

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.
Petitioner,

v.

INGENIOSPEC, LLC.
Patent Owner.

Patent No. 8,582,789

Inter Partes Review No. IPR2026-00144

DECLARATION OF DR. JOSHUA R. SMITH

TABLE OF CONTENTS

	Page
I. INTRODUCTION	1
II. SUMMARY OF GROUNDS	3
III. QUALIFICATIONS AND EXPERTISE	3
IV. LEGAL UNDERSTANDING	7
A. My Understanding of Claim Construction	7
B. A Person Having Ordinary Skill in the Art	8
C. My Understanding of Obviousness	8
V. THE '789 PATENT	10
A. Background of the '789 Patent	10
B. Prosecution History of the '789 Patent	10
C. Claim Construction	10
D. Priority Date of the Challenged Claims	11
VI. TECHNICAL ANALYSIS OF THE PRIOR ART	12
A. Ground 1: Claims 1-6, 8, 11-14, 19, 20, 22-24, 27-31, 33-36, 39-50, 52-58, 60-68, 70-72, 75, 77-79, 81, and 82 are Rendered Obvious by Anderson	12
2. Summary of Anderson	12
3. Claim 1	14
4. Claim 2	22
5. Claim 3	23
6. Claim 4	25
7. Claim 5	27
8. Claim 6	29
9. Claim 8	30
10. Claim 11	31
11. Claim 12	32
12. Claim 13	33

TABLE OF CONTENTS
(continued)

	Page
13. Claim 14	34
14. Claim 19	35
15. Claim 20	35
16. Claim 22	35
17. Claim 23	36
18. Claim 24	37
19. Claim 27	38
20. Claim 28	38
21. Claim 29	39
22. Claim 30	40
23. Claim 31	41
24. Claim 33	42
25. Claim 34	42
26. Claim 35	43
27. Claim 36	43
28. Claim 39	43
29. Claim 40	44
30. Claim 41	44
31. Claim 42	44
32. Claim 43	45
33. Claim 44	45
34. Claim 45	46
35. Claim 46	47
36. Claim 47	47
37. Claim 48	48

TABLE OF CONTENTS
(continued)

	Page
38. Claim 49	48
39. Claim 50	49
40. Claim 52	49
41. Claim 53	49
42. Claim 54	50
43. Claim 55	50
44. Claim 56	50
45. Claim 57	51
46. Claim 58	51
47. Claim 60	51
48. Claim 61	52
49. Claim 62	52
50. Claim 63	52
51. Claim 64	53
52. Claim 65	53
53. Claim 66	54
54. Claim 67	55
55. Claim 68	55
56. Claim 70	57
57. Claim 71	58
58. Claim 72	58
59. Claim 75	58
60. Claim 77	59
61. Claim 78	59
62. Claim 79	59

TABLE OF CONTENTS
(continued)

	Page
63. Claim 81	60
64. Claim 82	60
B. Ground 2: Claims 7 and 15-18 are Rendered Obvious by Anderson in view of Enzmann	61
2. Summary of Enzmann	61
3. Claim 7	62
4. Claim 15	66
5. Claim 16	67
6. Claim 17	67
7. Claim 18	67
C. Ground 3: Claims 9, 10, 21, 26, 51, and 59 Are Rendered Obvious By Anderson In View Of Mayer	68
2. Summary of Mayer	68
3. Claim 9	69
4. Claim 10	71
5. Claim 21	73
6. Claim 26	73
7. Claim 51	74
8. Claim 59	75
D. Ground 4: Claims 32 and 37 are Rendered Obvious by Anderson in View of Gabara	76
2. Summary of Gabara	76
3. Claim 32	76
4. Claim 37	79
E. Ground 5: Claim 76 is rendered obvious by Anderson in view of Rader	79

TABLE OF CONTENTS
(continued)

	Page
2. Summary of Rader	79
3. Claim 76.....	82

Exhibit List

Exhibit Description	Exhibit #
U.S. Patent No. 8,582,789 to Cheung et al.	EX1001
Prosecution History of U.S. Patent No. 8,582,789	EX1002
Declaration of Dr. Joshua R. Smith	EX1003
Curriculum Vitae of Dr. Joshua R. Smith	EX1004
U.S. Patent No. 5,721,783 to Anderson	EX1005
U.S. Patent No. 7,245,730 to Enzmann	EX1006
U.S. Patent Pub. No. 2004/0170086 to Mayer et al.	EX1007
U.S. Patent No. 7,024,000 to Gabara et al.	EX1008
U.S. Patent No. 6,944,474 to Rader et al.	EX1009
Federal Communications Commission. <i>In the Matter of the Review of the Commission's Rules and Policies Governing the Implementation of the Telecommunications Act of 1996</i> . FCC 02-328, 2002.	EX1010
Excerpts from A. OPPENHEIM ET AL., SIGNALS & SYSTEMS SECOND EDITION (Prentice Hall Inc., 1997)	EX1011
U.S. Patent No. 7,388,962 to Cheung et al.	EX1012
G. KENNEDY ET AL., ELECTRONIC COMMUNICATION SYSTEMS 4TH ED. (Tata McGraw-Hill 1993)	EX1013

I, Dr. Joshua R. Smith, make this declaration in connection with the proceeding identified above.

I. INTRODUCTION

1. I have been retained by counsel for Apple Inc. (“Petitioner” or “Apple”) in connection with the proceeding identified above. I submit this declaration in support of Apple’s Petition for *Inter Partes* Review of United States Patent No. 8,582,789 (EX1001, “the ’789 patent”).

2. I have reviewed and am familiar with the ’789 patent, which issued on November 12, 2013. I understand that the Petition for *inter partes* review that accompanies this Declaration (the “Petition”) seeks to cancel claims 1-24, 26-37, 39-68, 70-72, 75-79, 81, and 82 (the “challenged claims”) of the ’789 patent.

3. In preparation for this Declaration, I reviewed the exhibits provided by the Petitioner, including the ’789 patent. In addition to the above exhibits and other documents, my opinions herein are based upon my personal knowledge, professional judgment, education, and experience gained through my years as a computer scientist, professor, and consultant.

4. The ’789 patent is generally directed to a hearing enhancement system. (EX1001, Abstract.) I am familiar with the technology described in the ’789 patent both as of its earliest possible priority date of April 15, 2003, and its actual U.S. filing date of June 6, 2008.

5. I have been asked to consider how a person of ordinary skill in the art (“POSITA”) would have understood the challenged claims in light of the disclosure of the ’789 patent. I also have been asked to consider how a POSITA would have understood the following prior art references:

Prior Art Reference	Abbreviation
U.S. Patent No. 5,721,783 to Anderson	Anderson (EX1005)
U.S. Patent No. 7,245,730 to Enzmann	Enzmann (EX1006)
U.S. Patent Pub. No. 2004/0170086 to Mayer et al.	Mayer (EX1007)
U.S. Patent No. 7,024,000 to Gabara et al.	Gabara (EX1008)
U.S. Patent No. 6,944,474 to Rader	Rader (EX1009)

6. Further, I have been asked to consider and provide my technical review, analysis, insights, and opinions regarding whether a POSITA would have understood the disclosures of the above references to render obvious the challenged claims.

7. I am being paid \$650 per hour for my work on this matter. My compensation is not dependent on the outcome of this *inter partes* review and in no way affects the substance of my statements in this declaration.

8. I reside in Seattle, Washington, USA.

II. SUMMARY OF GROUNDS

9. I understand that the Petition for *inter partes* review of the '789 patent asserts the following grounds of unpatentability:

Ground	35 U.S.C. §	Claims(s)	Prior Art Reference(s)
1	103	1-6, 8, 11-14, 19, 20, 22-24, 27-31, 33-36, 39-50, 52-58, 60-68, 70-72, 75, 77-79, 81, 82	Anderson
2	103	7, 15-18	Anderson in view of Enzmann
3	103	9, 10, 21, 26, 51, 59	Anderson in view of Mayer
4	103	32, 37	Anderson in view of Gabara
5	103	76	Anderson in view of Rader

III. QUALIFICATIONS AND EXPERTISE

10. In formulating my opinions, I have relied upon my knowledge, training, and experience. My qualifications are stated more fully in my *curriculum vitae*, which has been provided as EX1004. Here, I provide a brief summary of my qualifications.

11. I am the Milton and Delia Zeuschel Professor at the University of Washington, jointly appointed in the Department of Electrical and Computer Engineering and in the Allen School. I am providing this Declaration as an independent professional working through my consulting company, Sensor Expert

LLC, not as a representative of the University of Washington or any other organization.

12. I have at least twenty years of experience with wireless communication, wireless sensing, and audio technology. I have worked on wireless systems as an engineer, in academic research, and as a supervisor of academic research. I am a Fellow of the National Academy of Inventors (NAI). According to the NAI, "Election to NAI Fellow status is the highest professional distinction accorded solely to academic inventors." I am also a Fellow of the Institute of Electrical and Electronic Engineers ("IEEE"). According to the IEEE, the "Grade of Fellow is conferred by the Board of Directors upon a person with an extraordinary record of accomplishments." The specific citation in my elevation to Fellow was for "contributions to far- and near-field wireless power, backscatter communication and electric field sensing." At most one tenth of one percent of the worldwide membership can join the ranks of IEEE Fellow each year.

13. I received my Ph.D. and S.M. degrees in Media Arts and Sciences from the Massachusetts Institute of Technology. This was an interdisciplinary program at the MIT Media Lab. As part of this program, my group, led by Neil Gershenfeld, engaged with the fields of Applied Physics, Electrical Engineering, and Computer Science. I also received a M.A. in Physics from Cambridge University, and dual B.A. degrees in Computer Science and Philosophy from

Williams College. As a graduate student at the MIT Media Lab, I worked on numerous projects relating to wearable technology and audio. For the Brain Opera, which premiered in 1996 at Lincoln Center in New York City, I developed firmware for numerous custom digital musical instruments. For the 1997 Wearable Computing event at the Media Lab, I collaborated on two wearable audio projects: a musical dress which used capacitive sensing to convert body motion into sound, and a musical jacket with a conductive thread embroidered keypad. I designed a custom Midi synthesizer circuit board used in both of these projects. In addition to science/engineering publications like SIGGRAPH, both projects appeared in Vogue, the fashion magazine.

14. From 2004 to 2011, I worked at Intel Corporation, where I rose to the rank of Principal Engineer before leaving Intel to become a professor. At Intel, I started the Wireless Identification and Sensing Platform (“WISP”) project, in which we designed and built wirelessly powered and wirelessly charged sensor tags from the ground up. We demonstrated a number of firsts, such as the first wirelessly powered accelerometer sensor. In the area of audio, we developed a wirelessly powered speaker that produced sound with no wires or batteries, by directly converting strong electromagnetic signals into audio signals.

15. At Intel, I also served on a committee that made patent filing decisions about wireless technology for the entire company. I also served on

Intel's Strategic Patent Team for wireless technology, which allocated patent filing budgets for each year for the company among various technical subjects within the wireless area. Prior to Intel, I was Chief Scientist at Escher Group and Director of Escher Labs, where I worked on a variety of sensor systems.

16. In 2011, I joined the University of Washington as an Associate Professor. I received tenure in 2014, and was promoted to Professor and awarded the Milton and Delia Zeuschel Professorship in 2017. At the University of Washington, I currently lead research in a number of areas including wireless sensing, wireless communication, and other topics. At UW, I have worked on projects at the intersection of wireless and audio, such as a battery-free wireless microphone, and a battery free phone, which uses ultra-low power methods to convert between radio waves and audio in both directions: phone to basestation and basestation to phone. My research in these areas has been funded by Federal agencies including the National Science Foundation (NSF), National Institutes for Health (NIH), the Department of Defense (DoD), Defense Advanced Research Projects Agency (DARPA), the Advanced Research Projects Agency for Energy (ARPA-E), and the National Aeronautics and Space Administration (NASA). It has also been funded by corporations such as Intel, Google, Bosch, Microsoft, and Amazon. I teach or have taught wireless communication, wireless power, analog electronics, digital circuits and systems, and other topics. In my wireless

communication class, I also cover selected topics in wireless transmission of audio signals, as well as synthesis of audio signals. I am also the Electrical and Computer Engineering Department's Associate Chair for Professional Programs. In this role, I make decisions about which courses are offered in the Department's Professional Masters Degree Program and often who will teach them. I recently added a course on synthesis and processing of digital audio. I have also co-founded three startup companies, each based on technology developed in my lab.

17. I am a named inventor on 57 U.S. patents and at least 16 foreign patents. At least 27 of my U.S. patents and 13 of my foreign patents have been licensed. I have published over 188 articles and edited one book, entitled "Wirelessly Powered Sensor Networks and Computational RFID." My work has been cited over 27,000 times, and my "H-index," which measures publication impact, is 80. My nine most cited works all relate to wireless technology.

IV. LEGAL UNDERSTANDING

A. My Understanding of Claim Construction

18. I have been advised and understand that claim construction is a matter of law and that the final claim construction will ultimately be determined by the Patent Trial and Appeal Board (the "Board"). I have been advised and understand that patent claims are construed from the perspective of one of ordinary skill in the art at the time the claimed invention was made. I have further been advised and

understand that, in an *inter partes* review, patent claims are to be construed according to the methodology set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005). In performing my analysis and rendering my opinions, I have interpreted claim terms by giving them the ordinary and customary meaning they would have to the POSITA reading the '789 patent as of April 15, 2003, and in light of its specification and file history.

B. A Person Having Ordinary Skill in the Art

19. I have been advised and understand that a POSITA is presumed to be aware of all pertinent art, thinks along conventional wisdom in the art, and is a person of ordinary creativity, not an automaton. With this understanding, based on the disclosures of the '789 patent and the assumed priority date of April 15, 2003, a POSITA would have had a Bachelor's degree and a Master's degree in Electrical Engineering, Computer Engineering, Physics, or a related field, as well as one to two years of academic or industry experience in mobile devices, wireless communications, or audio electronics, or comparable industry experience.

C. My Understanding of Obviousness

20. I have been advised and understand that a claimed invention is unpatentable if the differences between the invention and the prior art are such that, at the time the invention was made, the subject matter as a whole would have been obvious at the time the invention was made to a POSITA to which the subject

matter pertains. This means that even if all of the requirements of the claim cannot be found in a single prior art reference that would anticipate the claim, the claim can still be invalid.

21. It is my understanding that obviousness is a question of law based on underlying factual findings: (1) the scope and content of the prior art; (2) the differences between the claims and the prior art; (3) the level of skill in the art; and (4) objective considerations of non-obviousness. I understand that for a single reference or a combination of references to render the claimed invention obvious, a POSITA must have been able to arrive at the claims by altering or combining the applied references.

22. I also understand that prior art references can be combined under several different circumstances. For example, it is my understanding that one such circumstance is when a proposed combination of prior art references results in a system that represents a predictable variation, which is achieved using prior art elements according to their established functions.

23. 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 considering the prior art. I understand this test should not be rigidly applied, but that the test can be important to avoiding such hindsight.

V. THE '789 PATENT

A. Background of the '789 Patent

24. The '789 patent relates to a hearing enhancement system. (EX1001, 1:53-55.) For example, the '789 patent describes that a system can include a directional speaker that transmits audio signals to a user with higher power at particular frequencies, to enhance the hearing of the user. (EX1001, 3:25-33.)

B. Prosecution History of the '789 Patent

25. I understand that the application that became the '789 patent was allowed with only a single rejection, for non-statutory double patenting over its parent, which was promptly overcome by the applicant with a terminal disclaimer. (EX1002.) I understand that in an "examiner's statement of reasons for allowance," the Examiner explained: "The limitations claims [sic] in the patent application (7388962) are broader than the scope of the claims in the present application." (EX1002, 308.) I understand the Examiner provided no other reasons for allowance beyond reiterating the limitations of claim 1. (EX1002, 308-09.) However, in my view, as shown herein, all limitations of the challenged claims were known in the prior art.

C. Claim Construction

26. As discussed above, I understand that, during an *inter partes* review, words in a claim are given their ordinary and customary meaning, which is the meaning understood by a POSITA at the time of the alleged invention after reading

the entire patent. In performing my analysis and rendering my opinions, I have interpreted claim terms by giving them the ordinary and customary meaning they would have to the POSITA reading the '789 patent as of April 15, 2003, and in light of its specification and file history.

