UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Hutchinson Technology Incorporated
Hutchinson Technology Operations
Petitioners

v.

Nitto Denko Corporation

Patent Owner

Patent No. 8,895,870

Issue Date: November 25, 2014

Title: PRINTED CIRCUIT BOARD AND METHOD OF MANUFACTURING THE SAME

Inter Partes Review No. <u>not assigned</u>

PETITION FOR INTER PARTES REVIEW UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 42.100 *ET. SEQ.*

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I. BACKGROUND AND QUALIFICATIONS

A. Introduction

1. I have been retained on behalf of the Petitioner as an independent expert consultant to provide this declaration concerning the technical subject matter relevant to the *inter partes* review of U.S. Patent No. 8,895,870 (the "'870 patent").

2. I submit this declaration to offer my expert opinion regarding the validity of the claims of the '870 patent. Specifically, I have considered whether claims 1, 2, and 4 of the '870 patent are valid under 35 U.S.C. sections 102 and 103. I understand that Nitto Denko Corporation has sued Petitioner Hutchinson Technology Incorporated. in the United States District Court for the District of New Jersey, case number 2:16-cv-03595-MF, for allegedly infringing the '870 patent.

3. I have set forth my academic and professional qualifications and relevant experience in Section II of this declaration and have attached a copy of my curriculum vitae as Appendix A.

4. I am being compensated at my standard hourly rate of $350 per hour for the time I spend on this matter. My compensation is not related in any way to the outcome of this proceeding, and I have no other interest in this proceeding.

5. It is my opinion that claims 1, 2 and 4 of the ’870 patent are invalid based on the prior art. The substance and bases of my opinions appear below.

6. I am the founder of Coughlin Associates, a consulting firm in the area of digital storage and digital storage applications. I have over 36 years of digital storage engineering and engineering management experience both as a consultant and at companies working on magnetic recording and digital storage systems. Some of the companies I have worked for include: Ampex, Maxtor, Micropolis, Nashua Computer Products, Polaroid, Seagate Technology and SyQuest. I am also an author, conference organizer and participant and have been a professor and lecturer in these areas as well.

B. Experience

7. I have an extensive engineering background in magnetic heads and media as well as in the integration of these and other technologies into hard disk drives and other magnetic storage devices. I was responsible as an individual contributor and a high level engineering and corporate manager for the design of magnetic storage for many generations of hard disk drives at Seagate, Syquest, Maxtor and Micropolis. I am an inventor in 6 US patents. I also have been involved in due diligence and quality analysis of hard disk drive manufacturing facilities and processes, provided failure analysis services on digital storage

products and worked on factory yield improvements. I have also been involved in storage systems launches and related market analysis. In addition, I have provided expert witness services on hard disk drive and storage systems related cases. I have provided marketing, intellectual property and technology assessments and projections. Consulting clients include companies such as LSI, Network Appliance, PriceWaterhouseCoopers, Quantum, Seagate Technology, Western Digital and The Woodside Fund.

C. Publications and Presentations

8. I have technical publications dating back to 1981 on magnetic recording technology topics. I have an extensive collection of technical articles published in peer reviewed professional journals as well as trade journals from the 1980's through 2016. Since 1997, I have written market and technology analysis reports and articles including the Digital Entertainment report series focusing on data storage and the creation, distribution and reception of entertainment content, Magnetic Storage Capital Equipment and Technology Report and various other reports. I have been co-editor of the Biannual International INEMI (International Electronics Manufacturing Initiative) Mass Storage Roadmap since 2003. I have contributed chapters for several edited professional books on digital storage and related topics.

9. I have published over 400 articles, reports, technical papers, blogs and presentations. I have also done many white papers for storage-oriented companies, especially in the media and entertainment storage industry. I do regular digital storage blogs for Forbes.com and occasional blogs for Post Magazine and other web sites. I am the author of Digital Storage in Consumer Electronics, published in 2008 by a division of Elsevier. A complete list of my publications is attached as Exhibit B.

10. I have given technology and market assessment presentations at the annual Storage Visions and Creative Storage conferences (which I started and organize), International Disk Equipment Manufacturers Association (IDEMA) and Institute for Information Storage Technology (IIST) Conferences and for the IEEE Magnetics Society as well as the IEEE Consumer Electronics Society conferences. The IEEE (sometimes known as the Institute of Electrical and Electronics Engineers) is the largest technical engineering organization in the world. I have presented at many venues and for many organizations on digital storage and storage applications.

D. Professional Activities

11. I am a senior member of the IEEE, was publicity chairman of the 1992, 1996, 2002, and 2004 IEEE Magnetics society TMRC conferences and am a

past chairman of the Santa Clara Valley Magnetics Society, past chairman of the SCV Consumer Electronics Society and past Chairman of the Santa Clara Valley IEEE Section and the IEEE Region 6 Central Area. I have also been a member of the Administrative Committee for the IEEE Consumer Electronics Society and I was Vice President of Operations for the society for three years. I was a distinguished lecturer for the IEEE CE Society for four years speaking all over the world on digital storage in consumer electronics. I have been on the Technical Program Committee (TPC) for several IEEE CE Society conferences and I am an editor or senior editor of the IEEE Consumer Electronics Transactions and the Consumer Electronics magazine.

12. I was general chairman of the 2011 IEEE Sections Congress in San Francisco. I am past Director of IEEE Region 6 (having served on the IEEE BoD for two years) and I am leading the Future Directions Committees of the IEEE Consumer Electronics Society. I am Vice President of Professional Activities for IEEE USA and I am chairman of the IEEE Public Visibility Committee. I have served on many IEEE professional committees over the years.

13. I have been active with IDEMA where I have been chairman or a member of several committees. I was one of the founding members of the Solid State Storage Initiative group of SNIA where I have been the Marketing or

Education Chair for six years. I received volunteer recognition awards from IDEMA, SNIA as well as the IEEE. I have organized magnetic recording Symposia from 1997-2002 for IIST at Santa Clara University where I was also an adjunct professor associated with the IIST in the Electrical Engineering Dept.

14. In addition to the IEEE Consumer Electronics and Magnetics Society I am also a member of the IEEE Computer Society, IEEE Broadcast Technology Society, IEEE Communications Society, Association of Computer Machinery, American Physical Society, American Association for the Advancement of Science, Society of Motion Picture and Television Engineers, Storage Networking Industry Association and the American Vacuum Society.

15. I am the chairman and organizer of the annual Storage Visions and Creative Storage Conferences, well known in the data storage and storage applications industries. I am also the general chairman of the annual Flash Memory Summit. In 2011 a colleague and I started a series of roughly quarterly networking and technology events called the Storage Valley Supper Club, which are still ongoing..

E. Testimony in Other Cases

16. Besides the current case, I have performed work as an expert witness since 1998 doing activities including patent portfolio review as well as serving as

an expert witness for various types of legal cases. I have completed reports for legal cases and also given deposition testimony in the following cases: Remote Diagnostics Technologies v. Butler & Binnon, Case No. 990100804, Multnomah County Circuit Court, Oregon; Remote Diagnostics Technologies v. Intel, Case No. 1:01-cv-00589, Western District of Texas, Granito v. International Business Machines, Inc. Case No. 2001-027510; Hurkes Harris Design v. Fujitsu Computer Products of America, Case No. 2001-1-CV-812127; Crandall v. Hartford Ins. Co. et al., case No. 1:10-cv-00127, United States District Court, Idaho; Avid Technology Inc. v. Harmonic Inc., case No. 1:11-1040-GMS, SRF, United States District Court of Deleware.

II. MATERIALS REVIEWED

17. In forming my opinions expressed below, I considered the '870 patent and its file history. I have also considered the following documents:

Exhibit No.	Description
1001	U.S. Patent No. 8,895,870 ("the '870 patent")
1002	Prosecution History for U.S. Patent No. 8,895,80 ("the '870 prosecution history").
1003	U.S. Patent Pub. No. 2009/0283314 ("Ohsawa Publication")
1004	U.S. Patent No. 6,543,673 ("Lennard Patent")

1005	U.S. Patent No. 6,882,038 ("Kuzawinski Patent")
1006	U.S. Patent Pub. No. 2007/0145543 to ("Zeng Publication")
1007	U.S. Patent Pub. No. 2008/0102608 ("Ishii Publication")
1008	U.S. Patent Pub. No. 2008/0185177 ("Chou Publication")
1010	Complaint filed June 20, 2016 in Nitto Denko Corporation v. Hutchinson Technology Incorporated, United States District Court District of New Jersey, Case No. 2:16-cv-03595-MF
1011	U.S. Patent Pub. No. 2009/0211386 ("Yang Publication")
1013	Shaowei, Deng, et al. "Effects of Open Stubs Associated with Plated Through-Hole Vias in Backpanel Designs," International Symposium on Electromagnetic Compatibility, 2004

18. Further, in regards to my opinions herein, I rely on my own knowledge, training, and more than 36 years of experience in designing, developing, and teaching courses on digital storage technology and its applications.

III. LEGAL PRINCIPLES USED IN THE ANALYSIS

19. I am not a patent attorney nor have I independently researched the law on patentability. I have a general understanding of validity, prior art and priority date based on my experience with patents and my discussions with counsel.

20. Prior Art. I understand that an invention by another must be made before the priority date of a particular patent claim in order to qualify as "prior art" under 35 U.S.C. § 102 or § 103, that a printed publication or a product usage must be publicly available before the priority date of a particular patent claim in order to qualify as "prior art" under 35 U.S.C. § 102(a), that a printed publication or a product usage or offer for sale must be publicly available more than one year prior to the date of the application for patent in the United States in order to qualify as "prior art" under 35 U.S.C. § 102(b), or that the invention by another must be described in an application for patent filed in the United States before the priority date of a particular patent claim in order to qualify as "prior art" under 35 U.S.C. § 102(e). I understand that the Defendants have the burden of proving that any particular reference or product usage or offer for sale is prior art.

21. Anticipation: I understand that anticipation analysis is a two-step process. The first step is to determine the meaning and scope of the asserted claims. Each claim must be viewed as a whole, and it is improper to ignore any element of the claim. For a claim to be anticipated under U.S. patent law: (1) each and every claim element must be identically disclosed, either explicitly or inherently, in a single prior art reference; (2) the claim elements disclosed in the single prior art reference must be arranged in the same way as in the claim; and (3)

the identical invention must be disclosed in the single prior art reference, in as complete detail as set forth in the claim. Where even one element is not disclosed in a reference, the anticipation contention fails. Moreover, to serve as an anticipatory reference, the reference itself must be enabled, i.e., it must provide enough information so that a person of ordinary skill in the art can practice the subject matter of the reference without undue experimentation.

22. Inherency. I further understand that where a prior art reference fails to explicitly disclose a claim element, the prior art reference inherently discloses the claim element only if the prior art reference must necessarily include the undisclosed claim element. Inherency may not be established by probabilities or possibilities. The fact that an element may result from a given set of circumstances is not sufficient to prove inherency. I have applied these principles in forming my opinions in this matter.

23. Obviousness. I understand that a patent claim is invalid under 35 U.S.C. § 103 as being obvious only if the differences between the claimed invention and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person of ordinary skill in that art. An obviousness analysis requires consideration of four factors: (1) scope and content of the prior art relied upon to challenge patentability; (2) differences

between the prior art and the claimed invention; (3) the level of ordinary skill in the art at the time of the invention; and (4) the objective evidence of non-obviousness, such as commercial success, unexpected results, the failure of others to achieve the results of the invention, a long-felt need which the invention fills, copying of the invention by competitors, praise for the invention, skepticism for the invention, or independent development.

24. Analogous Art. I understand that a prior art reference is proper to use in an obviousness determination if the prior art reference is analogous art to the claimed invention. I understand that a prior art reference is analogous art if at least one of the following two considerations is met. First a prior art reference is analogous art if it is from the same field of endeavor as the claimed invention, even if the prior art reference addresses a different problem and/or arrives at a different solution. Second, a prior art reference is analogous art if the prior art reference is reasonably pertinent to the problem faced by the inventor, even if it is not in the same field of endeavor as the claimed invention.

25. Obviousness Combinations. I understand that it must be shown that one having ordinary skill in the art at the time of the invention would have had a reasonable expectation that a modification or combination of one or more prior art references would have succeeded. Furthermore, I understand that a claim may be

obvious in view of a single prior art reference, without the need to combine references, if the elements of the claim that are not found in the reference can be supplied by the knowledge or common sense of one of ordinary skill in the relevant art. However, I understand that it is inappropriate to resolve obviousness issues by a retrospective analysis or hindsight reconstruction of the prior art and that the use of "hindsight reconstruction" is improper in analyzing the obviousness of a patent claim.

26. I further understand that the law recognizes several specific guidelines that inform the obviousness analysis. First, I understand that a reconstructive hindsight approach to this analysis, i.e., the improper use of post-invention information to help perform the selection and combination, or the improper use of the listing of elements in a claim as a blueprint to identify selected portions of different prior art references in an attempt to show that the claim is obvious, is not permitted. Second, I understand that any prior art that specifically teaches away from the claimed subject matter, i.e., prior art that would lead a person of ordinary skill in the art to a specifically different solution than the claimed invention, points to non-obviousness, and conversely, that any prior art that contains any teaching, suggestion, or motivation to modify or combine such prior art reference(s) points to the obviousness of such a modification or combination. Third, while many

combinations of the prior art might be "obvious to try", I understand that any obvious to try analysis will not render a patent invalid unless it is shown that the possible combinations are: (1) sufficiently small in number so as to be reasonable to conclude that the combination would have been selected; and (2) such that the combination would have been believed to be one that would produce predictable and well understood results. Fourth, I understand that if a claimed invention that arises from the modification or combination of one or more prior art references uses known methods or techniques that yield predictable results, then that factor also points to obviousness. Fifth, I understand that if a claimed invention that arises from the modification or combination of one or more prior art references is the result of known work in one field prompting variations of it for use in the same field or a different one based on design incentives or other market forces that yields predicable variations, then that factor also points to obviousness. Sixth, I understand that if a claimed invention that arises from the modification or combination of one or more prior art references is the result of routine optimization, then that factor also points to obviousness. Seventh, I understand that if a claimed invention that arises from the modification or combination of one or more prior art references is the result of a substitution of one known prior art element for another known prior art element to yield predictable results, then that factor also points to obviousness.

27. Dependent Claims. I understand that a dependent claim incorporates each and every limitation of the claim from which it depends. Thus, my understanding is that if a prior art reference fails to anticipate an independent claim, then that prior art reference also necessarily fails to anticipate all dependent claims that depend from the independent claim. Similarly, my understanding is that if a prior art reference or combination of prior art references fails to render obvious an independent claim, then that prior art reference or combination of prior art references also necessarily fails to render obvious all dependent claims that depend from the independent claim.

28. Time of Invention. Subject to a claim by claim analysis, in general, I understand that the "time of invention" for the '870 patent is either the date of the U.S. Patent Appl. No. 12/862,338 on August 24, 2010 or the filing of provisional application number 61/241,525 on September 11, 2009 or the filing of the Japanese patent application 2009-198288 on August 28, 2009.

IV. LEVEL OF ORDINARY SKILL IN THE ART

29. In my opinion, an individual having ordinary skill in the art at the time at which the earliest patent to which the '870 patent claims priority was filed

(August 28, 2009) would have been a technical person either with (i) a Bachelor's degree in electrical engineering or electronics engineering, and approximately five years of experience working in the area of circuit board design and resonant electrical interference of open circuits in the Hard Disk Drive (HDD) industry or (ii) a Master's degree in engineering and up to two years of experience working in the area of disk drive technology, including circuit board design and resonant electrical interference of open circuits.

30. In my opinion, an individual having ordinary skill in the art would have knowledge of all the s of problems associated with circuit board design. This would include interference of a transmitted signal created by the arrangement and sizing of wires and traces, including resonant electrical interference caused by open ended circuit components. This would also include knowledge of all different types of layouts for circuit boards, including trace, terminal, and electrode pad variations for rigid as well as flexible substrate circuits.

31. I understand that the person of ordinary skill is a hypothetical person who is assumed to be aware of all the pertinent information that qualifies as prior art. In addition, the person of ordinary skill in the art makes inferences and takes creative steps.

V. STATE OF THE ART

A. Circuit Boards

32. The ’870 patent relates to plating leads for electroplating of circuit board terminals, and more generally to the design of circuit boards to avoid electrical interference.

33. By way of background, a printed circuit board (PCB) mechanically supports and electrically connects electronic components using conductive traces (sometimes referred to as “leads” or “lines”) and terminal pads (or connection pads or electrode pads) generally made from copper or copper alloys. These copper elements are formed on an insulating sub-layer usually made from polyimide. The insulating layer is often attached to a conductive substrate or base. Various electrical components can be attached to the terminal pads to create electrical circuits and perform useful electrical functions.

34. PCBs may have a rigid or flexible insulating sub-layer. A flexible PCB utilizes a flexible insulating sub-layer. Flexible PCBs are commonly used to create more compact finished devices, such as cell phones, smart watches and disk drives.

35. A printed circuit board is part of a broader class of electrical circuits. The same electrical principles in operation on a printed circuit board are in

operation on any electrical circuit that operated at high frequency. Electrical circuits are used in all electronic devices including hard disk drives, integrated circuits (ICs) and the packaging that interfaces with ICs.

B. Overview of Hard Disk Drive flexible PCBs

36. By way of overview and illustration, a typical hard disk drive (HDD) is shown below.

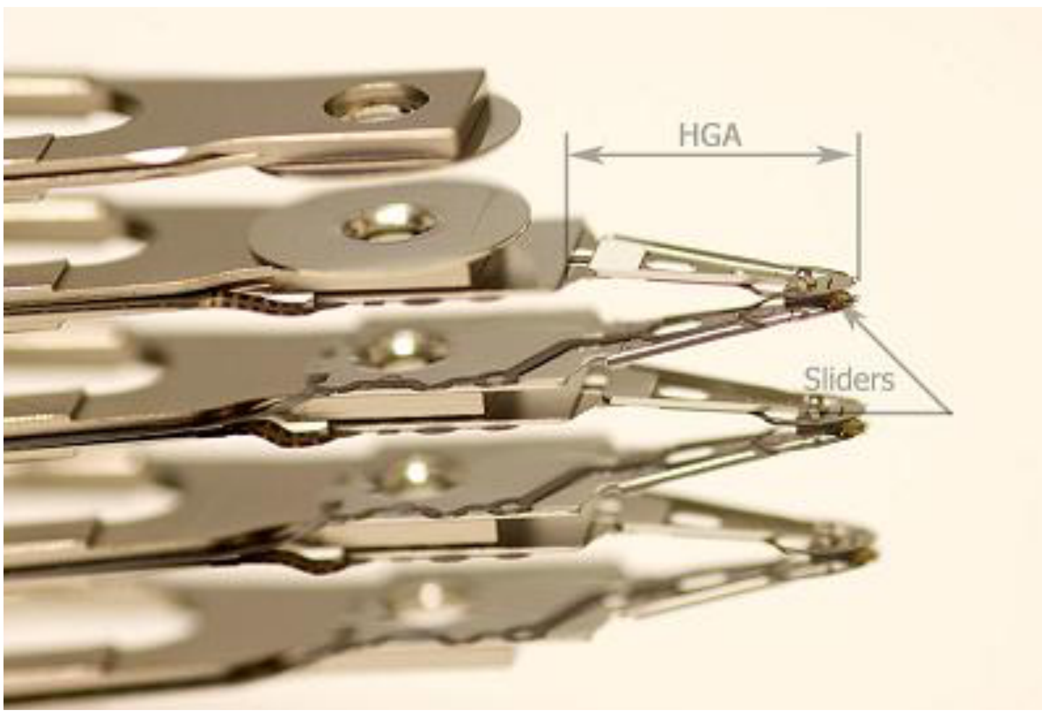
37. The head stack assembly (HSA) shown above and in more detail below, has a copper wire coil, called the voice-coil, which moves between the top and bottom magnets in the voice coil actuator, when a current is applied to the coil. The bearing lets the HSA move freely back and forth across the disk surface where

the read/write head, sometimes referred to as a slider, can read from or record information to the disk surface. The HSA has a preamplifier on it close to the bearing and a flexible circuit leading away from the preamplifier that connects with the drive electronics. The drive electronics controls the voice coil actuator as well as reading and writing data from the magnetic disks.

