

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SUZHOU MOJAWA INTELLIGENT ELECTRONIC CO., LTD.,
Petitioner

v.

SHENZHEN SHOKZ CO., LTD.,
Patent Owner

Inter Partes Review No.: IPR2025-00842

**DECLARATION OF CHRIS KYRIAKAKIS IN SUPPORT OF
PETITION FOR *INTER PARTES* REVIEW OF
U.S. PATENT NO. 11,197,084**

I hereby declare under penalty of perjury under the laws of the United States of America that the following is true and correct, and that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I understand that willful false statements are punishable by fine or imprisonment or both under Section 1001 of Title 18 of the United States Code.

Date: May 7, 2025



Chris Kyriakakis

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Exhibit No.	Description
1001	U.S. Patent No. 11,197,084
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1003	[RESERVED]
1004	CN107454492A (“Li”) [Certified English Translation]
1005	CN106937222A (“Liao”) [Certified English Translation]
1006	CN202931524U (“Asaka”) [Certified English Translation]
1007	JP2008294872A (“Numata”) [Certified English Translation]
1008	CN205356672U (“Wang”) [Certified English Translation]
1009	CN205017577U (“Xu”) [Certified English Translation]
1010	WO 2009/086838 (“Nielsen”)
1011	US 2008/0279409 (“Hupkes”)
1012	US 7,672,469 (“Dyer”)
1013	US 8,515,103 (“Mei”)
1014	US 2016/0080853 (“Chen”)
1015	US 9,866,966 (“Lott”)
1016	US 2018/0316999 (“Bellas”)
1017	US 5,987,147 (“Nishimoto”)
1018	JP2007189269A (“Nakada”) [Certified English Translation]
1019	US 2014/0126742 (“Eggebraaten”)
1020	US 8,223,997 (“Wilson, II”)
1021	US 8,111,860 (“Retchin”)
1022	WO 2008/007666 (“Fujita”) [Certified English Translation]
1023	US9253563 (“Fukuda”)
1024	Stanley A. Gelfand, <i>Hearing: An Introduction to Psychological and Physiological Acoustics</i> (5th ed. 2010)
1025	CN107454492A (“Li”) [Original]
1026	CN106937222A (“Liao”) [Original]
1027	CN202931524U (“Asaka”) [Original]
1028	JP2008294872A (“Numata”) [Original]
1029	CN205356672U (“Wang”) [Original]
1030	CN205017577U (“Xu”) [Original]
1031	JP2007189269A (“Nakada”) [Original]
1032	WO 2008/007666 (“Fujita”) [Original]

TABLE OF CLAIMS

[1pre] A loudspeaker apparatus, comprising:
[1a] an ear hook including a first plug end and a second plug end,
[1b] the ear hook being surrounded by a protective sleeve, the protective sleeve being made of an elastic waterproof material;
[1c] a core housing for accommodating an earphone core, the core housing being fixed to the first plug end and elastically abutted against the protective sleeve; and
[1d] a circuit housing for accommodating a control circuit or a battery, the circuit housing being fixed to the second plug end, the control circuit or the battery driving the earphone core to vibrate, the vibration of the earphone core generating a driving force to drive a housing panel of the core housing to vibrate, the driving force being not parallel to a normal line of the housing panel.
[2pre] The loudspeaker apparatus of claim 1,
[2a] wherein the ear hook further includes: an elastic metal wire;
[2b] a wire; and
[2c] a fixed sleeve, the fixed sleeve fixing the wire on the elastic metal wire, the protective sleeve being formed, by injection molding, on periphery of the elastic metal wire, the wire, the fixed sleeve, the first plug end, and the second plug end.
[3pre] The loudspeaker apparatus of claim 2, wherein
[3a] the first plug end and the second plug end are formed, by injection molding, at both ends of the elastic metal wire respectively,
[3b] the first plug end and the second plug end are arranged with a first wiring channel and a second wiring channel respectively, and
[3c] the wire extends along the first wiring channel and the second wiring channel.
[4] The loudspeaker apparatus of claim 3, wherein the wire passes through the first wiring channel and the second wiring channel.
[5pre] The loudspeaker apparatus of claim 3, wherein
[5a] the first wiring channel includes a first wiring groove and a first wiring hole connecting the first wiring groove and an outer end surface of the first plug end,
[5b] the wire extends along the first wiring groove and the first wiring hole and is exposed on the outer end surface of the first plug end,
[5c] the second wiring channel includes a second wiring groove and a second wiring hole connecting the second wiring groove and the outer end surface of the first plug end, and

[5d] the wire extends along the second wiring groove and the second wiring hole and is exposed on the outer end surface of the second plug end.
[6] The loudspeaker apparatus of claim 2, wherein the ear hook includes at least two fixed sleeves spaced apart along the elastic metal wire.
[7pre] The loudspeaker apparatus of claim 1, wherein
[7a] the core housing is arranged with a first socket connecting with an outer end surface of the core housing,
[7b] a stopping block is arranged on an inner sidewall of the first socket, and
[7c] the first socket is connected to the first plug end.
[8pre] The loudspeaker apparatus of claim 7,
[8a] wherein the first plug end includes: an inserting portion being at least partially inserted into the first socket and abutting against an outer side surface of the stopping block; and
[8b] two elastic hooks being arranged on a side of the inserting portion facing inside of the core housing, wherein:
[8c] the two elastic hooks are brought together under action of external thrust and the stopping block, and
[8d] after passing through the stopping block, the two elastic hooks are elastically restored to be stuck on an inner surface of the stopping block to realize the fixation of the core housing and the first plug end.
[9pre] The loudspeaker apparatus of claim 8, wherein
[9a] the inserting portion is partially inserted into the first socket, and
[9b] an exposed part of the inserting portion is arranged in a stepped manner to form an annular table surface spaced apart from the outer end surface of the core housing.
[10pre] The loudspeaker apparatus of claim 9, wherein
[10a] the protective sleeve further extends to a side of the annular table surface facing the outer end surface of the core housing, and
[10b] when the core housing and the first plug end are fixed, the protective sleeve elastically abuts against the core housing to realize sealing.
[12pre] The loudspeaker apparatus of claim 1, wherein
[12a] the housing panel and the earphone core are in a transmission connection, and
[12b] all or part of the housing panel is used to contact or abut a user's body to conduct a sound generated by the vibration of the earphone core.
[13pre] The loudspeaker apparatus of claim 12,
[13a] wherein when a straight line of the driving force has a positive direction pointing to outside of the loudspeaker apparatus from the housing panel and the

normal line has a positive direction pointing to the outside of the loudspeaker apparatus, an angle between the two lines in their positive direction is an acute angle.
[14pre] The loudspeaker apparatus of claim 12, wherein
[14a] the earphone core includes a coil and a magnetic circuit system, and
[14b] an axis of the coil or the magnetic circuit system is not parallel to the normal line, the axis being perpendicular to a radial plane of the coil or the magnetic circuit system.
[15pre] The loudspeaker apparatus of claim 12, wherein
[15a] the driving force has a component in a first quadrant or a third quadrant of an XOY plane coordinate system, wherein an origin O of the XOY plane coordinate system is on a contact surface between the loudspeaker apparatus and a human body, an X-axis of the XOY plane coordinate system is parallel to a coronal axis of the human body, a Y-axis of the XOY plane coordinate system is parallel to a sagittal axis of the human body, a positive direction of the X-axis faces outside of the human body, and a positive direction of the Y-axis faces front of the human body.
[16pre] The loudspeaker apparatus of claim 1,
[16a] wherein the earphone core further includes a magnetic circuit component generating a first magnetic field
[16b] the magnetic circuit component including: a first magnetic unit configured to generate a second magnetic field;
[16c] a first magnetically conductive unit; and
[16d] at least one second magnetic unit, the at least one second magnetic unit surrounding the first magnetic unit and forming a magnetic gap with the first magnetic unit, a magnetic field strength of the first magnetic field in the magnetic gap being greater than a magnetic field strength of the second magnetic field in the magnetic gap.
[17pre] The loudspeaker apparatus of claim 16,
[17a] wherein the magnetic circuit component further includes: a second magnetically conductive unit; and
[17b] at least one third magnetic unit being connected to the second magnetically conductive unit and the at least one second magnetic unit.
[18pre] The loudspeaker apparatus of claim 17,
[18a] wherein the magnetic circuit component further includes: at least one fourth magnetic unit being located below the magnetic gap and connected to the first magnetic unit and the second magnetically conductive unit.
[19pre] The loudspeaker apparatus of claim 17, wherein

[19a] the first magnetically conductive unit is connected to the upper surface of the first magnetic unit,
[19b] the second magnetically conductive unit includes a bottom plate and a sidewall; and
[19c] the first magnetic unit is connected to the bottom plate of the second magnetically conductive unit.
[20pre] The loudspeaker apparatus of claim 17, further comprising:
[20a] at least one electrically conductive unit being connected to at least one unit of the first magnetic unit, the first magnetically conductive unit, or the second magnetically conductive unit.

I. INTRODUCTION

1. My name is Chris Kyriakakis. I have been engaged by Petitioner Suzhou Mojawa Intelligent Electronic Co., Ltd. (“Mojawa”) to provide my expert opinions in support of the above-identified petition for *inter partes* review of U.S. Patent No. 11,197,084 B2 (the “’084 Patent,” EX1001), challenging the validity of claims 1-10 and 12-20 (the “Challenged Claims”).

2. I am being compensated for my time at the rate of \$525 per hour. This compensation is not contingent upon my performance, the outcome of this matter, or any issues involved in or related to this matter.

3. In reaching the conclusions described herein, I have considered the documents and materials identified in the Index of Exhibits above, in addition to any materials cited in this report. My opinions are also based upon my education, training, research, knowledge, and personal and professional experience.

4. Based on my review of the ’084 Patent and its prosecution history, the other materials I have considered, and my knowledge and experience, my opinions are as follows:

a. Claims 1 is invalid due to obviousness based on Li, Fujita, and the knowledge of a POSITA;

b. Claims 12-15 are invalid due to obviousness based on Li, Fujita, Fukuda, and the knowledge of a POSITA;

c. Claims 2-6 are invalid due to obviousness based on Li, Fujita, Asaka, and the knowledge of a POSITA;

d. Claims 7-10 are invalid due to obviousness based on Li, Fujita, Numata, and the knowledge of a POSITA; and

e. Claims 16-20 are invalid due to obviousness based on Li, Fujita, Wang, Xu, Nielsen, and the knowledge of a POSITA.

II. BACKGROUND AND QUALIFICATIONS

5. I earned my Bachelor of Science degree in Engineering and Applied Science from the California Institute of Technology (Caltech) in 1985. I received my Master of Science degree in Electrical Engineering in 1987 and my Ph.D. in Electrical Engineering in 1993, both from the University of Southern California (“USC”).

6. I am a tenured Associate Professor in the Department of Electrical and Computer Engineering at USC.

7. My research interests lie at the intersection of acoustics, psychoacoustics (the science that studies human perception of sound), and audio signal processing. I have worked in the area of audio signal processing for more than 20 years with particular emphasis on spatial and 3D audio. I have published nearly 100 technical papers, including several peer-reviewed papers. I have published a book on spatial audio entitled *Immersive Audio Signal Processing* and

hold several patents in audio processing for headphone optimization, acoustic measurement of loudspeakers in rooms, loudspeaker crossover optimization, and loudspeaker response correction using signal processing. My publications examine various aspects of sound measurement, echo cancellation, microphone arrays, noise removal, filter banks, how sound interacts with the acoustical elements of the environment, novel methods for surround sound recording and reproduction, and the perception of sound by human listeners.

8. A major focus of my research has been on developing novel multichannel audio capture and rendering algorithms. In addition to the mathematical development of the algorithms, I have performed several multichannel recordings with multiple wired and wireless microphones over the past 20 years. For example, in 2003, I performed a multichannel recording with a 64-track recording of a live performance of the group Duran Duran, 24-track recordings of the Boston Symphony and the Handel and Haydn Society, multi-track recordings of experimental music in the WGBH studios in Boston, 48-track recordings of the Dizzy Gillespie band at USC, live multi-track performances of Byzantine chanters in simulated ancient acoustic environments, as well as 32-track Byzantine studio chant recordings of Cappella Romana. In all of these recordings, a combination of wired and wireless microphones were used in conjunction with digital multitrack recording gear and SMPTE timecode synchronization.

9. Another focus of my early research was on head-related transfer functions (HRTFs) and how they can be measured and modeled using various signal processing approaches. I developed several implementations of HRTF-based 3D audio for rendering spatial sounds over headphones. I have also researched microphone arrays for applications in enhanced far field voice recognition. This includes methods for Direction of Arrival finding and beam forming from linear and circular microphone arrays. I have also investigated methods for noise removal and reverberation reduction from microphone signals.

10. In addition, over the past few years I have worked on methods for echo cancellation for applications in wearable devices. Previous other work includes loudspeakers and how they interact with their acoustical environment, and specifically loudspeaker transducers. In particular, I have researched the role of sound reflections, absorption, and diffusion in the performance of loudspeakers. I have also published several technical papers on acoustical measurement methods in rooms and device enclosures and developed novel signal processing algorithms for optimizing sound system performance. I have worked on methods for echo cancellation for applications in wearable devices. Other topics I have researched include multichannel audio acquisition and rendering, virtual microphones and virtual speakers, hybrid headphone-loudspeaker rendering methods, and advanced

signal processing techniques for optimizing sound quality from small portable devices.

11. I am the founding Director of the USC Immersive Audio Laboratory with facilities for experimental work in room acoustics, multichannel audio, and psychoacoustics. This laboratory also serves as a unique teaching facility for my undergraduate course in Introduction to Digital Audio and my graduate course in Immersive Audio Signal Processing. Both courses have a major acoustics component that examines the interaction of sound with the acoustical environment and the basic principles of microphones (including wireless microphones) and loudspeaker design. The graduate course was developed through a two-year grant I received from the National Science Foundation entitled “Collaborative Learning in Engineering Using Immersive Environments,” and was the first of its kind to assess the impact of audio immersion in student learning. In addition to the courses I teach, I have also supervised and served on Ph.D. dissertation committees for more than 30 students.

12. From 2003-2018, I was the co-founder and Chief Technology Officer of Audyssey Laboratories, a USC spin-off company that develops and licenses audio technology to leading consumer electronics and automotive companies around the world. As part of my work at Audyssey, I developed a measurement methodology for headphones and earphones and created a database with 500+

measurements of products from nearly 100 manufacturers, created audio algorithms related to sound optimization that are used in millions of home theater systems, cars, and IMAX theaters worldwide.

13. I also developed audio algorithms and designed speakers. These speakers were novel acoustical designs that used a combination of unique enclosures, passive radiators (i.e., speaker diaphragms that are driven by changes in surrounding air pressure), and audio signal processing to optimize their performance and overcome limitations that arise from small drivers and enclosures. For example, we used signal processing technologies combined with novel acoustical design to extend the bass response of small woofers and passive radiators beyond what was previously possible in small speaker enclosures. The innovations in these designs have received awards, including Popular Science's "Best of What's New."

14. In 2019, I joined Syng as the Chief Audio Scientist. Syng creates innovative products for next generation spatial audio and my role there includes research and development of audio algorithms for sound capture using microphone arrays to measure the acoustics of the room and loudspeaker beamforming for wirelessly rendering sound in various directions.

15. In April 2018 I was elected as Senior Member of the Institute of Electrical and Electronic Engineers (IEEE) in recognition of my contributions to the

field of engineering. I am also a member of the Audio Engineering Society (AES), an association for professionals in the audio industry.

16. In 2006, I received a World Technology Network Award. This organization presents awards to innovators in several areas in which technology can foster a paradigm change. My award was for innovations in immersive audio that enable new capabilities in media and journalism. Other award recipients at that event included Vice President Al Gore, Google, and SpaceX. In addition, my work has been featured in multiple news articles, including pieces by *The Atlantic*, the *BBC World Service*, the *New York Times*, and National Public Radio.

17. In the late 1990s and early 2000s, I was a faculty researcher and later Deputy Director of the National Science Foundation's engineering research center established at USC. I studied the fundamental and technological limitations of immersive audio and the role of acoustics on the performance of microphones and loudspeakers. In 2003, together with one of my graduate students, I received the award for Best Paper at the Institute of Electrical and Electronics Engineers ("IEEE") Conference on Signals, Systems and Computers.

18. My qualifications, publications, professional experience and expertise are set forth more fully in my curriculum vitae, attached as Appendix A.

III. DOCUMENTS AND OTHER MATERIALS RELIED UPON

19. In preparing this declaration, I have reviewed and/or considered at least the documents cited in the List of Exhibits, and the documents referenced in this declaration. I have also reviewed the entire prosecution history of the '084 Patent.

20. Additionally, I have utilized my own experience and expertise, including regarding the knowledge and capabilities of a person of ordinary skill in the relevant art in the timeframe of the claimed priority date of the '084 Patent.

IV. STATUTORY GROUNDS FOR CHALLENGE

21. In this declaration, I offer opinions on the following grounds that are the basis for this IPR proceeding:

Ground	Claims	Basis	Prior Art
1	1	Obviousness	Li and Fujita
2	12-15	Obviousness	Li, Fujita, and Fukuda
3	2-6	Obviousness	Li, Fujita, and Asaka
4	7-10	Obviousness	Li, Fujita, and Numata
5	16-20	Obviousness	Li, Fujita, Wang, Xu, and Nielsen

V. RELEVANT PATENT LAW AND LEGAL STANDARDS

22. I am not an attorney. For the purposes of this declaration, I have been informed about certain aspects of the law that are relevant to forming my opinions. My understanding of the law is as follows.

A. Date of Invention

23. I have been asked to use the date of the filing of the earliest application to which priority is claimed (*i.e.*, January 5, 2019) as the date of invention for purposes of my analysis.

B. Anticipation

24. I am informed and understand that a patent claim is invalid as “anticipated” under 35 U.S.C. §102 if a prior art disclosure teaches every element required by the claim, either expressly or inherently. The identical invention must be shown in as complete detail as is contained in the claim. When a claim covers several structures or compositions, either generically or as alternatives, the claim is deemed anticipated if any of the structures or compositions within the scope of the claim is known in the prior art. Petitioner’s counsel has informed me that for a claimed limitation to be inherently present, the prior art reference need not expressly disclose the limitation, so long as the claimed limitation necessarily flows from a disclosure in the reference.

C. Obviousness

25. I am informed and understand that a patent claim is invalid as “obvious” under 35 U.S.C. §103 if the differences between the invention and the prior art are such that the subject matter as a whole would have been obvious at the time of the invention to a person having ordinary skill in the art to which the subject

matter pertains. Obviousness, as has been explained to me, is based on (i) the scope and content of the prior art, (ii) the differences between the prior art and the claim, (iii) the level of ordinary skill in the art, and (iv) any secondary indicia of non-obviousness (*e.g.*, “secondary considerations” such as commercial success in the marketplace of the claimed invention), to the extent that they exist.

26. I further understand that obviousness may be demonstrated by showing that it would have been obvious to combine the teachings of more than one item of prior art. In determining whether a piece of prior art could have been combined with other prior art or with other information within the knowledge of a person having ordinary skill in the art, the following are examples of approaches and rationales that may be considered:

- Combining prior art elements according to known methods to yield predictable results;
- Simple substitution of one known element for another to obtain predictable results;
- Use of a known technique to improve similar devices (methods, or products) in the same way;
- Applying a known technique to a known device (method or product) ready for improvement to yield predictable results;

- Applying a technique or approach that would have been obvious to try (choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success);
- Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to a person having ordinary skill in the art; and
- Some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

27. I further understand that an invention may be obvious if one of ordinary skill in the art, facing a wide range of needs created by developments in the field, would have seen an obvious benefit to the solutions tried by the applicant. When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, it may be obvious to a person of ordinary skill to try the known options. If a technique has been used to improve one device, and a person of ordinary skill in the art (“POSITA”) would recognize that it

would improve similar devices in the same way, using the technique would have been obvious.

28. Petitioner's counsel has informed me that a single reference can render a patent claim obvious if any differences between that reference and the claims would have been obvious to a POSITA.

29. I further understand that a POSITA is a hypothetical person who is presumed to be aware of all of the relevant art at the time of the invention. The person of ordinary skill may be able to fit together the teachings of multiple patents and/or printed publications employing ordinary creativity and the common sense that familiar items may have uses in another context or beyond their primary purposes.

30. I also understand that when considering the obviousness of a patent claim, one should consider whether a teaching, suggestion, or motivation to combine the references exists so as to avoid impermissibly applying hindsight when combining or modifying the prior art. I understand this test should not be applied rigidly, but that the test can be important to avoid such hindsight.

31. I also understand that one of ordinary skill in the art must have a reasonable expectation of success in combining or modifying prior art references.

32. I also understand that all elements of a claim must be considered in an obviousness analysis.

D. Standard of Proof

33. I understand that the standard to prove unpatentability in an inter partes review proceeding is by a preponderance of the evidence, which means more likely than not.

VI. LEVEL OF ORDINARY SKILL IN THE ART

34. I have considered the level of ordinary skill in the art relevant to the '084 Patent. I understand that factors such as the education level of those working in the field, the sophistication of the technology, the types of problems encountered in the art, the prior art solutions to those problems, and the speed at which innovations are made may help establish the level of skill in the art.

35. A person of ordinary skill in the art ("POSITA") at the time of the earliest filing date of the '084 Patent (January 5, 2019), would have had a Bachelors' degree in electrical or computer engineering or a comparable field of study, plus approximately two to three years of professional experience with acoustic technology. Additional graduate education could substitute for professional experience, and significant experience in the field could substitute for formal education.

36. I am and was at the time of the earliest filing date at least a person of skill in the relevant art, of a level at least as high as or more than ordinarily skilled persons, and I am able to provide insight and opinions into the understandings of

such persons at all relevant times by virtue of my education, training and experience.

VII. THE '084 PATENT AND ITS PROSECUTION HISTORY

A. Overview of the '084 Patent

37. The '084 Patent is titled “Loudspeaker Apparatus” and claims priority to Chinese Application No. 201910009927.4, filed on January 5, 2019.

38. The '084 Patent is directed to a loudspeaker apparatus, specifically, bone conduction headphones with a modular design that includes an ear hook 10 surrounded by a protective sleeve 16, a core housing 20 for accommodating an earphone core 50, and a circuit housing 30 for accommodating a control circuit 60 or battery 70. *See, e.g.*, EX1001, Abstract, 8:44-9:28, 36:49-63, Fig. 2.

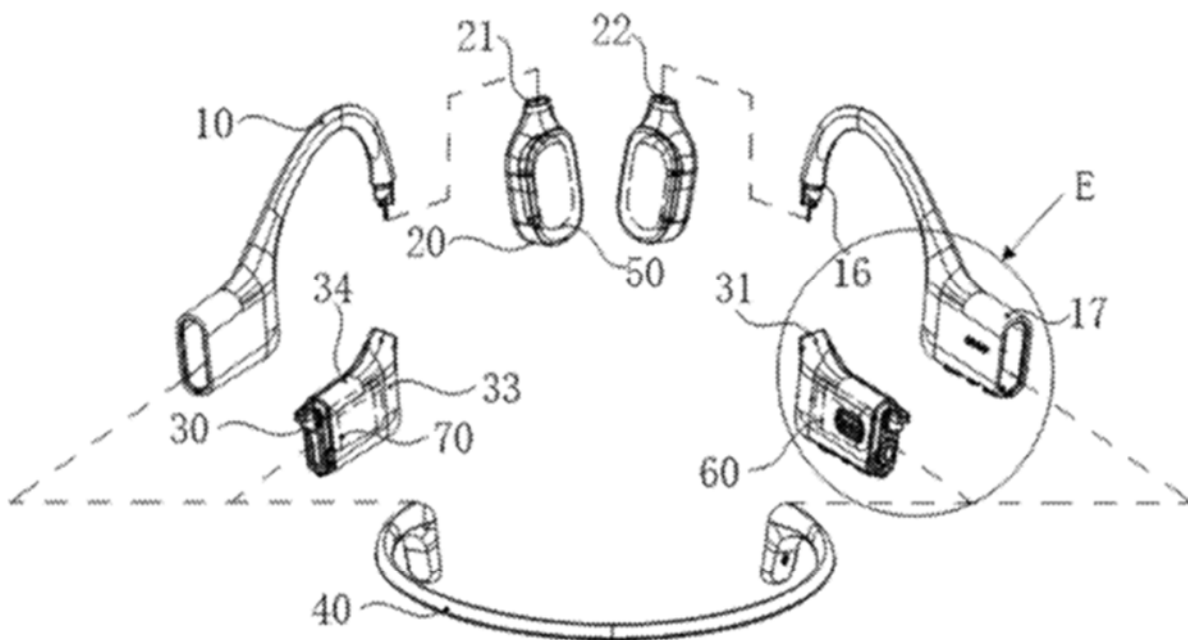


FIG. 2

39. The ear hook 10 includes a first plug end 14 for affixing the core housing 20 and second plug end 15 for affixing the circuit housing 30. *Id.*, Abstract, 8:44-9:28, 36:50-63, Figs. 2, 5.

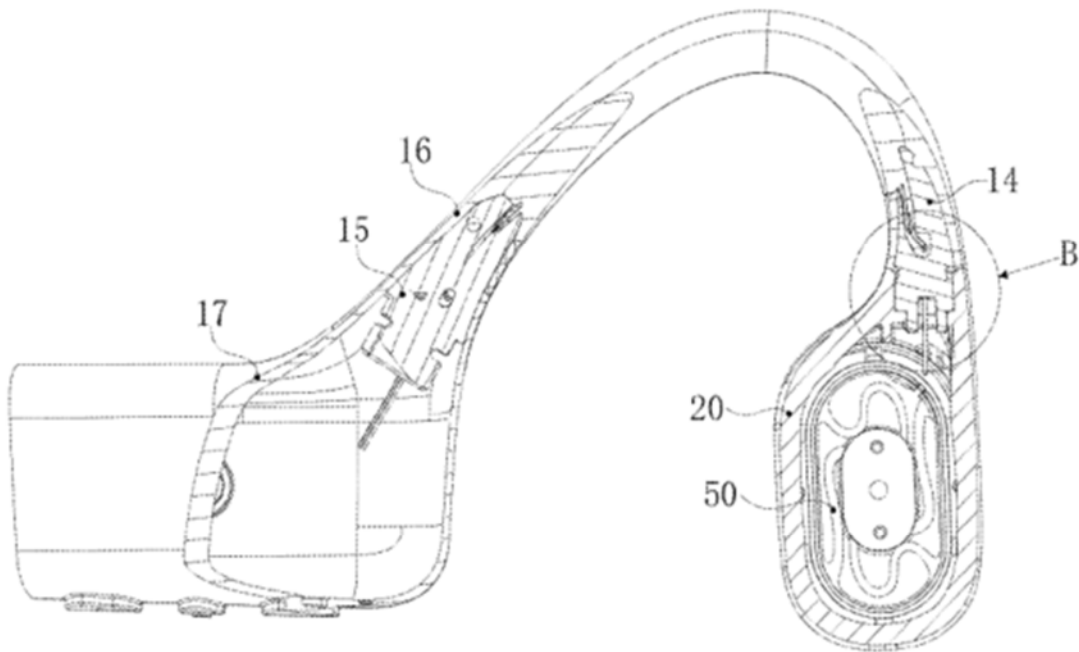


FIG. 5

40. Bone conduction speakers typically include a housing in contact with the human body. *E.g., id.*, Figs. 10-12, 17:14-41, 19:29-21:32. The speakers create sound by transmitting vibration to a housing panel 1003 in contact with the human body, and then that vibration travels to the auditory nerve. *E.g., id.; id.*, 24:13-33. In some embodiments of the speaker, a straight line B (or a vibrating direction of a driving device) of a driving force generated by the driving component 1001 and applied to a panel 1003 and housing 1004 via a transmission component 1002 along a straight line B, and a normal line A of the panel 1003 may form an angle θ . *Id.*,

17:14-46, Fig. 10. In other words, the straight line B is not parallel to the normal line A. *Id.*, 17:45-46.

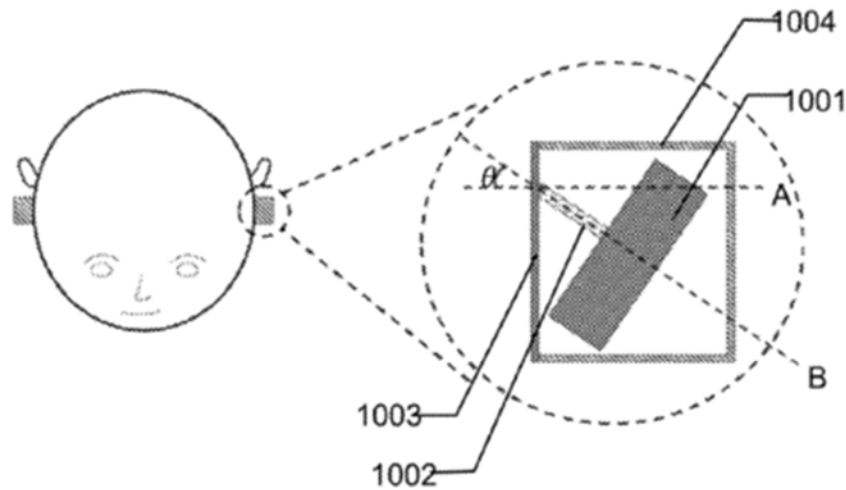


FIG. 10

41. The '084 Patent also discloses a magnetic circuit component 2100 for inclusion in the bone conduction speaker to generate sound. EX1001, Figs. 15-21, 23:12-34:39, 38:38-39:8. As shown below in Figure 16, “the magnetic circuit component 2100 may include a first magnetic unit 2102, a first magnetically conductive unit 2104, a second magnetically conductive unit 2106, and a second magnetic unit 2108.” *Id.*, 24:61-65. A voice coil 2128 may also be located in the gap between magnets. *Id.*, 25:67-26:1.

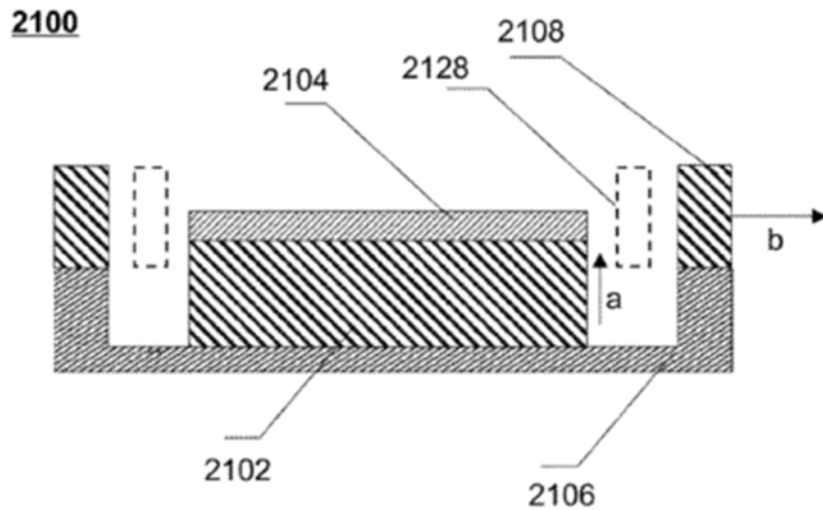


FIG. 16

42. The text of the Challenged Claims is presented in the “Table of Claims” that precedes Section I, along with an identifier of each limitation in those claims. I will refer to these limitation identifiers throughout this declaration.

B. Prosecution History and Priority Date

43. The '084 Patent was filed on December 30, 2020 and claims priority to Chinese Application No. 201910009927.4, filed on January 5, 2019. EX1001, (22), (30). The application was filed with 25 original claims, but five claims were cancelled in a preliminary amendment. EX1002, 192-97 (12/30/2020 claims), 123-30 (12/30/2020 Amendment). The final 20 claims of the patent issued on December

7, 2021 without rejection by the examiner or further amendment by the applicant.

Id., 1 (Issue Notification).

44. The examiner provided a brief statement of reasons for allowance:

The prior art of record does not disclose a hook for a speaker apparatus having two plugs one being connected to transducers and one to circuitry, meanwhile the hook being surrounded by a waterproof sleeve covering hook and with an earphone housing elastically abutting against the protective cover. Prior art of record Such as Kim (10306351) although disclosing a plugs for a speaker apparatus (Fig 2) they are missing a waterproof sleeves for the hooks with earphone core housing abutting against the hooks. The examiner does not see any motivations in combining the prior art of record to achieve the claimed limitations.¹

EX1002, 13 (October 18, 2021 Notice of Allowance).

45. These purported novel features, however, were disclosed explicitly or at least implicitly in the prior art as discussed herein well before the '084 Patent's priority date.

VIII. PATENT OWNER'S INFRINGEMENT CONTENTIONS

46. I have reviewed what I have been informed are Patent Owner's current Complaint and Patent Owner's infringement contentions from the

¹ All emphasis, color, and annotations are added, unless otherwise indicated.

concurrent litigation *Shenzhen Shokz Co., Ltd. v. Shenzhen Wenming Technology Co., Ltd. et al*, 1-24-cv-06717 (N.D. Ill.).

IX. CLAIM CONSTRUCTION

47. In this section, I list terms that require construction and I have applied those constructions in my subsequent analysis. For all other terms, I applied the plain and ordinary meaning that a POSITA would have for the terms.

A. Claim Construction Standards

48. Counsel for Petitioner has informed me, and I understand that in an *inter partes* review (“IPR”), challenged claims are interpreted using the same claim construction standard that is used to construe the claim in a civil action in federal district court. I understand that this means that claim terms of a patent are given the ordinary and customary meaning the terms would have to a POSITA, in view of the description provided in the patent itself and the patent’s file history. I understand that to determine how a POSITA would have understood a claim term, one should look to those sources available that show what a POSITA would have understood the disputed claim language to mean. I understand that, in construing a claim term, one looks primarily to the intrinsic patent evidence, including the words of the claims themselves, the remainder of the patent, and the patent’s prosecution history.

49. I understand that extrinsic evidence, which is evidence external to the patent and the prosecution history, may also be useful in interpreting patent claims

but that extrinsic evidence cannot be used to vary or contradict the meaning indicated by the intrinsic patent evidence, which I understand is the claims, specification and prosecution history of the '084 Patent. I understand that words or terms should be given their ordinary and accepted meaning unless it appears that the inventors were using them to mean something else. In making this determination, the claims, the remainder of the patent, and the prosecution history are of paramount importance. Additionally, the patent and its prosecution history must be consulted to confirm whether the patentee has acted as its own lexicographer (*i.e.*, provided its own special meaning to any disputed terms), or intentionally disclaimed, disavowed, or surrendered any claim scope.

50. I do not contend that the below proposed constructions are complete constructions of these limitations or the claims for any other purpose, including for issues that have been raised in the related litigation.

51. I have construed any claim term not listed below according to its plain and ordinary meaning to a POSITA at the time of the '084 Patent's earliest claimed priority date.

B. Construction of Terms from the '084 Patent

- 1. “the second wiring channel includes a second wiring groove and a second wiring hole connecting the second wiring**

**groove and the outer end surface of the first plug end”
(claim 5)**

52. This term should be construed as “the second wiring channel includes a second wiring groove and a second wiring hole connecting the second wiring groove and the outer end surface of the second plug end.”

53. A POSITA would have understood that there is a typo where “first” was written instead of “second.” This is clear, and would be clear to a POSITA, from the claim 5 language, where the first two substantive claim elements address the “first” wiring channel, wiring groove, wiring hole, and plug end, and the third and fourth substantive claim elements address the “second” version of the same structures, including the “second plug end” in the final claim element. If the term is not construed with “second plug end,” there would be no disclosure of the first plug end connecting to the disclosed “second” elements, and the connection would have to traverse the space between the first and second plugs. Therefore, “first plug end” in this claim element should be construed as “second plug end.”

54. I have applied these constructions in my analysis of the ’084 Patent and the prior art. However, my opinions regarding obviousness set forth herein are applicable even if any of these claim terms is given its plain and ordinary meaning, and my conclusions are not dependent on any particular construction. I reserve the

right to respond to arguments made by Patent Owner with regard to the interpretation of any of these terms.

X. OVERVIEW OF THE PRIOR ART

55. My opinions in the declaration are based on the knowledge of a POSITA and the documents described below.

A. CN107454492A (“Li”) (EX1004)²

56. Li was filed on August 18, 2017 and published on December 8, 2017. EX1004, (22), (45). I have been informed by counsel for Petitioner that Li is prior art to the '084 Patent under post-AIA §102(a)(1). Li was not cited as prior art to the '084 Patent and thus was not considered by the patent examiner during prosecution. EX1001, (56).

57. As shown below in Figures 1-2, Li discloses a bone conduction earphone with an ear hook assembly 11, with a first housing 111 containing a battery pack 13 or control circuit assembly 14 and a second housing 112 forming the bone conduction speaker. EX1004, Abstract, [0023], [0040], Figs. 1-2. The first housing 111 and second housing 112 are connected by a first elastic metal wire 1131 that is covered by a first elastic coating layer 1132. *Id.*, [0004]-[0005], [0023], Figs. 1-2. Li discloses a rear hook assembly 12 that fits around the back of a user's

² EX1004 is a certified English translation of this reference, cited throughout. The original reference is available at EX1025.

head and has plug-in portions 123 that connect to the first housings of both ear hook assemblies. *Id.*, [0058], Fig. 5.

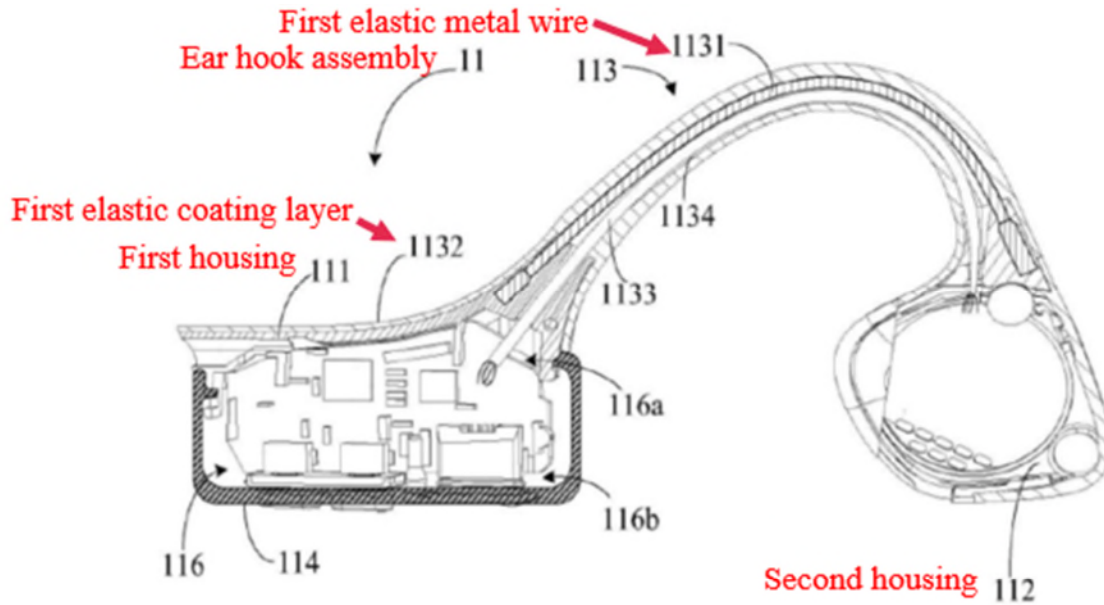


Figure 1

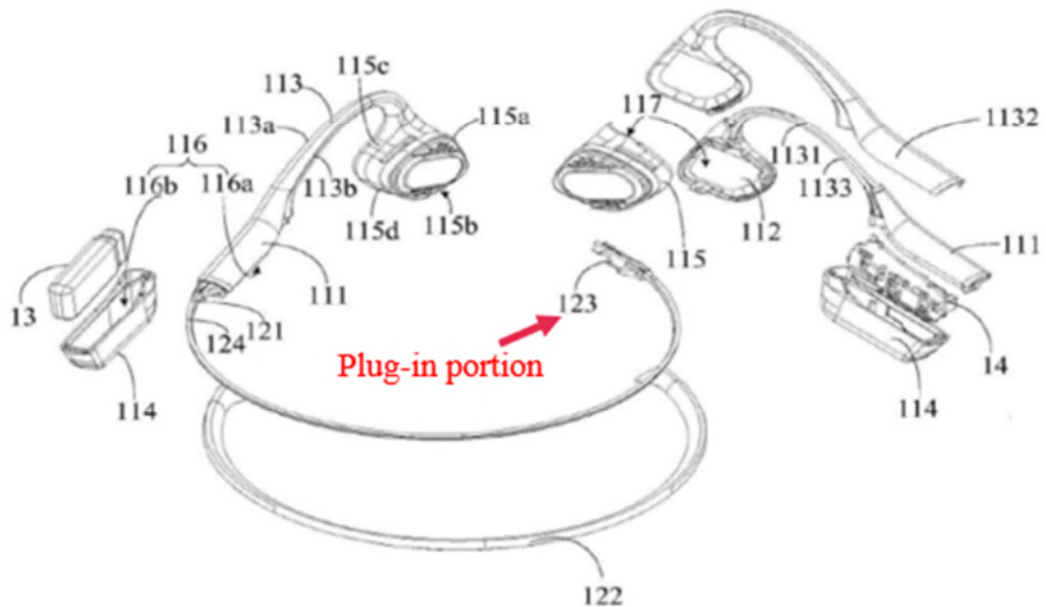


Figure 2

B. CN106937222A (“Liao”) (EX1005)³

58. Liao was filed on August 13, 2015 and published on July 7, 2017.

EX1005, (22), (45). I have been informed by counsel for Petitioner that Liao is prior art to the '084 Patent under post-AIA §102(a)(1). Liao was not cited as prior art to the '084 Patent and thus was not considered by the patent examiner during prosecution. EX1001, (56).

59. As shown below in Figure 2-B, Liao discloses a bone conduction speaker with a housing 210, a panel 220, an energy conversion device 230, and connection members 240. EX1005, [0055], Fig. 2-B. The energy conversion device 230 vibrates panel 220 against the human skin, and the vibration is also transmitted to the housing 210. *Id.*, [0056]. In some embodiments, the panel 220 can be directly attached to the housing 210 “by clamping or welding” without connection members 240. *Id.*, [0057]-[0058].

³ EX1005 is a certified English translation of this reference, cited throughout. The original reference is available at EX1026.

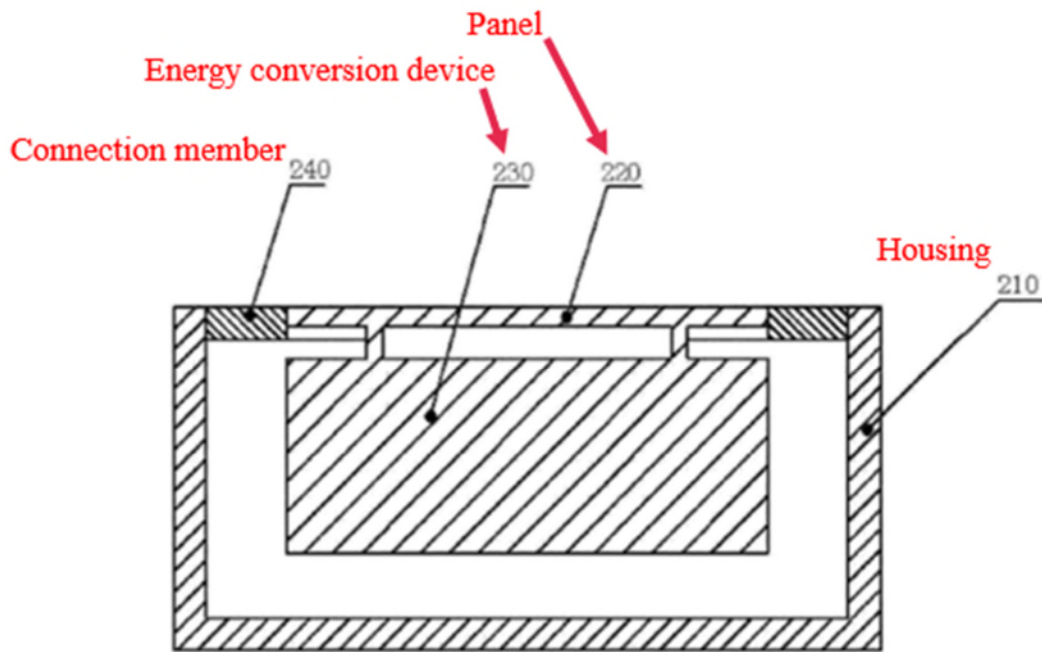


Figure 2-B

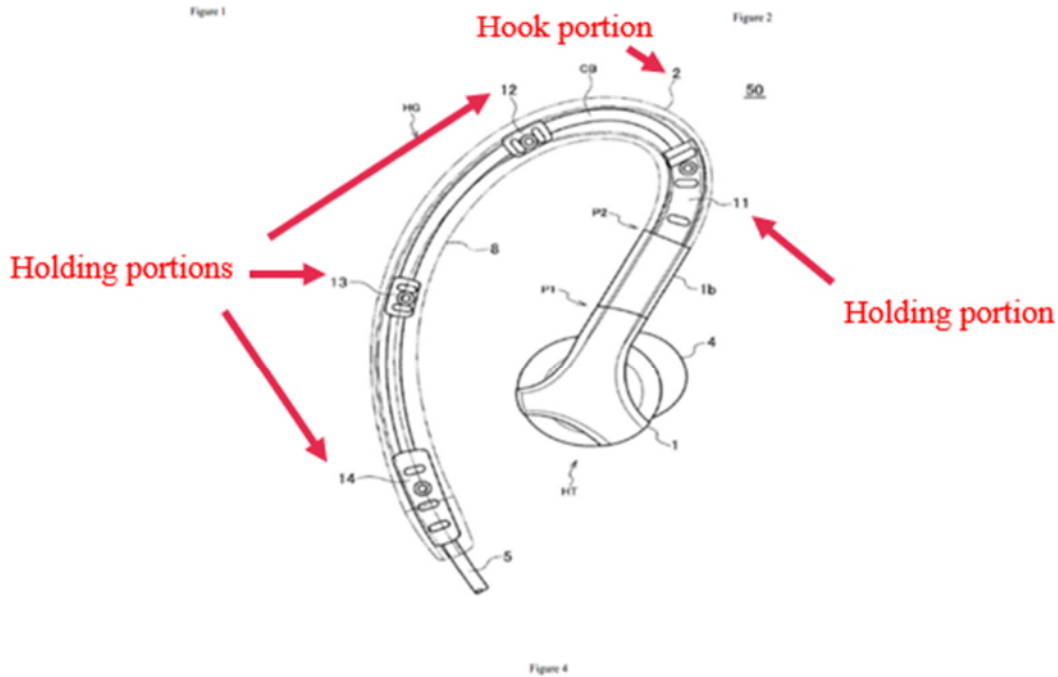
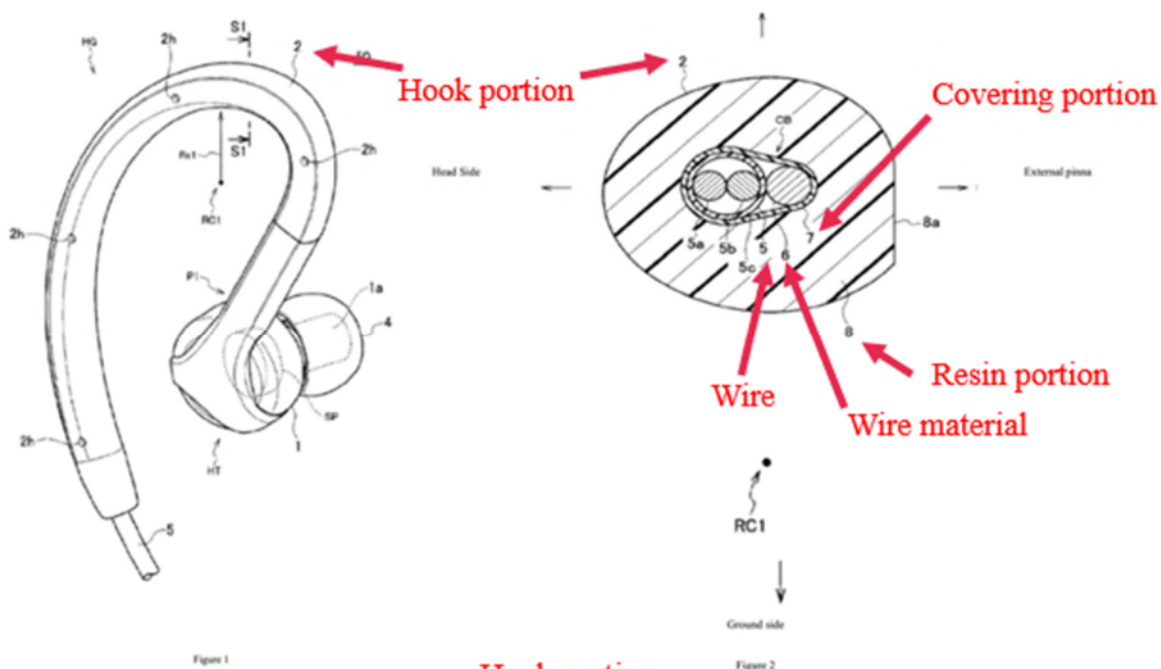
C. CN202931524U (“Asaka”) (EX1006)⁴

60. Asaka was filed on May 16, 2012 and published on May 8, 2013. EX1006, (22), (45). I have been informed by counsel for Petitioner that Asaka is prior art to the '084 Patent under post-AIA §102(a)(1). Asaka was not cited as prior art to the '084 Patent and thus was not considered by the patent examiner during prosecution. EX1001, (56).

61. Asaka discloses an ear hook and earphone. EX1006, (54). Figure 2 depicts a cross-section view of the ear hook, including the shape of the integrated wire CB. *Id.*, [0030], [0067]. The hook portion 2 in Figure 2 is composed of wire 5,

⁴ EX1006 is a certified English translation of this reference, cited throughout. The original reference is available at EX1027.

wire material 6, a covering portion 7 that integrates wire 5 and wire material 6, and a resin portion 8 that wraps around the covering portion 7. *Id.*, [0058], Figs. 1-2. As shown in Figures 4 and 5, there are 4 holding portions along the extension direction of the integrated wire CB inside the hook portion 2—holding portion 11 to holding portion 14—which are spaced apart from each other. *Id.*, [0086].

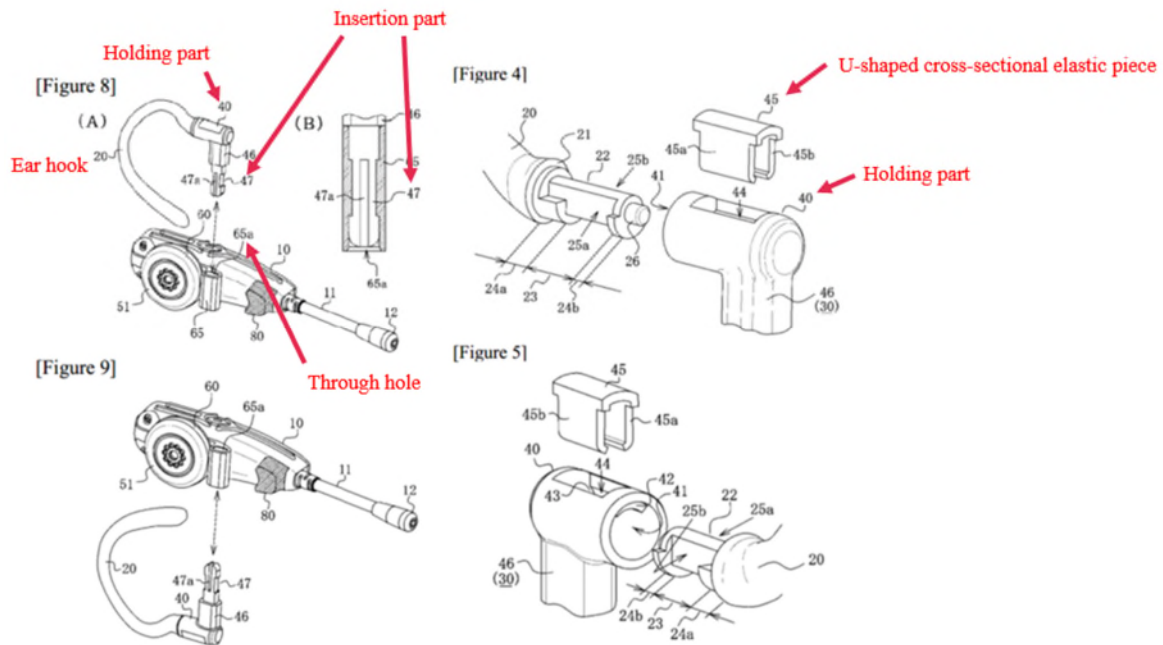


D. JP2008294872A (“Numata”) (EX1007)⁵

62. Numata was filed on May 26, 2007 and published on December 4, 2008. EX1007, (22), (43). I have been informed by counsel for Petitioner that Numata is prior art to the '084 Patent under post-AIA §102(a)(1). Numata was not cited as prior art to the '084 Patent and thus was not considered by the patent examiner during prosecution. EX1001, (56).

63. Numata discloses a wireless headset with an earhook. EX1007, Abstract, Figs. 1-3. Numata teaches that the earhook part 20 is connected to the holding part 40 by use of a U-shaped cross-sectional elastic piece 45, as depicted in Figures. 4-5. *Id.* at [0022]-[0023], [0025], Figs. 4-5. Numata also teaches that the earhook part 20 is connected to the rest of the wireless headset by means of an insertion part 47 into through-hole 65a. *Id.*, [0033]-[0034], Figs. 8-9.

⁵ EX1007 is a certified English translation of this reference, cited throughout. The original reference is available at EX1028.

