ground plane traces. As discussed above with respect to claim 8, Balakrishnan in view of Balakrishnan ’152 and Young teaches such a flexure, specifically one that uses stacked traces in one section and ground plane traces in the other section. Tarnopolsky, ¶125.

a. **“An integrated lead head suspension flexure”**

Balakrishnan teaches this limitation. *Supra*, section IV.B.1.a.

b. **“A mounting region”**

Balakrishnan teaches this limitation. *Supra*, section IV.C.2.b.

c. **A gimbal extending distally from the mounting region and having bond pads**

Balakrishnan and Young each teaches this limitation. *Supra*, section IV.C.2.c.

d. **A tail extending proximally from the mounting region and having terminal pads**

Balakrishnan teaches this limitation. *Supra*, section IV.C.2.d.

e. **First trace sections having a first structural configuration electrically connected to the terminal pads and extending over at least a portion of the tail**

In Balakrishnan, the first trace sections are the interleaved sections of segment 62, which extend over the tail. *Supra*, section IV.C.2.e. It would have been obvious to replace the interleaved traces of Balakrishnan with the stacked traces of Balakrishnan ’152. *Supra*, sections IV.D.1.b and IV.D.1.e. Thus, Balakrishnan in view of Balakrishnan ’152 teaches this limitation.

f. Wherein the first trace sections extend over substantially all of the tail and mounting region

As discussed in Sections IV.C.2.e and IV.C.2.f above, the interleaved first trace sections of Balakrishnan extend over substantially all of the tail and mounting region. As discussed in Sections IV.D.1.b and IV.D.1.e, it would have been obvious to replace the interleaved traces of Balakrishnan with the stacked traces of Balakrishnan ’152. Thus, the stacked traces of Balakrishnan ’152 would also cover substantially all of the tail and mounting regions. Balakrishnan teaches that the impedance-reducing effect of the traces should be used on as much of the traces as feasible, given other design considerations. Ex. 1003, 7:40-48. Balakrishnan ’152 teaches that the traces on at least the mounting portion of the flexure 14 are stacked. Ex. 1005, Fig. 3 & 3B. The cutline 3B in Fig. 3 shows that at this cutline the traces are stacked. A POSITA reading Balakrishnan and Balakrishnan ’152 would have understood that the traces should be stacked at least over the tail and mounting regions, as shown by these two references. Tarnopolsky ¶¶115, 121, 125. Thus, Balakrishnan in view of Balakrishnan ’152 teaches this limitation.

g. **Second trace sections having a second structural configuration different than the first structural configuration electrically connected to the bond pads and extending over at least a portion of the gimbal, wherein the second trace sections extend over substantially all of the gimbal**

Balakrishnan and Young teach this limitation. *Supra*, Section IV.C.2.g. Swapping Balakrishnan's interleaved traces for Balakrishnan '152's stacked traces would not affect the configuration of Balakrishnan's second trace sections. Tarnopoksly, ¶¶115, 136.

h. **Transition structures electrically connecting the first trace sections to the second trace sections, wherein the transition structures directly electrically connect the first and second trace sections**

As discussed in Sections IV.B.2.h, IV.C.2.h and IV.D.1.d above, Balakrishnan and Young teach the claimed transition structures. As discussed in Sections IV.D.1.b and IV.D.1.e, it would have been obvious to replace the interleaved traces of Balakrishnan with the stacked traces of Balakrishnan '152. Furthermore, Balakrishnan '152 teaches that there is a current path through the traces from the head to the pre-amplifier. Ex. 1005, 4:22-32. This would include both the ground plane section and stacked section. It would have been obvious to use Young's transition structures to implement the same direct electrical connection recited in the '746 patent. Tarnopolsky, ¶¶97, 98, 122. Thus, Balakrishnan in view of Balakrishnan '152 and Young teaches this limitation.

i. **Wherein the first trace sections have a first structural configuration from the set including interleaved traces, stacked traces and ground plane traces**

As discussed in Section IV.B.1.e, Balakrishnan teaches that the first trace sections have an interleaved trace configuration. As discussed in Sections IV.D.1.b and IV.D.1.e, it would have been obvious to replace the interleaved traces of Balakrishnan with the stacked traces of Balakrishnan '152. Tarnopolsky, ¶126. Thus, Balakrishnan in view of Balakrishnan '152 teaches this limitation.

j. **The second trace sections have a second structural configuration from the set including interleaved traces, stacked traces and ground plane traces.**

Balakrishnan teaches that the second trace sections, which are formed on the flexure 15, at least in the areas near the head, are ground plane traces. *Supra*, section IV.B.1.f. Swapping Balakrishnan's interleaved traces for Balakrishnan '152's stacked traces would not affect the configuration of Balakrishnan's second trace sections. Tarnopoksly, ¶115. Thus, Balakrishnan teaches this limitation.