38. The complete head stack assembly (HSA) is depicted in more detail below. Included in the HSA are head gimbal assemblies (HGAs) that are affixed to the extended actuator arms of the HSA.

39. The actuator arms go between adjacent disks or platters in the HDD as shown in paragraph 36. HGAs have read/write heads or "sliders" on the end of each HGA. The sliders fly above the disk surface when the disk is rotating.

40. Shown below is a close up of the HSA actuator arms with HGAs attached and a read/write head or slider attached to the ends of the HGAs

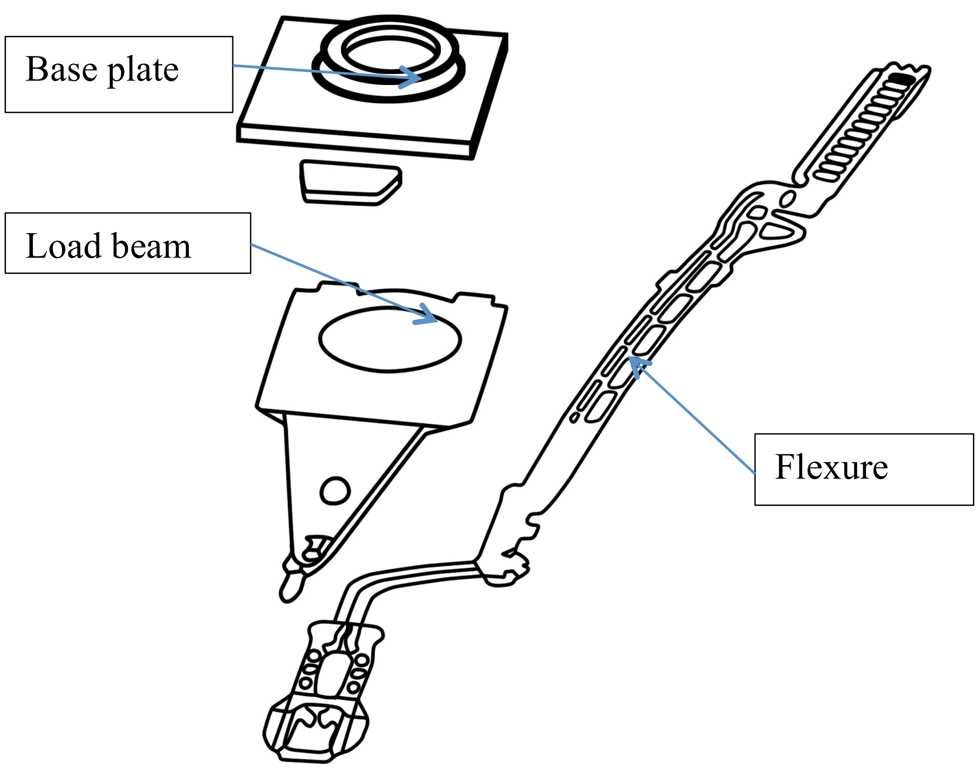


41. HGAs are devices for transmitting information (signals) to and from the magnetic read/write heads (sliders) and the drive electronics. In addition, HGAs are key elements in positioning the magnetic read/write heads on the disk drive tracks and in supporting the air bearing between the read/write head and the disk. The rotation of the disks generates an air bearing which permits the slider on

the end of an HGA to fly above the disk surface. The following paragraphs discuss the components of an HGA.

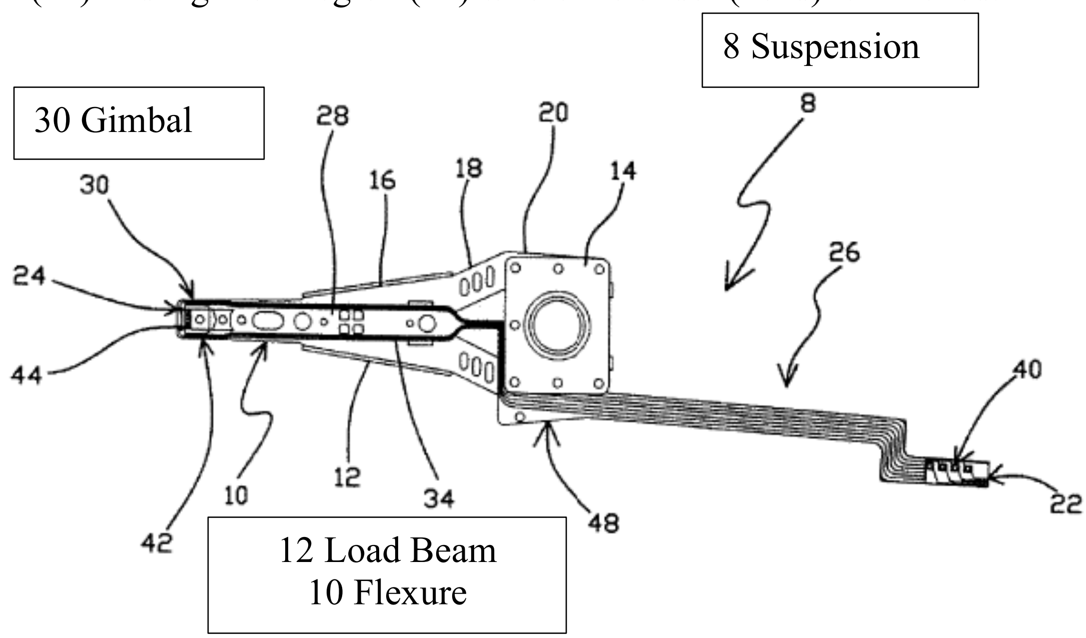
42. The parts of a hard disk drive suspension are shown below. When a slider is attached to a completed suspension, the entire assembly is called a head gimbal assembly (HGA). When all of the HGAs in a hard drive are attached to their actuator arms (using the HGA base plates), they are part of the Head Stack Assembly (HSA) as shown in paragraph 38.

43. The "suspension" is assembled from three sub-assemblies; the base plate, the load beam, and the flexure as shown below.



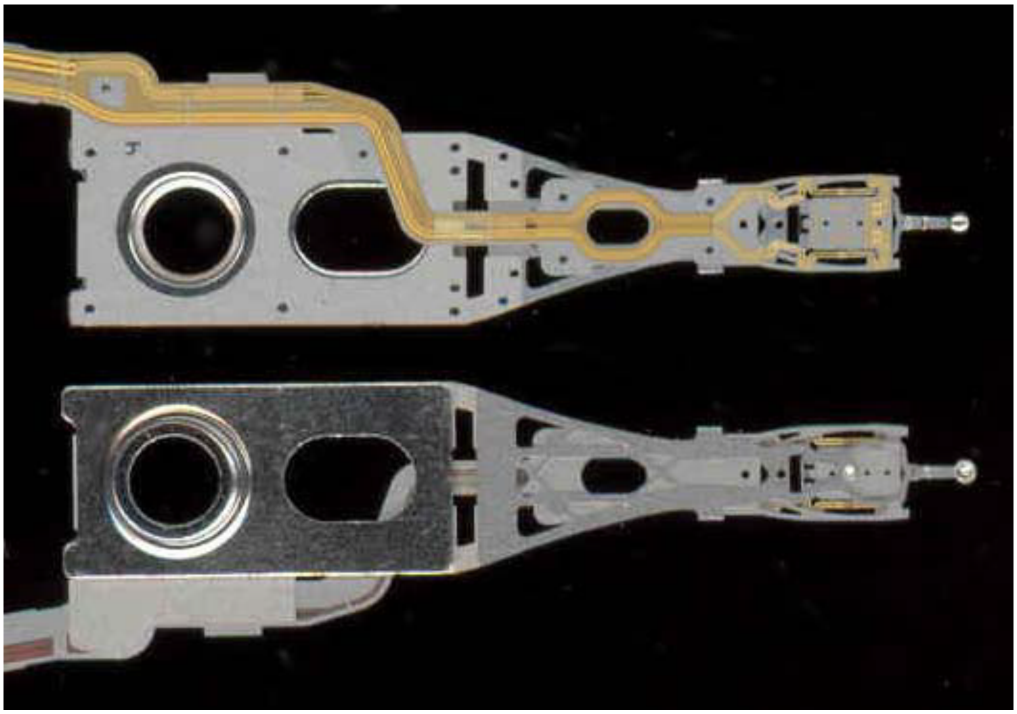
44.

45. The load beam (12) is formed from stainless steel and includes a beam region (16), a hinge region (18) and a mounting region (20). The base plate (14) is welded to the mounting region (20) at the end of the load beam. The flexure (10) is an integrated lead, or wireless flexure. It has a tail region (26), a mounting or base region (28) that is welded or otherwise attached to the beam region (16) of the load beam (12) and a gimbal region (30) where the slider (head) is attached.

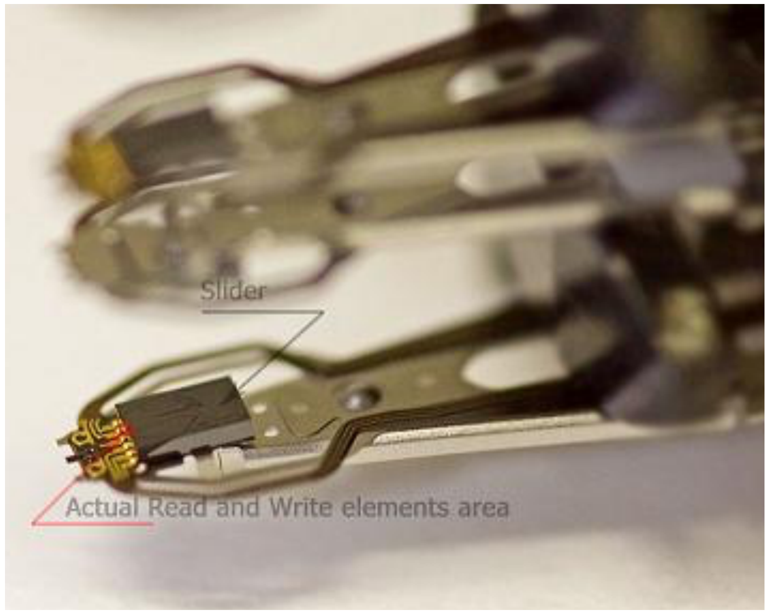


46. A read/write head (or slider) is electrically connected to the flexure (suspension board with circuit) through connector pads (in the gimbal region of the flexure) allowing electrical signals to flow into and out of the read write head or slider. Shown below are the front and back-sides of a suspension (without the slider attached). In the top image, the flexure extends from the left to the right side and includes the conductive traces that electrically connect the read/write head

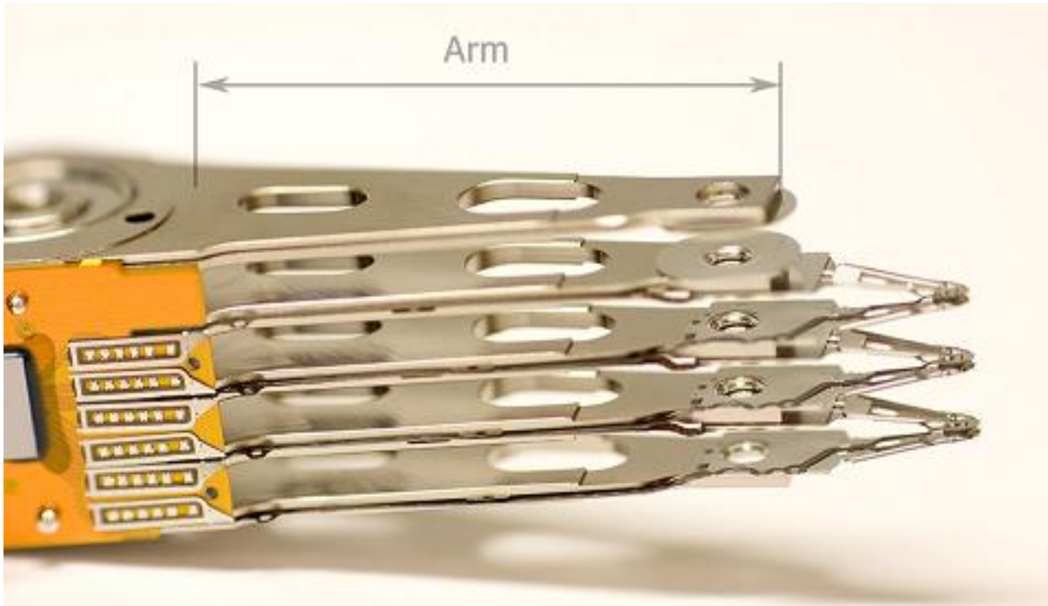
(slider) to the drive electronics (preamplifier). Also shown are the hinge, the load beam and the base plate.



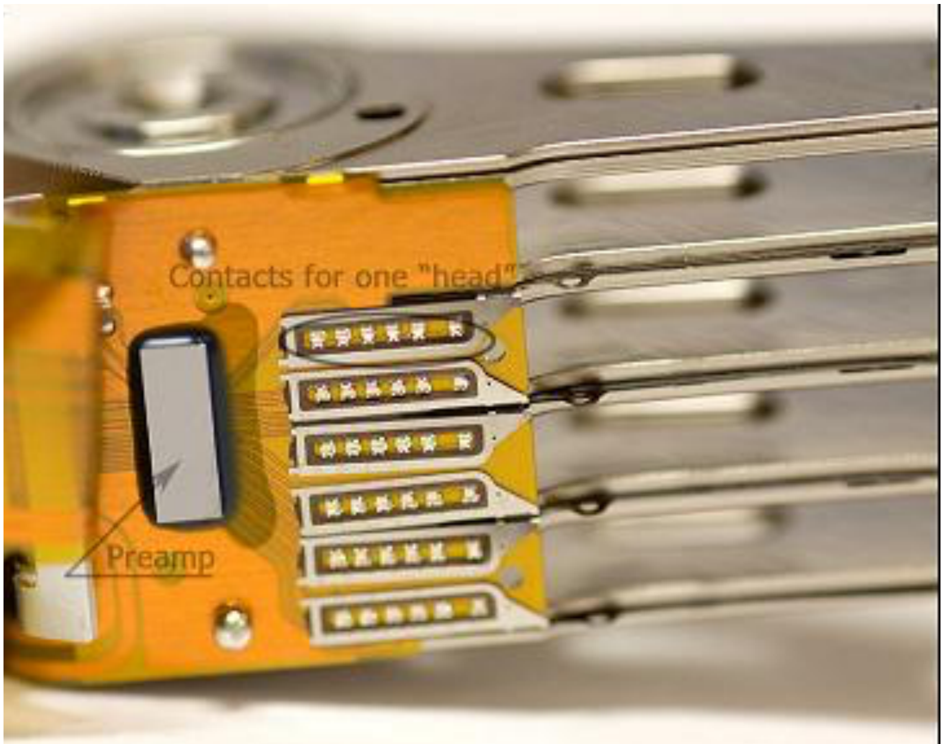
47. On the left side of the slider are terminal pads on both the slider and suspension where these terminals are soldered together to make an electrical connection as shown below.



48. Shown below is a close-up of head stack assembly (HSA). In this image the HGAs are attached to the actuator arms. Also shown are the flexible printed circuit boards (PCBs), which extend from the HGA, and twist to follow the side of arm back to the pre amplifier terminals, which are connection points to connect the preamplifier to the conductor traces.

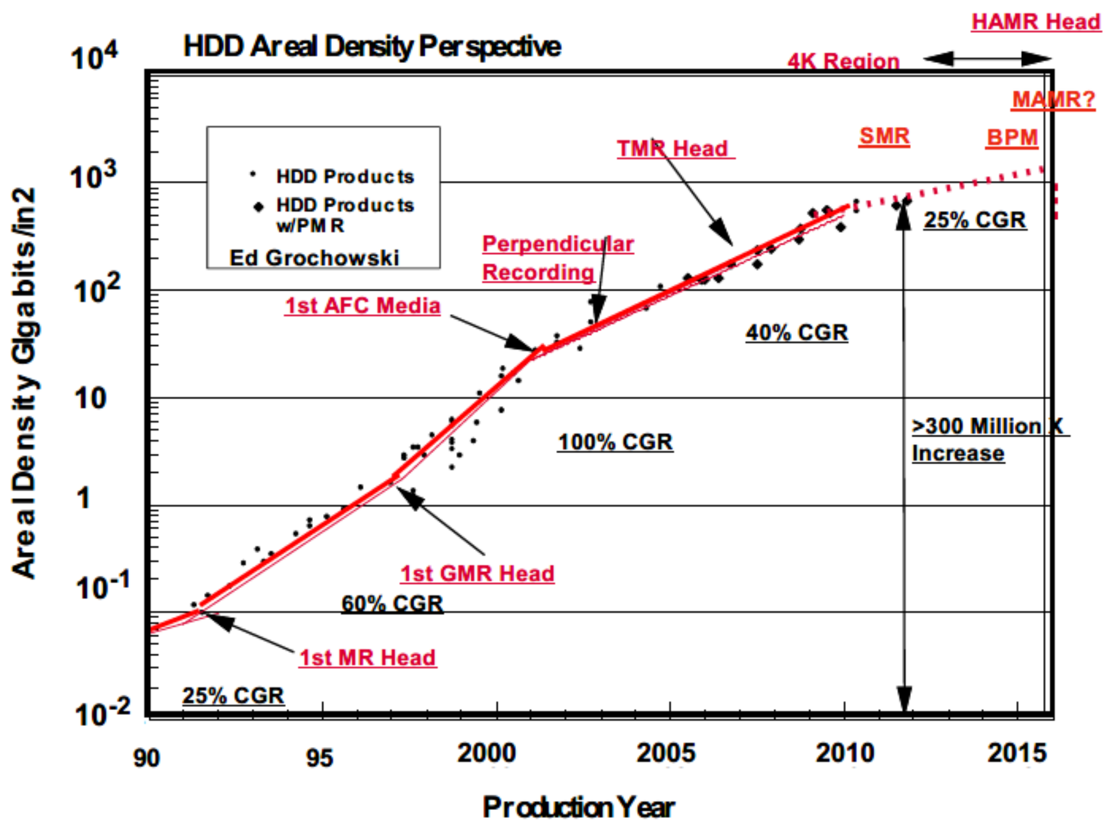


49. The electrical connection points between the preamplifier terminals and the flexible printed circuit boards (PCBs) terminals are shown more clearly below.