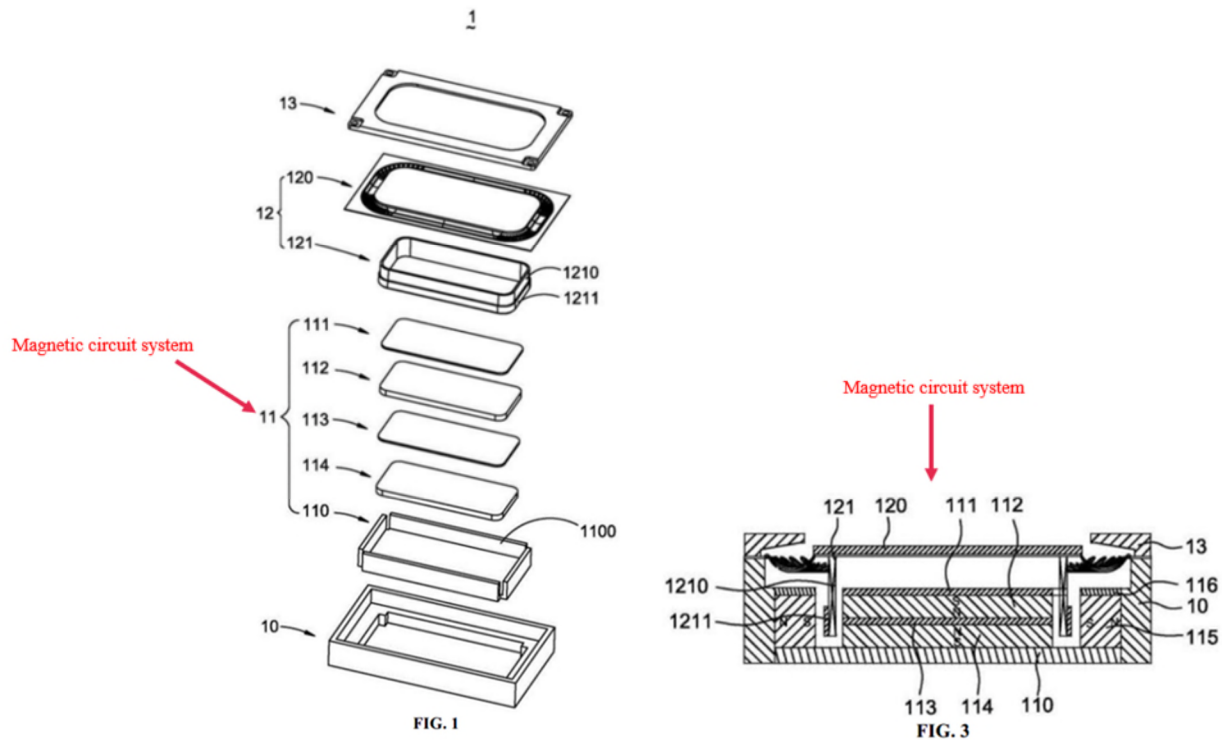


E. CN205356672U (“Wang”) (EX1008)⁶

64. Wang was filed on December 24, 2015 and published on June 29, 2016. EX1008, (22), (45). I have been informed by counsel for Petitioner that Wang is prior art to the '084 Patent under post-AIA §102(a)(1). Wang was not cited as prior art to the '084 Patent and thus was not considered by the patent examiner during prosecution. EX1001, (56).

65. Wang discloses a loudspeaker made with a magnetic circuit system 11 configured to generate a magnetic field. EX1008, (54), [0018], Figs. 1, 3.

⁶ EX1008 is a certified English translation of this reference, cited throughout. The original reference is available at EX1029.

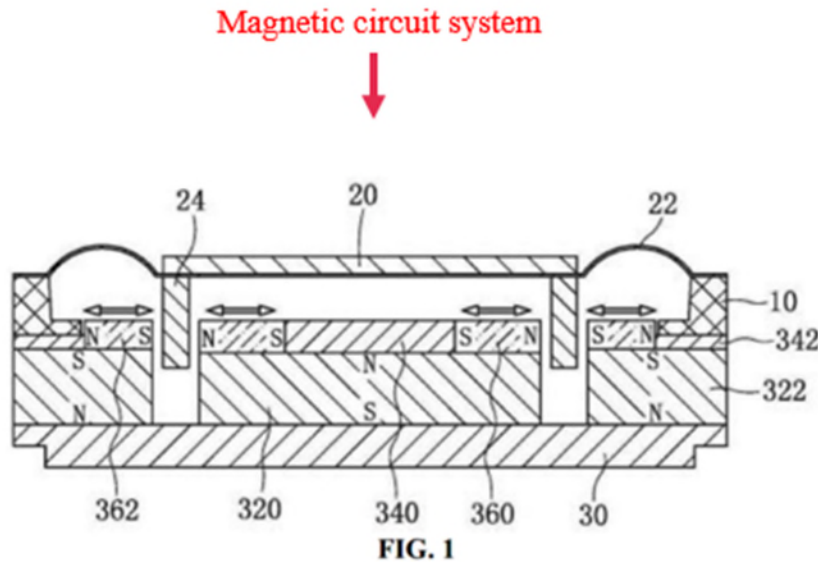


F. CN205017577U (“Xu”) (EX1009)⁷

66. Xu was filed on October 19, 2015 and published on February 3, 2016. EX1009, (22), (45). I have been informed by counsel for Petitioner that Xu is prior art to the '084 Patent under post-AIA §102(a)(1). Xu was not cited as prior art to the '084 Patent and thus was not considered by the patent examiner during prosecution. EX1001, (56).

67. Xu discloses a micro loudspeaker that uses a magnetic circuit system to operate. EX1009, (54), [0026], Fig. 1.

⁷ EX1009 is a certified English translation of this reference, cited throughout. The original reference is available at EX1030.



G. WO 2009/086838 (“Nielsen”) (EX1010)

68. Nielsen was filed on January 6, 2009 and published on July 16, 2009. EX1010, (22), (43). I have been informed by counsel for Petitioner that Nielsen is prior art to the '084 Patent under post-AIA §102(a)(1), (a)(2). Nielsen was not cited as prior art to the '084 Patent and thus was not considered by the patent examiner during prosecution. EX1001, (56).

69. Nielsen discloses a magnet assembly for a loudspeaker. EX1010, (54). Specifically, Nielsen discloses that an outer surface 10 of the T-yoke and/or the upper, inner surface 36 of the top plate is/are provided with a layer of a conductive material. *Id.*, Figs. 1, 3A, 16:1-4, 17:6-15.

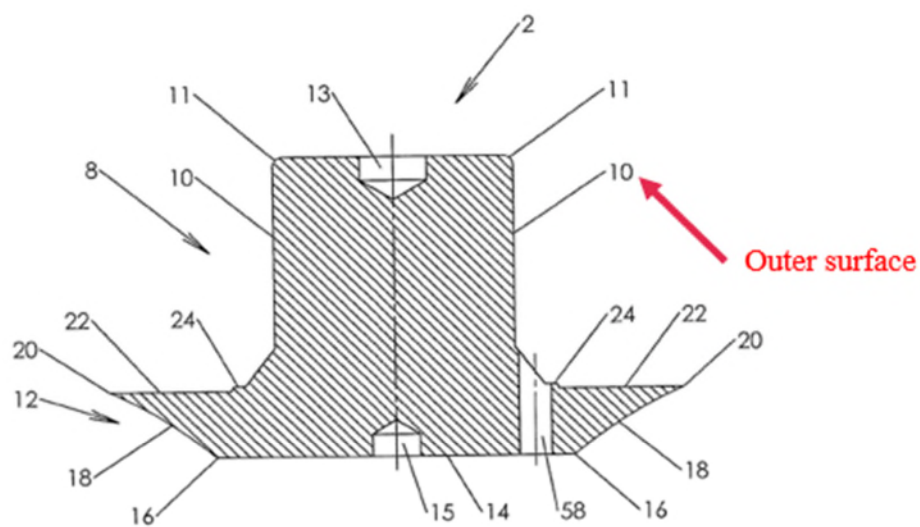


Fig. 1

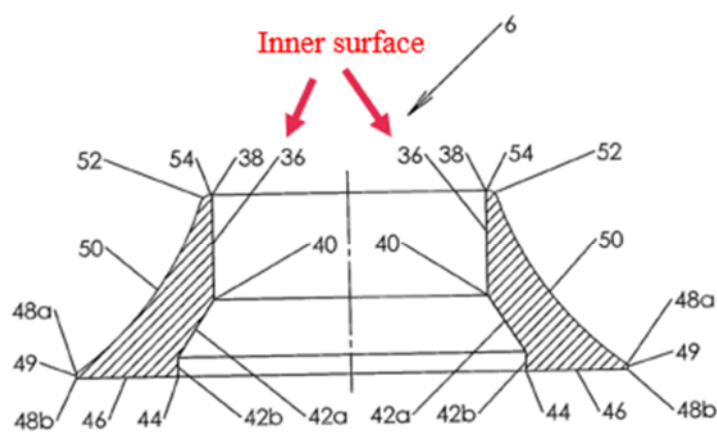


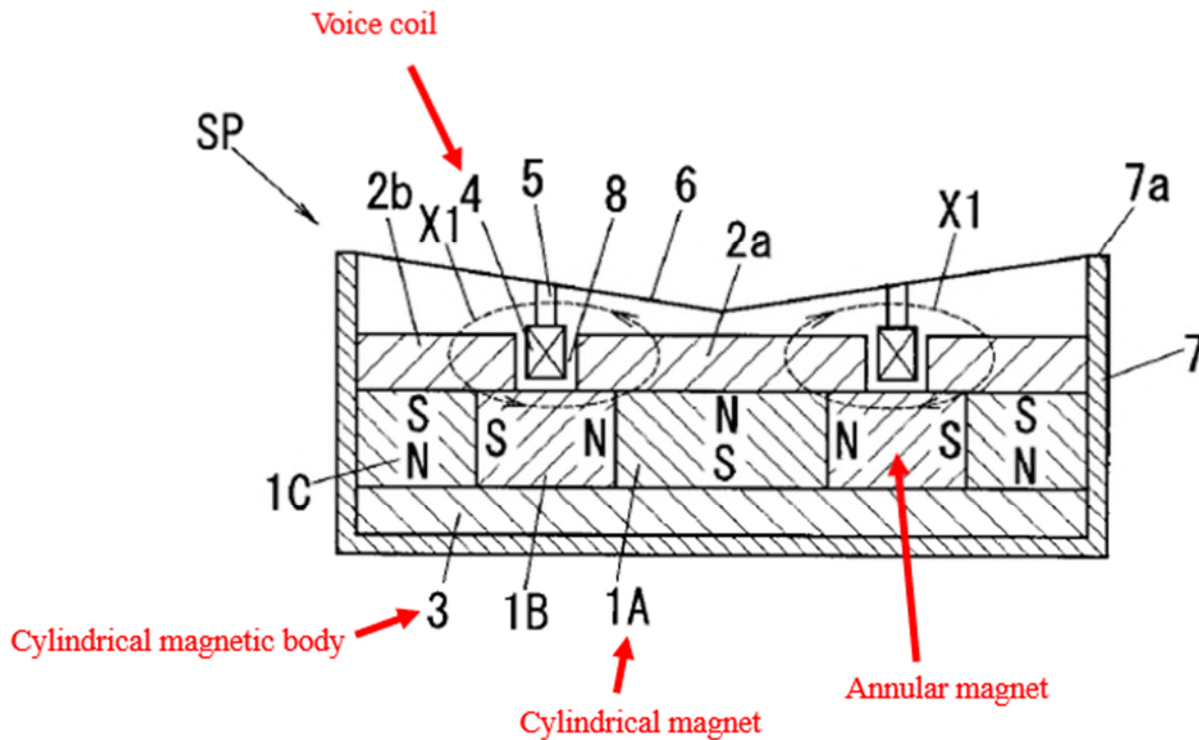
Fig. 3a

H. JP2007189269A (“Nakada”) (EX1018)⁸

70. Nakada was filed on December 22, 2005 and published on July 26, 2007. EX1018, (22), (43). I have been informed by counsel for Petitioner that Nakada is prior art to the '084 Patent under post-AIA §102(a)(1). Nakada was not cited as prior art to the '084 Patent and thus was not considered by the patent examiner during prosecution. EX1001, (56).

71. Nakada discloses a speaker device including magnets and a voice coil, such as depicted in Figure 2(b) below. EX1018, Abstract, Fig. 2(b). The object of Nakada's invention is to provide a smaller speaker device due to its compact design that still provides strong electromagnetic attractive force. *Id.*, Abstract, Fig. 2(b), [0016]-[0029].

⁸ EX1018 is a certified English translation of this reference, cited throughout. The original reference is available at EX1031.



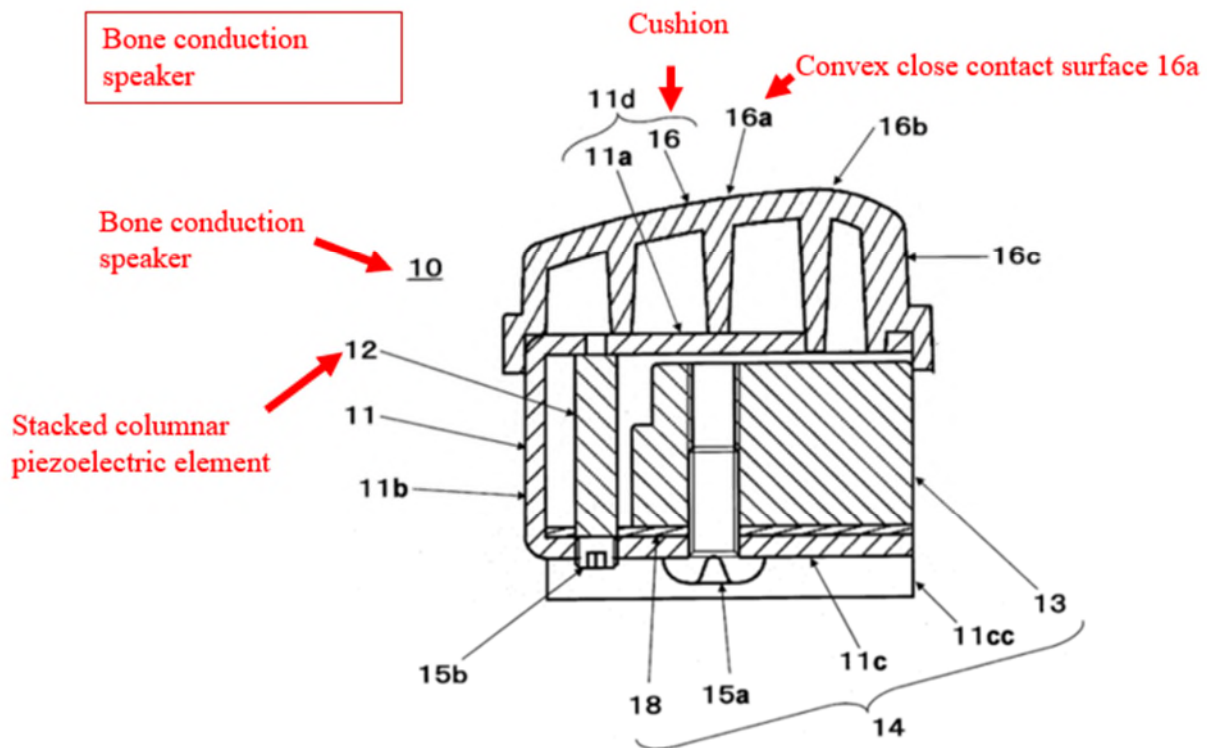
I. WO 2008/007666 (“Fujita”) (EX1022)⁹

72. Fujita was filed on July 10, 2007 and published on January 17, 2008. EX1022, (22), (43). I have been informed by counsel for Petitioner that Fujita is prior art to the '084 patent under post-AIA §102(a)(1), (a)(2). Fujita was not cited as prior art to the '084 patent and thus was not considered by the patent examiner during prosecution. EX1001, (56).

73. Fujita discloses a bone conduction receiver 1 with a bone conduction speaker 10 for converting sound information to oscillation. EX1022, Abstract. The

⁹ EX1022 is a certified English translation of this reference, cited throughout. The original reference is available at EX1032.

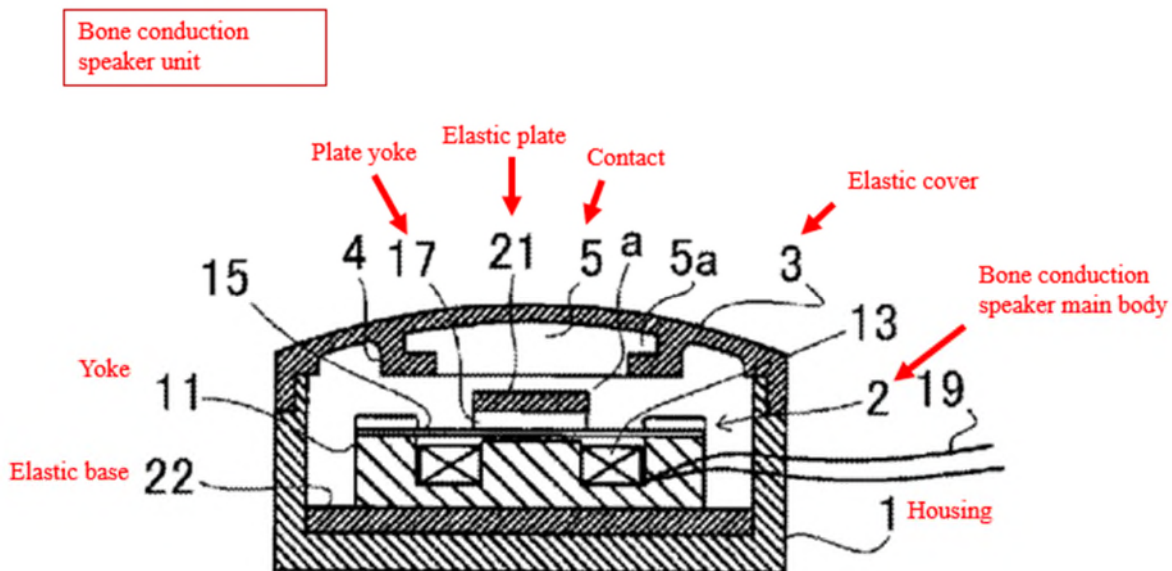
bone conduction speaker 10 has a multilayer columnar piezoelectric element 12 for generating oscillation in accordance with the sound information, and a cushion 16 for transmitting the oscillation generated by the multilayer columnar piezoelectric element 12 by abutting to the human head. *Id.*; Fig. 1.



J. US9253563 (“Fukuda”) (EX1023)

74. Fukuda was filed on October 25, 2013 and issued on February 2, 2016. EX1023, (22), (45). I have been informed by counsel for Petitioner that Fukuda is prior art to the '084 patent under post-AIA §102(a)(1), (a)(2). Fukuda was not cited as prior art to the '084 patent and thus was not considered by the patent examiner during prosecution. EX1001, (56).

75. Fukuda discloses a bone conduction speaker unit incorporating a bone conduction speaker main body 2 in a housing 1, wherein an elastic plate 21 is fixed on a top face of a plate yoke 17 of the bone conduction speaker main body 2; an elastic base 22 is disposed on a rear face of a yoke 11; and an elastic cover 3 for holding a contact 5 which, upon a pressing force having been applied thereto in use, is abutted against the plate yoke 17 through the elastic plate 21 is loaded on the housing 1. EX 1005, Abstract, Fig. 1.



K. Interchangeable Audio Headset Prior Art

76. Modular audio portions of headsets, including speakers, control circuits, and batteries, were well-known as of the priority date of the '084 Patent. The speaker portions were modular for various reasons, such as sound quality, ease of use, aesthetics, user comfort, EX1011, [0007], component replacements and

removability, upgrades, changes, shape simplification, and reducing manufacturing and production costs due to the simple shape of components, EX1012, 2:4-15; EX1014, [0004], EX1015, 2:6-17, EX1016, [0056], [0079], [0085], [0096], comfort, safety, and wearing stability, EX1013, 11:5-8, and allowing for different uses, and allowing for situation other than listening to music or speech. EX1015, 2:6-9.¹⁰ The control circuit and/or battery portions were also modular for various reasons, for example, so that different designs of circuit modules and power modules having different configurations with different functions can be selectively used, EX1014, [0017], and so batteries could be removed and/or recharged to provide additional life to a device. EX1015, 5:19-6:17. Modular electrical connections were achieved through various connectors, including plugs, jacks, and pins. EX1012, 3:21-35, EX1019, Figs. 1-15, [0009]-[0015], [0035], [0045]. The following is a brief overview of some illustrative prior art examples.

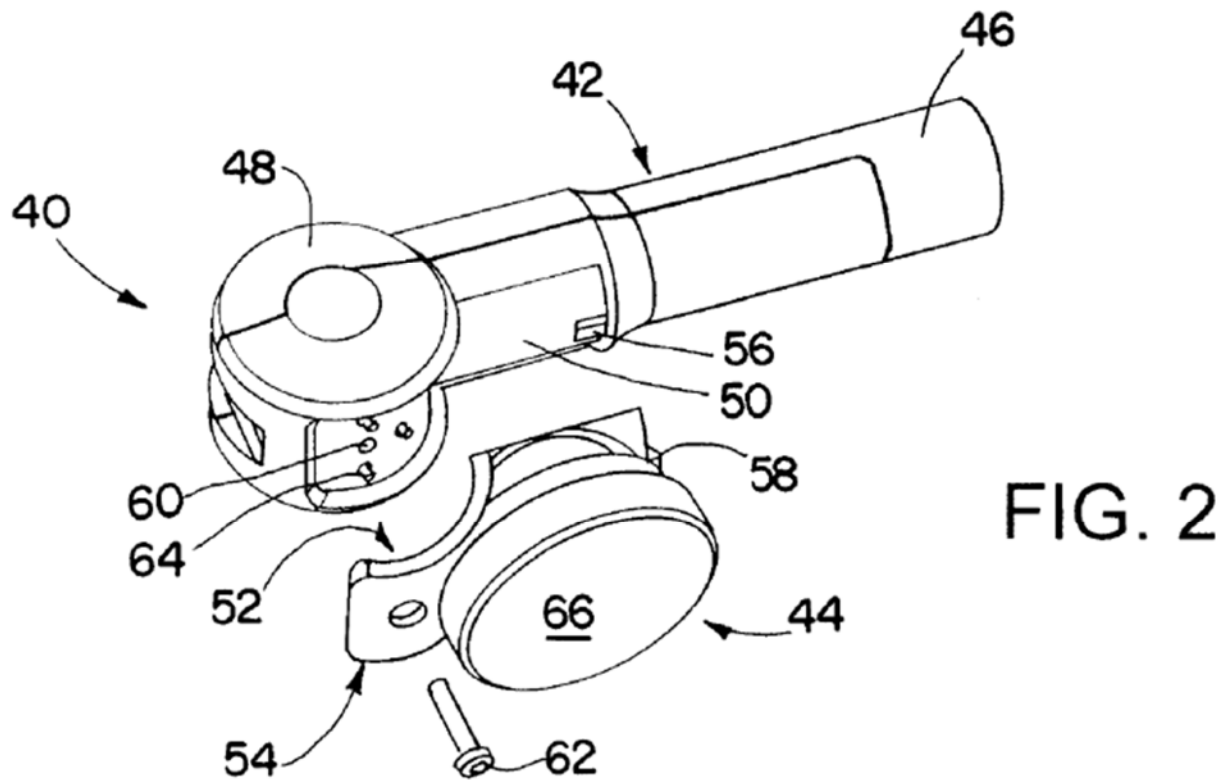
¹⁰ Lott explains “For instance, a continued goal of the headphone market is to utilize wireless monitors in combination with microphones for noise-reduction, enhanced hearing, and the production of audio signals, like voice feedback. Accordingly, various embodiments configure a wireless audio system that provides low signal latency along with a diverse range of capabilities that may, or may not, be facilitated by attachments physically connected to a wireless monitor.” EX1015, 2:9-17.

1. U.S. Patent Pub. No. 2008/0279409 to Hupkes (“Hupkes”) (EX1011)

77. Hupkes was filed on May 11, 2007, and published on November 13, 2008. EX1011, (22), (43). I have been informed by counsel for Petitioner that Hupkes is prior art to the '084 Patent under post-AIA §102(a)(1), (a)(2). Hupkes was not cited as prior art to the '084 Patent and thus was not considered by the patent examiner during prosecution. EX1001, (56).

78. Hupkes discloses an earpiece speaker system 40 having “a plurality of exchangeable speaker modules that allow the earpiece speaker system 40 to function as either an in-concha earpiece or an in-ear earpiece as part of [a] headset 22. The speaker modules are easily exchangeable such that a user can exchange speaker modules as desired.” EX1011, [0030].

79. As shown in Figure 2 below, the earpiece speaker system 40 includes an earpiece body 42 having a speaker module mount surface 50 that abuts a speaker module 44. *Id.*, [0031]-[0032]. A “recess 56 and hook 58 cooperate to retain the speaker module 44.” *Id.*, [0032]. A threaded bore 60 also holds the speaker module 44 by receiving a screw 62; however, other securing means can be used. *Id.*



80. Hupkes's modular design allows users to change speakers for "sound quality, ease of use, aesthetics, user comfort, etc." *Id.*, [0005]; *see also* [0006]-[0007].

2. U.S. Patent No. 7,672,469 to Dyer et al. ("Dyer") (EX1012)

81. Dyer was filed on November 17, 2005, and issued on March 2, 2010. EX1012, (22), (45). I have been informed by counsel for Petitioner that Dyer is prior art to the '084 Patent under post-AIA §102(a)(1), (a)(2). Dyer was not cited as prior art to the '084 Patent and thus was not considered by the patent examiner during prosecution. EX1001, (56).

82. As shown in Figure 2 below, Dyer discloses an audio monitoring system 200 having a left in-ear monitor 201 and a right in-ear monitor 203.

EX1012, Fig. 2, 3:13-15. The in-ear monitors 201, 203, include a connection jack 207 to releasably connect cables 209, 211. *Id.*, 3:21-35. The connection jack 207 may be a standard jack such as a 2-pin jack. *Id.*, 3:22-23.

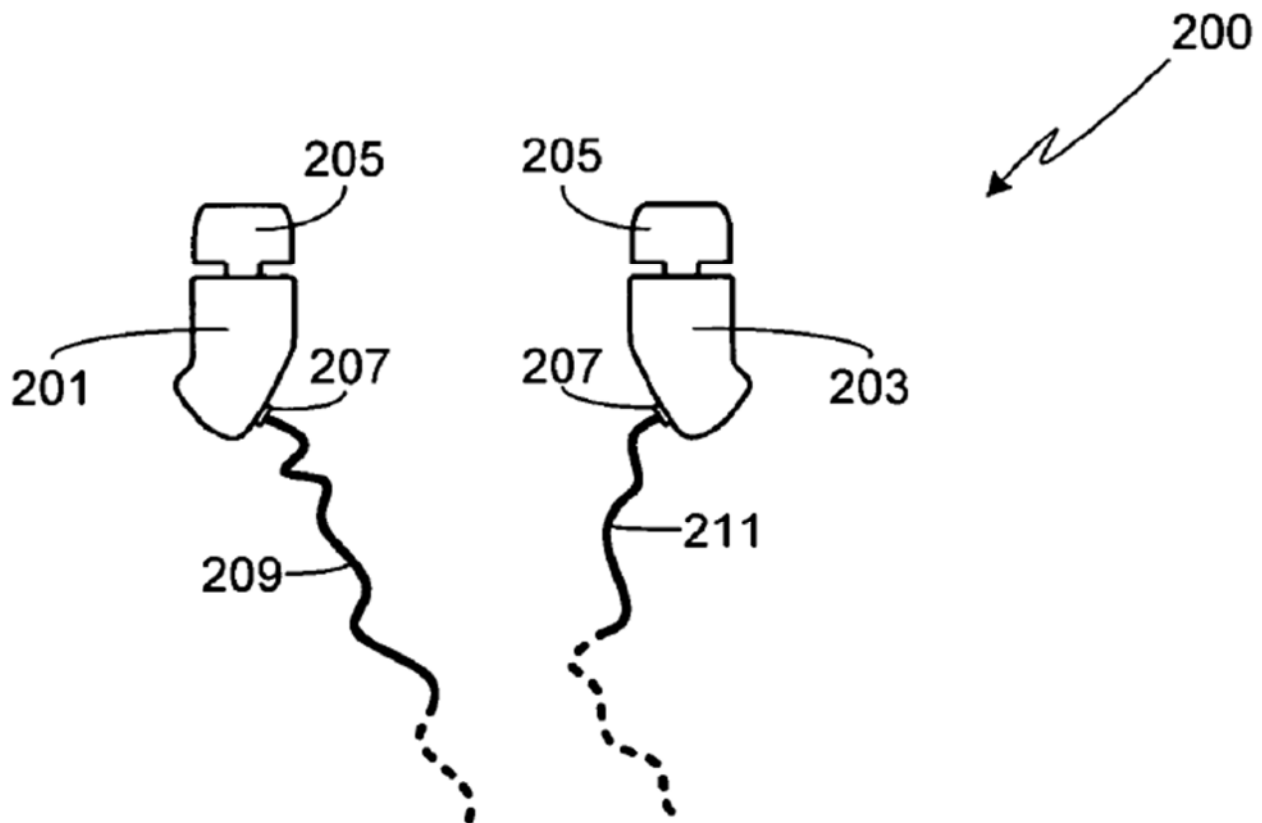


FIG. 2

83. Dyer's modular design allows the in-ear monitors to be easily replaced, upgraded, or changed to a different component and reducing costs due to, for example, manufacturing. *Id.*, 2:4-15.

3. U.S. Patent No. 8,515,103 to Mei ("Mei") (EX1013)

84. Mei was filed on November 22, 2010, and issued on August 20, 2013. EX1013, (22), (45). I have been informed by counsel for Petitioner that Mei is prior art to the '084 Patent under post-AIA §102(a)(1), (a)(2). Mei was not cited as prior art to the '084 Patent and thus was not considered by the patent examiner during prosecution. EX1001, (56).

85. As shown below in Figure 1, Mei discloses headphones having attachable/detachable unit 1016C, which mates with speaker cup holding unit 1008 through the ball/male unit 1012. EX1013, Fig. 1, 10:62-11:8.

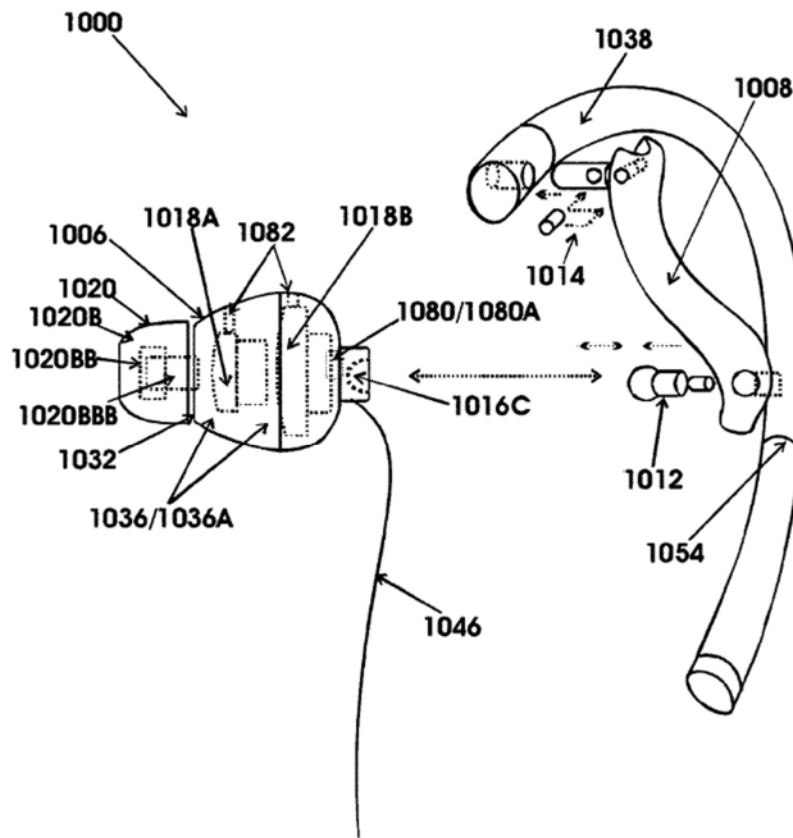


FIG. 1

86. Mei's modular design allows for "holding and adjusting functions for hearing comfort, hearing safety, wearing comfort, and wearing stability, for example so that the earphone may be worn for sports." *Id.*, 11:5-8.

87. Furthermore, Mei teaches an embodiment with an attachable/detachable wireless carrier unit 2060, which may contain a battery unit 2076. *Id.*, 22:23-23:2.

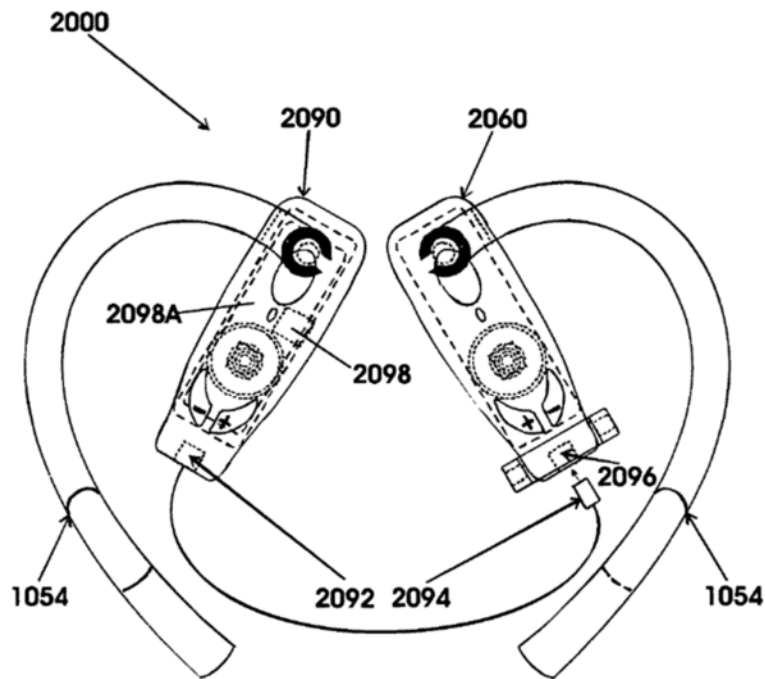
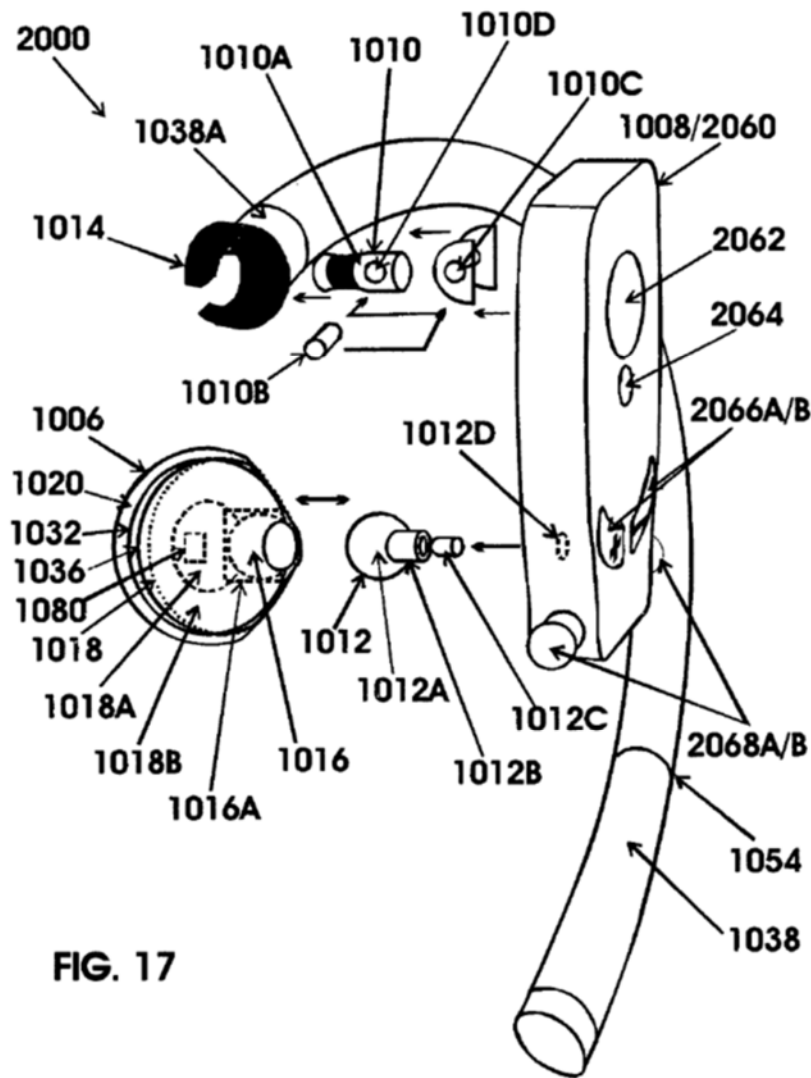


FIG. 19

88. “The carrier unit 2060 may be separable and independent from the ear band unit 1038 through the roller/ball unit 1010 and hole or big C-style socket unit 1014, or in other words, may be assembled or unassembled in this manner by the user. . . . The carrier unit 2090 has the same separable and independent structure and function as the carrier unit 2060. Therefore, a user can switch the carrier unit 2060 with the carrier 2090 easily and conveniently for left or right ear cell phone talking.” *Id.*, 23:64-24:8, Figs. 17, 19.



4. U.S. Patent Pub. No. 2016/0080853 to Chen (“Chen”) (EX1014)

89. Chen was filed on September 17, 2014, and published on March 17, 2016. EX1014, (22), (43). I have been informed by counsel for Petitioner that Chen is prior art to the '084 Patent under post-AIA §102(a)(1), (a)(2). Chen was not cited as prior art to the '084 Patent and thus was not considered by the patent examiner during prosecution. EX1001, (56).

90. As shown below in Figure 1, Chen discloses a modular headphone system having a “circuit module (3) and the power module (7) are respectively detachably connected to the earphone bodies (1) of the respective earphone modules (see Fig. 3) so that different designs of circuit modules (3) and power modules (7) having different configurations with different functions can be selectively used.” EX1014, Fig. 1, [0017]. “The power module (7) is . . . adapted for providing the circuit module (3) and the earphone modules with the necessary working power supply” *Id.*, [0015].

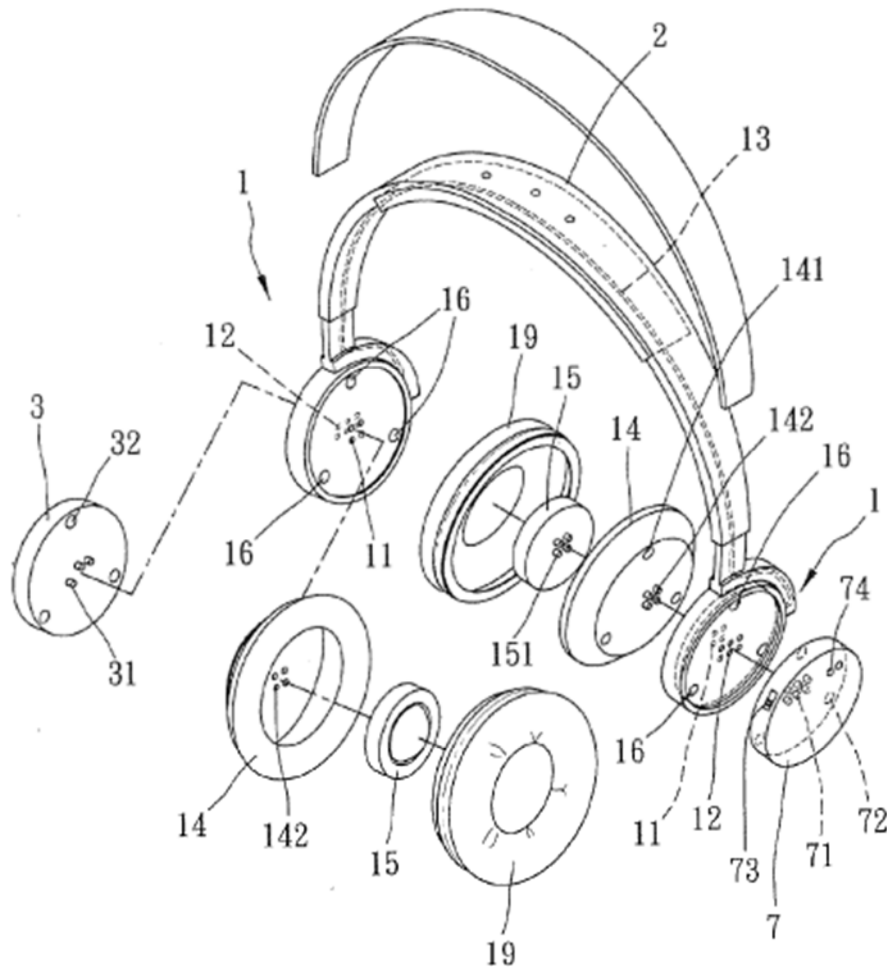
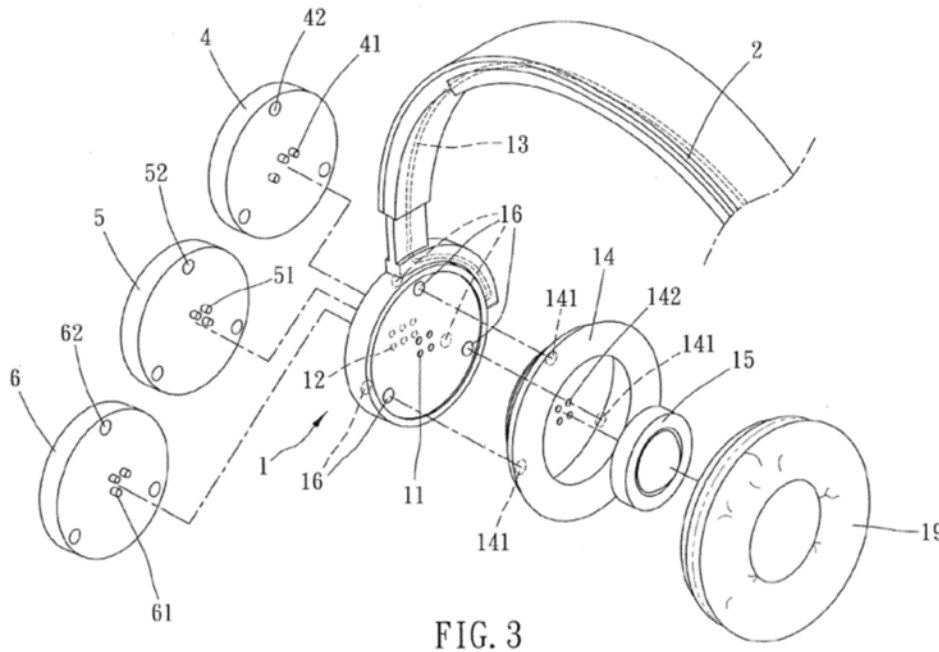


FIG. 1

91. The modular design allows users to change designs and configurations and allows for different functions and upgrades. *Id.*, [0004], [0017].

92. Chen teaches that “powerful magnets (141)(16)(32)(42)(52)(62)(72) can be used for connection in a detachable manner between the circuit module (3) and power module (7) and the earphone bodies (1) of the respective earphone

modules. Hook joints, snaps, screw joints and other detachable fastening means may be selectively used as a substitute.” *Id.*, [0017], Fig. 3.

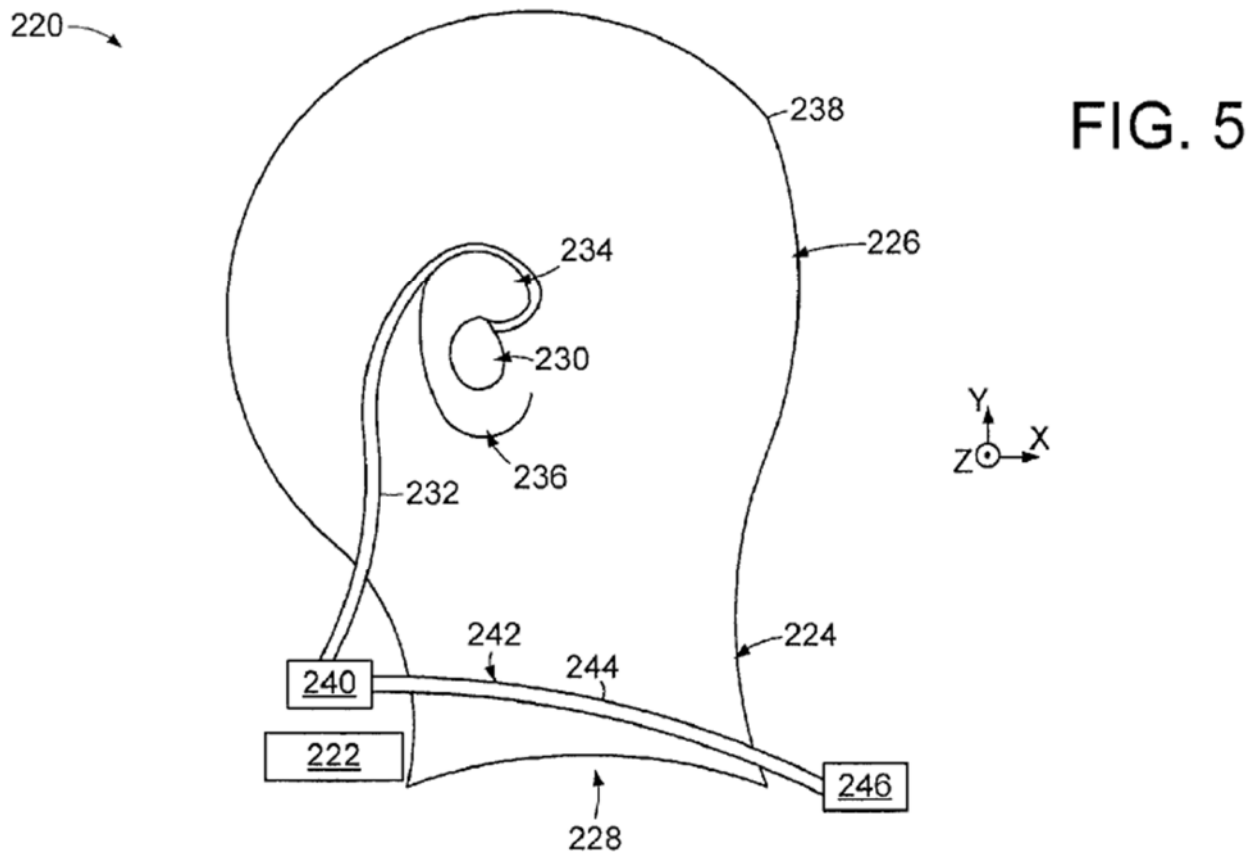


5. U.S. Patent No. 9,866,966 to Lott (“Lott”) (EX1015)

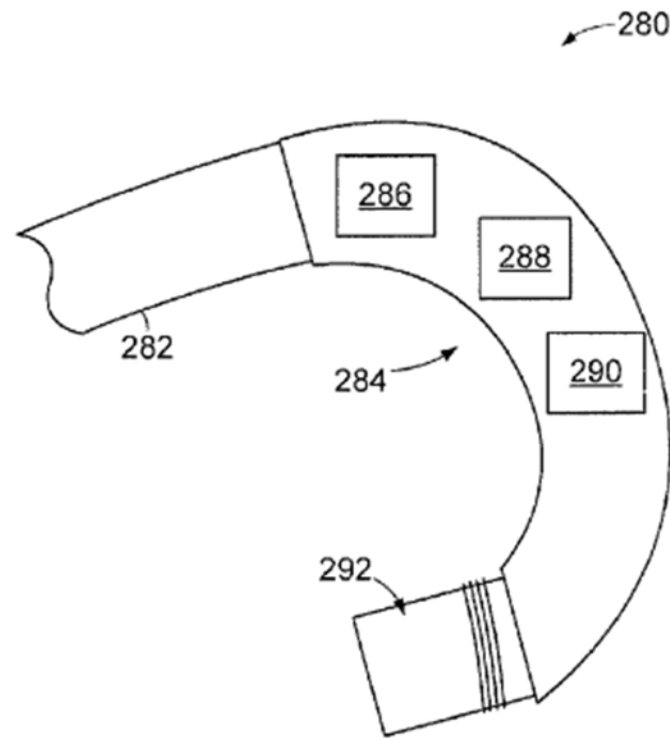
93. Lott was filed on May 20, 2016, and published on January 9, 2018. EX1015, (22), (45). I have been informed by counsel for Petitioner that Lott is prior art to the '084 Patent under post-AIA §102(a)(1), (a)(2). Lott was not cited as prior art to the '084 Patent and thus was not considered by the patent examiner during prosecution. EX1001, (56).

94. Lott discloses a wireless audio system, including a first in-ear monitor 230, as shown in Figure 5 below. EX1015, Fig. 5, 5:33-44. Also shown are modular auxiliary extensions 232 that may include a secondary portion 242. *Id.*, 5:45-6:17.

The auxiliary extensions 232 and secondary portion 242 may be, for example, a microphone extension, an electrical circuit, or control circuitry. *Id.*



95. As shown below in Figure 7, Lott also discloses an auxiliary extension 280 having a “cable 282 extend[ing] from an ear hook portion 284 that is adapted to rest in contact with the forward pima portion of the user’s ear along with a portion of the user’s head.” *Id.*, Fig. 7, 6:65-7:2.



96. The ear hook 284 also has a physical connector 292 to connect the in-ear monitor 230. *Id.*, 7:33-35. This “connector 292 may be a standardized configuration, such as an MMCX, IEM 2-pin connector, or may be an inductive connector that employs magnetic surfaces to secure the ear hook portion 284 and establish an electrical connection.” *Id.*, 7:35-39. The connector 292 can be attached and detached from the in-ear monitor 230 at will. *Id.*, 7:39-42.

97. Lott discloses that its modular design is advantageous so that headphones/monitors can be used in “situations other than listening to music or speech.” *Id.*, 2:6-9. Accordingly, Lott discloses “a wireless audio system that

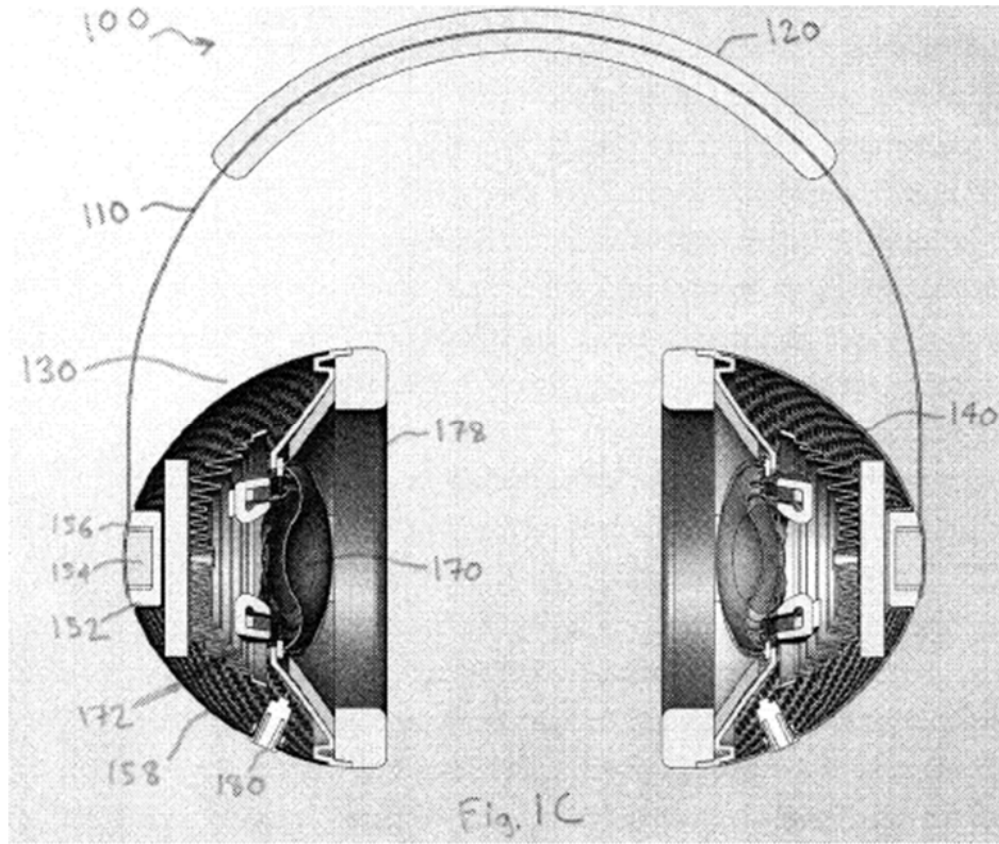
provides low signal latency along with a diverse range of capabilities that may, or may not, be facilitated by attachments physically connected to a wireless monitor.” *Id.*, 2:13-17.

98. Lott also teaches that the monitor can be adapted to allow a microphone extension 216 to be attached (a boom microphone). *Id.*, 5:19-32. The microphone extension “has an auxiliary battery that can be removed and/or recharged to provide additional life to the wireless monitor.” *Id.* Furthermore, one or both in-ear monitors may be supported by an electrical circuit connected via the auxiliary extension, providing an additional battery. *Id.*, 5:59-66. Last, Lott teaches an in-ear monitor with an audio processor that is powered by a rechargeable, removable battery. *Id.*, 4:2-5, Fig. 3.

6. U.S. Patent Publication No. 2018/0316999 to Bellas et. al. (“Bellas”) (EX1016)

99. Bellas was filed on April 26, 2017, and published on November 1, 2018. EX1016, (22), (43). I have been informed by counsel for Petitioner that Bellas is prior art to the '084 Patent under post-AIA §102(a)(1), (a)(2). Bellas was not cited as prior art to the '084 Patent and thus was not considered by the patent examiner during prosecution. EX1001, (56).

100. Bellas discloses headphones, including a headband 100 that is detachably connected to a sphere cup 152, sphere magnet 154, and sphere insert 156, which are shown below in Figure 1C. EX1016, Fig. 1C, [0072], [0078].



101. The modular design is beneficial for reducing product size, simplifying component shapes, and reducing production costs. *Id.*, Fig. 1C, [0079], [0085], [0096].

7. U.S. Patent Publication No. 2014/0126742 to Eggebraaten (“Eggebraaten”) (EX1019)

102. Eggebraaten was filed on November 5, 2013, and published on May 8, 2014. EX1019, (22), (43). I have been informed by counsel for Petitioner that

Eggebraaten is prior art to the '084 Patent under post-AIA §102(a)(1), (a)(2).

Eggebraaten was not cited as prior art to the '084 Patent and thus was not considered by the patent examiner during prosecution. EX1001, (56).