27. I believe the challenged claims are unpatentable under any reasonable interpretation of the claim language.

D. Priority Date of the Challenged Claims

28. I understand that the '789 patent claims priority to a provisional patent application filed on April 15, 2003, and that this date is the earliest possible priority date to which the '789 patent could be entitled. (EX1001.) Accordingly, for the purposes of this declaration, I have assumed a priority date of April 15, 2003, for the challenged claims. I express no opinion as to whether the '789 patent is actually entitled to that priority date. If it is determined that the '789 patent is entitled to a priority date later than April 15, 2003, it would not change any of my opinions expressed herein.

VI. TECHNICAL ANALYSIS OF THE PRIOR ART

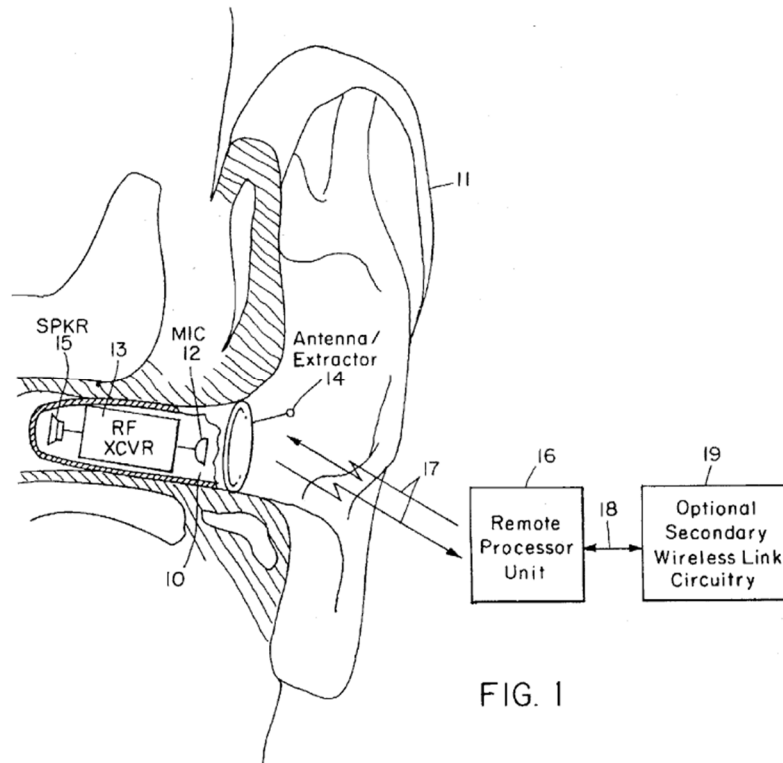
A. Ground 1: Claims 1-6, 8, 11-14, 19, 20, 22-24, 27-31, 33-36, 39-50, 52-58, 60-68, 70-72, 75, 77-79, 81, and 82 are Rendered Obvious by Anderson

29. It is my view that Anderson teaches every limitation of claims 1-6, 8, 11-14, 19, 20, 22-24, 27-31, 33-36, 39-50, 52-58, 60-68, 70-72, 75, 77-79, 81, and 82, for the reasons set forth below.

2. Summary of Anderson

30. Anderson is a U.S. Patent issued to inventor James Anderson. The underlying application (Appl. No. 08/479,629) was filed on June 7, 1995, and issued as U.S. Patent No. US 5,721,783 on February 24, 1998 (EX1005). I understand Anderson is thus prior art to the '789 patent under at least 35 U.S.C. §§102(a), (b), and (e). I understand Anderson was not cited or considered during prosecution of the '789 patent.

31. Anderson discloses a hearing aid system including “an earpiece housing worn in or at the ear and a remote processor unit (RPU) worn by or located near the user that wirelessly receives signals from and transmit signals to the earpiece.” (EX1005, 1:7-10.) FIG. 1 illustrates:



(EX1005, FIG. 1.)

32. The hearing aid system can be used as a “wireless communication device[] for hands-free cellular telephone ... ‘handsets,’ covert operation and control of hearing aids, hearing protection and noise cancellation simultaneous with binaural hearing aid functions, [and] hearing test equipment.” (EX1005, 1:11-16.)

33. Anderson is analogous art to the claimed invention at least because it is directed to the same field of endeavor—hearing aids that modify a signal based on a user’s hearing characteristics. By disclosing a system “where the audio signals are enhanced according to the user’s needs,” Anderson is reasonably

pertinent to the problem faced by the '789 patent inventor—providing a hearing enhancement system. (EX1005, 1:61-62; EX1001, 5:44-45.)

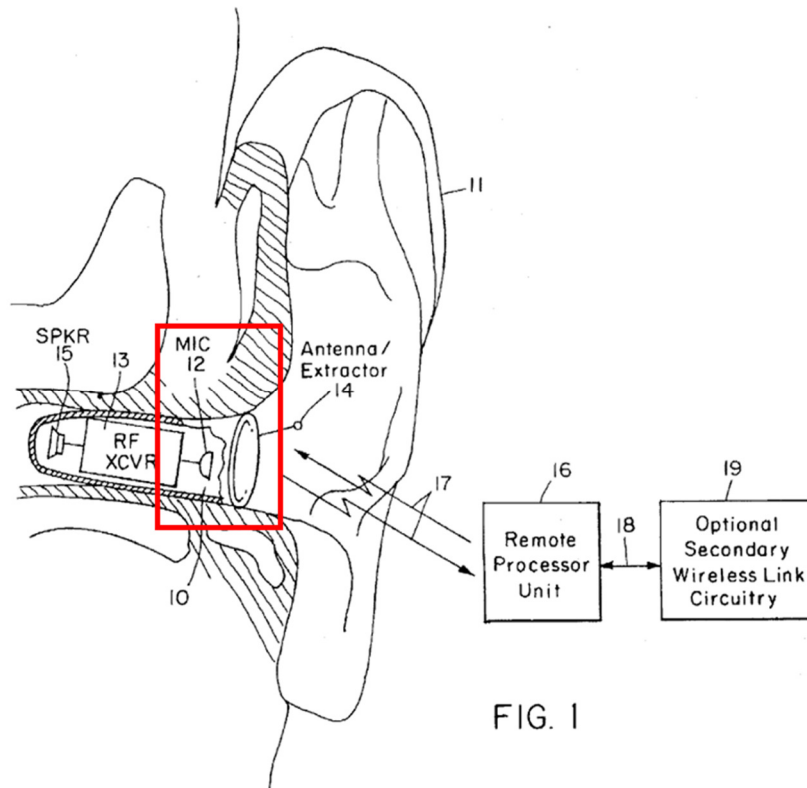
3. Claim 1

a. **[Preamble] *A hearing enhancement system for a user, comprising:***

34. Anderson discloses hearing aids for “hearing protection and noise cancellation simultaneous with binaural hearing aid functions.” (EX1005, 1:14-16.) The system includes “an earpiece housing worn in or at the ear and a remote processor unit (RPU)” where “audio signals are enhanced according to the user’s needs.” (EX1005, 1:7--8, 61-62.)

b. **[A] *an audio system configured to receive input signals for broadcasting, and configured to up-convert the received input signals into up-converted signals to be wirelessly transmitted;***

35. Anderson discloses an audio system that receives sounds from the ambient environment, *i.e.*, input signals. (EX1005, 22:61-23:5.) For example, the environmental sounds are “picked up by a microphone 12 in the earpiece 10 and transmitted with other information ... over a primary two-way wireless link 17 to the RPU 16.” (EX1005, 22:64-23:3.) FIG. 1 illustrates:



(EX1005, FIG. 1 (annotated).)

36. From there, the enhanced audio signals are “transmitted from the RPU 16 over the wireless link 17 to the earpiece 10, where they are converted by a speaker 15 to sounds that can only be heard by the user 11.” (EX1005, 23:11-14.) Anderson further teaches that an “auxiliary speaker can be supplied in the RPU 16 as a peripheral 950 device that allows people other than the user to hear the same sounds as those produced by the earpiece speaker 15.” (EX1005, 23:14-17.) The input signals are thus received for broadcasting, at least because they are received for presentation to the user and to others.

37. Anderson discloses the earpiece transmits up-converted replies including “audio data from the earpiece 10 to the RPU.” (EX1005, 10:23.) The POSITA would have understood that in the ’789 patent, up-conversion refers to modulation of the baseband audio onto a higher-frequency carrier for wireless transmission, and the complementary down-conversion refers to demodulation back to baseband (*see, e.g.*, EX1001, 12:13–16 (“The audio signals from these instruments can be up-converted and transmitted as a WiFi signal to be picked up by the system. The system then down-converts the WiFi signal to re-generate the audio signals for the user.”)). This is consistent with Anderson, which discloses that “a modulated (via modulator 830) low-power 60 MHz oscillator 835 is applied to voltage point V1, causing the diode 43 to turn on and off at a 60 MHz rate and act as a mixer.” (EX1005, 12:21-24.) “The mixer diode 43 generates frequency components centered at the difference frequency of 5700 MHz and the sum frequency of 5820 MHz.” (EX1005, 12:24-26.) “The 5820 MHz sum component passes through the resonator 42, forming the reply (e.g., the modulated, up-converted signal) which is wirelessly transmitted from the earpiece transponder antenna 40 to the RPU.” (EX1005, 12:26-29.) Figure 4 illustrates a schematic of the earpiece transponder:

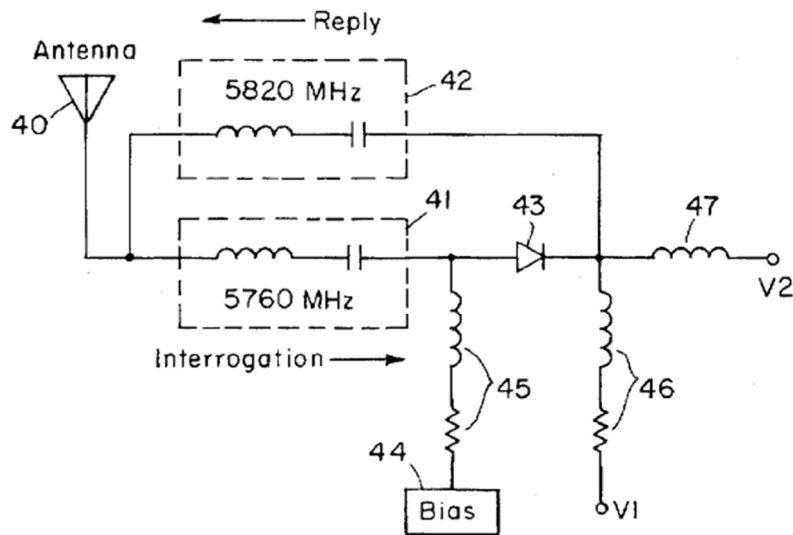


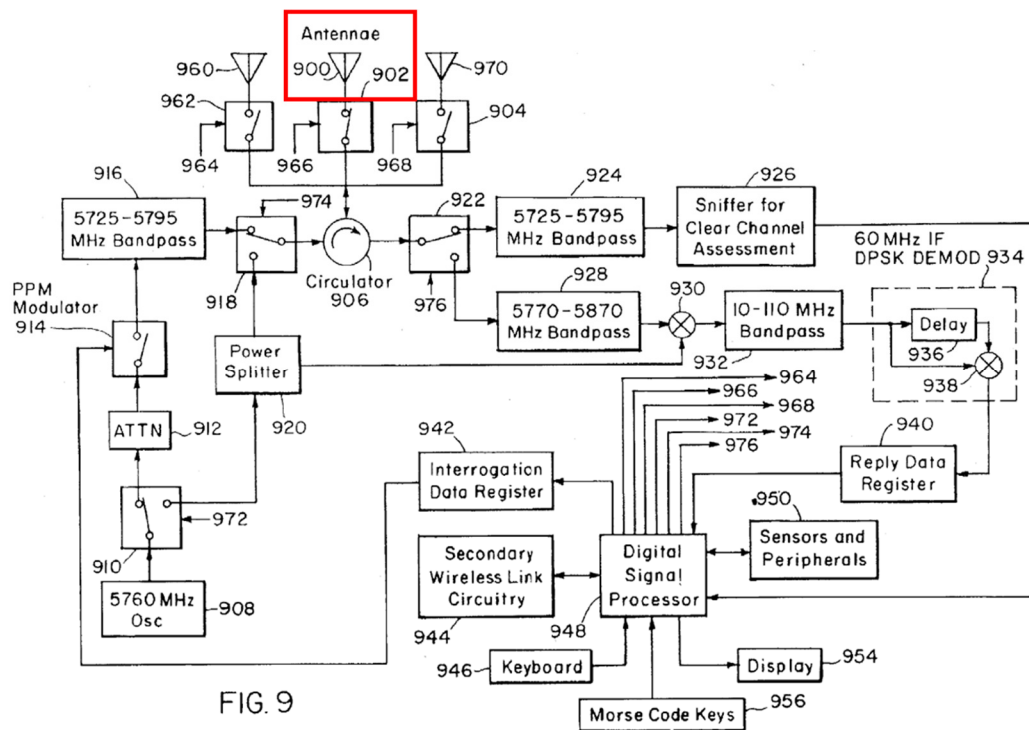
FIG. 4

(EX1005, FIG. 4.)

38. The POSITA would have recognized from the above disclosures that Anderson teaches up-converting the received input signals to be wirelessly transmitted because Anderson's audio system (*e.g.*, the earpiece) is configured to modulate audio signals received by the microphone onto a 60 MHz carrier frequency (*i.e.*, the frequency of oscillator 835), which is then up-converted into an up-converted reply signal at a frequency of 5820 MHz (*i.e.*, the sum frequency generated by mixer diode 43), to be wirelessly transmitted to the RPU. (EX1005, 12:20-30.)

c. [B] a wireless receiver configured to wirelessly receive the up-converted signals;

39. Anderson discloses that the “5820 MHz sum component passes through the resonator 42, and forms the reply which is wirelessly transmitted from the earpiece transponder antenna 40 to the RPU.” (EX1005, 12:26-29.) The RPU includes one or more antennas (e.g., antenna 900 in FIG. 9 below) for wirelessly receiving the up-converted reply:

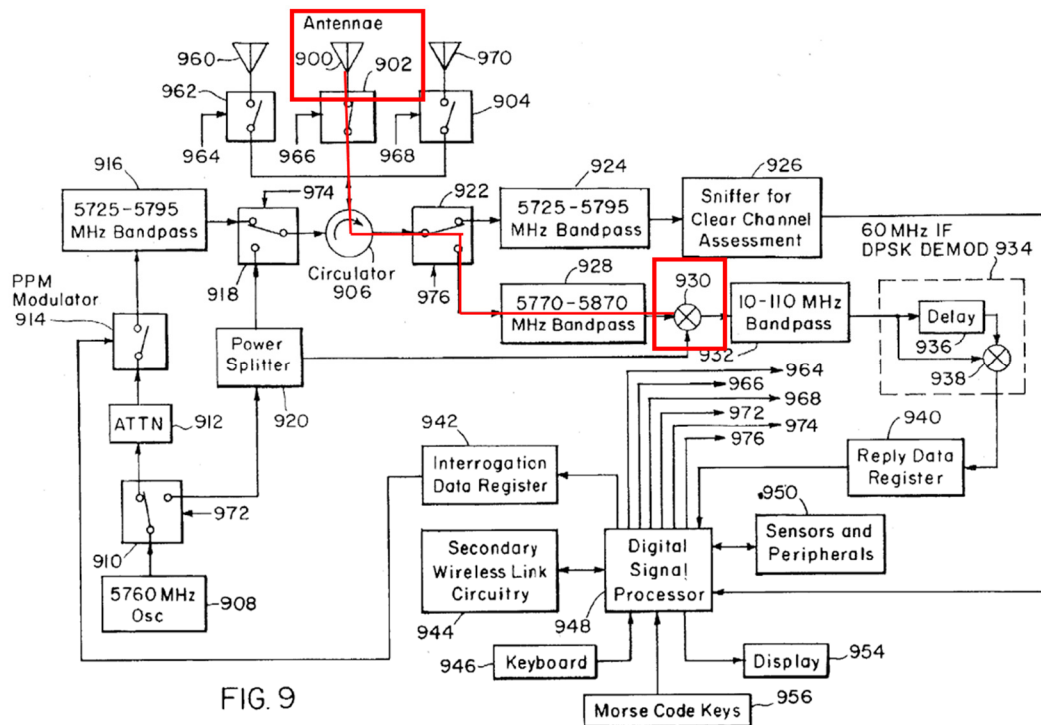


(EX1005, 13:6-10, FIG. 9 (annotated).)