C. High Frequency Circuits

50. The disk drive industry has continued to increase the amount of data that can be stored on a hard drive disk surface. These increases in area density of information stored on HDDs required higher data rates and higher frequencies over time. Achieving higher data rates requires improvements in many aspects of the hard disk drive design, including the design of flexures on HGAs. Below is a graph showing the improvement in HDD areal density commencing in 1990:



51. Modern hard disk drive circuitry operates at signal frequencies that are greater than 1 GHz. Thus, hard disk drive electronics operate in the microwave electromagnetic region (frequencies between 300 MHz to 300 GHz). The flexible printed circuit board (PCB) used in the flexure of an HGA is a microwave circuit.

52. At microwave frequencies the characteristics of electrical circuits are much different than at lower frequencies or for no frequency (DC) signals. Common electrical characteristics such as capacitance and inductance are often a

strong function of frequency in microwave circuits. In addition, at microwave frequencies the electrical signals are carried near the surface of the conductive traces, i.e., these conductive traces are transmission lines with electric and magnetic fields that extend beyond the conductive traces. These fields will interact with any adjacent materials, making these circuits very sensitive to their environment. In addition, these circuits are sensitive to internal or external noise sources that can interfere with the transmitted signal. Designers use known designs and techniques to minimize noise in the circuits.

53. Each component of an electrical circuit has its own electrical impedance that is dependent upon on its physical characteristics, for example, the physical shape, materials, and local environment. For instance, the impedance of a conductive trace is dependent upon its width, thickness, and length, properties of adjacent dielectric materials, and other characteristics.

54. The impedance of a conductive trace will be higher if the width of the trace is narrower and lower if the width of the trace is wider. Sometimes, signals running through parts of a trace may be distorted depending on the impedance characteristics of that part of the trace. Electrical resonance is a phenomenon where the signals entering a component of an electrical circuit produce large

amplitude oscillations at resonant frequencies. These resonant frequencies can impact the signals being transmitted through the circuit.

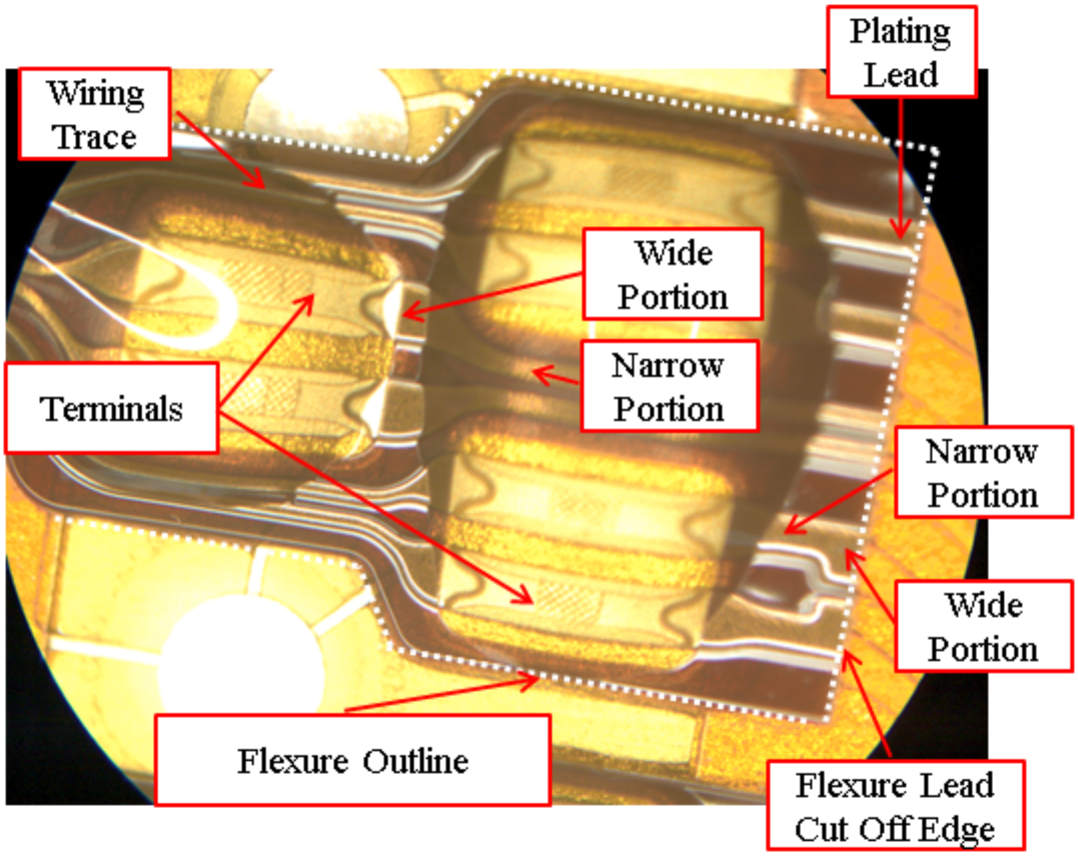
55. A stub is a length of a conductive trace that is open or short circuited on one end and connected to the rest of the circuit at the opposite end. Stubs have a characteristic resonant frequency. In a microwave (high frequency) circuit, stubs with designed features that create desirable resonance conditions, can serve as useful circuit elements. For example, they can be used as bypass or notch filters to allow certain signal frequencies to pass through the transmission line or to suppress certain frequencies.

56. However, stubs can also cause issues in circuits where they are not playing a useful designed purpose. Open stubs can reflect part of the signal in a transmission line and have a negative impact on circuit board signal transmission.

57. Traces on printed circuit boards, can be used for electroplating terminals on a circuit board during the manufacturing process. Typically, terminals are electroplated with a gold layer in order to promote good solder adhesion to that terminal. To electroplate the terminals, the printed circuit board is immersed in a salt bath containing the metal to be deposited. A current is applied to trace leads that are connected to the terminals to be plated. This will result in deposition of the metal out of the bath onto the terminal surfaces. The traces used

to conduct electricity to the terminals are sometime referred to as “lead wires” for plating, and also sometimes called plating tails or plating bars.

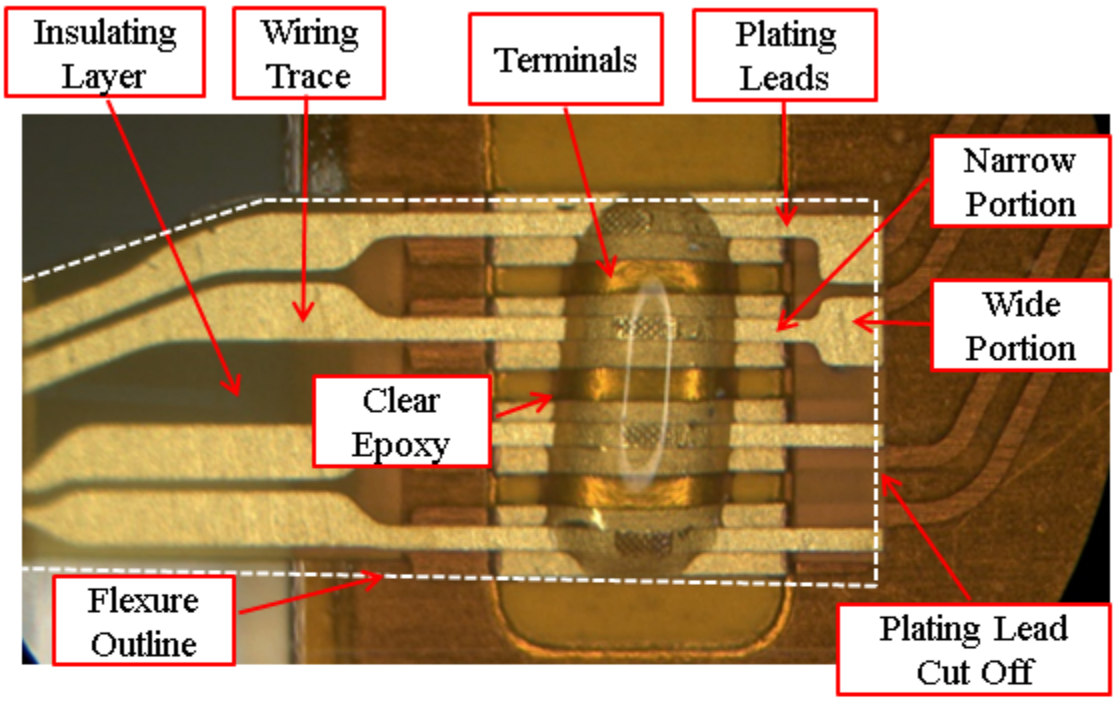
58. The use of “lead wires” for plating was well-known prior to the filing date of the ’870 patent. The photo below illustrates one example of “lead wires” for plating found in a flexure product manufactured by the Patent Owner that was incorporated into a Samsung HDD model number HE160HJ that was made in May 2007. I reviewed this photo and confirmed that these were typically of the design of lead wires for plating at that time.



View of Widening Plating Leads of Nitto Suspension/Flexure in Samsung Hard Drive circa 2007

59. The photo below illustrates yet another example of a flexure product with "lead wires" for plating made and sold prior to the filing date of the '870 patent. The flexure product shown in the photo is called the HTI 3530 Finch Product and was developed, manufactured, and sold by Petitioner as early as May 2002 and incorporated into a Western Digital Hard Drive. The flexure below is assembled in the hard drive and shows the attachment of flexure terminals to the

preamp terminals. This also shows narrow to wide plating leads extending from the right side of the terminals. I reviewed this photo and confirmed that these were typically of the design of lead wires for plating at that time.



HTI 3530 Finch Product found in WD HDD made in 2005

60. In short, the use of "lead wires" for plating was well-known and widely used by those with ordinary skill in the art in the HDD industry before the filing date of the '870 patent.

61. These lead wires for plating can be an example of stubs. For instance, after these lead wires are used for plating, the connection to the power source is severed, leaving open-ended connections on the side of the circuit board. In high-

frequency (microwave) circuits, due to the concentration of energy near the resonant state of a stub on a transmission line, transmitted signal components near to this resonant frequency are amplified and injected back into the transmission line (traces), which then interferes with the transmitted signal, partially distorting that signal.

62. The degraded signal transmitted through the conductive traces on the flexible circuit board could cause problems in reading back data recorded on the hard disk drive. Controlling the degradation of electrical signals through a flexible (or rigid) circuit board is a problem common to all high-frequency circuits, whether in a flexure of an HGA or in integrated circuit packaging.

63. An example of the negative impact of stubs on commercial products is signal degradation from open stubs in vias in printed circuit boards. *See,* Exhibit 1013*,* Shaowei, Deng, et al. "Effects of Open Stubs Associated with Plated Through-Hole Vias in Backpanel Designs," International Symposium on Electromagnetic Compatibility, 2004.

64. These manufacturing processes and techniques discussed above are well understood to a person of ordinary skill in the art of making hard disk drive suspensions with circuits and the resulting HGAs at the time of the '870 patent priority date.

VI. THE '831 PATENT

A. Overview

65. The '870 patent issued on December 3, 2013 from U.S. Patent Appl. No. 13/286,740 (the "'831 application") which was filed on November 1, 2011.

66. The '870 patent issued on November 25, 2014 from U.S. Patent Appl. No. 12/862,338 (the "'338 application") which was filed on August 24, 2010. The '870 patent claims priority to provisional application number 61/241,525 which was filed on September 11, 2009.

B. CLAIM CONSTRUCTION

1. "lead wires for plating" [Claim 1, 2, 4]

67. The phrase "lead wires for plating" appears in claims 1, 2 and 4.

68. A person of ordinary skill would understand the plain and ordinary meaning of "lead wires for plating" as described in the specification and figures of the '870 patent as "any electrical stub, lead, plating lead, plating tail, or plating bar, used for a temporary connection during an electroplating process."

2. "suspension body" [Claims 1, 2, 4]

69. The phrase "suspension body" appears in claims 1, 2 and 4.

70. A person of ordinary skill would understand the plain and ordinary meaning of "suspension body" as described in the specification and figures of the '870 patent refers to a metal support structure for a flexible printed circuit board.

VII. HOW CHALLENGED CLAIMS ARE UNPATENTABLE

B. Claim 2: Ohsawa

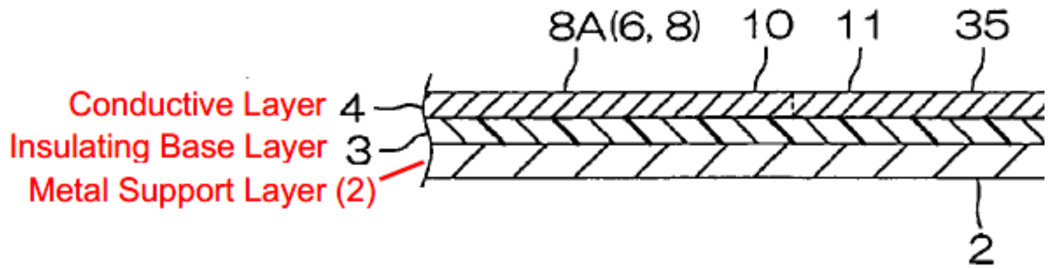
1. Independent Claim 2

[2a] A printed circuit board comprising:

a suspension body;
an insulating layer formed on said suspension body;
a wiring trace formed on said insulating layer

71. Ohsawa describes a wired circuit board with the exact features of claim 2, including having different widths on different linear portions of the plating leads.

72. Specifically, the Ohsawa discloses the main features of a standard suspension, printed circuit board ("wired circuit board 1"). Ex. 1003, Fig. 1; Id. ¶ 58 ("wired circuit boards 1 such as a suspension board with circuit . . ."). Particularly, Ohsawa discloses "a metal supporting layer 2, an insulating base layer 3, a conductive layer 4 formed on the insulating base layer." Id. ¶ 59; Id. at Fig. 1; Ohsawa illustrates these circuit board layers in Fig. 2:



Ex. 1003, Fig. 2 (annotations added).

73. The bottom layer in Fig. 2 of Ohsawa is a "metal support layer 2" which corresponds to the "suspension body" recited in claim 1 of the '870 patent. Id., at Fig. 2. A person of ordinary skill in the art would understand that a "suspension body" as used in the '870 patent refers to the metal support layer of the flexure. For instance, the '870 patent refers to the suspension body 10 as "formed of a long sized metal substrate". '870 Patent, Col. 6: 21 – 24. As shown below, Fig. 2 of the '870 patent illustrates the suspension body made of stainless steel as the bottom metal support layer "10", which has a base insulating layer "11" on top of the suspension body, and a conductive wiring trace "20" on top of the base insulating layer.

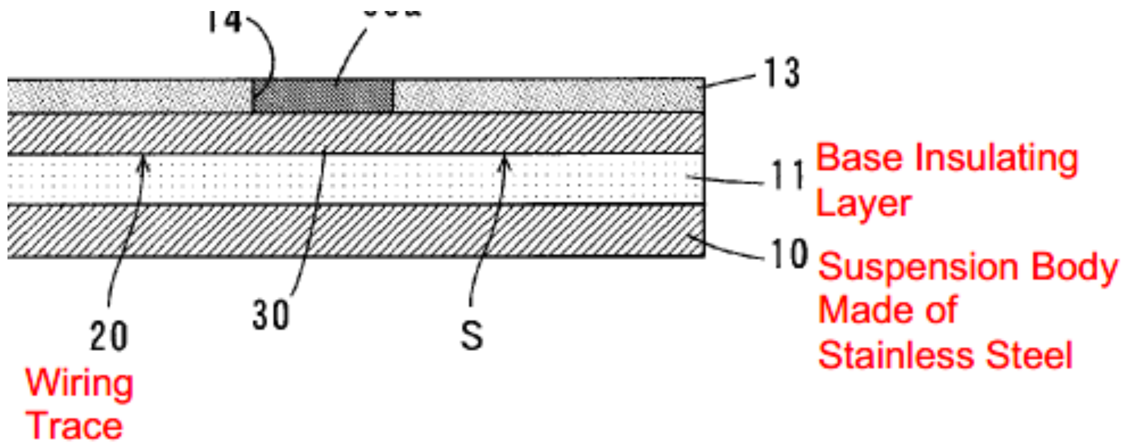


Fig. 2 ‘870 patent

74. As can be seen by comparing Fig. 2 of the ‘870 patent to Fig. 2 of the Ohsawa publication, the types of materials and the layers are identical in the disclosed layers of the claim. Additionally, Ohsawa discloses that “the metal support layer 2” is preferably made out of stainless steel. Ohsawa ¶ 60. Similarly, the ‘870 patent discloses that the suspension body is also made of stainless steel, for example. ‘870 patent, column 6, lines 59 – 60. Because both layers are made of the same material, a person of ordinary skill and experience would know and understand that these layers serve the same function and are identical or equivalent. Thus, the “metal support layer 2” of Ohsawa corresponds to the “suspension body” of claim 2.

75. Additionally, the middle layer in Fig. 2 of Ohsawa is an "insulating base layer 3" which is formed on top of the "metal support layer 2." Id., Fig. 2; Id. ¶ 59. Ohsawa also discloses that Fig. 4 (b) shows the step of "forming an insulating base layer on the metal supporting layer. Id. ¶ 35. Thus, the "insulating base layer 3" of Ohsawa corresponds to the "insulating layer formed on said suspension body" of claim 2.

76. Moreover, the correspondence is underscored because Ohsawa discloses that polyimide is preferably used for forming the insulating base layer 3. Ohsawa ¶ 63. Similarly the '870 patent describes "a base insulating layer made of polyimide … formed on the suspension body." '870 patent, column 6, lines 58 – 59. Polyimide is typically used as the insulating layer on PCBs. .