103. Eggebraaten discloses:

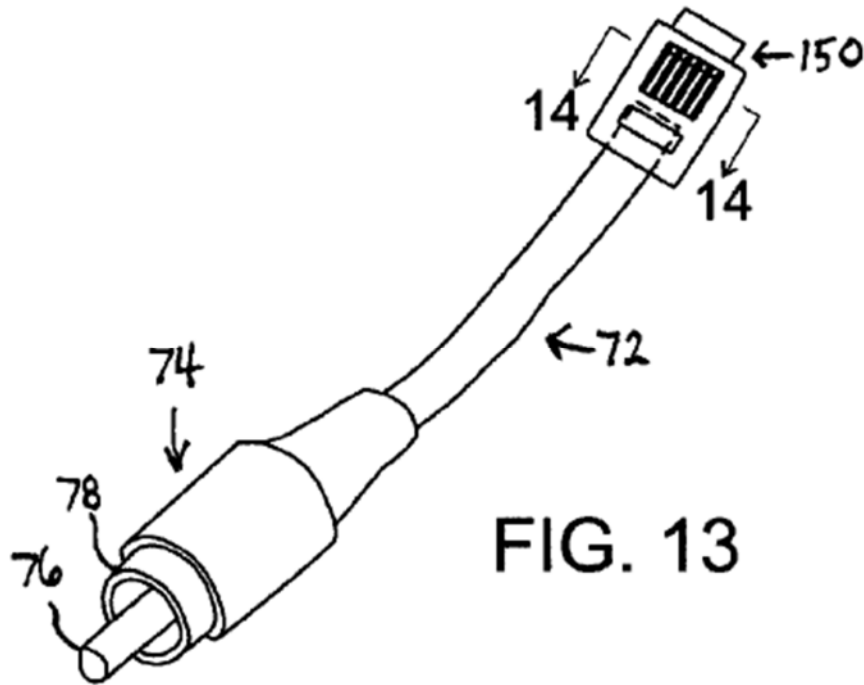
A multi-room audio distribution system 8 having a plurality of audio cable adapters that can be used to connect and distribute an electrical audio signal from an audio signal source 12 . . . to one or more audio receivers 18 such as . . . a headphones set, or another consumer electronic device each audio receiver having an audio input jack or a plurality of audio input jacks with the purpose of providing a means to play audio (music) from a single audio signal source on one or more of such audio receivers in one or more locations.

EX1019, Abstract.

104. Eggebraaten discloses various known electrical connections such as modular jacks (*e.g.*, various versions of RJ-11 style, RJ-45, TRS audio cable adapter, and RCA plugs and jacks). *Id.*, [0009]-[0015], [0035], [0045]. For example, Figure 13 shows:

[An] RCA digital audio cable adapter having a RCA connector 74 (RCA digital source or receiver connection assembly) having a male tip 76 and a female shield 78 at one end electrically connected by two cable conductors to a 6p2c modular plug 150 at the other end with said male tip electrically connected to a

conductor 3 in position 3 of said plug and said female shield electrically connected to a conductor 4 in position 4 of said plug.



Id., [0047], Fig. 13.

105. Eggebraaten listed its design benefits as follows:

The present invention allows one or more audio receivers to run simultaneously from a single audio signal from a single lowpower output device (audio signal source) such as a personal computer or an MP3 player or a comparable device, allows a user to select his own audio receiver or audio receivers and/or speakers and/or headphone sets, and allows the audio signal to be communicated from one end of a building, house, or premises wired network to the other end of the network without significant loss of audio quality.

Id., [0007].

**XI. GROUND 1: LI, FUJITA, AND THE KNOWLEDGE OF A POSITA
RENDER OBVIOUS CLAIMS 1 AND 11**

106. As shown below, Li and Fujita, in view of the knowledge of a POSITA, render claims 1 and 11 obvious.

A. Motivation to Combine Li and Fujita

107. At the time of the '084 Patent, it would have been obvious to a POSITA to combine Li and Fujita by using bone conduction speakers of the type taught by Fujita in bone conduction earphones of the type taught by Li because, although Li's invention describes nearly all of the overall structure of the earphone device, it does not provide details on the construction or implementation of the bone conduction speakers themselves, including the design of the vibration mechanism, and therefore a POSITA would have looked to other references in the field for details of such design. A POSITA would therefore have been motivated to look to known designs such as Fujita's and to use Fujita's bone conduction speaker design in a bone conduction earphones such as those described in Li, and understood that a Li-Fujita combination was a practical construction of the bone conduction speakers. A POSITA would have been capable of combining the disclosures of Li and Fujita

108. Li teaches bone conduction earphones were already established technology: "Bone conduction earphones use bone conduction technology to receive

speech and closely adhere to the bone, and sound waves are directly transmitted by the bone to the auditory nerve. Therefore, both ears can be exposed without damaging the eardrum, ***and it is therefore loved by a large number of consumers.***” EX1004, [0002]. The improvement to bone conduction earphones as taught by Li does not explicitly concern the technology of the bone conduction speaker itself, but rather “improv[ing] the poor bending performance of existing bone conduction earphones,” specifically the elastic nature of the ear hook. *Id.*, [0003]-[0005]. Indeed, Li only describes the bone conduction speaker it utilizes in general terms. *Id.*, [0024], [0040], [0046], [0050].

109. A POSITA would therefore have looked to Fujita for a bone conduction speaker design to be used in the Li earphones. The contemporaneous references are squarely in the same field of bone conduction speaker devices, with Fujita recognizing the use of bone conduction speakers in many different applications such as hearing aids, mobile phones, and information devices. EX1022, [0001]-[0002]. Fujita acknowledges bone conduction speakers were a known technology by the time it was published, a decade before Li. *Id.* A POSITA would therefore have been motivated to use Fujita’s construction of the bone conduction speakers and capable of combining the disclosures of Li and Fujita to do so.

110. A POSITA would have recognized the benefit of using Fujita’s bone conduction speaker in Li because Fujita teaches a bone conduction speaker that

“efficiently transmit[s] the output vibration” due to the speaker’s design making “accurate contact with the face.” EX1022, [0007]-[0017]. A POSITA would have understood, for example, that the design of the bone conduction speaker in Fujita would enhance the efficiency of how the sound is transmitted using the Li earphones. The benefit of providing such improvement would have motivated the POSITA to make the combination. Because Li discloses a bone conduction speaker but does not provide details about its construction or design, a POSITA would look to Fujita for additional information for the device’s construction.

111. Combining Li with Fujita would simply involve applying known techniques (*i.e.*, a bone conduction speaker as taught by Fujita) to a known device ready for improvement (Li’s bone conduction earphones) to yield predictable results (operating bone conduction earphones with improved sound efficiency). A POSITA would have had a reasonable expectation of success in the combination because Li’s earphones are designed to be worn over the ear with the bone conduction speaker touching the side of the user’s head to transfer vibrations and generate sound, which is the same orientation in which Fujita’s bone conduction speaker is designed to be used. EX1004, Figs. 1-2; EX1022, Figs. 1, 6, 8. A POSITA thus would have had a reasonable expectation that the modification of Li with Fujita would be successful because a POSITA would have found that the teachings of Li and Fujita could have been predictably combined due to the predictability of the bone conduction speaker

art and the known interchangeability of the various elements, including vibration mechanisms and housing. Therefore, a POSITA would have considered it obvious to include the bone conduction speaker of Fujita in Li for the benefits described above.

112. If Patent Owner argues the portions of Li and Fujita cited below relate to different, incompatible embodiments (which they do not), it would have been obvious to a POSITA to combine such embodiments into a single device at least because such embodiments are described in the same prior art reference, are fully compatible with each other, and could be combined with minimal effort to achieve predictable results.

113. Therefore, a POSITA would have considered it obvious to include the bone conduction speaker of Fujita in Li for the benefits described above.

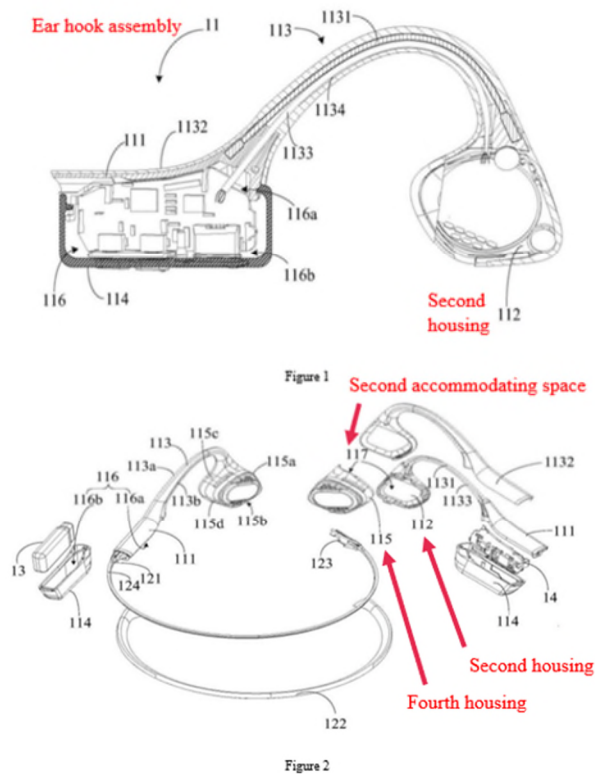
B. Claim 1

1. [1pre] A loudspeaker apparatus, comprising:

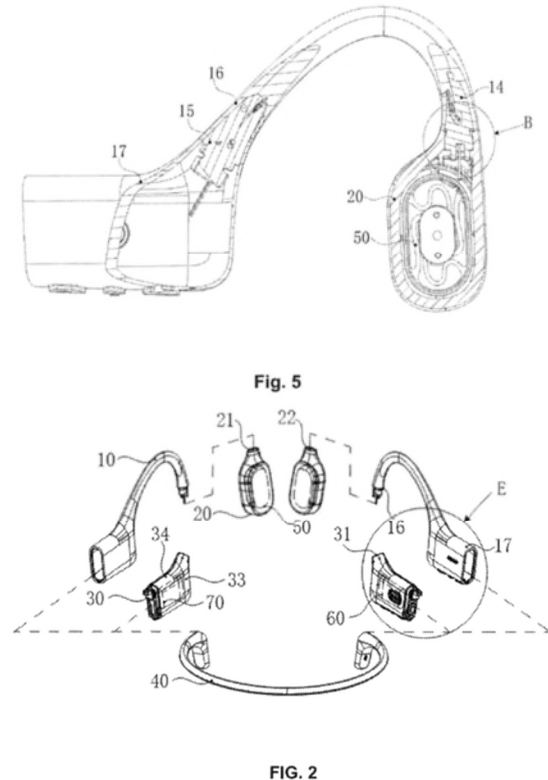
114. To the extent the preamble is limiting, Li discloses or renders obvious *a loudspeaker apparatus*¹¹: “a bone conduction earphone,” as shown below in Figures 1-2. EX1004, Abstract, Figs. 1-2. “The fourth housing 115 cooperates with

¹¹ '084 Patent claim language is italicized throughout.

the second housing 112 to form a second accommodating space 117 for accommodating the bone conduction speaker.” *Id.*, [0043].



Li, Figures 1, 2



'084 Patent, Figures 5, 2

115. Li discloses that “a bone conduction earphone also comprises bone conduction speakers, batteries, control circuits, and other components. For example, bone conduction speakers are used to output sound to users via vibration in a bone conduction manner.” EX1004, [0024].

2. [1a] an ear hook including a first plug end and a second plug end,

116. Li’s connecting component 113 constitutes *an ear hook*. “The ear hook assembly 11 is generally used for users to hang the bone conduction earphone

on their ears when wearing them [T]he ***connecting component 113*** can directly contact the ear and support the bone conduction earphone via the base of human ear.” EX1004, [0025]-[0026], [0023], Fig. 1.

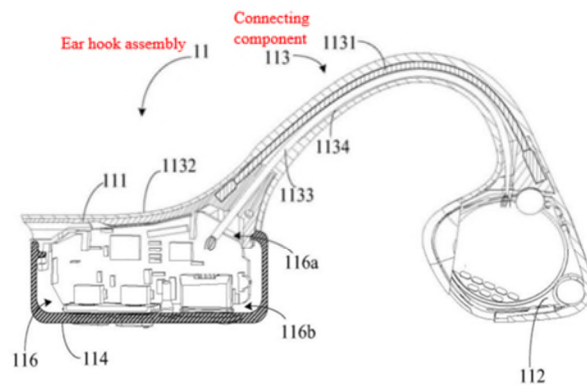


Figure 1

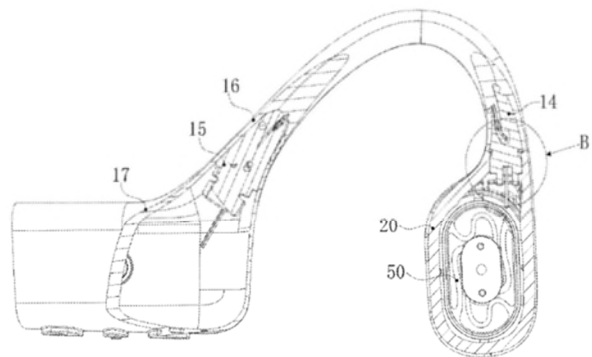


Fig. 5

Li, Figure 1

'084 Patent, Figure 5

117. Li renders obvious an ear hook including *a first plug end* and *a second plug end*. Li discloses plug-in portions 123 provided at both ends of the second elastic metal wire 121. EX1004, [0058]. The plug-in portions 123 are respectively connected and fixed to the first housings 111 of the two ear hook assemblies 11. *Id.*, [0058], Figs. 2, 9. The plugs may be designed for either a tight fit or to be locked. EX1004, [0062]-[0069].

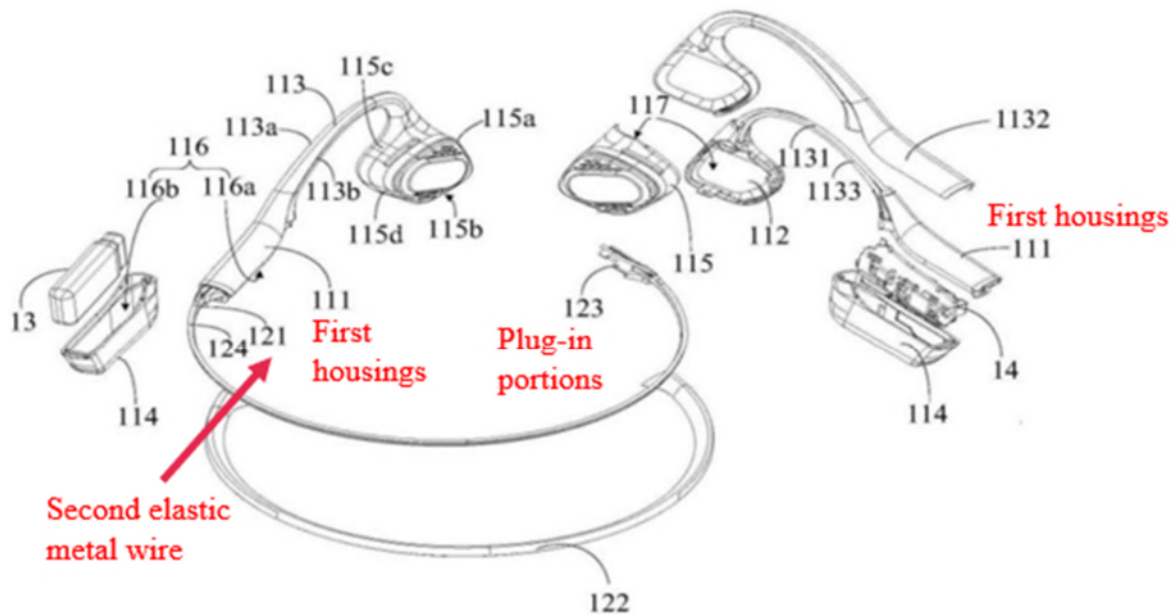


Figure 2

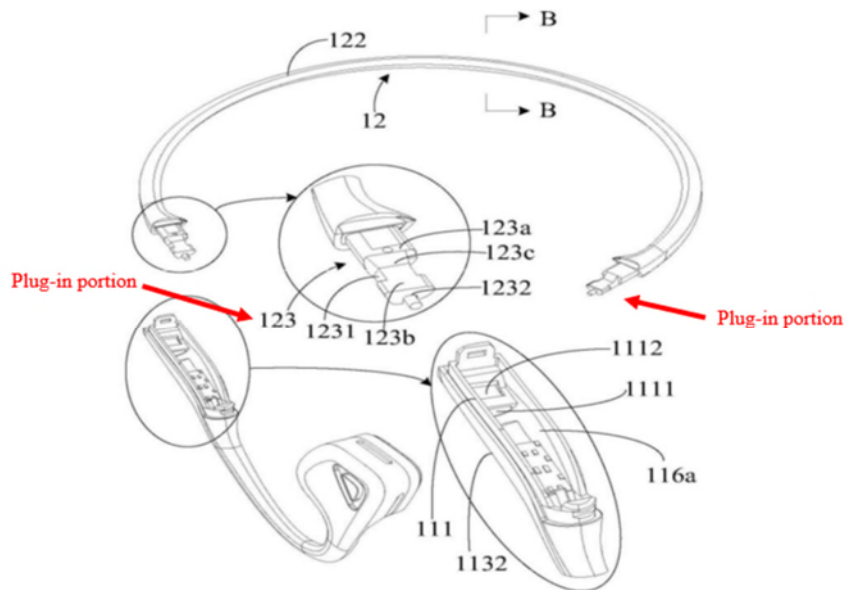


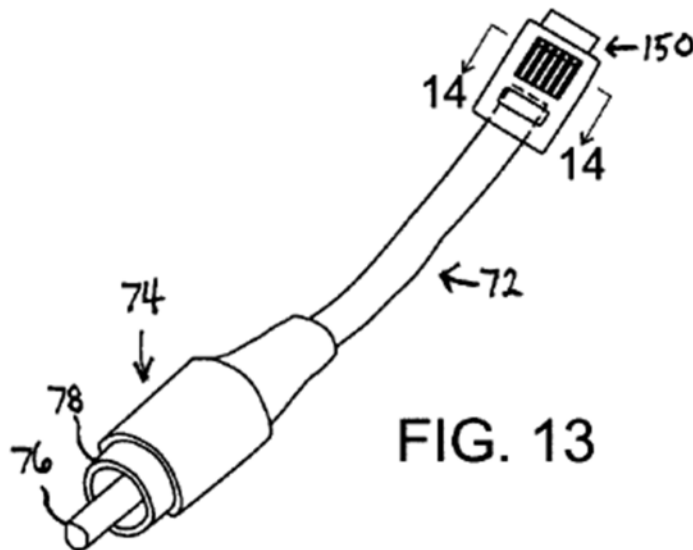
Figure 9

Li, Figures 2, 9

118. It would have been obvious to a POSITA to include a *first plug end* in Li's ear hook using the same general design of the plug-in portions 123. As

discussed above in §X.K, modular portions, such as speaker portions and control circuit housing portions, of headsets were well-known as of the priority date of the '084 Patent. *E.g.*, EX1011, Fig. 2, [0006]-[0007], [0030]-[0032]; EX1012, Fig. 2, 2:4-15, 3:13-35; EX1013, Fig. 1, 10:62-11:8; EX1014, Fig. 1, [0004], [0017]; EX1015, Figs. 5, 7, 2:6-17, 5:33-6:17, 6:65-7:42. The speaker portions were modular for various reasons, such as sound quality, ease of use, aesthetics, user comfort, EX1011, [0007], component replacements and removability, upgrades, changes, shape simplification, and reducing manufacturing and production costs due to the simple shape of components, EX1012, 2:4-15; EX1014, [0004], EX1015, 2:6-17, EX1016, [0056], [0079], [0085], [0096], comfort, safety, and wearing stability, EX1013, 11:5-8, and allowing for different uses, and allowing for situation other than listening to music or speech. EX1015, 2:6-17. In bone conduction, the earphone core is the vibrating mechanism of the speaker. EX1004, [0024]; *e.g.*, EX1001, 1:47-48 (“The control circuit or the battery may drive the earphone core to vibrate to generate a sound.”). Also, while Li does not disclose a method for the second wire set 124 in plug-in portions 123 to electrically “connect the components inside the two ear hook assemblies 11, such as the battery and the control circuit assembly 14,” EX1004, [0069], a POSITA would have found it obvious to configure the plug-in portions 123 with known modular electrical connections such as pins and contacts commonly found in jacks, and plugs such as the types shown

below, and to include mating pins and contacts in corresponding sockets of the speaker housing and control circuit housing for electrically connecting the ear hook to those housings. EX1012, 3:21-35; EX1019, Figs. 1-15, [0009]-[0015], [0035], [0045]. A POSITA would have been motivated to use such known modular electrical connections for the additional benefit of reducing manufacturing costs and complexity. EX1019, [0031] (“inexpensive to manufacture”).



Id., Fig. 13.

119. Accordingly, it would have been obvious for a POSITA to add an ear hook including *a first plug end* to Li between the ear hook and earphone core given that modular speaker portions of headsets were well-known as of the priority date of the '084 Patent. Providing the *first plug end* would have achieved the well-known benefits of a modular speaker portion discussed above including cost savings. In fact, the '084 Patent mentions reducing manufacturing cost and adjusting for design

changes as a benefit of its modular design, which modular designs were known to do. EX1001, 11:66-12:11, 16:29-40.

120. Li similarly renders obvious the *second plug end*. Indeed, the prior art teaches the benefits of detachable components in a modular headphone design similar to the '084 Patent's circuit housing for accommodating a control circuit or a battery. EX1014, [0015], [0017], Figs. 1, 3 (detachable "power module . . . adapted for providing the circuit module (3) and the earphone modules with the necessary working power supply"; "[T]he circuit module (3) and the power module (7) are respectively detachably connected to the earphone bodies (1) of the respective earphone modules . . . so that different designs of circuit modules (3) and power modules (7) having different configurations with different functions can be selectively used."); EX1015, 4:2-5, Fig. 3 (in-ear monitor with an audio processor that is powered by a removable battery); 5:19-6:17 (modular extensions include control circuitry or a microphone extension that has "an auxiliary battery that can be removed and/or recharged to provide additional life to the wireless monitor"); EX1013, 22:23-23:2, 23:64-24:8, Figs. 17, 19 (headphones with a wireless carrier unit with a battery unit, the wireless carrier unit having a separable and independent structure that can be disassembled by the user). The prior art also teaches various electrical connectors for connecting modular pieces electrically. EX1012, 3:21-35; EX1019, Figs. 1-15.

121. Accordingly, it would have been obvious for a POSITA to add an ear hook including a *second plug end* to Li between the ear hook and circuit housing given that modular speaker portions of headsets were well-known as of the priority date of the '084 Patent. This design in Li would achieve the benefits of a modular earphone design already recognized by the reference, including reducing earphone size, simplifying the structure, reducing weight, facilitating later wiring, and reducing costs, especially when it comes to replacing the housing containing the earphone's battery or control circuit. *See* EX1004, [0059]. It would also similarly achieve the well-known benefits of a modular speaker end, such as ease of use, aesthetics, user comfort, EX1011, [0007], component replacements and removability, upgrades, changes, shape simplification, and reducing manufacturing and production costs due to the simple shape of components, EX1012, 2:4-15; EX1014, [0004], EX1015, 2:6-17, EX1016, [0079], [0085], [0096], comfort, safety, and wearing stability, EX1013, 5:38-48, and allowing for different uses. EX1015, 2:6-17. Such a design would involve structures already in use in Li and slight modifications to where they appear in the device.

122. Further, Li teaches that “[b]y connecting the plug-in portion 123 of the rear hook assembly 12 with the first housing 111 of the two ear hook assemblies 11, the issue of large earphone size caused by screw fixation in existing bone conduction earphones are improved, simplifying the structure, reducing the weight

of bone conduction earphones, facilitating later wiring, and reducing costs.”

EX1004, [0059]. Li further teaches that the rear suspension assembly 12 contains wires “to connect the components inside the two ear hook assemblies 11, such as the battery and the control circuit assembly 14.” *Id.*, [0069], Fig. 12.

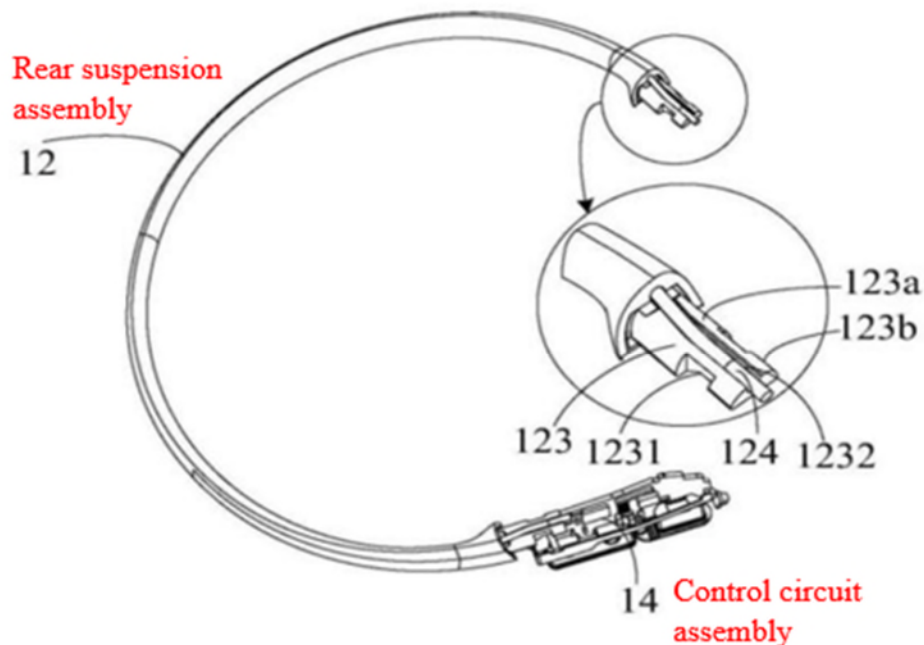


Figure 12

Li, Figure 12

123. It therefore would have been obvious to a POSITA to modify the ear hook assembly 11 of Li to include a *first plug end* and *second plug end* on either side of connecting component 113 in order to connect the first housing 111 and second housing 112. *Id.*, [0023]. Li already discloses plug ends in its design and recognizes their benefits in a modular earphone design, including reducing earphone size, simplifying the structure, reducing weight, facilitating later wiring,

and reducing manufacturing costs and complexity. *Id.*, [0059]. A POSITA would easily have recognized these benefits would be further realized by adding plug ends to other components of the earphones, including on either end of connecting component 113. The design would require nothing more than adding Li's already designed plug ends to that portion of the device. The first housing 111 in Li is already designed to receive and connect such plug ends.

124. Therefore, Li discloses or renders obvious element [1a].

3. [1b] the ear hook being surrounded by a protective sleeve, the protective sleeve being made of an elastic waterproof material;

125. Li discloses or renders obvious this limitation. Li discloses or renders obvious that *the ear hook*—connecting component 113—is *surrounded by a protective sleeve*—a first elastic coating layer 1132—*being made of an elastic waterproof material* (silicone).

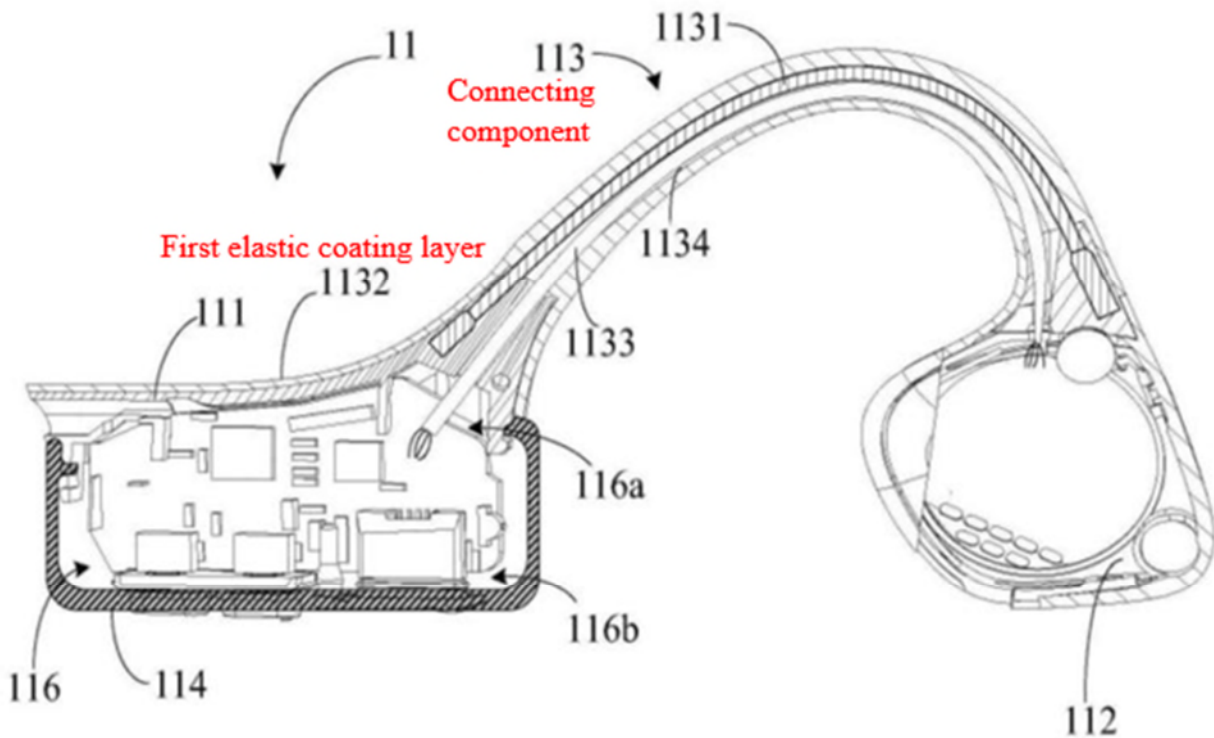


Figure 1

Li, Figure 1

126. Li discloses that “[t]he connecting component 113 comprises a first elastic metal wire 1131 and **a first elastic coating layer 1132 wrapped around the first elastic metal wire 1131.**” EX1004, [0026], [0030], Figs. 1, 3. “Due to the elastic effect of the first elastic coating layer 1132, the user can wear the bone conduction earphone comfortably. . . . Optionally, the first elastic coating layer 1132 is a silicone layer. Of course, in other embodiments, the first elastic coating layer 1132 can also be a latex layer or a rubber layer, or other elastic plastic layers, or a composite material layer containing silicone.” *Id.*, [0028].

127. A POSITA would have understood the material of the first elastic coating layer, for example, silicone, to be waterproof. EX1004, [0073] (“waterproof lining board 143” is covered with a “third elastic coating layer 143b” that can be made of “silicone”). For example, silicone was known in the art to be waterproof, including as a covering for electronic audio devices. EX1020, Abstract, 1:14-2:45, 12:32-33 (waterproof case for protecting electronic audio device, including a waterproof bag made of silicone); EX1021, 2:50-4:53, 6:52-63, Fig. 5b (waterproof bone conduction headphones with silicone sealing). Li’s disclosure of other waterproof components such as a waterproof lining board 143 would inform a POSITA that other elements like first elastic coating layer 1132 would be waterproof. EX1004, [0071].

4. [1c] a core housing for accommodating an earphone core, the core housing being fixed to the first plug end and elastically abutted against the protective sleeve; and

128. Li renders obvious this limitation. Li discloses *a core housing for accommodating an earphone core*: the combination of the second housing 112 and the fourth housing 115 that forms the second accommodating space 117 as shown below.

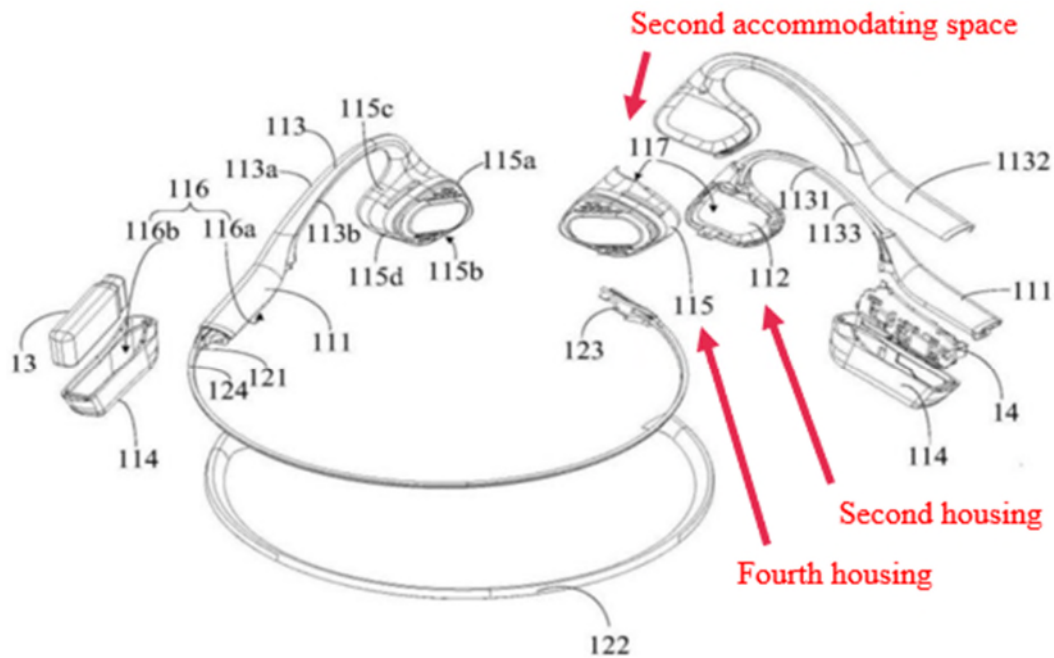


Figure 2

Li, Figure 2

129. Li discloses: “Referring to figures 1, 2, and 8, optionally, the ear hook assembly 11 comprises a third housing 114 and a fourth housing 115. . . . ***The fourth housing 115 cooperates with the second housing 112 to form a second accommodating space 117 for accommodating the bone conduction speaker.***”

Optionally, the fourth housing 115 and the third housing 114 are plastic housings.”

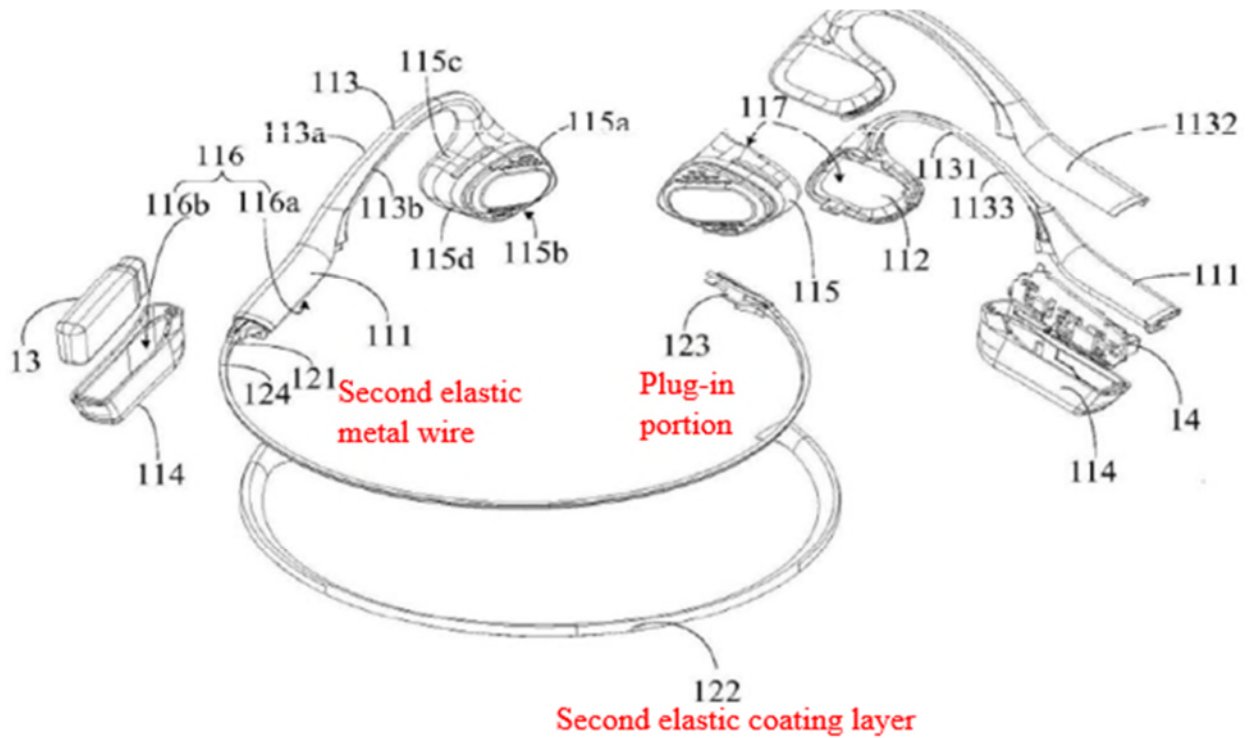
EX1004, [0043], Figs. 1, 2, 8.

130. Further, as discussed above in [1a], it would have been obvious to a POSITA to include a *first plug end* on one end of Li's ear hook to connect it to the earphone core (Li's second and fourth housings 112, 115 that together form the claimed *core housing*) using Li's plug-in portions 123 design, EX1004, [0058],

given that modular speaker portions of headsets were well-known as of the priority date of the '084 Patent. This first plug would provide *the core housing being fixed to the first plug end* because Li's plug design would be replicated between the core housing and earphone. It therefore would have been obvious to configure Li's *core housing* with a socket and corresponding electrical pins/contacts as discussed above to mate with the *first plug end* of the *ear hook* and connect it to the *first plug end* of the *ear hook* to achieve the benefits of a modular earphone design already recognized by Li, including reducing earphone size, simplifying the structure, reducing weight, facilitating later wiring, and reducing costs, especially when it comes to replacing the housing comprising the earphone's speaker. *See id.*, [0059]. Such design would involve structures already in use in Li and slight modifications to where they appear in the device.

131. Li renders obvious the core housing being (i) fixed to the first plug end and (ii) *elastically abutted against the protective sleeve*, and it would be obvious to replicate that same design at the first plug location as explained above.

132. Li teaches a *plug end and elastically abutted against the protective sleeve*. As shown below in Figure 2, "[t]he rear hook assembly 12 comprises a second elastic metal wire 121, a second elastic coating layer 122 wrapped around the second elastic metal wire 121, and plug-in portions 123 provided at both ends of the second elastic metal wire 121." *Id.*, Fig. 2, [0058].



Li, Figure 2

The second elastic coating layer 122 may be silicone, rubber, latex, or a composite including silicone. *Id.*, [0058]. As shown in Figure 2, the second elastic coating layer 122 abuts the third housing 114 at the plug-in portion 123. Thus, Li teaches a housing elastically abutted against the protective sleeve. Further, because it would have been obvious to replicate that same design at the first plug location as explained above in [1a], that design would yield the core housing (Li's second and fourth housing 112, 115) being fixed to the first plug end *and elastically abutted against the protective sleeve* over Li's connecting component 113 (*ear hook*).

133. Additionally, Li also teaches that its *core housing* is covered by the same first elastic coating layer 1132 of connecting component 113: “Referring to figures 1 and 2, optionally, ***the first elastic coating layer 1132 further covers at least portion of the outer surfaces of the first housing 111 and the second housing 112, such as the entire outer surface.*** . . . This enhances the texture and unity of the bone conduction earphone, and the presence of the first elastic coating layer 1132 can further protect the housing and internal components, making the bone conduction earphone more wear-resistant.” *Id.*, [0036]. Li therefore acknowledges the benefits of having a coating of the *protective sleeve* over the entirety of the *ear hook* and the *core housing*. It therefore would have been obvious to a POSITA to have elastic coating over all of the entire bone conduction earphone to achieve the same benefits, such as wear-resistance, of tightly constructed earphones.

134. Li therefore discloses or renders obvious element [1c].

5. **[1d] a circuit housing for accommodating a control circuit or a battery, the circuit housing being fixed to the second plug end, the control circuit or the battery driving the earphone core to vibrate, the vibration of the earphone core generating a driving force to drive a housing panel of the core housing to vibrate, the driving force being not parallel to a normal line of the housing panel.**

135. The combination of Li and Fujita renders this limitation obvious. Li’s third housing 114 and first housing 111 constitute the *circuit housing for accommodating a control circuit or a battery*. Li teaches that in its bone conduction

headphones, “the third housing 114 of the ear-hook assembly 11 cooperates with the first housing 111 to form a first accommodating space 116 for accommodating the battery assembly 13 or the control circuit assembly 14.” EX1004, [0046], [0024], Figs. 1, 2.

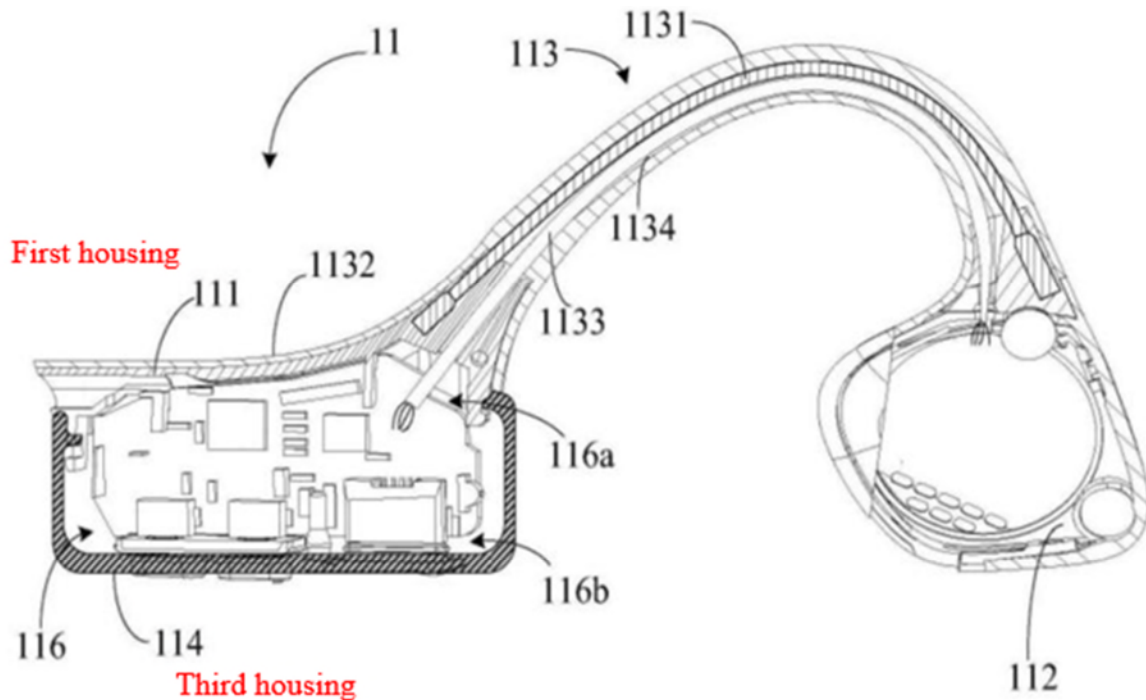


Figure 1

Li, Figure 1

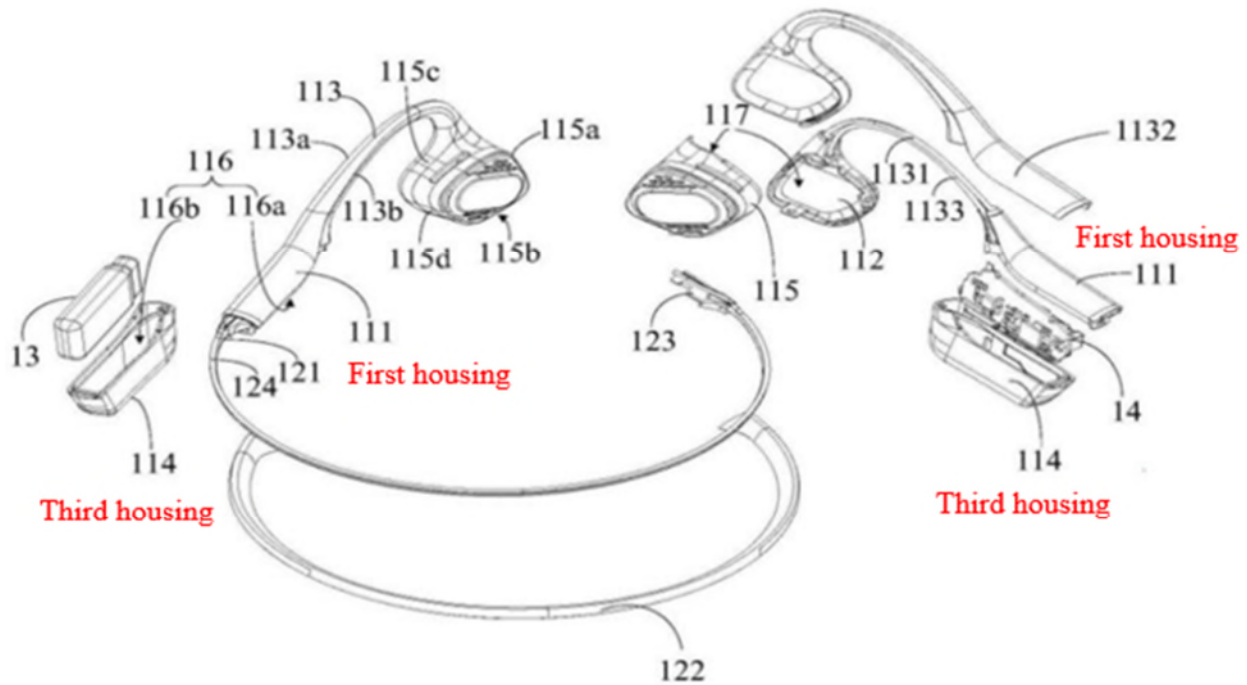


Figure 2

Li, Figure 2

136. Li also discloses or renders obvious *the control circuit or the battery driving the earphone core to vibrate*:

[B]one conduction speakers are used to output sound to users via vibration in a bone conduction manner. The battery is used to power the various components of the bone conduction earphone. The control circuit is used to control the bone conduction earphone, such as for adjusting volume, turning on and off, playing audio, and Bluetooth communication.

Id., [0024]. Further, Li discloses that “[t]he first wire set 1133 can move through the lead channel 1134 for electrically connecting the bone conduction speaker with

the battery pack 13 or the control circuit assembly 14.” *Id.*, [0046]. “The battery supplies power to the other components of the bone conduction earphone via the battery management circuit.” *Id.*

137. Li renders obvious *the circuit housing being fixed to the second plug end*. Li discloses *the circuit housing* as explained above (the combination of third housing 114 and first housing 111). Li also renders obvious *the second plug end* (plug-in portions 123) as shown in [1a] above. As shown in Figure 2 below, “[t]he plug-in portions 123 are respectively connected and fixed to the first housings 111 of the two ear hook assemblies 11.” *Id.*, [0058]. Accordingly, Li renders obvious *the circuit housing being fixed to the second plug end*.

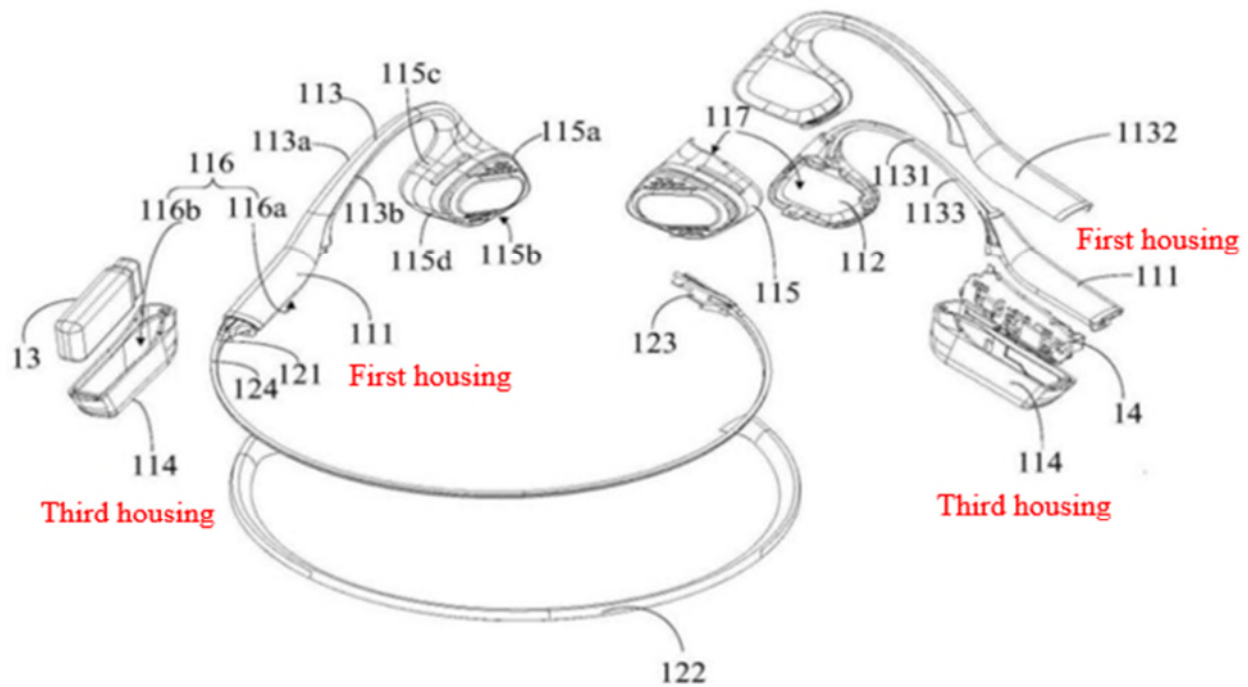


Figure 2

Li, Figure 2

138. A POSITA would also find it obvious to locate sockets that mate with plug-in portions 123 on the corresponding end of connecting component 113 at the other end of first housing 111 in a location at or near the green arrows shown in connecting component 113 below.

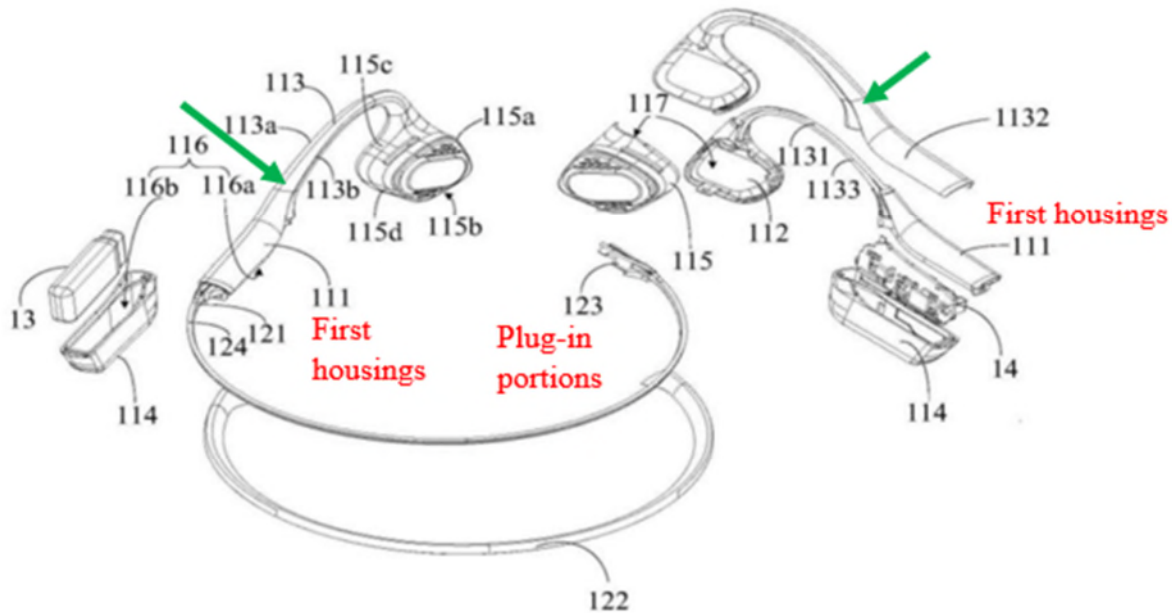


Figure 2

Li, Figure 2

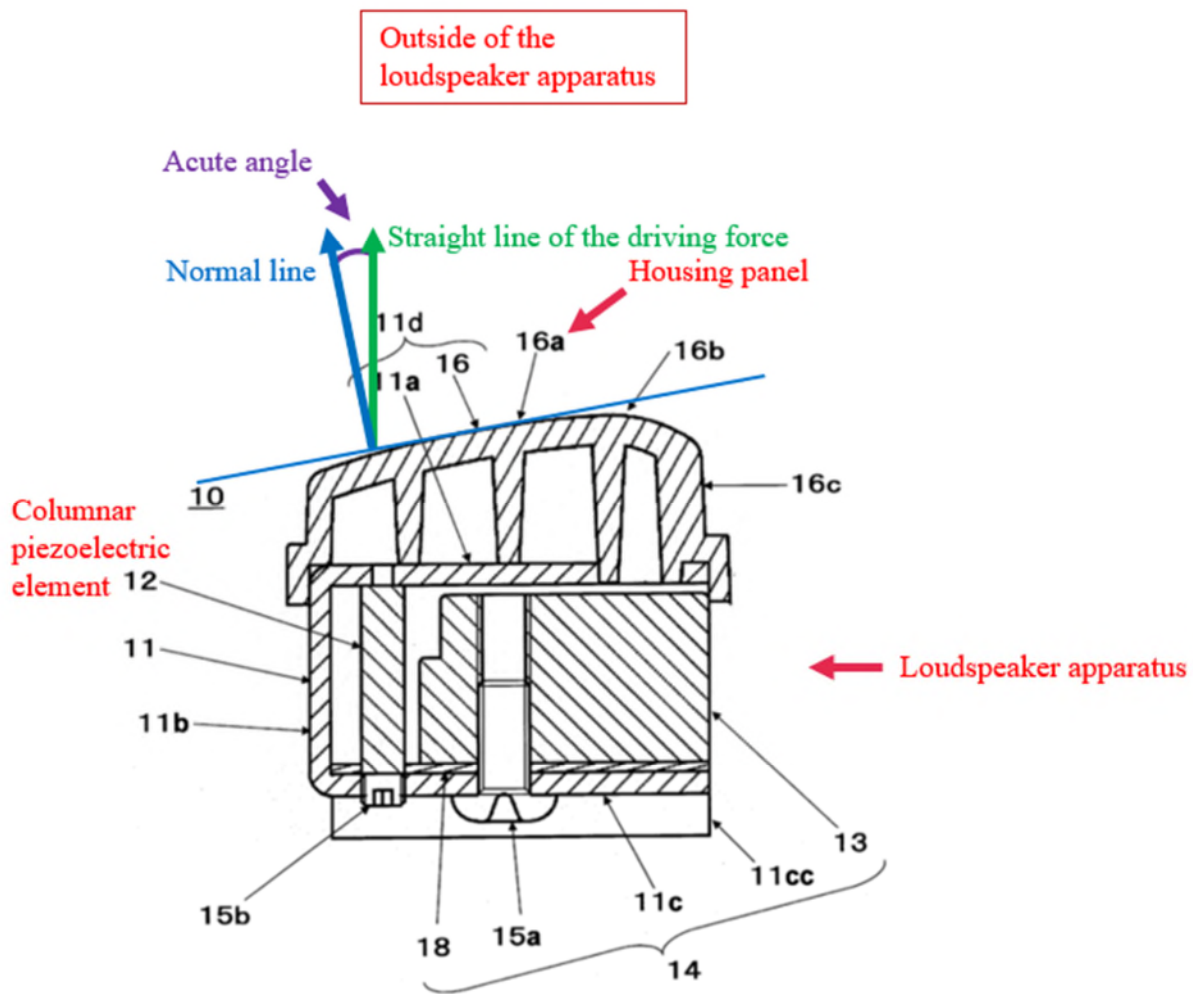
139. A POSITA would find those locations obvious for the same reasons it would have been obvious to add sockets to the bone conduction speaker housing corresponding to the plug ends added to connecting component 113 proximate the bone conduction speaker housing. See [1a]. The prior art teaches the benefits of modular circuit housing design, as described in [1a], and the design in Li would achieve these well-known benefits using structures already in use in Li.

