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APPLE INC.
Petitioner,

v.

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Patent Owner.

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DECLARATION OF DR. CHRIS KYRIAKAKIS

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3.	[B] <i>a wireless receiver configured to wirelessly receive customized audio output signals for the user, the customized audio output signals having been customized based on at least predetermined hearing characteristics associated with the user such that the customized audio output signals at least compensate for the hearing impairment regarding the user's ability to hear; and</i>	38
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3.	<i>[B] a second microphone configured to pick up at least ambient sound input associated with an environment in the vicinity of the head-worn personal electronic apparatus, the second microphone being positioned to be directed away from the user when the head-worn wearable electronic device is being worn by the user.</i>	70
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3.	[B] <i>a second microphone;</i>	75
4.	[C] <i>wherein the first microphone is configured to pick up at least audio input from at least the user,</i>	76
5.	[D] <i>wherein the second microphone is configured to pick up at least environmental audio input associated with an environment in the vicinity of the head-worn wearable electronic device, and</i>	76
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2.	[A] <i>wherein the head-worn wearable electronic device comprises at least a first microphone and a second microphone,</i>	77
3.	[B] <i>wherein the first microphone is configured to pick up at least audio sound from at least the user,</i>	77
4.	[C] <i>wherein the second microphone is configured to pick up at least ambient noise associated with an environment in the vicinity of the head-worn wearable electronic device, and</i>	77
5.	[D] <i>wherein the electronic circuitry is configured to: determine an ambient noise level based on at least the ambient noise; and</i>	78
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2.	[A] <i>wherein the head-worn personal electronic apparatus comprises: a first microphone configured to pick up at least audio input from at least the user, the first microphone being at least partially in the head-worn personal electronic apparatus and is positioned to be directed towards the user when the head-worn personal electronic apparatus is being worn by the user; and</i>	79
3.	[B] <i>a second microphone configured to pick up at least ambient sound input associated with an environment in the vicinity of the head-worn personal electronic apparatus, the second microphone being positioned to be directed away from the user when the head-worn wearable electronic device is being worn by the user.</i>	79
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3.	[B] provide at least the ambient audio output signal to the at least one speaker.	80
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3.	[B] wherein the ambient audio output signal is dependent on the ambient noise level.	81
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2.	[A] a first microphone configured to pick up at least audio input from at least the user, the first microphone being at least partially in the head-worn personal electronic apparatus; and	81
3.	[B] a second microphone configured to pick up at least ambient sound input associated with an environment in the vicinity of the head-worn personal electronic apparatus, the second microphone being at least partially in the head-worn personal electronic apparatus, ...	81

4.	[C] wherein the second microphone is positioned to be further away from mouth of the user than the first microphone when at least the head-worn personal electronic apparatus of the head-worn personal electronic apparatus is being worn.	82
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2.	[A] wherein the head-worn personal electronic apparatus comprises: a first microphone; and.....	84
3.	[B] a second microphone;.....	84
4.	[C] wherein the first microphone is configured to pick up at least audio input from at least the user, ...	84
5.	[D] wherein the second microphone is configured to pick up at least environmental audio input associated with an environment in the vicinity of the head-worn wearable electronic device, and	84
6.	[E] wherein the electronic circuitry is configured to process the audio input from at least the user picked-up via the first microphone to remove at least a portion of the environmental audio input associated with the environment picked-up via the second microphone.....	84
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2.	[A] wherein the audio input from at least the user picked-up via the first microphone includes at least a voice input, and	85
3.	[B] wherein the environmental audio input associated with the environment includes at least ambient noise.	85
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3.	[B] wherein the second microphone is at least partially in the head-worn personal electronic apparatus and is positioned so as to be directed away from the user of the head-worn personal electronic apparatus.	86
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3.	[B] wherein the environmental audio input includes at least ambient noise.	86
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2.	[A] wherein the head-worn wearable electronic device comprises: a first microphone configured to pick up at least audio input from at least the user; and	87
3.	[B] a second microphone configured to pickup at least environmental audio input associated with environmental sound in the vicinity of the head-worn personal electronic apparatus, and	87
4.	[C] wherein the electronic circuitry is configured to: determine an environmental sound level based on at least the environmental audio input; and.....	87
5.	[D] amplify at least a portion of the audio input from the first microphone, with the amplification being at least in part dependent on the environmental sound level.	87
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3.	[B] wherein the first microphone is configured to pick up at least audio sound from at least the user, ...	89
4.	[C] wherein the second microphone is configured to pick up at least ambient noise associated with an environment in the vicinity of the head-worn wearable electronic device, and	89
5.	[D] wherein the electronic circuitry is configured to: determine an ambient noise level based on at least the ambient noise; and	89
6.	[E] modify at least a portion of the audio sound picked-up via the first microphone, with the modification being at least in part dependent on the ambient noise level.	89
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2.	[A] a first microphone configured to receive audio picked-up from the user; and	89
3.	[B] a second microphone configured to receive audio picked-up outward away from the user, ...	90
4.	[C] wherein the audio picked-up from at least the second microphone is used at least for noise cancelation, and at least a portion of the audio picked-up from the second microphone is subtracted from the audio picked-up from the first microphone.	90
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3.	[B] a second microphone at least partially contained within the head-worn personal electronic apparatus, the second microphone being positioned to pick up at least environmental audio input associated with an environment around the head-worn personal electronic apparatus, ...	92
4.	[C] wherein the electronic circuitry is configured to modify the customized audio output signals to be output to the user via the at least one speaker to cancel at least a portion of noise associated with the environment, the modification of the customized audio output signals being dependent at least in part on the environmental audio input picked-up via the second microphone.	92
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2.	[A] wherein the head-worn personal electronic apparatus comprises: a radiation detector configured to capture radiation data, ...	103

3.	[B] wherein the electronic circuitry is configured to process at least the radiation data captured by the radiation detector, and.....	104
4.	[C] wherein the electronic circuitry is configured to determine whether the head-worn personal electronic apparatus is being worn by a user based on at least the processed radiation data.....	105
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2.	[A] wherein the head-worn personal electronic apparatus includes a force sensor configured to receive a user input based at least on sensing force applied to the force sensor, and.....	105
3.	[B] wherein the force sensor is configured to detect the user input, the detected user input operating to alter at least an operation of the head-worn wearable electronic device.....	107
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2.	[A] wherein the head-worn personal electronic apparatus comprises: a radiation emitter at least partially contained within the head-worn personal electronic apparatus and configured to at least direct radiation towards the user when at least the head-worn personal electronic apparatus of the head-worn personal electronic apparatus is being worn; and	108
3.	[B] a radiation detector at least partially contained within the head-worn personal electronic apparatus and configured to detect radiation reflected back from the user when at least the head-worn personal electronic apparatus of the head-worn personal electronic apparatus is being worn,.....	109

4.	[C] wherein the radiation detector is operatively connected to the electronic circuitry, and wherein electronic circuitry within the head-worn personal electronic apparatus is configured to facilitate determining whether the head-worn personal electronic apparatus of the head-worn personal electronic apparatus is being worn by the user based on at least the detected radiation.	110
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3.	[B] <i>a second microphone at least partially contained within the head-worn personal electronic apparatus, the second microphone being positioned to pick up at least environmental audio input associated with an environment around the head-worn personal electronic apparatus,</i>	116
4.	[C] <i>wherein the electronic circuitry is configured to modify the customized audio output signals to be output to the user via the at least one speaker to cancel at least a portion of noise associated with the environment, the modification of the customized audio output signals being dependent at least in part on the environmental audio input picked-up via the second microphone.</i>	116
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1. [Preamble] *A head-worn personal electronic apparatus operable to at least output customized audio output, comprising: 117*
 2. [A] *at least one speaker, the at least one speaker being configured to be wearable proximate to an ear of a user; 117*
 3. [B] *a wireless receiver configured to wirelessly receive customized audio output signals for the user, the customized audio output signals having been customized based on at least predetermined hearing characteristics associated with the user such that the customized audio output signals at least compensate for the hearing impairment regarding the user's ability to hear; 117*
 4. [C] *electronic circuitry including at least an integrated circuit, the electronic circuitry being configured to output the customized audio output signals to the at least one speaker; 117*
 5. [D] *a force sensor at least partially contained within the head-worn personal electronic apparatus and configured to receive a user input based at least on sensing force applied to the force sensor, the force sensor is configured to detect the user input, the detected user input operating to alter at least an operation of the head-worn wearable electronic device; 118*
 6. [E] *a first microphone configured to pick up at least audio input from at least the user, the first microphone being at least partially in the head-worn personal electronic apparatus and is positioned to be directed towards the user when the head-worn personal electronic apparatus is being worn by the user; and.....118*
 7. [F] *a second microphone configured to pick up at least ambient sound input associated with an environment in the vicinity of the head-worn personal electronic apparatus, the second microphone being positioned to be directed away from the user when the head-worn wearable electronic device is being worn by the user;.....118*

8.	[G] wherein the at least one speaker is configured to generate at least a portion of the customized audio output for the user in accordance with at least the portion of the customized audio output signals.	118
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3.	[B] wherein the electronic circuitry is configured to process at least the radiation data captured by the radiation detector, and configured to determine whether the head-worn personal electronic apparatus is being worn by a user based on at least the processed radiation data.	119
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2.	[A] wherein the head-worn personal electronic apparatus wherein the head-worn personal electronic device is configured to receive a voice input via the first microphone, determine a requested operation from the voice input using voice recognition, and control an operation by the head-worn personal electronic device based on the requested operation.	119
G.	Claim 80	119
1.	[Preamble] A head-worn personal electronic apparatus as recited in claim 77, ...	119
2.	[A] wherein the electronic circuitry is configured to modify the customized audio output signals to be output to the user via the at least one speaker to cancel at least a portion of noise associated with the environment, the modification of the customized audio output signals being dependent at least in part on the ambient sound input picked-up via the second microphone.	120

H.	Claim 81	120
1.	[Preamble] <i>A head-worn personal electronic apparatus as recited in claim 77,</i>	120
2.	[A] <i>wherein the ambient sound input picked-up from at least the second microphone is used at least for noise cancelation, and at least a portion of the ambient sound input picked-up from the second microphone is subtracted from the audio picked-up from the first microphone.</i>	120
I.	Claim 82	120
1.	[Preamble] <i>A head-worn personal electronic apparatus as recited in claim 77,</i>	120
2.	[A] <i>wherein the electronic circuitry is configured to: determine an ambient noise level based on at least the ambient sound input; and</i>	120
3.	[B] <i>modify at least a portion of the audio sound picked-up via the first microphone, with the modification being at least in part dependent on the ambient noise level.</i>	121
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1.	[Preamble] <i>A head-worn personal electronic apparatus as recited in claim 77,</i>	121
2.	[A] <i>wherein the electronic circuitry is configured to: produce an ambient audio output signal based on at least the ambient sound input; and</i>	121
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2.	[A] <i>wherein the head-worn personal electronic apparatus comprises: a sensor at least partially contained within the head-worn personal electronic structure and configured to sense data indicative of whether the head-worn personal electronic apparatus is being worn by the user.</i>	122
C.	Claim 26	122
1.	[Preamble] <i>A head-worn personal electronic apparatus as recited in claim 25, ...</i>	122
2.	[A] <i>wherein the head-worn personal electronic apparatus is configured to at least alter operation of the head-worn personal electronic apparatus based at least in part on the sensed data from the sensor.</i>	123
D.	Claim 27	123
1.	[Preamble] <i>A head-worn personal electronic apparatus as recited in claim 26, ...</i>	123
2.	[A] <i>wherein the operation of the head-worn personal electronic apparatus being altered concerns control of the audio output being provided to the user.</i>	123
E.	Claim 28	123
1.	[Preamble] <i>A head-worn personal electronic apparatus as recited in claim 26, ...</i>	123
2.	[A] <i>wherein the operation of the head-worn personal electronic apparatus being altered concerns operation of the head-worn personal electronic apparatus in a lower power operation.</i>	123
XIII.	CLAIMS 61-64 ARE RENDERED OBVIOUS BY ANDERSON IN VIEW OF LYNCH, NEMIROVSKI, BODLEY, AND ZADESKY	124

A.	Motivation to Combine with Reasonable Expectation of Success	124
B.	Claim 61	124
1.	[Preamble] <i>A head-worn personal electronic apparatus as recited in claim 60,</i>	124
2.	[A] <i>wherein the head-worn personal electronic apparatus comprises: a user input device supported by the head-worn personal electronic apparatus, the user input device being configured to receive a user input, the user input device is based on at least capacitive effect, wherein the user input being received induces at least a capacitive change to produce at least an electrical response.</i>	124
C.	Claim 62	125
1.	[Preamble] <i>A head-worn personal electronic apparatus as recited in claim 61,</i>	125
2.	[A] <i>wherein the electronic circuitry is electrically connected to the user input device to receive user input data from the user input device, and wherein the head-worn personal electronic apparatus is configured to distinguish at least whether the user input pertains to a forward sliding action or a backward sliding action with respect to the user input device using at least the electronic circuitry and the user input data.</i>	125
D.	Claim 63	125
1.	[Preamble] <i>A head-worn personal electronic apparatus as recited in claim 61,</i>	125
2.	[A] <i>wherein the head-worn wearable electronic device includes an accelerometer.</i>	125
E.	Claim 64	126
1.	[Preamble] <i>A head-worn personal electronic apparatus as recited in claim 63,</i>	126

2.	<i>[A] wherein the head-worn personal electronic apparatus comprises: a radiation sensor, operatively connected to the rechargeable battery, at least partially contained within the head-worn personal electronic apparatus and configured to sense radiation.</i>	126
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1.	<i>[Preamble] A head-worn personal electronic apparatus operable to at least output customized audio output, comprising:</i>	127
2.	<i>[A] at least one speaker, the at least one speaker being configured to be wearable proximate to an ear of a user;</i>	127
3.	<i>[B] a wireless receiver configured to wirelessly receive customized audio output signals for the user, the customized audio output signals having been customized based on at least predetermined hearing characteristics associated with the user such that the customized audio output signals at least compensate for the hearing impairment regarding the user's ability to hear;</i>	127
4.	<i>[C] electronic circuitry including at least an integrated circuit, the electronic circuitry being configured to output the customized audio output signals to the at least one speaker;</i>	127
5.	<i>[D] a touch sensitive surface at least partially contained within the head-worn personal electronic apparatus and configured to sense a touch input associated with the user, wherein the sensed touch input operating to at least alter operation of the head-worn electronic personal audio apparatus;</i>	127

6. [E] *a sensor at least partially contained within the head-worn personal electronic structure and configured to sense data indicative of whether the head-worn personal electronic apparatus is being worn by the user, the head-worn personal electronic apparatus is configured to at least alter operation of the head-worn personal electronic apparatus based at least in part on the sensed data from the sensor; 128*
7. [F] *a first microphone configured to pick up at least audio input from at least the user, the first microphone being at least partially in the head-worn personal electronic apparatus and is positioned to be directed towards the user when the head-worn personal electronic apparatus is being worn by the user; and.....128*
8. [G] *a second microphone configured to pick up at least ambient sound input associated with an environment in the vicinity of the head-worn personal electronic apparatus, the second microphone being positioned to be directed away from the user when the head-worn wearable electronic device is being worn by the user, ...128*
9. [H] *wherein the at least one speaker is configured to generate at least a portion of the customized audio output for the user in accordance with at least the portion of the customized audio output signals. 128*
- C. Claim 66 129
 1. [Preamble] *A head-worn personal electronic apparatus as recited in claim 65, ...129*
 2. [A] *wherein the sensor comprises a radiation detector configured to capture radiation data, and.....129*
 3. [B] *wherein the electronic circuitry is configured to process at least the radiation data captured by the radiation detector, and configured to determine whether the head-worn personal electronic apparatus is being worn by a user based on at least the processed radiation data.....129*
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1.	[Preamble] <i>A head-worn personal electronic apparatus as recited in claim 65,</i>	129
2.	[A] <i>wherein the head-worn personal electronic apparatus wherein the head-worn personal electronic device is configured to receive a voice input via the first microphone, determine a requested operation from the voice input using voice recognition, and control an operation by the head-worn personal electronic device based on the requested operation.</i>	129
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1.	[Preamble] <i>A head-worn personal electronic apparatus as recited in claim 65,</i>	130
2.	[A] <i>wherein the electronic circuitry is configured to modify the customized audio output signals to be output to the user via the at least one speaker to cancel at least a portion of noise associated with the environment, the modification of the customized audio output signals being dependent at least in part on the ambient sound input picked-up via the second microphone.</i>	130
F.	Claim 69	130
1.	[Preamble] <i>A head-worn personal electronic apparatus as recited in claim 65,</i>	130
2.	[A] <i>wherein the ambient sound picked-up from at least the second microphone is used at least for noise cancelation, and at least a portion of the ambient sound picked-up from the second microphone is subtracted from the audio picked-up from the first microphone.</i>	130
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1.	[Preamble] <i>A head-worn personal electronic apparatus as recited in claim 65,</i>	130
2.	[A] <i>wherein the electronic circuitry is configured to: determine an ambient noise level based on at least the ambient sound input; and</i>	131
3.	[B] <i>modify at least a portion of the audio sound picked-up via the first microphone, with the modification being at least in part dependent on the ambient noise level.</i>	131

H.	Claim 71	131
1.	[Preamble] <i>A head-worn personal electronic apparatus as recited in claim 65,</i>	131
2.	[A] <i>wherein head-worn personal electronic apparatus is configured to support voice calls to the user, and</i>	131
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1.	[Preamble] <i>A head-worn personal electronic apparatus as recited in claim 65,</i>	132
2.	[A] <i>wherein the electronic circuitry is configured to: produce an ambient audio output signal based on at least the ambient sound input; and</i>	132
3.	[B] <i>provide at least the ambient audio output signal to the at least one speaker.</i>	132
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3.	[B] <i>wherein the ambient audio output signal is dependent on the ambient noise level.</i>	133
L.	Claim 87	133