3. It Would Have Been Obvious To Combine the Teachings of Balakrishnan, Young and Balakrishnan '152

As of the '746 Patent's filing date, it would have been obvious to a POSITA to modify Balakrishnan to include Balakrishnan '152's stacked traces and Young's transition structures, to arrive, with a reasonable expectation of success, at the subject matter of claims 8 and 11. Tarnopolsky ¶¶115, 124, 127-136.

A POSITA would have known of Balakrishnan, Young and Balakrishnan ’152, and been strongly motived to consider these references, since Balakrishnan cites to and incorporates both Young and Balakrishnan ’152 by reference. Indeed, these references all teach the same physical device (an interconnect array in a flexure for a hard drive), and share the same object of improving said array. Thus, these references are in the same field of endeavor as the ’746 patent. Tarnopolsky, ¶¶102-103, 115.

A POSITA reviewing Balakrishnan would have recognized that Balakrishnan teaches that it is desirable to control the impedance characteristics of a trace conductor array in a hard drive. Tarnopolsky ¶128. This includes reducing inductance and/or capacitance (Ex. 1003, 2:44-50), and reducing the impedance characteristics of the trace conductor array. *Id*., 4:1-6. Balakrishnan teaches that there are various different ways to accomplish this improvement, including using interleaved or stacked trace conductor arrays. *Id*., 3:10-38. Indeed, Balakrishnan expressly identifies both Young and Balakrishnan ’152 as known solutions to the problem of improving the electrical characteristics of a trace conductor array in a hard drive. *Id*.; Tarnopolsky ¶128.

A POSITA would have appreciated that Balakrishnan ’152’s trace conductor array would improve Balakrishnan’s hard disk flexure, because Balakrishnan ’152’s array, using stacked trace conductors, uses less space across the interconnect trace array. Tarnopolsky, ¶131. This would allow the interconnect trace conductor array to be implemented further along the flexure in the distal direction towards the head, which Balakrishnan teaches is desirable. *Id.* A POSITA would have appreciated that this savings in space would, in appropriate circumstances, justify any potential tradeoff in increased manufacturing complexity. Tarnopolsky, ¶¶129-130. Balakrishnan also teaches that it is desirable to use inductance-reducing traces in the tail region, as well as the mounting region. Ex. 1003, 7:40-67, Figs. 3-5. Balakrishnan ’152 teaches that its stacked traces reduce inductance as well. Ex. 1005, 8:17-61. Thus, a POSITA would have been motivated to use stacked traces in all regions that Balakrishnan teaches using interleaved traces. Indeed, a POSITA would have been aware of the benefits and disadvantages of using interleaved and stacked traces, and the selection of one versus the other would have been merely a simple design choice. Tarnopolsky ¶¶115, 136.

Using Balakrishnan ’152’s stacked trace conductor array in place of Balakrishnan’s interleaved trace conductor array would have been successful. Tarnopolsky ¶¶135-136. First, Balakrishnan expressly teaches that Balakrishnan ’152’s array is suitable to improve electrical characteristics in a hard disk flexure. Ex. 1003, 3:11-25. Second, Balakrishnan ’152 teaches that its array reduces inductance and impedance. Ex. 1005, 8:7-61. Third, Balakrishnan, Young and

Balakrishnan ’152 teach that sections of a trace conductor array, such as Balakrishnan’s interleaved array or Balakrishnan ’152’s stacked array are connected in between the other elements in the current path between the head and the pre-amplifier. Tarnopolsky ¶¶122, 132-134. Young teaches the use of the same transition structures as recited in the ’746 patent to connect a non-interleaved (i.e. ground plane) section to the interleaved section. Tarnopolsky, ¶¶122, 132.