140. Fujita discloses or renders obvious *the vibration of the earphone core* (the vibrating mechanism of the Fujita speaker, including stacked columnar piezoelectric element 12) *generating a driving force to drive a housing panel of the core housing* (cushion 16, and specifically convex close contact surface 16a) to

vibrate, the driving force being not parallel to a normal line of the housing panel:

“The bone conduction speaker (10) is provided with a multilayer columnar piezoelectric element (12) for generating oscillation in accordance with the sound information, and a [cushion] (16), which protrudes from the case (2) for transmitting the oscillation generated by the multilayer columnar piezoelectric element (12) by abutting to the human head.” EX1022, Abstract, [0027], [0030], [0037], Fig. 2. Convex close contact surface 16a is located on Fujita’s cushion 16, which is disclosed as being made of a material with “high rigidity.” *Id.*, [0028], [0030].

141. As can be seen for example in Figure 2, the driving force is not parallel to a normal line of the housing panel.



Fujita, Figure 2

142. A POSITA would understand the annotated “normal line” above in Figure 2 to be one example of a normal line because the housing panel used to contact the user’s body in Fujita is non-planar (has a curvature). A POSITA would understand the normal line may be determined by selecting a certain point in an area when the panel is in contact with human skin, determining a tangent plane of the panel at the selected point, and determining a straight line that passes through

the point and is perpendicular to the tangent plane, and designating the straight line as the normal line of the panel. *See, e.g.*, EX1001, 19:32-20:14. A POSITA would therefore understand that when the panel used to contact the user's body is non-planar like in Fujita, different points correspond to different tangent planes of the panel, and the determined normal line may also be different. Therefore, the above annotated example is just one example of a normal line in Fujita.

143. Therefore, Li and Fujita disclose or render obvious claim 1.

XII. GROUND 2: LI, FUJITA, FUKUDA, AND THE KNOWLEDGE OF A POSITA RENDER OBVIOUS CLAIMS 12-15

A. Motivation to Combine Li and Fujita

144. It would have been obvious to a POSITA to combine Li with Fujita for the reasons discussed above in §XI.A.

B. Motivation to Combine Li-Fujita and Fukuda

145. At the time of the '084 Patent, it would have been obvious to a POSITA to combine Li-Fujita with Fukuda, specifically Fukuda's magnetic circuit system vibration mechanism in place of Fujita's piezoelectric mechanism in its bone conduction speaker, and a POSITA would have been motivated to do so.

146. Magnetic circuit systems were commonly found in speakers at the time of Li and Fujita, including bone conduction speakers at the time of Li, in order to provide efficient, high-quality sound to the user. EX1005, [0052], [0053] (using "high-density permanent magnets" in bone conduction speaker achieves "better

sound quality”), [0143], [0145], [0148]-[0152], [0171], Figures 11, 18-A, 18-B, 22-A; EX1008, [0005], [0013] (“multiple magnetic steels in the middle of the voice coil” in a loudspeaker “significantly improv[es] the electromechanical conversion efficiency and enhance[es] the sensitivity of the loudspeaker”); EX1009, [0002]-[0003] (micro loudspeaker with “high magnetic flux density, high sensitivity, and good overall acoustic performance”); EX1010, 4:1-12 (a magnet assembly for a loudspeaker “providing a magnet system which even after extended continuous use has less distortion of the sound and at the same time provides a very compact design”); EX1018, Abstract, Fig. 2(b), [0016]-[0029] (compact speaker design with strong electromagnetic attractive force). Fukuda offers an improved bone conduction speaker design with a magnetic circuit system that is “simple in construction, allowing the manufacturing cost to be held at a minimum, and yet is completed as an independent unit with minimized sound leakage,” allowing it to be incorporated in devices. EX1023, 3:6-28.

147. A POSITA at the time would understand that the sound quality of a magnetic speaker driver like Fukuda’s is generally higher than that of a piezoelectric driver, and further more that it is easier to fine tune the frequency response of a magnetic driver like Fukuda’s to achieve the desired performance. Therefore, a POSITA would have looked to Fukuda to improve the speaker in the Li-Fujita earphones with a magnetic circuit system vibration mechanism in place of

the piezoelectric mechanism in Fujita including the multilayer columnar piezoelectric element 12 and base weight 13, in order to provide the benefits of a magnetic circuit system, such as efficient, high-quality sound, as well as a simple construction. A POSITA would look to Fukuda for inspiration and improvement of the Li-Fujita earphone speakers. A POSITA would have recognized the benefit of Fukuda's improvement, motivating the combination.

148. Combining Li-Fujita with Fukuda would simply involve applying known techniques (*i.e.*, magnetic circuit speaker design and construction) to a known device ready for improvement (Li-Fujita's bone conduction speaker) to yield predictable results (bone conduction speaker with a magnetic circuit system). A POSITA would have had a reasonable expectation of success in the combination because the Li-Fujita earphones already disclose bone conduction speakers, and Fukuda discloses the use of a magnetic circuit system in such speakers, which was well-known in the art. A POSITA thus would have had a reasonable expectation that the modification of Li-Fujita with Fukuda would be successful because a POSITA would have found that the teachings of Li-Fujita with Fukuda could have been predictably combined due to the predictability of the art of bone conduction speakers with magnetic circuit systems and the known interchangeability of the various elements, including the components of manufacture.

149. If Patent Owner argues the portions of Fukuda cited below relate to different, incompatible embodiments (which they do not), it would have been obvious to a POSITA to combine such embodiments into a single device at least because such embodiments are described in the same prior art reference, are fully compatible with each other, and could be combined with minimal effort to achieve predictable results.

150. Therefore, a POSITA would have considered it obvious to modify the Li-Fujita earphones with Fukuda's magnetic circuit system for use in the Fujita bone conduction speaker for the benefits described above.

C. Claim 12

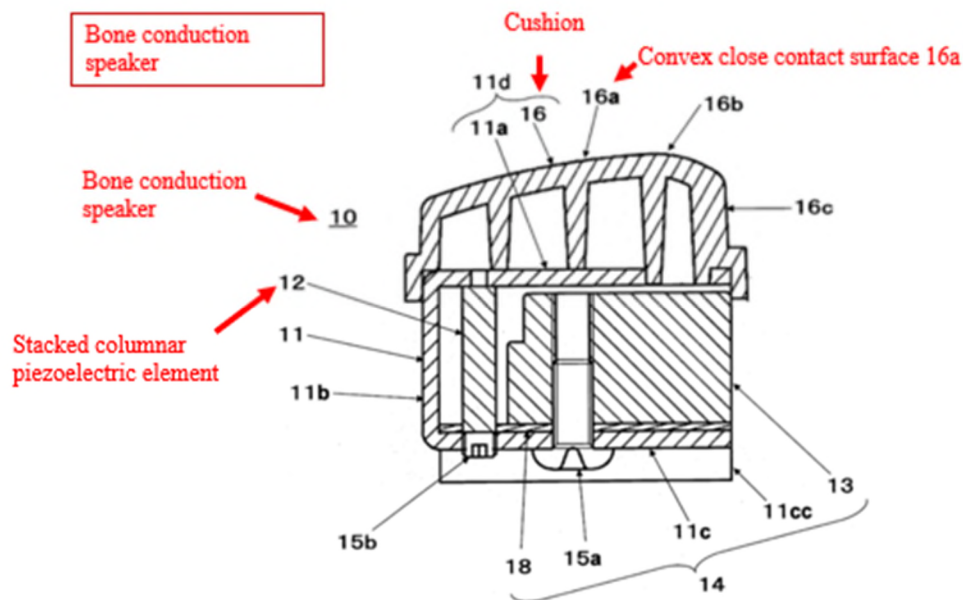
1. [12pre] The loudspeaker apparatus of claim 1, wherein

151. The Li-Fujita combination renders obvious *the loudspeaker apparatus of claim 1. See claim 1.*

2. [12a] the housing panel and the earphone core are in a transmission connection, and

152. Fujita discloses or renders obvious *the housing panel* (cushion 16, convex close contact surface 16a) *and the earphone core* (the vibrating mechanism of the Fujita speaker, including stacked columnar piezoelectric element 12) *are in a transmission connection*: “[T]he vibration output part 11a is provided with a cushion 16. *The vibration output part 11a and the cushion 16 form a vibration transmitting part 11d, and the vibration transmitting part 11d transmits the*

vibration generated by the stacked columnar piezoelectric element 12.” EX1022, [0027]. Therefore, Fujita discloses or renders obvious *the housing panel and the earphone core are in a transmission connection.*



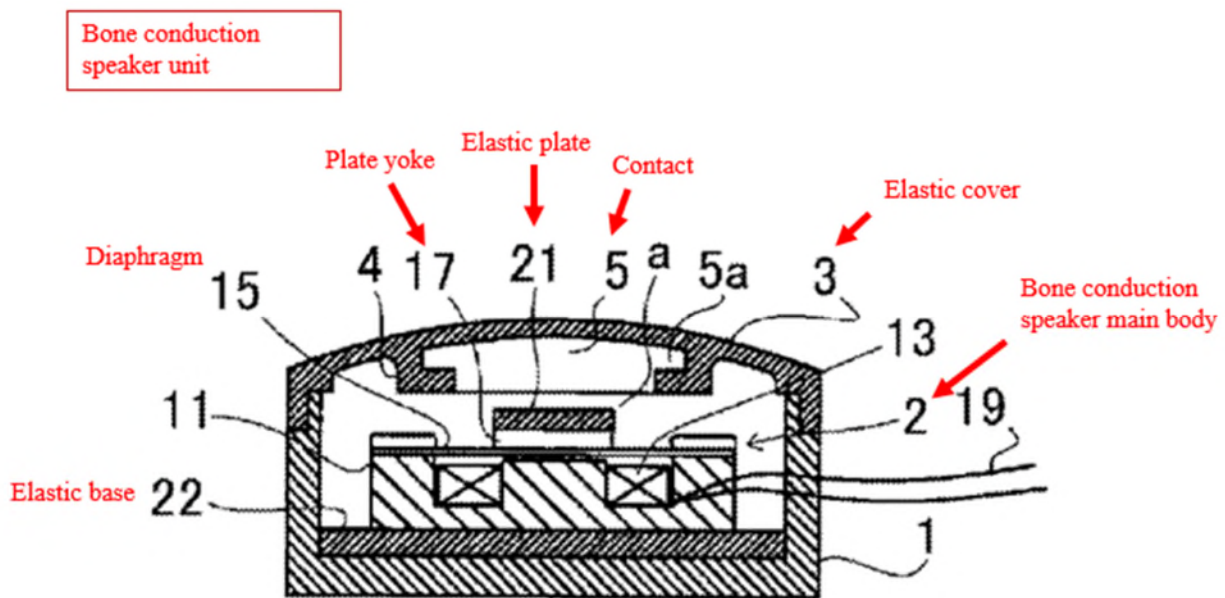
Fujita, Figure 2

Id., Fig. 2.

153. To the extent Fujita does not disclose or render obvious this claim element, it is disclosed or rendered obvious by Fukuda. Fukuda discloses a *housing panel* (elastic cover 3) and an *earphone core* (the vibrating mechanism of the Fukuda speaker in bone conduction speaker main body 2, including Fukuda’s magnetic circuit system (center pole 12, yoke 11, rod-shaped magnets 14)) that are *in a transmission connection*. As can be seen in Figure 1, for example, bone conduction speaker body 2 has a transmission connection to elastic cover 3 when

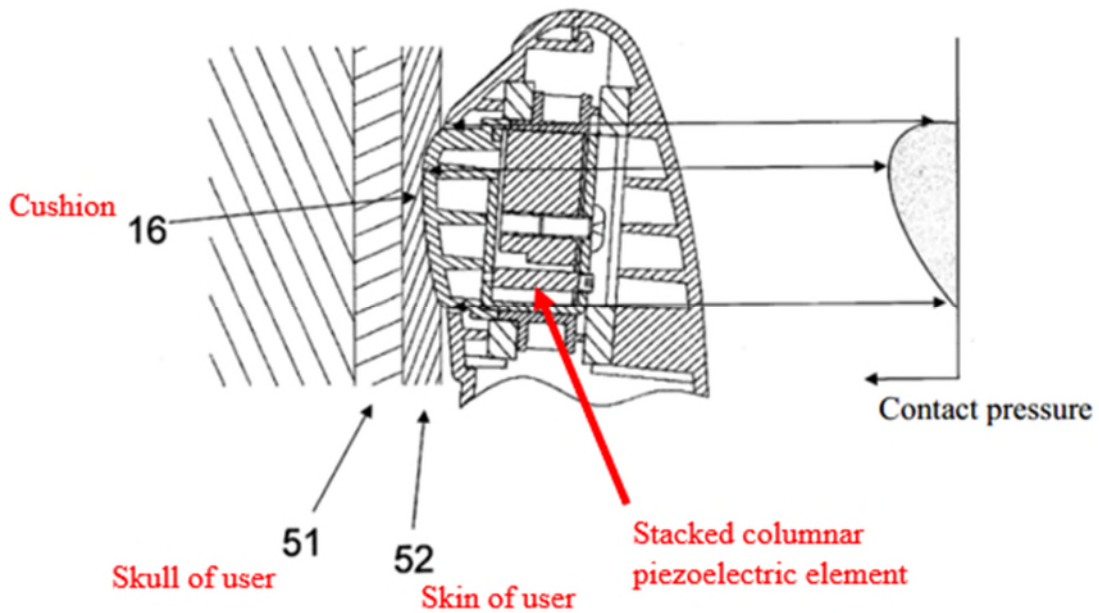
the speaker is operating by the sequential arrangement of the following components between them: diaphragm 15, plate yoke 17, elastic plate 21, and contact 5.

EX1023, 4:25-4:56, Fig. 1, Abstract.

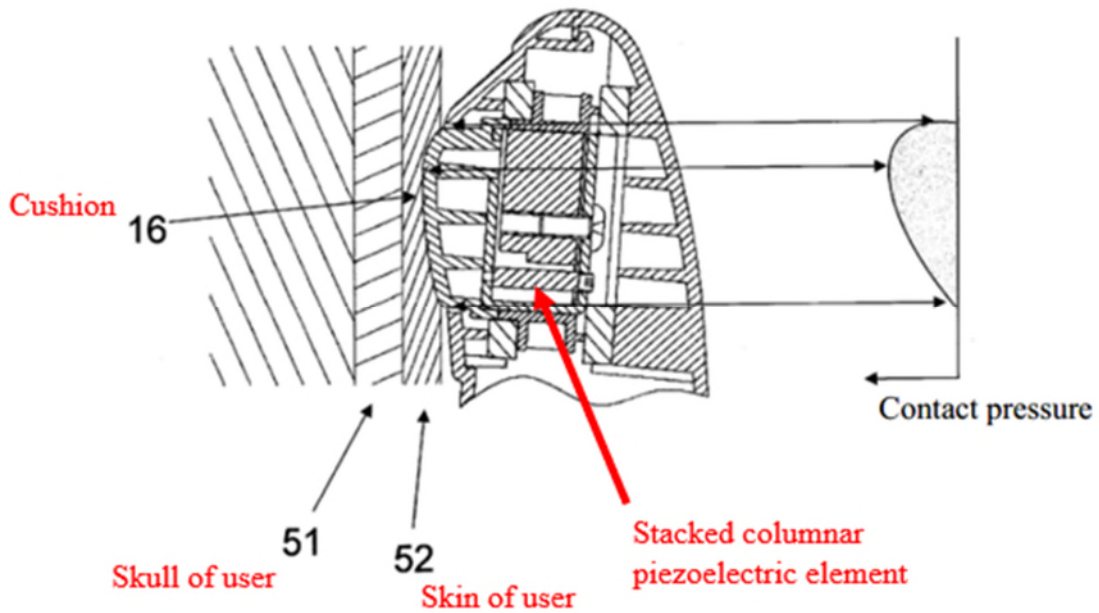


3. [12b] all or part of the housing panel is used to contact or abut a user's body to conduct a sound generated by the vibration of the earphone core.

154. Fujita discloses or renders obvious *all or part of the housing panel* (cushion 16, convex close contact surface 16a) *is used to contact or abut a user's body to conduct a sound generated by the vibration of the earphone core* (the vibrating mechanism of the Fujita speaker, including stacked columnar piezoelectric element 12), as seen for example in Figures 4 and 6 where convex close contact surface 16a contacts the skin on a user's head to conduct the sound generated by the vibration of stacked columnar piezoelectric element 12. EX1022, Figures 4-6:



Fujita, Figure 4



Fujita, Figure 6

“The contact structure between the cushion 16 and the head is as shown in Figure 4, and the hard cushion 16, the soft skin 52 and the hard skull 51 form a sandwich structure. The cushion 16 is a component protruding from the casing 2. The cushion 16 is provided with an apex part in the position most protruding from the casing 2. The apex part is arranged near one end of the cushion 16. In addition, the stacked columnar piezoelectric element 12 is arranged near the other end of the cushion 16. . . . As shown in Figure 5, in the signal (vibration) transmission system from the cushion 16 to the skull 51, a contact point a is a contact point corresponding to an input signal of the cushion 16.” *Id.*, [0030]-[0035], [0037].

155. To the extent Fujita does not disclose or render obvious this claim element, it is disclosed or rendered obvious by Fukuda. Fukuda discloses *all or part of the housing panel* (elastic cover 3) *is used to contact or abut a user's body to conduct a sound generated by the vibration of the earphone core* (the vibrating mechanism of the Fukuda speaker in bone conduction speaker main body 2, including Fukuda's magnetic circuit system (center pole 12, yoke 11, rod-shaped magnets 14)): “[A]t the time of calling, if the elastic cover 3 is pressed against a side face of the heard, or the like, the elastic cover 3 is pushed in toward the inside, thereby the bottom face of the contact 5 being brought into plane contact with the plate yoke 17 through the elastic plate 21. In this state, upon a vibration being generated by a voice signal, the vibration is transmitted to the contact 5 through the

plate yoke 17 and the elastic plate 21, and transmitted from the contact 5 to the skull, thus a bone conduction speech reception being made possible” EX1023, 5:42-55, 4:40-56, Figure 1, 3:6-28.

156. Li-Fujita or Li-Fujita-Fukuda therefore discloses claim 12.

D. Claim 13

1. [13pre] The loudspeaker apparatus of claim 12,

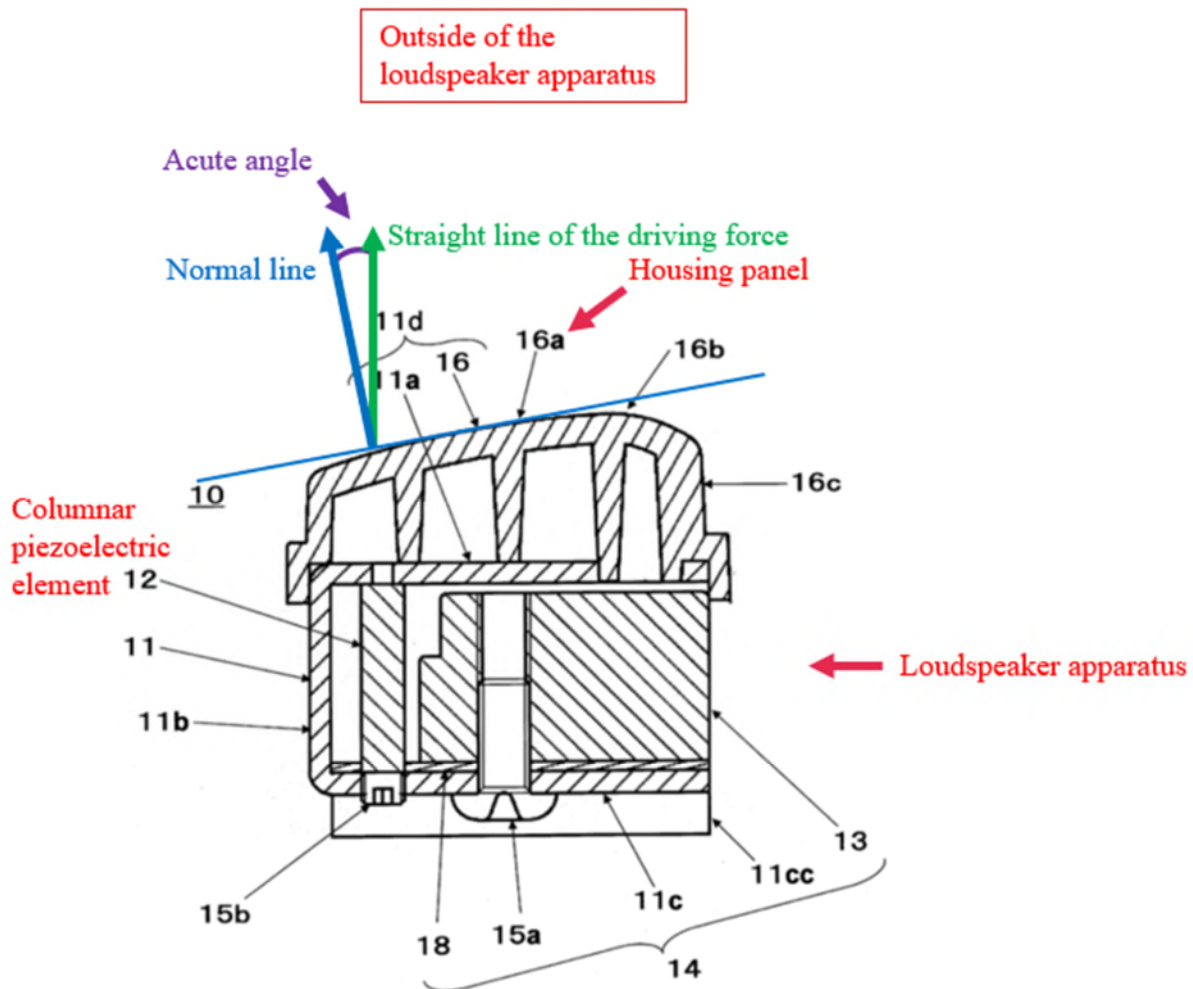
157. Li-Fujita or Li-Fujita-Fukuda render obvious *the loudspeaker apparatus of claim 12. Supra* claim 12.

2. [13a] wherein when a straight line of the driving force has a positive direction pointing to outside of the loudspeaker apparatus from the housing panel and the normal line has a positive direction pointing to the outside of the loudspeaker apparatus, an angle between the two lines in their positive direction is an acute angle.

158. Fujita discloses or renders obvious this claim limitation, as can be seen for example in Figure 2 and its depiction of the *housing panel* (cushion 16, convex close contact surface 16a), *a straight line of the driving force has a positive direction pointing to outside of the loudspeaker apparatus from the housing panel* (the green line pointing outside of the bone conduction speaker, where the arrow indicates the positive direction), *the normal line has a positive direction pointing to the outside of the loudspeaker apparatus*, (the blue line pointing outside of the bone conduction speaker, where the arrow indicates the positive direction), and *an angle*

between the two lines in their positive direction is an acute angle (in purple).

EX1022, Figure 2:



Fujita, Figure 2

159. A POSITA would understand the annotated “normal line” above in Figure 2 to be one example of a normal line because the housing panel used to contact the user’s body in Fujita is non-planar (has a curvature). A POSITA would understand the normal line may be determined by selecting a certain point in an

area when the panel is in contact with human skin, determining a tangent plane of the panel at the selected point, and determining a straight line that passes through the point and is perpendicular to the tangent plane, and designating the straight line as the normal line of the panel. *See, e.g.*, EX1001, 19:32-20:14. A POSTIA would therefore understand that when the panel used to contact the user's body is non-planar like in Fujita, different points correspond to different tangent planes of the panel, and the determined normal line may also be different. Therefore, the above annotated example is just one example of a normal line in Fujita.

E. Claim 14

1. [14pre] The loudspeaker apparatus of claim 12, wherein

160. Li-Fujita or Li-Fujita-Fukuda render obvious *the loudspeaker apparatus of claim 12. See claim 12.*

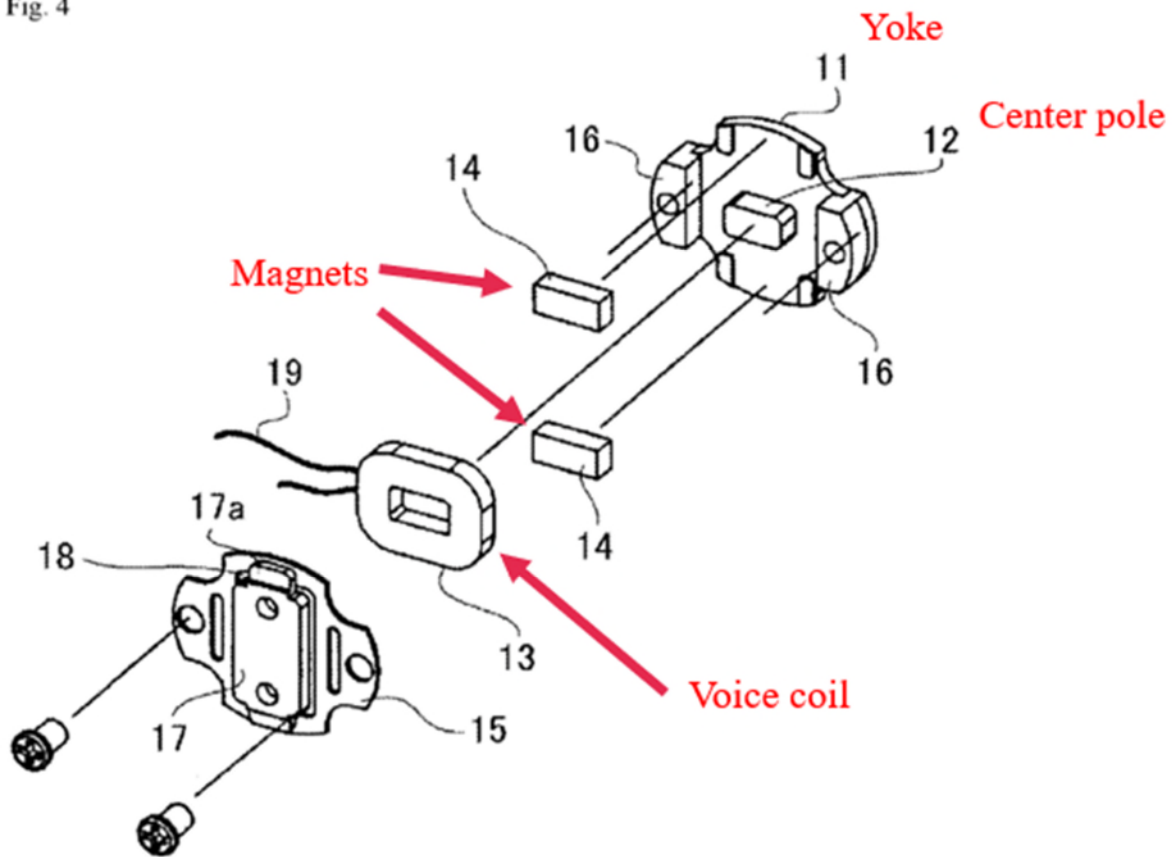
2. [14a] the earphone core includes a coil and a magnetic circuit system, and

161. This claim element is rendered obvious by the Li-Fujita-Fukuda combination. Fujita discloses an *earphone core* ([1d], the vibrating mechanism of the bone conduction speaker in Fujita). It would have been obvious to a POSITA to add Fukuda's *coil* (voice coil 13) and *magnetic circuit system* (center pole 12, yoke 11, rod-shaped magnets 14) from the Fukuda *earphone core* to the Fujita *earphone core* in place of Fujita's piezoelectric mechanism, for the reasons discussed above.

§XII.B. As described in Fukuda, "[t]he bone conduction speaker main body 2 is

configured as shown in, for example, FIG. 4 (reproduced below), with a voice coil 13 being disposed so as to surround a center pole 12 provided in the central portion of a yoke 11, a pair of bar-like magnets 14, 14 being fixed to both sides of the voice coil 13, and a diaphragm 15 being disposed so as to cover the voice coil 13 and the magnets 14, 14.” EX1023, 3:57-67, Figure 4.

Fig. 4



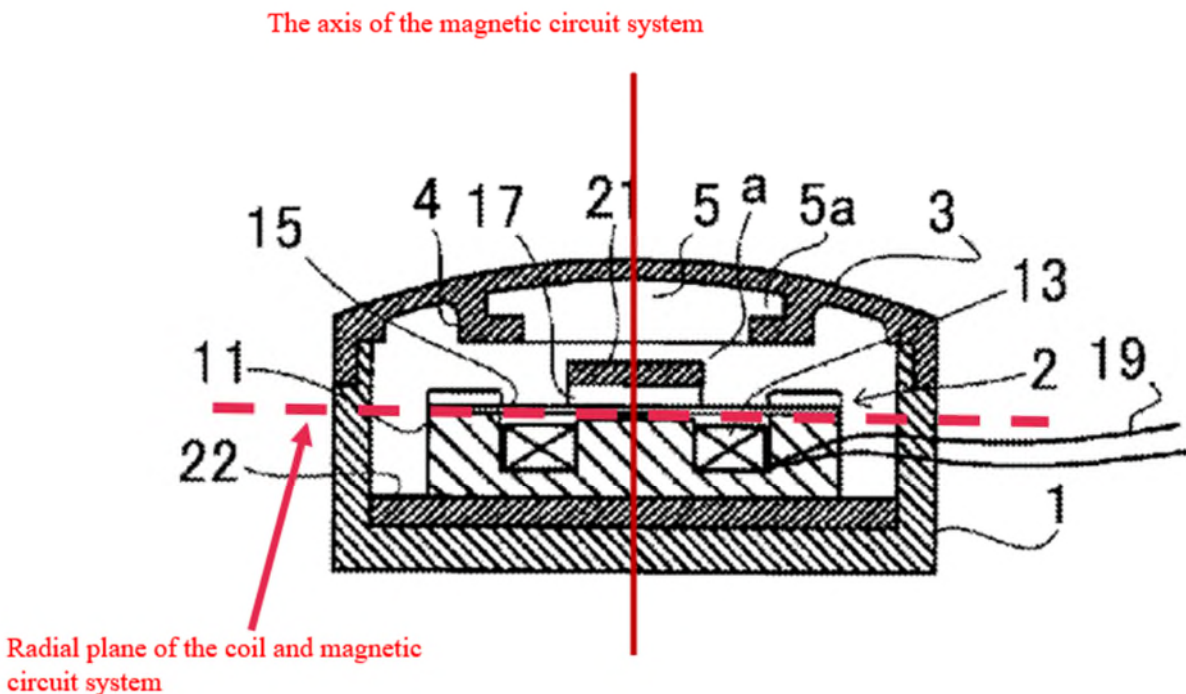
Fukuda, Figure 4

162. Furthermore, it would be obvious to a POSITA that in the Li-Fujita-Fukuda combination, *the housing panel and the earphone core* would remain in a

transmission connection (see claim 12) because that is how both Fujita and Fukuda are constructed. See claim 12. The type of vibration mechanism would merely be changed from piezoelectric to magnetic.

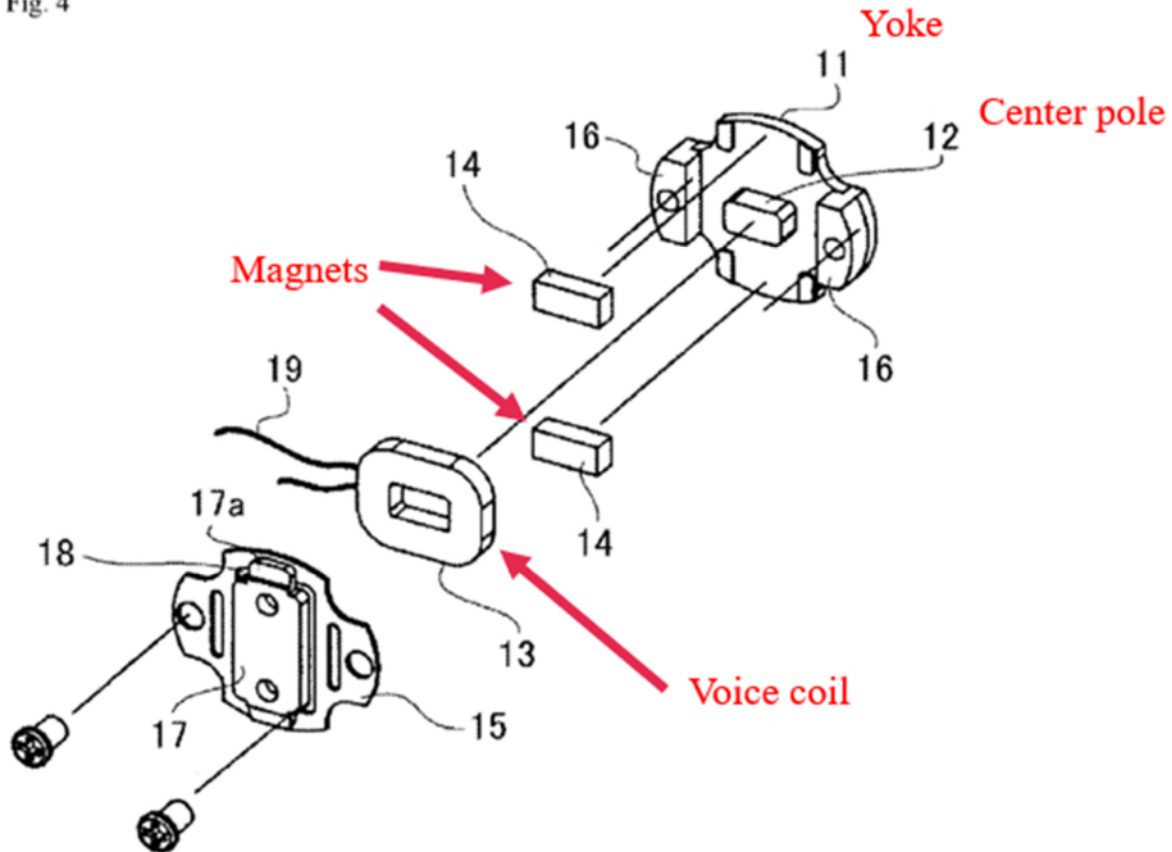
3. [14b] an axis of the coil or the magnetic circuit system is not parallel to the normal line, the axis being perpendicular to a radial plane of the coil or the magnetic circuit system.

163. The Li-Fujita-Fukuda combination renders obvious this claim element. As can be seen in Figure 1 below of Fukuda, *an axis* (below in red) *of the coil* (voice coil 13) *or the magnetic circuit system* (center pole 12, yoke 11, rod-shaped magnets 14) *is perpendicular to a radial plane of the coil or the magnetic circuit system* (also annotated in red). EX1023, Figs. 1, 4.



Fukuda, Figure 1

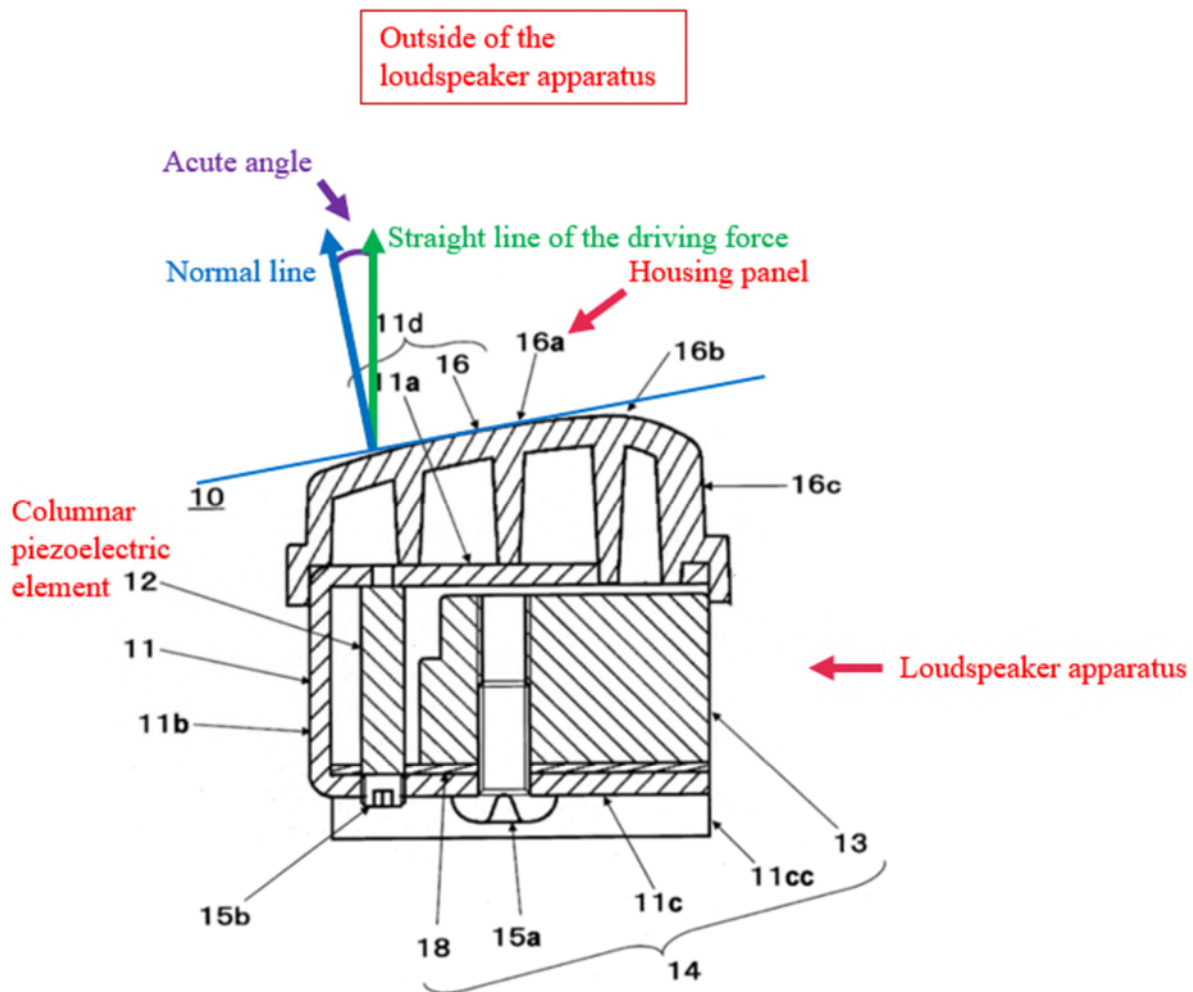
Fig. 4



Fukuda, Figure 4

164. A POSITA would find it obvious that in adding Fukuda's magnetic circuit system *earphone core* in place of Fujita's piezoelectric mechanism *earphone core* in the Li-Fujita-Fukuda combination (§XII.B), *an axis of Fukuda's coil or the magnetic circuit system* would not be *parallel to the normal line* in Fujita, *the axis being perpendicular to a radial plane of the coil or the magnetic circuit system*,

because the normal line of Fujita is angled and would therefore not be parallel to the *radial plane of the coil or the magnetic circuit system*. EX1022, Figure 2.



Fujita, Figure 2

165. A POSITA would understand the annotated “normal line” above in Fujita Figure 2 to be one example of a normal line because the housing panel used to contact the user’s body in Fujita is non-planar (has a curvature). A POSITA

would understand the normal line may be determined by selecting a certain point in an area when the panel is in contact with human skin, determining a tangent plane of the panel at the selected point, and determining a straight line that passes through the point and is perpendicular to the tangent plane, and designating the straight line as the normal line of the panel. *See, e.g.*, EX1001, 19:32-20:14. A POSTIA would therefore understand that when the panel used to contact the user's body is non-planar like in Fujita, different points correspond to different tangent planes of the panel, and the determined normal line may also be different. Therefore, the above annotated example is just one example of a normal line in Fujita.

F. Claim 15

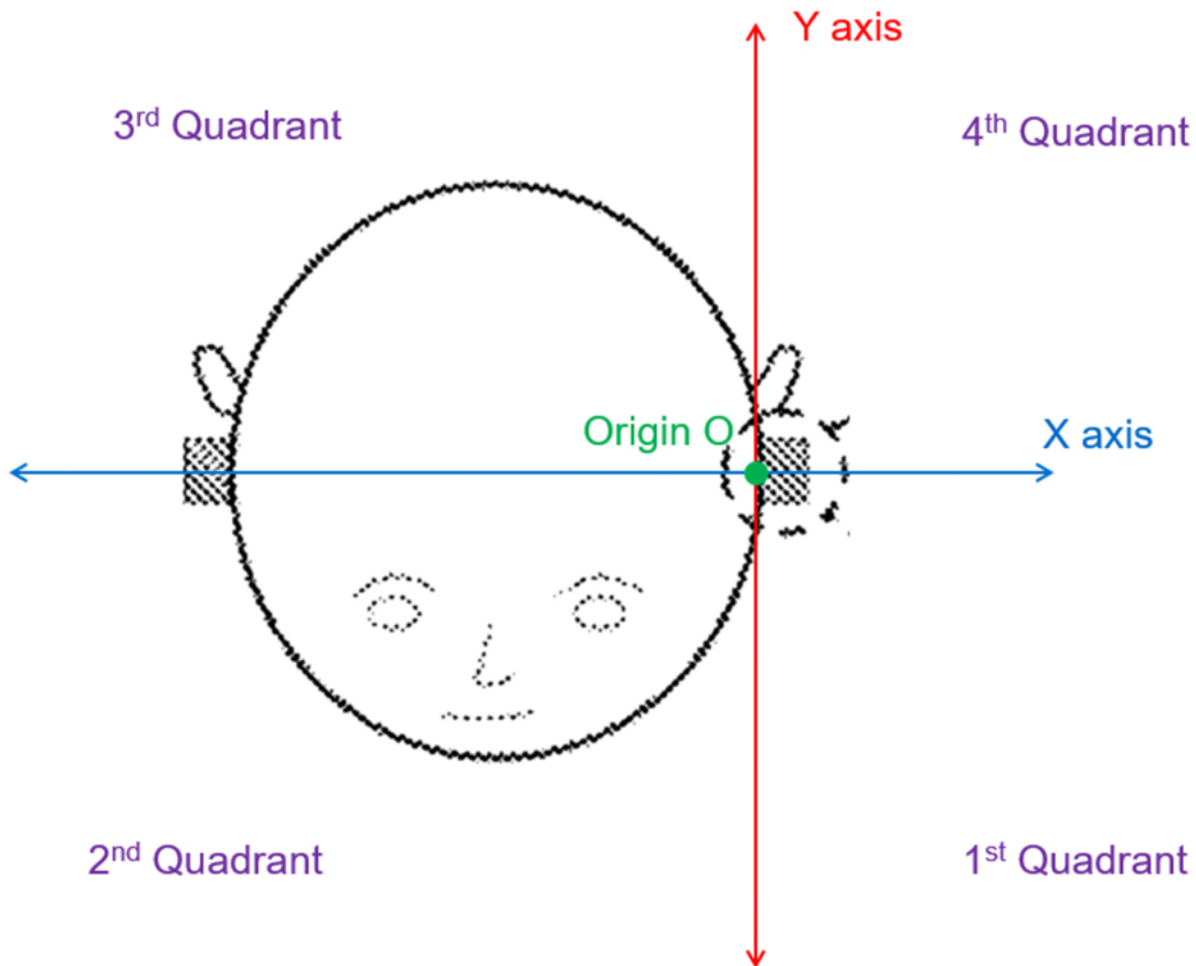
1. [15pre] The loudspeaker apparatus of claim 12, wherein

166. Li-Fujita or Li-Fujita-Fukuda render obvious *the loudspeaker apparatus of claim 12. See claim 12.*

2. [15a] the driving force has a component in a first quadrant or a third quadrant of an XOY plane coordinate system, wherein an origin O of the XOY plane coordinate system is on a contact surface between the loudspeaker apparatus and a human body, an X-axis of the XOY plane coordinate system is parallel to a coronal axis of the human body, a Y-axis of the XOY plane coordinate system is parallel to a sagittal axis of the human body, a positive direction of the X-axis faces outside of the human body, and a positive direction of the Y-axis faces front of the human body.

167. Fujita discloses or renders obvious this claim. The second portion of this claim (*wherein an origin O of the XOY plane coordinate system is on a contact*

surface between the loudspeaker apparatus and a human body, an X-axis of the XOY plane coordinate system is parallel to a coronal axis of the human body (the axis running from side to side, dividing a human body into front and back portions, EX1024, Page 6), a Y-axis of the XOY plane coordinate system is parallel to a sagittal axis of the human body (the axis running from front to back, dividing a human body into a left and right side, EX1024, Page 6), a positive direction of the X-axis faces outside of the human body, and a positive direction of the Y-axis faces front of the human body) is depicted in the annotated figure below, as is also described in the specification regarding the quadrant system in the '084 Patent:



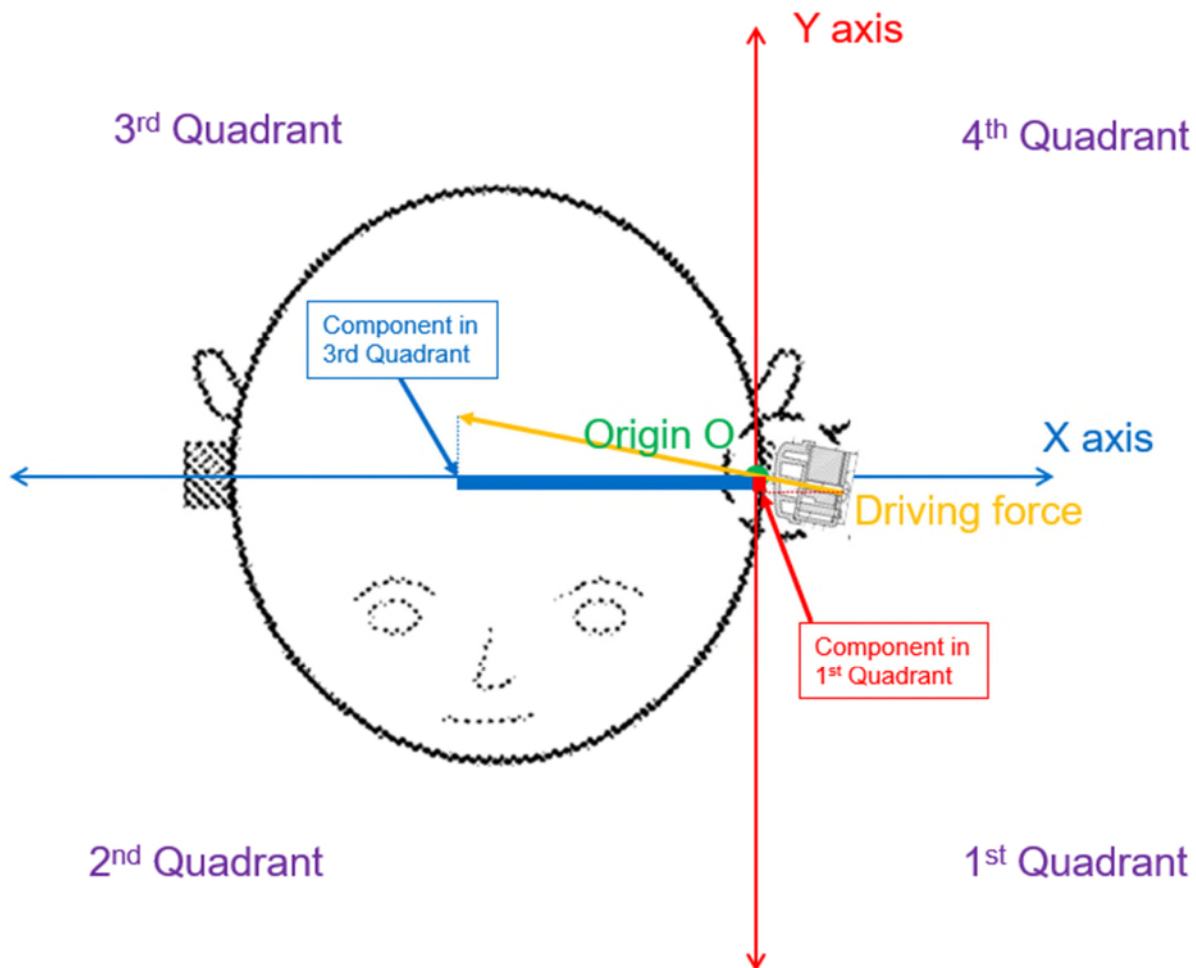
[T]he XOY plane coordinate system is a reference coordinate system whose origin O is located on a contact surface between the panel and/or the housing and the human body after the bone conductive loudspeaker is worn on the human body. The X axis is parallel to the coronal axis of the human body, the Y axis is parallel to the sagittal axis of the human body, and the positive direction of the X axis faces the outside of the human body, the positive direction of the Y axis faces the front of the human body. Quadrants should be understood as four regions divided by the horizontal axis (such as X axis) and the vertical axis (such as

Y axis) in a rectangular coordinate system. Each region is a quadrant. The quadrant is centered at the origin, and the X axis and Y axis are the dividing lines. The upper right region (the region enclosed by the positive half axis of the X axis and the positive half axis of the Y axis) is the first quadrant, the upper left region (the region enclosed by the negative half axis of the X axis and the positive half axis of the Y axis) is the second quadrant, the lower left region (the region enclosed by the positive half axis of the X axis and the negative half axis of the Y axis) is the third quadrant, and the lower right region (the region enclosed by the positive half axis of the X axis and the negative half axis of the Y axis) is the fourth quadrant. The points on the X axis and the Y axis do not belong to any quadrant. ***It should be understood that the driving force in the embodiment may be directly located in the first quadrant and/or the third quadrant of the XOY plane coordinate system, or the driving force may point to other directions, but the projection or component in the first quadrant and/or the third quadrant is not equal to 0 in the XOY plane coordinate system***

EX1001, 18:41-19:5. A POSITA would be familiar with the *coronal axis of the human body* and the *sagittal axis of the human body* through his or her work in acoustic technology. See, e.g., EX1024, Page 6.

168. A POSITA would understand that when the bone conduction speaker of Fujita is used by a user, the orientation of the device, as depicted in the below

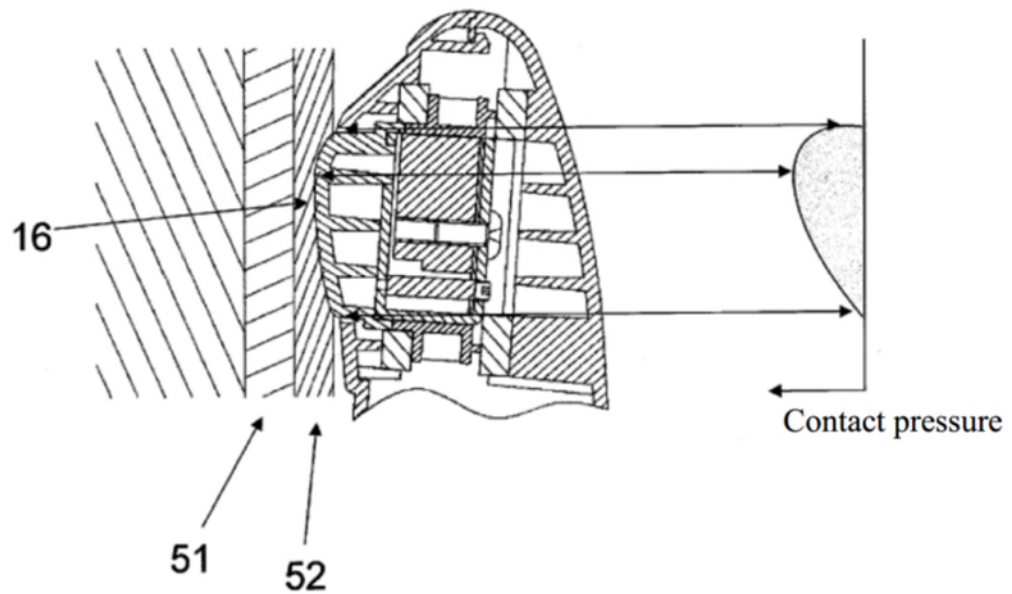
figure, would necessarily result in the first portion of this claim, *the driving force has a component in a first quadrant or a third quadrant of an XOY plane coordinate system*, because a vector of the driving force would necessarily point in the direction of the third quadrant due to the angle of the housing in contacting the user's head, resulting in an X and Y component in a first quadrant or a third quadrant of an XOY plane coordinate system.



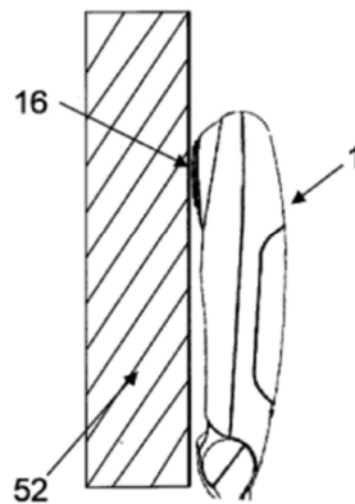
169. As can be seen in the below figures in Fujita, the bone conduction speaker, as taught to be used in a mobile phone embodiment, for example, is angled

in the orientation depicted in the above annotated figure, which necessarily angles the driving force to have *a component in a first quadrant or a third quadrant of an XOY plane coordinate system as claimed.*

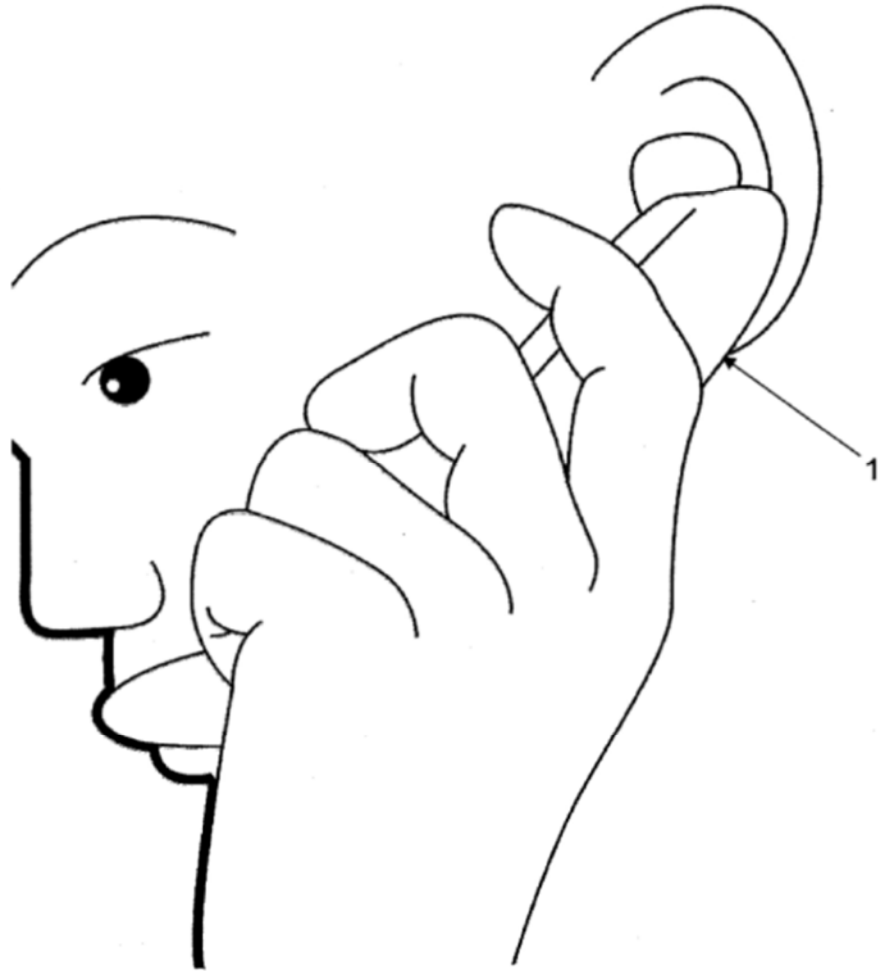
[Figure 6]



[Figure 7A]



[Figure 8]



EX1022, Figs. 6, 7A, 8.