40. Anderson discloses “the RF reply travels through a selected antenna 900,” such that antenna 900 is a wireless receiver configured to wirelessly receive the up-converted reply signals. (EX1005, 13:1-17.)

d. [C] a down-converter configured to down-convert the received up-converted signals into down-converted signals;

41. Anderson discloses the up-converted reply “travels through a selected antenna 900, antenna selection switch 902, circulator 906, routing switch 922... bandpass filter 928 and IF mixer 930.” (EX1005, 13:8-12.) FIG. 9 illustrates:

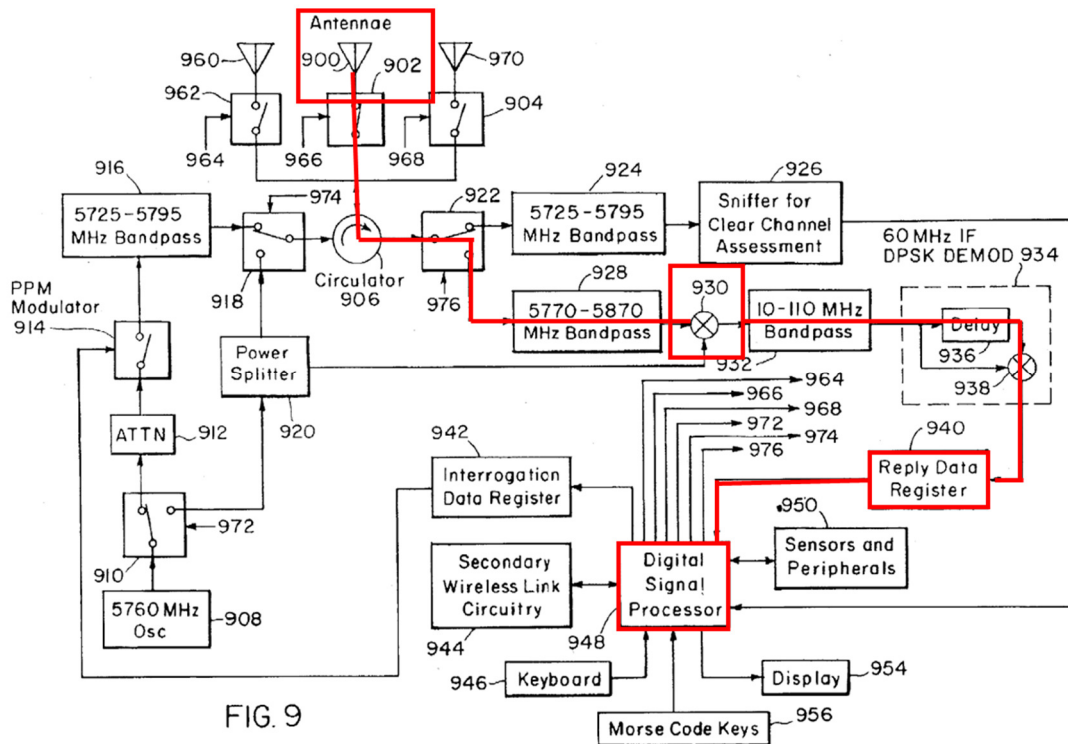


(EX1005, FIG. 9 (annotated).)

42. Anderson discloses that “IF mixer 930 *downconverts* the reply by mixing it with a small amount of RF power from the 5760 MHz oscillator 908 via switch 910 ... and power splitter 920,” thus producing a down-converted signal (i.e., a demodulated signal). (EX1005, 13:12-17 (emphasis added).)

- e. **[D] a modifier configured to modify the down-converted signals into modified signals based on at least one hearing characteristic of the user to enhance the hearing of the user; and**

43. Anderson discloses that once the signals are down-converted by IF mixer 930, “[t]he resulting bits are stored in the reply data register 940 for processing by the DSP 948.” (EX1005, 13:21-22.) Subsequently, “the audio signals are enhanced according to the user’s needs by the RPU DSP 948.” (EX1005, 23:4-5.) FIG. 9 illustrates:



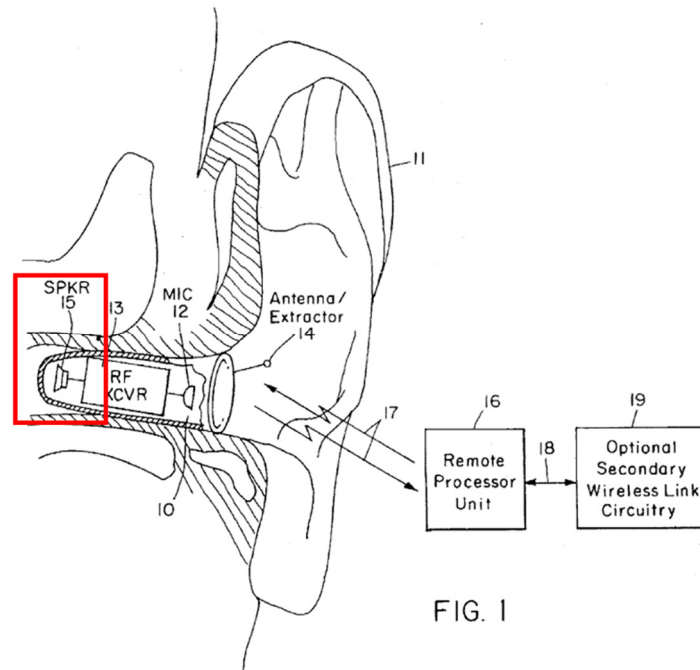
(EX1005, 13:6-22, FIG. 9 (annotated).)

44. For example, “amplification and other forms of signal enhancement, take[] place in the RPU,” which “performs signal enhancement to compensate for the user’s hearing loss” using a stored program. (EX1005, 2:35-37, 27:15-17.)

Such amplification can be based on hearing characteristics of the user, which are identified by subjecting the user to a hearing test that “determines appropriate gain vs. frequency parameters” for the stored program. (EX1005, 27:14-15.) The POSITA would have understood this process to modify the audio signals based on a hearing characteristic of the user, *e.g.*, the user’s impaired ability to hear particular audio frequencies. The stored program in the RPU meets the claimed modifier at least because it modifies the down-converted signals stored in the reply data register, *i.e.*, by performing amplification and other signal enhancement; and because the amplification signal enhancement is based on hearing characteristics (*i.e.*, the user’s hearing loss across frequencies) as described above. (EX1005, 23:4-5.)

f. [E] *a speaker configured to generate audio output signals from the modified signals for the user.*

45. Anderson discloses the enhanced audio signals are “transmitted from the RPU 16 over the primary wireless link 17 to the earpiece 10, where they are converted by a speaker 15 to sounds that can only be heard by the user 11.” (EX1005, 23:11-14.) The wireless transmission from the RPU to the earpiece conveys the modified signals generated by the RPU’s DSP for playback, such that the earpiece speaker generates audio output from those modified signals. (EX1005, 23:8-14.) FIG. 1 illustrates:



(EX1005, FIG. 1 (annotated).)

46. Anderson further discloses an “auxiliary speaker ... that allows people other than the user to hear the same sounds as those produced by the earpiece speaker 15.” (EX1005, 23:14-17.)

4. Claim 2

a. **[Preamble] A hearing enhancement system as recited in claim 1,**

47. This element is met as described for claim 1.

b. **[A] wherein the up-converted signals are in the WiFi frequency band.**

48. Anderson discloses that while a “frequency band slightly below 6 GHz ... is used here to illustrate the operation of a full-featured preferred embodiment,” “[o]peration in many frequency bands is possible as long as the

applicable requirements are met.” (EX1005, 9:3-8.) Anderson also discloses that “[o]perating frequencies in the 900 MHz to 6 GHz range have long been used” and that “[o]peration of the full-featured preferred embodiment of the invention within this frequency range is desirable due to the availability of low-cost components.” (EX1005, 7:39-40, 7:46-49.) The POSITA would understand that one WiFi frequency band utilized before the priority date of the ’789 patent includes a frequency of approximately 2.4 GHz. (EX1010, 2.) Since 2.4 GHz is within the 900 MHz to 6 GHz range taught by Anderson, Anderson teaches that the up-converted signals can be in the WiFi frequency band.

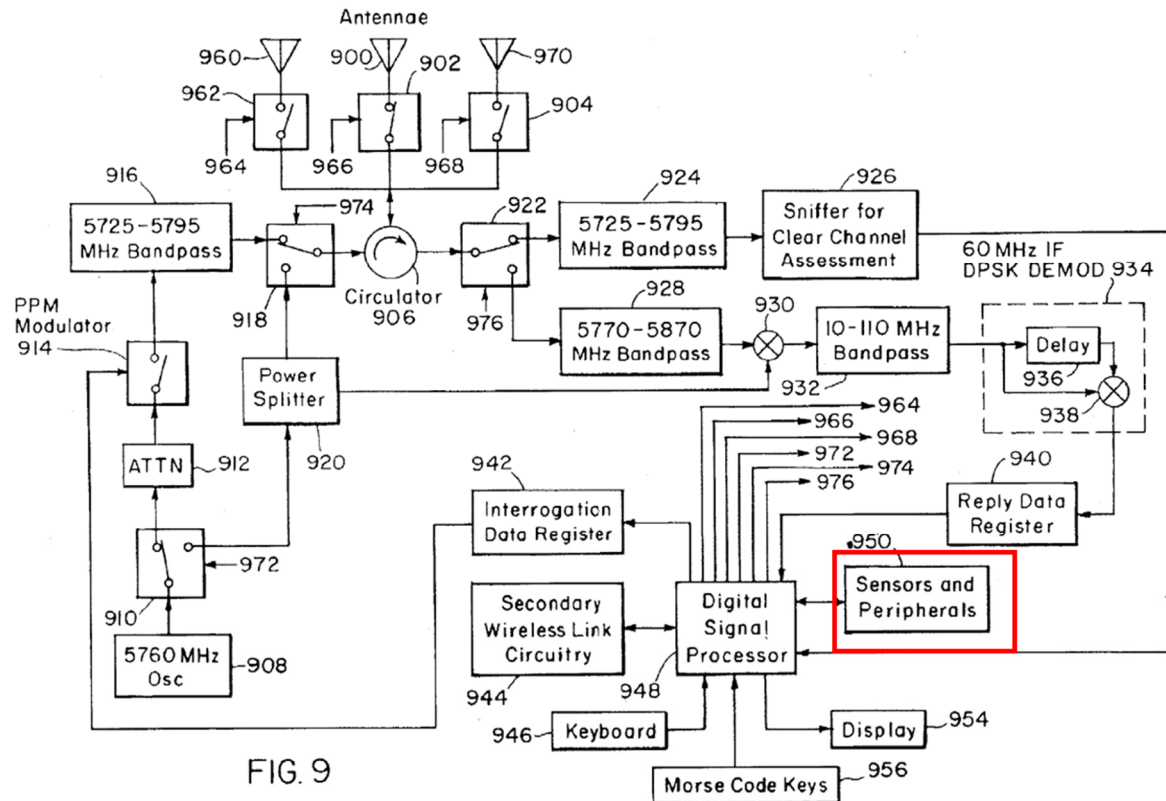
5. Claim 3

a. *[Preamble] A hearing enhancement system as recited in claim 1,*

49. This element is met as described for claim 1.

b. *[A] wherein the audio system is selected from the list consisting a television, a stereo system, a CD player and a radio.*

50. Anderson discloses that the RPU can be wirelessly connected to peripheral devices that can provide music audio signals. (EX1005, 25:50-26:5.) For example, “[m]usic can be provided from pre-stored information including ... a commercial broadcast radio receiver.” (EX1005, 25:56-59.) FIG. 9 illustrates:



(EX1005, 25:56-26:5, FIG. 9 (annotated).)

51. The POSITA would understand that, for a commercial broadcast radio station to wirelessly communicate an audio signal to the RPU and attached broadcast radio receiver, similar up-conversion and down-conversion of audio signals would be performed as described for the earpiece. For example, Anderson teaches that commercial FM broadcasting stations can transmit signals between about 88 to 108 MHz. (EX1005, 4:26-29.) To achieve transmission at these frequencies, the broadcasting station modulates an audio baseband signal (typically between 20 Hz and 20 kHz) onto a higher frequency FM carrier, thereby upconverting the audio signal to the FM broadcast frequency.

52. Further, the POSITA would have known that, after reception, in a system combining Anderson with a commercial radio receiver (as Anderson expressly teaches, at 25:56–26:5), the attached “commercial radio broadcast receiver” would extract the audio signal from the FM carrier by demodulation, down-converting the signal from the high-frequency FM carrier to the original audio frequency range for further processing. ((EX1005, 25:56-26:5.) This is at least because commercial broadcast radio receivers universally employ FM demodulation to recover the original audio signal from an FM carrier, and a POSITA would recognize that such demodulation inherently down-converts the signal to the audio frequency range. (*See generally* EX1011, 594-97; EX1013, 118-179.)

6. Claim 4

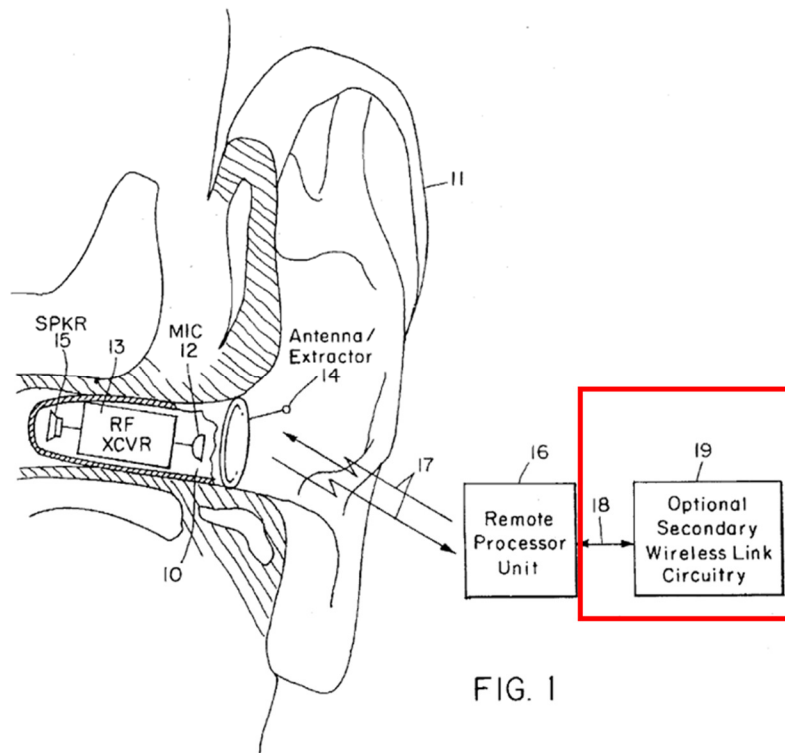
a. [Preamble] *A hearing enhancement system as recited in claim 1,*

53. This element is met as described for claim 1.

b. [A] *wherein the audio system is a phone.*

54. Anderson discloses providing “communication services (*e.g.*, cellular telephone and paging services) to the user via the hearing aid system.” (EX1005, 2:43-44.) In particular, Anderson teaches that “a separate cellular telephone transceiver not physically integrated with the RPU can be worn on the user’s wrist or ankle and communicate with an RPU in the user’s pocket (which in turn

communicates with one or more earpieces) via a wired or wireless two-way link as shown, e.g., in link 18 of FIG. 1.” (EX1005, 25:4-10.) For example, FIG. 1 shows an example of an optional secondary wireless link circuitry that can be used to connect the RPU to a separate cellular telephone transceiver:



(EX1005, FIG. 1 (annotated).)