1. [Preamble] *A head-worn personal electronic apparatus operable to at least output customized audio output, comprising: 133*
2. [A] *at least one speaker, the at least one speaker being configured to be wearable proximate to an ear of a user; 133*
3. [B] *a wireless receiver configured to wirelessly receive customized audio output signals for the user, the customized audio output signals having been customized based on at least predetermined hearing characteristics associated with the user such that the customized audio output signals at least compensate for the hearing impairment regarding the user's ability to hear; 133*
4. [C] *electronic circuitry including at least an integrated circuit, the electronic circuitry being configured to output the customized audio output signals to the at least one speaker; 133*
5. [D] *a user input device at least partially contained within the head-worn personal electronic apparatus and configured to receive a user input, the user input operating to alter at least an operation of the head-worn wearable electronic device; 133*
6. [E] *a radiation detector at least partially contained within the head-worn personal electronic structure and configured to configured to capture radiation data indicative of whether the head-worn personal electronic apparatus is being worn by the user, the head-worn personal electronic apparatus is configured to at least alter operation of the head-worn personal electronic apparatus based at least in part on the captured radiation data; 134*
7. [F] *a first microphone at least partially contained within the head-worn personal electronic apparatus, the first microphone being positioned to pick up at least audio input from at least the user; and 134*

8.	[G] <i>a second microphone at least partially contained within the head-worn personal electronic apparatus, the second microphone being positioned to pick up at least environmental audio input associated with an environment around the head-worn personal electronic apparatus, ...</i>	134
9.	[H] <i>wherein the at least one speaker is configured to generate at least a portion of the customized audio output for the user in accordance with at least the portion of the customized audio output signals.</i>	134
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1.	[Preamble] <i>A head-worn personal electronic apparatus as recited in claim 87, ...</i>	134
2.	[A] <i>wherein the head-worn personal electronic apparatus wherein the head-worn personal electronic device is configured to receive a voice input via the first microphone, determine a requested operation from the voice input using voice recognition, and control an operation by the head-worn personal electronic device based on the requested operation.</i>	135
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1.	[Preamble] <i>A head-worn personal electronic apparatus as recited in claim 87, ...</i>	135
2.	[A] <i>wherein the electronic circuitry is configured to modify the customized audio output signals to be output to the user via the at least one speaker to cancel at least a portion of noise associated with the environment, the modification of the customized audio output signals being dependent at least in part on the ambient sound input picked-up via the second microphone.....</i>	135
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1.	[Preamble] <i>A head-worn personal electronic apparatus as recited in claim 87, ...</i>	135

2.	[A] wherein the ambient sound input picked-up from at least the second microphone is used at least for noise cancelation, and at least a portion of the ambient sound input picked-up from the second microphone is subtracted from the audio picked-up from the first microphone.....	136
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1.	[Preamble] A head-worn personal electronic apparatus as recited in claim 87, ...	136
2.	[A] wherein the electronic circuitry is configured to: determine an ambient noise level based on at least the ambient sound input; and.....	136
3.	[B] modify at least a portion of the audio sound picked-up via the first microphone, with the modification being at least in part dependent on the ambient noise level.	136
Q.	Claim 92	136
1.	[Preamble] A head-worn personal electronic apparatus as recited in claim 87, ...	136
2.	[A] wherein the electronic circuitry is configured to: determine an environmental sound level based on at least the environmental audio input; and.....	136
3.	[B] amplify at least a portion of the audio input from the first microphone, with the amplification being at least in part dependent on the environmental sound level.	137
R.	Claim 95	137
1.	[Preamble] A head-worn personal electronic apparatus as recited in claim 87, ...	137
2.	[A] wherein the electronic circuitry is configured to: produce an ambient audio output signal based on at least the ambient sound input; and.....	137
3.	[B] provide at least the ambient audio output signal to the at least one speaker.	137
S.	Claim 96	137
1.	[Preamble] A head-worn personal electronic apparatus as recited in claim 95, ...	137

2.	[A] wherein the electronic circuitry is configured to: determine an ambient noise level based on at least the ambient sound input, ...	137
3.	[B] wherein the ambient audio output signal is dependent on the ambient noise level.	138
T.	Claim 97	138
1.	[Preamble] A head-worn personal electronic apparatus as recited in claim 87, ...	138
2.	[A] wherein head-worn personal electronic apparatus is configured to support voice calls to the user, and	138
3.	[B] wherein the at least one operation of the head-worn personal electronic apparatus being altered concerns at least accepting or declining a voice call to the user.	138
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1.	[Preamble] A head-worn personal electronic apparatus as recited in claim 87, ...	138
2.	[A] wherein the at least one operation of the head-worn personal electronic apparatus being altered concerns control of the customized audio output being provided to the user.	138
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2.	[A] wherein the head-worn personal electronic apparatus is configured to provide audio alerts to the user via the at least one speaker, and	139
3.	[B] wherein the audio alerts are dependent on one or more user preference settings.	139
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1.	[Preamble] A head-worn personal electronic apparatus as recited in claim 87, ...	139

2.	<i>[A] wherein the electronic circuitry is configured to modify the customized audio output signals to be output to the user via the at least one speaker to cancel at least a portion of noise associated with the environment, the modification of the customized audio output signals being dependent at least in part on the environmental audio input picked-up via the second microphone, ...</i>	139
3.	<i>[B] wherein, when the head-worn personal electronic apparatus is being worn by the user, the first microphone is positioned to be directed more towards the user's mouth than is the second microphone, and.....</i>	140
4.	<i>[C] wherein, when the head-worn personal electronic apparatus is being worn by the user, the second microphone is directed more away from the user's mouth than is the first microphone.</i>	140
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Exhibit List

Exhibit Description	Exhibit #
U.S. Patent No. 11,921,355 to Howell	EX1001
Prosecution History of U.S. Patent No. 11,921,355	EX1002
Declaration of Dr. Chris Kyriakakis	EX1003
Curriculum Vitae for Dr. Chris Kyriakakis	EX1004
U.S. Patent No. 7,620,433 to Bodley	EX1005
U.S. Patent No. 7,046,230 to Zadesky et al.	EX1006
U.S. Patent No. 6,671,379 to Nemirovski	EX1007
U.S. Patent No. 7,599,508 to Lynch et al.	EX1008
U.S. Patent No. 7,010,332 to Irvin et al.	EX1009
U.S. Patent No. 5,721,783 to Anderson	EX1010
Excerpts from P. HOROWITZ AND W. HILL, THE ART OF ELECTRONICS (Cambridge Univ. Press 2nd Ed. 1989)	EX1011
Defendant's Proposed Claim Constructions in <i>IngenioSpec, LLC v. Apple Inc.</i> , Case No. 1:25-cv-00867 (W.D. Tex. Dec. 22, 2025)	EX1012
Excerpts from R. CHABAY AND B. SHERWOOD, MATTER & INTERACTIONS II: ELECTRIC & MAGNETIC INTERACTIONS (John Wiley & Sons, Inc. 2nd Ed. 2007)	EX1013

Exhibit Description	Exhibit #
Radio Shack 1996 Catalog	EX1014
Excerpts from R. MURPHY, INTRODUCTION TO AI ROBOTICS (MIT Press 2000)	EX1015
Excerpts from L. BAXTER, CAPACITIVE SENSORS: DESIGN AND APPLICATIONS (IEEE Press 1997)	EX1016
P. Henry et al., <i>Bone Conduction: Anatomy, Physiology, and Communication</i> , Army Research Laboratory, ARL-TR-4138 (May 2007)	EX1017
U.S. Patent No. 7,500,746 to Howell et al.	EX1018
Manufacturer's Datasheet for Sharp PD100MC0MPx Photodiode	EX1019
Excerpts from L. BLOOMFIELD, HOW EVERYTHING WORKS (John Wiley & Sons, Inc. 2008)	EX1020
Excerpts from ACADEMIC PRESS DICTIONARY OF SCIENCE AND TECHNOLOGY (Academic Press, Inc. 1992)	EX1021
Excerpts from CHAMBERS DICTIONARY OF SCIENCE AND TECHNOLOGY (Chambers Harrap Publishers Ltd 2007)	EX1022
Excerpts from R. GRAF, MODERN DICTIONARY OF ELECTRONICS (Butterworth-Heinemann 7th Ed. 1999)	EX1023
Plaintiff's Sept. 19, 2025 Infringement Claim Chart for U.S. Patent No. 11,921,355 in <i>IngenioSpec, LLC v. Apple Inc.</i> , Case No. 1:25-cv-00867 (W.D. Tex.)	EX1024

I, Chris Kyriakakis, make this declaration in connection with the *inter partes* review proceeding no. IPR2026-00332.

I. INTRODUCTION

1. I have been retained by counsel for Apple Inc. (“Petitioner” or “Apple”) in connection with the *inter partes* review proceedings nos. IPR2026-00331 and IPR2026-00332, which challenge United States Patent No. 11,921,355 (EX1001, “the ’355 patent”). This declaration is submitted in support of Apple’s Petition in the IPR2026-00332 proceeding. A substantively identical declaration is submitted in support of Apple’s Petition in the IPR2026-00331 proceeding.

2. I have reviewed and am familiar with the ’355 patent, which issued on March 5, 2024. I understand that in the aforementioned proceedings, Apple is filing two Petitions for *inter partes* review (the “Petitions”) that together seek to cancel claims 1-55, 57-72, 75-82, 85-92, and 95-100 (the “challenged claims”) of the ’355 patent. I understand the number and volume of the challenged claims, in view of word limits for IPR petitions, necessitate two separate Petitions, with each Petition addressing different claims. My opinions herein are not in any way affected by how the challenged claims are distributed between the two Petitions, by which of the two Petitions addresses a particular claim, or by the manner in which the claims are presented in the Petitions.

3. In preparation for this Declaration, I reviewed the exhibits provided by the Petitioner, including the '355 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 scientist, professor, and consultant.

4. The '355 patent is generally directed to wearable audio devices. (EX1001, 3:37-47.) I am familiar with the technology described in the '355 patent as of its earliest possible priority date of July 28, 2004, as well as its actual U.S. filing date of May 8, 2023.

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 '355 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. 7,620,433	Bodley (EX1005)
U.S. Patent No. 7,046,230	Zadesky (EX1006)
U.S. Patent No. 6,671,379	Nemirovski (EX1007)
U.S. Patent No. 7,599,508	Lynch (EX1008)
U.S. Patent No. 7,010,332	Irvin (EX1009)
U.S. Patent No. 5,721,783	Anderson (EX1010)
P. HOROWITZ AND W. HILL, THE ART OF ELECTRONICS (Cambridge Univ. Press 2nd Ed. 1989)	Horowitz (EX1011)

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 \$575 per hour for my work on this matter. My compensation is not dependent on the outcome of these *inter partes* review proceedings and in no way affects the substance of my statements in this declaration.

8. I reside in Los Angeles, California, USA.

II. SUMMARY OF GROUNDS

9. I understand that the Petitions for *inter partes* review of the '355 patent together assert grounds of unpatentability as summarized below:

35 U.S.C. § ¹	Claim(s)	Prior Art References
103	1, 2, 17, 18, 51, 52, 54, 58, 59	Anderson, Lynch
103	3-5, 19-21	Anderson, Lynch, Bodley
103	6, 22-24	Anderson, Lynch, Bodley, Zadesky
103	7-12, 29-40, 53, 57, 60	Anderson, Lynch, Nemirovski
103	13, 14, 41-50	Anderson, Lynch, Irvin
103	15, 16, 77-82, 85, 86	Anderson, Lynch, Nemirovski, Irvin
103	25-28	Anderson, Lynch, Bodley, Irvin
103	61-64	Anderson, Lynch, Nemirovski, Bodley, Zadesky
103	65-72, 75, 76, 87-92, 95-100	Anderson, Lynch, Nemirovski, Bodley, Irvin
103	55	Anderson, Lynch, Irvin, Horowitz

¹ Throughout this Declaration, all statutory citations are pre-AIA based on the earliest possible priority date of July 28, 2004.

I understand that because the challenged claims are split across two Petitions, such that each Petition challenges different claims, each of the Petitions may present fewer grounds than those identified above and in this Declaration. For the same reason, I understand that the grounds presented in each Petition may be presented differently than they are presented in the chart above, or in this Declaration. My opinions herein do not depend in any way on how the grounds may be numbered, ordered, or otherwise presented in the Petitions.

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 exhibit EX1004. Here, I provide a brief summary of my qualifications.

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

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

13. My research interests lie at the intersection of acoustics, psychoacoustics (the science that studies human perception of sound), and audio signal processing. I have worked in the area of audio signal processing for more than 20 years with particular emphasis on spatial and 3D audio. I have published nearly 100 technical papers, including several peer-reviewed papers. I have published a book on spatial audio entitled Immersive Audio Signal Processing and hold several patents in audio processing for headphone optimization, acoustic measurement of loudspeakers in rooms, loudspeaker crossover optimization, and loudspeaker response correction using signal processing. My publications examine various aspects of sound measurement, echo cancellation, microphone arrays, noise cancellation, filter banks, how sound interacts with the acoustical elements of the environment, novel methods for surround sound recording and reproduction, and the perception of sound by human listeners.

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

and circular microphone arrays. I have also investigated methods for noise removal and reverberation reduction from microphone signals.

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

16. I am the founding Director of the USC Immersive Audio Laboratory with facilities for experimental work in room acoustics, multichannel audio, and psychoacoustics. This laboratory also serves as a unique teaching facility for my undergraduate course in Introduction to Digital Audio and my graduate course in Immersive Audio Signal Processing. Both courses have a major acoustics

component that examines the interaction of sound with the acoustical environment and the basic principles of microphones (including wireless microphones) and loudspeaker design. The graduate course was developed through a two-year grant I received from the National Science Foundation entitled “Collaborative Learning in Engineering Using Immersive Environments,” and was the first of its kind to assess the impact of audio immersion in student learning. In addition to the courses I teach, I have also supervised and served on Ph.D. dissertation committees for more than 30 students.

17. From 2003-2018, I was the co-founder and Chief Technology Officer of Audyssey Laboratories, a USC spin-off company that develops and licenses audio technology to leading consumer electronics and automotive companies around the world. A major project that I led and worked on was focused on the measurement and characterization of in-ear and over ear earbuds and headphones. This work included the development of methods for measuring earbuds and headphones using a mannequin with artificial ears and, in particular, methods for testing for proper seal prior to taking acoustical measurements. It also included the use of ear canal microphones and comparisons of the in-ear microphone response with a reference microphone in the room. A database of over 500 in-ear earbuds and headphones was created using these methods. The acoustical correction filters

that were generated for each headphone were implemented as an embedded solution that could run on DSP processors in mobile devices and laptop computers.

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

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

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

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

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

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

IV. LEGAL UNDERSTANDING

A. My Understanding of Claim Construction

23. 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 ’355 patent as of the earliest possible priority date of July 28, 2004, and in light of its specification and file history.

B. A Person Having Ordinary Skill in the Art

24. 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 ’355 patent and the assumed priority date of July 28, 2004, a POSITA would have had a Bachelor of Science 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

25. 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.

26. 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.

27. 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.

28. 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 '355 PATENT

A. Background of the '355 Patent

29. The '355 patent relates to wearable audio devices, such as eyeglasses, with electrical components that produce audio output customized to hearing characteristics of a user. (EX1001, 3:37-47.) For example, the electrical components can support signal capturing, processing, and display; and can be used to provide audio output and/or audio pick-up. (EX1001, 3:48-60.) However, as set forth herein, it is my view that the claims of the '355 patent do not represent any patentable improvement over the prior art.

B. Priority Date

30. I understand that the application that became the '355 patent (Appl. No. 18/144,557) was filed on May 8, 2023, and claims priority to various patent filings. (EX1001.) My analysis herein assumes a priority date of July 28, 2004, which I understand is the date of the earliest document to which the '355 patent claims priority. I do not take a position here as to whether the '355 patent is

actually entitled to that priority date. If the '355 patent were entitled only to a priority date later than July 28, 2004, it would not change any of my analysis or opinions herein.

C. Prosecution History of the '355 Patent

31. I understand that the prosecution of the '355 patent was not robust, and that over one hundred claims were allowed by the Examiner in only eight months. (EX1002.) I understand that in the Notice of Allowance, the Examiner suggested that limitations of the claims were not met by the prior art. (EX1002, 1448.) But as demonstrated herein, all limitations of the challenged claims were known in the prior art and thus cannot confer patentability.

D. Claim Construction

32. 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 '355 patent as of July 28, 2004, and in light of its specification and file history.

33. I do not believe any claim construction is necessary for the purposes of the Petition. I believe the challenged claims are unpatentable under any reasonable interpretation of the claim language.

34. I understand that in a co-pending litigation matter, Petitioner proposed the following claim constructions:

Term / Claims	Petitioner's Proposed Construction in Co-Pending Litigation
“head-worn personal electronic apparatus” / “head-worn wearable electronic device” / “head-worn electronic personal audio apparatus”/ “head-worn electronic device” / Preamble ('355 patent) '355 patent, claims 1-3, 5-19, 21-54, 57-70, 72, 75-82, 85-92, 95-100	“electronic eyewear or headwear”
“[a/the] speaker[s] ... proximate to an ear of a user” / “the first speaker . . . proximate to a first ear of the user” / “the second speaker ... proximate to a second ear of the user” '355 patent, claims 1, 17, 65, 77, 87	“[a/the] speaker[s] . . . near an ear of the user” / “the first speaker . . . near a first ear of the user” / “the second speaker . . . near a second ear of the user”

35. As set forth herein, it is my view that the grounds described herein are consistent with Petitioner's litigation constructions above and with no express

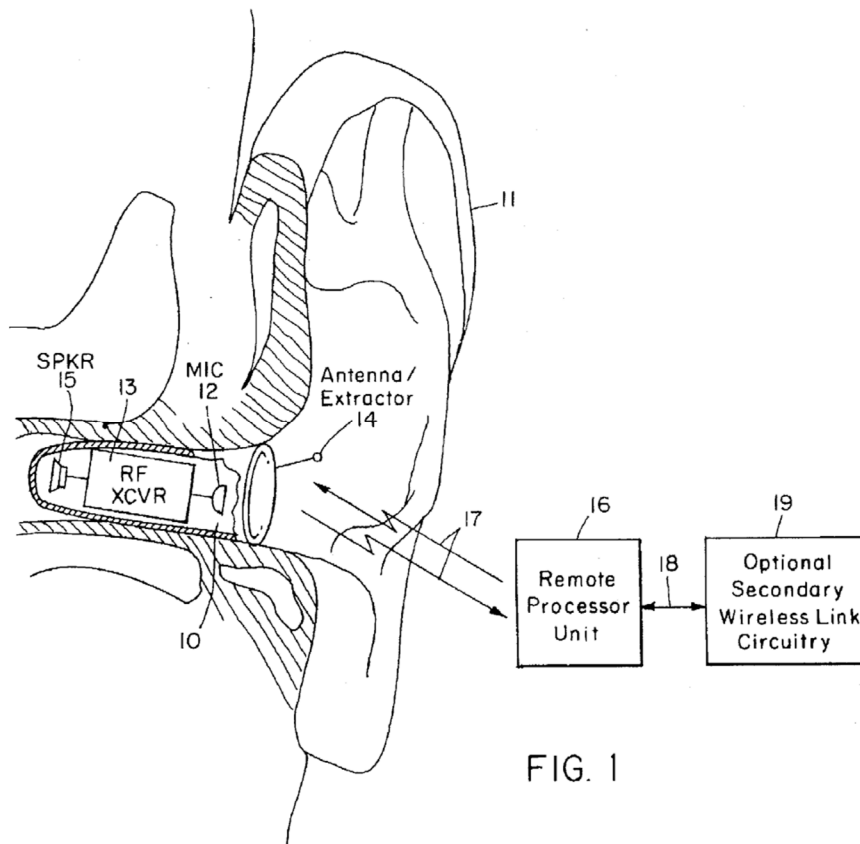
construction. That is, the claims are unpatentable regardless of whether the Board applies Petitioner's litigation constructions or declines to construe the claims.