170. It would have been obvious to a POSITA to use the bone conduction speaker of Fujita with the Li earphones for the reasons discussed above. §XI.A. A POSITA would have further found it obvious to angle the bone conduction speaker in Fujita in the same way (*i.e.*, with the *component* in the *third quadrant* or *first quadrant*) when used in the Li earphones because Fujita teaches that is the optimal positioning of its bone conduction speaker when used: “As shown in Figure 7A, the

ideal usage posture of the bone conduction receiver 1 of the embodiment is to be arranged substantially parallel to the face 52a.” EX1022, [0038], Figs. 6, 7A, 8.

171. For the reasons above, Fujita discloses or renders obvious this claim.

XIII. GROUND 3: LI, FUJITA, ASAKA, AND THE KNOWLEDGE OF A POSITA RENDER OBVIOUS CLAIMS 2-6

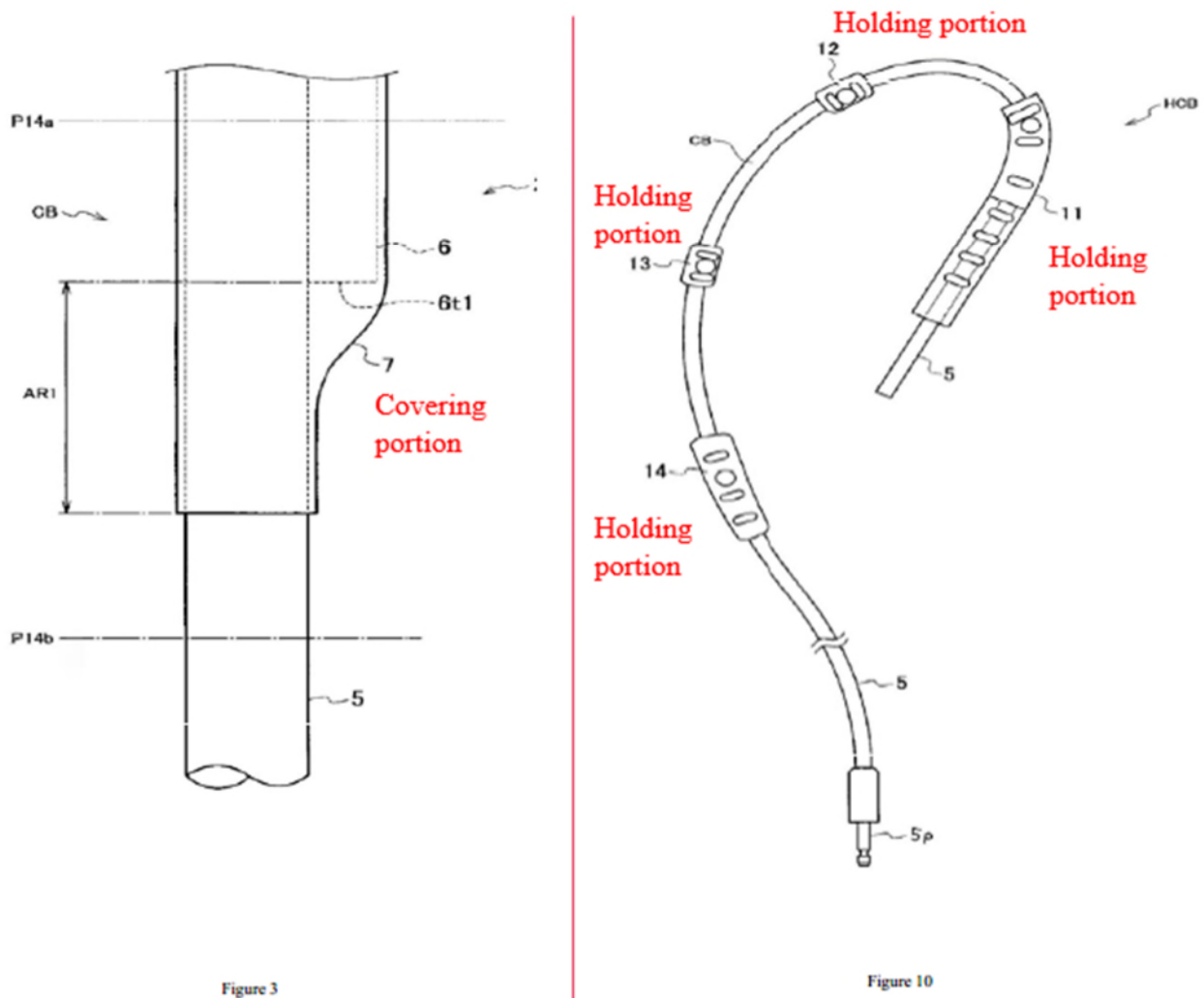
172. As shown below, Li, Fujita, and Asaka in view of the knowledge of a POSITA, render claims 2-6 obvious.

A. Motivation to Combine Li and Fujita

173. It would have been obvious to a POSITA to combine Li with Fujita for the reasons discussed above in §XI.A.

B. Motivation to Combine Li, Fujita, and Asaka

174. It would have been obvious to a POSITA to further modify the Li-Fujita combination by using covering portion 7 and holding portions 11-14 as taught by Asaka and shown below on the wires in the Li-Fujita ear hook, and a POSITA would have been motivated to do so.



Asaka, Figures 3, 10

EX1006, Figs. 3, 10.

175. Asaka is an ear hook and earphone and therefore a POSITA would look to it due to it being in the same field of wearable ear hook earphones as Li-Fujita. Asaka also has a similar construction and design to Li-Fujita's ear hook portions. Asaka teaches that its invention, including covering portion 7 and holding portions 11-14, keep the wires of the ear hook in position during the injection

molding process so that the resin portion 8 covering them and the ear hook “will not easily cause faults due to sweat or water droplets and uneven thickness of the resin, and has a beautiful appearance and simple manufacturing process.” EX1006, Abstract, [0009]-[0028].

176. Li discloses a first elastic coating layer 1132 of similar materials to that in Asaka (silicone, latex, rubber, elastic plastic, or a composite material layer containing silicone) formed using injection molding over wires also analogous to the wires in Asaka. *See* claim 2; EX1004, [0026], [0028]-[0030], [0036]-[0037], [0041], Figures 1-3. A POSITA would therefore have looked to Asaka to improve the manufacturing of the Li-Fujita earphones, including to improve their wear-resistant nature and beautiful appearance—aims shared by Asaka. EX1004, [0030], [0032], [0036]. A POSITA would have recognized the benefit of using Asaka’s covering portion 7 and holding portions 11-14 on the earphone wires in Li-Fujita for this reason. A POSITA would have understood, for example, that the construction of the earphone in Asaka would improve the manufacturing and quality of the first elastic coating layer 1132. The benefit of providing such improvement would have motivated the POSITA to make the combination.

177. Combining Asaka with Li and Fujita would simply involve applying known techniques (*i.e.*, ear hook earphone design and construction) to a known device ready for improvement (Li-Fujita’s ear hook earphones) to yield predictable

results (ear hook earphones with improved manufacturing and protective sleeve). A POSITA would have had a reasonable expectation of success in the combination because the Li-Fujita ear hook was already constructed with injection molding of the first elastic coating layer 1132, which is the same way Asaka's ear hook is designed to be constructed with resin portion 8—a manufacturing that the structures in Asaka are designed to improve.

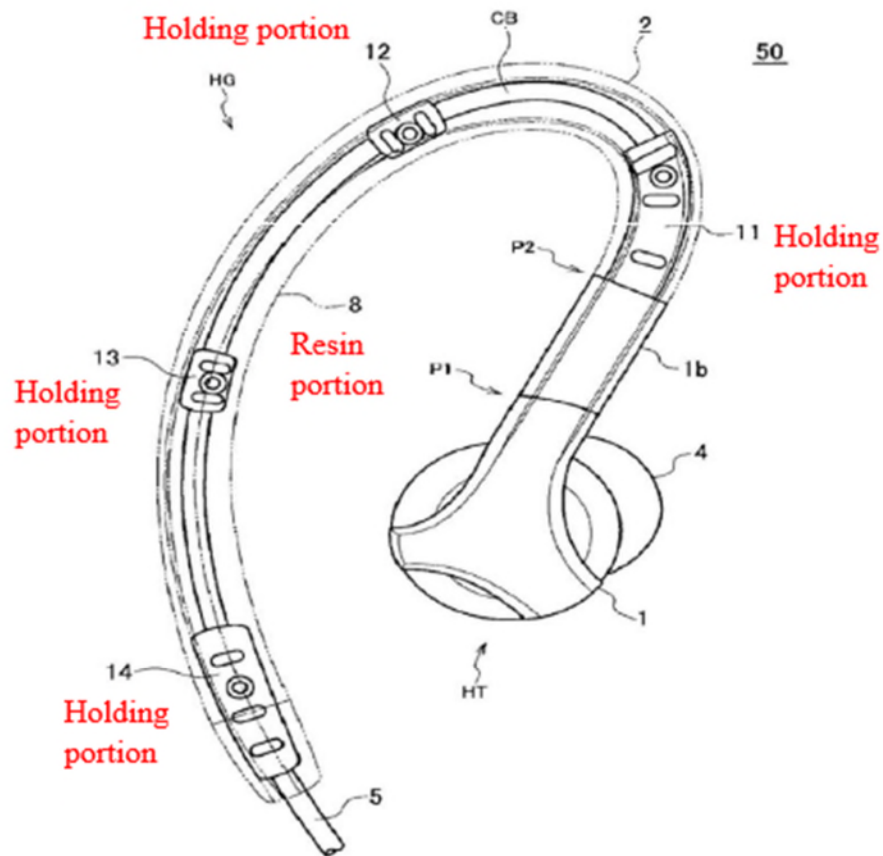


Figure 4

Asaka, Figure 4

EX1006, Fig. 4.

178. A POSITA thus would have had a reasonable expectation that the modification of Li-Fujita with Asaka would be successful because a POSITA would have found that the teachings of Li-Fujita with Asaka could have been predictably combined due to the predictability of the ear hook earphone art and manufacturing and the known interchangeability of the various elements, including the components of manufacture.

179. If Patent Owner argues the portions of Asaka cited below relate to different, incompatible embodiments (which they do not), it would have been obvious to a POSITA to combine such embodiments into a single device at least because such embodiments are described in the same prior art reference, are fully compatible with each other, and could be combined with minimal effort to achieve predictable results.

180. Therefore, a POSITA would have considered it obvious to include Asaka's covering portion 7 and holding portions 11-14 in Li-Fujita for the benefits described above.

C. Claim 2

1. [2pre] The loudspeaker apparatus of claim 1,

181. The Li-Fujita combination renders obvious *the loudspeaker apparatus of claim 1*. See claim 1.

2. [2a] wherein the ear hook further includes: an elastic metal wire;

182. Li discloses *wherein the ear hook further includes: an elastic metal wire, i.e., the first elastic wire 1131 in connecting component 113 of earhook assembly 11*: “Referring to figures 1 and 2, the embodiment of the bone conduction earphone of the present invention comprises an ear hook assembly 11, wherein the ear hook assembly 11 comprises a first housing 111, a second housing 112, and a connecting component 113 connecting the first housing 111 and the second housing 112, wherein the connecting component 113 comprises **a first elastic metal wire 1131** connecting the first housing 111 and the second housing 112 at both ends, and a first elastic coating layer 1132 wrapped around the first elastic metal wire 1131.”
EX1004, [0023], Figure 1.

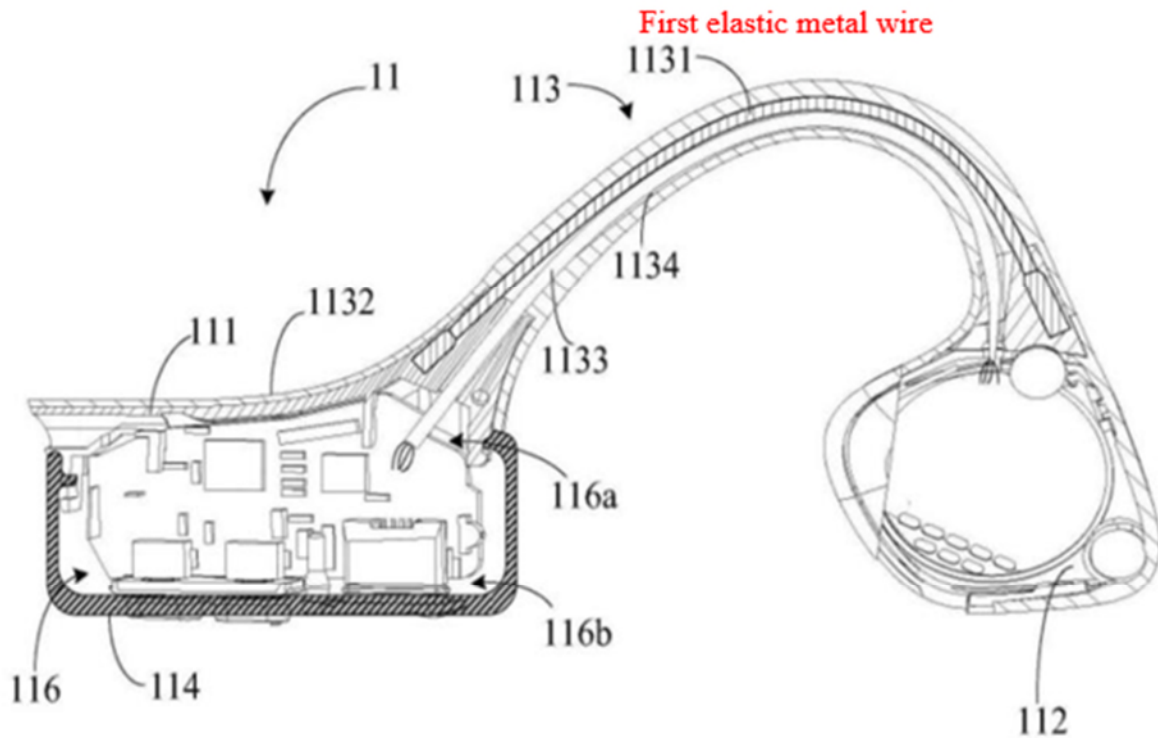


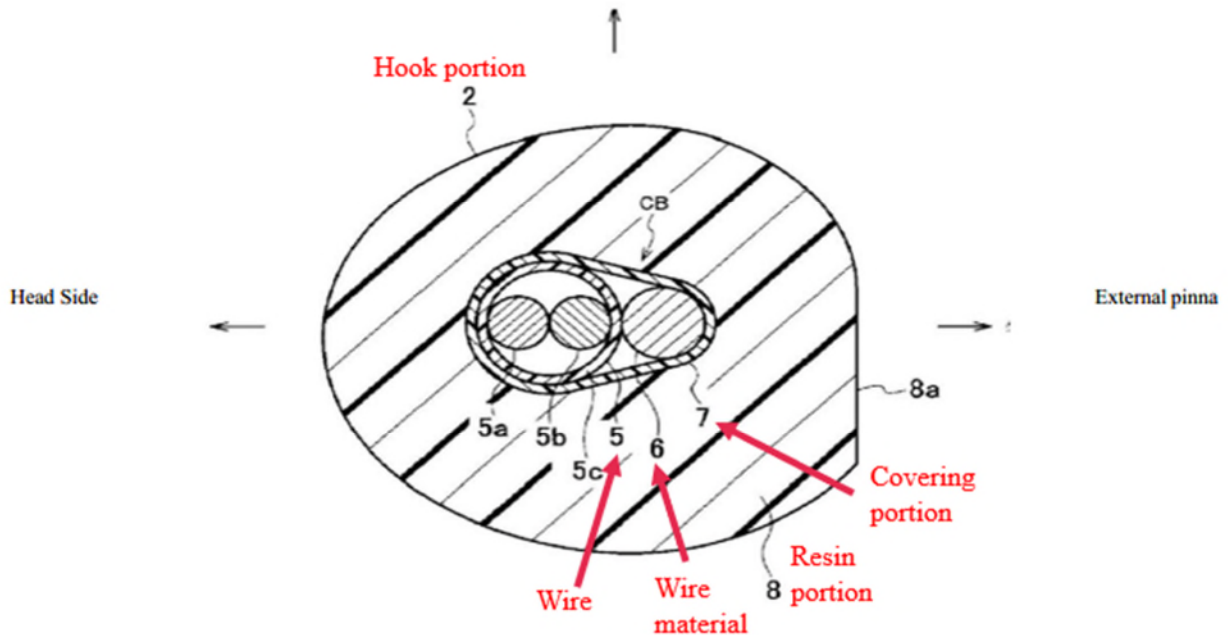
Figure 1

Li, Figure 1

183. Asaka also discloses or renders obvious an *ear hook* that *further includes: an elastic metal wire* (wire material 6): “The hook portion 2 in figure 2 is composed of the following portions: wire 5, the core wire material of hook portion 2, namely **wire material 6**, a covering portion 7 that integrates wire 5 and wire material 6, and a resin portion 8 that wraps around the covering portion 7.”

EX1006, [0058], [0029]-[0030], Figures 1, 2. “The material of wire material 6 can be, for example, stainless steel SUS, with an outer diameter of 0.8 mm.” *Id.*, [0062].

“The characteristic of wire material 6 is that it can be changed to the desired shape with fingers and maintain the deformed shape.” *Id.*, [0063].



Id., Fig. 2 (excerpt).

3. [2b] a wire; and

184. Li and Asaka disclose or render obvious this limitation. For example, in Li: *a wire* is first wire set 1133: “By setting a lead channel 1134, for example, during later assembly, one end of the **first wire set 1133** can be connected first (e.g., in a board mounted manner) to the components inside the second housing 112, such as a bone conduction speaker. Then, the other end of the first wire set 1133 can be passed through the lead channel 1134 to connect to the components inside the first housing 111, such as the battery pack 13, control circuit assembly 14, or adapter

circuit board 15.” EX1004, [0040], Figure 1. As discussed above in §XI.B.2 (Ground 1, claim 1, limitation [1a]), a POSITA would have found it obvious to include electrical contacts, pins or plugs, such as those shown on either of the ends of EX1019, Fig. 13, in the plug ends of the ear hook, and to include mating contacts, pins or plugs in the corresponding sockets of the speaker housing and control circuit housing. Doing so allows the wires at both ends of the first wire set to be electrically connected to the desired components in the speaker housing and control circuit housing via the contacts/pins/plugs of the ear hook plug ends and mating housing sockets while maintaining the ability to disconnect the ear hook from the speaker housing and/or control circuit housing to realize the benefits of the modular design discussed in Ground 1. ¶118. A POSITA would know that pins and plugs also provide a more secure way to connect components (*e.g.*, to avoid accidental disconnection).

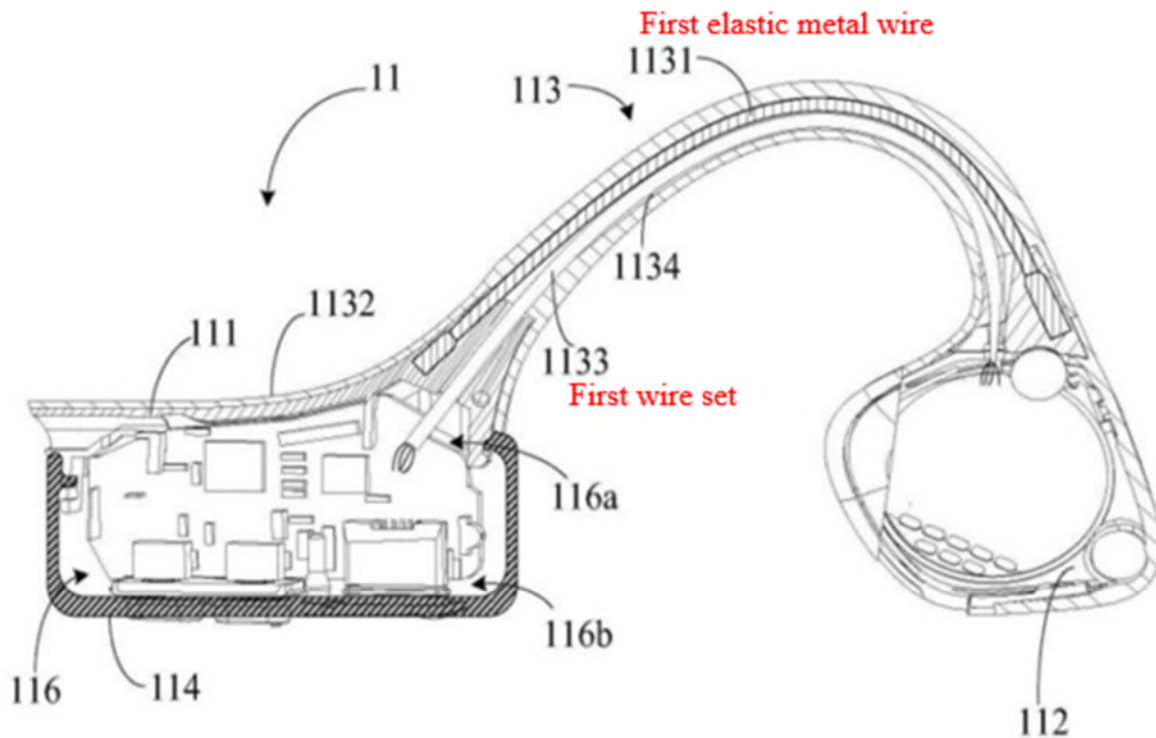


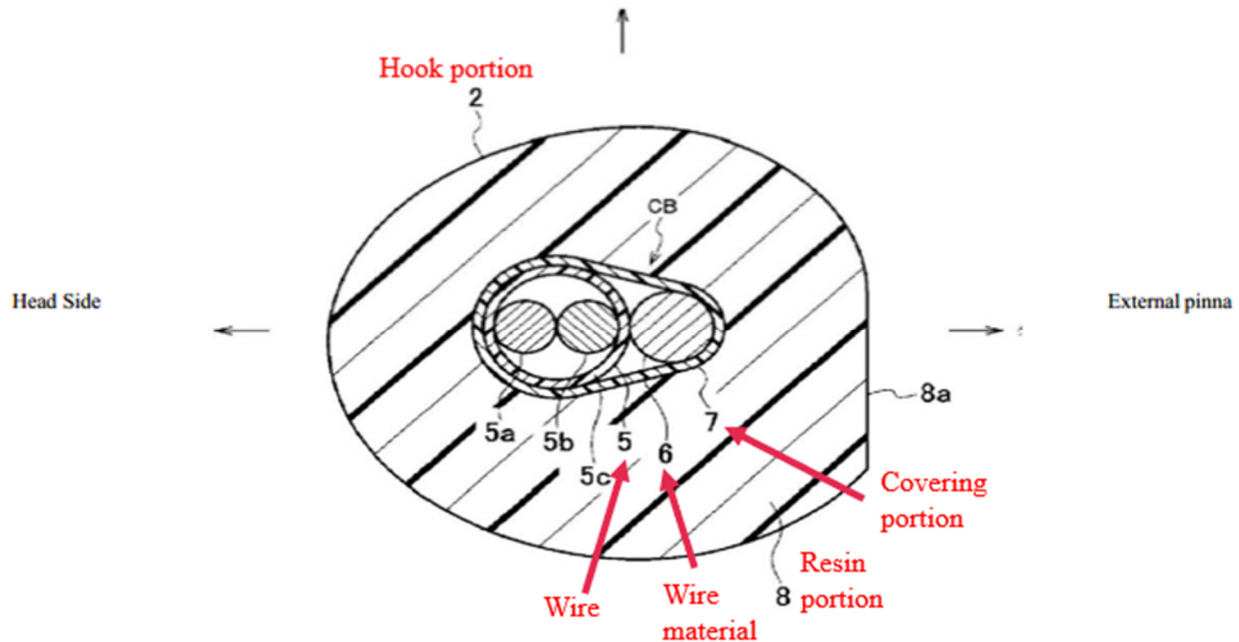
Figure 1

Li, Figure 1

Id., Fig. 1.

185. Asaka also discloses or renders obvious *a wire*, wire 5: “The hook portion 2 in figure 2 is composed of the following portions: **wire 5**, the core wire material of hook portion 2, namely wire material 6, a covering portion 7 that integrates wire 5 and wire material 6, and a resin portion 8 that wraps around the covering portion 7.” EX1006, [0058], [0029]-[0030], Figures 1, 2. “The wire 5 is a two-core wire material composed of a core wire material 5a, a core wire material

5b, and an outer coating 5c covering them, with an outer diameter of, for example, 1.4 mm.” *Id.*, [0060].



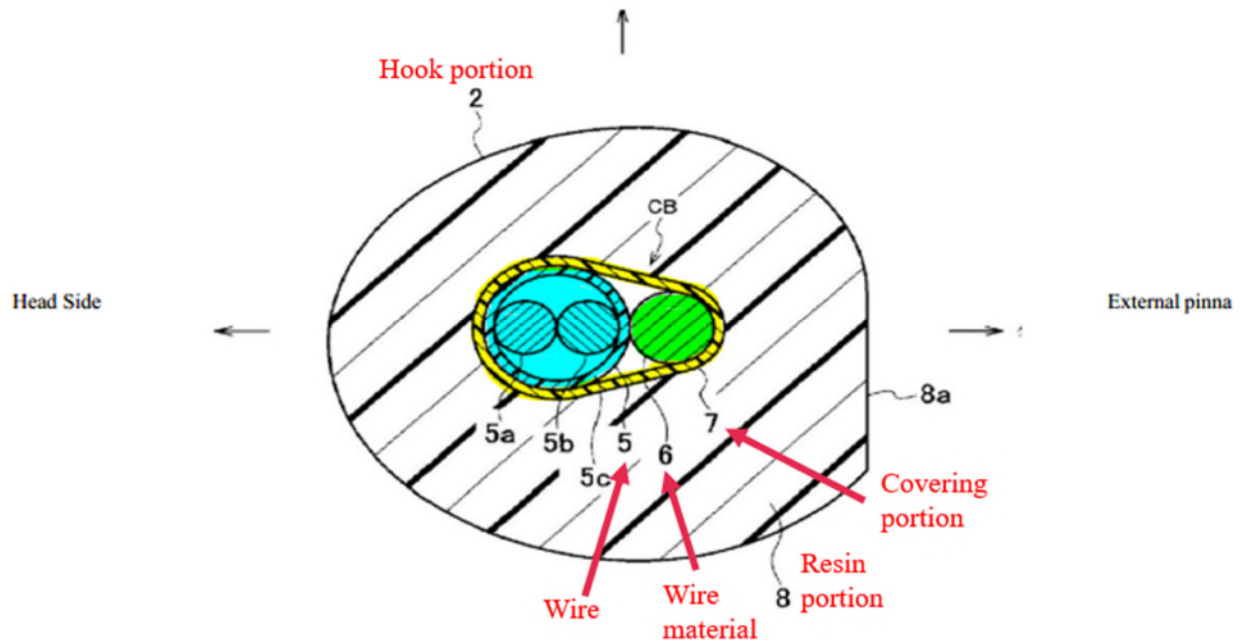
Id., Fig. 2 (excerpt).

4. [2c] a fixed sleeve, the fixed sleeve fixing the wire on the elastic metal wire, the protective sleeve being formed, by injection molding, on periphery of the elastic metal wire, the wire, the fixed sleeve, the first plug end, and the second plug end.

186. Asaka discloses or renders obvious a *fixed sleeve* (covering portion 7 (highlighted in yellow below)), *the fixed sleeve fixing the wire* (wire 5, highlighted in blue) *on the elastic metal wire* (wire material 6, highlighted in green): “Wire 5 and wire material 6 are combined together and covered by the **covering portion 7**. It is best for wire 5 and wire material 6 to be tightly adhered together.” EX1006,

[0064]. “The covering portion 7 is a universal heat shrink tubing.” *Id.*, [0065],

Figure 2.



187. Asaka discloses or renders obvious another *fixed sleeve* (holding portions 11 to 14 (highlighted below)): “As shown in figures 4 and 5, there are **4 holding portions** along the extension direction of the integrated wire CB inside the hook portion 2, namely **holding portion 11 to holding portion 14**, which are spaced apart from each other by a certain distance. In this embodiment, the holding portion 12 and the holding portion 13 are set as the same component.” *Id.*, [0086], Figures 4-5. The integrated wire CB contains the wire 5 and wire material 6, and the integrated wire CB passes through holding portions 11-14, as can be seen for example in Figure 4. *Id.*, [0059], Figure 4, [0142] (“wire 5 and wire material 6 can pass through each holding portion 11-14 and be integrated with them”), [0023],

Abstract. “The material of each holding portion 11-14 can be polyethylene PE.” *Id.*, [0087]. Asaka therefore teaches, and a POSITA would have understood, that holding portions 11 to 14 *fix the wire (wire 5) on the elastic metal wire (wire material 6)*.

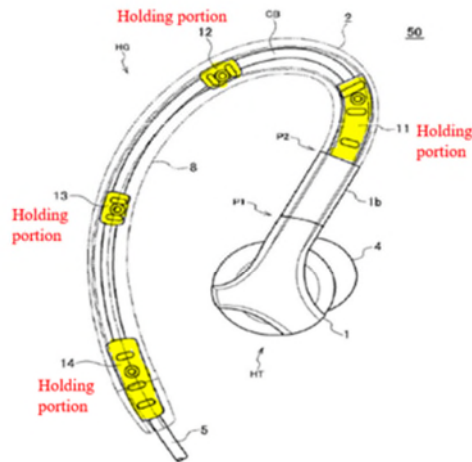


Figure 4

Asaka, Figure 4

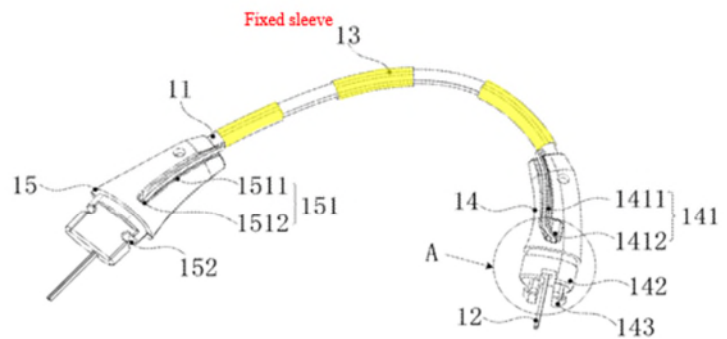


Fig. 3

'084 Patent, Figure 3

188. Combining the fixed sleeve as disclosed in Asaka with Li and Fujita, the Li, Fujita, and Asaka combination renders obvious *the protective sleeve being formed, by injection molding, on periphery of the elastic metal wire, the wire, the fixed sleeve, the first plug end, and the second plug end*. The *protective sleeve* in Li, a first elastic coating layer 1132, see [1b], is taught to be *formed by injection molding* on periphery of the ear hook and its components, including the first elastic metal wire 1131 (*an elastic metal wire*), first wire set 1133 (*a wire*), and the entire outer surface of the first housing 111 and the second housing 112. EX1004, [0029]-

[0030], [0036]-[0037], [0041], Figure 1. It therefore would have been obvious to a POSITA to form the protective sleeve on periphery of the *fixed sleeve* of Asaka with Li (covering portion 7 or holding portions 11 to 14) because Li already teaches forming the first elastic coating layer 1132 onto the first elastic metal wire 1131 and first wire set 1133. As such, it would be obvious to form the protective sleeve on covering portion 7 or holding portions 11 to 14, too, because they are also on the first elastic metal wire 1131 and first wire set 1133 and their purpose is to fix the wires together.

189. It would have also been obvious to a POSITA to *form[] the protective sleeve on periphery of . . . the first plug end, and the second plug end* in Li (see claim 1) because Li already teaches the first elastic coating layer 1132 being formed on periphery of the first housing 111 and the second housing 112, as well as connecting component 113. *Id.*, [0029]-[0030], [0036]-[0037], [0041]. Li's *protective sleeve* is therefore formed in the same areas where it would be obvious that the *first plug end* and *second plug end* of Li would be. A POSITA would be motivated to form the *protective sleeve* there to serve the same purposes of the first elastic coating layer 1132 in Li of protecting the components of the ear hook, including to “enhance[] the texture and unity of the bone conduction earphone, and . . . protect the housing and internal components, making the bone conduction earphone more wear-resistant.” *Id.*, [0036].

190. It further would have been obvious for a POSITA to *form[] the protective sleeve . . . on periphery of at least the elastic metal wire, the wire, and the fixed sleeve*, because Asaka teaches its resin portion 8, analogous to the *protective sleeve*, being formed *on periphery of the elastic metal wire* (wire material 6), *the wire* (wire 5), and *the fixed sleeve* (covering portion 7 or holding portions 11 to 14). EX1006, Abstract, [0058], [0066], [0088], [0143], Figures 2, 4.

D. Claim 3

1. [3pre] The loudspeaker apparatus of claim 2, wherein

191. The Li-Fujita-Asaka combination renders obvious the loudspeaker apparatus of claim 2. *See* claim 2.

2. [3a] the first plug end and the second plug end are formed, by injection molding, at both ends of the elastic metal wire respectively,

192. Li renders obvious *the first plug end and the second plug end*. *See* [1a]. It would have been obvious to a POSITA that *the first plug end and the second plug end are formed, by injection molding, at both ends of the elastic metal wire respectively* because Li teaches that its plugs can be formed at the end of a wire by injection molding. EX1004, [0058]. The *elastic metal wire* is Li's first elastic metal wire 1131 or Asaka's wire material 6. *See* claim 2. Li teaches that the plug-in portions 123 on the rear hook assembly 12 are provided at both ends of the second elastic metal wire 121. *Id.*, [0058], Figs. 2, 9. Li teaches "the plug-in portion 123

can be fixed to both ends of the second elastic metal wire 121 **by injection molding**, which can make the plug-in portion 123 more firmly fixed to both ends of the second elastic metal wire 121.” *Id.*, [0058]. It therefore would have been obvious to a POSITA to construct the *first plug end* and *second plug end* in the same way on each end of the ear hook, *by injection molding, at both ends of the elastic metal wire respectively*, because that is already how the plug ends disclosed in Li are constructed. Their location is simply moved to both ends of the ear hook (which, again, a POSITA would be motivated to construct as discussed above in [1a]) and its *elastic metal wire*. A POSITA would simply use the same production technique already disclosed in the Li reference.

193. For those reasons, Li-Fujita-Asaka renders [3a] obvious.

3. [3b] the first plug end and the second plug end are arranged with a first wiring channel and a second wiring channel respectively, and

194. The Li-Fujita-Asaka combination renders this limitation obvious. Li discloses or renders obvious *a first wiring channel and a second wiring channel* (buried wire grooves 1232 at the ear hook plugs proximate the speaker (first channel) and the circuit (second channel) when Li’s plugs are replicated on connecting component 113 as explained in [1a]): “Referring to figures 9, 12, and 13, optionally, the rear hook assembly 12 further comprises a second wire set 124 wrapped by a second elastic coating layer 122, wherein both ends of the second

wire set 124 are exposed from the second elastic coating layer 122, and ***the top surface of the plug-in portion 123 is provided with a buried wire groove 1232*** for accommodating the exposed portion of the second wire set 124.” EX1004, [0069].

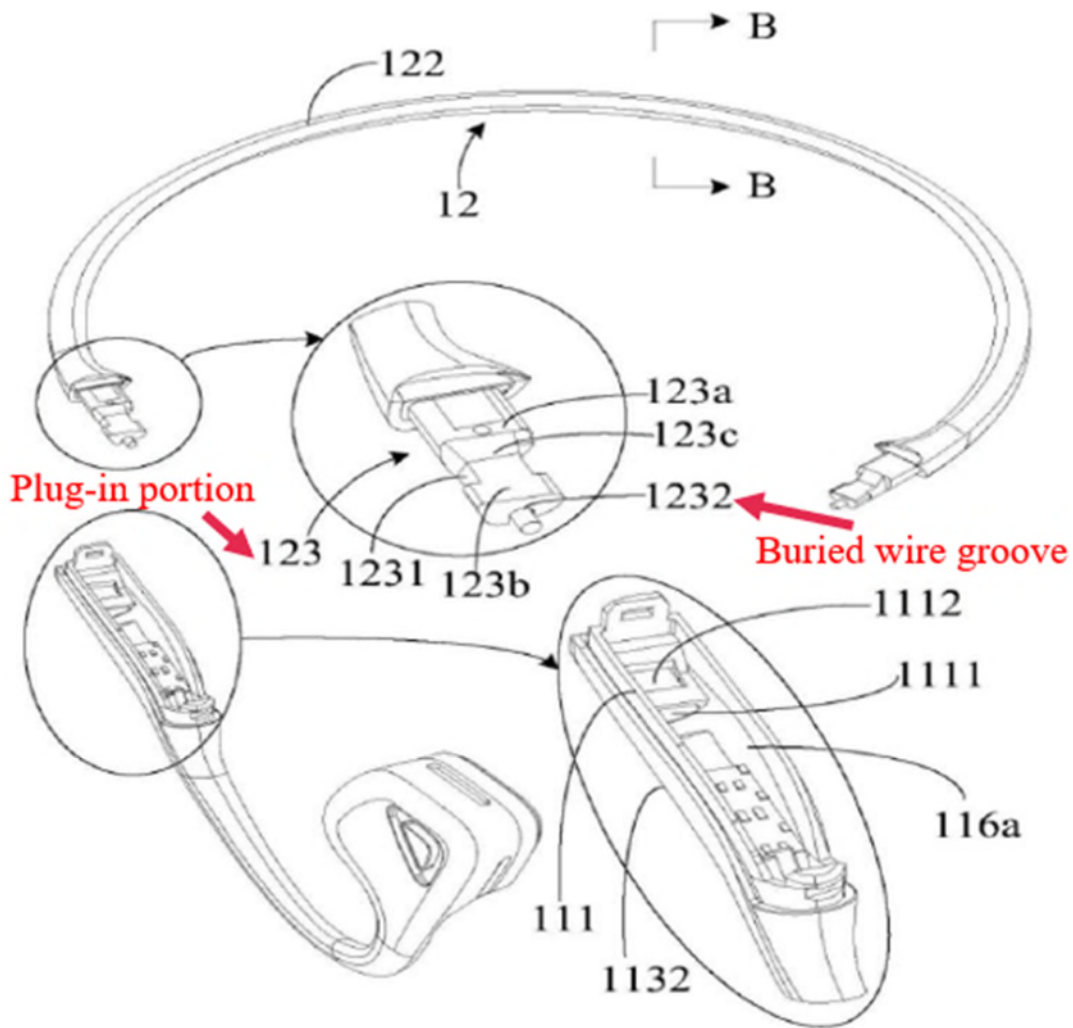


Figure 9

Li, Figure 9

Id., Fig. 9. “In this embodiment, the second wire set 124 is used to connect the components inside the two ear hook assemblies 11, such as the battery and the

control circuit assembly 14. Setting the buried wire groove 1232 can effectively arrange and fix the second wire set 124 on the one hand, and reduce the footprint on the other hand.” *Id.*, [0069], Figures 9, 12, 13.

195. Li teaches that buried wire groove 1232 is present in both plug-in portions 123 on either end of the rear hook assembly 12, and it would therefore be present if Li’s plugs were included on both ends of Li’s connecting component 113. *Id.*

196. It therefore would have been obvious to a POSITA to arrange *the first plug end and the second plug end . . . with a first wiring channel and a second wiring channel respectively* in the same way because that is already how the plug ends disclosed in Li are constructed. Their location is simply moved to both ends of the ear hook (which, again, a POSITA would be motivated to construct as discussed above in [1a]). Exemplary plug locations are shown below with green arrows.

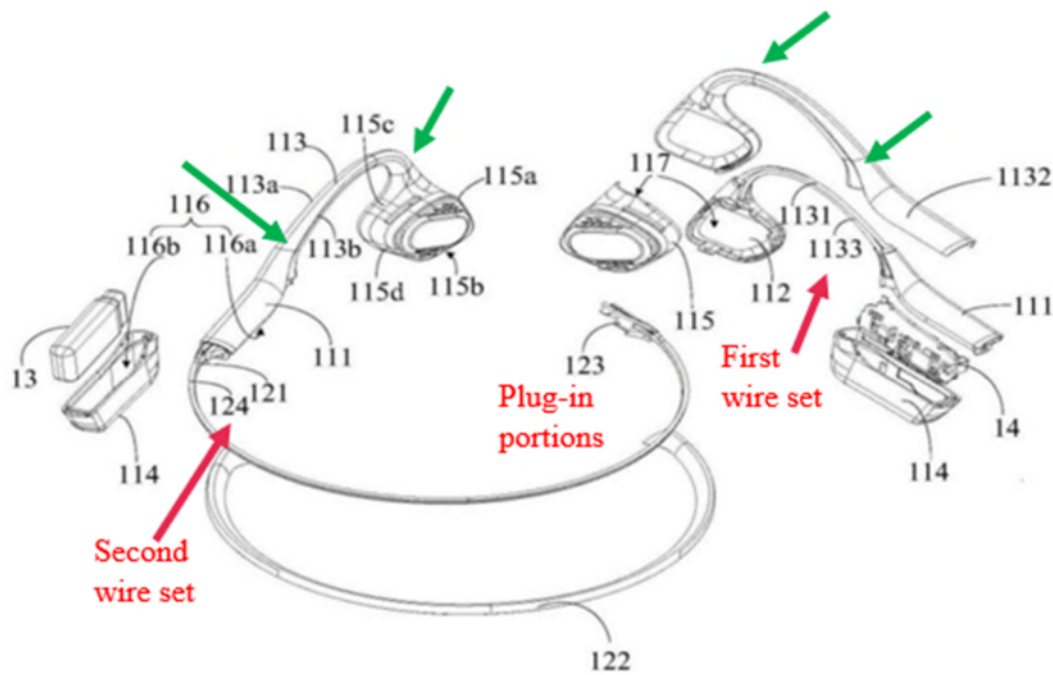


Figure 2

Li, Figure 2

EX1004, Fig. 2.

197. A POSITA would simply use the same production technique already disclosed in the Li reference, including the buried wire groove 1232 for each *first plug end* and *second plug end*, therefore providing the *first wiring channel* and a *second wiring channel*.

198. For those reasons, Li-Fujita-Asaka renders [3b] obvious.

4. [3c] the wire extends along the first wiring channel and the second wiring channel.

199. The Li-Fujita-Asaka combination renders this limitation obvious. Li discloses or renders obvious a *wire* (second wire set 124) that *extends along* buried wire grooves 1232:

Referring to figures 9, 12, and 13, optionally, the rear hook assembly 12 further comprises **a second wire set 124** wrapped by a second elastic coating layer 122, wherein both ends of the second wire set 124 are exposed from the second elastic coating layer 122, and the top surface of the plug-in portion 123 is provided with a buried wire groove 1232 **for accommodating the exposed portion of the second wire set 124**. In this embodiment, the second wire set 124 is used to connect the components inside the two ear hook assemblies 11, such as the battery and the control circuit assembly 14. Setting the buried wire groove 1232 can effectively arrange and fix the second wire set 124 on the one hand, and reduce the footprint on the other hand.

EX1004, [0069], Figures 9, 12, 13.

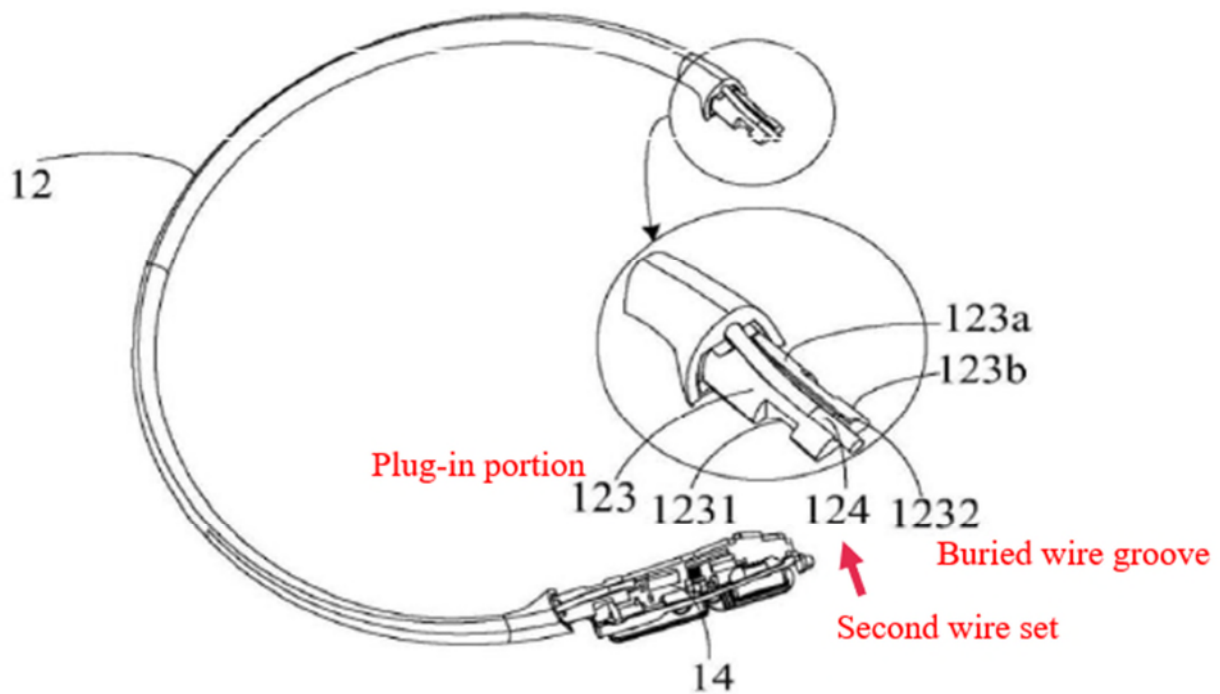


Figure 12

Li, Figure 12

200. As shown in [3b], *the first wiring channel and the second wiring channel* are buried wire grooves 1232 located at the ear hook plugs proximate the speaker (first channel) and the circuit (second channel)). Accordingly, when Li's plugs are replicated on connecting component 113 as explained in [1a], it would have been obvious to a POSITA to have *the wire* (second wire set 124, which in the ear hook location would be Li's first wire set 1133) *extend[ing] along the first wiring channel and the second wiring channel* (replicated buried wire grooves 1232 at plug locations) because that is how the plug ends disclosed in Li are constructed. Their location is simply moved to both ends of the ear hook (*see* [1a]). A POSITA

would use the same production technique disclosed in Li, only with Li's first wire set 1133 rather than second wire set 124, extending along buried wire grooves 1232. As discussed above, the first and second plug ends would be configured with pins or contacts commonly found in jacks and plugs, and the respective ends of the second wire set would pass through the first and second wiring channels for connection to the pins/contacts at the first and second plug ends (not shown in the figure above) for mating with corresponding pins or contacts in the sockets of the respective speaker and control circuit housings.

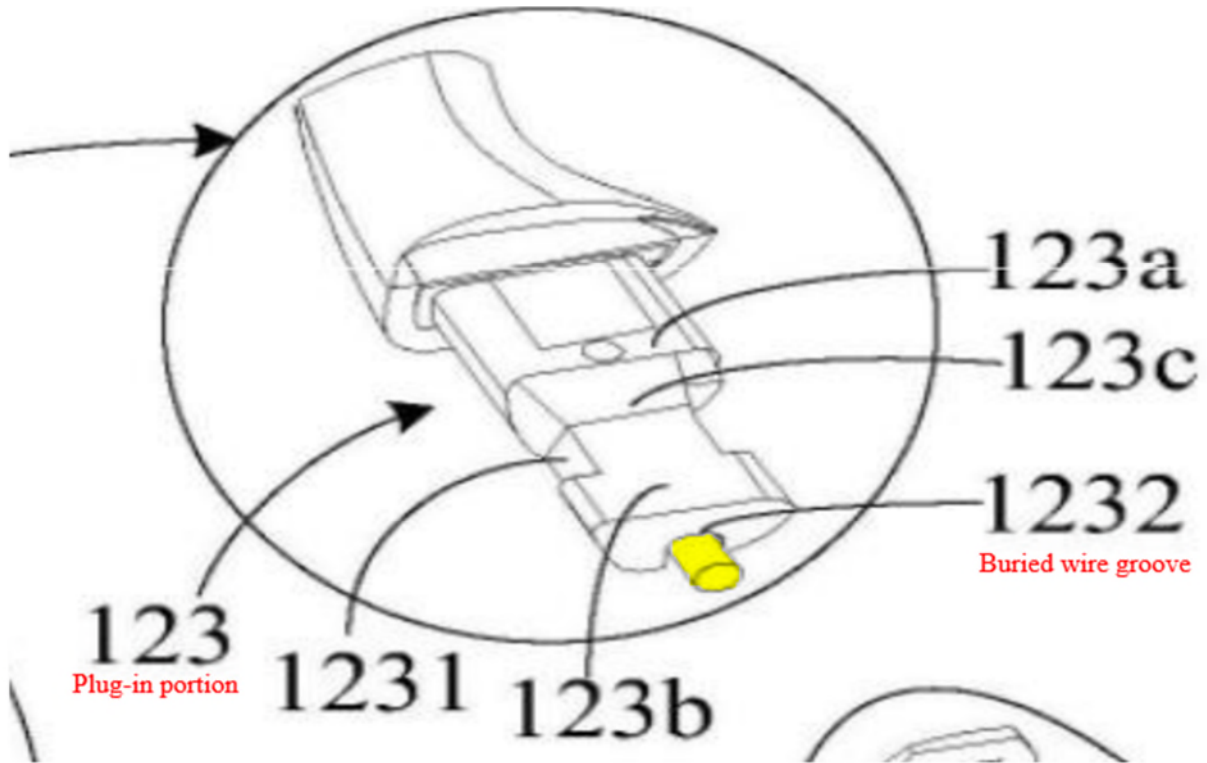
201. For those reasons, Li-Fujita-Asaka renders [3c] obvious.

E. Claim 4

1. **[4] The loudspeaker apparatus of claim 3, wherein the wire passes through the first wiring channel and the second wiring channel.**

202. The Li-Fujita-Asaka combination renders obvious claim 3. See claim 3. In the same way the Li-Fujita-Asaka combination renders obvious *the wire extends along the first wiring channel and the second wiring channel*, the combination renders obvious *wherein the wire passes through the first wiring channel and the second wiring channel*. See claim 3. For example, Li teaches that second wire set 124 protrudes through wire groove 1232 as is visible in Fig. 9 below (highlighted) with its exposed wire. EX1004, [0069], Figure 9. Accordingly,

Li's second wire set 124 would pass through the first wiring channel and the second wiring channel.



Id., Fig. 9 (excerpt).