55. Accordingly, Anderson teaches an audio system that is a phone, (i.e., the separate cellular transceiver that communicates wirelessly with the RPU through link 18). (EX1005, 25:4-10.) The POSITA would understand that the separate cellular transceiver receives input audio signals (e.g., a user’s speech or incoming call audio) and converts those signals for wireless communication.

Through wireless link 18, the transceiver transmits these audio signals to the RPU, which in turn processes and delivers enhanced audio to the user's earpiece.

(EX1005, 25:4-10, FIG. 1.)

56. The POSITA would have known that such wireless transmission between the cellular transceiver and the RPU inherently involves up-conversion (modulation) and down-conversion (demodulation) of audio signals. Specifically, to transmit audio wirelessly, the transceiver modulates (up-converts) a baseband audio signal onto a higher-frequency carrier suitable for the wireless link, which may operate over any of a variety of frequency bands used for short-range or cellular communication. (*See generally* EX1011, 582-625; EX1013, 1-11.) The RPU, equipped with a corresponding wireless receiver, demodulates (down-converts) the received signal to recover the baseband audio for further processing and enhancement. (*See generally* EX1011, 582-625; EX1013, 1-11.)

57. Thus, Anderson teaches that the audio system (i.e., the separate cellular telephone transceiver) receives audio input signals, then up-converts and transmits them to the RPU over wireless link 18. (EX1005, 25:4-10; FIG. 1.)

7. Claim 5

a. [Preamble] *A hearing enhancement system as recited in claim 1,*

58. This element is met as described for claim 1.

b. [A] wherein the audio system receives the input signals from a microphone.

59. Anderson discloses that “sounds from the ambient environment are picked up by a microphone 12 in the earpiece 10 and transmitted ... over a primary two-way wireless link 17 to the RPU 16, where the audio signals are enhanced according to the user’s needs by the RPU DSP 948.” (EX1005, 22:64-23:5.) FIG. 1 illustrates:

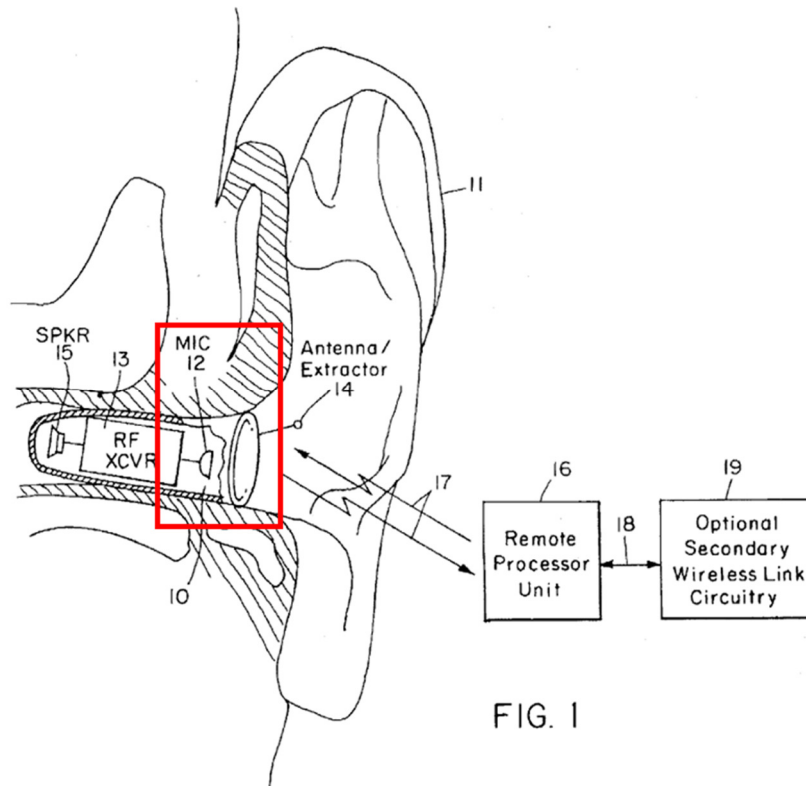


FIG. 1

(EX1005, FIG. 1 (annotated).)

60. Thus, Anderson teaches the sounds in the ambient environment are input signals received from the earpiece microphone. (EX1005, 22:61-23:5.)

8. Claim 6

- a. ***[Preamble] A hearing enhancement system as recited in claim 1,***

61. This element is met as described for claim 1.

- b. ***[A] wherein the down-converted signals are modified such that a portion of the audio output signals has an increased power to enhance the hearing of the user.***

62. Anderson discloses that “amplification and other forms of signal enhancement, take[] place in the RPU.” (EX1005, 2:35-37.) The POSITA would understand that amplifying down-converted signals in the RPU increases their power, because signal power increases in proportion to the square of signal amplitude. (EX1011, 5-7.) Anderson discloses that amplification levels set by the RPU are “hearing aid parameters” used to “provide hearing enhancement.” (EX1005, 23:30-31; 23:51-52.) Thus, the amplification of the down-converted signals increases audio signal power to enhance user hearing.

63. In addition, Anderson teaches that such amplification can vary with frequency, based on the user’s hearing characteristics. (EX1005, 27:4-17.) For example, the RPU DSP applies “gain vs. frequency parameters” derived from a hearing test to compensate for loss at specific frequency bands. (EX1005, 27:4-17.) Thus, using Anderson’s amplification techniques, the RPU increases the power of certain portions of the audio signal (e.g., such as frequency bands

corresponding to the user's hearing loss) to enhance those frequencies relative to others.

9. Claim 8

a. [Preamble] *A hearing enhancement system as recited in claim 1,*

64. This element is met as described for claim 1.

b. [A] *wherein the at least one hearing characteristic of the user is determined via calibrating the user's hearing,*

65. Anderson discloses that hearing tests can be performed to determine hearing loss at different frequencies. (EX1005, 27:4-17.) For example, the “RPU DSP 948 can be used to generate tones of varying frequencies and amplitudes... to perform a hearing test that determines appropriate gain vs. frequency parameters for a program stored in the RPU DSP 948 that performs signal enhancement to compensate for the user's hearing loss.” (EX1005, 27:9-17.) The POSITA would understand that the user's hearing loss with respect to frequency used to determine appropriate gain vs. frequency parameters corresponds to the claimed “hearing characteristic.” This is at least because the '789 patent discloses that during calibration, the system “generates different SPL at each [frequency] band” and creates the hearing profile based on the “specific power level that the user feels most comfortable” for each frequency band, indicating that the hearing characteristic obtained through calibration represents hearing loss with respect to

frequency. (EX1001, 7:28-41.) Accordingly, Anderson describes determining hearing characteristics, such as the user's hearing loss across frequencies, by calibrating the user's hearing with a hearing test. (EX1005, 27:4-17.)

c. [B] *wherein the power of the audio output signals can be changed as a function of frequency, and*

66. As described above, Anderson's hearing test "determines appropriate gain vs. frequency parameters for a program stored in the RPU DSP 948 that performs signal enhancement." (EX1005, 27:14-16.) That is, the RPU DSP 948 adjusts the gain (and therefore, power) of the audio signal based on frequency.

d. [C] *wherein the user can change the power of the audio output signals.*

67. Anderson discloses the system can include "[a]n RPU keyboard suitable for covert data entry 72, or voice recognition capabilities in the RPU ... used to control hearing aid parameters (such as amplification level set by the RPU DSP 948)." (EX1005, 23:26-31.) Thus, a user can change the amplification (and thereby power, as described for claim 6[A]) of audio output signals using an input mechanism.

10. Claim 11

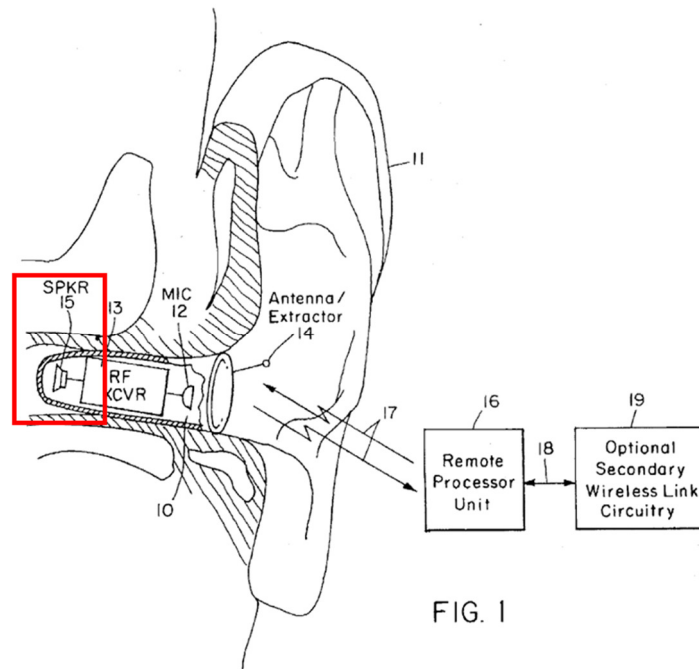
a. [Preamble] *A hearing enhancement system as recited in claim 1,*

68. This element is met as described for claim 1.

b. [A] wherein the speaker is an ear speaker.

69. Anderson discloses the enhanced audio signals are “converted by a speaker 15 to sounds that can only be heard by the user 11.” (EX1005, 23:13-14.)

FIG. 1 illustrates speaker 15 in an ear 11:



(EX1005, 3:52-64, FIG. 1 (annotated).)

70. Thus, speaker 15, as part of earpiece 10 that is “worn in the ear,” is an ear speaker. (EX1005, 3:52-64, FIG. 1.)

11. Claim 12

a. [Preamble] A hearing enhancement system as recited in claim 1,

71. This element is met as described for claim 1.

b. [A] wherein the speaker is in a headset.

72. Anderson discloses that the earpiece can be a headset comprising a speaker. (EX1005, 5:46-49.) FIG. 2 illustrates such an example:

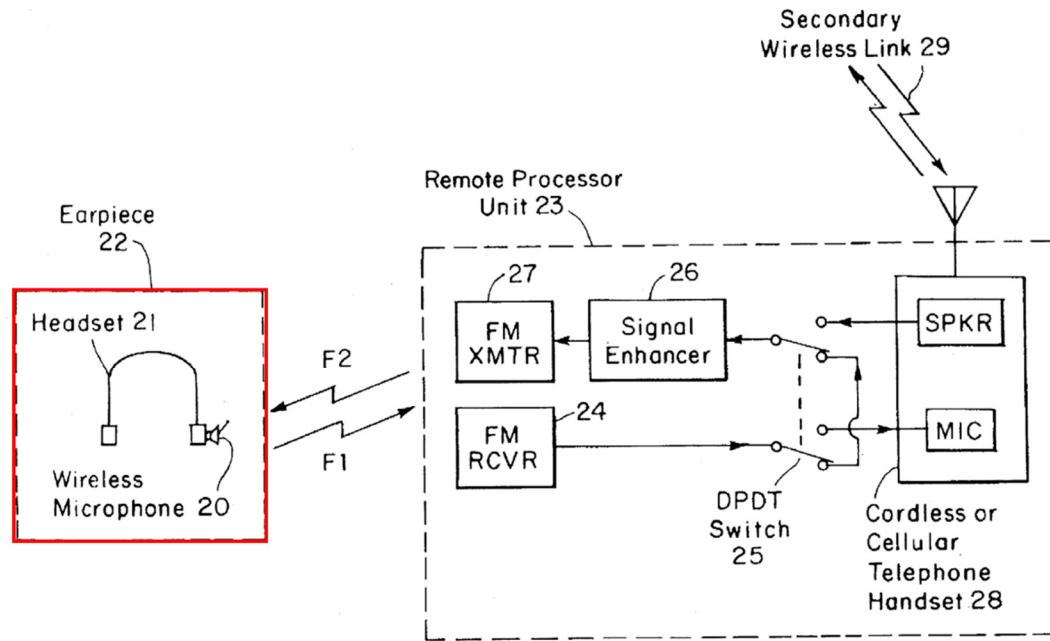


FIG. 2

(EX1005, FIG. 2 (annotated).)

12. Claim 13

- a. [Preamble] A hearing enhancement apparatus for a user, the apparatus being wirelessly coupled to an audio system, which is configured to up-convert input signals into up-converted signals to be wirelessly transmitted, the apparatus comprising:**

73. This element is met as described for claim 1, preamble and 1[A].

- b. ***[A] a wireless receiver configured to wirelessly receive the up-converted signals;***

74. This element is met as described for claim 1[B].

- c. ***[B] a down-converter configured to down-convert the received up-converted signals into down-converted signals;***

75. This element is met as described for claim 1[C].

- d. ***[C] a modifier configured to modify the down-converted signals into modified signals based on at least one hearing characteristic of the user to enhance the hearing of the user; and***

76. This element is met as described for claim 1[D].

- e. ***[D] a speaker configured to generate audio output signals from the modified signals for the user.***

77. This element is met as described for claim 1[E].

13. Claim 14

- a. ***[Preamble] A hearing enhancement apparatus as recited in claim 13,***

78. This element is met as described for claim 13.

- b. ***[A] wherein the down-converted signals are modified such that a portion of the audio output signals has an increased power to enhance the hearing of the user.***

79. This element is met as described for claim 6[A].

14. Claim 19

- a. **[Preamble] *A hearing enhancement apparatus as recited in claim 13,***

80. This element is met as described for claim 13.

- b. **[A] *wherein the up-converted signals are in the WiFi frequency band.***

81. This element is met as described for claim 2[A].

15. Claim 20

- a. **[Preamble] *A hearing enhancement apparatus as recited in claim 13,***

82. This element is met as described for claim 13.

- b. **[A] *wherein the at least one hearing characteristic of the user is determined via calibrating the user's hearing,***

83. This element is met as described for claim 8[A].

- c. **[B] *wherein the power of the audio output signals can be changed as a function of frequency, and***

84. This element is met as described for claim 8[B].

- d. **[C] *wherein the user can change the power of the audio output signals.***

85. This element is met as described for claim 8[C].

16. Claim 22

- a. **[Preamble] *A hearing enhancement apparatus as recited in claim 13,***

86. This element is met as described for claim 13.

- b. [A] *wherein the down-converted signals are further modified based on the noise level of the environment of the apparatus.***

87. Anderson discloses “auxiliary body-worn microphones ... may be used to measure background noise for the purpose of automatically setting hearing aid parameters.” (EX1005, 7:10-13.) Hearing aid parameters include “amplification level[s] set by the RPU DSP 948” or “gain vs. frequency parameters.” (EX1005, 23:30-31, 27:15.) Further, Anderson discloses “adaptive volume control,” which modifies amplification levels of the down-converted signals based on measured background noise levels in the RPU’s environment. (EX1005, 2:4-6, 21:55-56.)

17. Claim 23

- a. [Preamble] *A hearing enhancement apparatus as recited in claim 13,***

88. This element is met as described for claim 13.

- b. [A] *wherein the apparatus is also configured to operate as at least a part of a phone.***

89. Anderson discloses providing “communication services (*e.g.*, cellular telephone and paging services) to the user via the hearing aid system.” For example, as illustrated in FIG. 2, RPU 23 may be integrated with telephone handset 28:

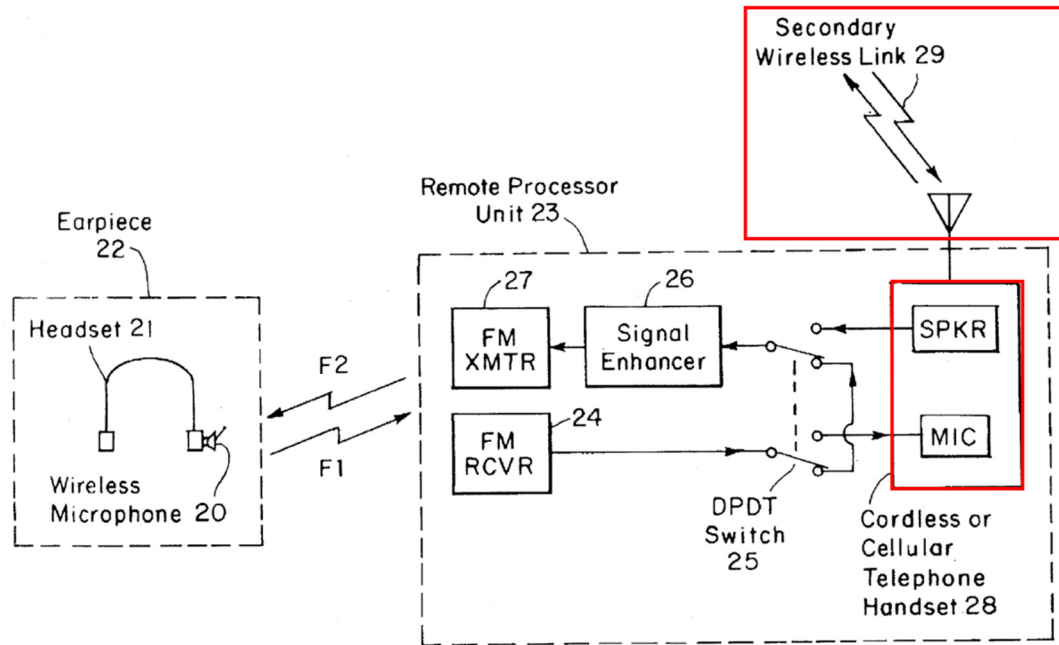


FIG. 2

(EX1005, 5:61-6:3, FIG. 2 (annotated).)