Finally, a POSITA reviewing Balakrishnan would have recognized that Balakrishnan’s trace conductor array was connected to the read/write head, because Balakrishnan expressly taught this. Ex. 1003, 4:12-16; 6:60-63. A POSITA would have further recognized that Young as well as Balakrishnan ’152 both expressly taught that the electrical connection between a trace conductor array and the read/write head can include connection pads and gold ball bonds (i.e. bond pads). Ex. 1004, 5:60-65; Ex. 1005, 7:30-43; Tarnopolsky, ¶¶84, 133-134. Indeed, both of these teachings are contained with the four corners of Balakrishnan, since the entirety of Young and Balakrishnan ’152 is incorporated by reference into Balakrishnan. Ex. 1003, 3:16-38. Thus, it would have been quite straightforward for a POSITA to implement the connection taught by Balakrishnan between the trace conductor array and the read/write head, using the connection pads and gold ball bonds taught by Young or Balakrishnan ’152. Tarnopolsky ¶¶133-134. There would have been every expectation that this would be successful, since Balakrishnan ’152, Young and Balakrishnan are both connecting the exact same types of components together. Tarnopolsky ¶¶109-110, 127, 133, 181.

E. Grounds 4 & 5: Claims 9 and 15 are obvious over Balakrishnan in view of Yuuki (Ground 4) and further in view of Balakrishnan ’152 or Young (Ground 5).

Claims 9 and 15 of the ’746 Patent are directed to an integrated lead head suspension flexure, containing electrical traces in two sections, where the traces in each of the two sections have different structural configurations, and the two sections are impedance matched. Balakrishnan in view of Yuuki (and further in view of Balakrishnan ’152/Young) teaches such a flexure. Balakrishnan teaches a flexure having sections with different structural configurations, and Yuuki teaches that such structures are impedance matched. Balakrishnan, Young and Balakrishnan ’152 teach the use of bond pads to make the connections between the traces and the head. Tarnopolsky, ¶¶137-138.

1. <u>Claim 9</u>

a. **An integrated lead head suspension flexure having a plurality of regions including a tail and a gimbal, including:**

Balakrishnan teaches this limitation. *Supra*, section IV.B.1.a.

b. **first trace sections having a first structural configuration on a first region of the flexure;**

Balakrishnan teaches this limitation. *Supra*, section IV.B.1.b.

c. **second trace sections having a second structural configuration different than the first configuration on a second region of the flexure,**

Balakrishnan teaches this limitation. *Supra*, sections IV.B.1.c & IV.B.1.f.

d. **the second trace sections electrically connected to the first trace sections,**

Balakrishnan teaches this limitation. *Supra*, Section IV.B.1.d.

e. **wherein the first trace sections are substantially impedance matched to the second trace sections;**

Balakrishnan in view of Yuuki teaches that the first trace sections are substantially impedance matched to the second trace sections. Balakrishnan teaches the benefits of tuning impedance values in a trace conductor array, but it does not expressly teach how to do impedance matching. Ex. 1003, 1:5-12, 3:50-55, 3:65-4:6, 6:3-10. However, impedance matching is a broad and well-known concept[4], dating at least as far back as 1949, fifty-nine years prior to the filing date of the ’746 patent. Tarnopolsky, ¶¶143-145. Thus, it would have been obvious to

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[4] A POSITA would understand “impedance matching” to mean “connecting across a source impedance of a matching impedance that allows optimum undistorted energy transfer.” Ex. 1016, IEEE Standard Dictionary of Electrical and Electronic Terms, Second Edition, 1977, adopted as an American National Standard “IEEE Std. 100-1977,” at 319; Tarnopolsky, ¶143.

any POSITA to impedance match any two connected parts of a system to optimize the energy transfer between the two parts, simply based on the basic understanding of electrical circuit theory that any POSITA would have. *Id.* Indeed, as the Examiner noted in the file history of the '746 patent, "Official Notice is given that it was notoriously old and well known in the art to apply impedance matching to parts of an electrical assembly, including electrical connectors." Ex. 1002, at 290 (Nov. 18, 2011 Office Action, at 4). And furthermore, "it would have been obvious to one of ordinary skill in the art at the time the invention was made to have different trace sections of [the cited reference] to be matched in terms of impedance. The motivation would have been: such matching was very well established as having a positive effect on electrical characteristics." *Id.*; Tarnopolsky, ¶147.