VI. CLAIMS 1, 2, 17, 18, 51, 52, 54, 58, AND 59 ARE RENDERED OBVIOUS BY ANDERSON IN VIEW OF LYNCH

A. Summary of Anderson

36. Anderson is a U.S. Patent that was filed on June 7, 1995 and issued on February 24, 1998. (EX1010.) I understand Anderson is thus prior art to the '355 patent under at least 35 U.S.C. §§102(a), (b), and (e). I understand that Anderson was not cited or considered during prosecution of the '355 patent.

37. Anderson discloses a hearing aid that includes an earpiece and a remote processor unit (RPU) that receives signals from and transmits signals to the earpiece. (EX1010, 1:7-10.) FIG. 1 illustrates:



(EX1004, FIG. 1.)

38. As shown in FIG. 1, the earpiece (10) includes a microphone (12), a wireless RF transceiver (13), and a speaker (15). (EX1010, 3:58-60.) The earpiece wirelessly communicates with an RPU (16) via a two-way RF link. (EX1010, 4:1-3.) The RPU can be carried or worn by the user. (EX1010, 4:4-7.) In some embodiments, the RPU can include a telephone handset or interface with a telephone network. (EX1010, 4:7-12, 5:61-6:5.)

39. Anderson discloses “many variations of the system shown in FIG. 1.” (EX1010, 4:15-18.) In some embodiments, the earpiece is worn in the user’s ear

canal, such as shown for earpiece 10 in FIG. 1; or may utilize a behind-the-ear (“BTE”) unit. (EX1010, 3:53-58.) In some embodiments, such as shown in FIG. 2, the earpiece belongs to a head-worn headset 21:

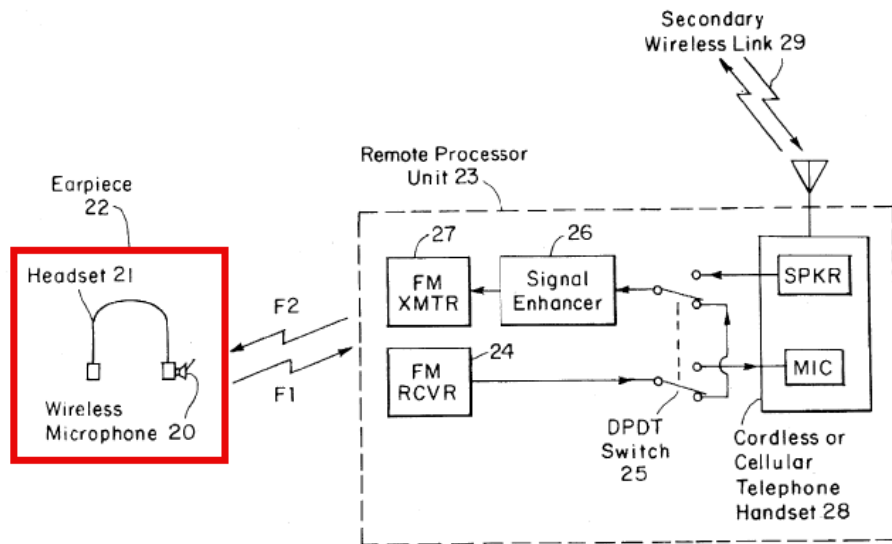


FIG. 2

(EX1010, 4:15-39, FIG. 2 (annotated).)

40. The headset earpiece 22 shown in FIG. 2 is “functionally similar” to the in-ear earpiece 10 shown in FIG. 1. (EX1010, 4:33-35.) The headset earpiece 22 can be made using commercial off-the-shelf components, such as a Radio Shack model 12-103 headset receiver:



(EX1014, 46; EX1010, 4:26-39.)

41. During operation of the hearing aid, audio signals from the environment are picked up by the microphone of the earpiece and transmitted over the two-way wireless link to the RPU. (EX1010, 1:55-59.) The RPU then enhances the audio signals, *e.g.*, by adjusting the signals to accommodate for a user's hearing impairment, and subsequently transmits the enhanced signals over the two-way wireless link to the earpiece. (EX1010, 1:61-63, 27:4-17.) In some embodiments, the system can provide mobile telephone functionality, *e.g.*, via a secondary wireless link. (EX1010, 23:19-26, 24:45-25:14, FIG. 2.) Noise cancellation features are also disclosed. (EX1010, 2:60-65.)

42. Anderson is analogous art to the '355 patent because it is directed to the same field of endeavor: wearable devices with electrical components, including those that provide audio output. (EX1001, Abstract; 3:37-47; EX1010, Abstract,

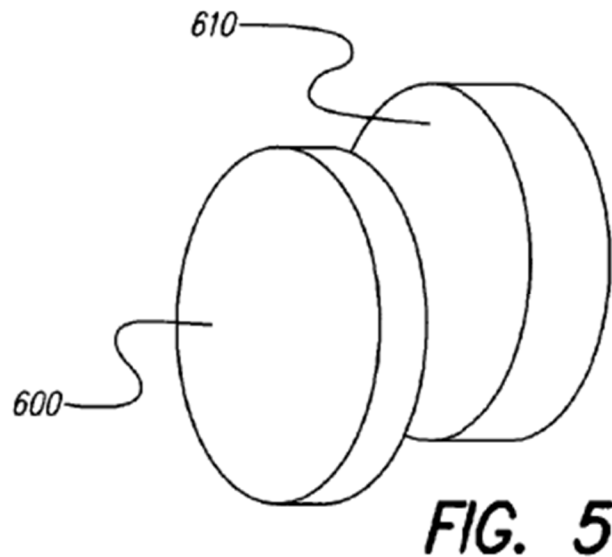
1:5-2:39.) For example, Anderson relates to wearable hearing aid systems in which audio signals are presented to a user—analogous to the wearable audio devices of the '355 patent. (*See* EX1001, 3:36-64; EX1010, 1:5-2:39.) Similarly, by disclosing systems in which “audio signals are enhanced according to the user’s needs,” Anderson is reasonably pertinent to a problem faced by the '355 patent inventor—using wearable devices to provide users with “enhanced hearing.” (EX1001, 3:37-47; EX1010, 1:55-63.)

B. Summary of Lynch

43. Lynch is a U.S. Patent that was filed on April 14, 2004 and issued on October 6, 2009. (EX1008.) I understand Lynch is thus prior art to the '355 patent under at least 35 U.S.C. §§102(a) and (e). I understand that Lynch was not cited or considered during prosecution of the '355 patent.

44. Lynch discloses a wireless assistive listening device cap (“ALD Cap”) for a hearing aid device. (EX1008, 1:61-2:23.) The ALD Cap contains electronics that supplement or replace those of the hearing aid. (EX1008, 3:1-4.) Various types of hearing aids are contemplated, including head-mounted hearing aids that do, or do not, use a BTE unit. (EX1008, 1:61-2:23.) The ALD Cap improves the comfort, ergonomics, and aesthetics of the hearing aid by fastening electronic components of the hearing aid to the top of the user’s head. (EX1008, 1:17-57, 2:20-23.) The ALD Cap is attached on top of head-mounted components of a

hearing aid system, *e.g.*, via a magnet; and can communicate wirelessly with those components. (EX1008, 2:63-66, 3:5-12, 3:34-44.) FIG. 5 illustrates an ALD Cap 600 connected to an external component 610 of a hearing aid system:



(EX1008, 4:37-41, FIG. 5.)

45. Lynch is analogous art to the '355 patent because it is directed to the same field of endeavor: wearable devices with electrical components, including devices that provide audio output. (EX1001, Abstract; 3:37-47; EX1008, Abstract, 1:10-2:23.) For example, Lynch relates to head-wearable hearing aid systems in which audio signals are presented to a user—analogue to the head-wearable audio devices of the '355 patent. (See EX1001, 3:36-64; EX1008, 1:61-2:23.) Similarly, by disclosing wearable systems that “provide[] access to assistive listening technology,” Lynch is reasonably pertinent to a problem faced by the

'355 patent inventor—using wearable devices to provide users with “enhanced hearing.” (EX1001, 3:37-47; EX1008, 2:20-23.)

C. Motivation to Combine Anderson and Lynch with Reasonable Expectation of Success

46. A POSITA would have been motivated to combine the teachings of Anderson and Lynch. In Anderson’s hearing aid, the earpiece communicates wirelessly with the RPU, which includes various electronic components to support the hearing aid, and is “worn by or located near the user,” such as in the user’s pocket or purse. (EX1010, 1:51-55, 4:4-7.) Locating electronic components in the RPU, rather than in the earpiece, advantageously reduces the size and power consumption of the earpiece. (EX1010, 1:63-2:4.) However, as Anderson notes, the RPU may be small and is “easily misplaced”. (EX1010, 21:31-34.) Anderson’s solution to this problem is for the earpiece to enter a stand-alone hearing aid mode with limited functionality while the user searches for the misplaced RPU. (EX1010, 21:31-22:2.)

47. However, Anderson’s solution to this problem is not ideal, because none of the hearing aid’s remote processor or communication features are available while in the stand-alone mode, and only “pre-selected” hearing aid parameters from default parameter storage are used. (EX1010, 21:57-62.) The POSITA would have been motivated to modify Anderson to reduce the risk of misplacing

the RPU, and thus entering the stand-alone mode, but without compromising the RPU's advantageous small size or wireless flexibility. The POSITA would have been motivated to use Lynch's ALD Cap teachings to mount the RPU on the user's head, thus minimizing the risk of separating the earpiece from the RPU (as both the earpiece and the RPU are co-located on the user's head); and realizing the advantages in comfort, ergonomics, and aesthetics described by Lynch. (EX1008, 1:61-2:23.)

48. The POSITA would have been motivated by express disclosures of Lynch, whose ALD Cap is specifically designed for use with head-wearable hearing aids such as those of Anderson; Lynch highlights that the ALD Cap provides access to assisted listening technology without introducing undesirable ear-worn components. (EX1008, 1:61-2:23.) Further, Anderson discloses that the RPU can be "carried on" the user's body, but it does not specify where; it would have been obvious for the POSITA to try mounting the RPU on the user's head, given the limited number of body locations on which the RPU could be carried. (EX1010, 6:1-3.) Mounting the RPU on the head using an ALD Cap, as in Lynch, would preserve or improve the advantages of Anderson's hearing aid; for example, Lynch supports wireless communication with the earpiece, preserving Anderson's "complete freedom of movement" while the hearing aid is worn. (EX1010, 2:32-35.)

49. The POSITA would have had a reasonable expectation of success in making the combination. First, Lynch’s ALD Cap is a hearing aid accessory that combines with various types of hearing aids, including head-mounted hearing aids that do not use BTE components—the same type of hearing aid (*e.g.*, featuring headset 21) disclosed in Anderson. (EX1008, 2:15-23.) Second, Anderson highlights that “many variations” of its hearing aid system are possible, and that the RPU can be flexibly implemented using “any of a wide variety of components well known in the art”. (EX1010, 12:48-49.) Third, Anderson discloses that the RPU may be small and have a “wide variety of form factors,” suggesting that it could be flexibly and easily repositioned, as by the ALD Cap. (EX1010, 20:48-52, 21:31-34.) Taken together, these factors indicate that adapting Anderson’s RPU in view of Lynch would have been a predictable endeavor with a reasonable expectation of success.

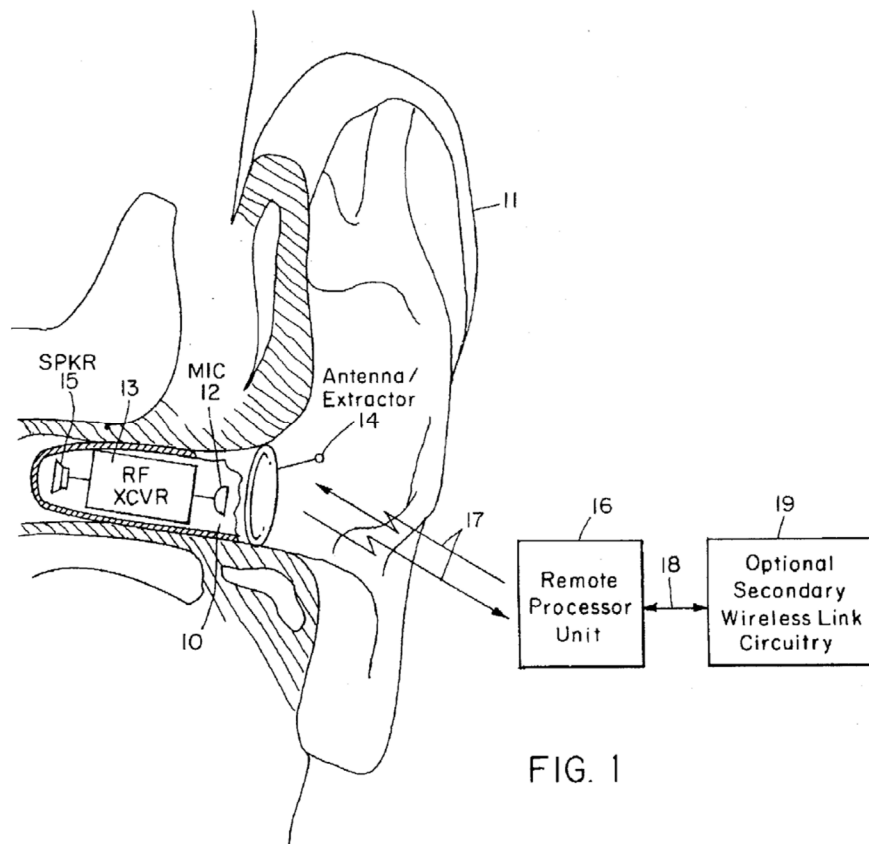
D. Claim 1

1. **[Preamble]² *A head-worn personal electronic apparatus operable to at least output customized audio output, comprising:***

50. Anderson in view of Lynch teaches the claimed head-worn personal electronic apparatus. Anderson discloses an electronic hearing aid that includes an

² See the claims appendix for a full recitation of each claim.

earpiece 10 with a microphone and speaker, and an RPU that communicates with the earpiece. (EX1010, 1:7-10, FIG. 1, FIG. 2.) The RPU receives audio signals and generates customized audio output signals that are “enhanced according to the user’s needs,” such as by enhancing the signals to compensate for hearing loss; the customized signals are then wirelessly transmitted from the RPU to the earpiece, which presents them to the user via the speaker. (EX1010, 1:61-62, 22:62-23:14, 27:4-17.) FIG. 1 illustrates:



(EX1010, FIG. 1.)

51. Anderson in view of Lynch teaches that the apparatus is head-worn, *i.e.*, electronic headwear worn on the user's head, in at least two embodiments. First, Anderson discloses that with respect to FIG. 1, the earpiece 10 can utilize a BTE unit instead of a completely-in-the-canal ("CIC") housing. (EX1010, 3:53-58.) In combination with Lynch, which teaches using an ALD Cap to supplement or replace electronic components of the BTE unit, this apparatus is head-worn—*e.g.*, because the ALD Cap attaches to the top of the user's head for support. (EX1008, 1:61-2:14.)

52. Second, Anderson teaches that the earpiece may be "form[ed]" from a headset 21, as shown in FIG. 2:

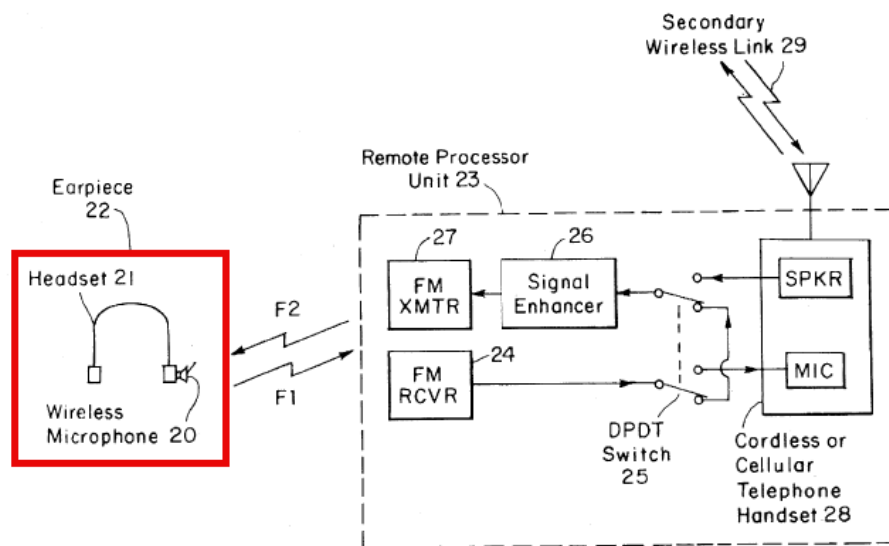


FIG. 2

(EX1010, 4:15-39, 5:52-54, FIG. 2 (annotated).)

53. The POSITA would have understood headset 21 and its earpiece 22 to be head-worn at least because FIG. 2 illustrates headset 21 (and thus earpiece 22) as including a headband that rests on the user's head for support; and because headset 21 can be a "Radio Shack (R) model 12-103" stereo headset, which similarly includes a headband, as shown below:



(EX1014, 46; EX1010, 4:26-39, FIG. 2.)

54. Anderson illustrates headset 21 and earpiece 22 within the context of a "limited-feature embodiment," shown in FIG. 2. (EX1010, 4:15-29.) However, the POSITA would have understood headset 21 and earpiece 22 to be combinable with the "full-featured" embodiment of FIG. 1. (EX1010, 3:53-58.) This is because Anderson characterizes FIG. 1 and FIG. 2 as showing two preferred embodiments of the same invention; explains that the headset earpiece shown in

FIG. 2 is “functionally similar” to the in-ear earpiece 10 of FIG. 1; and further explains that “many other earpiece housing types” can be used in place of the CIC earpiece housing shown in FIG. 1. (EX1010, 3:52-58, 4:15-35.) The POSITA would have understood from these disclosures that the FIG. 1 system could be flexibly implemented using various housings for the earpiece, including headset 21.