18. Claim 24

- a. **[Preamble]** *A hearing enhancement apparatus as recited in claim 13,*

90. This element is met as described for claim 13.

- b. **[A]** *wherein the at least one hearing characteristic of the user is wirelessly received and stored in the hearing enhancement apparatus.*

91. Anderson discloses that the earpiece can be configured to operate as a standalone hearing aid. (EX1005, 22:11-20.) For example, the earpiece stores hearing aid parameters “that control the stand-alone earpiece operation ... in the earpiece CIC default parameter storage.” (EX1005, 22:27-29.) Such parameters

include “a constant (read from the default parameter storage 870) to provide amplification [and]... maximum allowable values.” (EX1005, 21:52-54.) Such parameters can be altered using the RPU, which communicates with the earpiece wirelessly. (EX1005, 22:35-61.) For example, “information that is to ultimately be loaded into the earpiece default parameter storage 870 is then transmitted by the RPU,” and subsequently “received by the earpiece,” and “loaded into the CIC default parameter storage 870.” (EX1005, 22:55-60.) The POSITA would understand that the transmitted hearing aid parameters wirelessly represent hearing characteristics of the user. For example, the amplification constant represents a degree of the user’s hearing loss.

19. Claim 27

- a.** [Preamble] *A hearing enhancement apparatus as recited in claim 13,*

92. This element is met as described for claim 13.

- b.** [A] *wherein the speaker is an ear speaker.*

93. This element is met as described for claim 11[A].

20. Claim 28

- a.** [Preamble] *A hearing enhancement apparatus as recited in claim 13,*

94. This element is met as described for claim 13.

b. ***[A] wherein the speaker is in a headset.***

95. This element is met as described for claim 12[A].

21. Claim 29

a. ***[Preamble] A hearing enhancement apparatus as recited in claim 13,***

96. This element is met as described for claim 13.

b. ***[A] wherein the audio system is configured to operate as a phone,***

97. This element is met as described for claim 4[A].

c. ***[B] wherein the hearing enhancement apparatus is configured to operate in conjunction with or at least as a part of a mobile phone,***

98. This element is met as described for claim 23[A].

d. ***[C] wherein the speaker is an ear speaker, and***

99. This element is met as described for claim 11[A].

e. ***[D] wherein to enhance the hearing of the user, the modifier is configured to modify the down-converted signals into modified signals at one or more frequencies within the audio frequencies, with the one or more frequencies being determined by the at least one hearing characteristic of the user.***

100. As described above, Anderson discloses that hearing characteristics can be identified using a hearing test that “determines appropriate gain vs. frequency parameters for a program stored in the RPU DSP 948 that performs signal enhancement to compensate for the user’s hearing loss.” (EX1005, 27:14-

17.) That is, the stored program adjusts the gain of the audio signals at one or more frequencies based on the hearing characteristics (*e.g.*, the user's hearing loss with respect to frequency) identified by the hearing test. (EX1005, 27:4-24.)

22. Claim 30

- a. **[Preamble] *A hearing enhancement apparatus as recited in claim 29,***

101. This element is met as described for claim 29.

- b. **[A] *wherein the at least one hearing characteristic of the user is determined via calibrating the user's hearing at least across the one or more frequencies to generate at least a portion of the hearing profile of the user, and***

102. As discussed above, Anderson discloses that hearing tests can be performed by the earpiece and RPU for determining hearing loss at different frequencies. (EX1005, 27:4-17.) In one example, the "RPU DSP 948 can be used to generate tones of varying frequencies and amplitudes ... to perform a hearing test that determines appropriate gain vs. frequency parameters for a program ... that performs signal enhancement to compensate for the user's hearing loss."

(EX1005, 27:9-17.) The POSITA would understand that the user's measured hearing loss with respect to frequency corresponds to the claimed "hearing characteristic" and the gain vs. frequency parameters correspond to the claimed "hearing profile." This is at least because the '789 patent discloses that "the user's hearing is profiled so that frequency amplification is tailored to the user," and

“[t]hrough calibration, the user's hearing profile can be generated.” (EX1001, 3:59-60, 7:31-32.) For example, the '789 patent describes that during calibration, the system “generates different SPL at each [frequency] band” and creates the hearing profile based on the “specific power level that the user feels most comfortable” for each frequency band, indicating that the hearing profile represents amplification (or gain) with respect to frequency. (EX1001, 7:34-36.)

Accordingly, the system of Anderson calibrates the user's hearing via a hearing test, which utilizes tones of varying frequencies to generate the hearing profile, including gain vs. frequency parameters, based on the user's hearing loss with respect to frequency. (EX1005, 27:4-24.)

c. [B] *wherein the hearing profile is stored in the hearing enhancement apparatus.*

103. Anderson discloses the “gain vs. frequency parameters” are for “a program stored in the RPU DSP 948 that performs signal enhancement.” (EX1005, 27:14-16.) That is, the gain vs. frequency parameters and the signal enhancement program utilizing those parameters are stored in the RPU DSP 948.

23. Claim 31

a. [Preamble] *A hearing enhancement apparatus as recited in claim 30,*

104. This element is met as described for claim 30.

- b. ***[A] wherein the hearing enhancement apparatus allows the user to calibrate the user's hearing via a computing device.***

105. Anderson discloses that the hearing test used to calibrate the user's hearing is performed by the RPU DSP. (EX1005, 27:4-17.) The DSP (digital signal processor) is a computing device at least because Anderson describes DSPs as being a computer and that the RPU 16 can be used in lieu of a laptop computer. (EX1005, 2:46-51, 26:24-31.)

24. Claim 33

- a. ***[Preamble] A hearing enhancement apparatus as recited in claim 30,***

106. This element is met as described for claim 30.

- b. ***[A] wherein at least a portion of the at least one hearing characteristic of the user is wirelessly received by and stored in the hearing enhancement apparatus.***

107. This element is met as described for claim 24[A].

25. Claim 34

- a. ***[Preamble] A hearing enhancement apparatus as recited in claim 33,***

108. This element is met as described for claim 33.

- b. ***[A] wherein the hearing enhancement apparatus is a headset.***

109. This element is met as described for claim 12[A].

26. Claim 35

- a. **[Preamble] *A hearing enhancement apparatus as recited in claim 33,***

110. This element is met as described for claim 33.

- b. **[A] *wherein the hearing enhancement apparatus is a computing device that is wearable.***

111. Anderson discloses that the hearing aid includes the “remote processor unit (RPU) worn by or located near the user.” (EX1005, 1:8-9.) The RPU includes “a digital signal processor or other computer.” (EX1005, 2:46-47.) Thus, the RPU is a wearable computing device. (EX1005, 1:6-11, 2:46-47.)

27. Claim 36

- a. **[Preamble] *A hearing enhancement apparatus as recited in claim 33,***

112. This element is met as described for claim 33.

- b. **[A] *wherein the hearing enhancement apparatus is a mobile phone.***

113. This element is met as described for claim 23[A].

28. Claim 39

- a. **[Preamble] *A hearing enhancement apparatus as recited in claim 29,***

114. This element is met as described for claim 29.

- b. *[A] wherein at least a portion of the at least one hearing characteristic is wirelessly received by and stored in the hearing enhancement apparatus.*

115. This element is met as described for claim 24[A].

29. Claim 40

- a. *[Preamble] A hearing enhancement apparatus as recited in claim 39,*

116. This element is met as described for claim 39.

- b. *[A] wherein the hearing enhancement apparatus is a headset.*

117. This element is met as described for claim 12[A].

30. Claim 41

- a. *[Preamble] A hearing enhancement apparatus as recited in claim 39,*

118. This element is met as described for claim 39.

- b. *[A] wherein the hearing enhancement apparatus is a computing device that is wearable.*

119. This element is met as described for claim 35[A].

31. Claim 42

- a. *[Preamble] A hearing enhancement apparatus as recited in claim 39,*

120. This element is met as described for claim 39.

- b. ***[A] wherein the hearing enhancement apparatus is a mobile phone.***

121. This element is met as described for claim 23[A].

32. Claim 43

- a. ***[Preamble] A hearing enhancement apparatus as recited in claim 29,***

122. This element is met as described for claim 29.

- b. ***[A] wherein the hearing enhancement apparatus is configured to alter a power level of the audio output signals based on a noise level of the environment of the apparatus.***

123. This element is met as described for claim 22[A].

33. Claim 44

- a. ***[Preamble] A hearing enhancement apparatus as recited in claim 43,***

124. This element is met as described for claim 43.

- b. ***[A] wherein the hearing enhancement apparatus is configured to increase the power of the audio output signals as the noise level increases, and***

125. Anderson discloses that “auxiliary body-worn microphones ... may be used to measure background noise for the purpose of automatically setting hearing aid parameters.” (EX1005, 7:10-12.) Hearing aid parameters include “amplification level[s] set by the RPU DSP 948.” (EX1005, 23:30-31.) Further, Anderson discloses that the system can perform “adaptive volume control,” as

described for claim 22[A]. (EX1005, 2:4-6, 21:55-56.) In view of the above disclosures, the POSITA would have understood that Anderson's adaptive volume control included increasing amplification levels (and thereby power) automatically as measured background noise increases.

- c. ***[B] wherein the hearing enhancement apparatus is configured not to further increase the power of the audio output signals if the noise level is beyond a certain predetermined threshold.***

126. Anderson discloses that the system stores “settings for the nominal and maximum allowable earpiece volume,” ensuring audio does not exceed these limits. (EX1005, 22:32-33.) The system also performs adaptive volume control, adjusting amplitude based on noise levels. (EX1005, 2:4-6, 21:55-56, 7:10-12.) That is, amplification stops before exceeding the maximum volume, preventing further increases in audio output power when background noise surpasses a certain level. (EX1005, 2:4-6, 21:55-56, 7:10-12.)

34. Claim 45

- a. ***[Preamble] A hearing enhancement apparatus as recited in claim 29,***

127. This element is met as described for claim 29.

- b. [A] *wherein the apparatus includes a volume control that is configured to respond to a voice command of the user.***

128. Anderson discloses “[v]oice commands recognized by the RPU can cause the RPU to initiate actions such as changing hearing aid parameter settings (*e.g.*, volume).” (EX1005, 25:22-24.) Thus, the RPU includes a volume control that responds to a voice command. (EX1005, 25:22-24.)

35. Claim 46

- a. [Preamble] *A hearing enhancement apparatus as recited in claim 13,***

129. This element is met as described for claim 13.

- b. [A] *wherein the hearing enhancement apparatus is a headset.***

130. This element is met as described for claim 12[A].

36. Claim 47

- a. [Preamble] *A hearing enhancement apparatus as recited in claim 46,***

131. This element is met as described for claim 46.

- b. [A] *wherein the speaker is an ear speaker.***

132. This element is met as described for claim 11[A].

37. Claim 48

- a. **[Preamble] *A hearing enhancement apparatus as recited in claim 47,***

133. This element is met as described for claim 47.

- b. **[A] *wherein the audio output signals are changed in view of a preference of the user stored in the apparatus.***

134. Anderson discloses that a user can alter hearing aid parameters using an input mechanism. (EX1005, 2:51-55.) For example, “to change information in the earpiece CIC default parameter storage 870, ...[t]he RPU keyboard 946 is then used to enter a command to the DSP 948 that indicates the user’s desire to change information in the default parameter storage 870, followed by the new information to be stored.” (EX1005, 22:44-51.) Such stored parameters include “settings for the nominal and maximum allowable earpiece volume,” and indicate the user’s preference. (EX1005, 22:32-33.)

38. Claim 49

- a. **[Preamble] *A hearing enhancement apparatus as recited in claim 48,***

135. This element is met as described for claim 48.

- b. **[A] *wherein the audio output signals are changed based on audio sound in the environment of the apparatus.***

136. This element is met as described for claim 22[A].

39. Claim 50

- a. **[Preamble] *A hearing enhancement apparatus as recited in claim 49 further comprising***

137. This element is met as described for claim 49.

- b. **[A] *a microphone at least for receiving the audio sound in the environment of the apparatus.***

138. Anderson discloses that “auxiliary body-worn microphones ... may be used to measure background noise.” (EX1005, 7:10-12.) The auxiliary body-worn microphones receive noise from the environment of the apparatus. (EX1005, 7:10-12.)

40. Claim 52

- a. **[Preamble] *A hearing enhancement apparatus as recited in claim 46,***

139. This element is met as described for claim 46.

- b. **[A] *wherein the audio output signals are changed in view of a preference of the user stored in the apparatus.***

140. This element is met as described for claim 48[A].

41. Claim 53

- a. **[Preamble] *A hearing enhancement apparatus as recited in claim 46,***

141. This element is met as described for claim 46.

- b. *[A] wherein the audio output signals are changed based on audio sound in the environment of the apparatus.*

142. This element is met as described for claim 22[A].

42. Claim 54

- a. *[Preamble] hearing enhancement apparatus as recited in claim 53 further comprising*

143. This element is met as described for claim 53.

- b. *[A] a microphone at least for receiving the audio sound in the environment of the apparatus.*

144. This element is met as described for claim 50[A].

43. Claim 55

- a. *[Preamble] A hearing enhancement apparatus as recited in claim 13,*

145. This element is met as described for claim 13.

- b. *[A] wherein the hearing enhancement apparatus is a mobile phone.*

146. This element is met as described for claim 23[A].

44. Claim 56

- a. *[Preamble] A hearing enhancement apparatus as recited in claim 55,*

147. This element is met as described for claim 55.

- b. *[A] wherein the audio output signals are modified in view of a preference of the user stored in the apparatus.*

148. This element is met as described for claim 48[A].

45. Claim 57

- a. *[Preamble] A hearing enhancement apparatus as recited in claim 56,*

149. This element is met as described for claim 56.

- b. *[A] wherein the audio output signals are modified based on audio sound in the environment of the apparatus.*

150. This element is met as described for claim 22[A].

46. Claim 58

- a. *[Preamble] A hearing enhancement apparatus as recited in claim 57 further comprising*

151. This element is met as described for claim 57.

- b. *[A] a microphone at least for receiving the audio sound in the environment of the apparatus.*

152. This element is met as described for claim 50[A].

47. Claim 60

- a. *[Preamble] A hearing enhancement apparatus as recited in claim 55,*

153. This element is met as described for claim 55.

- b. *[A] wherein the audio output signals are modified based on audio sound in the environment of the apparatus.*

154. This element is met as described for claim 22[A].

48. Claim 61

- a. *[Preamble] A hearing enhancement apparatus as recited in claim 60 further comprising*

155. This element is met as described for claim 60.

- b. *[A] a microphone at least for receiving the audio sound in the environment of the apparatus.*

156. This element is met as described for claim 50[A].

49. Claim 62

- a. *[Preamble] hearing enhancement apparatus as recited in claim 13,*

157. This element is met as described for claim 13.

- b. *[A] wherein at least a portion of the hearing enhancement apparatus is in a head-mounted electronic device.*

158. This element is met as described for claim 12[A].

50. Claim 63

- a. *[Preamble] A hearing enhancement apparatus as recited in claim 62,*

159. This element is met as described for claim 62.

- b. ***[A] wherein the apparatus comprises a volume control that is configured to respond to a voice command.***

160. This element is met as described for claim 45[A].

51. Claim 64

- a. ***[Preamble] A hearing enhancement apparatus as recited in claim 62,***

161. This element is met as described for claim 62.

- b. ***[A] wherein the apparatus is configured to recognize at least a voice command from the user and operate according to the voice command.***

162. Anderson discloses “voice recognition computer programs implemented in the RPU electronics.” (EX1005, 25:18-19.) For example, “[v]oice commands recognized by the RPU can cause the RPU to initiate actions such as changing hearing aid parameter settings (*e.g.*, volume).” (EX1005, 25:22-24.) Thus, the RPU recognizes voice commands and operates accordingly. (EX1005, 25:16-24.)