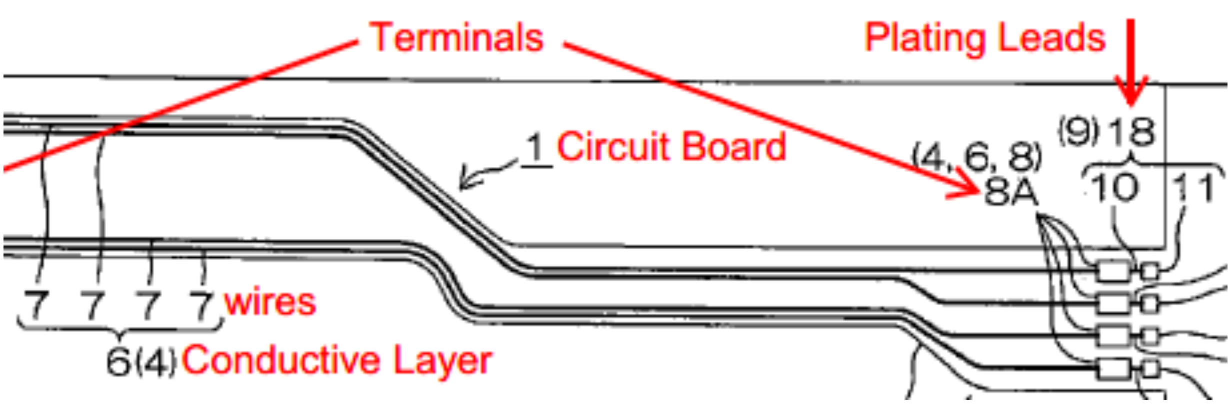
77. Also, Ohsawa discloses a "conductive layer 4" that forms the conductive patterns 6" on top of the insulating base layer 3. Id., Fig. 2; Id. ¶36 ("showing the step of forming a conductive layer on the insulating base layer"). For instance, Ohsawa discloses that the "conductive layer . . . includes conductive patterns 6." Ohsawa ¶ 67. Ohsawa also discloses that the conductive patterns 6 form a "plurality of wires" which corresponds to "wiring trace[s] formed on said insulating layer" of claim 2. Id. ¶ 68; Id., Figs. 1 – 2.

78. Ohsawa discloses that the conductive material for forming the conductive layer 4 is preferably copper. Ohsawa ¶ 66. Likewise, the '870 patent describes that the plurality of wiring traces and the plurality of lead wires for plating are made of copper and formed on the base insulating layer 11. '870 patent, Col 6: 61 – 63. Because both layers are made of the same material and are in the same orientation with respect to each other, a person of ordinary skill and experience would know and understand these layers serve the same function and are identical or equivalent.

79. A person of ordinary skill would understand that Ohsawa expressly discloses all the features of claim element [2a].

[2b] a terminal provided at a portion of said wiring trace; and

80. Ohsawa discloses a terminal at a portion of the wiring traces.



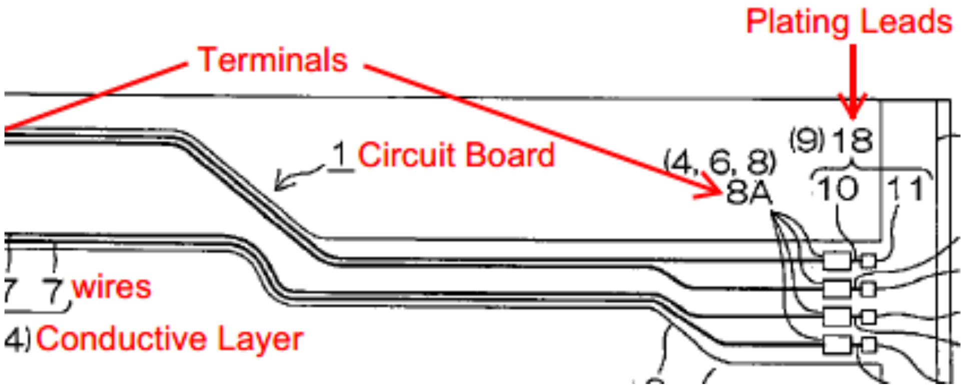
Ohsawa, Fig. 1

81. As shown above in Fig. 1, Ohsawa discloses conductive patterns 6 and 7 ("wiring trace[s]") arranged between terminal portions 8A & 8B. In its description of Fig. 1, Ohsawa discloses that "terminal portions 8 include external terminals 8A arranged in the lengthwise [] end … of the wires 7, and the magnetic side terminals 8B continuous with [the other] end portions of the wire." Ex. 1003 ¶ 68 – 69. In Ohsawa, the terminals are attached to, and thus part of, the conductive path of the wiring traces, and therefore are a portion of the wiring traces. Thus, Ohsawa's terminals 8A and 8B connected to the wires 7 correspond to claim element 2[b] that recites "a terminal provided at a portion of said wiring trace."

82. A person of ordinary skill would understand that Ohsawa expressly discloses the features of claim element [2b].

[2c] a lead wire for plating formed on said insulating layer and extending from said wiring trace

83. As shown in Fig. 1, Ohsawa discloses a plurality of "plating leads 18" that extend from the wiring traces where they contact the terminals 8A. Id., Fig. 1.



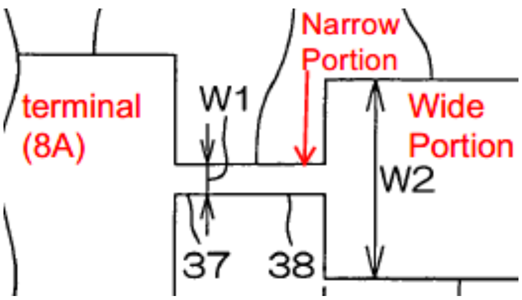
84. Ohsawa discloses that the "conductive layer 4 is formed on a surface of the insulating base layer 3 and integrally includes conductive patterns 6 and second plating leads 18." Id. ¶ 67. In fact as you can see from Fig. 1, the lead wires for plating 18, extend from the terminals 8A. In Ohsawa, the terminals are attached to and thus part of the conductive path of the wiring traces, and therefore are a portion of the wiring traces. Thus, Ohsawa discloses a "lead wire for plating [is] formed on said insulating layer and extend[s] from said wiring trace" as required by claim element 2c.

85. A person of ordinary skill would understand that Ohsawa expressly discloses the features of claim element [2c].

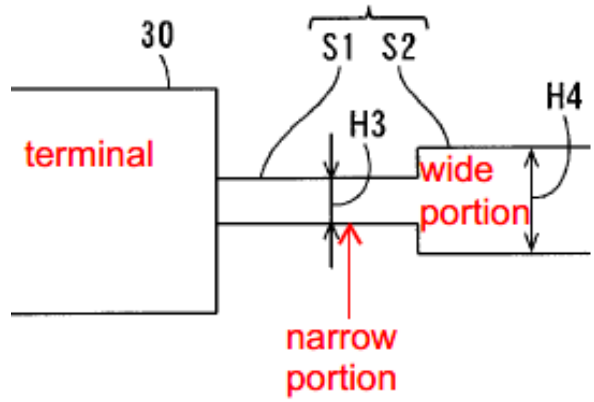
> **[2d] wherein said lead wire for plating includes: a first linear portion extending from said wiring trace and having a first width; and a second linear portion extending from said first linear portion and having a second width that is different from said first width, wherein said first width is smaller than said second width.**

86. Claim element [2d] describes a lead wire for plating with a narrow portion followed by a wide portion, where the narrow portion begins at the terminal. Ohsawa discloses that exact configuration: a lead wire 18 with a narrow section (10) with width W1 connected to the terminal 8A and a wide section (11) with width W2, where W2 is greater than W1. Therefore, this is a lead wire for

plating where a narrow portion, beginning at the terminal, is followed by a wide portion.



Ex. 1003 (Ohsawa), Fig. 3.



Ex. 1001 ('870 patent), Fig. 7

87. This is also clearly shown in Ohsawa's Fig. 3 compared to the '870 patent Fig. 7. Moreover, Ohsawa discloses that the "narrow portion" of the plating lead "is formed so as to extend in the lengthwise direction, and has a generally rectangular shape … from the … external terminal 8A. Ex. 1003 ¶ 76. Ohsawa further discloses that "the wide portion 11 is arranged forwardly adjacent to the narrow portion 10, and is formed in generally a rectangular shape … continuous with the narrow portion 10" as an example of a plating lead configuration. Id. ¶ 77.

88. Furthermore, in Ohsawa both the "wide portion 11" and the "narrow portion 10" are linear in shape (straight) and form a continuous linear plating lead. See, Id. ¶ 77; Id., Fig. 3.

89. A person of ordinary skill would understand that Ohsawa expressly discloses the features of claim element [2d].

90. Accordingly, Ohsawa expressly discloses all of the limitations of claim 2, and therefore anticipates claim 2.

C. Claim 1: Ishii in view of Zeng

1. Independent Claim 1

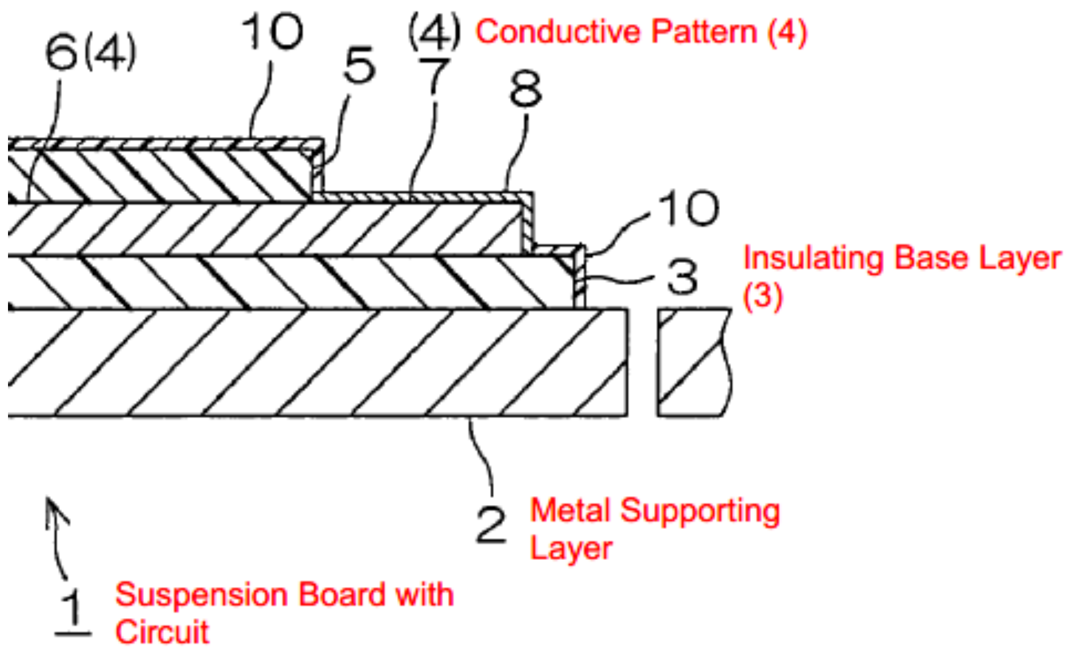
[1a] A printed circuit board comprising: a suspension body; an insulating layer formed on said suspension body; a plurality of wiring traces formed on said insulating layer;

91. Ishii discloses the main features of a standard flexible suspension printed circuit board. Ex. 1007 ¶ 3 and following paragraphs. Ishii discloses each of the layers of the suspension boards:

> The suspension board with circuit 1 includes a metal supporting layer 2, an insulating base layer 3 formed on the metal supporting layer 2, a conductive pattern 4 formed on the insulating base layer 3

Id. ¶ 48.

92. These features are illustrated in Ishii, Fig. 3:



93. Accordingly, "the metal supporting layer 2" of Ishii corresponds to the "suspension body" of claim 1 of the '870 patent. A person of ordinary skill in the art would understand that a "suspension body" as used in the '870 patent is a metal support layer of the flexure.

94. `For instance, the '870 patent refers to the suspension body 10 as "formed of a long sized metal substrate". '870 patent, Col. 6, lines 21 – 24. As shown below, Fig. 2 of the '870 patent illustrates the suspension body made of stainless steel as the bottom metal support layer "10", which has a base insulating layer "11" on top of the suspension body, and a conductive wiring trace "20" on top of the base insulating layer.

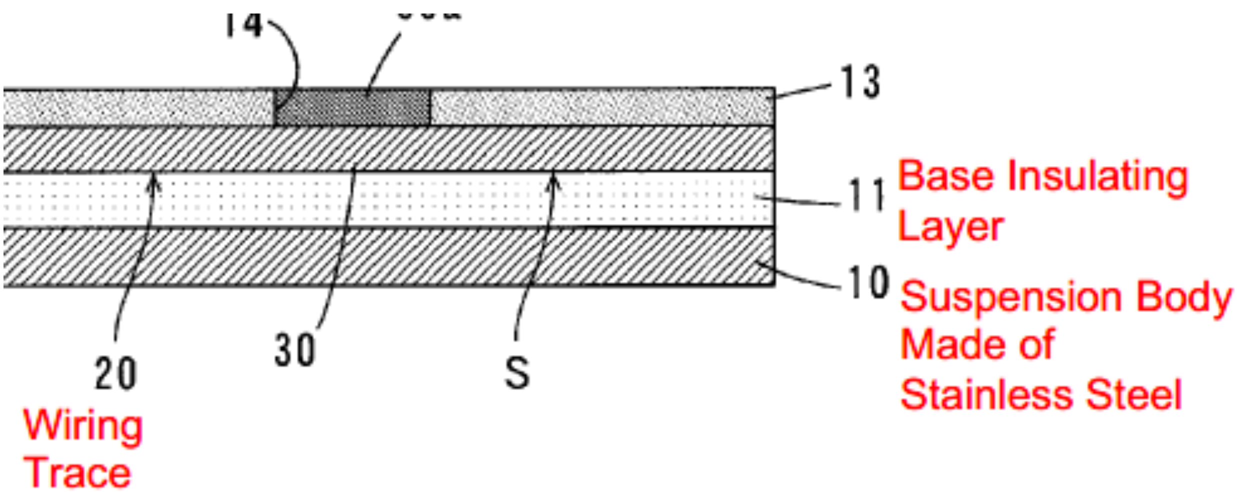


Fig. 2 '870 patent

95. Furthermore, the materials used for the metal support layer of Ishii and the suspension body of claim 1 of the '870 patent are the same. For instance, in Ishii, it discloses that the metal supporting layer 2 … is formed of a metal material, such as stainless steel . . ." Ishii ¶ 49. Similarly, the '870 patent discloses that the suspension body is also made of stainless steel, for example. '870 patent, column 6, lines 59 – 60.

96. Because both layers are made of the same material, a person of ordinary skill and experience would understand these layers serve the same support function and are identical or equivalent.

97. Additionally, the "insulating base layer 3 formed on the metal supporting layer 2" of Ishii corresponds to the insulating layer formed on the suspension body of claim 1 of the '870 patent.

98. Ishii discloses that "[p]referably the insulating base layer 3 is formed of polyimide." ¶50. Similarly the '870 patent describes "a base insulating layer made of polyimide … formed on the suspension body. '870 patent, column 6, lines 58 – 59. Because both layers are made of the same material and are in the same orientation with respect to each other, a person of ordinary skill and experience would understand that these layers serve the same support function and are identical or equivalent.

99. Finally, Ishii's disclosure of a "conductive pattern 4 formed on the insulating base layer" corresponds to the plurality of wiring traces formed on said insulating layer of claim 1 of the '870 patent.

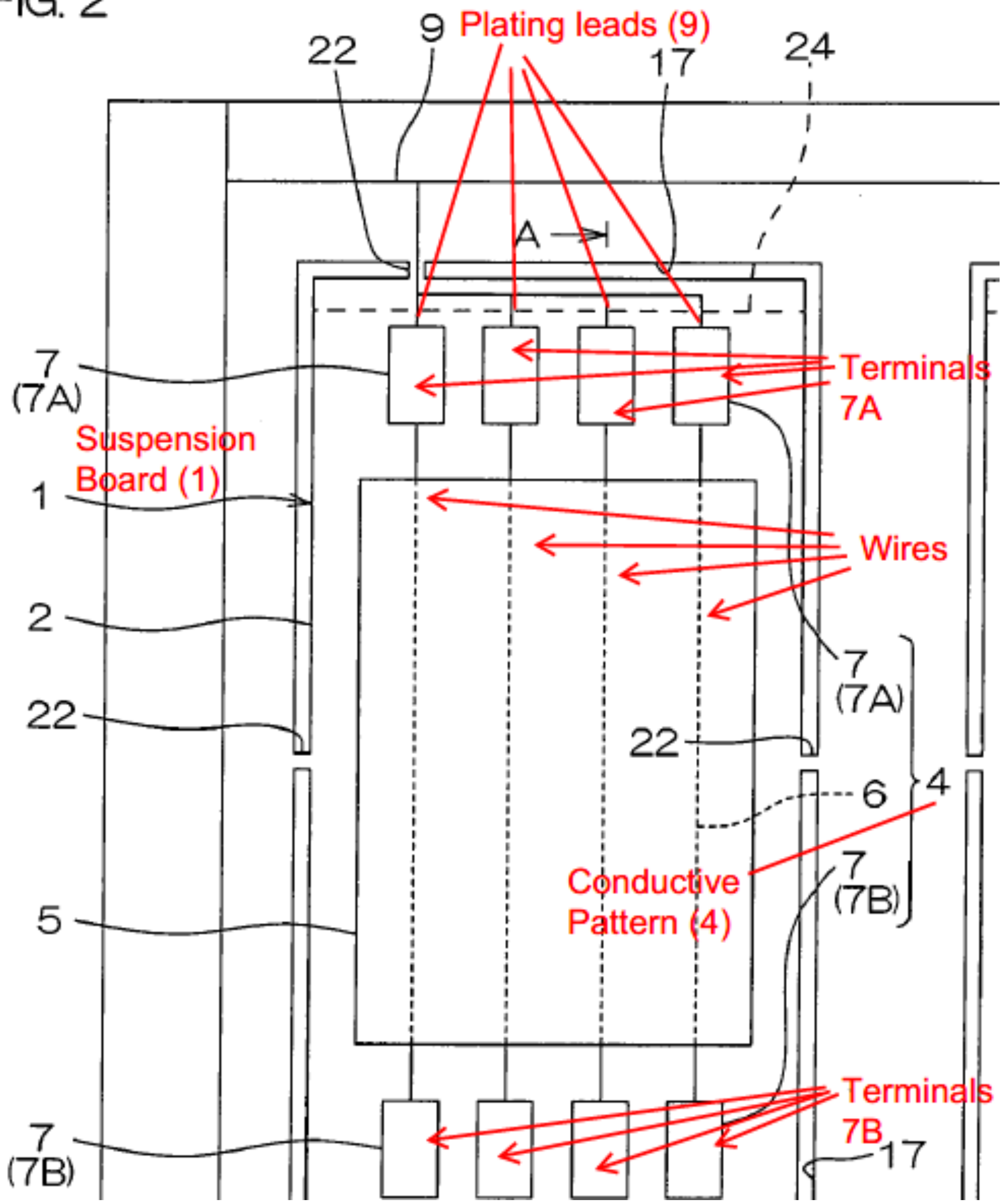
100. Ishii discloses "[p]referably the conductive pattern 4 is formed of copper." Ishii ¶ 54. Likewise, the '870 patent describes that the plurality of wiring traces and the plurality of lead wires for plating are made of copper and formed on the base insulating layer 11. '870 patent, column 6, lines 61 – 63. Because both layers are made of the same material and are in the same orientation with respect to each other, a person of ordinary skill and experience would understand these layers

serve the same function and are equivalent. The Ishii publication discloses element 1a.