55. The POSITA would have been motivated to use the headset instead of the CIC housing to realize advantages in cost, simplicity, and commercial availability described by Anderson. Even using headset 21 in a full-featured application, it would provide certain advantages over the in-ear embodiment. Unlike some CIC housings, the headset did not need to be customized to fit in a user’s ear canal. (EX1010, 4:15-5:60; EX1014, 46.) Additionally, there would have been comfort benefits: as Lynch discloses, many users do not like supporting objects with their ears, a problem addressed by replacing a CIC housing with a headset. (EX1008, 1:17-21.) And using a larger headset rather than a small in-ear device would make it easier and less expensive to include the processing and communication capabilities of the full-featured application, and would reduce the likelihood of misplacing the device. (EX1010, 2:36-39 (relaxing earpiece size constraints leads to a “cost-effective design”), 21:31-34.) Anderson provides specific guidance for adapting the headset using “techniques [that] are well known

in the art,” and notes that schematics and service manuals for the headset were readily available, demonstrating that the POSITA would have had a reasonable expectation of success in making the combination. (EX1010, 4:26-5:60.)

56. Because the POSITA would have combined headset 21 and its earpiece 22 with the full-featured FIG. 1 embodiment, throughout this Petition, unless otherwise noted, references to the earpiece 10 shown for FIG. 1 should be understood to apply equally to earpiece 22 and headset 21.

b. Combination of Anderson and Lynch

57. In the combination of Anderson and Lynch, described above in Section C, the RPU is mounted to the user’s head via an ALD Cap as taught by Lynch. Lynch’s ALD Cap includes electronic components that supplement or replace the components of a hearing aid device, which the POSITA would have understood to include Anderson’s RPU component. (EX1008, 2:56-3:4.) Lynch teaches that comfort, ergonomics, and aesthetics are improved by mounting these components on the user’s head. (EX1008, 1:17-57, 2:20-23.) The ALD Cap communicates wirelessly with the hearing aid device, analogous to how Anderson’s RPU communicates wirelessly with the earpiece. (EX1008, Abstract, 3:62-4:18; EX1010, FIG. 1, FIG. 2.)

58. The ALD Cap can be mounted to the user’s head via magnets, adhesives, or other fixation means. (EX1008, 3:5-12.) For hearing aids that

include a BTE unit, such as some embodiments of Anderson, Lynch's ALD Cap is placed on top of a cochlear implant headpiece that "attach[es] to the head, not the ear." (EX1008, 2:5-8.)

59. And for hearing aids that are head-mounted and do not use BTE (behind-the-ear) components, such as embodiments of Anderson that include headset 21, Lynch's ALD Cap can be placed on top of the hearing aid's head-mounted external components. (EX1008, 2:56-66.) The POSITA would have understood such components to include headset 21, which is both external and head-mounted.

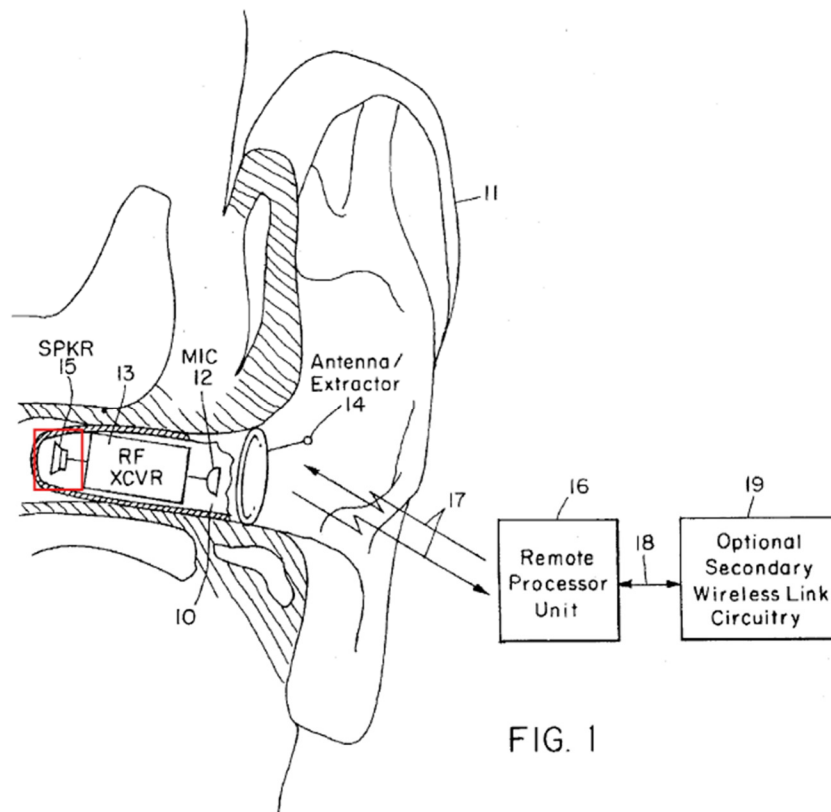
60. Thus, in the combination of Anderson and Lynch, Anderson's RPU would be worn on the user's head—either via Lynch's ALD Cap mounted on top of headset 21, or (for devices with BTE units) on a cochlear implant headpiece attached to the head. The POSITA would have been motivated to make the combination, with a reasonable expectation of success, for the reasons described in Section C above.

61. The POSITA would have understood the electronic hearing aid apparatus of the combination to be both personal (because it is worn by a single user) and head-worn (because it is supported by the top of the user's head, *e.g.*, via headset 21), thus meeting the claimed apparatus. (EX1010, 1:7-10, 3:52-58, 4:26-

39, FIG. 2; EX1014, 46.) The POSITA would further understand the claimed apparatus to include the RPU as described above.

2. [A] at least one speaker, the at least one speaker being configured to be wearable proximate to an ear of a user;

62. Anderson discloses that the earpiece of the hearing aid system includes a speaker, as illustrated in FIG. 1:



(EX1010, 3:60, FIG. 1 (annotated).)

63. As discussed above, in embodiments, a BTE unit can be used in place of an in-ear housing for a hearing aid; as the POSITA would have understood, BTE units of such systems are worn near (and thus proximate to) the ear and include

external electronic components such as speaker 15. (EX1010, 3:53-58; EX1008, 1:22-27, FIG. 1.)

64. Additionally, in embodiments, Anderson's earpiece belongs to head-worn headset 21, as shown in FIG. 2:

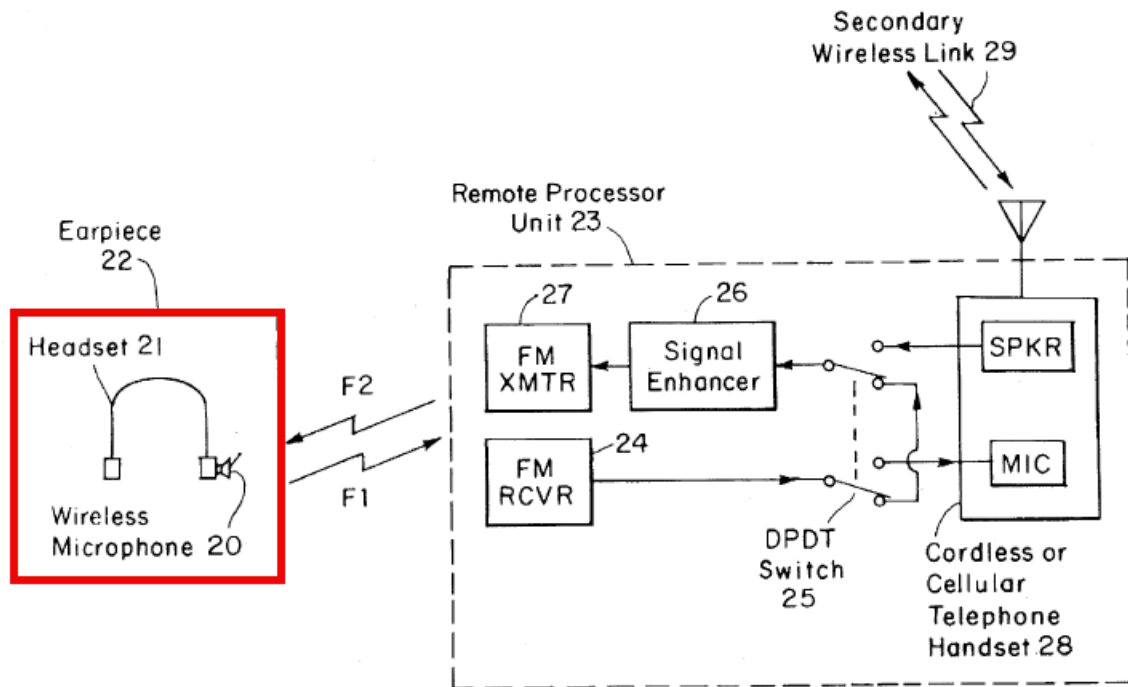


FIG. 2

(EX1010, 4:15-39, FIG. 2 (annotated).)

65. In these headset embodiments, headset 21 can be a “Radio Shack (R) model 12-103” stereo headset, shown below:



(EX1014, 46; EX1010, 4:26-39.)

66. The POSITA would have understood from these disclosures that Anderson's headset 21 can include a speaker for each ear, as shown above, with each speaker positioned near (and thus proximate to) its respective ear when the headset is worn.

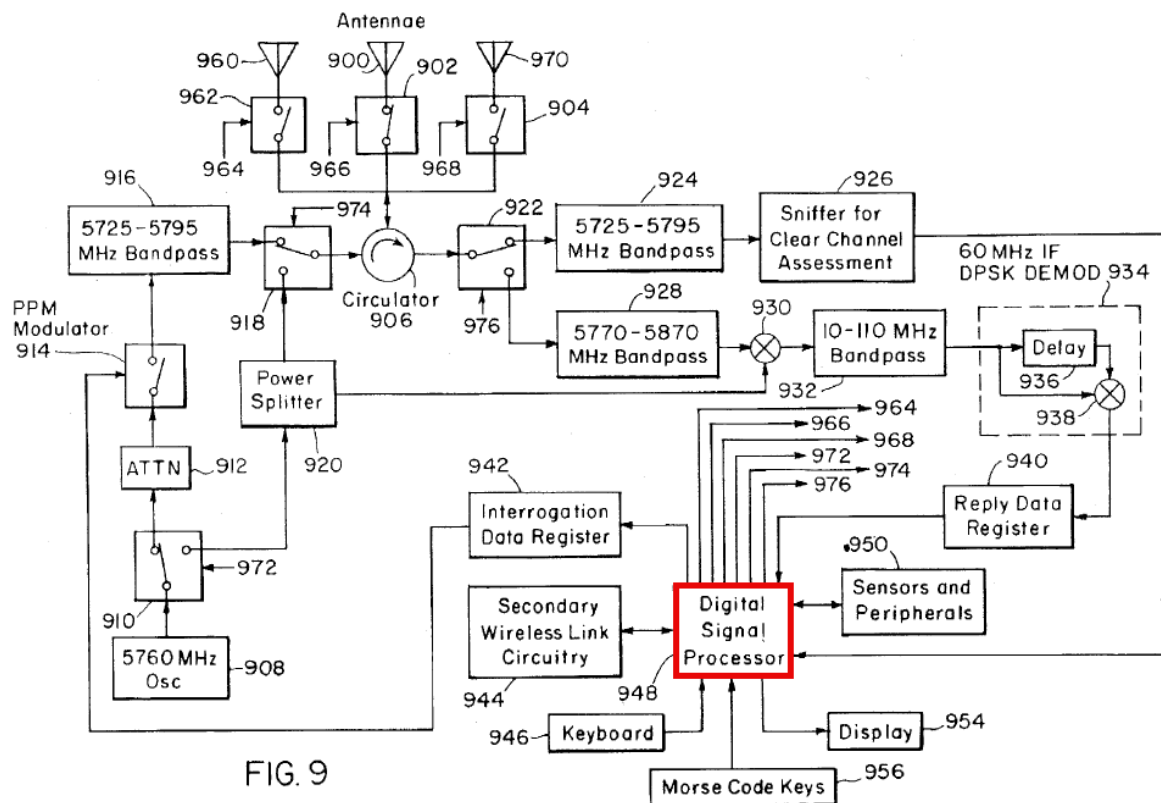
3. **[B] a wireless receiver configured to wirelessly receive audio output signals to be output to the user via the at least one speaker; and**

67. Anderson discloses a two-way wireless communication link 17 between the earpiece and the RPU. (EX1010, 4:1-4, FIG. 1.) Environmental audio signals are picked up by the earpiece's microphone 12 and transmitted wirelessly over the link 17 to the RPU. (EX1010, 1:51-63, 22:62-23:5.) In the RPU, these audio output signals are "enhanced according to the user's needs" and transmitted back to the earpiece, for presentation to the user via the earpiece's speaker 15. (EX1010, 1:55-63, 23:8-14.) The POSITA would thus understand Anderson's

RPU to include a wireless receiver to wirelessly receive, via communication link 17 from the earpiece, the audio output signals that are later customized and output via the speaker. As one example, Anderson discloses that an RPU can include an FM receiver tuned to the earpiece's transmission frequency. (EX1010, 4:44-49.)

4. [C] *electronic circuitry including at least an integrated circuit, the electronic circuitry being configured to*

68. Anderson's RPU comprises electronic circuitry that includes a digital signal processor (DSP) 948, as shown in FIG. 9:



(EX1010, 12:48-53, FIG. 9 (annotated).)

69. DSP 948 itself includes “several integrated circuits,” such as additional DSPs and supporting memory devices. (EX1010, 12:48-53, FIG. 9.)

5. [D] (i) *store hearing characteristics associated with the user;*

70. Anderson discloses a hearing test performed by the earpiece and RPU for a user of the hearing aid. (EX1010, 27:4-9.) The RPU’s DSP 948 generates tones of varying frequencies and amplitudes, which are presented to the user via the earpiece. (EX1010, 27:9-13.) Based on the user’s response to the tones, the hearing test determines “appropriate gain vs. frequency parameters” for a program stored in the DSP 948. (EX1010, 27:13-17.) The parameters are then used by DSP 948 to “perform[] signal enhancement to compensate for the user’s hearing loss.” (EX1010, 27:13-17.) This is consistent with the ’355 patent, which describes a “calibration” process that generates a “frequency hearing profile”, so that “amplification across frequencies is tailored to the hearing needs of the user.” (EX1001, 69:20-42.)

71. The POSITA would have understood Anderson’s gain vs. frequency parameters to be hearing characteristics associated with the user, *i.e.*, via the hearing test; and would further understand the parameters to be stored in the RPU’s electronic circuitry (*e.g.*, in a memory device of DSP 948) for access by DSP 948, *i.e.*, for the stored program to perform the signal enhancement. (EX1010, 27:13-17.)

6. ***[E] (ii) customize the received audio output signals to produce customized audio output signals for the user based on at least a portion of the stored hearing characteristics associated with the user such that the customized audio output signals at least compensate for the hearing impairment regarding the user's ability to hear; and***

72. As described for [B], the RPU receives audio output signals from the earpiece, enhances the signals, and sends the customized audio output signals back to the earpiece for presentation. (EX1010, 1:51-63.) As described for [D], the RPU enhances the signals by applying the stored gain vs. frequency parameters to “compensate for the user’s hearing loss.” (EX1010, 27:13-17.)

7. ***[F] (iii) output the customized audio output signals to the at least one speaker,***

73. As described for [B], the customized audio signals are transmitted from the RPU to the earpiece, where they are output to the user by the earpiece speaker 15. (EX1010, 1:55-63, 22:62-23:14.)

8. ***[G] wherein the at least one speaker is configured to generate at least a portion of the customized audio output for the user in accordance with at least the portion of the customized audio output signals.***

74. See element [F]. The customized audio signals received by the earpiece are “converted by a speaker 15 to sounds that can only be heard by the user 11.” (EX1010, 23:8-14.)

E. Claim 2

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 1,*

75. See claim 1.

2. **[A]** *wherein the received audio output signals are wirelessly received from a mobile communication device associated with the user.*

76. See claim 1[B]. The audio output signals are received by the RPU from the user's earpiece via wireless link 17. (EX1010, 22:62-23:5.) The earpiece is a mobile communication device at least because it is a device that "communicates wirelessly" with the RPU to send and receive signals; the earpiece can also communicate wirelessly with a telephone system, such as a cell phone. (EX1010, Abstract, 2:20-44.) The earpiece is mobile, and associated with the user, because it is worn by the user and "allows complete freedom of movement". (EX1010, 1:6-18.)

F. Claim 17

1. **[Preamble]** *A head-worn personal electronic apparatus operable to at least output customized audio output, comprising:*

77. See claim 1[Preamble].

2. **[A]** *at least one speaker, the at least one speaker being configured to be wearable proximate to an ear of a user;*

78. See claim 1[A].

3. ***[B] a wireless receiver configured to wirelessly receive customized audio output signals for the user, the customized audio output signals having been customized based on at least predetermined hearing characteristics associated with the user such that the customized audio output signals at least compensate for the hearing impairment regarding the user's ability to hear; and***

79. See claim 1[B], [D], and [E]. The customized audio output signals are wirelessly transmitted to the earpiece from the RPU via the two-way wireless link 17. (EX1010, 23:8-14.) The POSITA would have understood these wirelessly transmitted signals to be received by a wireless receiver of the earpiece, *i.e.*, the earpiece's RF transceiver 13. (EX1010, 3:58-60, 11:19-23, FIG. 4.)