52. Claim 65

- a. ***[Preamble] A hearing enhancement apparatus as recited in claim 64,***

163. This element is met as described for claim 64.

- b. *[A] wherein the at least one hearing characteristic of the user is identified via measuring the user's hearing at least across a plurality of frequencies.*

164. This element is met as described for claim 30[A].

53. Claim 66

- a. *[Preamble] A hearing enhancement apparatus as recited in claim 65,*

165. This element is met as described for claim 65.

- b. *[A] wherein the hearing enhancement apparatus is configured to alter a power level of the audio output signals so as to suppress at least a sound level associated with the environment of the apparatus so as to provide noise cancellation.*

166. Anderson discloses that “[t]he system is also capable of tinnitus masking and performing active noise cancellation to potentially enhance a user’s mental concentration abilities using techniques well known in the art and implemented in the RPU DSP 948.” (EX1005, 23:55–58.) Anderson further explains that “[t]he hearing protection function is achieved by limiting the amplitude of the audio signal produced by the earpiece (such limiting taking place in the earpiece under control of the ASIC 845), and also by having the earpiece create sound waves in opposition to sounds in the environment to effectively cancel loud sounds (using techniques well known in the art and implemented in the RPU DSP 948).” (EX1005, 23:58-65.) By limiting the amplitude of the audio

signal and generating opposing sound waves, Anderson's system reduces the amplitude of sound reaching the user's ear. A POSITA would have understood that altering amplitude directly also alters power, since the power of an audio or electrical signal is proportional to the square of its amplitude. (EX1011, 5-7.) Accordingly, Anderson teaches adjusting the amplitude (and therefore the power) of the audio signal to suppress a sound level of the environment. (EX1005, 23:53–65.)

54. Claim 67

- a. ***[Preamble] A hearing enhancement apparatus as recited in claim 66 further comprising***

167. This element is met as described for claim 66.

- b. ***[A] a microphone configured to receive audio sound at the environment of the apparatus for determining the sound level associated with the environment of the apparatus.***

168. This element is met as described for claim 50[A].

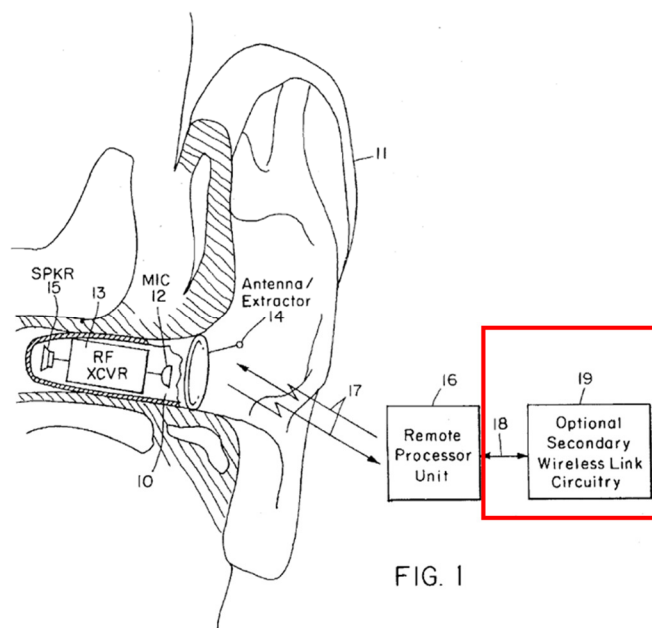
55. Claim 68

- a. ***[Preamble] A hearing enhancement apparatus as recited in claim 67,***

169. This element is met as described for claim 67.

b. [A] wherein the apparatus is configured to wirelessly couple to a cell phone.

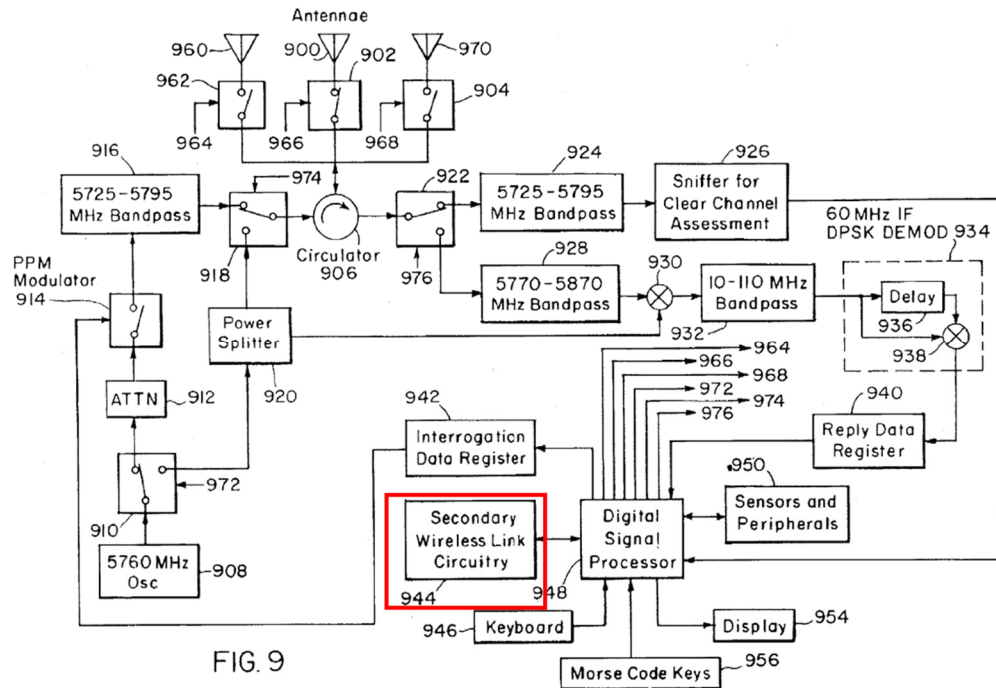
170. Anderson discloses that “a separate cellular telephone transceiver not physically integrated with the RPU can be worn on the user’s wrist ... and communicate with an RPU ... via a wired or wireless two-way link” as shown, *e.g.*, in link 18 of FIG. 1:



(EX1005, 25:4-9, FIG. 1 (annotated).)

171. Anderson also discloses a “secondary two-way wireless link ... can be used for communication between the RPU and a cellular telephone system.”

(EX1005, 23:19-25.) FIG. 9 illustrates:



(EX1005, FIG. 9 (annotated).)

172. That is, the RPU wirelessly couples to a cellular phone using a wireless link.

56. Claim 70

- a. **[Preamble]** *A hearing enhancement apparatus as recited in claim 64,*

173. This element is met as described for claim 64.

- b. **[A]** *wherein the hearing enhancement apparatus is configured to alter a power level of the audio output signals so as to suppress at least a sound level associated with the environment of the apparatus so as to provide noise cancellation.*

174. This element is met as described for claim 66[A].

57. Claim 71

- a. ***[Preamble] A hearing enhancement apparatus as recited in claim 70 further comprising***

175. This element is met as described for claim 70.

- b. ***[A] a microphone configured to receive audio sound at the environment of the apparatus for determining the sound level associated with the environment of the apparatus.***

176. This element is met as described for claim 50[A].

58. Claim 72

- a. ***[Preamble] A hearing enhancement apparatus as recited in claim 71,***

177. This element is met as described for claim 71.

- b. ***[A] wherein the apparatus is configured to wirelessly couple to a cell phone.***

178. This element is met as described for claim 68[A].

59. Claim 75

- a. ***[Preamble] A hearing enhancement apparatus as recited in claim 62,***

179. This element is met as described for claim 62.

- b. ***[A] wherein the apparatus is configured to wirelessly couple to a cell phone.***

180. This element is met as described for claim 68[A].

60. Claim 77

- a. **[Preamble]** *A hearing enhancement apparatus as recited in claim 62,*

181. This element is met as described for claim 62.

- b. **[A]** *wherein the at least one hearing characteristic of the user is identified via measuring the user's hearing at least across a plurality of frequencies.*

182. This element is met as described for claim 65[A].

61. Claim 78

- a. **[Preamble]** *A hearing enhancement apparatus as recited in claim 77,*

183. This element is met as described for claim 77.

- b. **[A]** *wherein the hearing enhancement apparatus assists in measuring the user's hearing.*

184. Anderson discloses the RPU DSP 948 can perform the hearing test that measures the user's hearing. (EX1005, 27:4-17.)

62. Claim 79

- a. **[Preamble]** *A hearing enhancement apparatus as recited in claim 62,*

185. This element is met as described for claim 62.

- b. *[A] wherein information regarding the at least one hearing characteristic of the user is wirelessly received and stored in the hearing enhancement apparatus.*

186. This element is met as described for claim 24[A].

63. Claim 81

- a. *[Preamble] A hearing enhancement apparatus as recited in claim 62,*

187. This element is met as described for claim 62.

- b. *[A] wherein the hearing enhancement apparatus is configured to alter a power level of the audio output signals so as to suppress at least a sound level associated with the environment of the apparatus so as to provide noise cancellation.*

188. This element is met as described for claim 66[A].

64. Claim 82

- a. *[Preamble] A hearing enhancement apparatus as recited in claim 81 further comprising*

189. This element is met as described for claim 81.

- b. *[A] a microphone configured to receive audio sound at the environment of the apparatus for determining the sound level associated with the environment of the apparatus.*

190. This element is met as described for claim 50[A].

B. Ground 2: Claims 7 and 15-18 are Rendered Obvious by Anderson in view of Enzmann

191. It is my view that Anderson in view of Enzmann teaches every limitation of claims 7 and 15-18, for the reasons set forth below.

2. Summary of Enzmann

192. Enzmann is a patent issued to inventor Mark Enzmann. The underlying application (Appl. No. 10/341,293) was filed on January 1, 2003. (EX1006.) I understand Enzmann is thus prior art to the '789 patent under at least 35 U.S.C. §§102(a) and (e).

193. Enzmann relates to “a hearing aid capable of communicating with a wireless phone.” (EX1006, 1:7-9.) The hearing aid of Enzmann can function as an ear bud for the wireless phone as well as act as a conventional hearing aid. (EX1006, 1:5-11, 4:1-4.) For example, the ear bud can capture sounds via a microphone 205, manipulate the sounds using a DSP 220, and output sounds using speaker 250. (EX1006, 3:20-67.) FIG. 2 illustrates:

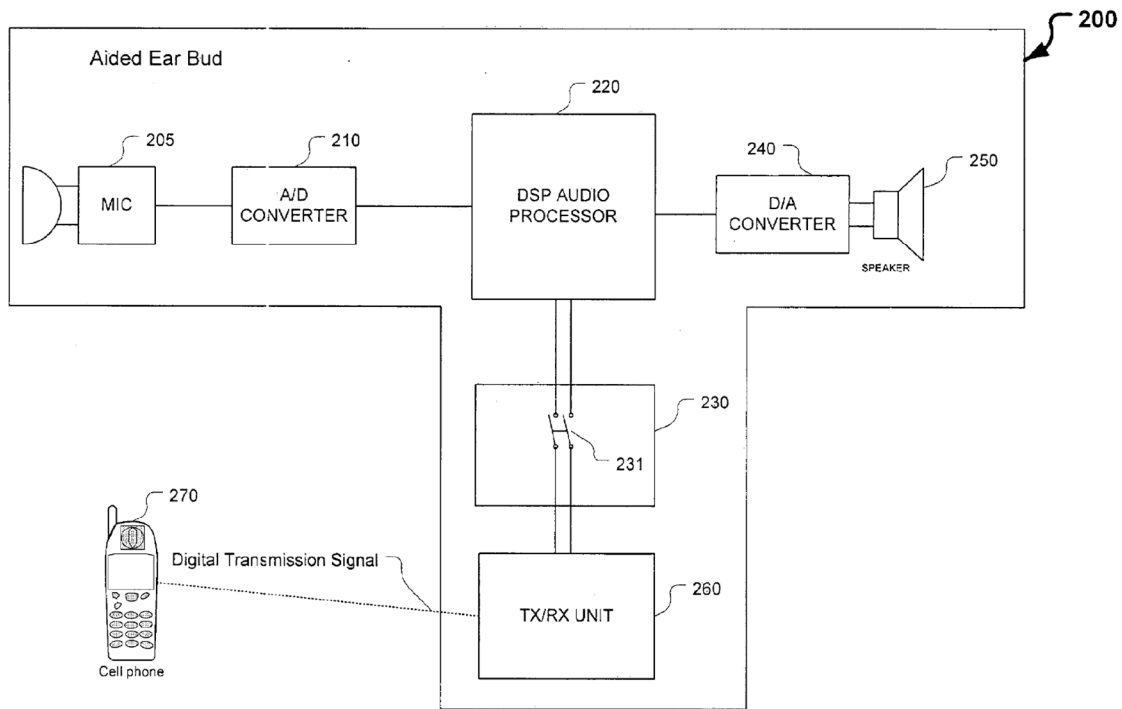


FIG. 2

(EX1006, FIG. 2.)

194. To amplify received audio signals, the DSP can adjust the audio signal based on “frequency mapping of the user’s hearing characteristics.” (EX1006, 3:40.) Enzmann is analogous art to the claimed invention at least because it is directed to the same field of endeavor—hearing aids that can wirelessly communicate with a mobile phone and modify a signal based on a user’s hearing characteristics.

3. Claim 7

- a. **[Preamble]** *A hearing enhancement system as recited in claim 6,*

195. This element is met as described for claim 6.

b. [A] *wherein the portion with increased power is selected based on frequency, and*

196. Anderson discloses the hearing test “determines appropriate gain vs. frequency parameters for a program stored in the RPU DSP 948 that performs signal enhancement to compensate for the user’s hearing loss.” (EX1005, 27:14-17.) Thus, Anderson teaches adjusting the gain (and thereby power) of the audio signal based on its frequency. (EX1005, 27:4-17; EX1011, 5-7.)

c. [B] *wherein a higher frequency portion has increased power.*

197. Enzmann discloses that the amplitude of the audio signals is modified based at least in part on amplification charts, which contain “a series of pre-stored dynamic frequency maps based on the user’s hearing characteristics.” (EX1006, 6:12-35.) An exemplary amplification chart indicating “the user lacks significant hearing capability in higher frequencies” is shown in FIG. 5:

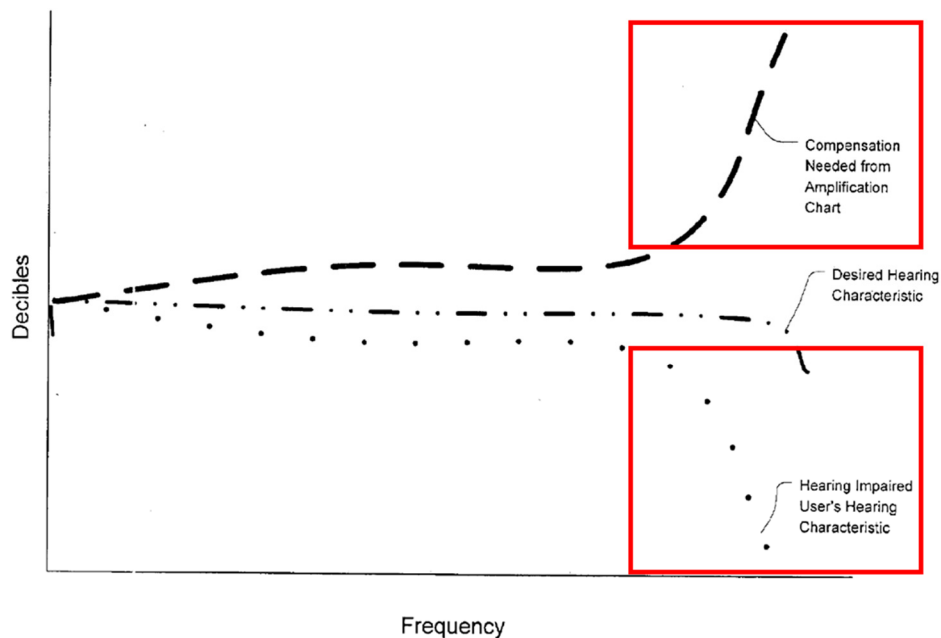


FIG. 5

(EX1006, 6:26-35, FIG. 5 (annotated).)