[1b] a first terminal provided at one end of each of said plurality of wiring traces; a second terminal provided at another end of each of said plurality of wiring traces;

101. As shown below in Fig. 2, Ishii discloses wires 6 of the conductive pattern 4 arranged between terminal portions 7A & 7B (Id., ¶56):

FIG. 2



Ex. 1007, Fig. 2.

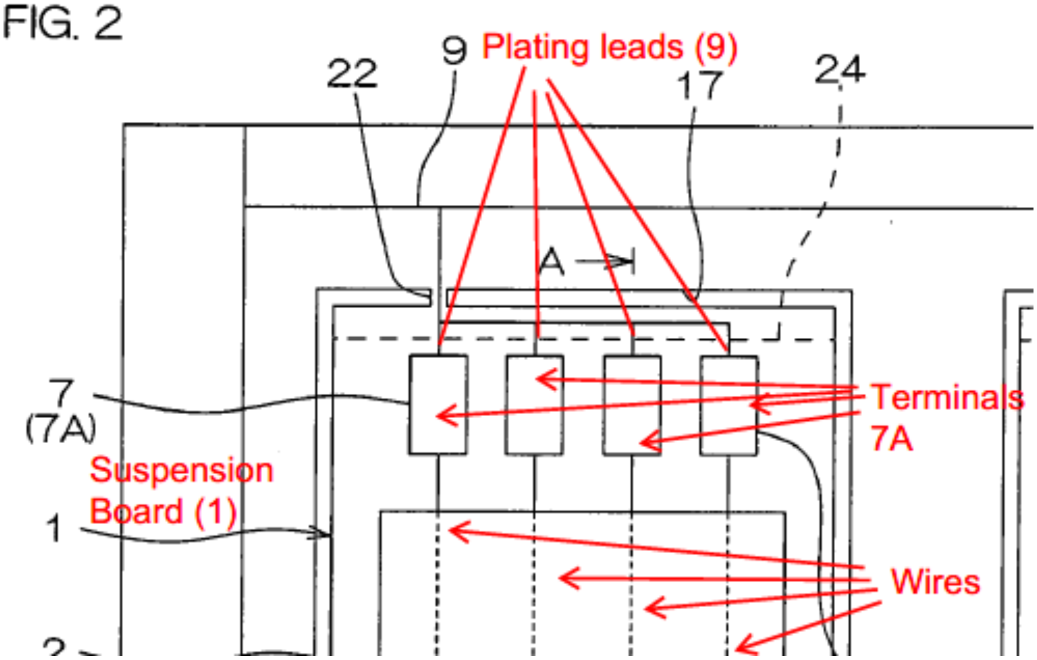
102. In Fig. 2, the terminal portions can be seen at both ends of the conductive patterns (wiring traces) as elements 7B and 7A. Id. & ¶¶ 41 – 44 (disclosing that wires run between terminal portions 7A and 7B). Thus, Ishii's

terminals 7A and 7B are connected to both ends of wires 6 and correspond to the "first terminal provided at one end of each of said plurality of wiring traces; and a second terminal provided at another end of each of said plurality of wiring traces." Accordingly, Ishii expressly discloses the limitations of element [1b].

[1c] a plurality of lead wires for plating formed on said insulating layer, one of said plurality of lead wires extending from each first terminal of said plurality of wiring traces, wherein the plurality of lead wires for plating are not connected to one another;

103. Ishii discloses that "a plating lead 9 is formed on the insulating base layer 3." Id. ¶ 71. These plating leads can be seen in Fig. 2:

FIG. 2



Id., Fig. 2.

104. A person of skill in the art would understand that (Nitto's) Ishii's plating leads 9, illustrated as a "line" on the wiring **schematic** of FIG. 2, would

necessarily have physical width and length dimensions. The flexure is separated or cut along the tear-line notch 24. Accordingly, Ishii's "plating leads 9" that are "formed on the insulating base layer 3" disclose a "plurality of lead wires for plating formed on said insulating layer." As described below, Ishii discloses the portion above the dotted line 24 is removed during manufacturing (Id. ¶ 65), which leaves multiple plating leads that each extend from terminals 7A, which thus discloses a plurality of lead wires for plating.

105. While Ishii shows in Fig. 2 that plating leads 9 are all connected initially, Ishii further describes that a portion of the plating leads 9 will be removed that connect them to each other, which creates separate plating leads 9 that are not connected. For instance, Ishii further discloses that notches 24 are provided "where plating lead 9 is branched into four leads, and is formed in a perforated shape. This allows removal of the portion where the plating lead 9 is combined into one lead." Ex. 1003 ¶ 65; See also Id., Fig. 2.

106. Accordingly, the portion in Fig. 2 above the dotted line is removed as part of manufacturing, leaving only four plating leads 9 with open ended connections that are connected to the terminals 7A. The four open ended plating leads from the terminal would comprise a plurality of lead wires for plating.

107. Additionally, in Fig. 2, each of the "plating leads 9" extend from separate "terminals 7A." Ex. 1007, Fig. 2. Ishii also discloses that "the plating lead 9 is branched so as to be connected to each . . . terminal portion 7A. Id. ¶ 46. Accordingly, Ishii discloses one of said plurality of lead wires extending from each first terminal of said plurality of wiring traces.

108. Accordingly, Ishii discloses all of the limitations of element [1c].

[1d] each of said plurality of lead wires for plating includes: a first linear portion extending from each first terminal and having a first width; and a second linear portion extending from said first linear portion and having a second width that is smaller than said first width.

109. Ishii does not disclose lead wires for plating with a first width connected to the terminal that is wider than a second width (e.g. terminal –wide portion – narrow portion). Rather, Ishii simply discloses plating leads. *See* Ex. 1007. For instance, Ishii discloses plating leads that have a singular thickness of 15 μm. *Id.* ¶ 128.

110. However, the configuration of element [1d] is disclosed explicitly by Zeng, which discloses "plating bars 140A and 140B" that corresponds to lead wires for plating. Id., ¶ 12. Particularly, Zeng discloses that plating bars 140 used to "provide an electric current … to allow plating of the contact points." Ex. 1006 ¶ 3. Furthermore, as shown in Figure 2, plating bars 140 are depicted as lines

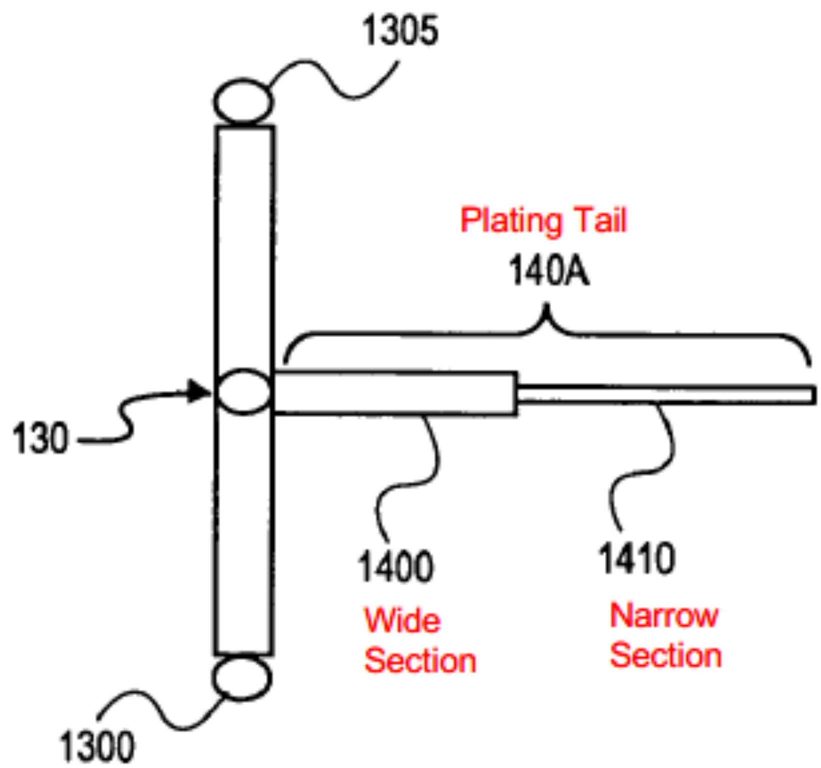
extending from contact points 130, and therefore must be thin metal lines (e.g. conductive traces, wires) that extend from the contact points 130. *Id*., Fig. 2.

111. Zeng also discloses lead wires for plating (plating bars 140), that have a first linear portion extending from each first terminal [that is narrower than] a second linear portion extending from the first linear portion. First, Zeng discloses that plating bar 140A (or lead wires for plating) extend from contact point 130. Ex. 1007 ¶ 12 ("Contact points 130 are electrically connected to edge metallization 135 though plating bars 140A and 140B.") Id., Fig. 3 (Illustrating plating tail 140A extending from contact point 130).

112. Additionally, "contacts points 130" are a type of terminal as described by Zeng and are "electrical contact points (e.g. contact pads on a surface of die 110) [that] are connected to a substrate package 120 through, for example, a conductive bump layer and/or wire bonds." Id. ¶ 10. Accordingly, electrical contact points, are another name for contact pads, which are another name for terminals – they connect electrical components on or to the board. Accordingly, the contact points 130 of Zeng are the first terminal in claim 1.

113. Second, Zeng discloses "FIG. 3 shows an embodiment where plating bar 140A is designated in two sections 1400 and 1410 …[and] section 1400 [has] a thickness or width dimension that is greater than a thickness or width dimension of

section 1410." Id. ¶ 14. Thus, Zeng's two sections 1400 and 1410 disclose the first and second linear portion, where the first linear portion is wider closer to the terminal (contact point 130).



Ex. 1006, Fig. 3.

114. Zeng discloses that this is one technique for shifting plating bar resonance and a person or ordinary skill in the art would understand that this resonance frequency shifting technique is used in order to avoid interference with the transmitted signals.

115. Zeng says that "One technique for shifting plating bar resonant frequency to [a] higher [frequency] is to modify a characteristic impedance along

the length of the plating bar." (Id. ¶ 14.) Likewise, the '870 patent states that in the lead wire for plating, "the first width may be larger than the second width . . . [and] [i]n this case, the resonance frequency in the lead wire for plating is increased." (Column 2, lines 46-53). The '870 patent further states "this allows the resonance frequency in the lead wire for plating to be higher than the electrical signal transmitted through the wiring trace." Id. As a result "effects of the resonance in the lead wire for plating to be exerted on the wave form of the electrical signal can be reduced." (Id.).

116. A person of ordinary skill in the art would know that the open ended leads on the suspension board might cause resonant interference with the transmitted signal, causing difficulties in the recovery of the transmitted information. Thus, a person of ordinary skill in the art – wishing to reduce the resonant interference of plating leads in the circuit– would combine these references (Ishii and Zeng) to make a flexible suspension circuit board with plating leads that are wider closer to the terminals as in claim 1.

117. One of the simplest and a well known techniques to change the impedance of a circuit component like a plating lead on a flexible PCB used in an HGA is to change its dimensions. The change in dimensions will change the resonant frequency in that circuit component. A circuit designer will change the

resonant frequency of the component (the plating lead) in order to make it different from the frequencies of the transmitted signal and thereby reducing potential interference with the transmitted signal. Although there are other techniques to change the impedance of a two dimensional circuit component on a printed circuit board, these other techniques require changing material properties, the thickness of films, etc. and would add additional steps and costs to PCB manufacturing.

118. While Ishii discloses plating leads that are open ended and likely to cause interference, a person of ordinary skill in the art would easily confirm from Zeng that changing the width of the plating leads extending from the terminals would change the electrical resonance and reduce the interference with the transmitted signals.

119. While the Zeng reference is directed to plating bars for a type of circuit board called an integrated circuit package substrate, the same principle applies to other types of printed circuit boards and would have predictable results, i.e., if one varies the width of the plating leads and thereby changes the resonant frequency of the plating leads then interference with the transmitted signals in the circuit board can be reduced. Whether the plating leads are on an integrated circuit package substrate or on a flexible printed circuit board connected to a suspension assembly, the known problem of open plating wires or stubs can be addressed by

changing plating wire width. Thus, a person of ordinary skill in the art would be motivated to review the Zeng reference as a solution to the plating lead resonance problem that does not require removal of the plating leads.

120. Indeed, the ‘870 patent itself even refers to in the background section to a different type of printed circuit board used for **integrated circuit packaging** called a “Ball Grid Array.” Ex. 1001 at Col 1:28-30. This teaches a person of ordinary skill in the art to consider prior art references to integrated circuit packaging. Accordingly, the ‘870 patent’s background teaches that integrated circuit packaging is in the same field of art as flexible printed circuit boards for suspension assemblies. Accordingly, one of ordinary skill in the art would certainly look to principles employed on integrated circuit packaging to apply to other printed circuit boards like flexible suspension boards for HGAs.

121. Accordingly, Zeng discloses all of the limitations of element [1d]. Its combination with Ishii therefore renders claim 1 obvious.

D. Claim 2: Ishii in view of Lennard

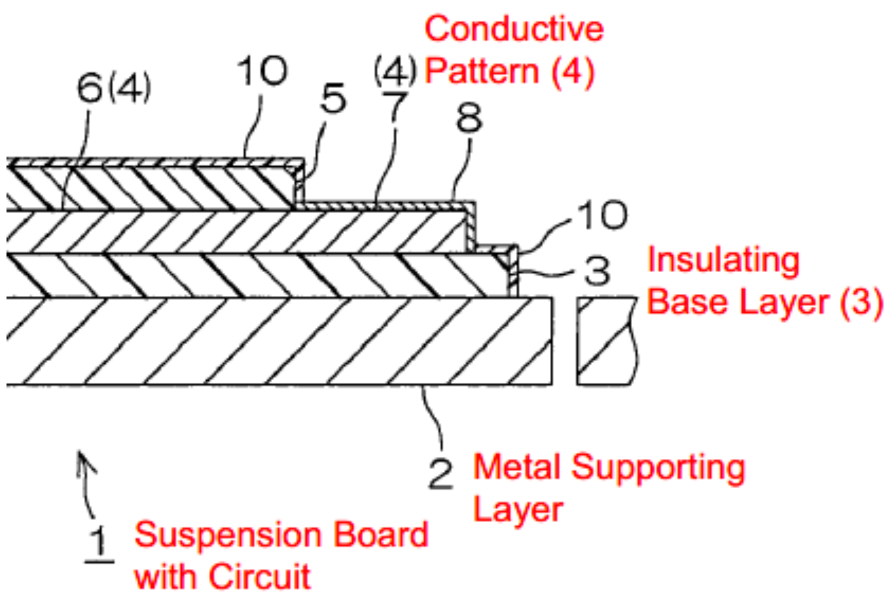
1. Independent Claim 2

[2a]: A printed circuit board comprising: a suspension body; an insulating layer formed on said suspension body; a wiring trace formed on said insulating layer;

122. The Ishii publication discloses the main features of a standard suspension, printed circuit board ("suspension boards with circuit 1"). Ex. 1007 ¶¶ 39, 40 – 44. Particularly, Ishii discloses each of the layers of the suspension boards:

> The suspension board with circuit 1 includes a metal supporting layer 2, an insulating base layer 3 formed on the metal supporting layer 2, a conductive pattern 4 formed on the insulating base layer 3

Id. ¶ 48. These features are illustrated in Fig. 3:



Id., Fig. 3.

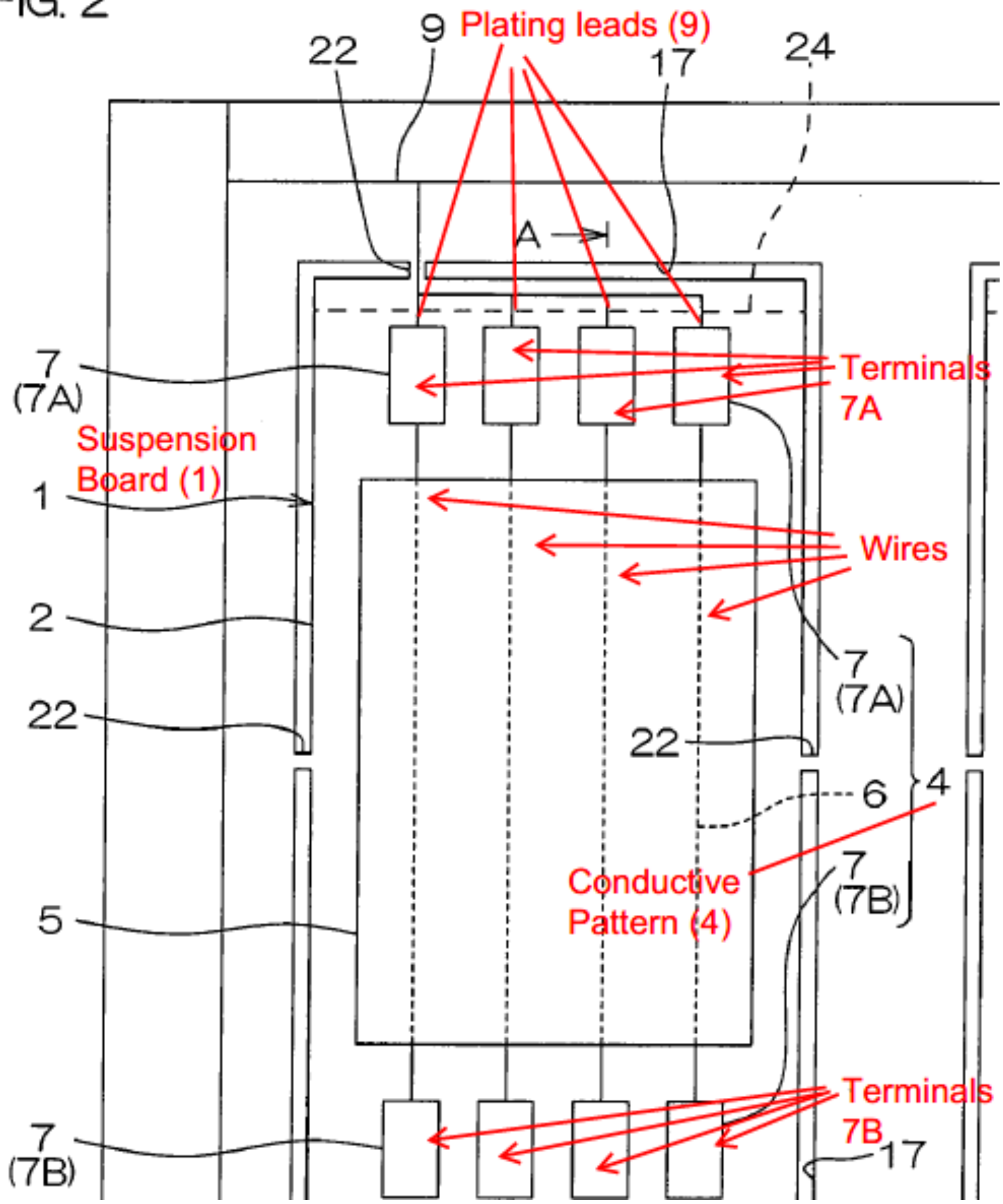
123. As is evident to a person or ordinary skill in the art, "the metal supporting layer 2" of Ishii corresponds to the *suspension body* of claim 2 in patent

'870. Additionally, the "insulating base layer 3 formed on the metal supporting layer 2" of Ishii corresponds to the *insulating layer formed on said suspension body* of claim 2 in the '870 patent. Finally, the "conductive pattern 4 formed on the insulating base layer" of Ishii corresponds to the *plurality of wiring traces formed on said insulating layer in the '870 patent*. Therefore, the Ishii Publication discloses all of the limitations of element [2a].