4. ***[C] electronic circuitry including at least an integrated circuit, the electronic circuitry being configured to output the customized audio output signals to the at least one speaker,***

80. Anderson's earpiece includes electronic circuitry that includes custom application-specific integrated circuit (ASIC) 845, which controls "all earpiece functions," as shown in FIG. 8:

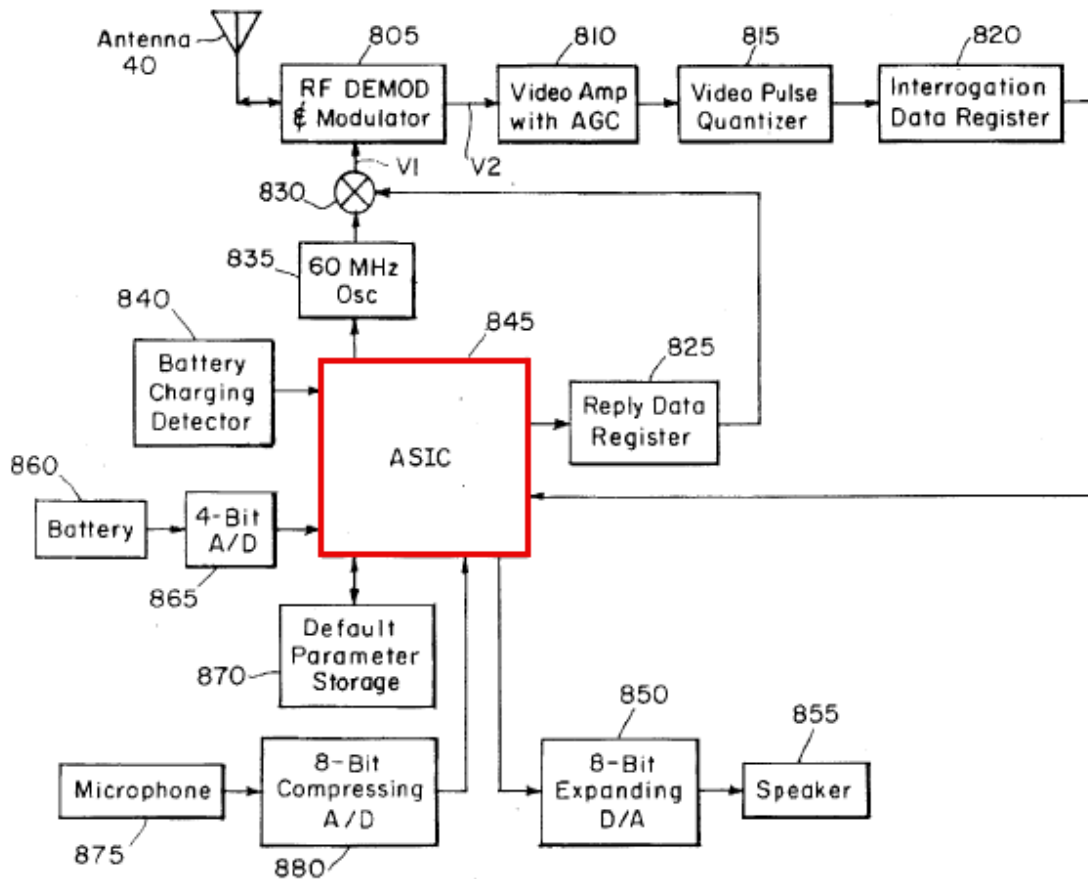


FIG. 8

(EX1010, 12:38-41, FIG. 8 (annotated).)

81. Under control of the ASIC 845, as described for claim 1[B] and [F], the earpiece receives the customized audio signals and outputs the signals to the user via speaker 15.

5. ***[D] wherein the at least one speaker is configured to generate at least a portion of the customized audio output for the user in accordance with at least the portion of the customized audio output signals.***

82. See claim 1[G].

G. Claim 18

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 17,*

83. See claim 17.

2. **[A]** *wherein the customized audio output signals are wirelessly received from a mobile communication device associated with the user.*

84. See claim 2[A].

H. Claim 51

1. **[Preamble]** *head-worn personal electronic apparatus as recited in claim 17,*

85. See claim 17.

2. **[A]** *wherein the head-worn personal electronic apparatus is configured to provide audio alerts to the user via the at least one speaker.*

86. Anderson discloses that the hearing aid “provides useful unsolicited information,” such as “a verbal warning that an earpiece or RPU battery voltage is low.” (EX1010, 24:15-23.) The POSITA would have understood such verbal warnings to be audio alerts, *e.g.*, alerts regarding battery status. The verbal warnings are sent from the RPU to the earpiece and “ultimately received as audio signals by the user,” *i.e.*, via the earpiece’s speaker. (EX1010, 24:20-23, 26:2-5.)

I. Claim 52

1. **[Preamble] *A head-worn personal electronic apparatus as recited in claim 51,***

87. See claim 51.

2. **[A] *wherein the audio alerts are dependent on one or more user preference settings.***

88. Anderson's audio alerts, as described for claim 51[A] (*e.g.*, verbal warnings about the earpiece or RPU battery), are provided to a user only "if desired," *i.e.*, dependent on a user preference for such alerts. (EX1010, 24:15-23.) The POSITA would have understood Anderson to teach a user preference setting, *e.g.*, an RPU "parameter setting[]," to indicate the user's preference for audio alerts. (EX1010, 20:52-55.)

J. Claim 54

1. **[Preamble] *A head-worn personal electronic apparatus as recited in claim 17,***

89. See claim 17.

2. **[A] *wherein the head-worn personal electronic apparatus comprises: a microphone at least partially internal to the head-worn personal electronic apparatus,***

90. Anderson discloses that "speech signals ... are picked up by the earpiece wireless microphone 20" for communication to the RPU. (EX1010, 5:3-

6:25.) The wireless microphone 20 is “mounted on” the headset 21 to “form” the earpiece 22, as shown in FIG. 2:

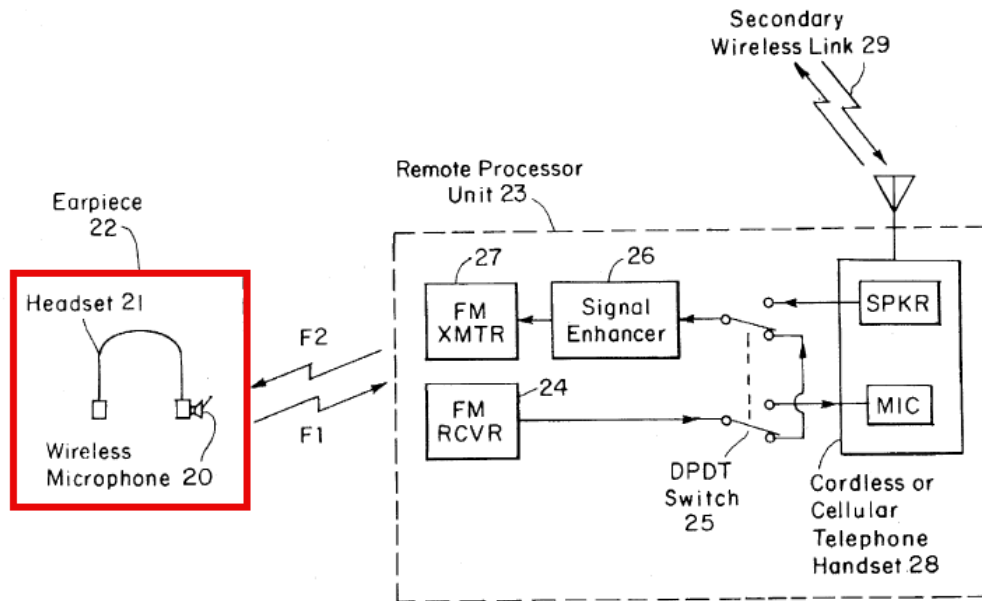


FIG. 2

(EX1010, 4:35-39, FIG. 2 (annotated).)

91. The earpiece apparatus is shown in FIG. 2 to include the headset 21; and is head-worn as described for claim 1, Preamble. (EX1010, FIG. 2.) The wireless microphone 20 is at least partially internal to this head-worn apparatus, in order to connect to the headset’s 1.5V battery, and to connect to the A/D converter 880 as shown in FIG. 8 (illustrating the earpiece):

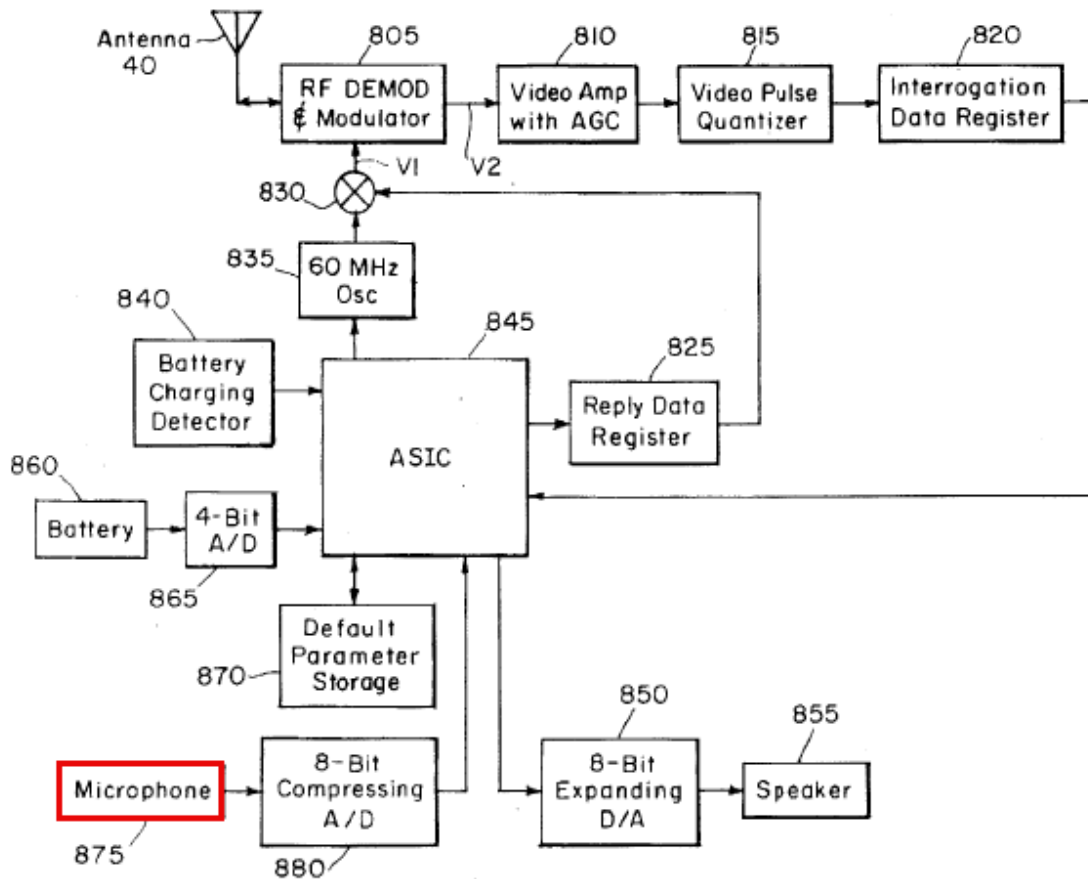


FIG. 8

(EX1010, 3:40-41, 5:52-54, 16:28-32, FIG. 8; EX1014, 46.)

92. Reference to FIG. 8's disclosures is appropriate in the combination, which implements Anderson's full-featured application (FIG. 8) in its headset-based device (FIG. 2).

3. ***[B] wherein the head-worn personal electronic device is configured to receive a voice input via the microphone, determine a requested operation from the voice input using voice recognition, and control an operation by the head-worn personal electronic device based on the requested operation.***

93. Anderson discloses using a voice recognition program to execute voice commands, such as for telephone dialing and hearing aid parameter control. (EX1010, 25:15-34.) The user's verbal commands are received as audio signals by the earpiece (*i.e.*, by the earpiece's microphone) and transmitted to the RPU. (EX1010, 25:29-30.) The RPU executes a voice recognition process (*e.g.*, by DSP 948) to identify voice commands from the audio signals, causing the RPU to initiate actions such as executing a telephone call. (EX1010, 25:41.)

K. Claim 58

1. ***[Preamble] A head-worn personal electronic apparatus as recited in claim 17,***

94. See claim 17.

2. ***[A] wherein the customized audio output includes music that was wirelessly received via the wireless receiver.***

95. Anderson discloses that the RPU can include a "peripheral device" to provide music or other information to the user. (EX1010, 24:45-47, 25:52-59.) The peripheral device can provide music from, *e.g.*, a compact disc. (EX1010, 25:52-59.) The RPU combines the customized audio signals described for claim 1[B] with "other" audio information, which the POSITA would have understood to

include the music from the RPU's peripheral device; and transmits this customized audio output to the earpiece via wireless link 17, where it is received by the earpiece's wireless receiver as described for claim 17[B]. (EX1010, 23:5-14.)

L. Claim 59

- 1. [Preamble] *A head-worn personal electronic apparatus as recited in claim 17,***

96. See claim 17.

- 2. [A] *wherein the customized audio output signals result from amplifying or attenuating different frequency bands differently according to at least the predetermined hearing characteristics associated with the user.***

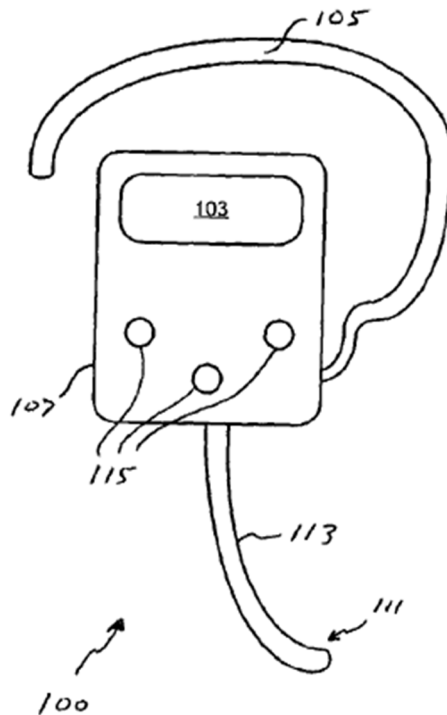
97. As described for claim 1[D], Anderson's RPU "performs signal enhancement to compensate for the user's hearing loss" based on gain vs. frequency parameters that are determined based on a hearing test. (EX1010, 27:4-17.) The POSITA would have understood such a gain parameter to characterize an amplitude of a signal; and thus would have understood Anderson's disclosure of using gain vs. frequency parameters to enhance the audio signals to include raising (amplifying) or lowering (attenuating) the amplitude of different frequency bands, based on their corresponding gain parameters, in accordance with the results of the user's hearing test. (EX1023, 314; EX1010, 27:4-17.)

**VII. CLAIMS 3-5 AND 19-21 ARE RENDERED OBVIOUS BY
ANDERSON IN VIEW OF LYNCH AND BODLEY**

A. Summary of Bodley

98. Bodley is a U.S. Patent that was filed on January 15, 2003, published on July 15, 2004, and issued on November 17, 2009. (EX1005.) I understand Bodley is thus prior art to the '355 patent under at least 35 U.S.C. §§102(a) and (e). I understand that Bodley was not cited or considered during prosecution of the '355 patent.

99. Bodley discloses a headset for wireless communication that includes an earpiece, a microphone, a speaker, and an integral display. (EX1005, 1:47-57, 2:38-50.) Bodley's headset attaches to the user using "any of a variety of means," including a headband for head support. (EX1005, 2:38-40.) FIG. 1 illustrates an ear-worn embodiment:



(EX1005, FIG. 1.)

100. The headset preferably connects to a “communications system” “that enables both voice and hearing data transfer,” such as a cell phone. (EX1005, 2:28-37.) The body (107) of the headset houses electronic components, and includes a touch-sensitive display (103) for presenting information (such as battery level) and receiving touch input (such as for entering phone numbers or operating the cell phone). (EX1005, 2:44-46, 2:65-67, 3:5-43.)

101. Bodley is analogous art to the ’355 patent because it is directed to the same field of endeavor: wearable devices with electrical components, including those that provide audio output. (EX1001, Abstract; 3:37-47; EX1005, Abstract, 1:47-67, 2:28-50.) For example, Bodley relates to wearable headsets in which

audio signals are presented to a user—analogous to the wearable audio devices of the '355 patent. (*See* EX1001, 3:36-64; EX1005, 2:28-50.) Similarly, by disclosing devices with electrical components to configure audio operation (*e.g.*, headset volume, voice dialing, ring mode), Bodley is reasonably pertinent to a problem faced by the '355 patent inventor—using wearable devices with electrical components to “facilitate audio support.” (EX1001, 3:37-47; EX1005, 1:47-67.)

B. Motivation to Combine with Reasonable Expectation of Success

102. The POSITA would have been motivated to combine the teachings of Bodley with those of Anderson and Lynch. Anderson discloses that the hearing aid's RPU includes pushbuttons (*e.g.*, a pushbutton keyboard) to enter data or control parameter settings. (EX1010, 2:51-55, 20:52-21:30, FIG. 7.) Voice control can also be used to enter telephone numbers. (EX1010, 2:51-55, 25:15-29.) However, as the POSITA would have recognized, both of these input mechanisms have drawbacks: for example, pushbuttons and keyboards have moving parts that are subject to mechanical failure, and typically require force and fine motor control that may be impractical for users with arthritis and other impairments—especially given the small size of Anderson's hearing aid. Voice control does not completely solve the problem, at least because Anderson discloses “limited-vocabulary” voice control that is limited to “certain pre-defined commands.” (EX1010, 25:22-34.) Additionally, voice control requires the user to

speak and thus may not be suitable for Anderson's desired "covert operation," for operation in noisy environments, or for users with speech impairments. (EX1010, 1:10-18, 20:48-60.)

103. The POSITA would have been motivated to address this usability problem, and would have looked to Bodley's teachings of touch inputs for wearable audio devices. Combining Anderson and Lynch with Bodley's touch-sensitive input device sensor—for example, installed in the headset earpiece itself, as taught by Bodley—would have addressed the problem. (EX1005, FIG. 1.) For example, Bodley's touch input lacks moving parts, improving reliability and durability— particularly significant for hearing aid devices that may see daily use in outdoor environments. Bodley's touch controls are also more user-accessible by permitting low-force inputs; and are suitable for loud environments or for covert use.

104. The POSITA would have had a reasonable expectation of success in making the combination. Anderson, Lynch, and Bodley share structural and functional similarities that render their teachings readily combinable. For example, Anderson, Lynch, and Bodley disclose head-worn devices for providing audio output to a user; those devices are implemented using analogous and well-understood components, such as microphones, speakers, wireless transceivers, and control circuitry. (EX1010, FIG. 1, FIG. 2; EX1008, 1:61-2:23, 3:62-4:4, FIG. 4;

EX1005, 1:47-67, 2:38-50, 3:44-4:3, FIG. 1, FIG. 9.) Given that Anderson already describes mechanisms for controlling earpiece functions, such as telephone dialing, it would have been straightforward to apply a well-understood touch control mechanism, as in Bodley, to perform analogous control operations. Accordingly, combining the teachings of Anderson and Lynch with Bodley would have applied known components and techniques to yield predictable results.