198. To compensate for such hearing loss, the amplification chart indicates a higher level of amplification is needed at higher frequencies than lower frequencies. (EX1006, 6:12-35.)

(ii) Motivation to Combine

199. The POSITA would have been motivated to combine the teachings of Anderson and Enzmann to meet the claim limitations. Anderson's RPU is configured to perform signal enhancement to compensate for the user's hearing loss based on gain vs. frequency parameters obtained by measuring a user's hearing characteristics. (EX1005, 27:4-17.) The POSITA would understand that

such gain vs. frequency parameters are user specific. Enzmann provides an example of such gain vs. frequency parameters in FIG. 5 for a user with decreased hearing in high frequency ranges. (EX1006, 6:12-35.) Because Enzmann explicitly teaches applying greater amplification at higher frequencies to correct high-frequency hearing loss, a POSITA would have recognized that incorporating Enzmann's frequency correction approach into Anderson's RPU would improve hearing enhancement for users with such high frequency loss. Accordingly, the POSITA would have been motivated to combine Enzmann's frequency-dependent correction with Anderson's system to achieve enhanced performance for users with high-frequency hearing loss.

200. The POSITA would have had a reasonable expectation of success in combining Anderson and Enzmann. Enzmann's techniques are broadly applicable to hearing aid devices and were "well-known techniques" used in hearing aids— analogous to Anderson's hearing aid system. (EX1006, 3:20-34.) Enzmann's signal amplification is implemented via digital logic 320 and DSP 220, analogous to DSP 948 of Anderson's RPU. (EX1006, 3:34-40, 3:59-4:13, 6:1-35; EX1005, 27:14-17.) Anderson and Enzmann also share other analogous components, such as microphones, speakers, digital to analog converters, analog to digital converters, and wireless transmitters and receivers. (EX1005, 2:25-28, 16:28-37; EX1006,

3:58-4:13, FIG. 2.) Enzmann and Anderson are thus easily combined based on familiar components.

4. Claim 15

- a.** **[Preamble]** *A hearing enhancement apparatus as recited in claim 14,*

201. This element is met as described for claim 14.

- b.** **[A]** *wherein the portion with the increased power is selected based on frequency,*

202. This element is met as described for claim 7[A].

- c.** **[B]** *wherein a higher frequency portion has increased power,*

203. This element is met as described for claim 7[B].

(ii) Motivation to Combine

204. The POSITA would have been motivated to combine the references as described for claim 7[B].

- d.** **[C]** *wherein the at least one hearing characteristic of the user is determined via calibrating the user's hearing,*

205. This element is met as described for claim 8[A].

- e.** **[D]** *wherein the power of the audio output signals can be changed as a function of frequency, and*

206. This element is met as described for claim 8[B].

- f. ***[E] wherein the user can change the power of the audio output signals.***

207. This element is met as described for claim 8[C].

5. Claim 16

- a. ***[Preamble] A hearing enhancement apparatus as recited in claim 15,***

208. This element is met as described for claim 15.

- b. ***[A] wherein the down-converted signals are further modified based on the noise level of the environment of the apparatus.***

209. This element is met as described for claim 22[A].

6. Claim 17

- a. ***[Preamble] A hearing enhancement apparatus as recited in claim 16,***

210. This element is met as described for claim 16.

- b. ***[A] wherein the apparatus is also configured to operate as at least a part of a phone.***

211. This element is met as described for claim 23[A].

7. Claim 18

- a. ***[Preamble] A hearing enhancement apparatus as recited in claim 14,***

212. This element is met as described for claim 14.

- b. ***[A] wherein the portion with increased power is selected based on frequency, and***

213. This element is met as described for claim 7[A].

c. [B] *wherein a higher frequency portion has increased power.*

214. This element is met as described for claim 7[B].

(ii) Motivation to Combine

215. The POSITA would have been motivated to combine the references as described for claim 7[B].

C. Ground 3: Claims 9, 10, 21, 26, 51, and 59 Are Rendered Obvious By Anderson In View Of Mayer

216. It is my view that Anderson in view of Mayer teaches every limitation of claims 9, 10, 21, 26, 51, and 59, for the reasons set forth below.

2. Summary of Mayer

217. Mayer is the publication of a United States patent application by inventors Yaron Mayer *et al.* I understand the underlying application (Appl. No. 10/693,823) was filed on October 23, 2003, claiming priority to two U.S. provisional applications filed on October 27, 2002, and October 30, 2002, respectively. (EX1007.) I understand Mayer is thus prior art to the '789 patent under at least 35 U.S.C. §§102(a) and (e).

218. Mayer relates to microphones and speakers. (EX1007, [0009].) The microphones of Mayer “can function without distortions or at least with much less distortions than conventional microphones over a much wider range of frequencies.” (EX1007, [0005].) The speakers of Mayer are an improvement over

conventional speakers because they have a broader frequency range and “less distortions than ordinary speakers.” (EX1007, [0009].) The microphones and speakers are directional and operate at ultrasonic frequencies. (EX1007, [0007], [0009], [0010].)

219. Mayer is analogous art to the claimed invention at least because it is directed to the same field of endeavor as the '789 patent; for example, Mayer describes improvement to microphones and speakers, which are components of the hearing aid devices of the '789 patent. (EX1001, 3:9-4:67.) Further, Mayer is reasonably pertinent to the problems faced by the '789 patent inventors, at least because the '789 patent describes utilizing microphones and speakers, as in Mayer, to address user hearing impairments. (EX1001, 3:9-4:67.)

3. Claim 9

- a. [Preamble] *A hearing enhancement system as recited in claim 1,***

220. This element is met as described for claim 1.

- b. [A] *wherein the speaker is configured to generate ultrasonic signals, with at least a portion of the ultrasonic signals transformed into the audio output signals in air.***

221. Mayer discloses “that interference patterns created between two or more high frequency sources can be used to create any lower-frequencies and volumes desired, thus creating also a membrane-less loudspeaker or earphone,”

and the “ultrasonic frequencies used in this case are close to the natural resonance frequency of the minute membranes.” (EX1007, [0009].) That is, the membrane-less speakers generate high-frequency ultrasonic signals that interfere with each other in air to produce lower frequency audible sound.

(ii) Motivation to Combine

222. The POSITA would have been motivated to combine the teachings of Anderson and Mayer to meet the claim limitations. Anderson’s hearing aid system is configured for hearing protection and noise cancellation simultaneous with binaural hearing aid functions. (EX1005, 1:14-16.) The POSITA would have understood that distortions in sounds produced by the speaker of Anderson’s hearing aid system would degrade the performance of such functions. Anderson’s hearing aid system would thus face a problem identified in Mayer: distortion caused by conventional speakers. (EX1007, [0009].) The POSITA would seek to minimize distortions in the audio output of Anderson’s hearing aid and would thus be motivated to combine Mayer with Anderson. This is because modifying Anderson’s system to incorporate Mayer’s low-distortion speakers would enable the system to produce clearer audio with reduced distortion, thereby improving the performance of its hearing protection and noise-cancellation functions. The POSITA would understand reduced distortion to be particularly beneficial in

hearing aid systems, as in Anderson, in which a main objective is to improve audio clarity and listenability for hearing-impaired users.

223. The POSITA would have had a reasonable expectation of success in combining Anderson and Mayer. Mayer's speakers are broadly applicable to systems that reproduce sounds, including loudspeakers and earphones—analogous to Anderson's hearing aid including a speaker. (EX1007, [0009]; EX1005, 2:26-28.) Mayer's speaker is analogous to speaker 15 of Anderson's earpiece. Further, Mayer explicitly describes that the speakers can be very compact, increasing compatibility with an earpiece. (EX1007, [0009], [0018].) Anderson and Mayer are thus readily combined.

4. Claim 10

a. [Preamble] *A hearing enhancement system as recited in claim 1,*

224. This element is met as described for claim 1.

b. [A] *wherein the speaker is a directional speaker.*

225. Mayer describes that “various frequencies that are created are preferably mixed together for example within a hollow resonance box or for example a hyperbolic or parabolic reflector, depending on whether the desired output is more directional.” (EX1007, [0009].) That is, the speaker of Mayer is directional depending on how the frequencies are mixed together.

(ii) Motivation to Combine

226. The POSITA would have been motivated to combine the references as described for claim 9[A]. Further, the POSITA would have been motivated to combine the teachings of Anderson and Mayer to incorporate Mayer's directional speaker design. While Mayer's low-distortion characteristics would already have improved the clarity of Anderson's audio output, Mayer also discloses optional directional configurations that further enhance system performance. (EX1007, [0009].) A POSITA would have recognized that using Mayer's directional structure would increase acoustic efficiency, by focusing sound energy toward the user's ear (and limiting the projection of sound energy away from the ear); and further would reduce sound radiation that could cause unwanted feedback to Anderson's system microphone. Accordingly, combining Mayer's directional speaker configuration with Anderson's hearing aid system would provide clearer, more efficient audio output while minimizing feedback.

227. The POSITA would have had a reasonable expectation of success in combining Anderson and Mayer. Mayer's speakers are broadly applicable to systems that reproduce sounds, including loudspeakers and earphones—analogous to Anderson's hearing aid including a speaker. (EX1007, [0009]; EX1005, 2:26-28.) Mayer's speaker is analogous to speaker 15 of Anderson's earpiece. Further, Mayer explicitly describes that the speakers can be very compact, increasing

compatibility with an earpiece. (EX1007, [0009], [0018].) Anderson and Mayer are thus easily combined.

5. Claim 21

- a. **[Preamble] *A hearing enhancement apparatus as recited in claim 13,***

228. This element is met as described for claim 13.

- b. **[A] *wherein the speaker is configured to generate ultrasonic signals, with at least a portion of the ultrasonic signals transformed into the audio output signals in air.***

229. This element is met as described for claim 9[A].

(ii) Motivation to Combine

230. The POSITA would have been motivated to combine the references as described for claim 9[B].

6. Claim 26

- a. **[Preamble] *A hearing enhancement apparatus as recited in claim 13,***

231. This element is met as described for claim 13.

- b. **[A] *wherein the speaker is a directional speaker.***

232. This element is met as described for claim 10[A].

(ii) Motivation to Combine

233. The POSITA would have been motivated to combine the references as described for claim 9[A].

7. Claim 51

- a. [Preamble] *A hearing enhancement apparatus as recited in claim 50,***

234. This element is met as described for claim 50.

- b. [A] *wherein the microphone is a directional microphone.***

235. This element is met by Mayer. Mayer discloses “the microphone is naturally at least partially directional.” (EX1007, [0007].)

(ii) Motivation to Combine

236. The POSITA would have been motivated to combine the teachings of Anderson and Mayer to meet the claim limitation. Anderson’s hearing aid system is configured for hearing protection and noise cancellation simultaneous with binaural hearing aid functions. (EX1005, 1:14-16.) The POSITA would understand that distortions in sounds recorded by the microphone of Anderson’s hearing aid system would degrade the performance of such functions. Further, inability to pick up sounds across a wide frequency band would also degrade the performance of Anderson’s hearing aid. Anderson’s hearing aid system would thus face problems identified in Mayer: distortion and limited frequency ranges inherent in conventional microphones. (EX1007, [0004].) The POSITA would seek to minimize distortions while increasing frequency range of the audio input of

Anderson's microphone and would thus be motivated to combine Mayer with Anderson in order to do so.

237. The POSITA would have had a reasonable expectation of success in combining Anderson and Mayer. Mayer's microphones are broadly applicable to systems that record sounds—analogous to Anderson's hearing aid that includes a microphone. (EX1007, [0005]; EX1005, 2:26-28.) Mayer's microphone is analogous to microphone 12 of Anderson's earpiece. Further, Mayer explicitly describes that the microphones can be made very compact, increasing compatibility with an earpiece. (EX1007, [0010].) Anderson and Mayer are thus readily combined.

8. Claim 59

a. [Preamble] *A hearing enhancement apparatus as recited in claim 58,*

238. This element is met as described for claim 58.

b. [A] *wherein the microphone is a directional microphone.*

239. This element is met as described for claim 51[A].

(ii) Motivation to Combine

240. The POSITA would have been motivated to combine the references as described for claim 51[A].

D. Ground 4: Claims 32 and 37 are Rendered Obvious by Anderson in View of Gabara

241. It is my view that Anderson in view of Gabara teaches every limitation of claims 32 and 37, for the reasons set forth below.

2. Summary of Gabara

242. Gabara is a U.S. Patent filed on June 7, 2000. (EX1008.) I understand Gabara is thus prior art to the '789 patent under at least 35 U.S.C. §§102(a) and (e).

243. Gabara is directed to systems and methods for conveniently reconfiguring or readjusting the performance characteristics of a hearing aid. (EX1008, Abstract.) Gabara teaches that a person's quality of hearing can vary over time, and a hearing aid requires periodic adjustment to compensate. (EX1008, 1:59-63). Gabara is analogous art to the claimed invention at least because it is directed to the same field of endeavor—customizable hearing aid systems. Similarly, by disclosing improvements to hearing aid systems, Gabara further is reasonably pertinent to the problems of hearing impairment correction faced by the '789 patent inventors.

3. Claim 32

a. [Preamble] *A hearing enhancement apparatus as recited in claim 30,*

244. This element is met as described for claim 30.

- b. [A] *wherein the hearing enhancement apparatus is configured to periodically remind the user to calibrate the user's hearing.***

245. Gabara discloses that “[d]ue to the effects of aging or other environmental factors, a person’s quality of hearing may vary over time” such that “a customized hearing aid may require periodic adjustments to take into account changes in the user’s hearing characteristics.” (EX1008, 1:59-63.) Based on this disclosure, the POSITA would understand that a customized hearing aid needed to be re-calibrated periodically to work effectively.

246. Anderson teaches that the hearing aid system provides medical reminders to the user. (EX1005, 24:32-44.) For example, Anderson teaches “[t]he RPU may also contain a ... time of-day clock, which would allow a user to be alerted when it is time to take medication and be given verbal instructions on what to take.” (EX1005, 24:32-36.) For example, the “system can also remind a user to be in a certain location at a given time (‘appointment reminders’), ... to individuals such as nursing home residents.” (EX1005, 24:39-43.) Since Anderson’s hearing aid system is customized to the user, the POSITA would have also understood that Anderson’s hearing aid system that provides medical reminders could provide reminders to re-calibrate the hearing aid. (EX1005, 27:4-17.)

(ii) Motivation to Combine

247. The POSITA would have been motivated to combine the teachings of Anderson and Gabara to meet the claim limitation. Anderson's hearing aid system is a customized hearing aid that enhances audio signals based on a user's needs, which are determined based on a hearing test. (EX1005, 24:32-44.) The POSITA would understand that as a person's hearing changes over time, the effectiveness of Anderson's hearing aid would decrease unless the hearing test was repeated to update the hearing characteristics of the user. Anderson's hearing aid system would thus face a problem identified in Gabara: that periodic adjustments are required to take into account changes in the user's hearing characteristics. (EX1008, 1:61-63.) The POSITA would seek to minimize degradation in the function of Anderson's hearing aid and would thus modify Anderson's hearing aid system to provide reminders regarding hearing tests in addition to the other medical reminders already provided by the system.