One example of this notoriously old and well known impedance matching is provided by Yuuki (Ex. 1006). Yuuki teaches that a transmission line 21 can be constructed of segments each having a different impedance, varying from higher to lower along the length of the transmission line from the output driver to the magnetic recording head. Ex. 1006, ¶¶0053-54. This is exactly what the '746 patent teaches to be the claimed impedance matching. Ex. 1001, 4:64-5:10, 5:48-56; Tarnopolsky, ¶146. As taught by the '746 patent, an architecture in which the impedances are varied from a higher impedance at the output driver (disk drive circuity) to a lower impedance at the recording head (read/write head), yields trace sections that are "impedance matched and configured so their impedances continuously vary" from higher to lower impedance. Ex. 1001, 5:4-6 (emphasis added).

In Yuuki, with reference to Fig. 5B below, the impedances are varied by varying the width or thickness of the wiring traces, or the thickness of the dielectric layer beneath the wiring traces. Ex. 1006, ¶¶0072, 0073, 0076, Fig. 5B. This is the exact same way that the '746 patent teaches to implement impedance matching between the driver (preamplifier) and the recording head (write head). Ex. 1001, 4:64-5:10; Tarnopolsky, ¶150.

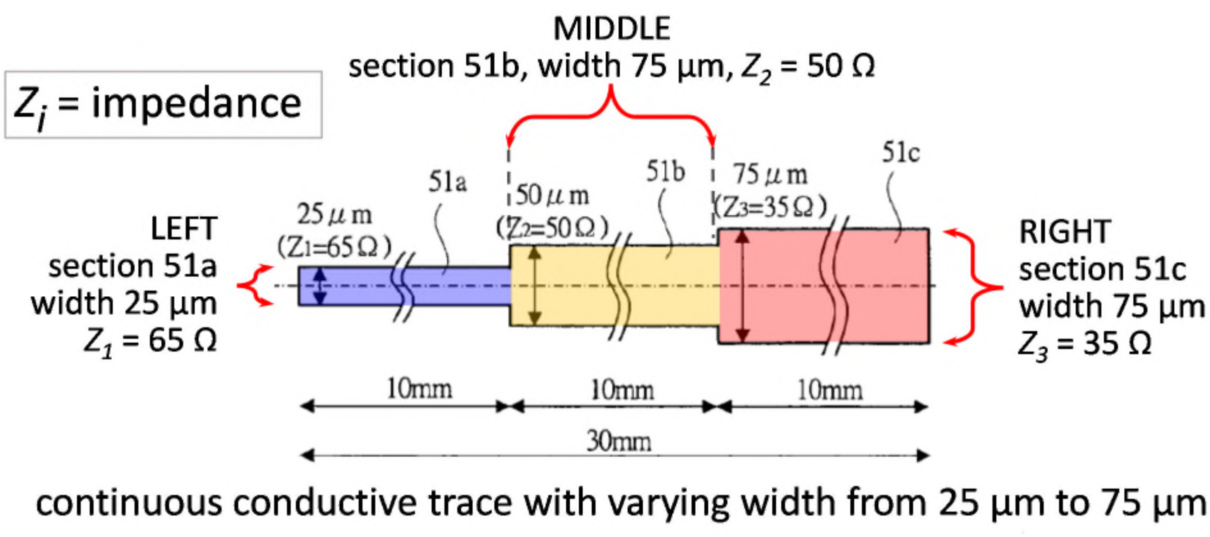


FIG. 5B

Ex. 1006, Fig. 5B (annotated)

In Yuuki, the first trace sections include sections 51a (blue), and the second traces include sections 51c (red). Ex. 1006, Fig. 5B. Section 51b (yellow) would be included in either the first or second section, as appropriate. Tarnopolsky, ¶151. Yuuki teaches that its wiring traces can include any number of divisions with different impedances, in order to impedance match the output driver to the recording head. *Id.*, ¶0077 (showing results from tests using two, three, six and sixteen divisions). Once the changes in impedance between the divisions became sufficiently small, the transmission line would implement a continuously varying impedance. Tarnopolsky, ¶151. Where there are more than two divisions, then the first trace sections would include the divisions having higher impedances, and the second trace sections would include the divisions having lower impedances, or vice versa. Thus, Yuuki teaches this limitation.