F. Claim 5

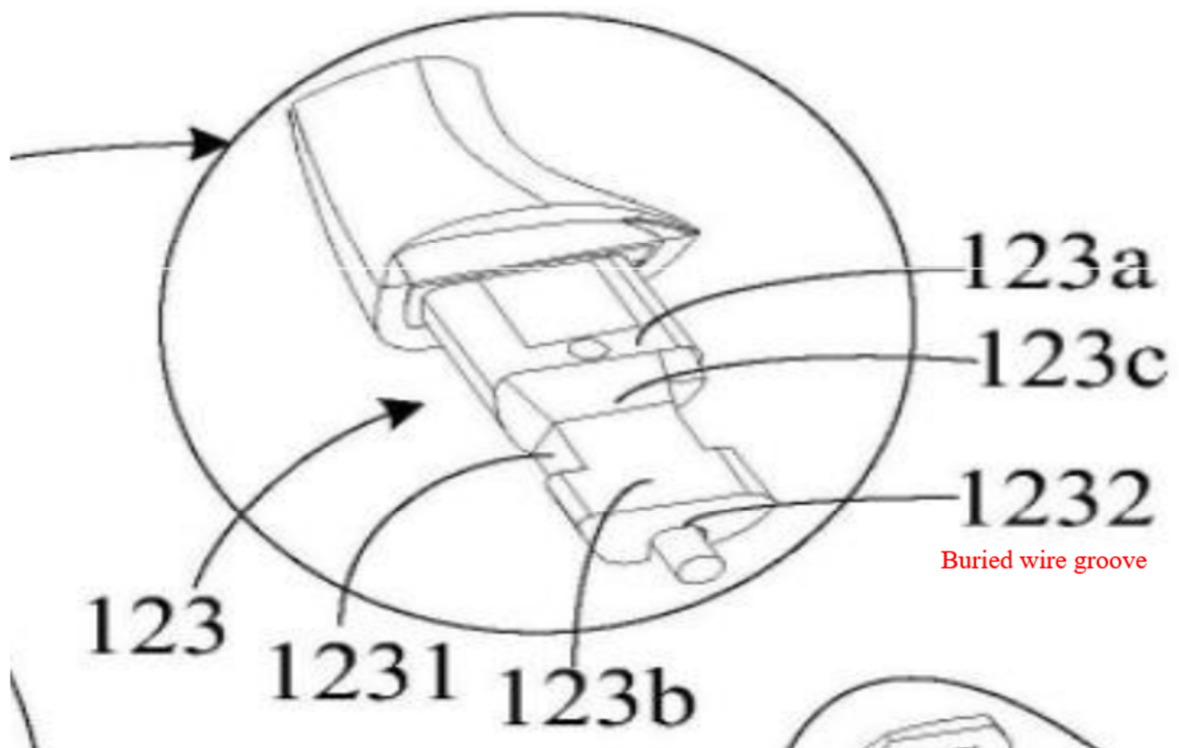
1. [5pre] The loudspeaker apparatus of claim 3, wherein

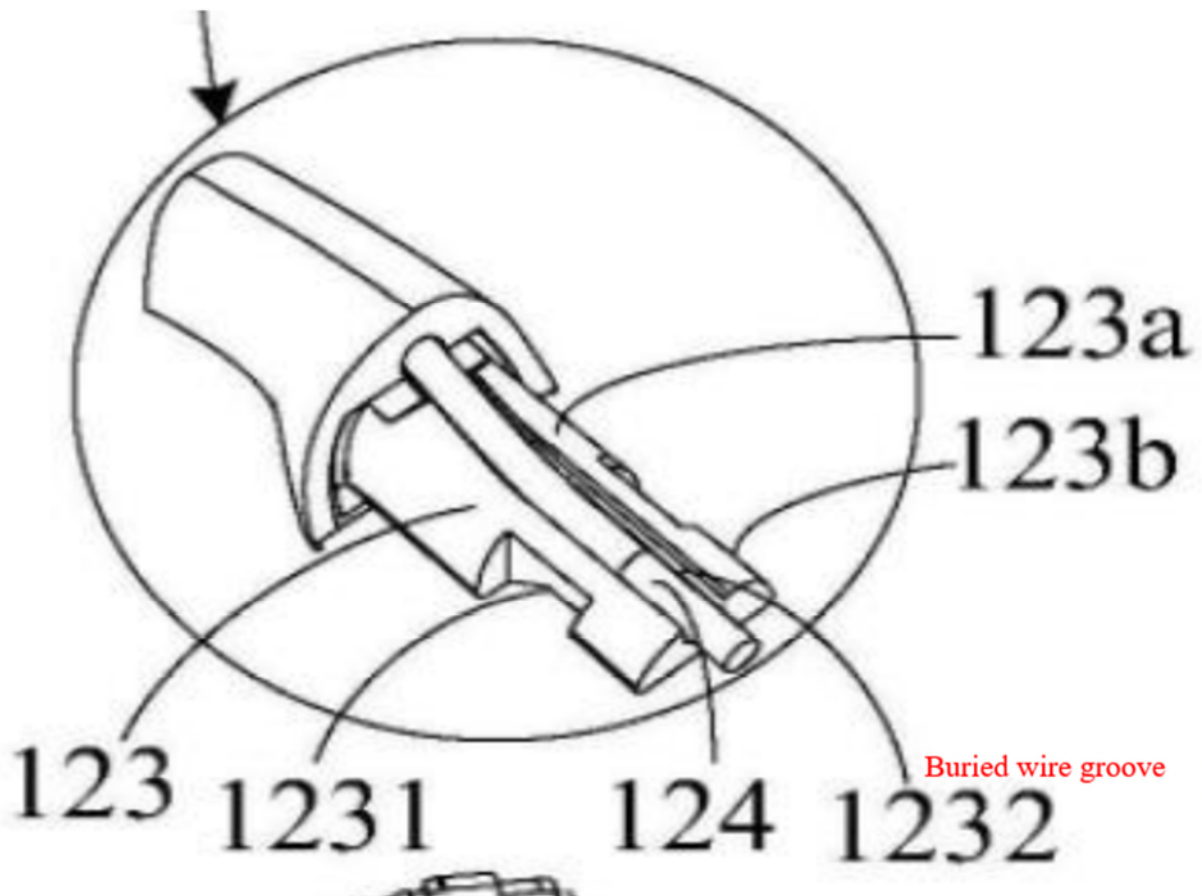
203. The Li-Fujita-Asaka combination renders obvious the loudspeaker apparatus of claim 3. See claim 3.

2. [5a] the first wiring channel includes a first wiring groove and a first wiring hole connecting the first wiring groove and an outer end surface of the first plug end,

204. The Li-Fujita-Asaka combination renders this claim limitation obvious. Li discloses or renders obvious a *first wiring channel*, buried wire groove

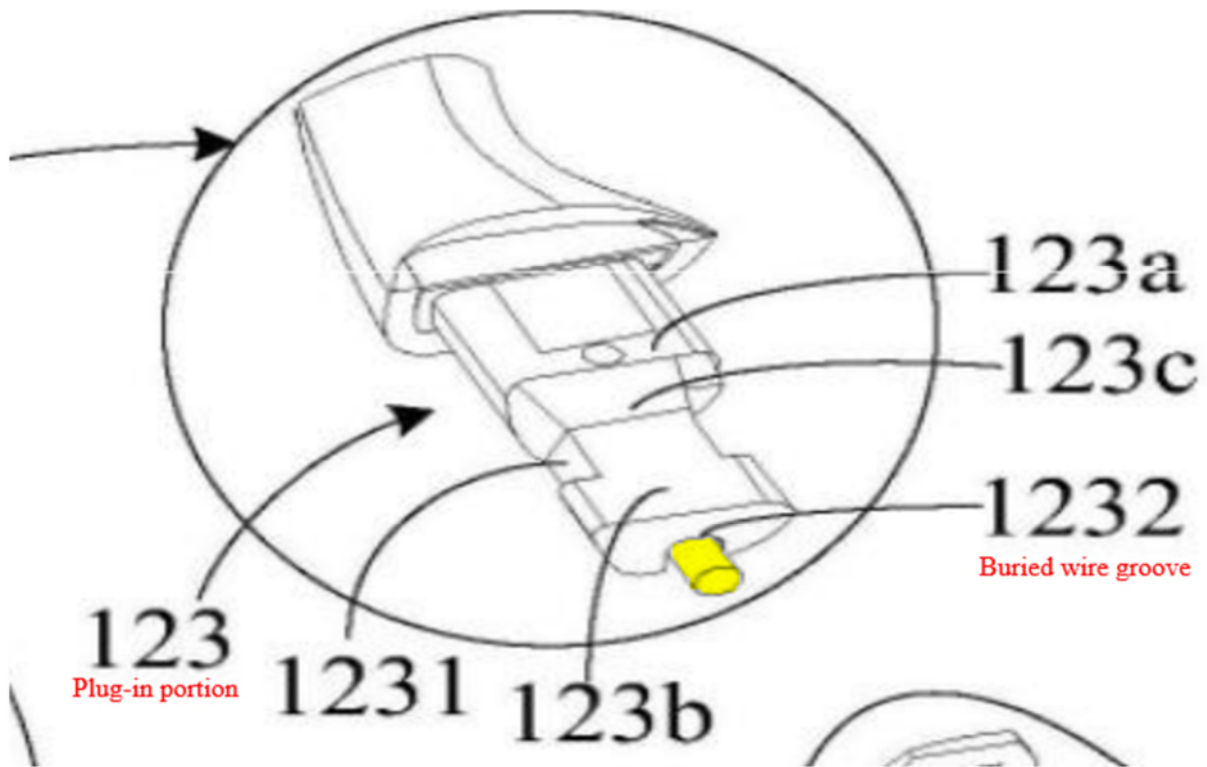
1232 (see claim 3), that further includes *a first wiring groove*. The buried wire groove 1232 has a groove shape and, thus, part of the buried wire groove 1232 shape is a groove where the wire sits as shown below. EX1004, [0069], Figs. 9, 12, 13.





Id., Figs. 9, 12 (excerpts).

205. Li teaches that buried wire groove 1232 has a *first wiring hole connecting the first wiring groove and an outer end surface of the first plug end*. Li teaches that second wire set 124 is “exposed” through the *first wiring hole*, such as shown in Figure 9, and that the *first wiring hole is connecting the first wiring groove and an outer end surface of the first plug end*, as is visible in Fig. 9 with its exposed wire, which is highlighted below coming out of a hole in buried wire groove 1232 at the outer end surface of plug-in portion 123. *Id.*, [0069], Figure 9.

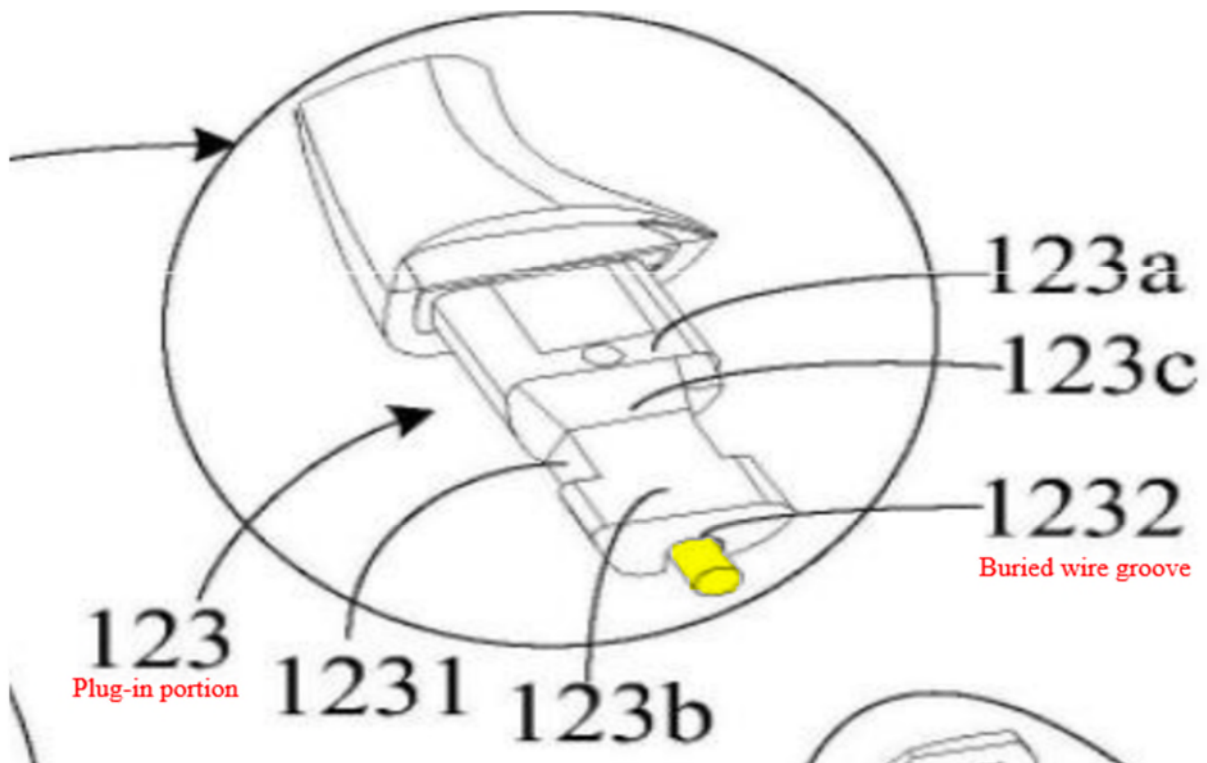


Id., Fig. 9 (excerpt).

206. It would have been obvious to a POSITA to design the *first wiring channel* (see claim 3) in the same way as already disclosed by buried wire groove 1232 in Li. The location of the structure is simply moved to both ends of the ear hook (which, again, a POSITA would be motivated to construct as discussed above in [1a]). A POSITA would simply use the same production technique already disclosed in the Li reference, including the buried wire groove 1232 for each *first plug end* and *second plug end* and providing it with the *first wiring channel* and claimed *first wiring hole* already taught in Li.

3. [5b] the wire extends along the first wiring groove and the first wiring hole and is exposed on the outer end surface of the first plug end,

207. The Li-Fujita-Asaka combination renders this claim limitation obvious. Li teaches *the wire extends along the first wiring groove and the first wiring hole and is exposed on the outer end surface of the first plug end*. A wire (second wire set 124) that *extends along the first wiring groove* (buried wire groove 1232) *and the first wiring hole and is exposed on the outer end surface of the first plug end*, as is depicted in Figure 9, for example. EX1004, [0069], Figure 9; see [5a]. The wire is *exposed on the outer end surface of the first plug end* as can be seen by Figure 9 (highlighted below).



EX1004, Fig. 9 (excerpt).

208. It would have been obvious to a POSITA to design the *first wiring channel* (see claim 3) in the same way as already disclosed by buried wire groove 1232 in Li, including the claimed *wire* (Li's first wire set 1133 or Asaka's wire 5) as analogous to second wire set 124. The location of the structure is simply moved to both ends of the ear hook (which, again, a POSITA would be motivated to construct as discussed above in [1a]). A POSITA would simply use the same production technique already disclosed in the Li reference, including *the wire extends along the first wiring groove and the first wiring hole and is exposed on the outer end surface of the first plug end* as already taught in Li.

4. **[5c] the second wiring channel includes a second wiring groove and a second wiring hole connecting the second wiring groove and the outer end surface of the first plug end, and**

209. The Li-Fujita-Asaka combination renders this claim limitation obvious, for the same reasons discussed above. See [5a], claim 3. It would have been obvious to a POSITA to implement the same structures of element [5a] with the second plug end on the opposite side of the ear hook for the same reasons discussed above, including because Li teaches the same plug-in portion 123 on each side of the rear hook assembly 12. *Id.*

5. **[5d] the wire extends along the second wiring groove and the second wiring hole and is exposed on the outer end surface of the second plug end.**

210. The Li-Fujita-Asaka combination renders this claim limitation obvious, for the same reasons discussed above. *See* [5b], claim 3. It would have been obvious to a POSITA to implement the same structures of element [5b] with the second plug end on the opposite side of the ear hook for the same reasons discussed above, including because Li teaches the same plug-in portion 123 on each side of the rear hook assembly 12. *Id.*

G. Claim 6

1. **[6] The loudspeaker apparatus of claim 2, wherein the ear hook includes at least two fixed sleeves spaced apart along the elastic metal wire.**

211. The Li-Fujita-Asaka combination renders obvious the loudspeaker apparatus of claim 2. *See* claim 2.

212. Asaka discloses or renders obvious *wherein the ear hook includes at least two fixed sleeves spaced apart along the elastic metal wire*. Holding portions 11 to 14 are *spaced apart along the elastic metal wire* (wire material 6): “As shown in figures 4 and 5, there are 4 holding portions along the extension direction of the integrated wire CB inside the hook portion 2, namely holding portion 11 to holding portion 14, ***which are spaced apart from each other by a certain distance.***”

EX1006, [0086], [0023], [0087], Figures 4-5.

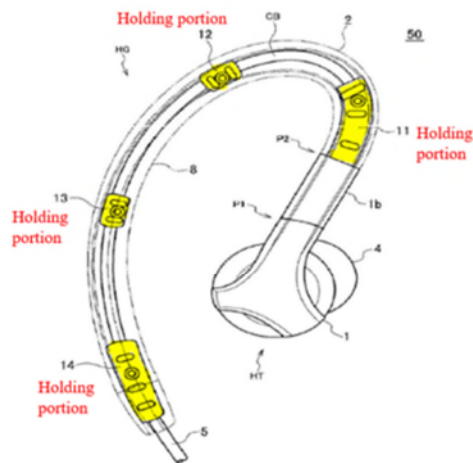


Figure 4

Asaka, Figure 4

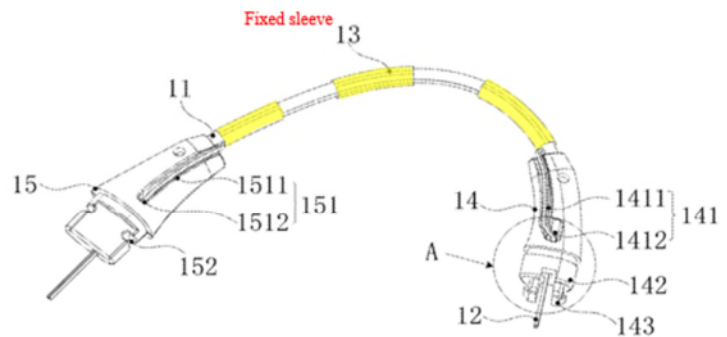


Fig. 3

'084 Patent, Figure 3

213. It would have been obvious to a POSITA for the other *fixed sleeve* disclosed in Asaka, covering portion 7, to be *at least two fixed sleeves spaced apart along the elastic metal wire* because that is the structure already in use by holding portions 11 to 14, and both covering portion 7 and holding portions 11 to 14 share the purpose of *fixing the wire (wire 5) on the elastic metal wire (wire material 6)*. EX1006, [0064], [0065], Figure 2. Manufacturing the covering portion 7 in this way would therefore be obvious to a POSITA and only require known techniques. For example, because the “covering portion 7 is a universal heat shrink tubing,” it would have been obvious to use this known and universal tubing where needed. *Id.* [0065].

214. Therefore, the Li-Fujita-Asaka combination renders obvious claim 6.

XIV. GROUND 4: LI, FUJITA, NUMATA, AND THE KNOWLEDGE OF A POSITA RENDER OBVIOUS CLAIMS 7-10

215. As shown below, Li, Fujita, and Numata in view of the knowledge of a POSITA, render claims 7-10 obvious.

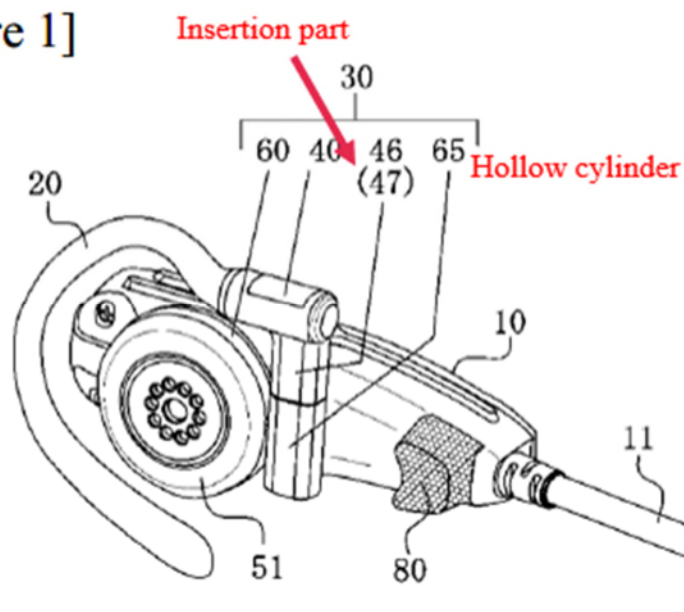
A. Motivation to Combine Li and Fujita

216. It would have been obvious to a POSITA to combine Li with Fujita for the reasons discussed above in §XI.A.

B. Motivation to Combine Li-Fujita and Numata

217. Moreover, it would have been obvious to a POSITA to further modify the Li-Fujita combination by using components of Numata, including Numata's insertion part 47 on the plug ends in Li-Fujita and the design of Numata's hollow cylinder 65 for the sockets in Li-Fujita.

[Figure 1]

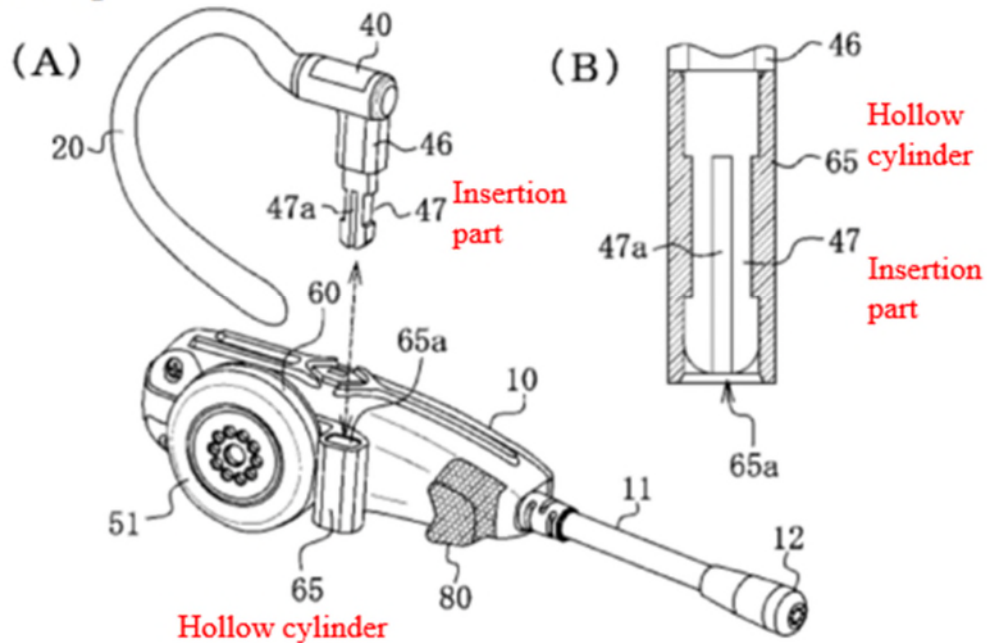


EX1007, Fig. 1.

218. A POSITA would have been motivated to do so because Li and Numata are squarely in the same field of wearable speaker headsets that require tightly fitting components. *E.g.*, EX1004, [0062]-[0064], [0036]; EX1007, [0011], [0020].

219. As shown above in Figure 1, Numata is a wireless headset that discloses connecting an earhook to the rest of the headset by means of a plug located on the earhook (insertion part 47) and a socket located on the rest of the headset (hollow cylinder 65). EX1007, Figure 8. A POSITA would look to its design due to it being in the same field of wearable speaker headsets as Li and sharing a similar construction and design—namely, ways to tightly connect components of headsets involving earhooks. Numata teaches that insertion part 47 can be connected “no matter in which direction” it is inserted in hollow cylinder 65. EX1007, [0034]. A POSITA would recognize the connection between the insertion part 47 and hollow cylinder 65 to be a secure fit as depicted in Figure 8 and to fulfill the device’s purpose of operating snugly on a user’s head.

[Figure 8]



Id., Fig. 8.

220. Li is similarly concerned with its plug ends having a secure, “tight fit” between the components of its device, as well as being “wear-resistant” in order to withstand active use of the device on a user’s head. EX1004, [0062]-[0064], [0036]. A POSITA would therefore have looked to Numata to improve the plugs and sockets of the Li-Fujita earphones, including to improve the wear-resistance of the Li-Fujita device, as well as to improve the ease of plugging in the components using either direction of the plug end disclosed in Numata. A POSITA would have recognized the benefit of using Numata’s insertion part 47 and hollow cylinder 65 in the Li-Fujita earphones, including as the plug and socket connecting the ear hook to the core housing and locating the Numata socket on the core housing, for these reasons. The

benefit of providing such improvement would have motivated the POSITA to make the combination.

221. Combining Numata with Li and Fujita would simply involve applying known techniques (*i.e.*, ear hook and speaker headset construction) to a known device ready for improvement (Li-Fujita's earphones) to yield predictable results (ear hook speakers with improved plugs and sockets). A POSITA would have had a reasonable expectation of success in the combination because the Li-Fujita device is already constructed with plugs and sockets, including with a socket in the circuit housing, which is the same way Numata discloses connecting its ear hook to its headset in an improved way. A POSITA thus would have had a reasonable expectation that the modification of Li-Fujita with Numata would be successful because a POSITA would have found that the teachings of Li-Fujita with Numata could have been predictably combined due to the predictability of the ear hook speaker art and manufacturing and the known interchangeability of the various elements, including the components of manufacture.

222. If Patent Owner argues the portions of Numata cited below relate to different, incompatible embodiments (which they do not), it would have been obvious to a POSITA to combine such embodiments into a single device at least because such embodiments are described in the same prior art reference, are fully

compatible with each other, and could be combined with minimal effort to achieve predictable results.

223. Therefore, a POSITA would have considered it obvious to include Numata's insertion part 47 and hollow cylinder 65 in Li-Fujita for the benefits described above.

C. Claim 7

1. [7pre] The loudspeaker apparatus of claim 1, wherein

224. The Li-Fujita combination renders obvious *the loudspeaker apparatus of claim 1*. See claim 1.

2. [7a] the core housing is arranged with a first socket connecting with an outer end surface of the core housing,

225. Li discloses or renders obvious this claim limitation. As explained above in [1c], Li's second housing 112 and the fourth housing 115 constitute *a core housing*. As also explained above in claim 1, a POSITA would be motivated to construct additional plug locations and exemplary plug locations are shown below with green arrows.

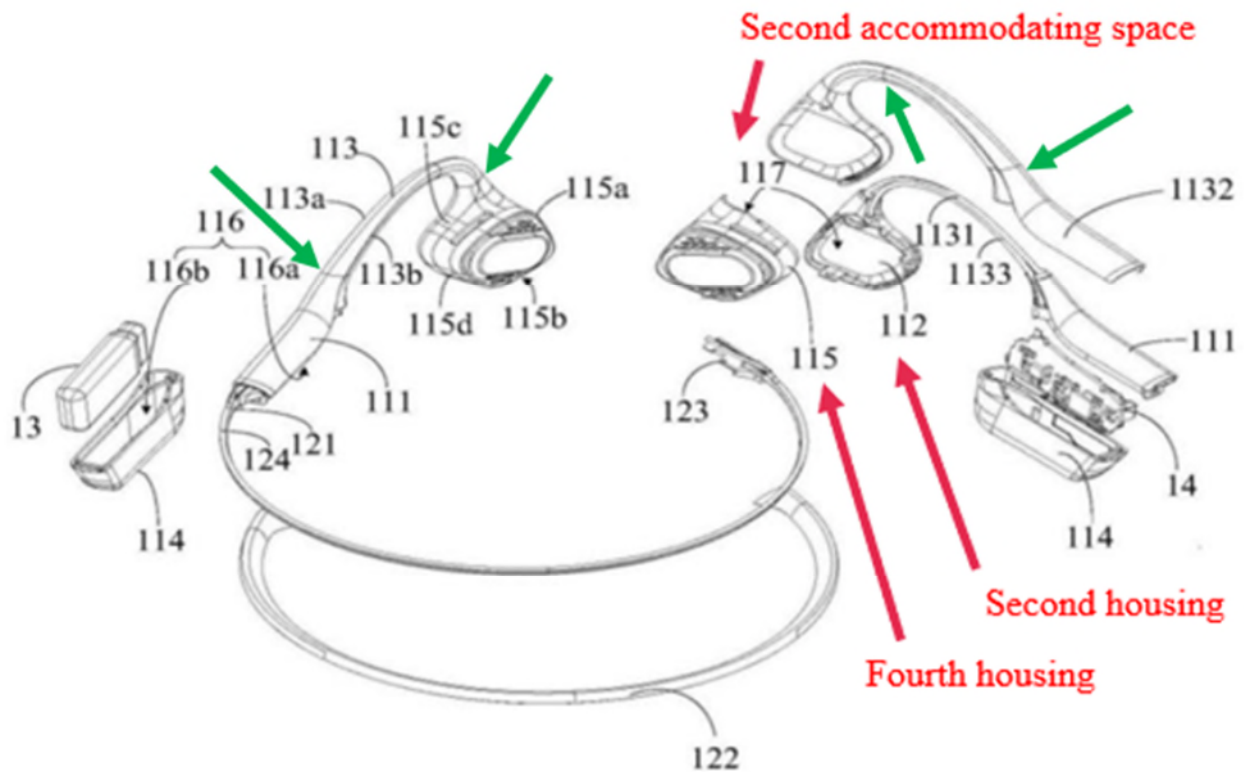


Figure 2

EX1004, Fig. 2.

226. Accordingly, if additional plugs are used, the connecting component 113 in ear hook assembly 11 would include plug ends 123. As such, the *core housing* identified above would include a housing arranged with a *socket* (a plug-in hole 1111) *connecting with an outer end surface of the core housing* (see green arrow locations above). As explained in Li, “the end of the first housing 111 is provided with a plug-in hole 1111 for allowing the insertion of the plug-in portion 123.” EX1004, [0060]-[0068], Figs. 9, 10, 11.

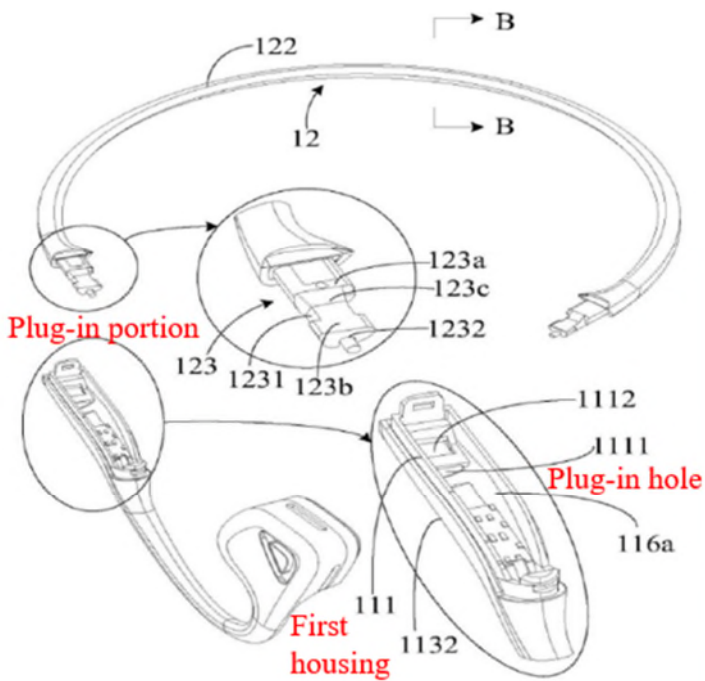


Figure 9

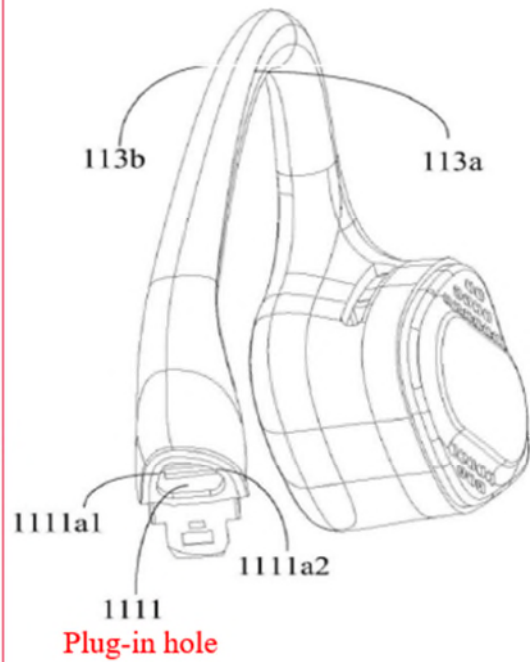


Figure 11

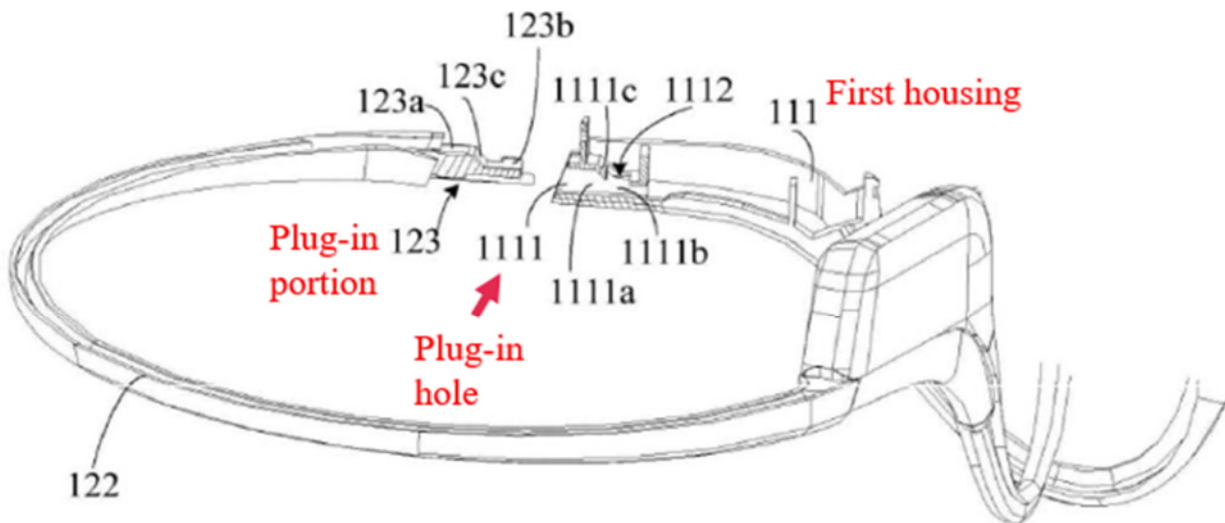


Figure 10

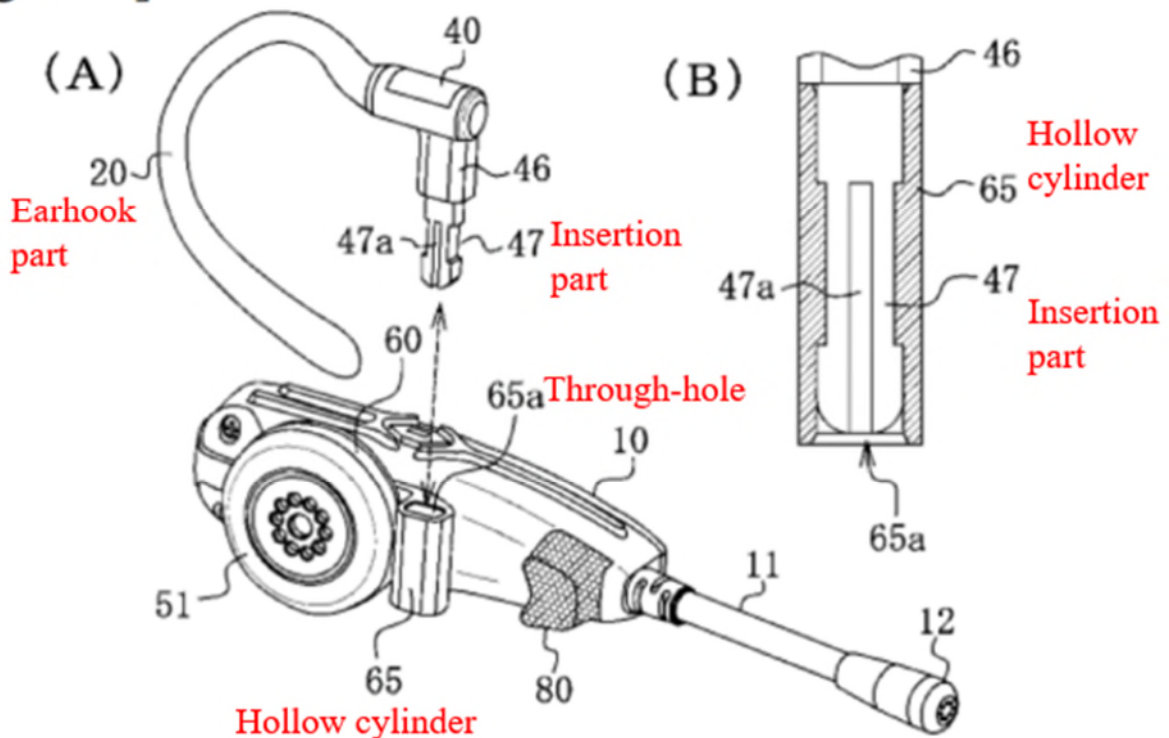
Id., Figs. 9-11.

227. It would have been obvious to arrange Li's *core housing* with a plug-in hole and connect it to the *first plug end* of the *ear hook* to achieve the benefits of

a modular earphone design already recognized by Li, including reducing earphone size, simplifying the structure, reducing weight, facilitating later wiring, and reducing costs, especially when it comes to replacing the earphone's speaker. See *id.*, [0059]; see [1c]. Such design would involve structures already in use in Li and slight modifications to where they appear in the device.

228. To the extent Li does not disclose or render obvious *arranged with a first socket connecting with an outer end surface*, Numata discloses or renders obvious that limitation. Numata discloses an earhook part 20 that is connected to a wireless headset by means of an insertion part 47 into through-hole 65a of the hollow cylinder 65 (*first socket*). EX1007, [0032]-[0035], Figs. 1-3, 8-9.

[Figure 8]

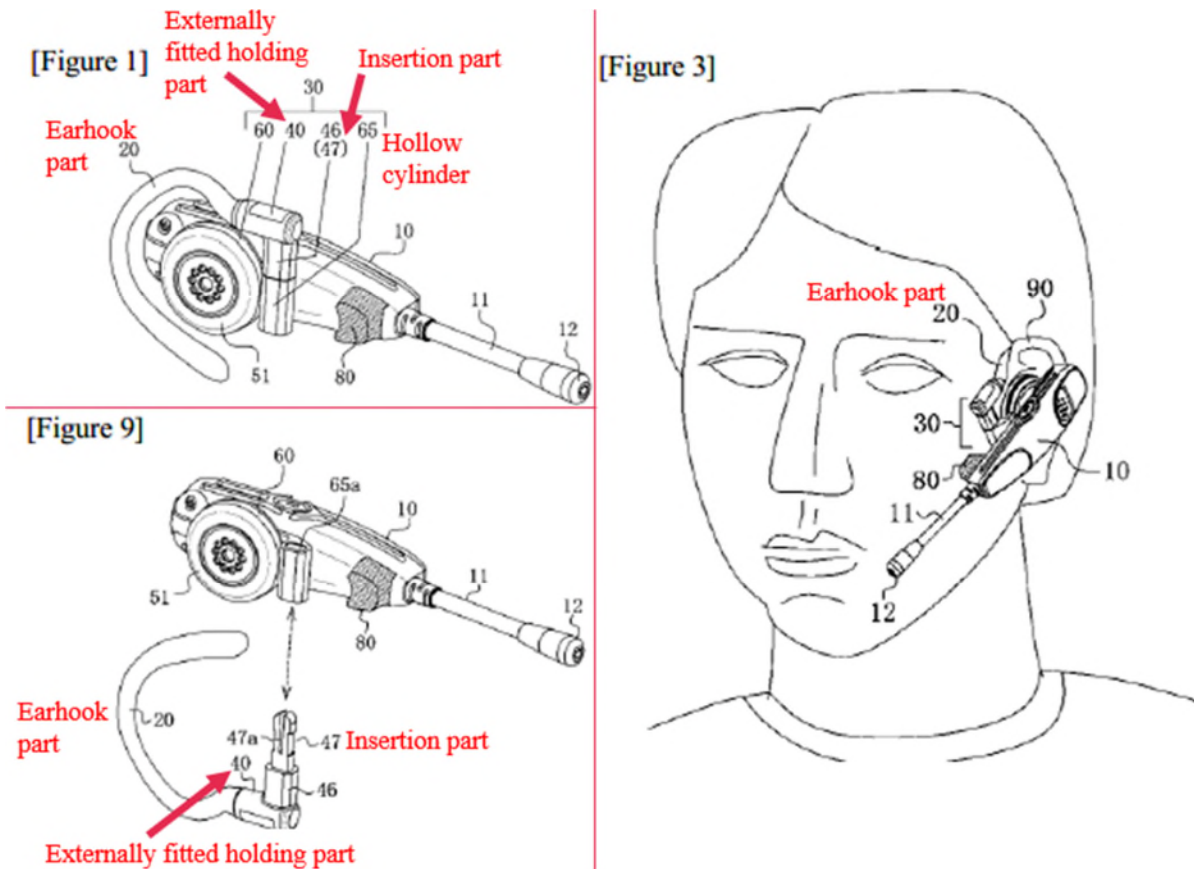


Id., Fig. 8.

229. The hollow cylinder 65 is *connecting with an outer end surface* of the headset not including the earhook. *Id.*

[A]s shown in Figure 8 (A), when the insertion part 47 is inserted into the through-hole 65A of the hollow cylinder 65 from above to fix the earhook part 20, the headset is worn on the left ear, as shown in Figures 1 and 2; on the contrary, as shown in Figure 9, when the insertion part 47 is inserted from below to fix the earhook part 20, the headset is worn on the right ear, as shown in Figure 10. Therefore, the headset of this embodiment can be worn on both the left and right ears only by changing the assembly of the earhook part 20 and the externally fitted holding part 40.

Id., [0033].



Id., Figs. 1, 3, 9.

230. A POSITA would have been motivated to combine Numata's *first socket to the outer end surface of the core housing* in Li for the reasons discussed above, including in a smaller size to allow for use with the Li invention. §XIV.B.

3. [7b] a stopping block is arranged on an inner sidewall of the first socket, and

231. Li discloses or renders obvious this claim limitation. Li discloses or renders obvious a *stopping block* (elastic convex portion) *arranged on an inner sidewall of the first socket* (plug-in hole 1111) as described below.

[T]he end of the first housing 111 is provided with a plug-in hole 1111 for allowing the insertion of the plug-in portion 123. The plug-in portion 123 has a concave portion, and the plug-in hole 1111 has ***an elastic convex portion inside***. When the plug-in portion 123 is inserted into the plug-in hole 1111, the elastic convex portion is engaged with the concave portion to fix the plug-in portion 123 and the plug-in hole 1111 together. For example, when the plug-in portion 123 is inserted into the plug-in hole 1111, the elastic convex portion is first compressed and then snapped into the concave portion under the action of elastic recovery force.

EX1004, [0060], Figures 9-10. The convex shape can be seen in Figure 11 (highlighted) below.

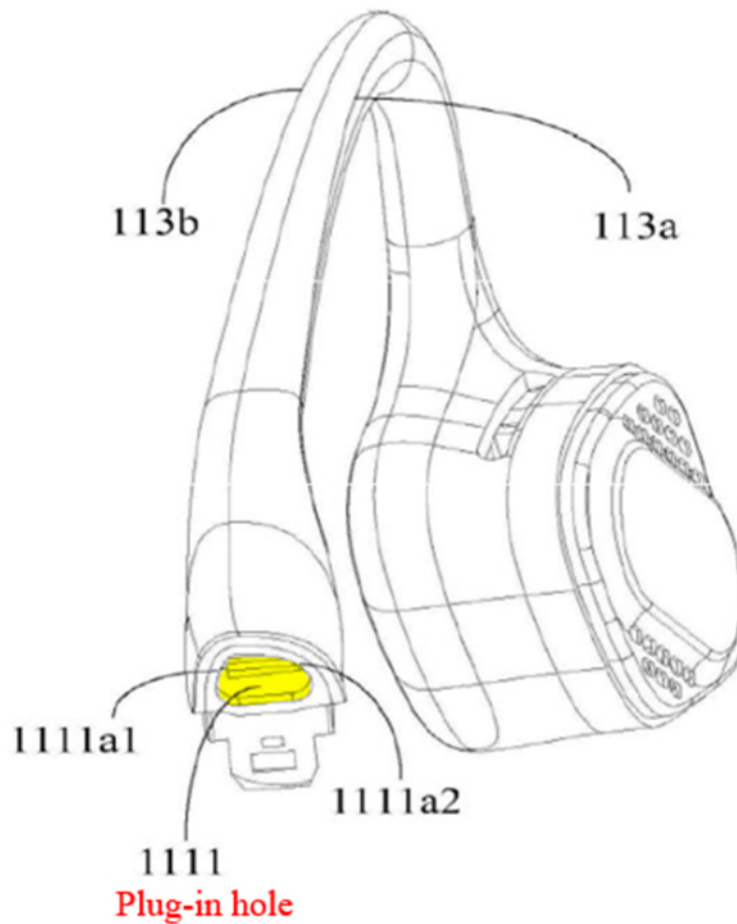
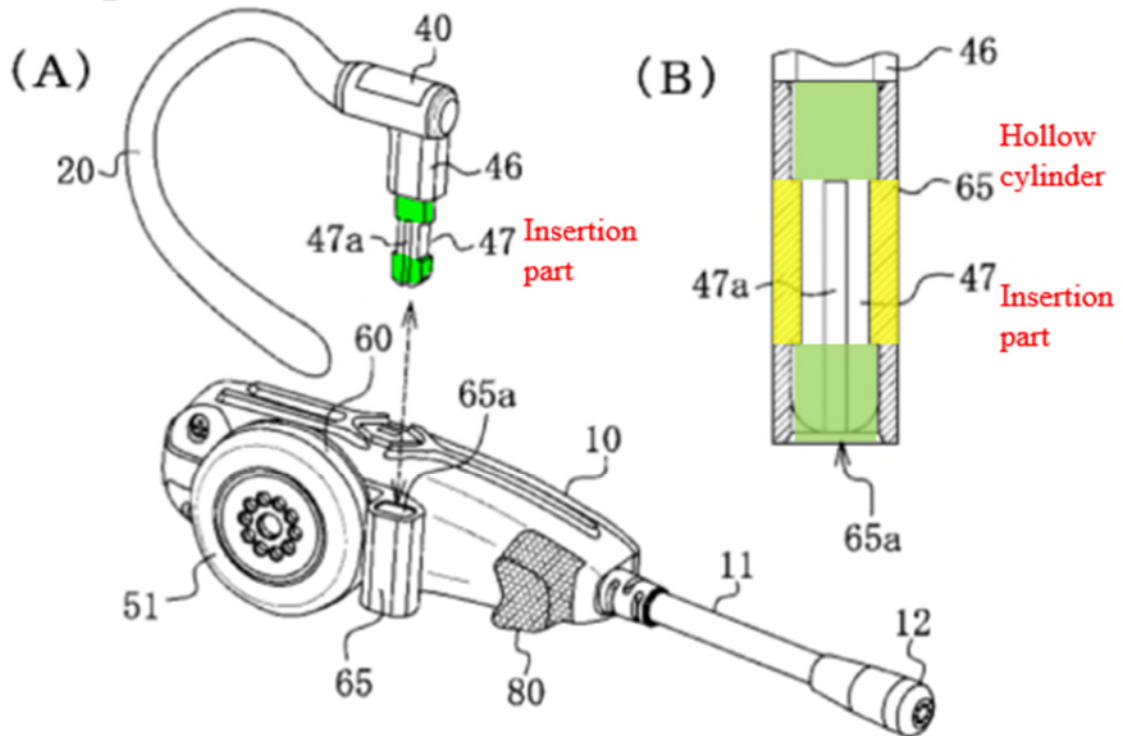


Figure 11

Id., Fig. 11.

232. To the extent Li does not disclose or render obvious this limitation, Numata discloses or renders that limitation obvious. Numata discloses or renders obvious *a stopping block arranged on an inner sidewall of the first socket* (the shape of hollow cylinder 65), as can be seen, for example, as shown in highlighted Figure 8(b) below. EX1007, [0032]-[0035], Figure 8.

[Figure 8]



Id., Fig. 8. The green highlighted portion of insertion part 47 abuts the yellow highlighted portion of hollow cylinder thereby creating a *stopping block arranged on an inner sidewall of the first socket*.

4. [7c] the first socket is connected to the first plug end.

233. The Li-Fujita-Numata combination renders obvious this limitation. See [1c], (*the core housing being fixed to the first plug end*), [7a]. A POSITA would find it obvious to add the *first socket* to the *core housing* for the reasons discussed above thereby having plugs on Li's connecting component 113, to allow for the *first socket* to connect to the *first plug end* of the *ear hook* in order to achieve the benefits of a modular earphone design already recognized by Li, as well as for the

reasons a POSITA would be motivated to combine the Numata socket for use in Li-Fujita. *See* [1c], [7a], [7b], §XIV.B. For example, Numata discloses or renders obvious the *first socket* (hollow cylinder 65) connected to a plug end of an ear hook (insertion part 47). EX1007, [0032]-[0035], Figure 8. A POSITA therefore would have found it obvious to *connect the first socket to the first plug end*. §XIV.B. Furthermore, a POSITA would understand how to modify Numata's insertion part to allow for known modular electrical connections such as pins and contacts commonly found in jacks (*see* claims 1-3) in a place where they would not interfere with the two moving parts of insertion part 47, such as locating the connection in the fixed square portion above and out of the way of the two moving parts (highlighted in green in Figure 8 above in [7b]).

D. Claim 8

1. [8pre] The loudspeaker apparatus of claim 7,

234. The Li-Fujita-Numata combination renders obvious *the loudspeaker apparatus of claim 7*. *See* claim 7.

2. [8a] wherein the first plug end includes: an inserting portion being at least partially inserted into the first socket and abutting against an outer side surface of the stopping block; and

235. Li discloses or renders this claim limitation obvious. Li renders obvious *the first plug end* (plug-in portion 123). *See* [7a]. Li's plug-in portion 123

includes: an inserting portion being at least partially inserted into the first socket

(plug-in portion 123 mates with plug-in hole 1111). See [7a].

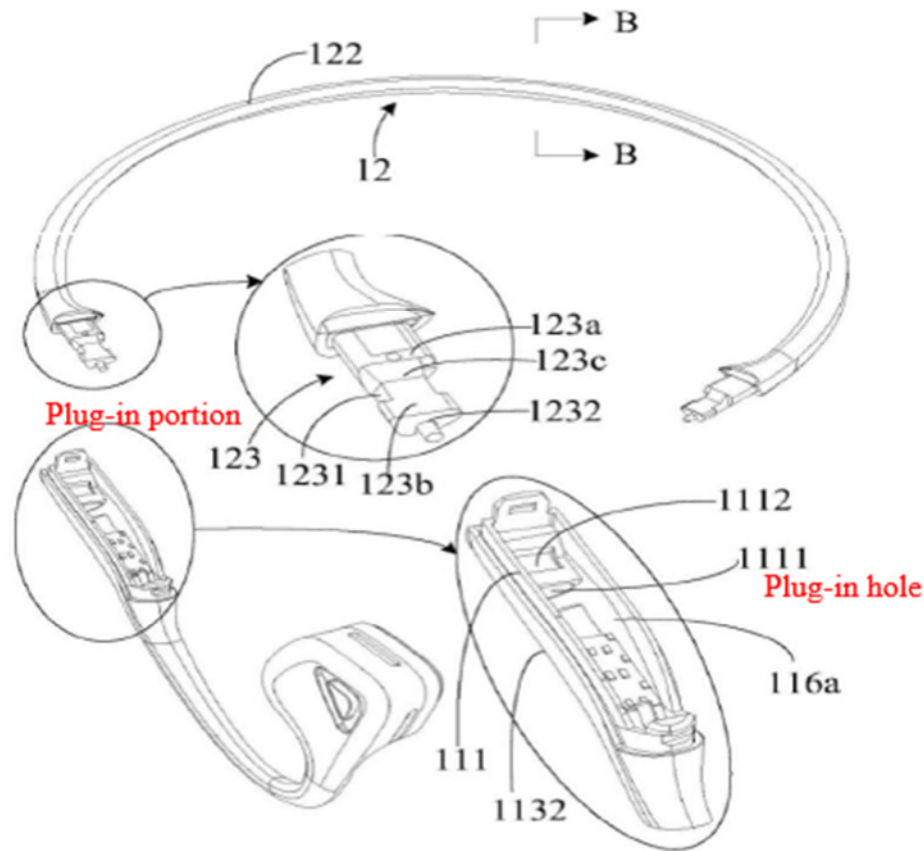


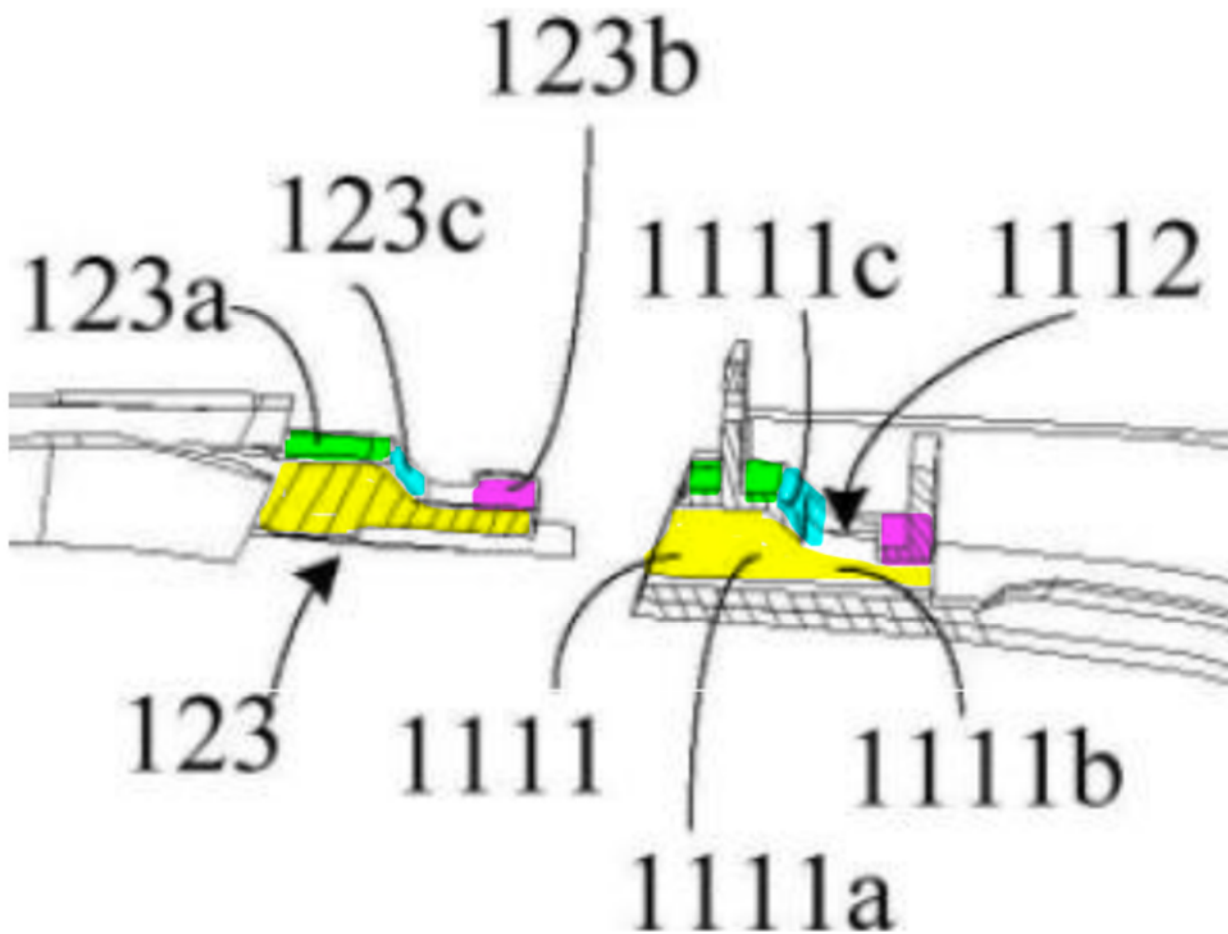
Figure 9

EX1004, Fig. 9. Li teaches “the end of the first housing 111 is provided with a plug-in hole 1111 ***for allowing the insertion of the plug-in portion 123,***” and that plug-in portion 123 has *an inserting portion* (first plug-in section 123a or second plug-in section 123b and/or first wedge-shaped transition section 123c) *being at least partially inserted into the first socket.* EX1004, [0060]-[0068], Figs. 9, 10, 11.