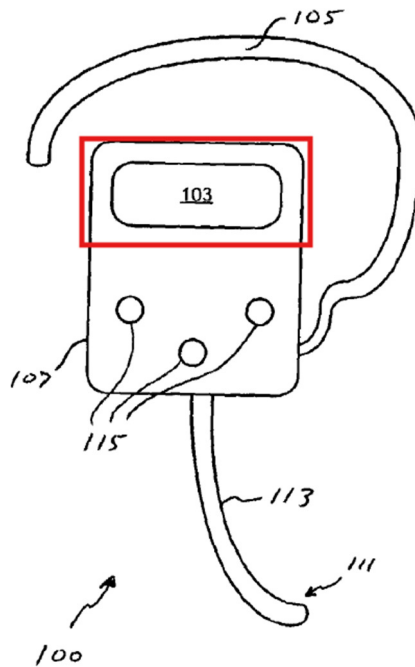
C. Claim 3

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 1,*

105. See claim 1.

2. **[A]** *wherein the head-worn personal electronic apparatus comprises: a touch sensitive surface at least partially contained within the head-worn personal electronic apparatus and configured to sense a touch input associated with the user,*

106. Bodley discloses a headset 100 that includes a touch-sensitive display panel 103, as shown in FIG. 1:



(EX1005, FIG. 1 (annotated), 2:40-41, 2:65-67.)

107. The display can be “touch sensitive, thus providing a touch screen for data input.” (EX1005, 3:20-21.)

108. The POSITA would have combined Bodley’s touch sensor teachings with the headset of Anderson and Lynch as described above in Section VI.A, *i.e.*, such that the head-worn earpiece of Anderson would include a touch-sensitive surface to provide touch input to control the hearing aid. While Bodley discloses a touch sensor as part of a display, the POSITA would have understood that a touch-sensitive surface such as in Bodley could have been incorporated with or without the display, and that the advantages of the combination described in Section VI.A.1

would apply equally to touch surface embodiments without a corresponding display.

3. **[B] *wherein the sensed touch input operating to at least alter operation of the head-worn electronic personal audio apparatus.***

109. In the combination of Bodley with Anderson and Lynch, the POSITA would have understood the touch-sensitive surface to provide at least the input functionality of Anderson's pushbuttons and/or voice control. For example, the touch-sensitive surface would be used to control parameter settings such as volume, or to perform operations such as telephone dialing, as disclosed by Anderson, thereby altering operation of the hearing aid apparatus. (EX1010, 20:52-55, 25:15-29.) These operations are consistent with behavior of the touch display in Bodley, *i.e.*, adjusting headset volume or dialing a telephone. (EX1005, 3:15-20.)

D. Claim 4

1. **[Preamble] *A head-worn personal electronic apparatus as recited in claim 3,***

110. See claim 3.

2. **[A] *wherein head-worn personal electronic apparatus is configured to support voice calls to the user, and***

111. Anderson discloses that its system includes "cellular telephone capabilities," including telephone dialing functions and communication with a

cellular telephone system. (EX1010, 23:14-35.) The POSITA would have understood such cellular telephone capabilities to include supporting voice calls to the user, which is a basic telephone function.

3. ***[B] wherein the at least one operation of the head-worn personal electronic apparatus being altered concerns at least accepting or declining a voice call to the user.***

112. As described for claim 3[B], the touch-sensitive surface of the combination would perform operations such as telephone dialing, as taught by Anderson and by Bodley. Anderson discloses that its telephone operations include “communicat[ing] with a conventional handset or speakerphone in the usual fashion,” which the POSITA would have understood to include accepting or declining voice calls. (EX1010, 24:50-55.)

E. Claim 5

1. ***[Preamble] A head-worn personal electronic apparatus recited in claim 3,***

113. See claim 3.

2. ***[A] wherein the at least one operation of the head-worn personal electronic apparatus being altered concerns control of the customized audio output being provided to the user.***

114. As described for claim 3[B], in the combination, the touch-sensitive surface would be used to control parameter settings including volume, thus controlling the customized audio output provided to the user (*i.e.*, via the earpiece

speaker from the RPU as described for claim 1[B]). (EX1010, 20:52-55, 25:15-29.)

F. Claim 19

1. [Preamble] *A head-worn personal electronic apparatus as recited in claim 17,*

115. See claim 17.

2. [A] *wherein the head-worn personal electronic apparatus comprises: a touch sensitive surface at least partially contained within the head-worn personal electronic apparatus and configured to sense a touch input associated with the user,*

116. See claim 3[A].

3. [B] *wherein the sensed touch input operating to at least alter operation of the head-worn electronic personal audio apparatus.*

117. See claim 3[B].

G. Claim 20

1. [Preamble] *A head-worn personal electronic apparatus as recited in claim 19,*

118. See claim 19.

2. [A] *wherein head-worn personal electronic apparatus is configured to support voice calls to the user, and*

119. See claim 4[A].

3. ***[B] wherein the at least one operation of the head-worn personal electronic apparatus being altered concerns at least accepting or declining a voice call to the user.***

120. See claim 4[B].

H. Claim 21

1. ***[Preamble] A head-worn personal electronic apparatus recited in claim 19,***

121. See claim 19.

2. ***[A] wherein the at least one operation of the head-worn personal electronic apparatus being altered concerns control of the customized audio output being provided to the user.***

122. See claim 5[A].

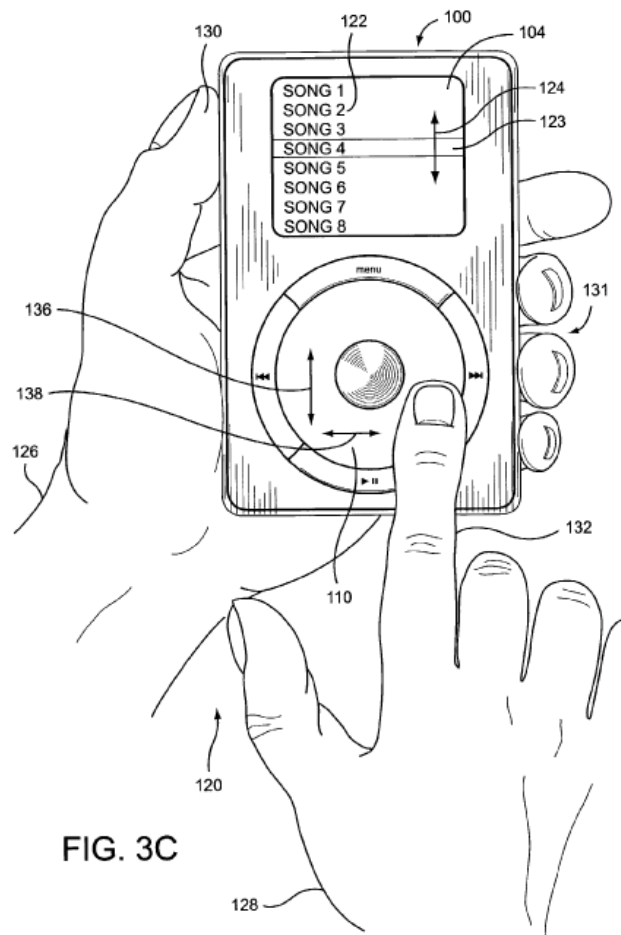
VIII. CLAIMS 6 AND 22-24 ARE RENDERED OBVIOUS BY ANDERSON IN VIEW OF LYNCH, BODLEY, AND ZADESKY

A. Summary of Zadesky

123. Zadesky is a U.S. Patent that was filed on July 1, 2002, published on April 24, 2003, and issued on May 16, 2006. (EX1006.) I understand Zadesky is thus prior art to the '355 patent under at least 35 U.S.C. §§102(a), (b), and (e). I understand that Zadesky was not cited or considered during prosecution of the '355 patent.

124. Zadesky relates generally to portable audio devices, and describes that an audio device can include a touch-sensitive surface (touchpad) for receiving touch input from a user and controlling the device. (EX1006, 1:47-3:22.) The

touchpad can control the media player based on a sliding input from the user, as shown in FIG. 3C:



(EX1006, FIG. 3C.)

125. Zadesky is analogous art to the '355 patent because it is directed to the same field of endeavor: portable devices with electrical components, including those that provide audio output. (EX1001, Abstract; 3:37-47; EX1006, 3:36-4:3.) For example, Zadesky discloses a handheld media player in which audio is

presented to a user—analogous to the audio devices of the '355 patent. (*See* EX1001, 3:36-64; EX1006, 3:38-46, 4:60-5:26.) Similarly, by disclosing that such handheld devices include electrical components (*e.g.*, touchpads) for providing audio control functions (*e.g.*, volume), Zadesky is reasonably pertinent to a problem faced by the '355 patent inventor—using wearable devices with electrical components to “facilitate audio support.” (EX1001, 3:37-47; EX1006, 10:34-51.)

B. Motivation to Combine with Reasonable Expectation of Success

126. The POSITA would have been motivated to combine the teachings of Anderson, Lynch, and Bodley with those of Zadesky to meet the claim limitations with a reasonable expectation of success. The POSITA would have been motivated to combine Anderson, Lynch, and Bodley as described for Sections V.C and VI.B. Additionally, the POSITA would have been motivated to combine Zadesky's touchpad teachings with the modified Anderson-Lynch-Bodley system. In the combined system, as described in Section VII, a headset includes a touch-sensitive surface for controlling settings and functions of an earpiece. (EX1005, 3:20-23.) However, the details of how a user would interact with the touch surface are not disclosed in Anderson, Lynch, or Bodley. The POSITA thus would have been motivated to look to other references to supply these missing details. The POSITA would have looked to Zadesky because Zadesky describes touchpad input techniques that “facilitate user interaction” with audio players such as Anderson's

wearable audio device; and explains the “numerous” advantages, including ease and speed of use, accessibility, and ergonomics. (EX1006, 3:26-37, 4:37-40, 5:61-6:8, 13:36-60.)

127. Zadesky describes using sliding input on a touch surface to improve on audio device functions, such as volume adjustment. (EX1006, 10:40-51.) The POSITA would have combined the sliding input with the touch surface in order to realize Zadesky’s advantages, such as faster, intuitive, and ergonomic control of audio devices. These advantages are especially significant for the wearable format of Anderson, Lynch, and Bodley, in which the user may not be able to see the touch surface (because it is worn on the user’s head), and may thus benefit from intuitive touch-based control techniques.

128. Further, Zadesky emphasizes its applicability to various portable audio device types; and that its teachings can be implemented using “widely varied” types of touchpads, such as disclosed in Bodley, and using common and well-understood electrical components (*e.g.*, microprocessors, memory) that are analogous to those of Anderson, Lynch and Bodley. (EX1006, 5:27-45, 6:4-8, 13:61-14:20.) Combining Zadesky with the combined system of Anderson, Lynch, and Bodley would thus merely require modifying the existing touch surface to recognize and respond to sliding input as described in Zadesky. Because of the natural compatibility of the references, and the straightforward and predictable

nature of incorporating Zadesky's teachings, the POSITA would have had a reasonable expectation of success in making the combination.

C. Claim 6

1. **[Preamble] *A head-worn personal electronic apparatus as recited in claim 3,***

129. See claim 3.

2. **[A] *wherein the head-worn personal electronic apparatus is configured to detect at least a sliding of a finger action with respect to the touch sensitive surface.***

130. Zadesky's portable media player device includes a touchpad 110 configured to "receive input from a finger moving across the surface of the touch pad 110" and control the media player accordingly, *e.g.*, by scrolling through a list of media files on the player, or "vary[ing] a characteristic of the media player," such as changing the volume. (EX1006, 5:61-6:8, 10:40-51.) The POSITA would have understood Zadesky's "finger moving across the surface" to disclose a sliding action.

131. The POSITA would have combined the touchpad input teachings of Zadesky with the touch surface of the Anderson-Lynch-Bodley system by configuring the touch surface to use sliding user input (as in Zadesky) to control the system's operations, such as telephone dialing, or controlling volume or other parameter settings. (EX1010, 20:52-55, 25:15-29.)

D. Claim 22

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 19,*

132. See claim 19.

2. **[A]** *wherein the head-worn personal electronic apparatus is configured to distinguish at least a direction of the user input with respect to the touch sensitive surface.*

133. See claim 22[A]. Zadesky teaches distinguishing a direction of the user input with respect to the touch-sensitive surface; for example, the “direction that the finger moves may be arranged to control the direction of scrolling,” *i.e.*, by moving “vertically up when the finger is moved in a first direction and vertically down when the finger is moved in a second direction.” (EX1006, 6:38-59.)

E. Claim 23

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 19,*

134. See claim 19.

2. **[A]** *wherein the head-worn personal electronic apparatus is configured to detect at least a sliding of a finger action with respect to the touch sensitive surface.*

135. See claim 6[A].

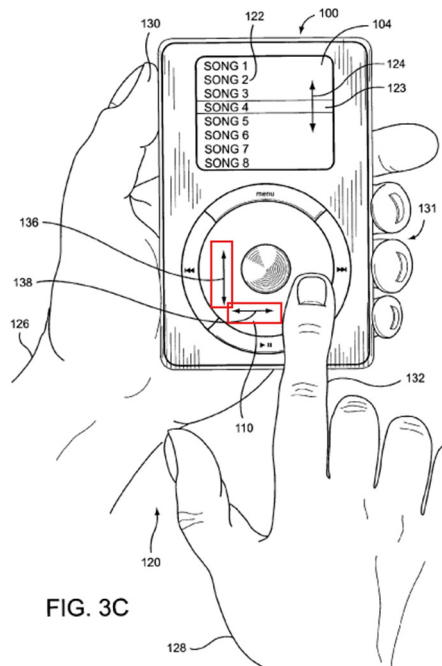
F. Claim 24

1. [Preamble] *A head-worn personal electronic apparatus as recited in claim 19,*

136. See claim 19.

2. [A] *wherein the head-worn personal electronic apparatus is configured to facilitate determination at least whether the user input pertains to a forward sliding action or a backward sliding action with respect to the touch sensitive surface.*

137. See claim 22[A]. Additionally, in Zadesky, as shown in FIG. 3C below, a user can “slide his or her finger 132 substantially tangentially from all sides of the touch pad,” such that the touchpad is “actuated *forwards and backwards* as shown by arrows 136 and side to side by arrows 138.” (EX1006, 9:17-21 (emphasis added).)



(EX1006, FIG. 3C (annotated).)

IX. CLAIMS 7-12, 29-40, 53, 57, AND 60 ARE RENDERED OBVIOUS BY ANDERSON IN VIEW OF LYNCH AND NEMIROVSKI

A. Summary of Nemirovski

138. Nemirovski is a U.S. Patent that was filed on July 31, 2001, published on October 3, 2002, and issued on December 30, 2003. (EX1007.) I understand Nemirovski is thus prior art to the '355 patent under at least 35 U.S.C. §§102(a), (b), and (e). I understand that Nemirovski was not cited or considered during prosecution of the '355 patent.

139. Nemirovski discloses an earset with multiple microphones for use in a communication system. FIG. 5 illustrates an embodiment:

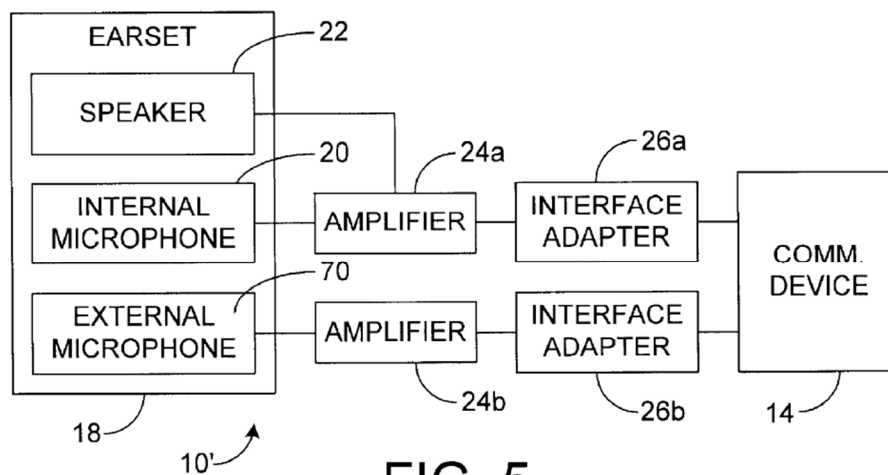


FIG. 5

(EX1007, FIG. 5.)

140. Nemirovski's earset can be "retained ... by a headset assembly," by which the POSITA would have understood the earset to be headwear (*i.e.*, worn supported by the top of the user's head via the headset assembly). (EX1007, 6:19-22.)

141. As shown in FIG. 5, an earset (18) includes an internal microphone (20), an external microphone (70), and a speaker (22). (EX1007, 9:46-50.) The microphones detect sounds and convert them into electrical signals. (EX1007, 4:34-35.) The signals are optionally amplified and then provided to a communication device (14) via an appropriate interface adapter (26a, 26b). (EX1007, 4:35-39.) The communication device can also transmit sounds to the user to be output via speaker 22. (EX1007, 4:42-47.)

142. The internal microphone 20 is directed toward the ear canal of the user, and the external microphone is pointed away from the user, such that the internal microphone detects sounds generated by the user (e.g., via transmission through an air medium) and the external microphone detects externally generated sounds. (EX1007, 5:45-50, 6:58-64, 9:22-26, 9:54-60.) The signals generated by the microphones can be used to "discern air pressure changes within the ear" (indicating user speech) from "externally produced noise, speech and the like," and the system can be "adapted to cancel externally generated noise from the detections of the internal microphone." (EX1007, 9:19-31, 19:8-13.)

143. Nemirovski is analogous art to the '355 patent because it is directed to the same field of endeavor: wearable devices with electrical components, including those that provide audio output. (EX1001, Abstract; 3:37-47; EX1007, Abstract, 2:10-45.) For example, Nemirovski discloses a head-worn earset with a microphone and speaker—analogous to the head-worn audio devices of the '355 patent. (*See* EX1001, 3:36-64; EX1007, 2:10-25.) Similarly, by disclosing that such earsets include electrical components operable to detect speech and produce a corrected microphone signal for the user, Nemirovski is reasonably pertinent to a problem faced by the '355 patent inventor— using wearable devices to provide users with “enhanced hearing.” (EX1001, 3:37-47; EX1007, 2:10-47.)