248. The POSITA would have had a reasonable expectation of success in making this modification. Anderson already teaches providing medical reminders and instructions to a user based in part on an internal clock. (EX1005, 24:32-44.) It would be straightforward for this process to also include reminders for re-calibrating the user's hearing. Anderson is thus easily modified based on the teachings of Gabara.

4. Claim 37

- a. [Preamble] *A hearing enhancement apparatus as recited in claim 36,***

249. This element is met as described for claim 36.

- b. [A] *wherein the hearing enhancement apparatus is configured to periodically remind the user to calibrate the user's hearing.***

250. This element is met as described for claim 32[A].

(ii) Motivation to Combine

251. The POSITA would have been motivated to combine the references as described for claim 32[A].

E. Ground 5: Claim 76 is rendered obvious by Anderson in view of Rader

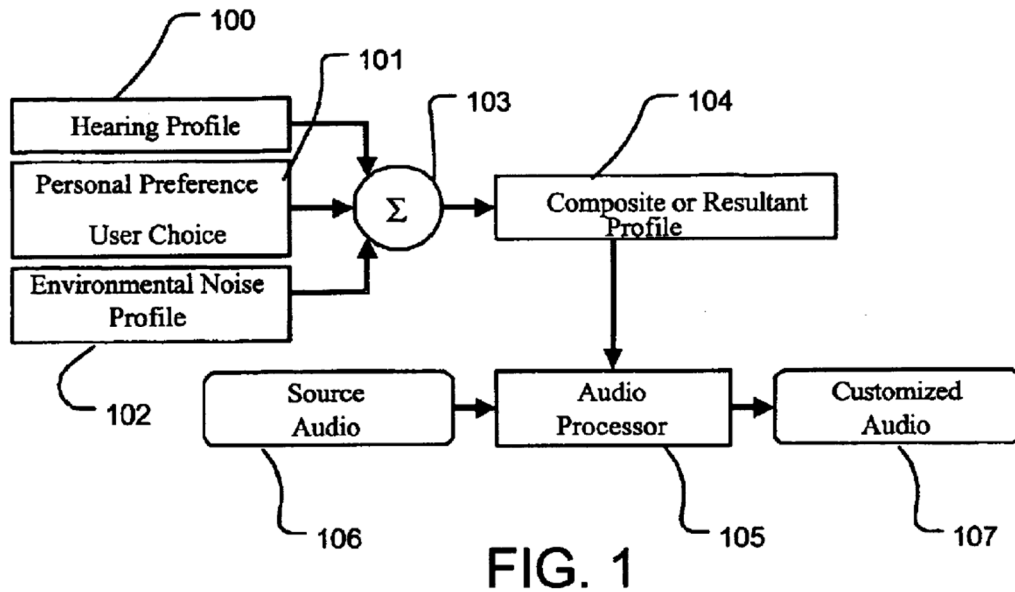
252. It is my view that Anderson in view of Rader teaches every limitation of claim 76, for the reasons set forth below.

2. Summary of Rader

253. Rader is a U.S. Patent issued to inventors R. Scott Rader *et al.* The underlying application (Appl. No. 09/957,344) was filed on September 20, 2001 and published on April 3, 2003. (EX1009.) I understand Rader is thus prior art to the '789 patent under at least 35 U.S.C. §§102(a) and (e).

254. Rader discloses techniques for enhancing sound based upon an individual's hearing profile, environmental factors, and personal choice using a

personal communication device. (EX1009, 1:9-15.) FIG. 1 illustrates forming a composite profile and using that to process audio:



(EX1009, 3:28-30, FIG. 1.)

255. Rader discloses that “[t]he personal choice of an individual may be important in setting customization parameters for delivery of enhanced audio.”

(EX1009, 8:59-61.) For example, the customization of audio is based on a “composite or resultant profile 104” which is a combination of “a hearing profile 100, a listener’s personal choice profile 101, and/or a profile 102 of the environmental noise.” (EX1009, 4:8-25, FIG. 1.)

256. In Rader, the power of the audio output is modified based on frequency because the “gain and compression ratio can vary with frequency,” based on a user’s combined audibility threshold. (EX1009, 7:5-6.) While Rader

describes the equations for the combined audibility threshold in terms of hearing impairment (THi), Rader also discloses that “THi could be replaced by, or supplemented with, a threshold parameter THc provided in response to information about a user’s personal choice.” (EX1009, 6:3-6.)

257. Rader’s device sends and receives audio signals wirelessly. (EX1009, 4:48-64.) FIG. 2 of Rader shows “a simplified block diagram of a mobile phone, representative of personal communication devices according to the present invention.” (EX1009, 3:32-34.)

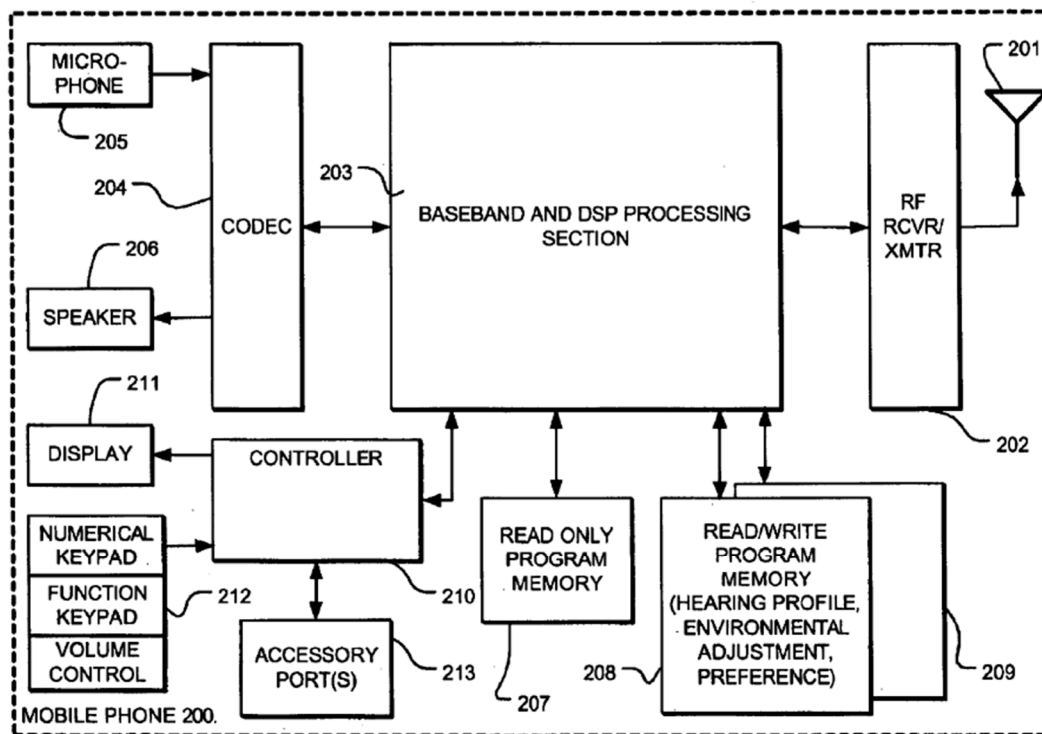


FIG. 2

(EX1009, 4:65-5:10, FIG. 2.)

258. As illustrated by FIG. 2, an exemplary device (mobile phone 200) “includes an [US] antenna 201 and a radio frequency RF receiver/transmitter 202, by which the phone 200 is coupled to a wireless communication medium.” (EX1009, 4:65-5:3.) The receiver/transmitter 202 is “coupled to baseband and digital signal processor DSP processing section 203, in which the audio signals are processed.” (EX1009, 5:4-6, FIG. 2.)

259. Rader is analogous art to the claimed invention at least because it is directed to the same field of endeavor—hearing enhancement systems for modifying audio signals based on a user’s hearing characteristics. By disclosing a system “designed to enhance the reception of audio by the listener,” Rader is reasonably pertinent to the problem faced by the ’789 patent inventor—providing a hearing enhancement system. (EX1009, 2:15-20; EX1001, 5:44-45.)

3. Claim 76

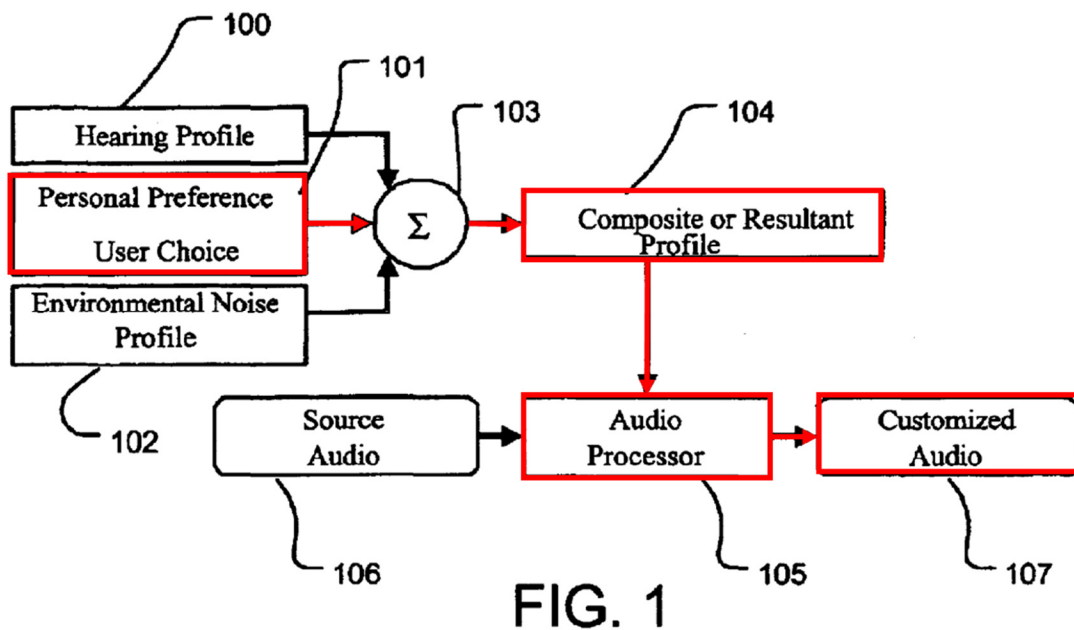
- a. **[Preamble] *A hearing enhancement apparatus as recited in claim 62,***

260. This element is met as described for claim 62.

- b. **[A] *wherein based on at least a preference of the user, the power of a first range of frequencies of the audio output signals is increased, and the power of a second range of frequencies of the audio output signals is not increased.***

261. Rader discloses that “[t]he personal choice of an individual may be important in setting customization parameters for delivery of enhanced audio.”

(EX1009, 8:59-61.) For example, the customization of audio is based on a “composite or resultant profile 104” which is a combination of “a hearing profile 100, a listener’s personal choice profile 101, and/or a profile 102 of the environmental noise.” (EX1009, 4:8-25, FIG. 1.) FIG. 1 illustrates:



(EX1009, 4:7-25, FIG. 1 (annotated).)

262. In Rader, the power of the audio output is modified based on frequency because the “gain and compression ratio can vary with frequency,” based on a user’s combined audibility threshold. (EX1009, 7:5-6.) While Rader describes the equations for the combined audibility threshold in terms of hearing impairment (THi), Rader also discloses that “THi could be replaced by, or supplemented with, a threshold parameter THc provided in response to information

about a user's personal choice.” (EX1009, 6:3-6.) The POSITA would understand that THc, the user's personal choice threshold, is frequency dependent. This is at least because Rader discloses that the audibility thresholds (*e.g.*, due to impairment, due to masked noise, and the resulting combination) are frequency dependent, as illustrated in FIGS. 12a-12c:

FIG. 12a

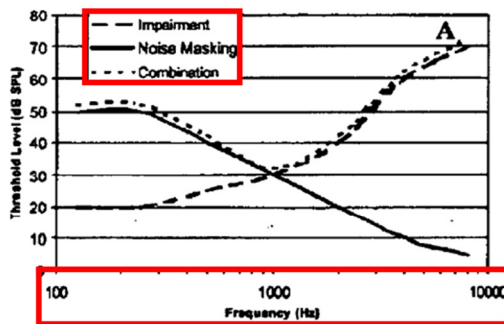


FIG. 12b

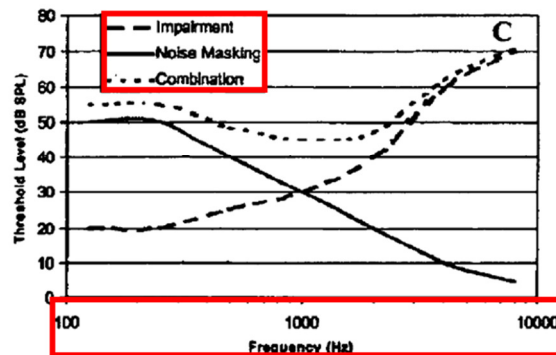
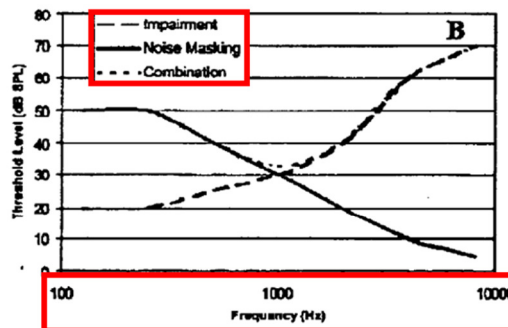


FIG. 12c

(EX1009, 5:43-7:18, FIGS. 12a-12c (annotated).)

263. Accordingly, Rader discloses that, by determining the personal choice threshold across a plurality of frequencies, the user can control the gain (and

thereby power) of the audio output signals on a plurality of frequency bands.

(EX1009, 5:43-7:18.)

264. Rader also discloses user interfaces for selecting and fine-tuning audio characteristics to define the user's personal choice profile. (EX1009, 8:59-9:31.)

For example, “[m]atrix navigation would be presentation of audio that is customized in one or several variables, and depending on user choice, establishing that choice as a vector in personalization.” (EX1009, 9:17-20.) Rader also teaches the compressive region “will have slopes that range from 1 (no compression) to 1/3 (3:1 compression).” (EX1009, 7:9-10.) Thus, the device is capable of selectively increasing the power of audio output signals in some frequency ranges while not increasing others. (EX1009, 7:7-10.) Taken together, the POSITA would understand that, based on the user preference, the device can selectively increase the power of a first range of frequencies while leaving a second range unchanged, thereby providing frequency-specific audio enhancement based on the user's preferences.

(ii) Motivation to Combine

265. A POSITA would have been motivated to combine the hearing aid system of Anderson with the personalized frequency-dependent audio processing of Rader. This would allow the system of Anderson to selectively increase power in one frequency range while leaving another unchanged, based on user preference.

Anderson's hearing aid system enhances audio signals according to a user's hearing characteristics determined through calibration. (EX1005, 27:4-17.) The POSITA would understand that, while such calibration provides objective compensation for hearing loss, users often prefer different sound balances in real-world listening environments. Rader identifies this problem and provides a solution by adjusting gain across frequency bands based on user preference to deliver more personalized sound. (EX1009, 4:7-25, 5:43-7:18, 8:59-61.) The POSITA would therefore have sought to incorporate Rader's preference-based frequency control into Anderson's calibrated system to allow users to tailor amplification in selected frequency ranges while maintaining comfort and clarity across others. Doing so would improve user satisfaction and adaptability in diverse listening conditions using familiar DSP-based hearing-enhancement techniques.

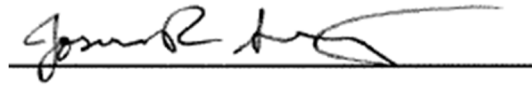
266. The POSITA would have had a reasonable expectation of success in combining Anderson and Rader. Both references employ digital signal processors to control gain and compression across frequency bands based on stored parameters. (EX1005, 27:4-17; EX1009, 4:65-5:10.) Incorporating Rader's user-adjustable frequency profiles into Anderson's DSP-based architecture would have only required modifying the gain-control logic using known techniques. Because both systems operate within the same field of hearing enhancement and rely on

compatible audio-processing structures, the combination would have been straightforward to implement with predictable and beneficial results.

I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code.

Executed the 21st of November, 2025 in New York, New York.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Joshua R. Smith", is written over a solid horizontal line.

Joshua R. Smith