236. Li discloses or renders obvious the *inserting portion* (first plug-in section 123a or second plug-in section 123b or first wedge-shaped transition section 123c) *abutting against an outer side surface of the stopping block* (elastic convex portion):

[T]he end of the first housing 111 is provided with a plug-in hole 1111 for allowing the insertion of the plug-in portion 123. The plug-in portion 123 has a concave portion, and the plug-in hole 1111 has an elastic convex portion inside. ***When the plug-in portion 123 is inserted into the plug-in hole 1111, the elastic convex portion is engaged with the concave portion to fix the plug-in portion 123 and the plug-in hole 1111 together.*** For example, when the plug-in portion 123 is inserted into the plug-in hole 1111, the elastic convex portion is first compressed and then snapped into the concave portion under the action of elastic recovery force.

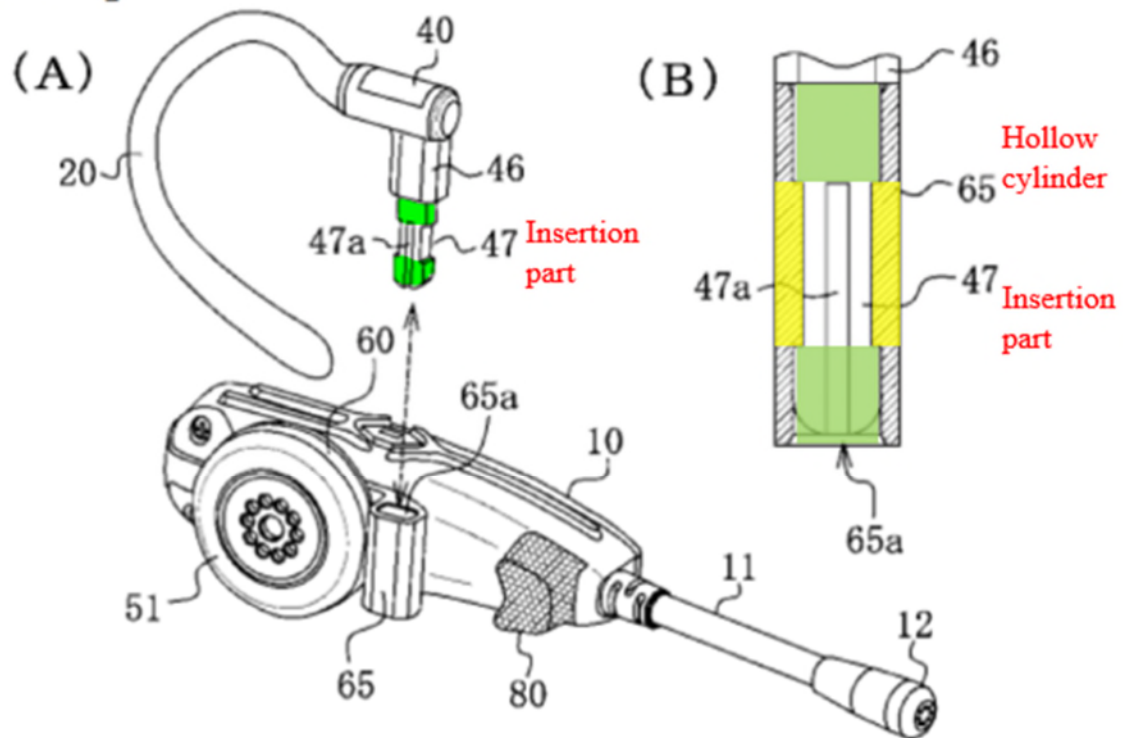
EX1004, [0060], Figures 9-10. Therefore, the first plug-in section 123a, second plug-in section 123b and/or first wedge-shaped transition section 123c *abuts against an outer side surface of* the elastic convex portion. This is shown below in Figure 10 with like colors for abutting locations.



Id., Fig. 10 (excerpt).

237. To the extent Li does not disclose or render obvious this limitation, Numata discloses or renders it obvious. Numata discloses or renders obvious a plug end on an ear hook (insertion part 47) with *an inserting portion being at least partially inserted into the first socket* (hollow cylinder 65, *see claim 7*) and *abutting against an outer side surface of the stopping block* (located in hollow cylinder 65, *see claim 7*), as is plainly seen in Figure 8(b). EX1007, [0032]-[0035], Figure 8.

[Figure 8]

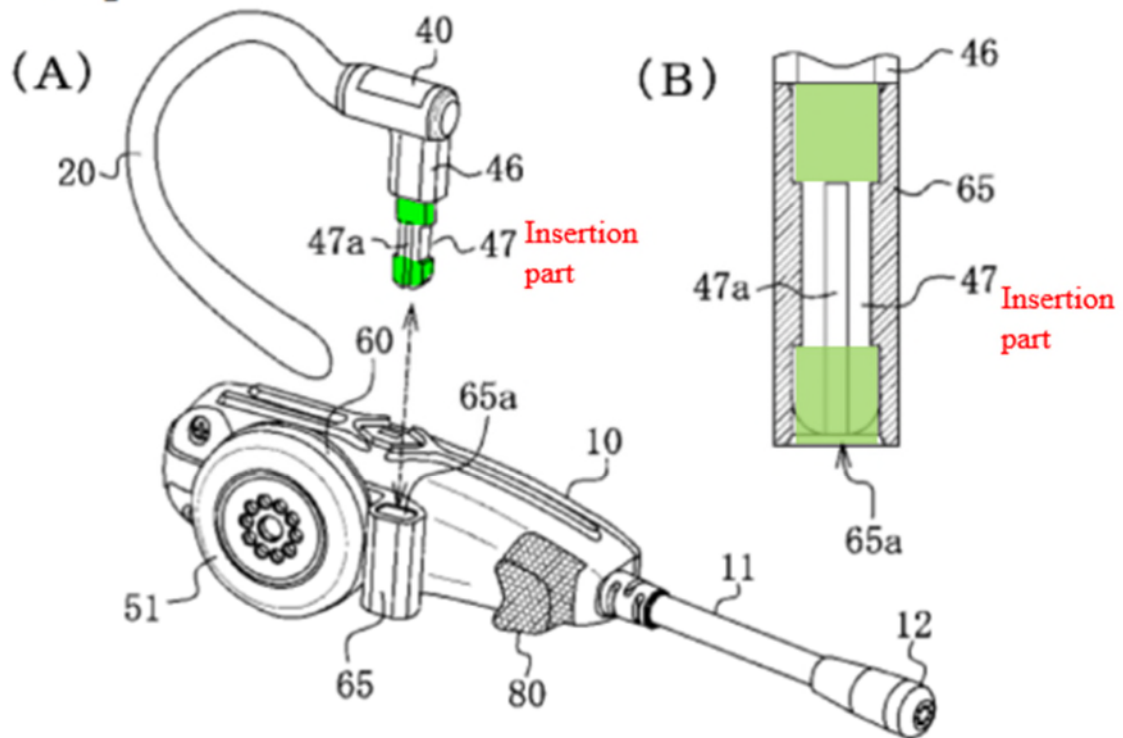


Id., Fig. 8. The green highlighted portion of insertion part 47 abuts the yellow highlighted portion of hollow cylinder thereby creating *an inserting portion* (insertion part 47) *being at least partially inserted into the first socket and abutting against an outer side surface of the stopping block*. A POSITA would have found it obvious to use the structure of Numata's insertion part 47 structures for Li's *first plug end* (plug-in portion 123) for the reasons discussed above. §XIV.B.

3. [8b] two elastic hooks being arranged on a side of the inserting portion facing inside of the core housing, wherein:

238. Numata discloses or renders this limitation obvious. Numata teaches a plug end on an ear hook (insertion part 47) that has *two elastic hooks being arranged on a side of the inserting portion*. EX1007, [0032]-[0035], Figure 8.

[Figure 8]



Id., Fig. 8.

239. A POSITA would have been motivated to use such a plug design for the *first plug end*, the two elastic hooks *being arranged on a side of the inserting portion facing inside of the core housing*, for the reasons discussed above. §XIV.B.

4. **[8c] the two elastic hooks are brought together under action of external thrust and the stopping block, and**

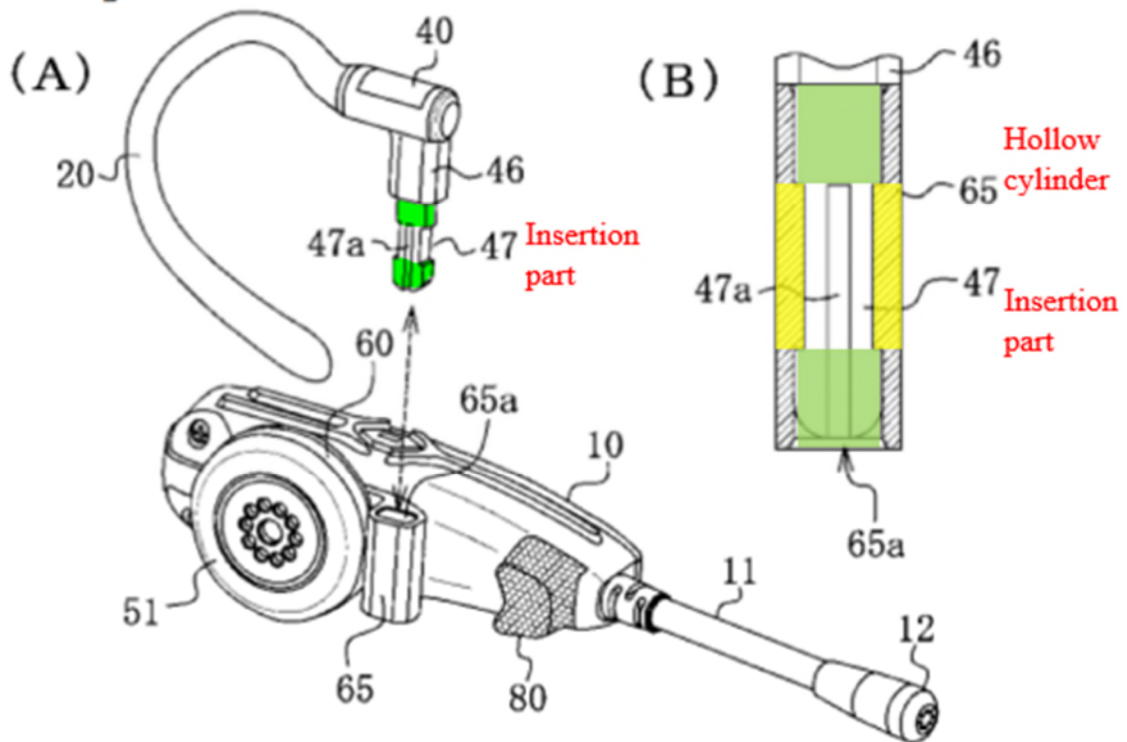
240. Numata discloses or renders obvious *the two elastic hooks (see [8b]) are brought together under action of external thrust and the stopping block:*

Furthermore, as shown in Figures 8 (A) and 9, at the same time the insertion part 47 forms a slit 47A from the front end to the axis, ***the parts divided into two sides by the slit 47A become the***

locking tongue connecting rod of the leaf spring. In addition, the through-hole 65A of the hollow cylinder 65, as shown in Figure 8 (B), can be engaged with the locking tongue connecting rod no matter in which direction is the insertion part 47 inserted. Besides, this engagement relationship can be easily released by inserting a tool from the opening in the opposite direction of the relevant insertion part 47 of the through-hole 65A to reduce the slit 47A, so the above assembly is easy to attach and detach and change.

EX1007, [0034], Fig. 8. This is shown in Figure 8 below.

[Figure 8]



Id., Fig. 8.

5. [8d] after passing through the stopping block, the two elastic hooks are elastically restored to be stuck on an inner

surface of the stopping block to realize the fixation of the core housing and the first plug end.

241. Li-Fujita-Numata renders obvious this limitation. Numata discloses or renders obvious *after passing through the stopping block* (stopping block in hollow cylinder 65), *the two elastic hooks* (insertion part 47) *are elastically restored to be stuck on an inner surface of the stopping block to realize fixation*. See [8a]-[8c]. A POSITA would have been motivated to use this plug design in the Li-Fujita combination *to realize the fixation of the core housing and the first plug end* for the reasons identified above. §XIV.B.

E. Claim 9

1. [9pre] The loudspeaker apparatus of claim 8, wherein

242. The Li-Fujita-Numata combination renders obvious *the loudspeaker apparatus of claim 8*.

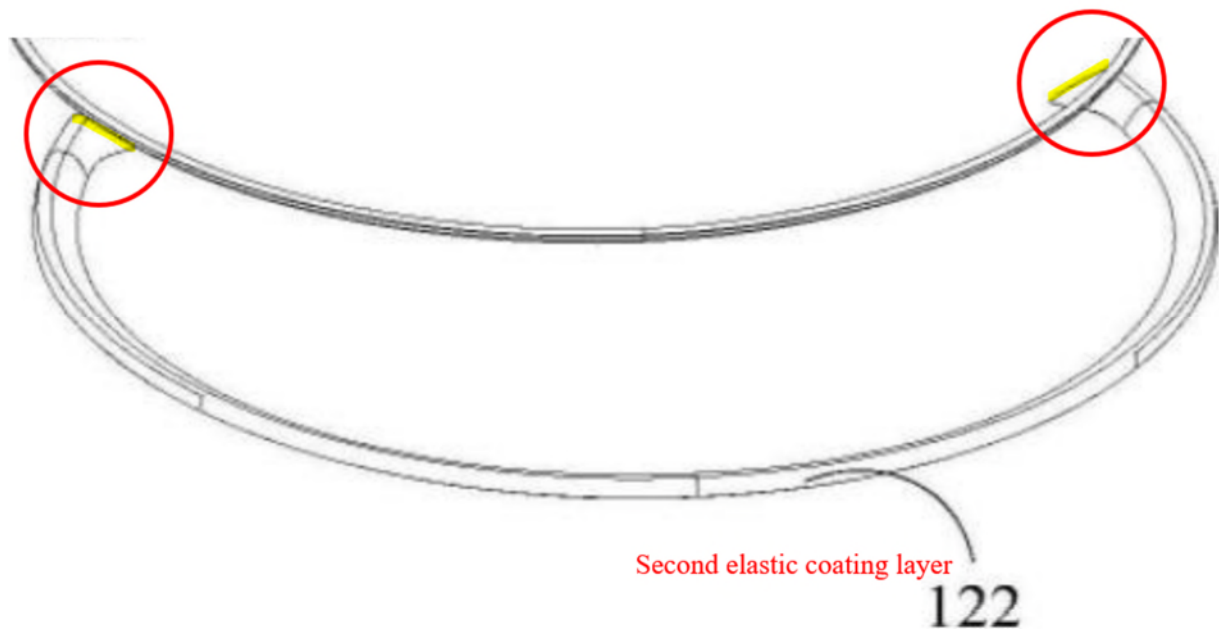
2. [9a] the inserting portion is partially inserted into the first socket, and

243. The Li-Fujita-Numata combination renders obvious this claim limitation. See [8a].

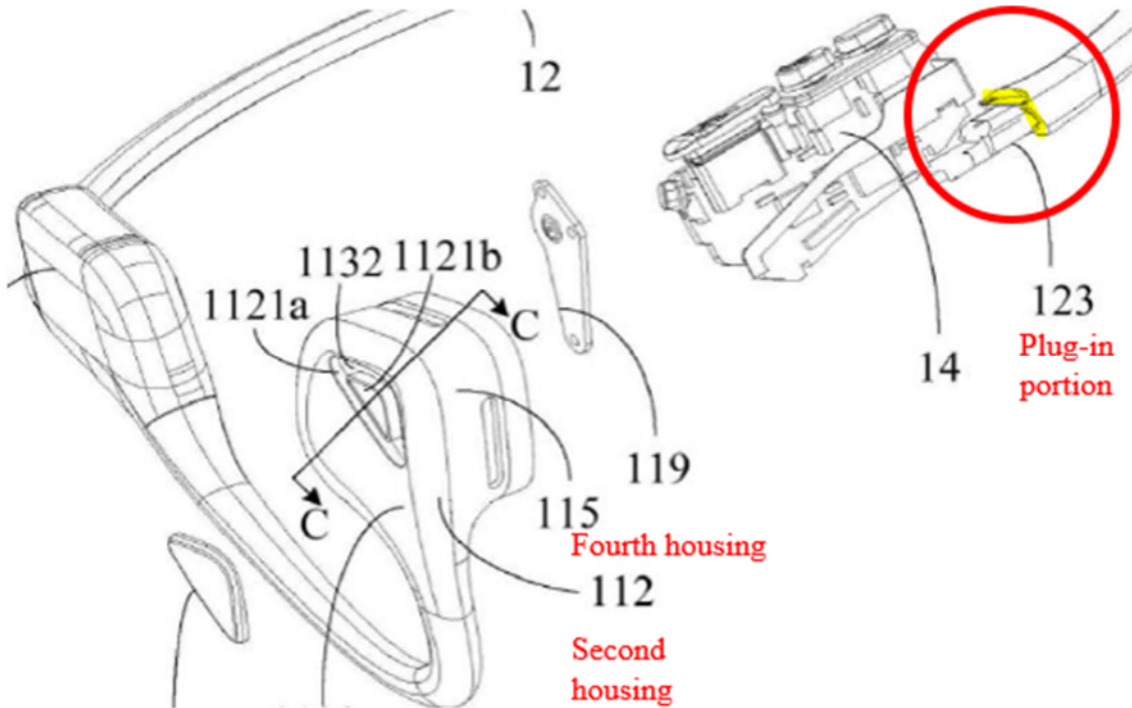
3. [9b] an exposed part of the inserting portion is arranged in a stepped manner to form an annular table surface spaced apart from the outer end surface of the core housing.

244. Li and Numata disclose or render obvious this limitation. Li discloses *an exposed part of the inserting portion* (plug-in portion 123) *is arranged in a*

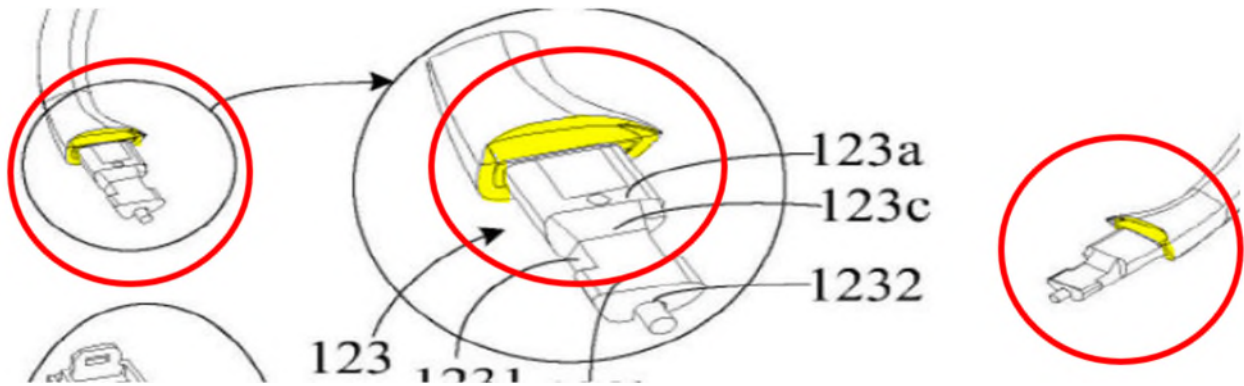
stepped manner to form an annular table surface spaced apart from the outer end surface (the end of second elastic coating layer 122 annotated in yellow and circled in red in Figures 2, 5, and 9 below) of the circuit housing (the combination of third housing 114 and first housing 111). EX1004, [0058], [0069]. It would have been obvious to a POSITA for the annular table surface to be spaced apart from the outer end surface of the core housing (the combination of the second housing 112 and the fourth housing 115) for the same reasons discussed above in [1c] (a core housing for accommodating an earphone core, the core housing being fixed to the first plug end and elastically abutted against the protective sleeve).



Id., Figure 2 (excerpt).



Id., Figure 5 (excerpt).



Id., Figure 9 (excerpt).

As shown above in yellow highlight, the shape of the second elastic coating layer 122 proximate the plug-in portion 123 is arranged in a stepped manner to form an annular table surface.

245. To the extent Patent Owner argues that the second elastic coating layer 122 is not included in an “inserting portion,” it would have been obvious to a POSITA to have this same structure on the *exposed part of the inserting portion* of the *first plug end* because Li is designed to “ensure a tight fit” between the plug and the socket. EX1004, [0062]-[0063]. Li’s device also has the goal of waterproofing, including by using its *protective sleeve* to “protect the housing and internal components, making the bone conduction earphone more wear-resistant.” *Id.*, [0036]; *see, e.g., id.*, [0037], [0056], [0071]. A POSITA would have understood that having an *annular table surface* on the *first plug end* would contribute to accomplishing these aims by supporting the sealing and waterproofing of the device. *Id.*, [0036]-[0037], [0056], [0062]-[0063], [0071]. These goals align with the purpose of the claimed *annular table surface* in the ’084 Patent:

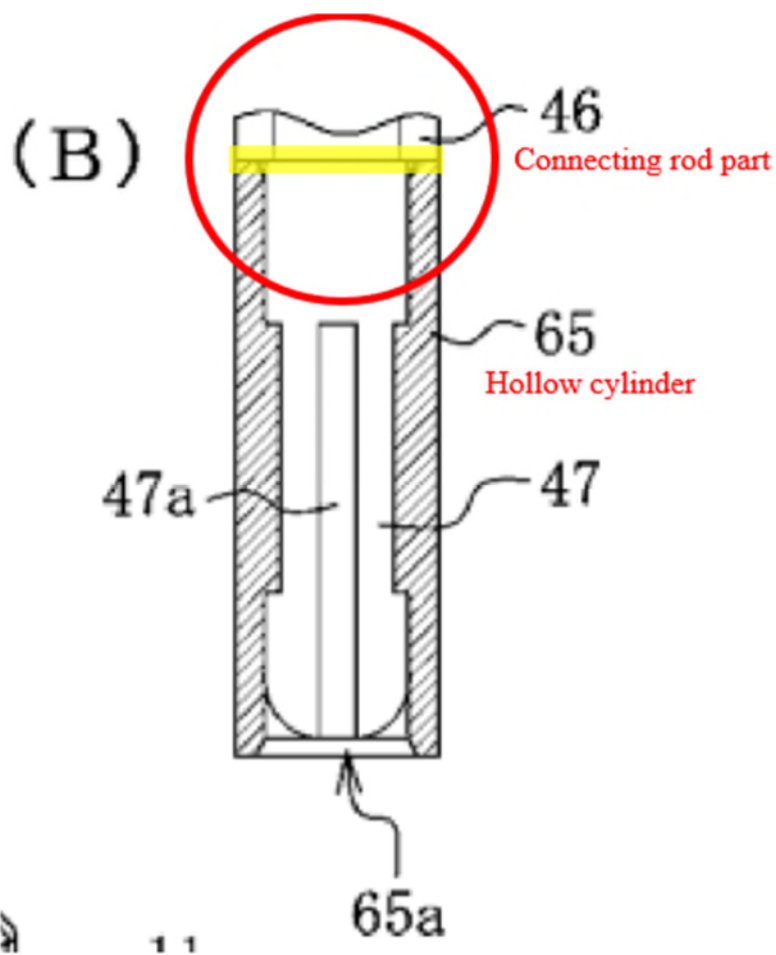
In some embodiments, the protective sleeve 16 may extend to the side of the annular table surface 1422 facing the outer end surface 21 of the core housing 20. When the socket 22 and the plug end 14 of the core housing 20 is plugged and fixed, the protective sleeve 16 may be at least partially filled in the space between the annular table surface 1422 and the outer end surface 21 of the core housing 20, and elastically abut against the core housing 20. Thus, it is difficult for external liquid to enter the inside of the core housing 20 from the junction between the plug end 14 and the core housing 20, thereby realizing the sealing

between the plug end 14 and the socket 22, protecting the earphone core 50, etc. inside the core housing 20, and improving the waterproof effect of the bone conductive MP3 player.

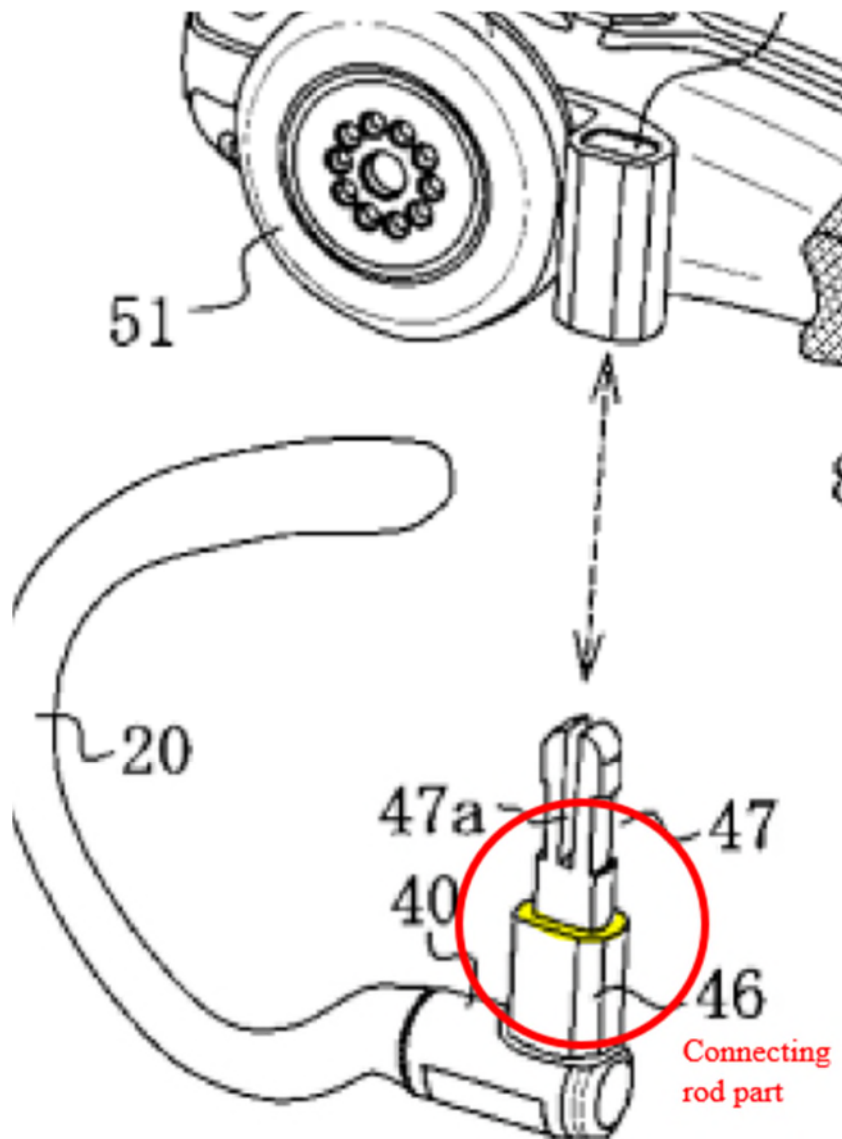
EX1001, 13:12-25.

246. It would have been obvious to a POSITA to construct the *inserting portion* of the *first plug* in the same way to fix a connection with the core housing because that is already how the plug ends disclosed in Li are constructed. Their location is simply moved to both ends of the ear hook (which, again, a POSITA would be motivated to construct as discussed above in [1a]). A POSITA would simply use the same production technique already disclosed in Li, and would be motivated to do so based on the benefits of modular earphone construction already disclosed in Li, as discussed above in [1a], [1c], and §X.K.

247. To the extent not rendered obvious by Li, Numata discloses or renders obvious this limitation. As can be seen, for example, in Figures 8(B) and 9, Numata discloses or renders obvious *an exposed part of the inserting portion* (connecting rod part 46) *is arranged in a stepped manner to form an annular table surface spaced apart from the outer end surface* (annotated in yellow and circled in red in Figures 8(B) and 9) *of the core housing* (Li's core housing, [7a], §XIV.B).



EX1007, Fig. 8(B).



Id., Fig. 9 (excerpt). As shown above in yellow highlight, the shape of the connecting rod part 46 is arranged in a stepped manner to form an annular table surface.

F. Claim 10

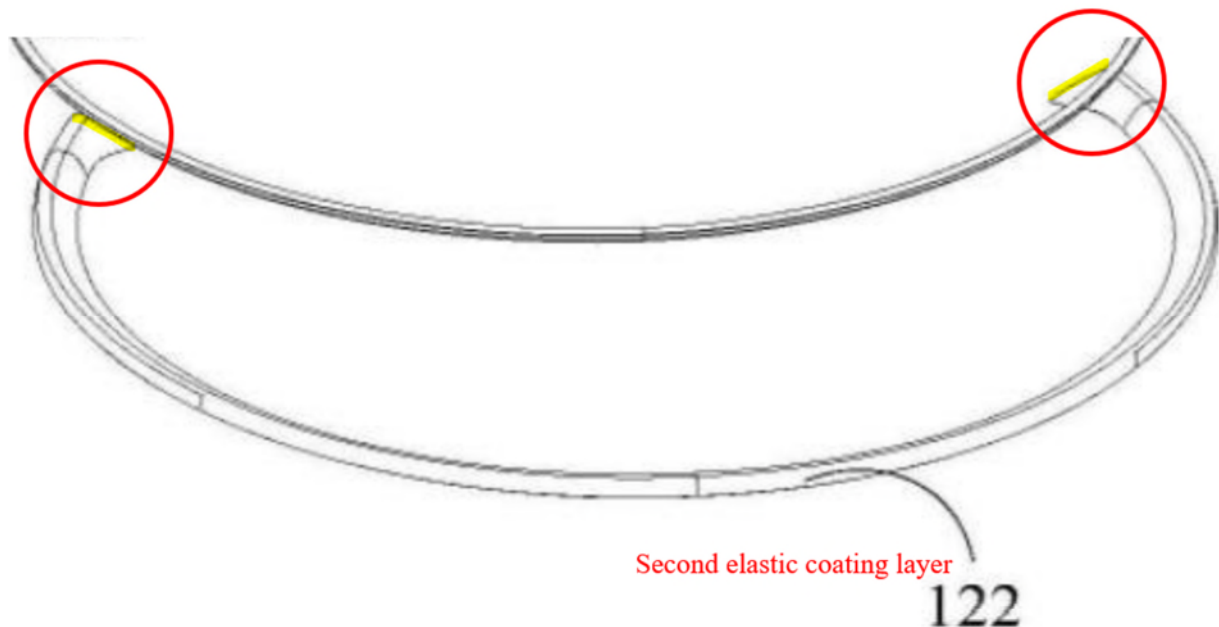
1. [10pre] The loudspeaker apparatus of claim 9, wherein

248. The Li-Fujita-Numata combination renders this limitation obvious.

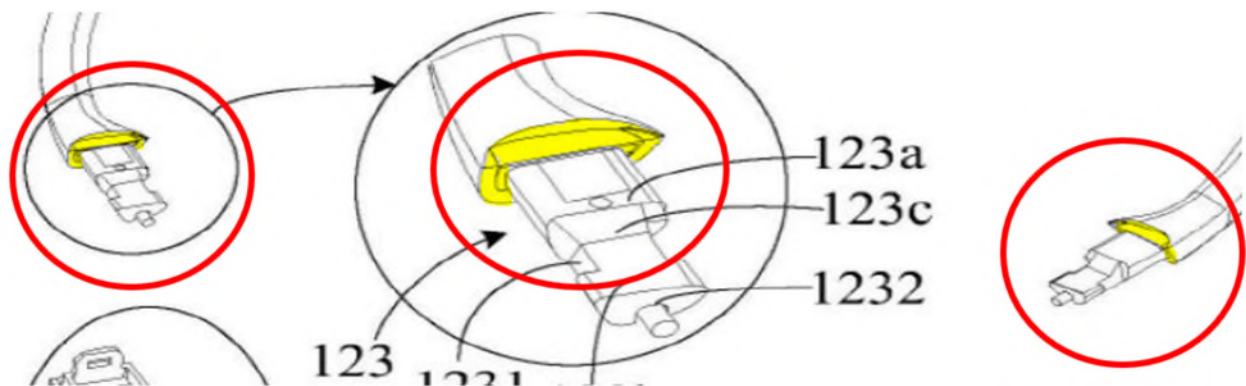
See claim 9.

2. [10a] the protective sleeve further extends to a side of the annular table surface facing the outer end surface of the core housing, and

249. Li and Numata disclose or render this limitation obvious. It would have been obvious to a POSITA to have Li's *protective sleeve* extend to the side of Numata's *annular table surface* because Li already has an analogous *protective sleeve* (second elastic coating layer 122) form an annular table surface shape proximate the plug-in portion 123 as shown above in Figures 2 and 9. As explained in claim 9 above, the second elastic coating layer 122 forms the annular table surface shape proximate the plug-in portion 123 as shown below in Figures 2 and 9.



EX1004, Figure 2 (excerpt).



Id., Figure 9 (excerpt).

250. The second elastic coating layer 122 is a *protective sleeve* because it is “a silicone layer . . . [or] a rubber layer or a latex layer, or a composite material layer including silicone.” *Id.*, [0058]. Because the second elastic coating layer 122 (*protective sleeve*) forms the annular table surface shape (see claim 9), it would

have been obvious for the *protective sleeve to further extend to a side of the Numata annular table surface facing the outer end surface of Li's core housing.*

3. [10b] when the core housing and the first plug end are fixed, the protective sleeve elastically abuts against the core housing to realize sealing.

251. Li discloses or renders obvious this limitation. As explained in [1c], Li renders obvious a *first plug end* elastically abutted against the protective sleeve. As shown below in Figure 2, “[t]he rear hook assembly 12 comprises a second elastic metal wire 121, a second elastic coating layer 122 wrapped around the second elastic metal wire 121, and plug-in portions 123 provided at both ends of the second elastic metal wire 121.” EX1004, Fig. 2, [0058].

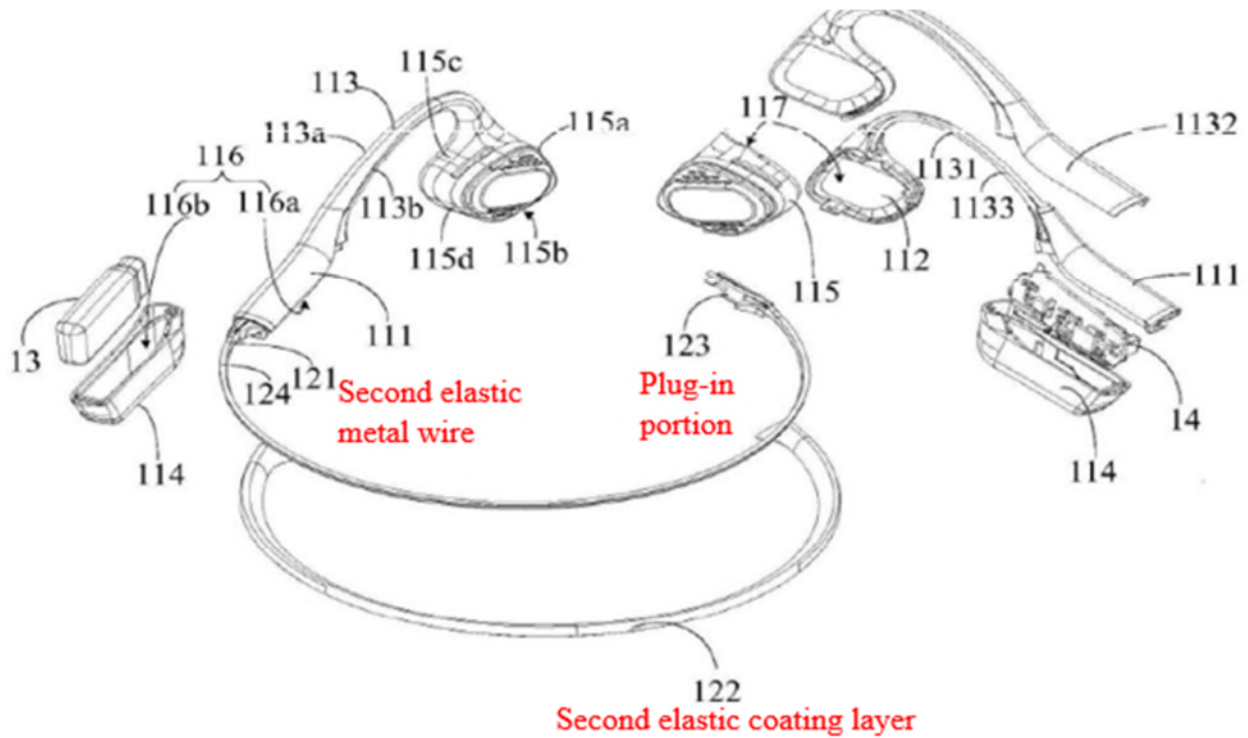


Figure 2

Li, Figure 2

252. The second elastic coating layer 122 may be silicone, rubber, latex, or a composite including silicone. *Id.*, [0058]. As shown in Figure 2, the second elastic coating layer 122 abuts the first elastic coating layer 1132 at the plug-in portion 123. Because Li's first elastic coating layer 1132 abuts the second elastic coating layer 122, Li teaches when the circuit housing and the plug end *are fixed, the protective sleeve* (second elastic coating layer 122) *elastically abuts against the circuit housing to realize sealing.*

253. It therefore would have been obvious to a POSITA *when the core housing and the first plug end are fixed, the protective sleeve elastically abuts*

against the core housing to realize sealing, including for the same reasons discussed above in [1c] (*a core housing for accommodating an earphone core, the core housing being fixed to the first plug end and elastically abutted against the protective sleeve*). Li is designed to “ensure a tight fit” between the plug and the socket. *Id.*, [0062]-[0063]. Li’s device also teaches waterproofing, including by using its *protective sleeve* to “protect the housing and internal components, making the bone conduction earphone more wear-resistant.” *Id.*, [0036]; *see, e.g., id.*, [0037], [0056], [0071]. A POSITA would have understood that when the *core housing* and the *first plug end* are fixed, the protective sleeve elastically abuts against the core housing to realize sealing in order to contribute to the waterproofing of the device. *Id.*

XV. GROUND 5: LI, FUJITA, WANG, XU, NIELSEN, AND THE KNOWLEDGE OF A POSITA RENDER OBVIOUS CLAIMS 16-20

254. As shown below, Li, Fujita, Wang, Xu, and Nielson in view of the knowledge of a POSITA, render claims 16-20 obvious.

A. Motivation to Combine Li and Fujita

255. It would have been obvious to a POSITA to combine Li with Fujita for the reasons discussed above in §XI.A.

B. Motivation to Combine Li-Fujita with Wang, Xu, and Nielsen

256. Moreover, it would have been obvious to a POSITA to further modify the Li-Fujita combination with magnetic circuit components and orientations

disclosed in Wang, Xu, and Nielsen—and for a POSITA to use the Wang, Xu, and Nielsen components and orientations between those three references (*see infra* [17b], [20a])—and a POSITA would have been motivated to do so.

257. As discussed above regarding the motivation to combine Li-Fujita with Fukuda (§XII.B), magnetic circuit systems were commonly found in speakers at the time of Li and Fujita, including bone conduction speakers at the time of Li, in order to provide efficient, high-quality sound to the user. EX1005, [0052], [0053] (using “high-density permanent magnets” in bone conduction speaker achieves “better sound quality”), [0143], [0145], [0148]-[0152], [0171], Figures 11, 18-A, 18-B, 22-A; EX1023, 3:6-28 (improved bone conduction speaker design with a magnetic circuit system that is “simple in construction, allowing the manufacturing cost to be held at a minimum, and yet is completed as an independent unit with minimized sound leakage”); EX1018, Abstract, Fig. 2(b), [0016]-[0029] (compact speaker design with strong electromagnetic attractive force). Wang, Xu, and Nielsen all offer improved magnetic circuit systems for use in loudspeakers. EX1008, Abstract; EX1009, Abstract, [0005]; EX1010, 4:1-12. For example, Wang solves issues related to efficiency of the magnetic circuit. EX1008, [0005]. Xu addresses problems in the structure of magnetic circuit systems that result in low magnetic flux density in a micro loudspeaker and a smaller magnetic field force acting on the voice coil, resulting in low sensitivity and poor overall acoustic performance.

EX1009, [0002]-[0003]. And Nielsen is directed to improving the performance of the magnet system in a speaker, including by creating a homogenous magnetic flux in the gap intended for the voice coil and providing a magnet system which has less distortion even after extended continuous use, and at the same time provides a compact design. EX1010, 4:1-12.

258. A POSITA at the time would understand that the sound quality of a magnetic speaker driver like Wang, Xu, and Nielsen is generally higher than that of a piezoelectric driver, and further more that it is easier to fine tune the frequency response of a magnetic driver to achieve the desired performance. Therefore, a POSITA would have looked to Wang, Xu, and Nielsen to improve the speaker in the Li-Fujita earphones with a magnetic circuit system vibration mechanism in place of the piezoelectric mechanism in order to provide the benefits of a magnetic circuit system, such as efficient, high-quality sound, as well as a simple construction. A POSITA would look to Wang, Xu, and Nielsen for inspiration and improvement of the Li-Fujita earphone speakers. A POSITA would have recognized the benefit of Wang, Xu, and Nielsen's improvements, motivating the combinations.

259. Therefore, a POSITA would have looked to Wang, Xu, and Nielsen to improve the speaker in the Li-Fujita earphones with a magnetic circuit system vibration mechanism in place of the piezoelectric mechanism in Fujita in order to provide the benefits of a magnetic circuit system, such as efficient, high-quality

sound, and simple construction, as well as to provide the best design of a magnetic circuit system with the strongest, most efficient magnetic field. Wang, Xu, and Nielsen are all in the same field of speaker technology involving magnetic circuit systems, and a POSITA would therefore look to the references for inspiration and improvement of the Li-Fujita earphone speakers. Accordingly, a POSITA would find the components and orientations of the magnetic speaker systems in Wang, Xu, and Nielsen to be interoperable with one another, and a POSITA would have recognized the benefit of their improvements, motivating their combination with the Li-Fujita earphones and with one another.

260. Combining Li, Fujita, Wang, Xu, and Nielsen would simply involve applying known techniques (*i.e.*, magnetic circuit speaker design and construction) to a known device ready for improvement (Li-Fujita's bone conduction speaker) to yield predictable results (bone conduction speakers with an improved magnetic circuit system). A POSITA would have had a reasonable expectation of success in the combinations because the Li-Fujita earphones already disclose bone conduction speakers, it was known in the art to use magnetic circuit systems in such speakers, and Wang, Xu, and Nielsen all disclose the use of improved magnetic circuit systems in speakers. A POSITA thus would have had a reasonable expectation that the modification of Li-Fujita with Wang, Xu, and Nielsen would be successful because a POSITA would have found that the teachings of Li-Fujita with Wang, Xu,

and Nielsen could have been predictably combined due to the predictability of the art of speakers with magnetic circuit systems and the known interchangeability of the various elements, including the components of manufacture.

261. If Patent Owner argues the portions of Wang, Xu, and Nielsen cited below relate to different, incompatible embodiments (which they do not), it would have been obvious to a POSITA to combine such embodiments into a single device at least because such embodiments are described in the same prior art reference, are fully compatible with each other, and could be combined with minimal effort to achieve predictable results.

262. Therefore, a POSITA would have considered it obvious to modify the Li-Fujita earphones with the components and orientations of the magnetic circuit systems in Wang, Xu, and Nielsen for the benefits described above.

C. Claim 16

1. [16pre] The loudspeaker apparatus of claim 1,

263. The Li-Fujita combination renders obvious the loudspeaker apparatus of claim 1. *See* claim 1.

2. [16a] wherein the earphone core further includes a magnetic circuit component generating a first magnetic field

264. The Li-Fujita-Wang combination renders this limitation obvious. Wang discloses or renders obvious *a magnetic circuit component generating a first*

magnetic field: “The ***magnetic circuit system 11 is configured to generate a magnetic field***, and the vibration system 12 is driven in the magnetic field to produce vibrations, thereby emitting sound.” EX1008, [0018], Figures 1, 3. A POSITA would have understood that the magnetic fields generated by all components of Wang’s magnetic circuit system, including the four components annotated below in Figure 3 (second main pole core 113, second main magnetic steel 114, magnetic yoke 110, secondary magnetic steel 115), generate *a first magnetic field*. *Id.*; EX1001, 25:64-26:45, Fig. 16.

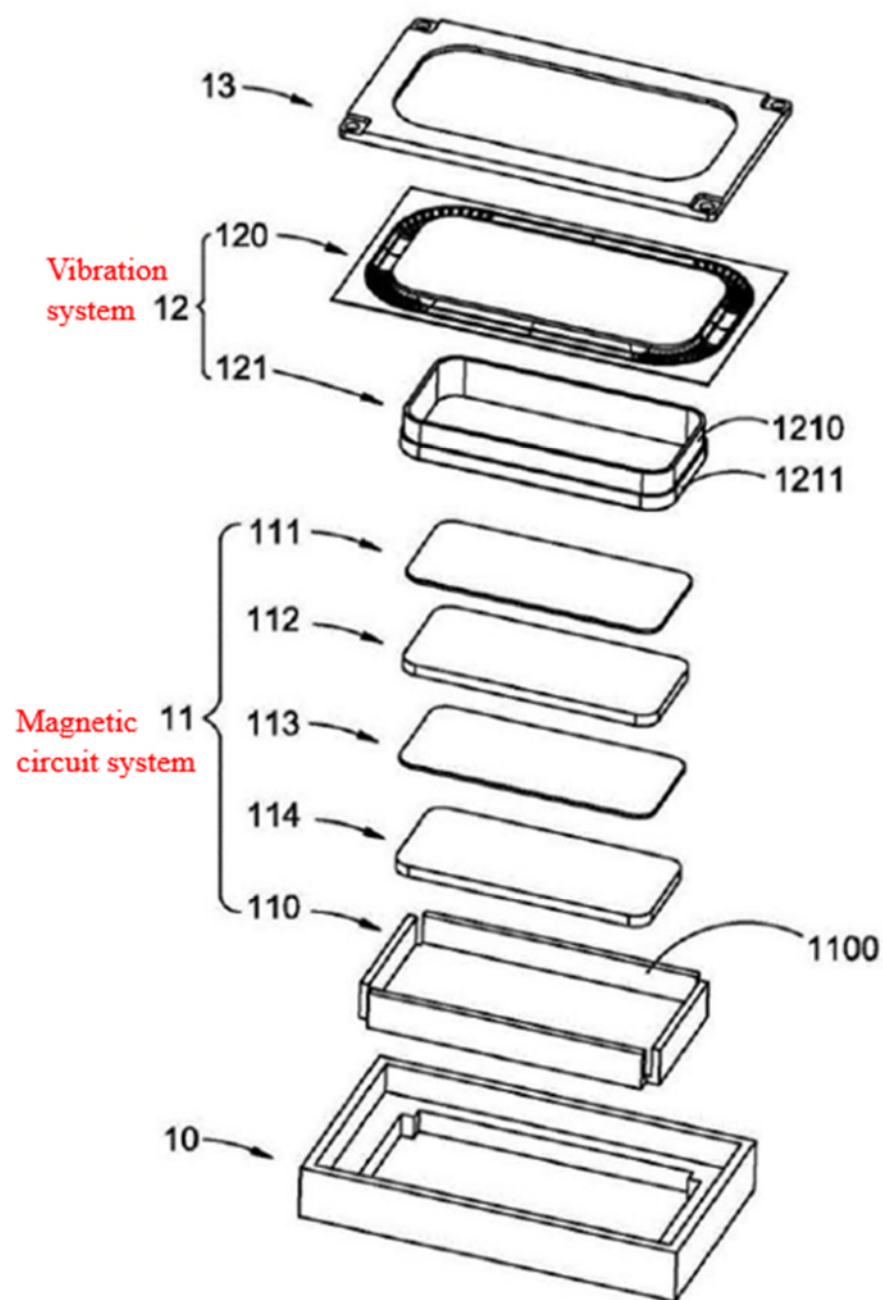
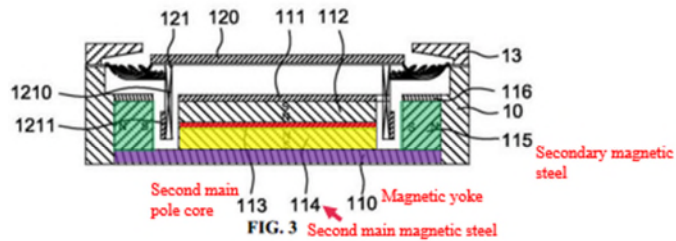


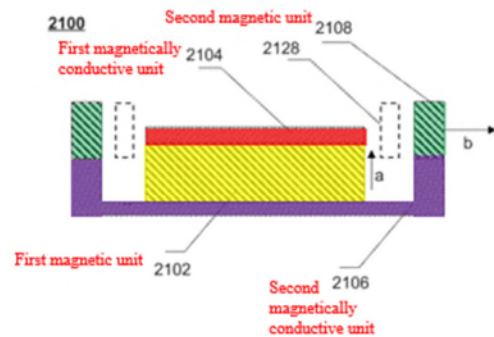
FIG. 1

Wang, Figure 1

EX1008, Fig. 1.



Wang, Figure 3



'084 Patent, Figure 16

EX1008, Fig. 3; EX1001, Fig. 16.

265. The Li-Fujita-Xu combination also renders this limitation obvious. Xu discloses or renders obvious *a magnetic circuit component generating a first magnetic field*: “As shown in FIG. 1 and FIG. 2 together, a micro loudspeaker, comprising a housing 10. The housing 10 accommodates a vibration system and *a magnetic circuit system*. The magnetic circuit system has a circular structure.” EX1009, [0026], Figures 1-2. A POSITA would have understood that the magnetic fields generated by all components of Xu’s magnetic circuit system, including inner magnet 320, inner spring washer 340, magnetic conductive plate 30, and outer annular magnet 362, annotated below, generate *a first magnetic field*. *Id.*; EX1001, 25:64-26:45, Fig. 16.

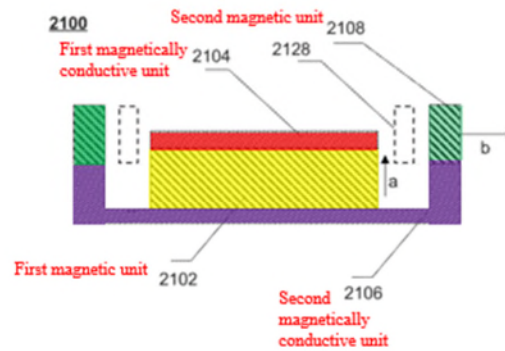
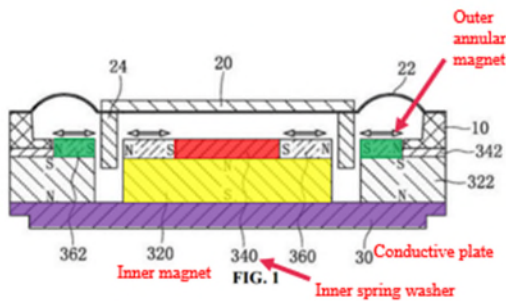


FIG. 16

EX1009, Fig. 1; EX1001, Fig. 16.

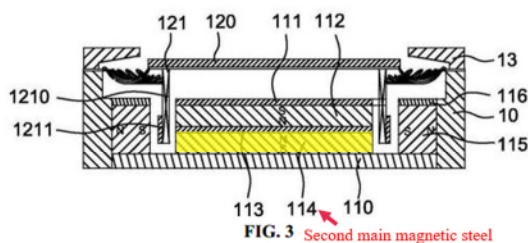
3. [16b] the magnetic circuit component including: a first magnetic unit configured to generate a second magnetic field;

266. The Li-Fujita-Wang combination renders this limitation obvious. Wang discloses or renders obvious *the magnetic circuit component* (see [16a]) *including: a first magnetic unit configured to generate a second magnetic field* (second main magnetic steel 114):

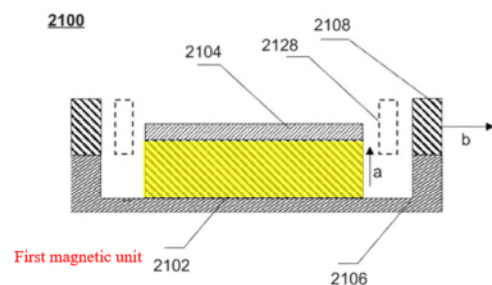
The magnetic circuit system 11 comprises a magnetic yoke 110 secured to the bobbin 10 and a series of components superimposed from top to bottom at the central position of the magnetic yoke 110: a first main pole core 111, a first main magnetic steel 112, a second main pole core 113, a **second main magnetic steel 114**, and continuing up to the nth main pole core and nth main magnetic steel.

EX1008, [0020]. The second main magnetic steel 114 is highlighted in yellow below.

267. A POSITA would have understood that second main magnetic steel 114 is *configured to generate a second magnetic field*, which would be different than the *first magnetic field* generated by the entire unit. *Id.*; EX1001, 25:64-26:45 (“In some embodiments, the magnetic circuit component 2100 may generate a first full magnetic field (also referred to ‘total magnetic field of magnetic circuit component’ or ‘first magnetic field’). The first magnetic unit 2102 may generate a second magnetic field. . . . The magnetic field strength of the first full magnetic field in the magnetic gap (also referred to as magnetic induction strength or magnetic flux density) may be greater than the magnetic field strength of the second magnetic field in the magnetic gap.”), Fig. 16.



Wang, Figure 3

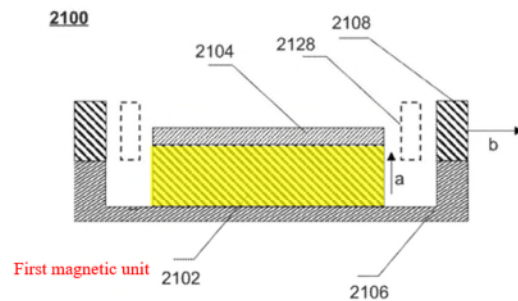
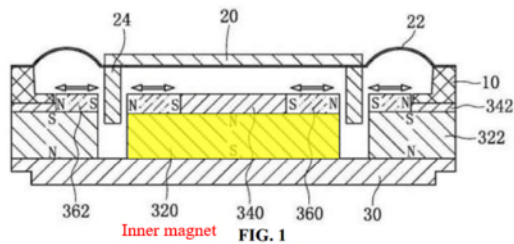


'084 Patent, Figure 16

268. The Li-Fujita-Xu combination also renders this limitation obvious. Xu discloses or renders obvious *the magnetic circuit component (see [16a]) including: a first magnetic unit configured to generate a second magnetic field (inner magnet 320):*

As shown in Fig. 1 and Fig. 2 together, a micro loudspeaker, comprising a housing 10. The housing 10 accommodates a vibration system and a magnetic circuit system. The magnetic circuit system has a circular structure. The magnetic circuit system comprises a magnetic conductive component, which in the embodiment is a magnetic conductive plate 30. A first magnet and a spring washer are sequentially secured on the magnetic conductive plate 30, with the magnetization direction of the first magnet being vertical. The first magnet comprises ***an inner magnet 320*** secured at the center of the magnetic conductive plate 30 and an outer magnet 322 secured at the edge of the magnetic conductive plate 30. . . . The ***inner magnet 320*** and the inner spring washer 340 form the inner magnetic circuit of the magnetic circuit system, while the outer magnet 322 and the outer spring washer 342 form the outer magnetic circuit of the magnetic circuit system. There is a magnetic gap between the inner magnetic circuit and outer magnetic circuit, and the end of the voice coil 24 of the vibration system is located within the magnetic gap.