[2b]: a terminal provided at a portion of said wiring trace; and

124. As shown below in Fig. 2, Ishii discloses conductive patterns 6 arranged between terminal portions 7A & 7B:

FIG. 2



Ex. 1007, Fig. 2.

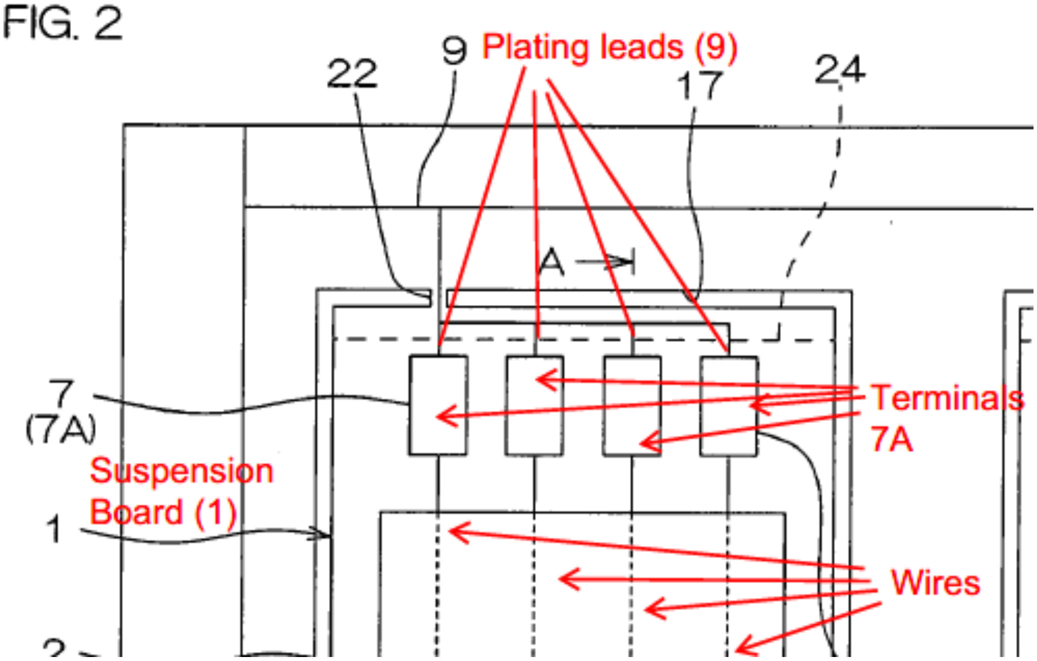
125. These terminal portions can be seen at both ends of the conductive patterns (wiring traces) as elements 7B and 7A. Id.; See also id. ¶¶ 41 – 44 (disclosing that wires, 6, run between terminal portions 7A and 7B). Thus, Ishii's

terminals 7a and 7B connected to both ends of wires 6 correspond to a terminal provided at a portion of said wiring trace in the '870 patent. Accordingly, Ishii discloses all of the limitations of element [2b].

[2c]: a lead wire for plating formed on said insulating layer and extending from said wiring trace,

126. Ishii discloses that "a plating lead 9 is formed on the insulating base layer 3." Ex. 1007 ¶71. These plating leads can be seen in Fig. 2:

FIG. 2



Id., Fig. 2.

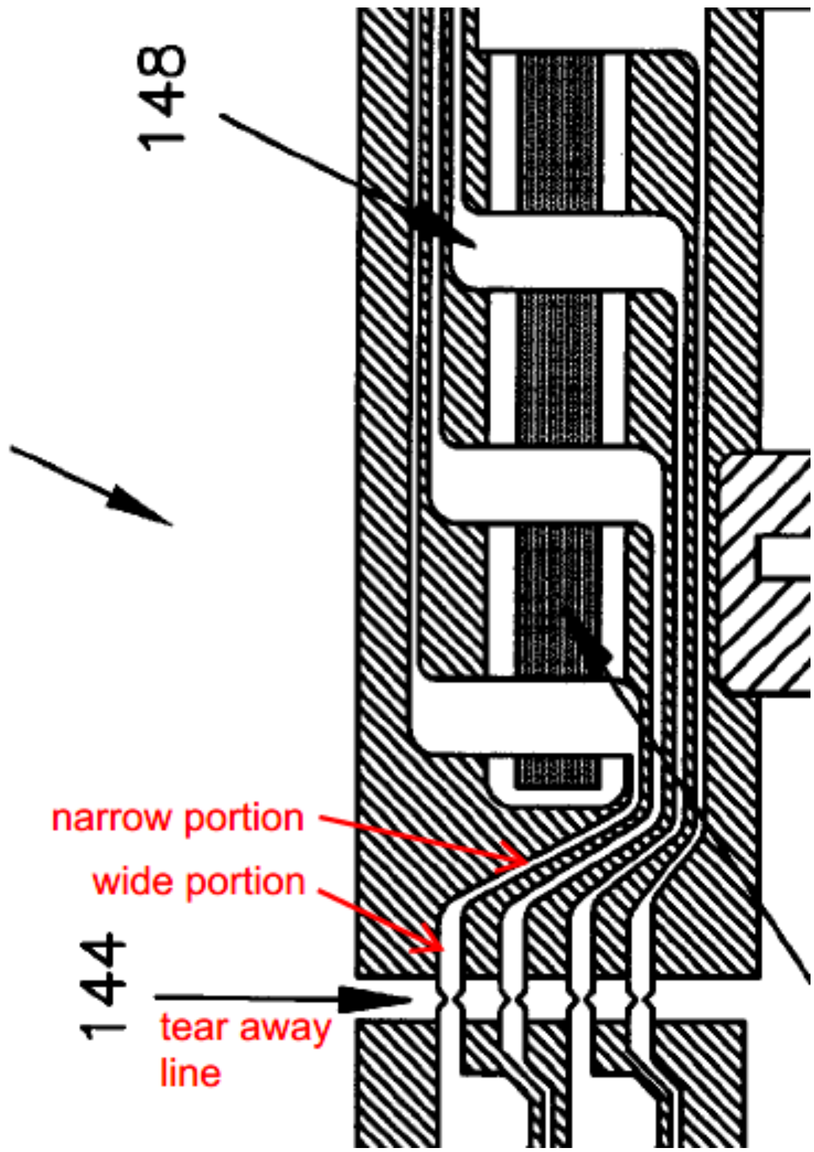
127. Accordingly, Ishii's "plating leads 9" disclose a lead wire for plating formed on said insulating layer.

128. Additionally, in Fig. 2, each of the “plating leads 9” extend from separate “terminals 7A.” Id., Fig. 2. Ishii also discloses that “the plating lead 9 is branched so as to be connected to each . . . connecting terminal portion 7A.” Id. ¶ 46. Thus, because the plating leads 9 extend from the terminal 7A, Ishii discloses a lead wire for plating … extending from said wiring trace. Accordingly, Ishii discloses all of the limitations of element [2c].

[2d] wherein said lead wire for plating includes: a first linear portion extending from said wiring trace and having a first width; and a second linear portion extending from said first linear portion and having a second width that is different from said first width, wherein said first width is smaller than said second width.

129. Element [2d] requires plating leads that are connected to the wire traces and have two portions: a narrower portion close to the connection to the trace, and a wider one connected to the narrower one. Ishii does not disclose element [2d]. Similar to Ohsawa, however, the Lennard Patent illustrates another suspension board with the plating leads that have a narrower portion adjacent to the terminal as required by patent ‘870 claim 2. Ex. 1004, Fig. 2. Specifically, Lennard discloses plating leads that are narrower on the side where they connect to the traces/terminal and wider towards the edge of the substrate. Id.

130. Fig. 2 of Lennard shows leads that connect to terminals that are narrower closer to the terminal, but that widen at the point at which they reach the tear off point of the test pads:



Id., Fig. 2.

131. As illustrated, the bottom tab will eventually be separated at 144 ("test pad tear away"). *Id.* at 3: 65 –4: 9 ("[a] test pad tear away 144 is provide as a region allowing the test pads 142 to be easily removed."); *See also, Id.* at 5:12 – 16. Accordingly, after tearing away the test pad (which is the portion below 144), the leads above 144 that terminate at the pinch points indicated by the arrow of 144 will be open stubs without any electrical connection. *Id.* at 4: 4 – 18 (disclosing that after tear away, the exposed portions 148 will be connected to the PCCA (Printed Circuit Cable Assembly, the preamp flex and cable assembly) electrical connections – leaving the ends at 144 to be open stubs).

132. Lennard also confirms that exposed leads 148 are terminals for connecting to the PCCA electrical connections. Id. Accordingly, Fig. 2 discloses open-ended leads that are narrower near the terminals 148, and wider near the open end 144. Id., Fig. 2. The first linear portion of the stub in Lennard connected to the terminal 148 that is narrow corresponds to the first linear portion extending from said wiring trace in patent '870 (e.g. the trace/terminal 148). The second linear portion of Lennard connected to the first linear portion that is wider than the first linear portion (as shown in Fig. 2) corresponds to the second linear portion extending from said first linear portion with a width that is [wider] than the width of the first linear portion in the '870 patent.

133. While Lennard does not explicitly state that the purpose of the "lead wires" is for plating, these are leads connected to terminals, which are normally electroplated. Therefore these would be understood by a person of ordinary skill in the art to be lead wires for plating.

134. A person of ordinary skill in the art would know that the open ended leads on the suspension board might cause electrical interference with the transmitted signal, causing difficulties in the recovery of the transmitted information. Thus, a person of ordinary skill in the art – wishing to reduce the electrical interference of plating leads in the circuit– would combine these references to make a flexible suspension circuit board with plating leads that are narrower closer to the terminals as in claim 2.

135. A person of ordinary skill in the art would be motivated to combine Ishii with Lennard, because both references describe circuit boards, and further because both relate to flexible circuit boards for hard disk drives. Additionally, both references have a component that is removed during assembly (a portion of the plating leads in Ishii and the tab below 144 in Lennard, as described above). This leaves open-ended wires on the circuit board that could cause electrical interference due to resonance with components of the transmitted signal.

136. As discussed above, a person or ordinary skill in the art designing a circuit board like Ishii would look to Lennard as an alternative solution for reducing electrical interference likely to occur in Ishii due to open ended stubs.For instance, one of skill in the art would see that in Lennard, the wires are designed to be wider at the open end and narrower near the terminal. The plating leads of Ishii could easily be modified as shown in Lennard to reduceelectrical interference from the open ended stubs.

137. Accordingly, the combination of Ishii and Lenard renders claim 2 obvious to a person of ordinary skill in the art.

E. Claim 4: Ishii + Chou + Kuzawinski

1. Independent Claim 4

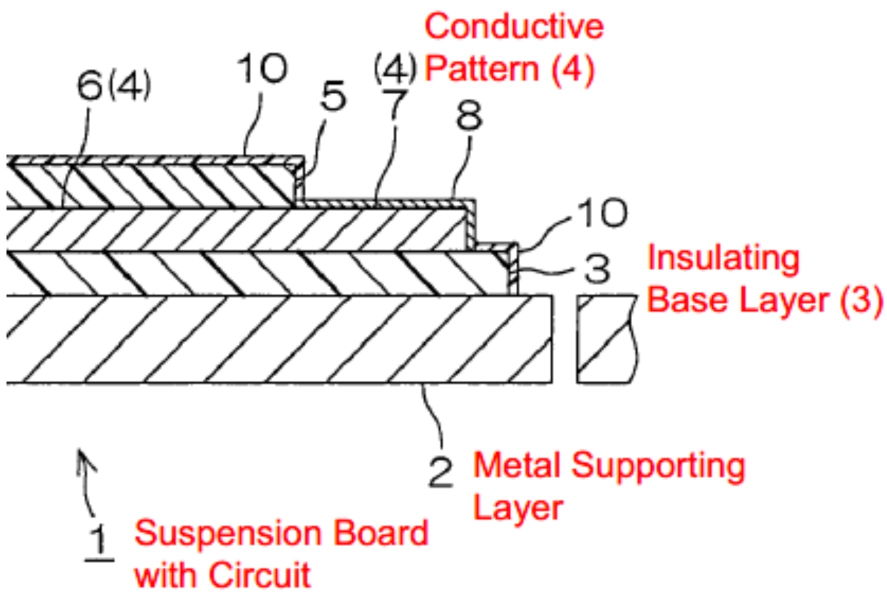
[4a]: A printed circuit board comprising: a suspension body; a base insulating layer; a plurality of wiring traces formed on said base insulating layer;

138. The Ishii publication discloses the main features of a standard suspension, printed circuit board ("suspension boards with circuit 1"). Ex. 1007 ¶¶ 39, 40 – 44. Particularly, Ishii discloses each of the layers of the suspension boards:

> The suspension board with circuit 1 includes a metal supporting layer 2, an insulating base layer 3 formed on

> the metal supporting layer 2, a conductive pattern 4 formed on the insulating base layer 3

Id. ¶ 48. These features are illustrated in Fig. 3:



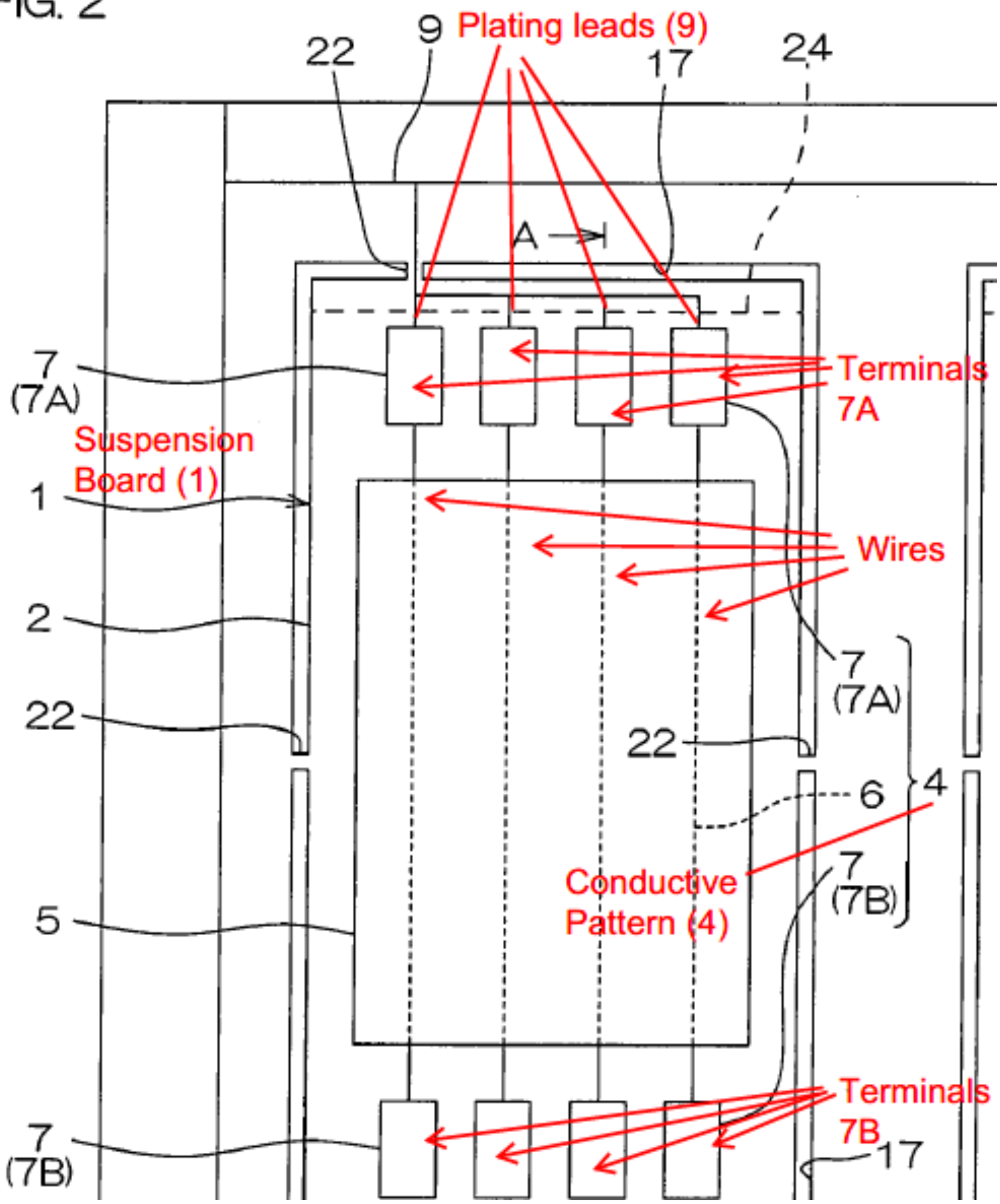
Id., Fig. 3.

139. As is evident to a person or ordinary skill in the art, "the metal supporting layer 2" of Ishii corresponds to the *suspension body* of claim 2 in patent '870. Additionally, the "insulating base layer 3 formed on the metal supporting layer 2" of Ishii corresponds to the *insulating layer of* claim 4 in patent '870. Finally, the "conductive pattern 4 formed on the insulating base layer" of Ishii corresponds to the *plurality of wiring traces formed on said base insulating layer in patent '870.* Therefore, the Ishii Publication discloses all of the limitations of element [4a].

[4b]: a first electrode pad provided at one end of each of said plurality of wiring traces; a second electrode pad provided at another end of each of said plurality of wiring traces;

140. As shown below in Fig. 2, Ishii discloses conductive patterns 6 arranged between terminal portions 7A & 7B:

FIG. 2



Ex. 1007, Fig. 2.

141. These terminal portions can be seen at both ends of the conductive patterns 6 (wiring traces) as elements 7B and 7A. Id; See also Id. ¶¶ 41 – 44 (disclosing that wires run between terminal portions 7A and 7B).