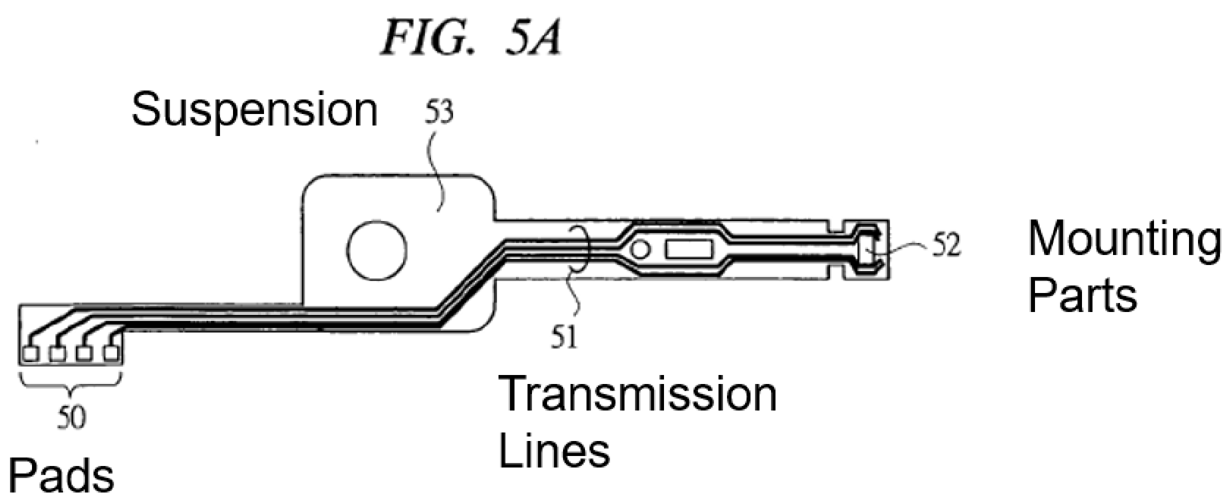
f. **bond pads on the gimbal having a first impedance; and**

Balakrishnan teaches a gimbal. *Supra*, section IV.B.1.a. Yuuki also teaches a gimbal, and that the transmission lines are connected to the head on the gimbal. With reference to Fig. 5A of Yuuki, the gimbal is the small square portion of the suspension 53 located at the recording head end, with the magnetic head mounting parts 52. Ex. 1006, Fig. 5A; Tarnopolsky, ¶¶152-153. The magnetic head mounting parts 52 include connection points, where the recording head is electrically connected to the suspension 53. *Id.* As taught by Yuuki, "the other ends [of the transmission lines 51] are respectively connected to magnetic head mounting parts 52" and "the magnetic head 12 is mounted and connected to each of the magnetic head mounting parts 52." Ex. 1006, ¶0068.

Balakrishnan teaches that the gimbal includes bond pads. *Supra*, section IV.B.2.c. Additionally, Young (Section IV.C.2.c) and Balakrishnan '152 (Section IV.D.2.c) each expressly disclose the use of bond pads on the gimbal for connecting the transmission lines to the head. These bond pads have a first impedance. A POSITA would have understood that every electrically-conductive construct has an impedance, and that this impedance is based on the particular structure of the construct. Tarnopolsky, ¶¶144, 154. Furthermore, a POSITA would have understood that these bond pads, when used with Yuuki's impedance-matching transmission lines, would have an impedance that substantially matches the impedance of the magnetic head 12, in order to reduce or eliminate any undesirable electrical effects from an impedance mismatch between the bond pads and the magnetic head 12. Tarnopolsky, ¶155. Yuuki teaches that the recording head 12 has a characteristic impedance of about 6 Ω. Ex. 1006, ¶0077. Thus, the first impedance for these bond pads would be about 6Ω. Tarnopolsky, ¶156.

g. **terminal pads on the tail having a second impedance that is different than the first impedance, and**

As discussed in Section IV.C.2.d, Balakrishnan teaches terminal pads on the tail. Yuuki also teaches terminal pads on the tail having a second impedance.



Ex. 1006, Fig. 5A (annotated)

Yuuki's suspension 53 and Balakrishnan's suspension assembly have the same essential components. Ex. 1006, ¶0068, Fig. 5A; Ex. 1003, Figs. 2-3. Yuuki's pads 50 electrically connect the read/write IC 10 to the suspension 53. Ex. 1006, ¶0068 ("the transmission lines 51 … are respectively connected to pads 50" and "[t]he read/write IC 10 is connected to the pads 50."); Tarnopolsky, ¶¶157-158.