EX1009, [0026]. The inner magnet 320 is annotated in yellow below. A POSITA would understand inner magnet 320 is *configured to generate a second magnetic field*, which would be different than the *first magnetic field* generated by the entire unit. *Id.*; EX1001, 25:64-26:45, Fig. 16.



EX1009, Fig. 1; EX1001, Fig. 16.

4. [16c] a first magnetically conductive unit; and

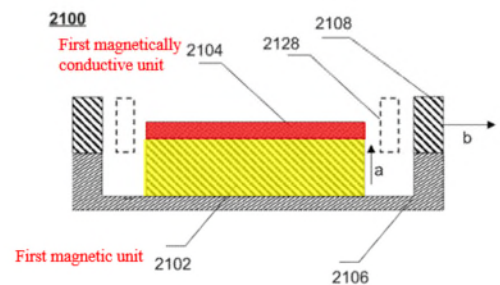
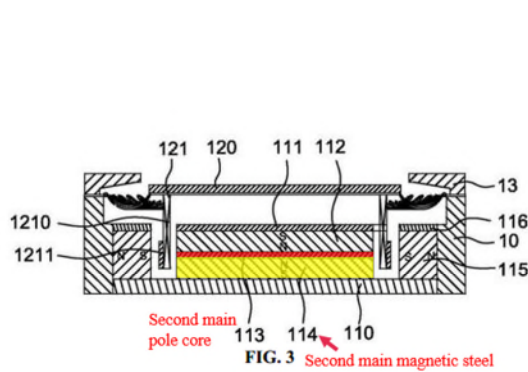
269. The Li-Fujita-Wang combination renders this limitation obvious.

Wang's second main pole core 113 (red below) constitutes *a first magnetically conductive unit*:

The magnetic circuit system 11 comprises a magnetic yoke 110 secured to the bobbin 10 and a series of components superimposed from top to bottom at the central position of the magnetic yoke 110: a first main pole core 111, a first main

magnetic steel 112, **a second main pole core 113**, a second main magnetic steel 114, and continuing up to the nth main pole core and nth main magnetic steel.

EX1008, [0020]. The second main pole core 113 is annotated in red below.



Wang, Figure 3

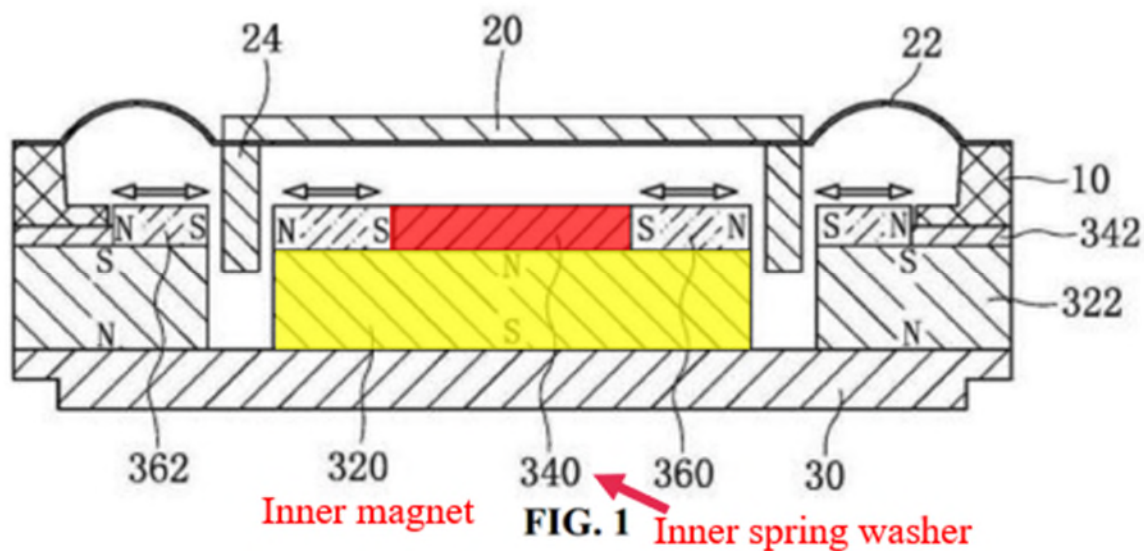
'084 Patent, Figure 16

270. The Li-Fujita-Xu combination also renders this limitation obvious. Xu discloses or renders obvious *a first magnetically conductive unit* (inner spring washer 340):

The magnetic circuit system comprises a magnetic conductive component, which in the embodiment is a magnetic conductive plate 30. A first magnet and a spring washer are sequentially secured on the magnetic conductive plate 30, with the magnetization direction of the first magnet being vertical. The first magnet comprises an inner magnet 320 secured at the center of the magnetic conductive plate 30 and an outer magnet 322

secured at the edge of the magnetic conductive plate 30. The spring washer comprises an **inner spring washer 340** secured on the inner magnet 320 and an outer spring washer 342 secured on the outer magnet 322. The inner magnet 320 and the **inner spring washer 340** form the inner magnetic circuit of the magnetic circuit system, while the outer magnet 322 and the outer spring washer 342 form the outer magnetic circuit of the magnetic circuit system.

EX1009, [0026]. The inner spring washer 340 is annotated in red below.



Id., Fig. 1.

5. [16d] at least one second magnetic unit, the at least one second magnetic unit surrounding the first magnetic unit and forming a magnetic gap with the first magnetic unit, a magnetic field strength of the first magnetic field in the

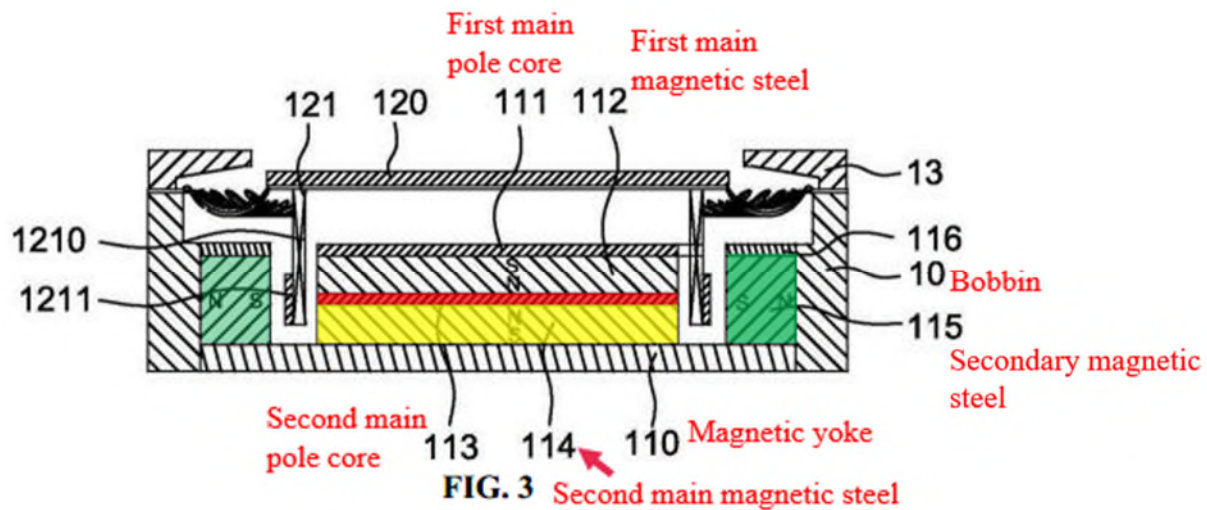
magnetic gap being greater than a magnetic field strength of the second magnetic field in the magnetic gap.

271. The Li-Fujita-Wang combination renders this limitation obvious.

Wang discloses or renders obvious *at least one second magnetic unit* (a secondary magnetic steel 115):

To increase the BL value of the magnetic circuit system, in another embodiment, as shown in Fig. 3, the magnetic circuit system 11 is further arranged with **a secondary magnetic steel 115** arranged on the magnetic yoke 110 and surrounding the voice coil 121, and a secondary pole core 116 attached to the surface of the **secondary magnetic steel 115**. This dual magnetic circuit design aims to increase the BL value of the magnetic circuit system 11. The magnetic poles of the secondary magnetic steel 115 are arranged horizontally, and the magnetic pole at one end of the secondary magnetic steel 115, which is close to the main magnetic steel, is different from the corresponding magnetic pole of the adjacent main magnetic steel. In the embodiment, the N poles of the first main magnetic steel 112 and the second main magnetic steel 114 are arranged oppositely, so the magnetic pole of the secondary magnetic steel 115 close to the first main magnetic steel 112 and the second main magnetic steel 114 is S pole.

EX1008, [0022]. The secondary magnetic steel 115 is annotated in green below.



Id., Fig. 3.

272. The secondary magnetic steel 115, as can be seen in Figure 3, surrounds second main magnetic steel 114 (*the first magnetic unit*) and forms a magnetic gap with it. Wang also discloses:

[t]o increase the BL value of the magnetic circuit system, in another embodiment, as shown in Fig. 3, the magnetic circuit system 11 is further arranged with a secondary magnetic steel 115 arranged on the magnetic yoke 110 and surrounding the voice coil 121, and a secondary pole core 116 attached to the surface of the secondary magnetic steel 115.

EX1008 at [0022].

273. The orientation of secondary magnetic steel 115 and second main magnetic steel 114 aligns with the orientation of the '084 Patent's claimed *second*

magnetic unit surrounding the first magnetic unit and forming a magnetic gap with the first magnetic unit. Compare EX1008, Figure 3 with EX1001, Figure 16.

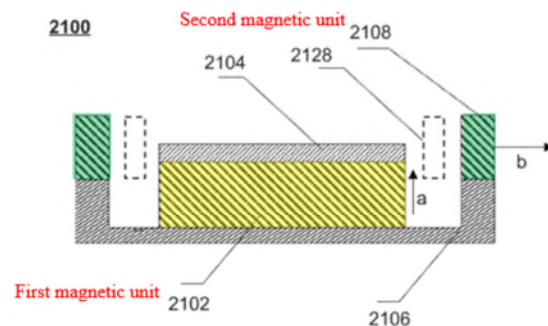
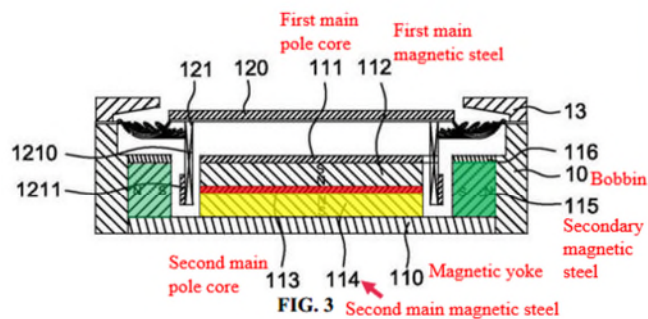


FIG. 16

A POSITA would have therefore understood that Wang disclosed *a magnetic field strength of the first magnetic field in the magnetic gap* (the magnetic field strength of magnetic circuit system 11 as a whole) *being greater than a magnetic field strength of the second magnetic field in the magnetic gap.*

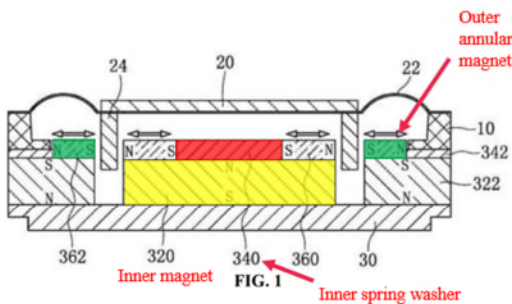
274. The Li-Fujita-Xu combination also renders this limitation obvious.

Xu's outer annular magnet 362 (green below) constitutes *at least one second magnetic unit*:

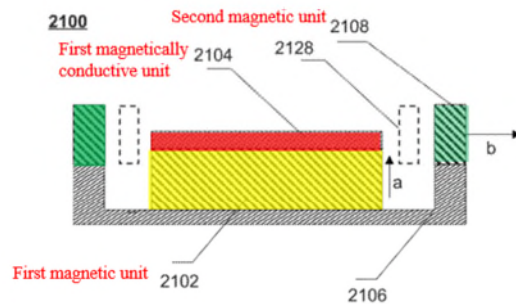
The second magnet comprises an inner annular magnet 360 secured on the inner magnet 320, as well as an ***outer annular magnet 362*** secured on the outer magnet 322. The inner annular

magnet 360 is secured at the edge of the inner magnet 320 that is close to the magnetic gap, with the inner spring washer 340 located on the inner side of the inner annular magnet 360. The **outer annular magnet 362** is secured at the edge of the outer magnet 322 that is close to the magnetic gap, with the outer spring washer 342 surrounding the outer side of the **outer annular magnet 362**.

EX1009, [0027]. The outer annular magnet 362 is annotated in green below.



Xu, Figure 1



'084 Patent, Figure 16

275. The outer annular magnet 362, as can be seen in Figure 1, surrounds inner magnet 320 (*the first magnetic unit*) and forms a magnetic gap with it. The orientation of outer annular magnet 362 and inner magnet 320 aligns with the orientation of the '084 Patent's claimed *second magnetic unit surrounding the first*

magnetic unit and forming a magnetic gap with the first magnetic unit. Compare EX1009, Figure 1 with EX1001, Figure 16.

276. Xu also discloses that the orientation of the poles of outer annular magnet 362 and inner magnet 320 result in “the magnetic field of the first magnet and the magnetic field of the second magnet will be superimposed and be directed to the position of the magnetic gap. . . . [T]his **increases the magnetic flux density at the magnetic gap**, significantly increasing the number of magnetic lines of force passing through the voice coil 24.” EX1009 at [0028]; *compare* EX1009, Figure 1 with EX1001, Figure 16. A POSITA would therefore would have understood that Wang discloses *a magnetic field strength of the first magnetic field in the magnetic gap* (the magnetic circuit system as a whole) *being greater than a magnetic field strength of the second magnetic field in the magnetic gap*.

D. Claim 17

1. [17pre] The loudspeaker apparatus of claim 16,

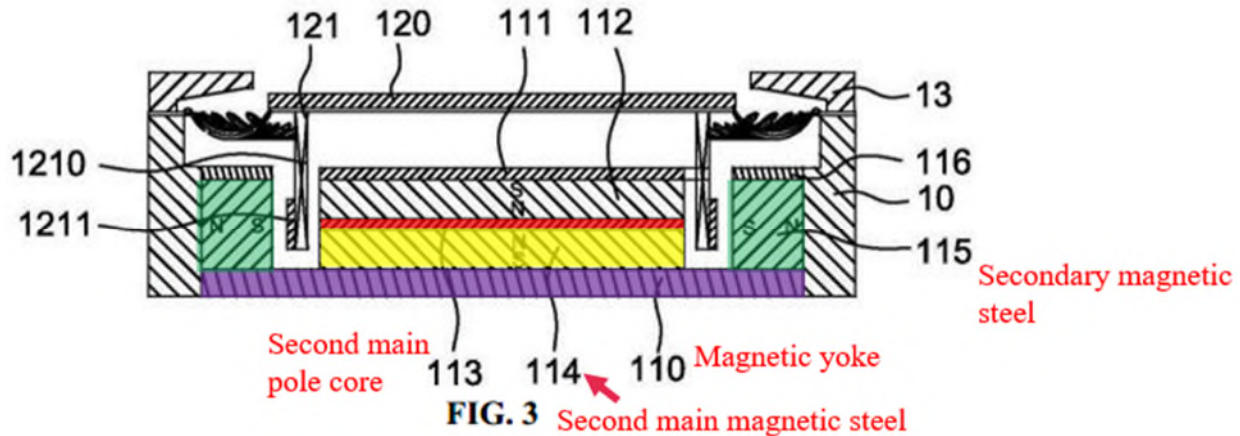
277. The Li-Fujita-Wang or Li-Fujita-Xu combinations render this limitation obvious. See claim 16.

2. [17a] wherein the magnetic circuit component further includes: a second magnetically conductive unit; and

278. The Li-Fujita-Wang combination renders this limitation obvious. Wang discloses or renders obvious *the magnetic circuit component* (see [16a]) *further includes: a second magnetically conductive unit* (magnetic yoke 110):

The magnetic circuit system 11 comprises a **magnetic yoke 110** secured to the bobbin 10 and a series of components superimposed from top to bottom at the central position of the magnetic yoke 110: a first main pole core 111, a first main magnetic steel 112, a second main pole core 113, a second main magnetic steel 114, and continuing up to the nth main pole core and nth main magnetic steel.

EX1008, [0020]. The magnetic yoke 110 is annotated in purple below.



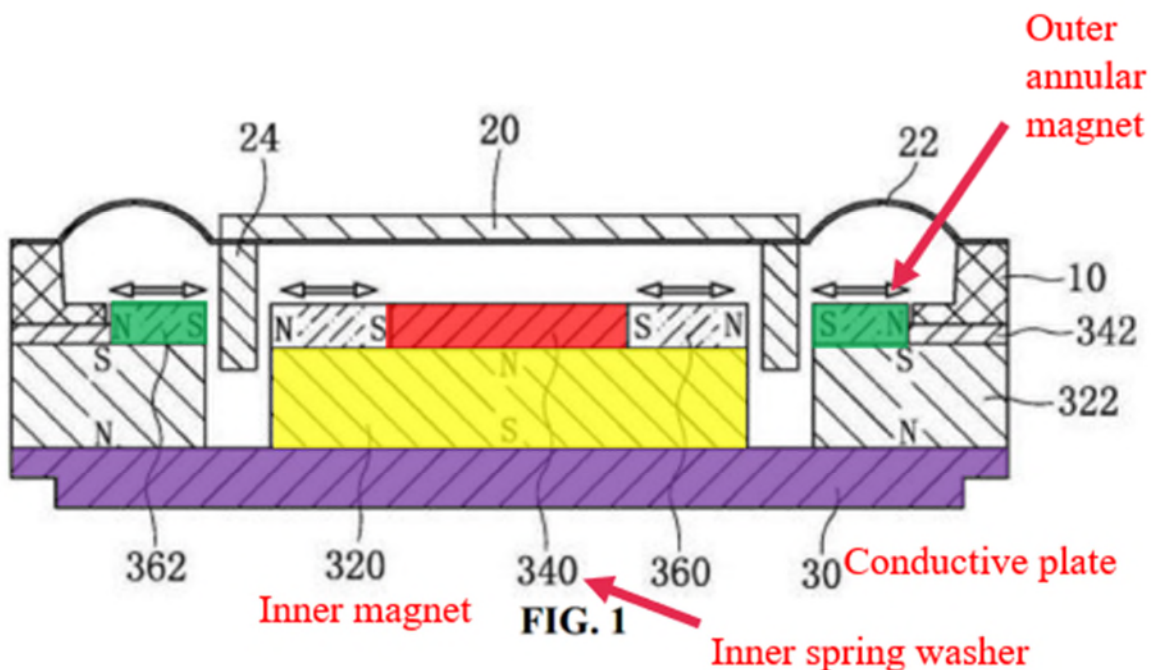
Id., Fig. 3.

279. The Li-Fujita-Xu combination also renders this limitation obvious. Xu discloses or renders obvious *the magnetic circuit component (see [16a]) further includes: a second magnetically conductive unit* (magnetic conductive plate 30- purple below):

The magnetic circuit system comprises a magnetic conductive component, which in the embodiment is a **magnetic conductive plate 30**. A first magnet and a spring washer are sequentially

secured on the magnetic conductive plate 30, with the magnetization direction of the first magnet being vertical. The first magnet comprises an inner magnet 320 secured at the center of the magnetic conductive plate 30 and an outer magnet 322 secured at the edge of the **magnetic conductive plate 30**.

EX1009, [0026]. The magnetic conductive plate 30 is annotated in purple below.



Id., Fig. 1.

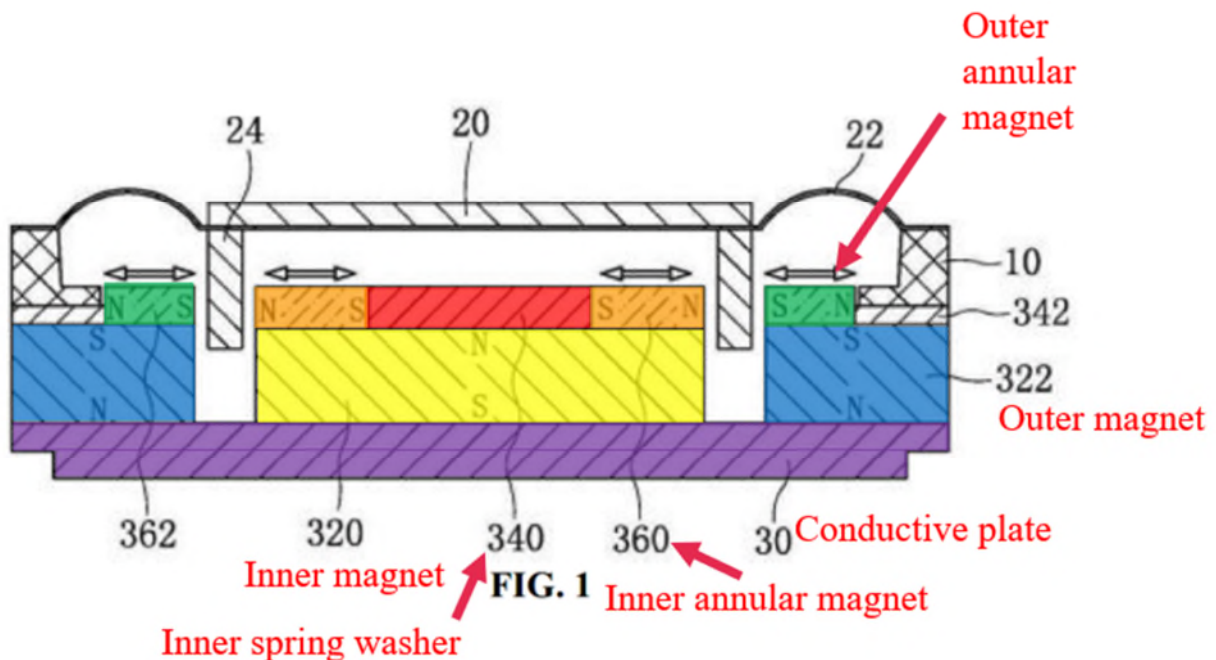
3. [17b] at least one third magnetic unit being connected to the second magnetically conductive unit and the at least one second magnetic unit.

280. The Li-Fujita-Xu combination renders this limitation obvious. Xu discloses or renders obvious *at least one third magnetic unit* (outer magnet 322,

annotated in blue) *being connected to the second magnetically conductive unit* (magnetic conductive plate 30, annotated in purple) *and the at least one second magnetic unit* (outer annular magnet 362, annotated in green):

The magnetic circuit system comprises a magnetic conductive component, which in the embodiment is a magnetic conductive plate 30. A first magnet and a spring washer are sequentially secured on the magnetic conductive plate 30, with the magnetization direction of the first magnet being vertical. The first magnet comprises an inner magnet 320 secured at the center of the magnetic conductive plate 30 and an **outer magnet 322** secured at the edge of the magnetic conductive plate 30.

EX1009, [0026]. The outer magnet 322 is annotated in blue below.



Id., Fig. 1.

E. Claim 18

1. [18pre] The loudspeaker apparatus of claim 17,

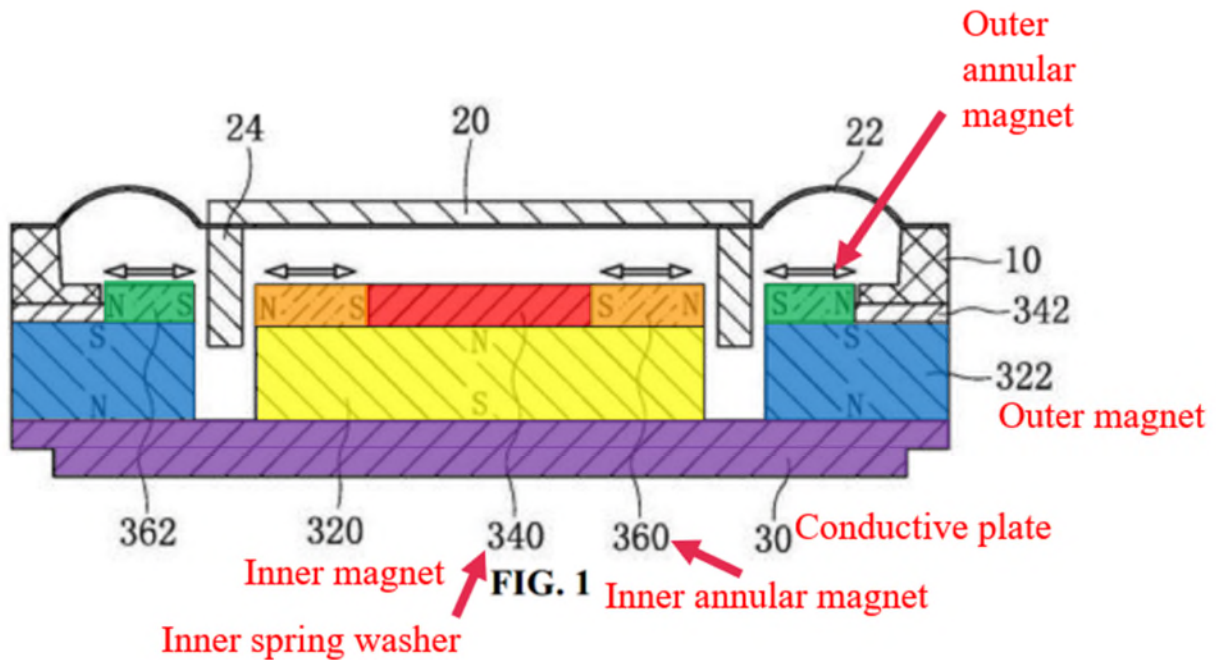
281. The Li-Fujita-Xu combination or Li-Fujita-Wang combination renders *the loudspeaker apparatus of claim 17* obvious. See claim 17.

2. [18a] wherein the magnetic circuit component further includes: at least one fourth magnetic unit being located below the magnetic gap and connected to the first magnetic unit and the second magnetically conductive unit.

282. The Li-Fujita-Xu combination renders this claim element obvious. Xu discloses or renders obvious *one fourth magnetic unit* (inner annular magnet 360, annotated in orange below) that is *connected to the first magnetic unit* (inner magnet 320, annotated in yellow below):

The second magnet comprises an ***inner annular magnet 360*** secured on the inner magnet 320, as well as an outer annular magnet 362 secured on the outer magnet 322. The ***inner annular magnet 360*** is secured at the edge of the inner magnet 320 that is close to the magnetic gap, with the inner spring washer 340 located on the inner side of the ***inner annular magnet 360***.

EX1009, [0027]. The inner annular magnet 360 is highlighted in orange below.

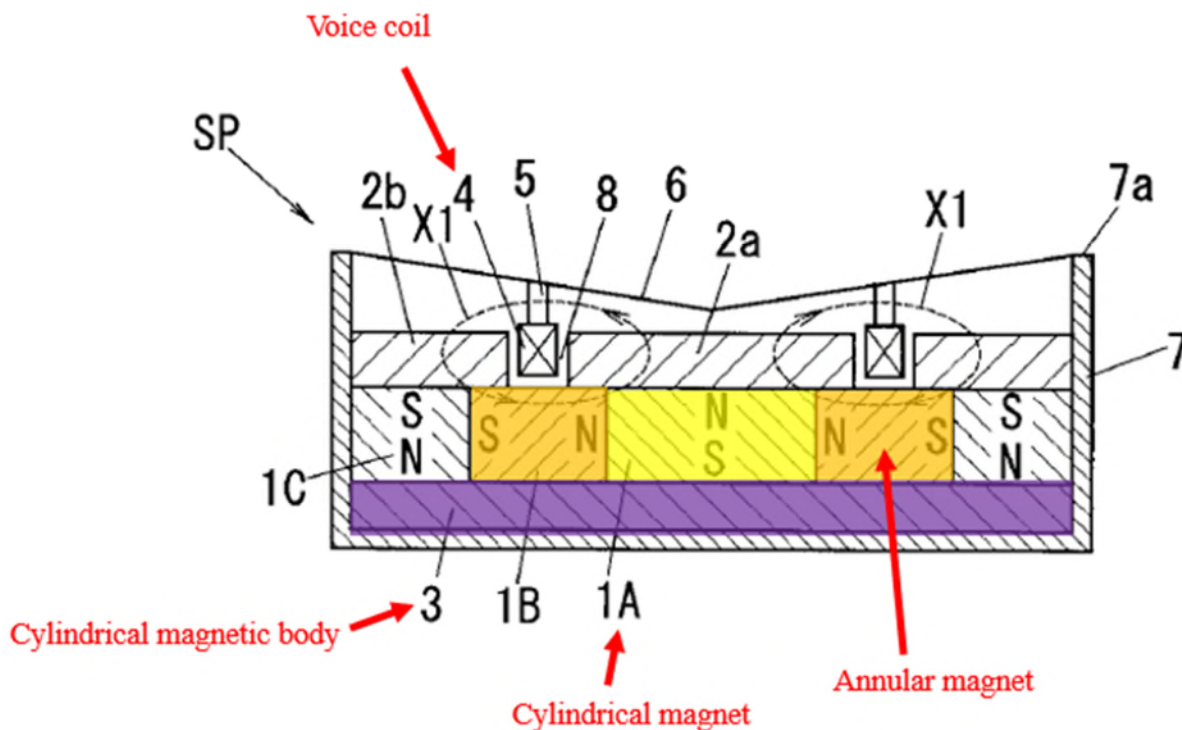


Id., Fig. 1.

283. A POSITA would have found it obvious to reorient inner annular magnet 360 to be *below the magnetic gap* and *connected to . . . the second magnetically conductive unit* (magnetic conductive plate 30, annotated in purple) because such a modification of Xu requires just a simple reorientation of the same components that a POSITA would have considered as another way to generate a strong magnetic field in Xu's magnetic circuit component. Xu already teaches orienting inner annular magnet 360 close to the magnetic gap, so such a reorientation of the magnet would have been obvious to a POSITA to try.

284. For example, in Nakada, another piece of magnetic speaker prior art to the '084 Patent, *one fourth magnetic unit being located below the magnetic gap* (first annular magnet 1B, annotated in orange below) is *connected to the first magnetic unit* (cylindrical magnet 1A, annotated in yellow below) *and the second magnetically conductive unit* (cylindrical magnetic body 3, annotated in purple).

EX1018, Fig. 2(b), [0018]-[0029].



Nakada, Figure 2(b)

285. Nakada teaches the benefit of such orientation as such: “[T]he first annular magnet 1B is present in the gap between the two conventional magnets. Therefore, the volume of the magnet increases, the magnetic energy also increases,

and the magnetic flux linked with the voice coil increases. Thus, the electromagnetic force acting on the voice coil 4 increases. As a result, the output power improves, and miniaturization can be achieved under the same output conditions compared to the conventional method.” EX1018, [0026]. A POSITA would understand that it is small, compact speaker designs like Nakada that still allow for strong electromagnetic attractive force due to the placement of components like first annular magnet 1B. *Id.*, Abstract, Fig. 2(b), [0016]-[0029]. It therefore would have been obvious for a POSITA to orient Xu’s inner annular magnet 360 in the same way as Nakada’s first annular magnet 1B to achieve the same known benefits of increasing magnetic energy and the number of magnetic fluxes to Xu’s voice coil while improving the compact size and output efficiency of the device.

286. Therefore, the Li-Fujita-Xu combination renders this claim element obvious.

F. Claim 19

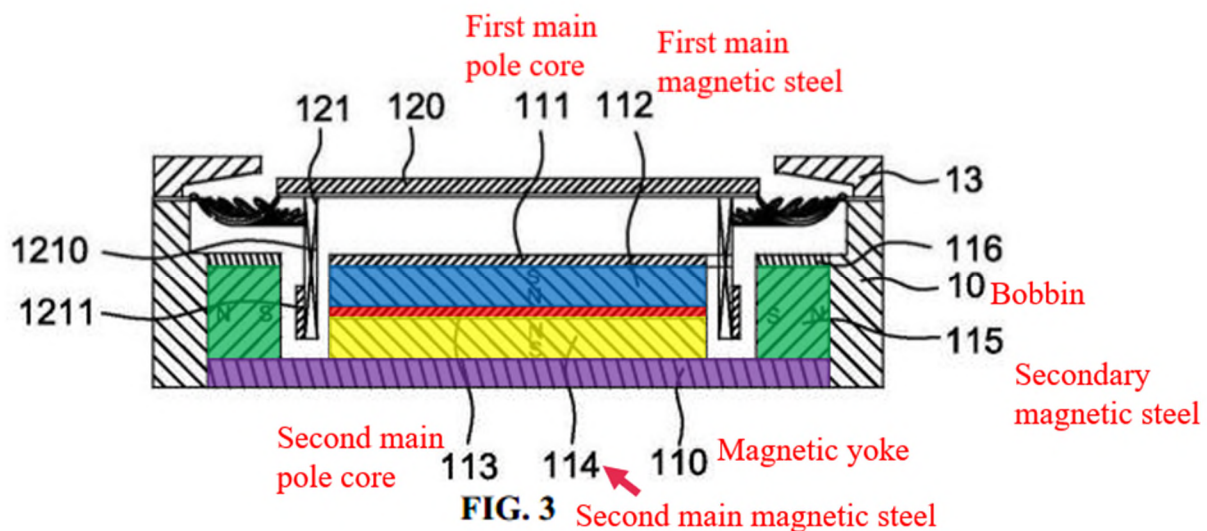
1. [19pre] The loudspeaker apparatus of claim 17, wherein

287. The Li-Fujita-Xu combination or Li-Fujita-Wang combination renders *the loudspeaker apparatus of claim 17* obvious. See claim 17.

2. [19a] the first magnetically conductive unit is connected to the upper surface of the first magnetic unit,

288. The Li-Fujita-Wang combination renders this claim element obvious.

Wang discloses or renders obvious that *the first magnetically conductive unit* (second main pole core 11, annotated in red below) *is connected to the upper surface of the first magnetic unit* (second main magnet steel 114, annotated in yellow below).



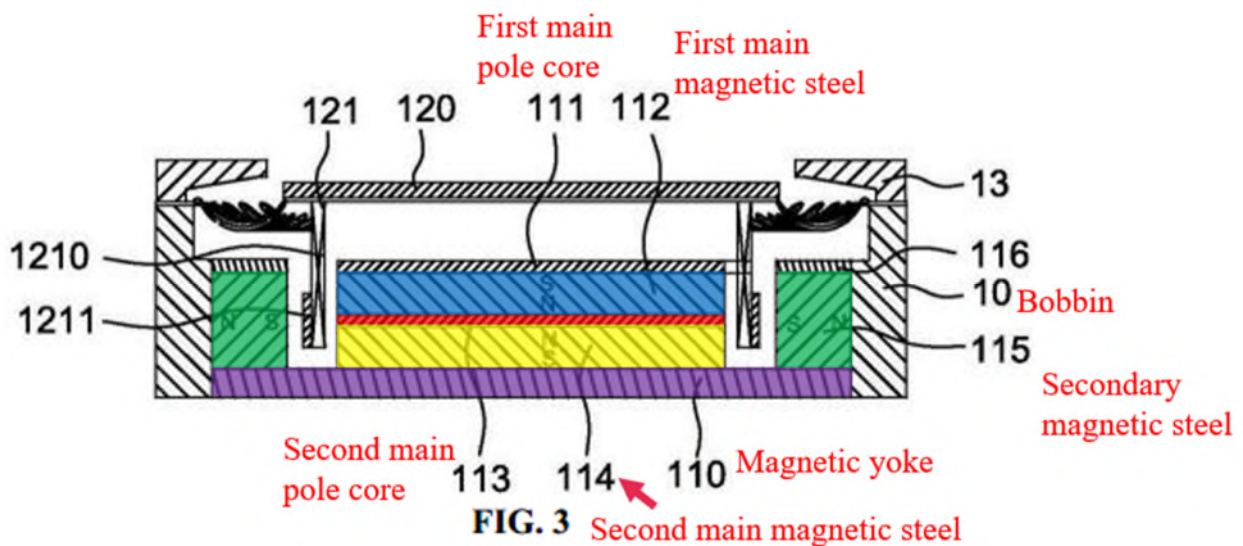
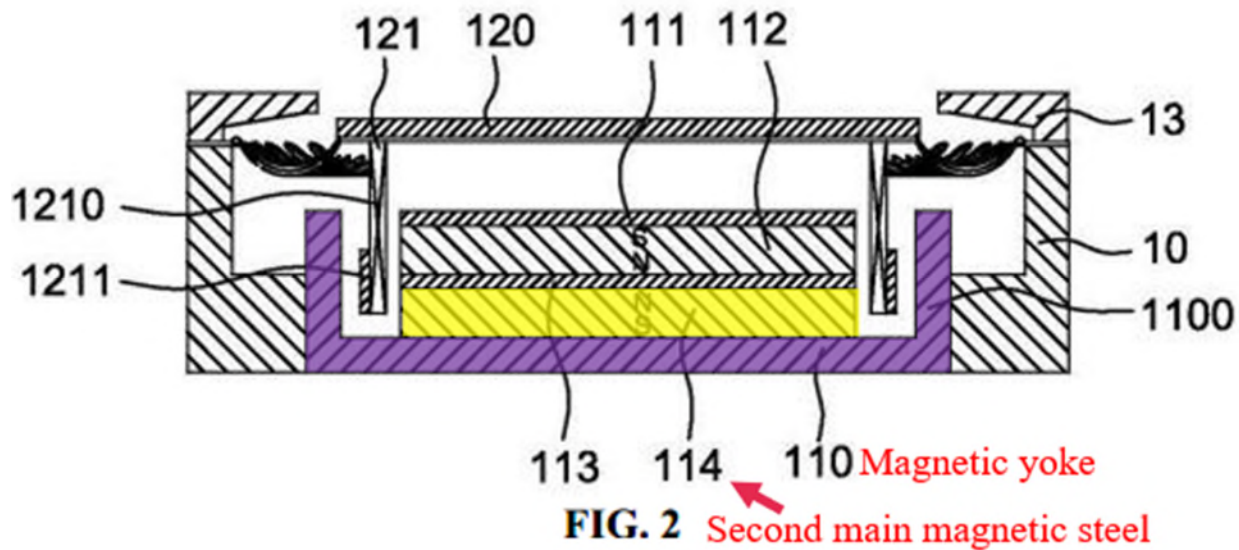
EX1008, Fig. 3; see also [16b], [16c].

3. [19b] the second magnetically conductive unit includes a bottom plate and a sidewall; and

289. The Li-Fujita-Wang combination renders this claim element obvious.

Wang discloses or renders obvious, in Figure 2, *the second magnetically conductive unit* (magnetic yoke 110, annotated in purple below) *includes a bottom plate and a*

sidewall: “The magnetic yoke 110 further comprises a flange 1100 arranged parallel to and spaced from the voice coil 121.” EX1008, [0022].



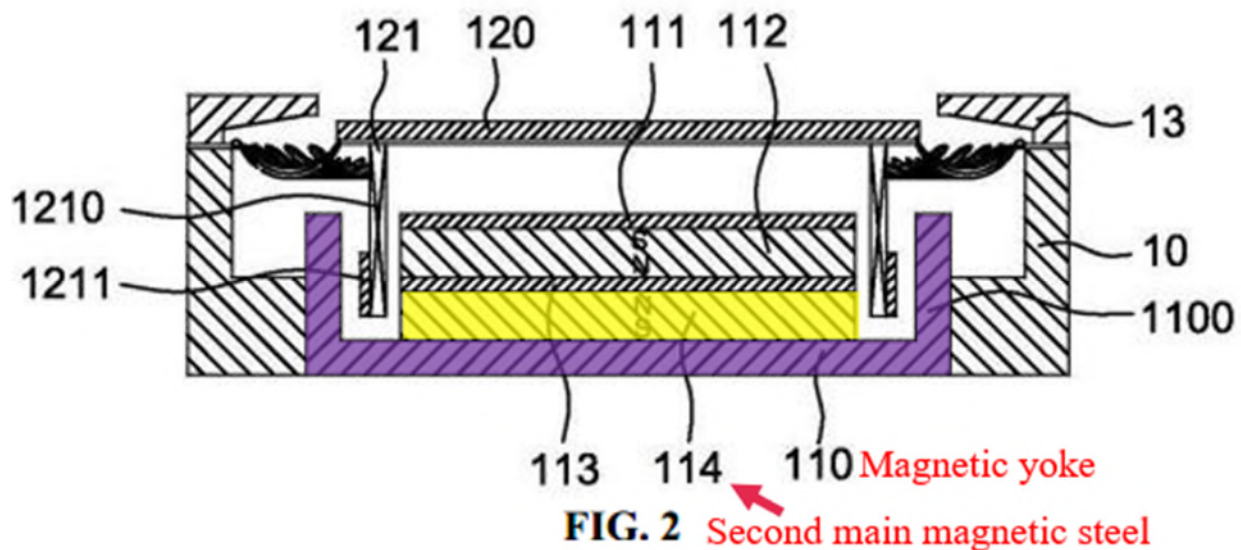
Id., Figs. 2, 3.

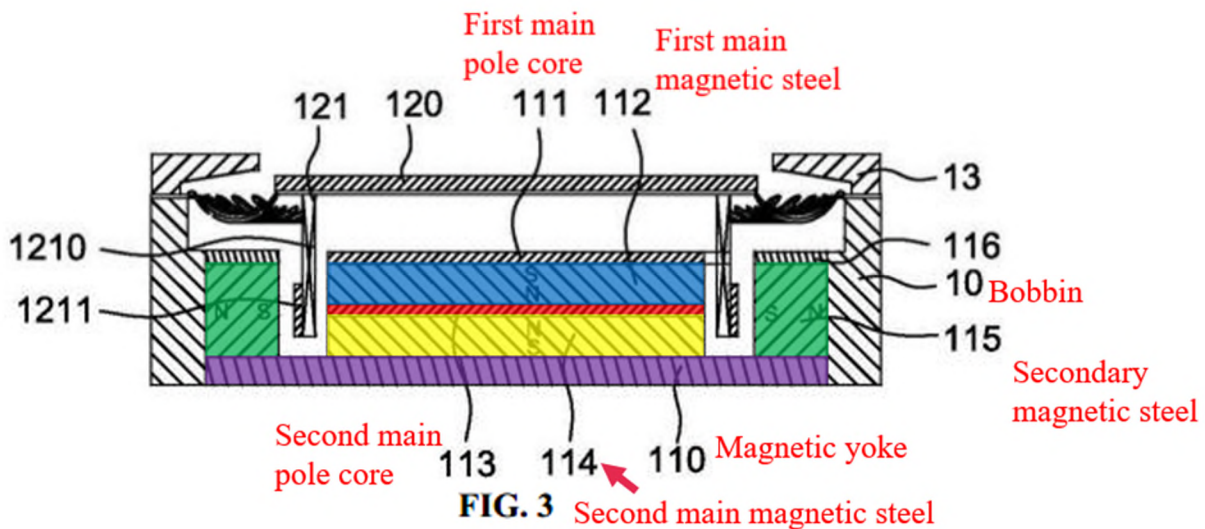
290. It would have been obvious to a POSITA to use the structure of the magnetic yoke 110 in Figure 2 along with the invention’s other structures disclosed

in Figure 3, including secondary magnetic steel 115, because the figures already have nearly identical structures and Wang does not strictly limit itself to separate embodiments of the invention in Figures 1 and 2. See EX1008, [0017], [0024].

4. [19c] the first magnetic unit is connected to the bottom plate of the second magnetically conductive unit.

291. The Li-Fujita-Wang combination renders this claim element obvious. In both Figures 2 and 3 in Wang, *the first magnetic unit* (second main magnet steel 114, annotated in yellow below) *is connected to the bottom plate of the second magnetically conductive unit* (magnetic yoke 110, annotated in purple).





EX1008, Figs. 2-3.

G. Claim 20

- 1. [20pre] The loudspeaker apparatus of claim 17, further comprising:**

292. The Li-Fujita-Wang combination or Li-Fujita-Xu combination renders obvious *the loudspeaker apparatus of claim 17*. See claim 17.

2. [20a] at least one electrically conductive unit being connected to at least one unit of the first magnetic unit, the first magnetically conductive unit, or the second magnetically conductive unit.

293. The Li-Fujita-Wang-Nielsen combination or Li-Fujita-Xu-Nielsen combination renders obvious this claim limitation. Nielsen discloses or renders obvious a layer of a conductive material (*one electrically conductive unit*) being connected to a magnetic unit:

In a preferred embodiment of the magnet assembly of the present invention, the cylindrical, outer surface 10 of the T-yoke and/or the upper, inner surface 36 of the top plate is/are provided with **a layer of a conductive material**, said layer extends axially in a length at least corresponding to the axial length of the gap 56.”

EX1010, 16:1-4.

294. Nielsen teaches the purpose of the layer of a conductive material as follows:

“The permanent magnet system is creating a static magnet field, whereas the alternating current (the music signal) in the voice coil creates a dynamic field. These currents are in opposite directions, which results in a dampening effect of the voice coils movement up and down. When these magnetic fields interact a fluxmodulation occurs. ***The conducting layers, as described above, reduce this phenomena.*** Eddy-currents occur in electrically conductive materials such as iron parts in the magnet system. ***The conducting layers also reduce the dampening effect caused by eddy-currents in the iron parts, located in the gap. Furthermore the conducting layers also reduce the self-inductance in the voice coil.*** This is mainly achieved by the conducting layer of the surface 10 of the T-yoke and partially by the conductive layer of the surface 36 of the top plate.

EX1010, 17:6-15.

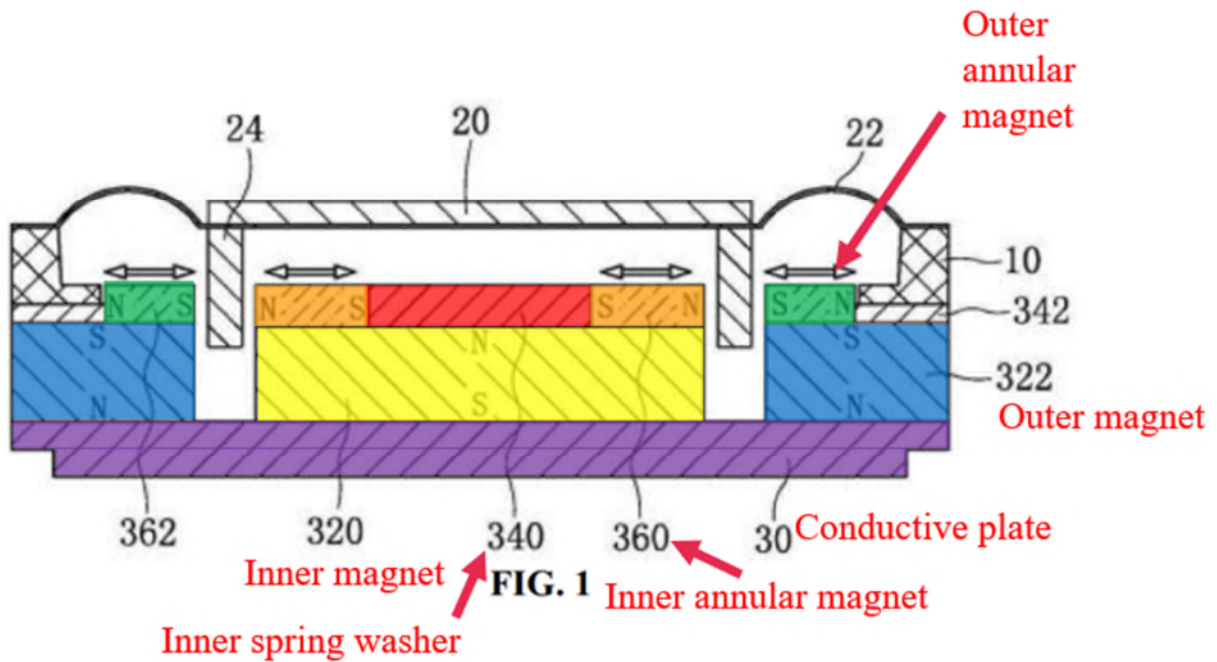
295. The purpose of the layer of a conductive material in Nielsen is the same as the claimed *one electrically conductive unit* in the '084 Patent, which is to reduce the inductive reactance of the voice coil:

A magnetic gap may be formed between the first magnetic unit 2102, the first magnetically conductive unit 2104, and the inner ring of the second magnetic unit 2108. A voice coil 2128 may be disposed in the magnetic gap. The first magnetic unit 2102, the first magnetically conductive unit 2104, the second magnetically conductive unit 2106, and the second magnetic unit 2108 may form a magnetic circuit. ***In some embodiments, the electrically conductive unit may reduce an inductive reactance of the voice coil 2128.*** For example, if a first alternating current flows through the voice coil 2128, a first alternating induced magnetic field may be generated near the voice coil 2128. Under the action of the magnetic field in the magnetic circuit, the first alternating induced magnetic field may cause the inductive reactance of the voice coil 2128 and hinder the movement of the voice coil 2128. When an electrically conductive unit (e.g., the first electrically conductive unit 2118, the second electrically conductive unit 2120, and the third electrically conductive unit 2122) is disposed near the voice coil 2128, the electrically conductive unit may induce a second alternating current under the action of the first alternating induced magnetic field. A third alternating current in the electrically conductive unit may generate a second alternating induced magnetic field near the third alternating current. The

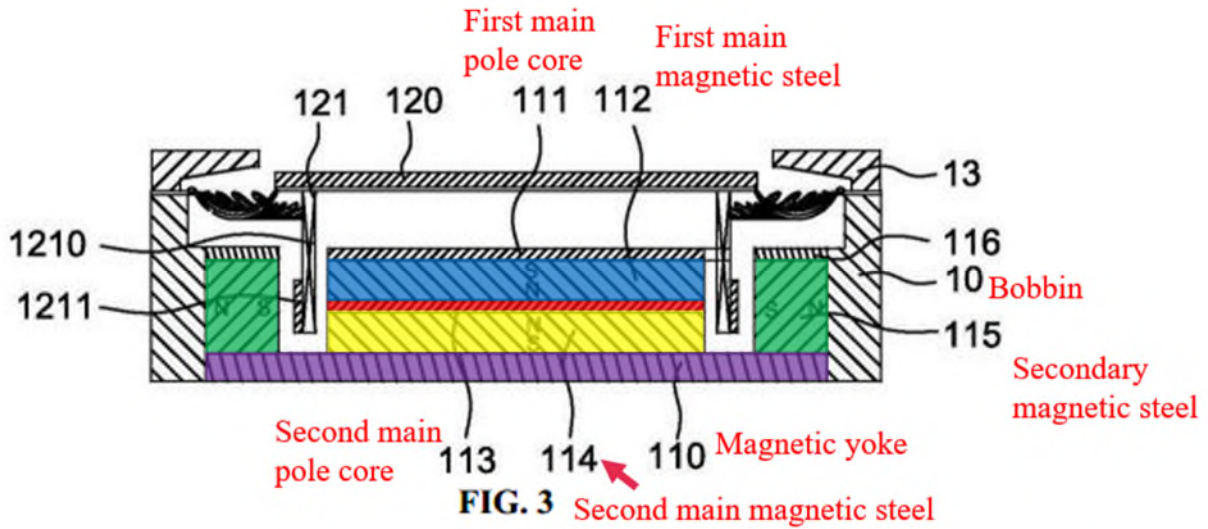
second alternating induction magnetic field may be opposite to the first alternating induction magnetic field, and weaken the first alternating induction magnetic field, thereby reducing the inductive reactance of the voice coil 2128, increasing the current in the voice coil, and improving the sensitivity of the speaker.

EX1001, 27:59-28:21.

296. It would have been obvious to a POSITA to add Nielsen's layer of a conductive material (*at least one electrically conductive unit*) to a surface of *at least one unit of the first magnetic unit* (yellow annotations below), *the first magnetically conductive unit* (red annotations below), *or the second magnetically conductive unit* (purple annotations below) in Wang or Xu, all of which have exposed sides for making the modification, to achieve the benefit taught by Nielsen of reducing the inductive reactance of the voice coil. *See §XV.B.* Electrically conductive units were common elements in magnet assemblies for speakers at the time, such as in Nielsen. Wang and Xu's exposed sides are shown below.



EX1009, Fig. 1.



EX1008, Fig. 3.

XVI. SECONDARY CONSIDERATIONS

297. At this time, I am not aware of any objective evidence (or “secondary considerations”) that would suggest the Challenged Claims are not obvious. For example, I am not aware of any evidence relating the purported invention to any commercial success, evidence of a long-felt need that was solved by the purported invention, evidence that others have copied the purported invention, failure of others facing the same state of the art to develop a satisfactory solution, professional approval or skepticism, or evidence that the purported invention achieved a surprising result. It is my opinion that all Challenged Claims would have been obvious to one of skill in the art.

298. I understand that if Patent Owner argues that objective evidence supports a finding of non-obviousness, I may be asked to review such evidence and formulate an opinion in response to Patent Owner’s arguments. I reserve my right to do so.

XVII. AVAILABILITY FOR CROSS-EXAMINATION

299. In signing the front cover of this declaration, I understand that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I acknowledge that I may be subject to cross examination in the case and that cross examination will take place within the United States. If cross examination is required of me, I will

appear for cross examination within the United States during the time allotted for cross examination.

XVIII. RIGHT TO SUPPLEMENT

300. I reserve the right to supplement my opinions in the future to respond to any arguments that the Patent Owner raises. This declaration represents only those opinions that I have formed to date. I reserve the right to revise, supplement, and/or amend my opinions stated herein based on new information that becomes available to me and on my continuing analysis of the materials already provided.

XIX. CONCLUSION

301. I may use the documents cited and/or listed herein, or portions of those documents, as exhibits at any hearing or trial in this proceeding. I may further prepare and use exhibits that summarize portions of my testimony or key terms or concepts presented therein, or other demonstrative exhibits, at any hearing or trial in this proceeding.

302. I reserve the right to supplement my testimony and this report in response to any judicial determinations, in response to the arguments expressed by the Patent Owner or the opinions of the Patent Owner's experts in this proceeding, and/or in light of additional evidence or testimony brought forth at trial or otherwise brought to my attention after the date of my signature.