142. Ishii refers to 7A and 7B as connecting terminal portions Id. ¶41. Connecting terminal portions 7B are used to connect the wiring traces (6) to the magnetic head (see ¶41). The external connecting terminal portions 7B are used to connect the wiring traces (6) to the read/write board, ¶44. Although read/write board is not a common term in the hard drive industry it is obvious to one of ordinary skill in the art that the read/write board is the pre-amplifier, which provides current to the wiring traces to write information with the write elements of the read/write heads and measures voltages between wiring traces to read information from the read elements of the read/write heads..

143. Since the connecting terminal portions in Ishii serve the same function as the electrode pads in patent '870 they are, in fact, the same thing.

144. We have established that Ishii describes terminal portions on both ends of wiring traces (conductive patterns) and that these wiring traces run between (electrode pads (terminal portions)

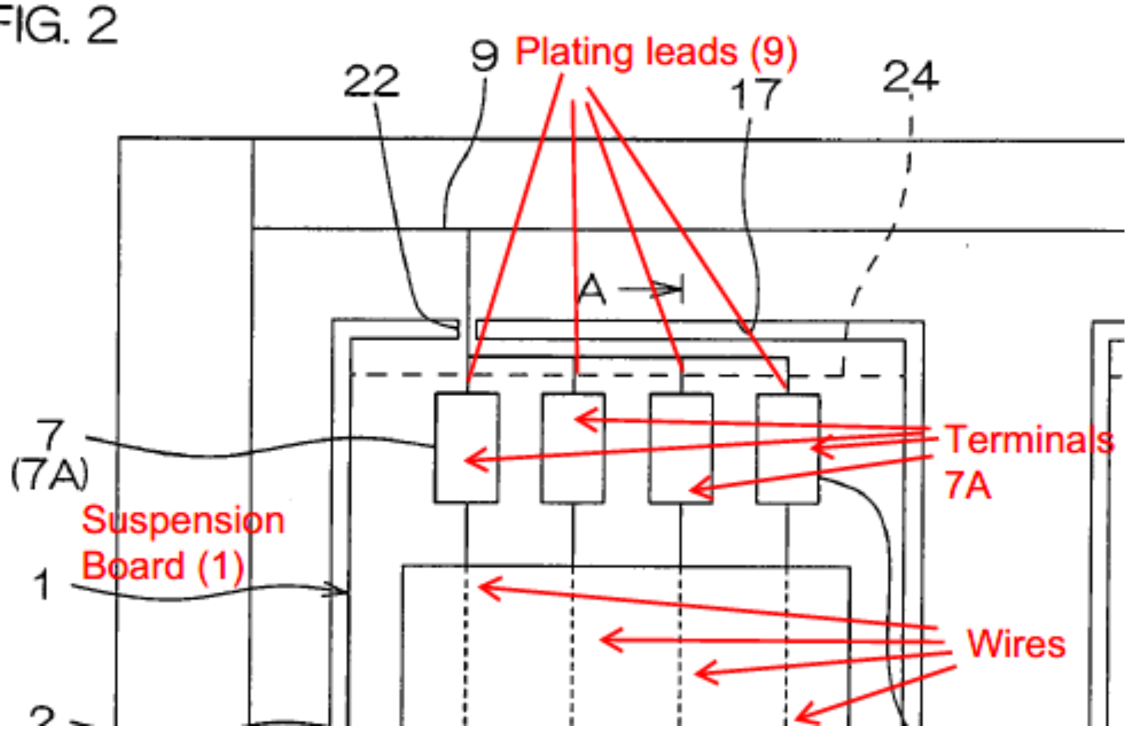
145. Accordingly, Ishii discloses all of the limitations of element [4b].

[4c]: a plurality of lead wires for plating formed on said

> **base insulating layer, one of said plurality of lead wires extending from each first electrode pad of said plurality of wiring traces; and a cover insulating layer provided to cover said plurality of lead wires for plating, wherein the plurality of lead wires for plating are not connected to one another,**

146. Ishii discloses a plurality of lead wires extending form each first electrode pad of said plurality of wiring traces, as shown below. Ishii discloses that "a plating lead 9 is formed on the insulating base layer 3." Ex. 1007 ¶ 71. These plating leads can be seen in Fig. 2,

FIG. 2



Ex. 1007, Fig. 2.

147. Ishii further discloses that notches 24 are provided "where plating lead 9 is branched into four leads, and is formed in a perforated shape. This allows removal of the portion where the plating lead 9 is combined into one lead." Id.¶ 65; See also id., Fig. 2. After removing the connected portion of the leads 9 along notches 24, only four open ended plating leads would remain. Accordingly, Ishii discloses a plurality of lead wires for plating formed on said insulating layer.

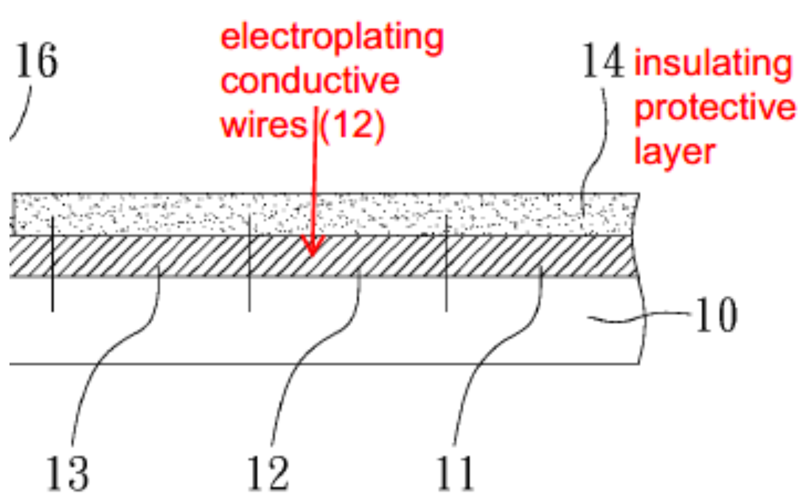
148. Additionally, in Fig. 2, each of the "plating leads 9" extend from separate "terminals portion 7A." Id., Fig. 2. Ishii also discloses that "the plating lead 9 is branched so as to be connected to each . . . terminal portion 7A. Id. ¶ 46.

149. Ishii refers to 7A and 7B as connecting terminal portions Id. ¶41. Connecting terminal portions 7A are used to connect the wiring traces (6) to the magnetic head (see ¶41). The external connecting terminal portions 7B are used to connect the wiring traces (6) to the read/write board, ¶44. Although read/write board is not a common term in the hard drive industry it is obvious to one of ordinary skill in the art that the read/write board is the pre-amplifier, which provides current to the wiring traces to write information with the write elements of the read/write heads and measures voltages between wiring traces to read information from the read elements of the read/write heads..

150. Since the connecting terminal portions in Ishii serve the same function as the electrode pads in patent '870 they are, in fact, the same thing.

151. Furthermore, Ishii's disclosure of "removal of the portion where the plating lead 9 is combined into one lead" confirms that Ishii discloses lead wires for plating that are not connected to one another. Ex. 1007 ¶ 65. For instance, the entire portion where the plating leads 9 are connected in Fig. 2 would be removed – thus leaving only unconnected, open ended plating leads 9.

152. Additionally, Ishii discloses "an insulating cover layer 5 formed on the insulating base layer 3 so as to cover the conductive pattern 4." Ex. 1007 ¶ 48. While Ishii does not disclose the cover layer provided to cover the plating leads – that is disclosed by Chou. Chou discloses that circuit board may include an "insulating protective layer 14 formed on the surfaces of the electroplating conductive wires 11." Chou ¶ 6; See also, Fig. 3B.



Chou, Fig. 3B.

153. Therefore, Ishii in combination with Chou discloses a cover insulting layer provided to cover said plurality of lead wires for plating. Furthermore, applying an insulating protective layer from Chou would have the same purpose and predictable results when applied to the suspension board of Ishii – to protect the wire from coatings or other processing steps including electroplating (protecting components that are not meant to be electroplated). One of or ordinary skill in the art of electroplating a circuit board who did not wish to electroplate the lead wires, for example to save the cost of the metal, would look to Chou to confirm that the cover layer could be extended over the plating leads.

154. Accordingly, Ishii in combination with Chou discloses all of the limitations of element [4c].

> **[4d]: wherein each of said plurality of lead wires for plating has a uniform width along a length extending from each first electrode pad to an edge of the suspension body, the uniform width of each of said plurality of lead wires for plating being larger than a width of each of said plurality of wiring traces.**

155. While Ishii and Chou disclose the majority of the features of claim 4, these references do not explicitly disclose element [4d], which requires plating leads that are wider than the wiring traces.

156. But Kuzawinksi explicitly does by reciting "a width of the plating tail substantially exceeds a width of the signal trace." Ex. 1005 at 4:45-47. Furthermore, Kuzawinski explicitly provides the rationale for doing this, including laying out the problem in detail in the background section:

> In high frequency … circuits, there can be a significant problem resulting from plating tails, in that the signal can reflect off the end of the tail . . .and then interfere [with the signals on the man traces] by cancelling the desired signal. A common solution to this problem is to remove all or most of the tail.

Id. at 1: 21 – 27.

157. Additionally, Kuzawinski details that the interference caused by the plating tail "stub" will depend on the width of the tail:

> Those skilled in the art will be aware that plating tail **36** will have a tail characteristic impedance at the operating frequency of the signals carried by trace **15** that is determined by the cross section of tail **36** . . .

Ex. 1005 at 2: 15 – 21.

158. Kuzawinski then discloses the straightforward solution which is to simply increase the plating tail width to change its impedance:

> Alternatively, the transverse dimensions of tail **36** could be set to differ from the trace characteristic impedance by increasing the width substantially from the standard trace width.

Id. at 2: 59 – 62.

159. A person of ordinary skill in the art – wishing to change the electrical interference of plating leads – would combine these references to make a suspension board with plating leads that are wider than the traces, decreasing the impedance of the plating leads. Lower impedance of the plating leads causes less interference with the electrical signals on the transmission line.

160. Thus, while Ishii discloses plating leads of unknown dimension with respect to the traces, a person of ordinary skill in the art would easily confirm – after reviewing Kuzawinski – that using uniformly thick leads that are wider than the standard wiring traces would be a way to reduce the electrical interference from the plating leads.

161. While the Kuzawinski reference is directed to plating tails (lead wires for plating) for a type of circuit board called an integrated circuit substrate, the same principle applies to plating tails in a flexible circuit board. In a flexible circuit board used in a hard disk drive flexure we can likewise change impedance by increasing the width of the plating tail. By changing the width of the lead wires

for plating we change the frequencies from the signal that are reflected by the plating lead. Changing the width of the plating lead as taught in Kuzawinski would have predictable results, i.e., to reduce interference in the transmitted signal from a floating plating lead.

162. Furthermore, the '870 patent itself refers to a type of printed circuit board used for integrated circuit packaging called a "Ball Grid Array." Ex. 1001 at 1:28 – 33. Accordingly, the '870 patent's background suggests that integrated circuit packaging is in the same field of art as circuit boards for suspension assemblies. Accordingly, one of ordinary skill in the art would certainly look to principles employed on integrated circuit packaging to apply to other printed circuit boards, like suspension boards.

163. Therefore, Kuzawinski discloses all of the limitations of element [4d]. Accordingly, Kuzawinski's combination with Ishii and Chou therefore renders claim 4 obvious.

F. Claim 2: Yang

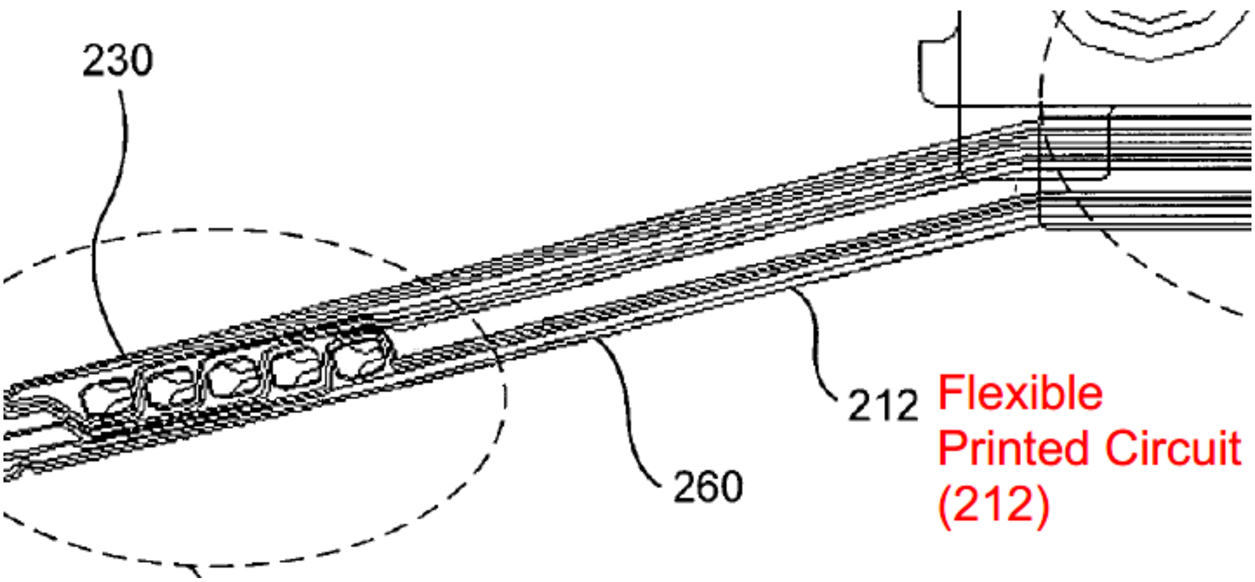
2. Independent Claim 2

[2a] A printed circuit board comprising:

a suspension body;
an insulating layer formed on said suspension body;
a wiring trace formed on said insulating layer

164. Yang, Exhibit 1011, describes a wired circuit board with the exact features of claim 2, including having different widths on different linear portions of the plating leads.

165. Yang clearly discloses the main features of a standard suspension, printed circuit board ("flexible printed circuit for a head gimbal assembly"). Ex. 1011 ¶ 9; *See also, id.* ("The flexible printed circuit includes multiple traces extending from a suspension of the head gimbal assembly"). Yang illustrates these circuit board components in Fig. 3:



Ex. 1003, Fig. 3 (annotations added).

166. Thus the "stainless steel substrate" which corresponds to the *suspension body* recited in claim 1 of the '870 patent. Id., at Fig. 2. Exhibit 1011, ¶25. A person of ordinary skill in the art would understand that a "suspension

body" as used in the '870 patent refers to a metal support layer of the flexure. For instance, the '870 patent refers to the suspension body 10 as "formed of a long sized metal substrate". '870 Patent, Col. 6: 21 – 24. As shown below, Fig. 2 of the '870 patent illustrates the suspension body made of stainless steel as the bottom metal support layer "10", which has a base insulating layer "11" on top of the suspension body, and a conductive wiring trace "20" on top of the base insulating layer.

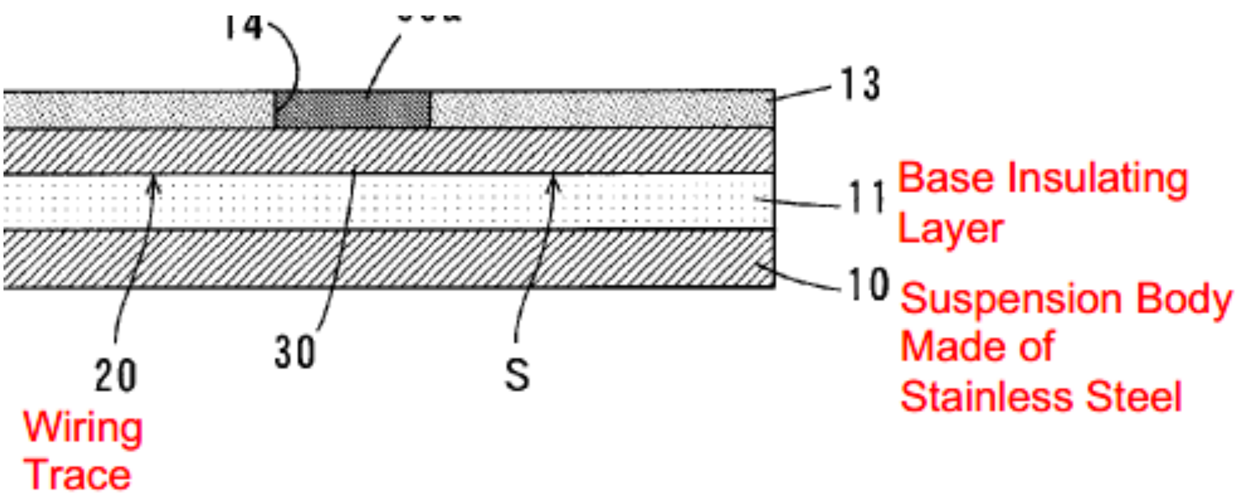


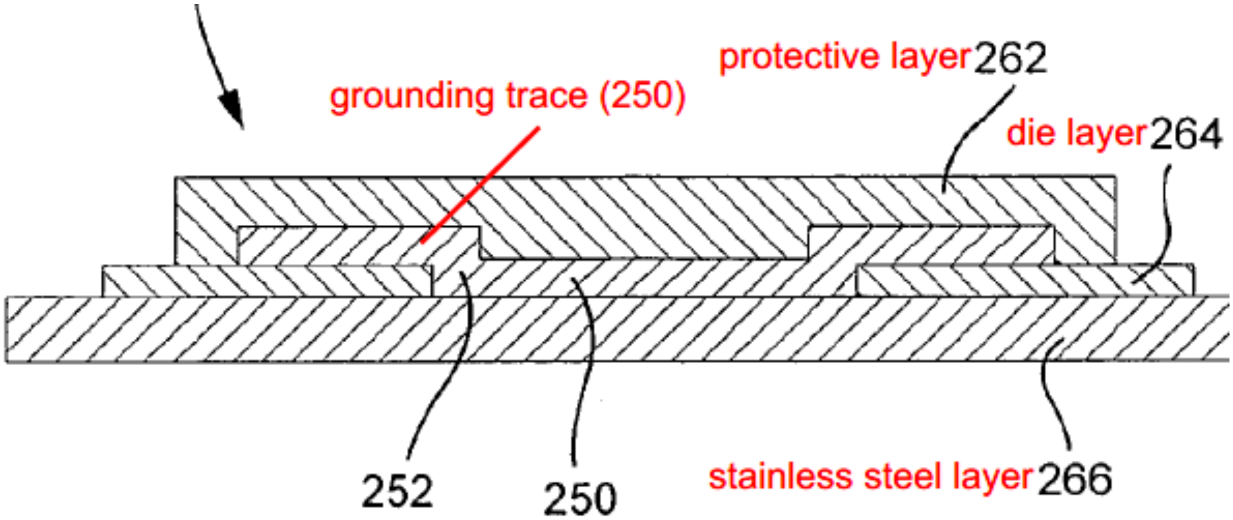
Fig. 2 '870 patent

167. Yang discloses that "FPC [flexible printed circuit] 212 and the flexure 224 are formed of a stainless steel substrate." Ex. 1011" ¶ 25. Similarly, the '870 patent discloses that the suspension body is also made of stainless steel, for example. '870 patent, column 6, lines 59 – 60. Because both layers are made of the

same material, a person of ordinary skill and experience would know and understand that these layers serve the same function and are identical or equivalent. Thus, a person of ordinary skill would understand that the "stainless steel substrate" of Yang corresponds to the "suspension body" of claim 2.