The terminal pads of Balakrishnan and Yuuki have a second impedance, which is different than the first impedance (of the bond pads). A POSITA would have understood that every electrically-conductive construct has an impedance, and that this impedance is based on the particular structure of the construct.

Tarnopolsky, ¶¶144, 154, 159. Thus, two structures that are different shapes or sizes will have different impedances. *Id.* Furthermore, a POSITA would have understood that Balakrishnan and Yuuki's terminal pads would be designed to have an impedance that substantially matched the impedance of the output driver 10a, in order to reduce or eliminate any undesirable electrical effects from an impedance mismatch between the output driver 10a and the terminal pads. Ex. 1006, ¶0007; Tarnopolsky ¶160. Yuuki teaches that the output driver 10a has a characteristic impedance of about 65 Ω. The recording head 12, on the other hand, has a characteristic impedance of about 6 Ω. Ex. 1006, ¶0077. Thus, the first impedance would be about 6Ω and the second impedance would be about 65Ω. Tarnopolsky ¶161.

h. **wherein the first and second trace sections substantially impedance match the first and second impedances.**

Yuuki teaches that the first and second trace sections substantially impedance match the first and second impedances. As explained above, the '746 patent discloses the exact same way of impedance matching that Yuuki teaches. The '746 patent states that the impedance at the terminal pads 24 is about 65Ω. Ex. 1001, 5:7. The impedance at the bond pads 22 is about 15Ω. *Id.*, 5:10. The first and second trace sections of the '746 patent "are <u>impedance matched</u> and configured so their impedances continuously vary" from 65Ω down to 15Ω. Ex. 1001, 5:3-12 (emphasis added); Tarnopolsky, ¶162.

Yuuki teaches the same thing. In Yuuki, the impedance at the pads 50 is about 65Ω, which is substantially the same as the impedance of the output driver 10a. Ex. 1006, ¶¶0007, 0077. The impedance at the magnetic head mounting parts 52 is about 6Ω, which is substantially the same as the impedance of the magnetic head 12. *Id*. The trace sections of Yuuki vary the impedance in the transmission line sections from, for example, 65Ω at the output driver end down to 35Ω at the magnetic head end. *Id.*, ¶0073. Furthermore, a POSITA would have understood that Yuuki's transmission lines were able to vary the impedance down from any desired starting point to any desired ending point. Tarnopolsky, ¶¶163-164. Thus, Yuuki teaches this limitation.

2. <u>Claim 15</u>

a. **15. An integrated lead head suspension flexure including:**

Balakrishnan teaches this limitation. *Supra*, section IV.B.1.a.

b. **a mounting region;**

Balakrishnan teaches this limitation. *Supra*, section IV.C.2.b.

c. **a gimbal extending distally from the mounting region and having bond pads;**

As discussed above in Section IV.C.2.c, Balakrishnan teaches this limitation. Yuuki also teaches this limitation. Section IV.E.1.f. In addition to Balakrishnan, Young (Section IV.C.2.c) and Balakrishnan '152 (Section IV.D.2.c) also teach that the connection to the head can be made using bond pads.

d. **a tail extending proximally from the mounting region and having terminal pads;**

As discussed above in Section IV.C.2.d, Balakrishnan teaches this limitation. Yuuki also teaches this limitation. Section IV.E.1.g.

e. **first trace sections having a first structural configuration electrically connected to the terminal pads and extending over at least a portion of the tail;**

Balakrishnan teaches this limitation. *Supra*, section IV.C.2.e.

f. **second trace sections having a second structural configuration different than the first structural configuration electrically connected to the bond pads and extending over at least a portion of the gimbal; and**

Balakrishnan teaches this limitation. *Supra*, section IV.C.2.g.

g. **transition structures electrically connecting the first trace sections to the second trace sections;**

Balakrishnan teaches this limitation. *Supra*, section IV.C.2.h.

h. **wherein the first and second traces are substantially impedance matched; and**

Yuuki teaches this limitation. *Supra*, section IV.E.1.e; Tarnopolsky, ¶¶144, 146-164.

i. **the flexure has a first impedance at the bond pads that is different than the second impedance at the terminal pads.**

Yuuki teaches this limitation. *Supra*, sections IV.E.1.f and IV.E.1.g; ; Tarnopolsky, ¶¶144, 146-164..