B. Motivation to Combine with Reasonable Expectation of Success

144. The POSITA would have been motivated to combine Anderson and Lynch with Nemirovski to meet the claim limitations with reasonable expectation of success. Anderson discloses an earpiece device for a hearing aid that is compatible with multiple microphones: for example, a first microphone in an earpiece, and a second, body-worn, microphone for detecting background noise, which is used to set hearing aid parameters such as volume amplification level. (EX1010, 7:10-13, 22:27-33, 23:26-31.)

145. The POSITA would have sought to combine Anderson with Nemirovski for several reasons. First, Anderson describes operational issues

relating to the body-worn microphone. For example, Anderson explains (and the POSITA would have recognized) that body-worn microphones suffer from various drawbacks, including being compromised by wind and clothing noise; not tracking the user's head motion; and possible incompatibility with stand-alone earpiece operation. (EX1010, 22:20-27.) Anderson suggests that it would be preferable to relocate the body-worn microphone in the earpiece to address these issues, but does not describe how to implement such a microphone configuration while still using the microphone to detect background noise. (EX1010, 22:20-27.)

146. Second, Anderson's earpiece is not just a one-way hearing aid; a microphone in the earpiece detects the user's speech, which can be used for voice recognition and/or for "cellular telephone capabilities," including "telephone dialing functions" and communication with a "cellular telephone system," such as via a secondary wireless link. (EX1010, 23:14-35, 24:45-25:14, 25:15-50, FIG. 1, FIG. 9.) For example, Anderson discloses that an earpiece microphone can be used to pick up audio, including speech, from the path between the user's mouth and ear. (EX1010, 26:57-61.) However, the POSITA would have understood that in such systems, the detected user speech can be obscured by the presence of environmental noise, which is undesirable for both voice recognition and telephone applications. Recognizing the problem, Anderson acknowledges that "a user may

not wish to transmit signals from the ambient audio environment over the secondary wireless link.” (EX1010, 26:55-57.)

147. However, Anderson’s proposed solutions to the problem of environmental noise (bone conduction and multiple earpieces) have drawbacks; for example, as the POSITA would have recognized, bone conduction provides “suboptimal sound transmission” to the ear; and requiring multiple earpieces instead of one can greatly increase expense, and may be unsuitable for some applications (*e.g.*, while driving). (EX1010, 26:54-65; EX1017, 2.) Anderson invites its combination with other systems, by suggesting that distinguishing environmental noise can be performed “using any of a number of techniques and circuits well known in the art”. (EX1010, 23:65-24:1.)

148. The POSITA would have been motivated to combine Anderson’s teachings with those of Nemirovski to address Anderson’s problems stemming from the body-worn environmental microphone, as well as the problem of separating environmental noise from the user’s speech detected by the earpiece microphone. Nemirovski describes an earpiece with a two-microphone configuration, including an external microphone for detecting environmental (background) noise; and discloses techniques for separating user speech from environmental noise, and for removing the noise from the user speech signal. (EX1007, 5:45-50, 6:58-64, 9:19-31, 9:54-60, 19:8-13.) The POSITA would have

been motivated to apply Nemirovski's microphone arrangement teachings to Anderson to realize the benefits described in Nemirovski, such as improved signal processing, and enabling the user to engage in other activities while speaking, without the drawbacks of bone conduction or multiple earpieces. (EX1007, 3:6-44, 10:8-11:6.) Nemirovski provides further support for the combination, *e.g.*, by explaining that multiple-earpiece solutions such as in Anderson are "discouraged" in some circumstances (such as while driving). (EX1007, 7:38-41.)

149. Although Anderson explains that hearing aids (such as in Anderson) may differ from cellular telephone handsets (as in Nemirovski) in their need to present environmental audio, the POSITA still would have looked to combine Nemirovski's teachings with Anderson. (EX1010, 2:7-16.) This is at least because Anderson includes voice and cell phone functionality, analogous to Nemirovski as described above; and because Nemirovski offers a solution to Anderson's noise and microphone placement problems.

150. The POSITA would have had a reasonable expectation of success in combining the teachings of Anderson, Lynch, and Nemirovski. For example, Anderson, Lynch, and Nemirovski each disclose analogous head-worn devices that support audio output in use with a communication system. (EX1010, 1:6-10, 6:19-22; EX1008, 1:61-2:23, 4:37-51; EX1007, 3:6-9.) The devices share various analogous and familiar components used in conventional ways, such as

microphones for detecting speech, speakers for presenting audio signals, and amplifier circuits for signal processing. (EX1010, 3:58-60, FIG. 1, FIG. 8; EX1008, 4:37-51; EX1007, 9:45-50, FIG. 5.) And Nemirovski provides implementation detail, such as specific signal processing methods for detecting speech, to guide its combination with systems such as Anderson and Lynch. (EX1007, 10:27-11:6.) Accordingly, combining Anderson and Lynch with Nemirovski would have involved combining known components to yield predictable results.

C. Claim 7

1. **[Preamble] *A head-worn personal electronic apparatus as recited in claim 1,***

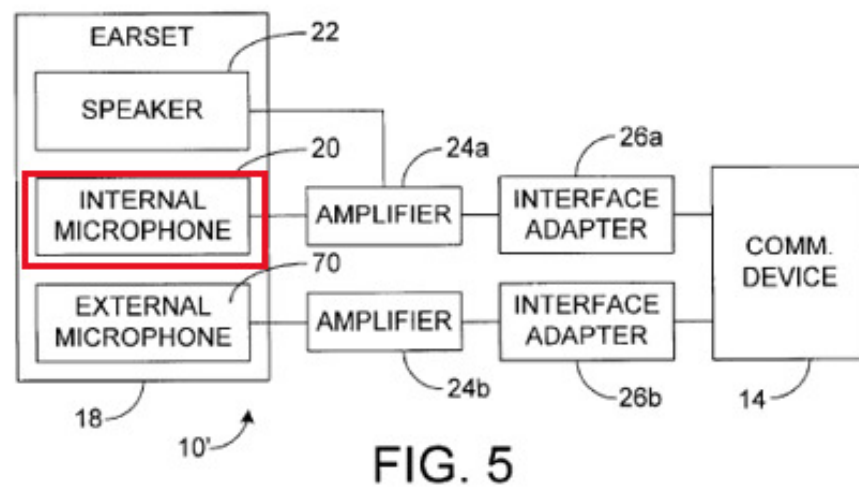
151. See claim 1.

2. **[A] *wherein the head-worn personal electronic apparatus comprises: a first microphone configured to pick up at least audio input from at least the user, the first microphone being at least partially in the head-worn personal electronic apparatus and is positioned to be directed towards the user when the head-worn personal electronic apparatus is being worn by the user; and***

152. The POSITA would have combined Nemirovski's teachings of microphones with the combined head-worn apparatus of Anderson and Lynch, as described in Section VIII.A, such that the earpiece of the combination would

include analogous microphones, *e.g.*, to improve speech detection and noise cancellation.

153. Nemirovski discloses that an internal microphone 20 of an earpiece detects “sounds emanating or coming out of the ear (or air pressure changes occurring within the ear) to accurately and reliably detect the speech of the user.” (EX1007, 3:6-23.) FIG. 5 illustrates:



(EX1007, 9:46-50, FIG. 5 (annotated).)

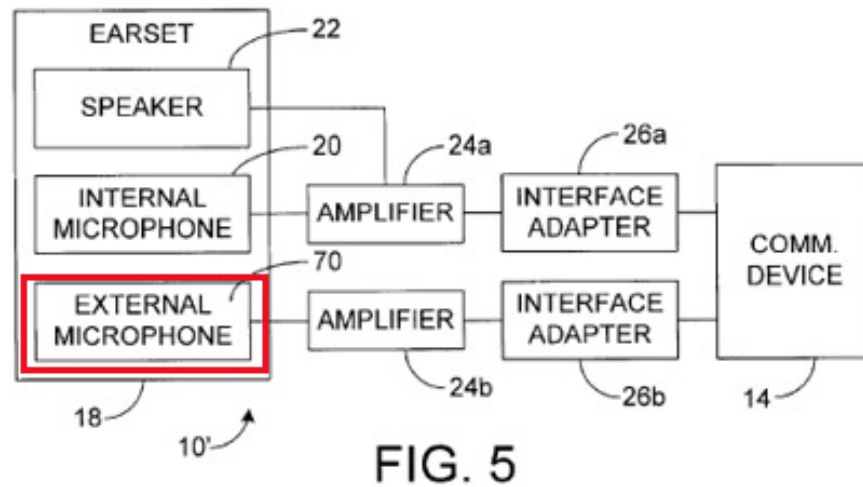
154. Nemirovski’s use of the microphone is consistent with Anderson’s disclosure of speech detection for voice commands and mobile telephone functionality, including communication with a cellular phone system. (EX1010, 23:19-26, 24:45-25:50, FIG. 1, FIG. 2.)

155. Nemirovski’s earset includes an internal microphone 20 disposed on an interior portion of a housing of the earset. (EX1007, 6:36-37; 9:46-50, FIG. 5.)

The internal microphone 20 is “*directed towards the ear canal of the user and detects sounds emanating or coming out of the ear (or air pressure changes occurring within the ear) to accurately and reliably detect the speech of the user.*” (EX1007, 3:15-18 (emphasis added).) The POSITA would have understood Nemirovski’s internal microphone 20, as combined with the apparatus of Anderson and Lynch, to be at least partially in the apparatus and directed toward the user when the apparatus is worn, so as to pick up audio input from the user.

3. ***[B] a second microphone configured to pick up at least ambient sound input associated with an environment in the vicinity of the head-worn personal electronic apparatus, the second microphone being positioned to be directed away from the user when the head-worn wearable electronic device is being worn by the user.***

156. Nemirovski discloses that the earset 18 includes an external microphone 70 that “points away from the person wearing the earset.” (EX1007, 9:46-58, FIG. 5.) FIG. 5 illustrates:



(EX1007, 9:46-50, FIG. 5 (annotated).)

157. The external microphone detects air pressure changes outside of the ear that result from “externally generated noise (other people’s speech, environmental noise, etc.)”—that is, ambient sound from the environment in the vicinity of the wearer. (EX1007, 9:53-58.) The POSITA thus would have understood the externally generated noise picked up by Nemirovski’s external microphone 70, as combined with the apparatus of Anderson and Lynch, to include this ambient audio input.

D. Claim 8

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 7,*

158. See claim 7.

2. [A] *wherein the electronic circuitry is configured to: determine an ambient sound level; and*

159. Anderson discloses that an external microphone (such as a body-worn microphone) can be used to “measure background noise for the purpose of automatically setting hearing aid parameters.” (EX1010, 7:10-13.) The POSITA would have understood such measuring background noise to include determining an ambient sound level (*i.e.*, by measuring a level of ambient background sounds). And Nemirovski discloses that an external microphone 70 of an earpiece can be used to detect “environmental noise”. (EX1007, 9:45-10:7, FIG. 5.) The POSITA thus would have understood that in the combination of Anderson and Lynch with Nemirovski, the earpiece of the apparatus would include an external microphone as taught by Nemirovski, and would use the microphone to determine the ambient sound level as described in Anderson. The POSITA would have been motivated to make this combination for the reasons described in Section VIII.B.

3. [B] *modify audio output to the at least one speaker dependent at least in part on the ambient sound level.*

160. As described above, Anderson discloses that the ambient sound level is measured “for the purpose of automatically setting hearing aid parameters.” (EX1010, 7:10-13.) Anderson further discloses that such hearing aid parameters can include the amplification level and the earpiece volume. (EX1010, 22:27-33, 23:26-31.) The POSITA would have understood setting the earpiece’s volume and

amplification level, as described in Anderson, to include modifying the audio output to the speaker of the earpiece.

E. Claim 9

1. **[Preamble] *A head-worn personal electronic apparatus as recited in claim 7,***

161. See claim 7.

2. **[A] *wherein the electronic circuitry is configured to: produce an ambient audio output signal based on at least the ambient sound input; and***

162. As described for claim 8[B], Anderson discloses measuring the ambient sound level, from an ambient sound input provided by a microphone; and using the ambient sound level to set the volume and amplification level of an audio output signal provided by the earpiece's speaker. (EX1010, 7:10-13, 22:27-33, 23:26-31.) The POSITA would have understood the output signal to include ambient audio, at least because Anderson's earpiece provides "audio signals from the ambient environment," as required for hearing aid applications. (EX1010, 2:7-16.)

3. **[B] *provide at least the ambient audio output signal to the at least one speaker.***

163. See element [A].

F. Claim 10

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 7,*

164. See claim 7.

2. **[A]** *wherein the electronic circuitry is configured to: determine an ambient noise level based on at least the ambient sound input,*

165. See claim 8[A]. In the combination described, Nemirovski's external microphone 70 detects "environmental noise" (an ambient sound input); and a level of that ambient noise is measured "for the purpose of automatically setting hearing aid parameters" as taught by Anderson. (EX1007, 9:45-10:7, FIG. 5; EX1010, 7:10-13.)

3. **[B]** *wherein the ambient audio output signal is dependent on the ambient noise level.*

166. As described for claim 8[B], Anderson discloses measuring the ambient noise level, from an ambient sound input provided by a microphone as in Nemirovski; and using the ambient noise level to set the volume and amplification level of an audio output signal provided by the earpiece's speaker. (EX1010, 2:7-16, 7:10-13, 22:27-33, 23:26-31.) For example, Anderson discloses that setting the output signal's volume level includes setting the "nominal and maximum allowable earpiece volume." (EX1010, 22:31-33.) The POSITA would thus

understand the audio output signal (*e.g.*, the signal's nominal and maximum volume) to be dependent on the ambient noise level.

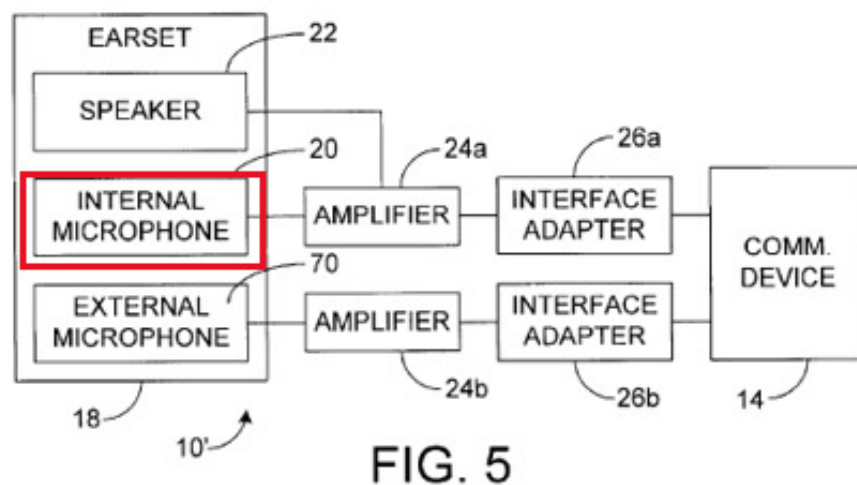
G. Claim 11

1. [Preamble] *A head-worn personal electronic apparatus as recited in claim 1,*

167. See claim 1.

2. [A] *wherein the head-worn personal electronic apparatus comprises: a first microphone; and*

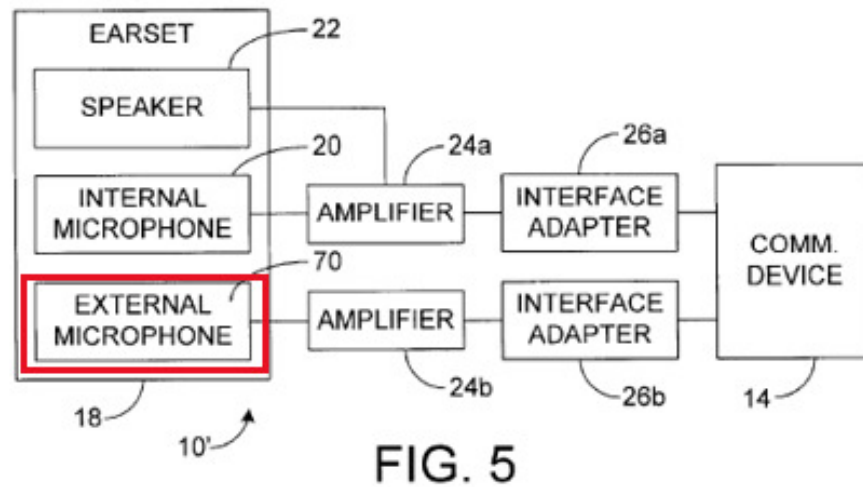
168. See claim 7[A]. For example, Nemirovski teaches a first (internal) microphone 20 of the apparatus, as shown in FIG. 5:



(EX1007, 9:46-50, FIG. 5 (annotated).)

3. [B] *a second microphone;*

169. See claim 7[A]. For example, Nemirovski teaches a second (external) microphone 70 of the apparatus, as shown in FIG. 5:



(EX1007, 9:46-50, FIG. 5 (annotated).)

4. [C] *wherein the first microphone is configured to pick up at least audio input from at least the user,*

170. See claim 7[A].

5. [D] *wherein the second microphone is configured to pick up at least environmental audio input associated with an environment in the vicinity of the head-worn wearable electronic device, and*

171. See claim 7[B].

6. [E] *wherein the electronic circuitry is configured to process the audio input from at least the user picked-up via the first microphone to remove at least a portion of the environmental audio input associated with the environment picked-up via the second microphone.*

172. Nemirovski teaches that a processing circuit can use the unique signals generated by the internal microphone 20 and the external microphone 70 “to distinguish between user produced speech and externally produced sounds.”

(EX1007, 10:8-26.) The system can then “cancel externally generated noise from the detections of the internal microphone 20” to produce a “relatively noise-free speech signal.” (EX1007, 10:8-26.) The POSITA thus would have understood that in the combination of Anderson and Lynch with Nemirovski, a processing circuit (e.g., Anderson’s RPU) processes the audio input from the first (internal) microphone in order to remove audio input that is associated with the environment, (*i.e.*, environmental noise picked up by the second (external) microphone).