168. Furthermore, the FPC 212 inherently discloses an insulating layer as a person of ordinary skill in the art would understand an insulating layer is required for a flexible printed circuit board 212 to function as every printed circuit board would require an insulating layer to avoid the traces from shorting out. Therefore, the wiring traces on FPC 212 correspond to the *wiring trace formed on the insulating layer* of claim 2. Additionally, the FPC and flexure provided to the base plate 220 of the suspension 216 correspond to the *insulating layer formed on the suspension body* of claim 2.

169. Furthermore, FIG. 7 of Yang discloses a grounding via that includes a protective layer 262, a die layer 264, and a stainless steel layer 266. Ex. 1011 ¶ 28. Additionally Yang discloses "the end 252 of the grounding trace 250 is sandwiched between these layers 262, 264, 266. Ex. 1011¶ 28. FIG. 7 of Yang illustrates these three layers:



170. As illustrated, at least a portion of the ground trace 252 is formed on top of the die layer 264. A person of ordinary skill in the art would understand that the reference to the "die layer" is an abbreviation for dialectic layer, which is an insulator separating the stainless base from the conductive traces in the flexible printed circuit. A person of ordinary skill in the art would understand that the "die layer 264" of Yang corresponds to the "insulating layer formed on said suspension body" of claim 2. Even if Yang did not expressly disclose the insulating layer, it is necessarily inherent in the Yang FPC because the traces must be electrically separated from the metal base layer. Without the insulating layer, the traces would be electrically shorted to the stainless steel base and could not transmit signals.

171. Also, Yang discloses the "flexible printed circuit includes multiple traces to electrically connect the slider to a conductive tab and a test tab." Ex. 1011 ¶ 8. As discussed and pictured above in Fig. 7, the traces are printed on top of the

die layer or "insulating layer" and therefore Yang discloses "a wiring trace formed on said insulating layer." *Id.* ¶ 28.

172. Because the traces of Yang and the traces of the "wiring trace" of claim 2 are in the same orientation with respect to each other, a person of ordinary skill and experience would know and understand these layers serve the same function and are identical or equivalent.

173. A person of ordinary skill would understand that Yang discloses all the features of claim element [2a].

[2b] a terminal provided at a portion of said wiring trace; and

174. Yang discloses traces 218 that are provided at conductive pads 232, which are a type of terminal:

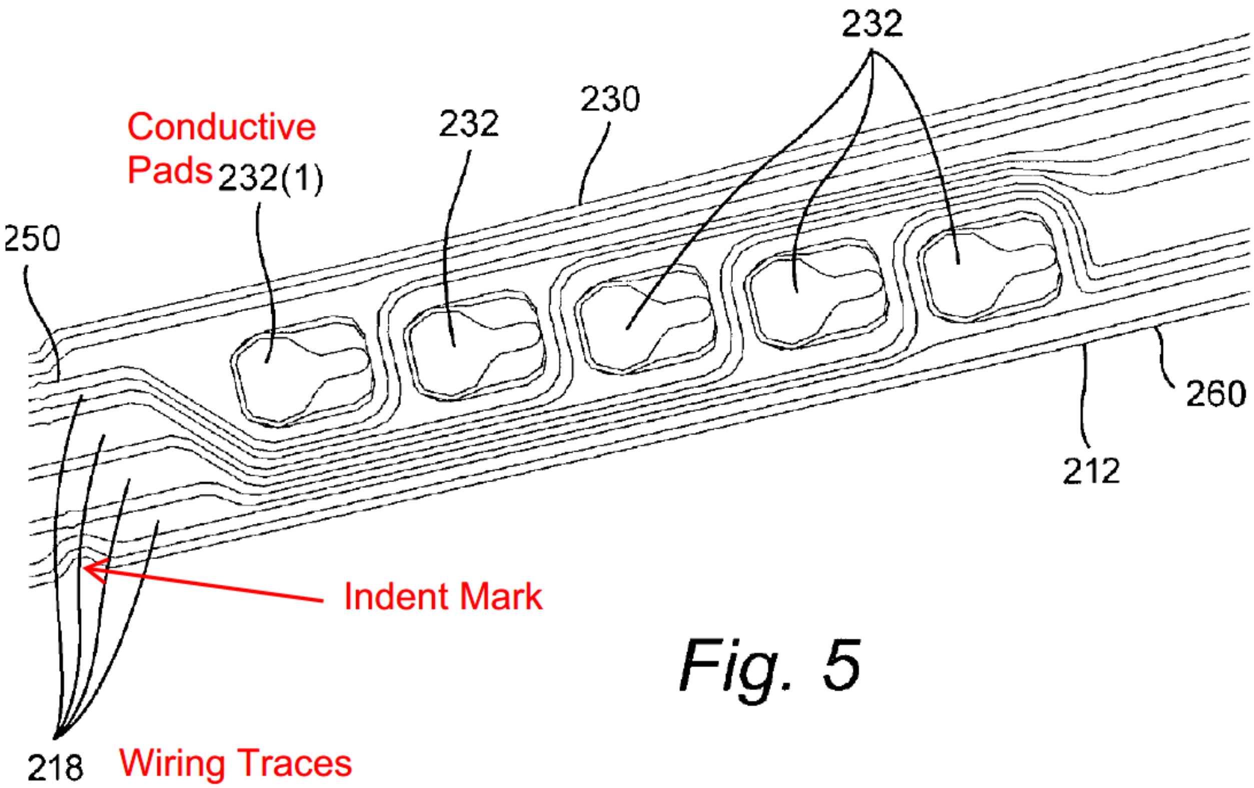


Fig. 5

175. Ex. 1011, Fig. 5. Yang discloses that "the multiple traces 218 are electrically connected to … conductive pads 232." Ex. 1011 ¶ 26. Thus, Yang's electrode pads 232 (terminals) connecting to traces 218 correspond to "a terminal provided at a portion of said wiring trace."

176. A person of ordinary skill would understand that Yang expressly discloses the features of claim element [2b].

[2c] a lead wire for plating formed on said insulating layer and extending from said wiring trace

177. Yang discloses that the "FPC 212 includes multiple traces or leads 218, e.g. four traces." Ex. 1011 ¶ 26. As illustrated, traces or leads 218 extend from

the terminals and eventually widen on the left side of Fig. 5. Accordingly, the traces 218 themselves form lead wire[s] for plating … extending from said wiring trace as they extend to the left in Fig. 5 and to the end of the test tab in Figure 4 as part of (and thus extending from) traces 218. Ex. 1011, Fig. 5.

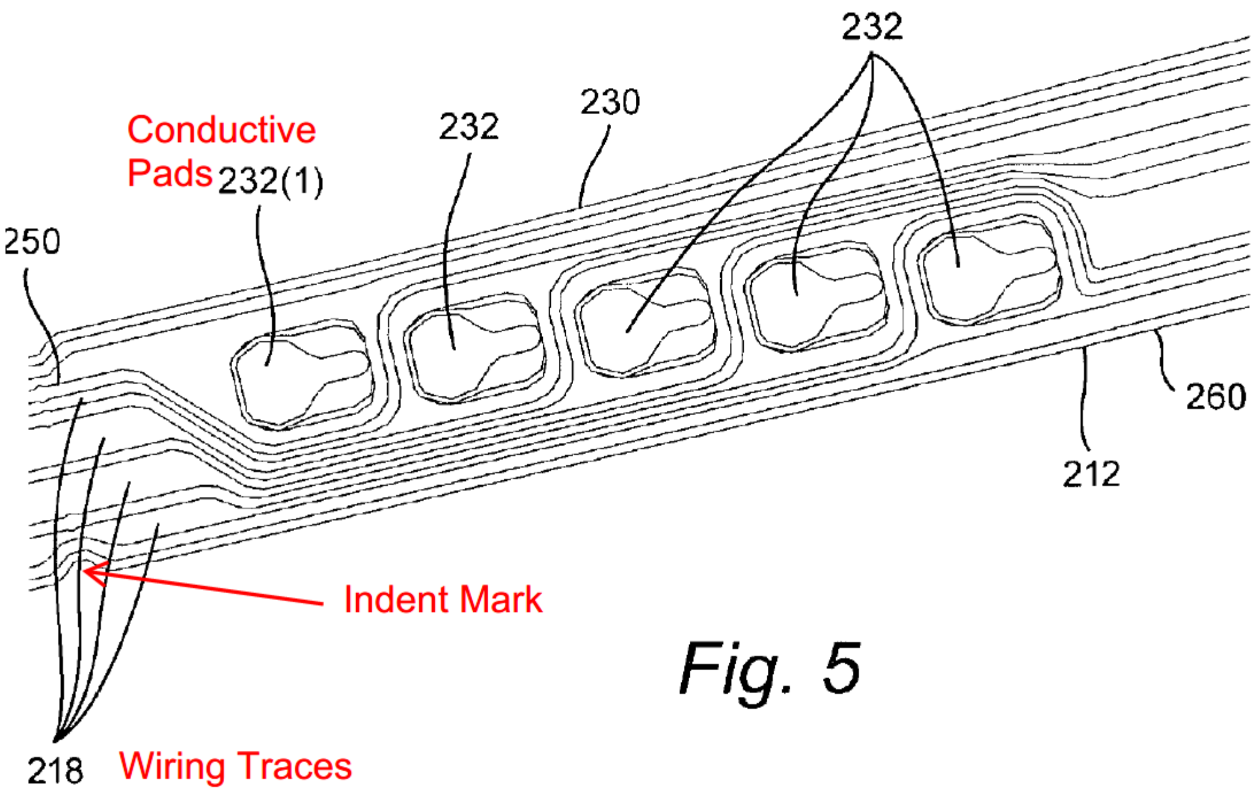
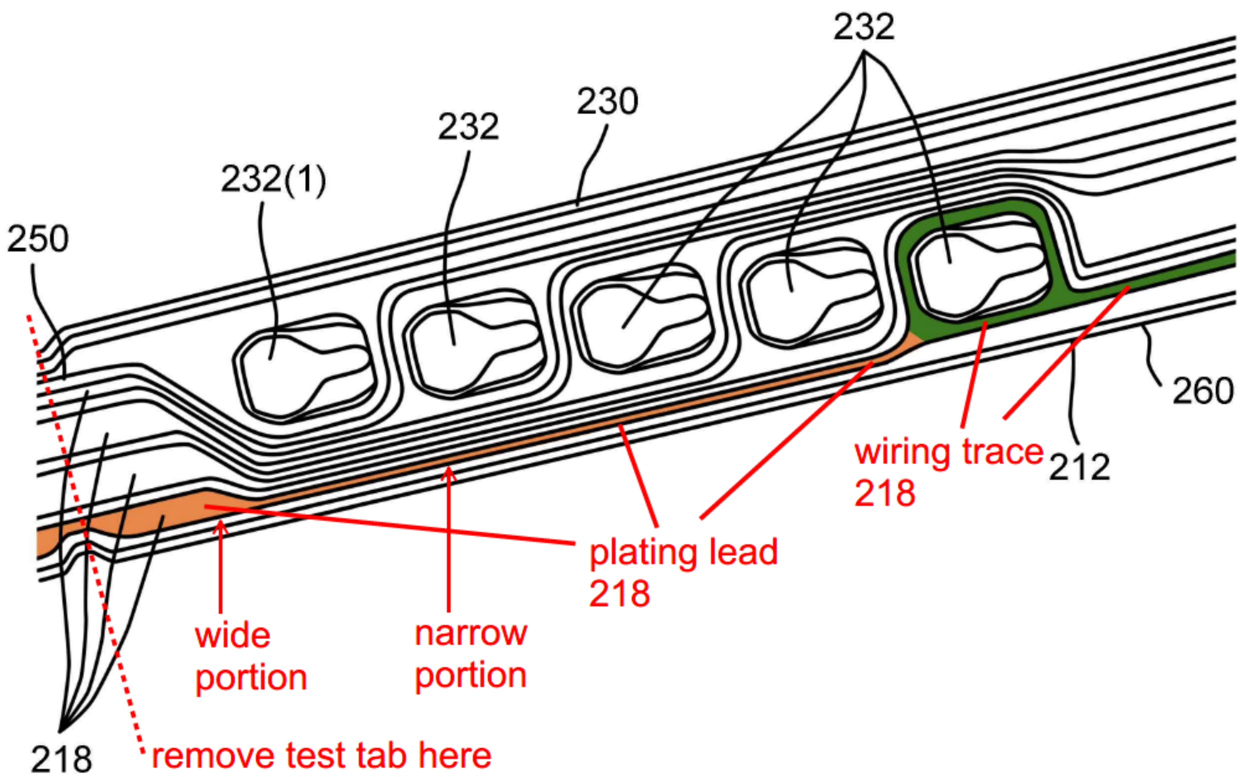


Fig. 5

178. Ex. 1011, Fig. 5. Additionally, the different shaded regions below of Fig. 5 illustrate the leads for plating (left side of the shaded portion of the trace 218) and the wiring traces (right side of the shaded portion of the trace 218):

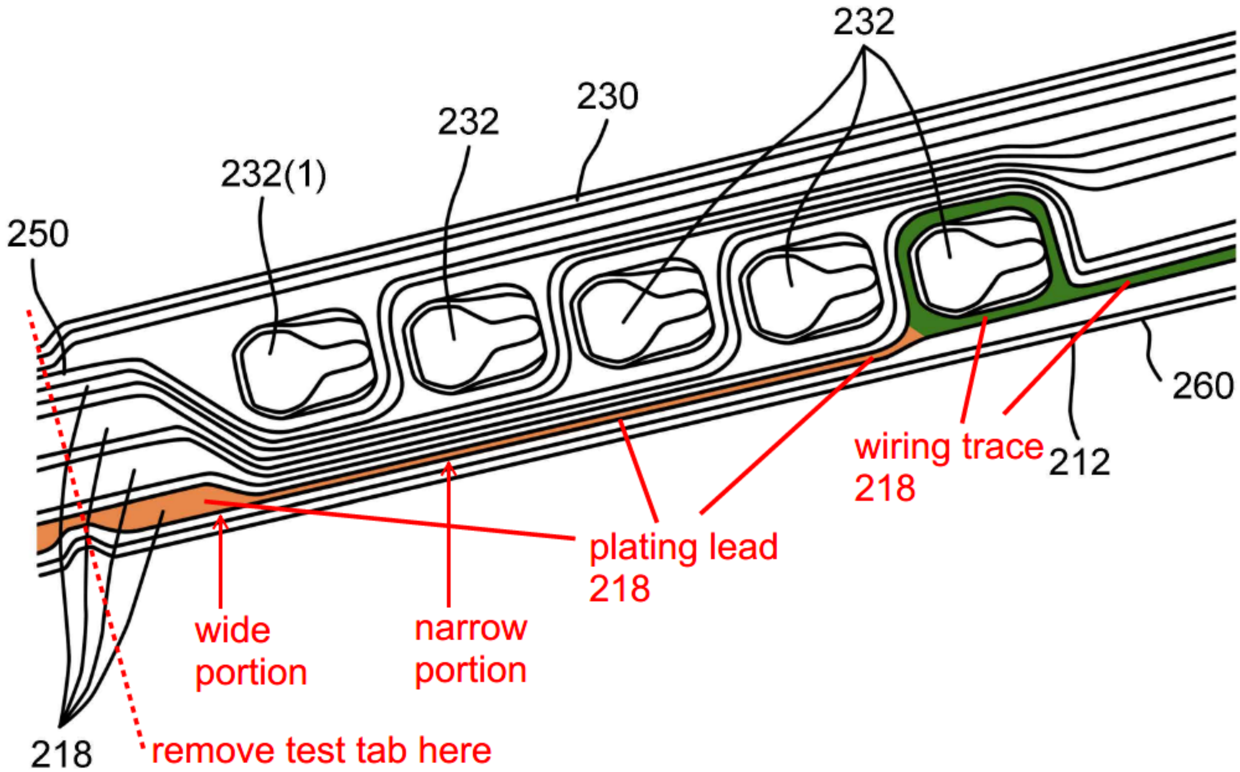


179. Ex. 1011, Fig. 5. While Yang does not expressly state the purpose of the leads 218 , which extend to the end of Fig 4, a person of ordinary skill in the art understands that wires 218 are connected the test terminals in Figure 4 and are used for plating in the manufacturing process of the FPC. As noted in Yang, the test tab 240 is removed from assembly "by cutting the tail 260 between the conductive tab 230 and the test tab 240" as shown in Fig 2. Ex. 1011, ¶29. The indentation marks on Fig. 2 and Fig. 5 show the point of separation. When Yang's FPC is used in a HDD, only the area to the right of the indentation line remains.

180. Thus, Yang discloses a "lead wire for plating [is] formed on said insulating layer and extend[s] from said wiring trace" as required by claim element 2c. A person of ordinary skill would understand that Yang expressly discloses the features of claim element [2c].

> **[2d] wherein said lead wire for plating includes: a first linear portion extending from said wiring trace and having a first width; and a second linear portion extending from said first linear portion and having a second width that is different from said first width, wherein said first width is smaller than said second width.**

181. Claim element [2d] describes a lead wire for plating with a narrow portion followed by a wide portion, where the narrow portion begins at the terminal. Yang discloses that exact configuration: a lead wire (shaded portion of 218 below on the left side of the conductive pad 232 it surrounds) with a narrow portion connected to the conductive pad 232 (terminal) and a wide portion connected to the narrow section:



182. As illustrated in Fig. 5, many of the traces 218 that are the leads for plating widen on the left side. Therefore, Yang discloses a narrow portion that is closest to the conductive pad 232 and a wide portion that is connected to the narrow portion. Ex. 1011, Fig. 5. Additionally, both the wide and narrow portions are linear in shape (straight) and form a continuous linear plating lead. Ex. 1011, Fig. 5.

183. A person of ordinary skill would understand that Yang expressly discloses the features of claim element [2d]. Accordingly, Yang anticipates claim 2.

VIII. CONCLUSION

184. In my opinion, the claims of the '870 Patent discussed above are invalid for the reasons stated above.

185. I reserve the right to supplement my opinions in the future to respond to any arguments raised by the owner of the '870 Patent and to take into account new information that becomes available to me.

186. I declare under penalty of perjury that all statements made herein are of my own knowledge and are true and correct.

Respectfully submitted,

Thomas M. Coughlin