3. **<u>It Would Have Been Obvious To Combine the Teachings of Balakrishnan, and Yuuki, and also Balakrishnan ’152/Young.</u>**

As of the ’746 Patent’s filing date, it would have been obvious to a POSITA to modify Balakrishnan to include Yuuki’s impedance matching transmission lines, and also Young or Balakrishnan ’152’s bond pads, to arrive with a reasonable expectation of success at the subject matter of claims 9 and 15. Tarnopolsky, ¶¶146, 169-181.

The motivations to combine Balakrishnan with Young and with Balakrishnan ’152 are discussed in detail above, Sections IV.C.3 and I.D.3. A POSITA would have been further motivated to combine Balakrishnan with Yuuki, to implement the well-known benefits of impedance matching in a trace array. Tarnopolsky, ¶146. A POSITA reviewing Balakrishnan would recognize that Balakrishnan teaches the benefits of tuning the impedance in the trace conductor array. Ex. 1003, 3:65-4:6. Balakrishnan ’152 and Young also teach further benefits of impedance matching in the transmission lines, including by varying the dimensions of the traces. Tarnopolsky, ¶¶172-174.

With these teachings in mind, a POSITA would naturally have looked to references teaching specific impedance matching techniques, including Yuuki. Tarnopolsky, ¶175. Yuuki is representative of the well-known principle that varying the physical structure of a transmission line, along its length, creates a predictably decreasing impedance in the line, along the length of the line. Tarnopolsky ¶148.

Yuuki expressly teaches how to impedance match the preamplifier and the recording head in a hard disk drive, using a segmented transmission line much like the arrays in Balakrishnan, Balakrishnan ’152 and Young, and just like in the ’746 patent. Tarnopolsky, ¶¶176-179. Thus, a POSITA would have appreciated that combining Balakrishnan with Yuuki, and also with Young or Balakrishnan ’152’s bond pads would yield predictable and successful results. Tarnopolsky, ¶¶170, 180-181.

V. CONCLUSION

For the foregoing reasons, claims 7-9, 11 and 15 of the ’746 patent are unpatentable. Accordingly, Petitioner respectfully requests institution of IPR and cancellation of each of these claims.

Dated: July 31, 2018

/Alex V. Chachkes/
Alex V. Chachkes, Reg. No. 41,663
Orrick, Herrington & Sutcliffe LLP
51 West 52nd Street
New York, NY 10019-6142
Main: (212) 506-5000
Direct: (212) 506-3748
Fax: (212) 506-5151
Email:

A34PTABDocket@orrick.com

CERTIFICATE OF WORD COUNT

The undersigned certifies that the foregoing CORRECTED PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 8,169,746 PURSUANT TO 35 U.S.C. § 312 AND 37 C.F.R. § 42.104 complies with the type volume limitation in 37 C.F.R. § 42.24(c)(1). According to the utilized word-processing system's word count, the petition—excluding the caption, table of contents, table of exhibits, mandatory notices, certificate of word count, and certificate of service—contains 13,696 words.

Dated: July 31, 2018

By: /Alex V. Chachkes/

Alex V. Chachkes, Reg. No. 41,663
Orrick, Herrington & Sutcliffe LLP
51 West 52nd Street
New York, NY 10019-6142
Main: (212) 506-5000
Direct: (212) 506-3748
Fax: (212) 506-5151
Email: A34PTABDocket@orrick.com

Attorney for Petitioner Nitto Denko Corporation

CERTIFICATE OF SERVICE

The undersigned hereby confirms that the foregoing Petition for *Inter Partes* Review and associated Exhibits 1001-1020 were served on July 31, 2018 via overnight courier upon the following counsel of record for Patent Owner:

FAEGRE BAKER DANIELS LLP
Patent Docketing - Intellectual Property
2200 Wells Fargo Center
90 South Seventh Street
Minneapolis, MN 55402-3901

Courtesy copies have also been directed to the following counsel of record for Patent Owner in *Hutchinson Tech. Inc. v. Nitto Denko Corp. et al.*, Case No. 17-cv-01992 (D. Minn.):

Daniel J. Burnham
NIXON PEABODY LLP
70 West Madison, Suite 3500
Chicago, IL 60602-4224
dburnham@nixonpeabody.com

/Alex V. Chachkes/
Alex V. Chachkes