H. Claim 12

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 1,*

173. See claim 1.

2. **[A]** *wherein the head-worn wearable electronic device comprises at least a first microphone and a second microphone,*

174. See claim 11[A] and claim 11[B].

3. **[B]** *wherein the first microphone is configured to pick up at least audio sound from at least the user,*

175. See claim 11[C].

4. **[C]** *wherein the second microphone is configured to pick up at least ambient noise associated with an environment in the vicinity of the head-worn wearable electronic device, and*

176. See claim 11[D].

5. ***[D] wherein the electronic circuitry is configured to: determine an ambient noise level based on at least the ambient noise; and***

177. See claim 10[A].

6. ***[E] modify at least a portion of the audio sound picked-up via the first microphone, with the modification being at least in part dependent on the ambient noise level.***

178. Nemirovski teaches that the earpiece can “cancel externally generated noise from the detections of the internal microphone 20” to produce a “relatively noise-free speech signal.” (EX1007, 10:8-26, 10:48-58.) In the below linear system, the internal and external microphone audio signals (Y_I and Y_E , respectively) each include a sound component S (user speech) and a noise component N (ambient noise such as from passing vehicles and machinery) picked up by the microphones:

$$F_{MI} * S + F_{MI} * N = Y_I \quad (\text{Eq. 1})$$

$$F_{ME} * S + F_{ME} * N = Y_E \quad (\text{Eq. 2})$$

(EX1007, 10:28-47.)

179. The terms F_{MI} and F_{ME} represent the impulse responses of the internal and external microphones, respectively. (EX1007, 10:30-34.) The linear system is solved for the speech component S and the ambient noise component N , such that the noise component can be canceled from the microphone signals, thus isolating the speech component. (EX1007, 10:20-26.) The resulting modified signal is

dependent on the ambient noise level because the ambient noise (N) is specifically targeted for cancellation.

I. Claim 29

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 17,*

180. See claim 17.

2. **[A]** *wherein the head-worn personal electronic apparatus comprises: a first microphone configured to pick up at least audio input from at least the user, the first microphone being at least partially in the head-worn personal electronic apparatus and is positioned to be directed towards the user when the head-worn personal electronic apparatus is being worn by the user; and*

181. See claim 7[A].

3. **[B]** *a second microphone configured to pick up at least ambient sound input associated with an environment in the vicinity of the head-worn personal electronic apparatus, the second microphone being positioned to be directed away from the user when the head-worn wearable electronic device is being worn by the user.*

182. See claim 7[B].

J. Claim 30

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 29,*

183. See claim 29.

2. [A] *wherein the electronic circuitry is configured to: determine an ambient sound level; and*

184. See claim 8[A].

3. [B] *modify audio output to the at least one speaker dependent at least in part on the ambient sound level.*

185. See claim 8[B].

K. Claim 31

1. [Preamble] *A head-worn personal electronic apparatus as recited in claim 29,*

186. See claim 29.

2. [A] *wherein the electronic circuitry is configured to: produce an ambient audio output signal based on at least the ambient sound input; and*

187. See claim 9[A].

3. [B] *provide at least the ambient audio output signal to the at least one speaker.*

188. See claim 9[B].

L. Claim 32

1. [Preamble] *A head-worn personal electronic apparatus as recited in claim 31,*

189. See claim 31.

2. [A] *wherein the electronic circuitry is configured to: determine an ambient noise level based on at least the ambient sound input,*

190. See claim 10[A].

3. **[B]** *wherein the ambient audio output signal is dependent on the ambient noise level.*

191. See claim 10[B].

M. Claim 33

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 17,*

192. See claim 17.

2. **[A]** *a first microphone configured to pick up at least audio input from at least the user, the first microphone being at least partially in the head-worn personal electronic apparatus; and*

193. See claim 7[A]. Nemirovski's internal microphone 20 is internal to the apparatus and "directed towards the ear canal of the user," so as to "detect[] sounds emanating or coming out of the ear (or air pressure changes occurring within the ear) to accurately and reliably detect the speech of the user." (EX1007, 3:15-18.)

3. **[B]** *a second microphone configured to pick up at least ambient sound input associated with an environment in the vicinity of the head-worn personal electronic apparatus, the second microphone being at least partially in the head-worn personal electronic apparatus,*

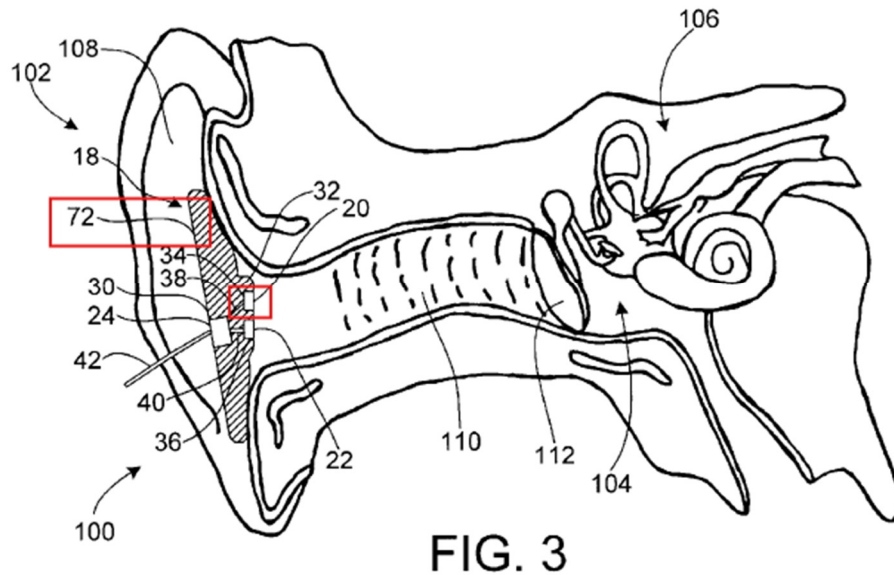
194. See claim 7[B]. Nemirovski's external microphone 70 is "disposed in a recess" of the housing of the apparatus. (EX1007, 9:35-37.) The external microphone 70 detects air pressure changes outside of the ear that result from

“externally generated noise (other people’s speech, environmental noise, etc.).”

(EX1007, 9:53-58.) The POSITA would thus understand Nemirovski’s external microphone to be at least partially in the apparatus and configured to pick up ambient sound input associated with the environment in the vicinity of the apparatus.

4. ***[C] wherein the second microphone is positioned to be further away from mouth of the user than the first microphone when at least the head-worn personal electronic apparatus of the head-worn personal electronic apparatus is being worn.***

195. Nemirovski’s external microphone 70 is disposed on an “exterior portion 72 of the housing 30” of the apparatus, while the internal microphone 20 is disposed on an “interior portion 32 of the housing 30” that is configured to be inserted into the ear (e.g., into the concha or ear canal). (EX1007, 6:36-49, 9:33-35.) FIG. 3 illustrates:



(EX1007, FIG. 3 (annotated).)

196. FIG. 3, illustrating the user's ear, shows that exterior portion 72 (and thus external microphone 70) is disposed further than interior portion 32 (and internal microphone 20) from the user's mouth. As the POSITA would have understood, this placement is a consequence of the microphones' different purposes: the internal microphone is closer to the mouth, to better detect speech while remaining insulated from external sounds; conversely, the external microphone is further from the mouth, to better detect such external sounds.

(EX1007, 6:30-35, 9:19-31.)

N. Claim 34

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 17,*

197. See claim 17.

2. **[A]** *wherein the head-worn personal electronic apparatus comprises: a first microphone; and*

198. See claim 11[A].

3. **[B]** *a second microphone;*

199. See claim 11[B].

4. **[C]** *wherein the first microphone is configured to pick up at least audio input from at least the user,*

200. See claim 11[C].

5. **[D]** *wherein the second microphone is configured to pick up at least environmental audio input associated with an environment in the vicinity of the head-worn wearable electronic device, and*

201. See claim 11[D].

6. **[E]** *wherein the electronic circuitry is configured to process the audio input from at least the user picked-up via the first microphone to remove at least a portion of the environmental audio input associated with the environment picked-up via the second microphone.*

202. See claim 11[E].

O. Claim 35

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 34,*

203. See claim 34.

2. **[A]** *wherein the audio input from at least the user picked-up via the first microphone includes at least a voice input, and*

204. Nemirovski's internal microphone 20 "detects sounds emanating or coming out of the ear (or air pressure changes occurring within the ear) to accurately and reliably detect the speech of the user," which the POSITA would have understood to include a voice input. (EX1007, 3:15-18.)

3. **[B]** *wherein the environmental audio input associated with the environment includes at least ambient noise.*

205. Nemirovski's external microphone 70 detects air pressure changes outside of the ear that result from "externally generated noise (other people's speech, environmental noise, etc.)," which the POSITA would have understood to include ambient noise. (EX1007, 9:53-58.)

P. Claim 36

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 34,*

206. See claim 34.

2. ***[A] wherein the first microphone is at least partially in the head-worn personal electronic apparatus and is positioned so as to be directed towards the user of the head-worn personal electronic apparatus, and***

207. See claim 7[A].

3. ***[B] wherein the second microphone is at least partially in the head-worn personal electronic apparatus and is positioned so as to be directed away from the user of the head-worn personal electronic apparatus.***

208. See claim 7[B]. Nemirovski's external microphone 70 can be "disposed in a recess" of the housing of the apparatus and "points away" from the wearer. (EX1007, 9:35-53.)

Q. Claim 37

1. ***[Preamble] A head-worn personal electronic apparatus as recited in claim 36,***

209. See claim 36.

2. ***[A] wherein the audio input from at least the user includes at least a voice input, and***

210. See claim 35[A].

3. ***[B] wherein the environmental audio input includes at least ambient noise.***

211. See claim 35[B].

R. Claim 38

1. ***[Preamble] A head-worn personal electronic apparatus as recited in claim 17,***

212. See claim 17.

2. ***[A] wherein the head-worn wearable electronic device comprises: a first microphone configured to pick up at least audio input from at least the user; and***

213. See claim 7[A].

3. ***[B] a second microphone configured to pickup at least environmental audio input associated with environmental sound in the vicinity of the head-worn personal electronic apparatus, and***

214. See claim 7[B].

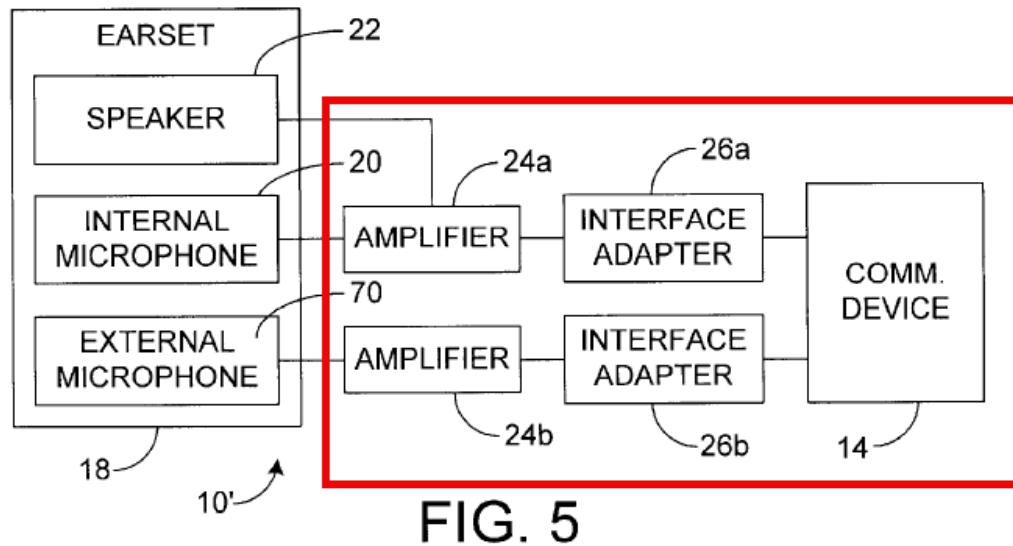
4. ***[C] wherein the electronic circuitry is configured to: determine an environmental sound level based on at least the environmental audio input; and***

215. See claim 8[A]. Nemirovski's external microphone detects "environmental noise"; and Anderson teaches that the microphone "measure[s] background noise for the purpose of automatically setting hearing aid parameters," which the POSITA would have understood to include determining an environmental sound level (*i.e.*, a background noise level) from the microphone's environmental audio input. (EX1007, 9:45-10:7, FIG. 5; EX1010, 7:10-13.)

5. ***[D] amplify at least a portion of the audio input from the first microphone, with the amplification being at least in part dependent on the environmental sound level.***

216. Nemirovski teaches that the signals from the first and second microphones are amplified and processed (*i.e.*, by amplifiers 24a and 24b respectively, interface adapters 26a and 26b respectively, and communication

device 14) such that the environmental noise component is canceled from the audio signal detected by the first microphone 20. (EX1007, 9:45-10:13, FIG. 5.) FIG. 5 illustrates:



(EX1007, FIG. 5 (annotated).)

217. This amplification of the first microphone's audio signal is dependent on the environmental sound level (*i.e.*, noise component N) as described for claim 12[E]; that is, the noise component N is canceled from the microphone audio signal to isolate the speech component of the signal. (EX1007, 10:20-47.)

S. Claim 39

1. [Preamble] *A head-worn personal electronic apparatus as recited in claim 17,*

218. See claim 17.

2. ***[A] wherein the head-worn wearable electronic device comprises at least a first microphone and a second microphone,***

219. See claim 7[A] and [B].

3. ***[B] wherein the first microphone is configured to pick up at least audio sound from at least the user,***

220. See claim 38[A].

4. ***[C] wherein the second microphone is configured to pick up at least ambient noise associated with an environment in the vicinity of the head-worn wearable electronic device, and***

221. See claim 38[B].

5. ***[D] wherein the electronic circuitry is configured to: determine an ambient noise level based on at least the ambient noise; and***

222. See claim 38[C].

6. ***[E] modify at least a portion of the audio sound picked-up via the first microphone, with the modification being at least in part dependent on the ambient noise level.***

223. See claim 39[D].

T. Claim 40

1. ***[Preamble] A head-worn personal electronic apparatus as recited in claim 17,***

224. See claim 17.

2. ***[A] a first microphone configured to receive audio picked-up from the user; and***

225. See claim 7[A].

3. **[B]** *a second microphone configured to receive audio picked-up outward away from the user,*

226. See claim 7[B].

4. **[C]** *wherein the audio picked-up from at least the second microphone is used at least for noise cancelation, and at least a portion of the audio picked-up from the second microphone is subtracted from the audio picked-up from the first microphone.*

227. See claim 12[E].

U. Claim 53

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 17,*

228. See claim 17.

2. **[A]** *wherein the at least one speaker is configured to be at least partially inserted into an ear of the user.*

229. Nemirovski discloses that in the head-worn apparatus, an interior portion 32 of the housing 30 positions the speaker 22 in the concha 122 of the user's ear, or within the ear canal. (EX1007, 6:39-49.)

V. Claim 57

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 17,*

230. See claim 17.

2. [A] *wherein the head-worn personal electronic apparatus comprises: an array of microphones configured for directional audio pickup.*

231. The apparatus includes an internal microphone 20 and an external microphone 70 as described for claim 7. (EX1007, 9:19-21.) The POSITA would have understood this array of microphones, as well as each of the individual microphones, to be configured for directional audio pickup. As Nemirovski teaches, the internal and external microphone are pointed in different directions: the internal microphone is directed “toward the ear canal of the user” and configured to detect sounds from the user and shield environmental sounds from outside the user; while the external microphone is “pointed away from the wearer” and configured to detect such environmental sounds. (EX1007, 9:19-35.) Even though the microphones may be “omnidirectional microphone[s],” and Nemirovski’s earset “does not rely on directionality” of the microphones themselves, the POSITA would nonetheless understand the microphones to be *configured* for directional audio pickup by virtue of their positions relative to the ear and the apparatus. (EX1007, 3:34-35, 7:13-14, 9:43-44.). For example, the internal microphone 20 is inserted into the ear and “shielded from environmental noise” by the housing 30 and the user’s head, which directionally “block[s] externally generated sound waves before reaching the microphone 20.” (EX1007, 7:8-14.) And the external microphone is configured for directional audio pickup

at least because it detects air pressure changes directionally located outside the ear
 “[a]s a result” of pointing away from the user. (EX1007, 9:51-55.)

W. Claim 60

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 59,*

232. See claim 59.

2. **[A]** *wherein the head-worn personal electronic apparatus comprises: a first microphone at least partially contained within the head-worn personal electronic apparatus, the first microphone being positioned to pick up at least audio input from at least the user; and*

233. See claim 7[A].

3. **[B]** *a second microphone at least partially contained within the head-worn personal electronic apparatus, the second microphone being positioned to pick up at least environmental audio input associated with an environment around the head-worn personal electronic apparatus,*

234. See claim 7[B].

4. **[C]** *wherein the electronic circuitry is configured to modify the customized audio output signals to be output to the user via the at least one speaker to cancel at least a portion of noise associated with the environment, the modification of the customized audio output signals being dependent at least in part on the environmental audio input picked-up via the second microphone.*

235. Anderson discloses performing background noise cancellation on the audio output presented to the user, *e.g.*, by creating sound waves in opposition to

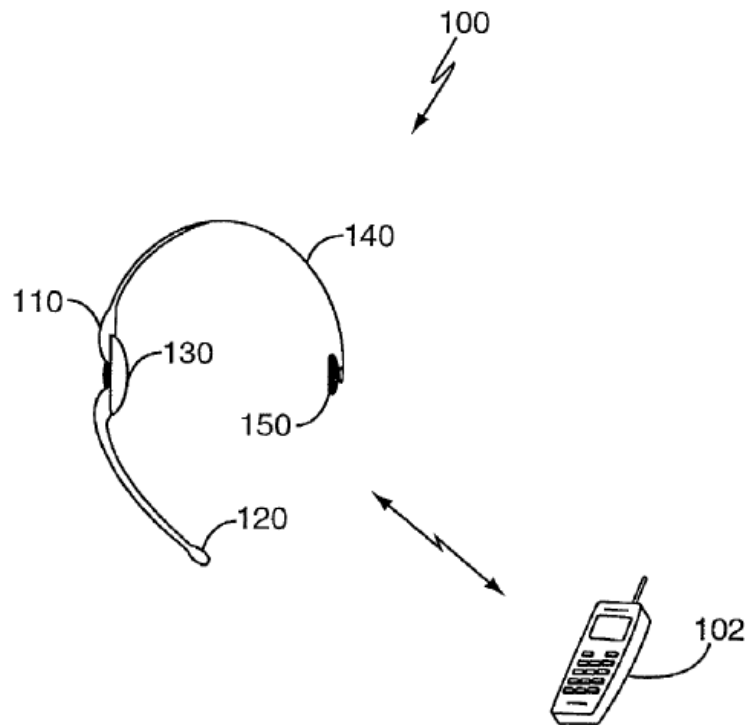
noise from the environment, so as to cancel the noise from the audio presented to the user. (EX1010, 2:60-65, 23:36-24:4.) As described for claim 8[A], in the combination of Anderson and Lynch with Nemirovski, Nemirovski's external microphone (rather than Anderson's body-worn microphone) would advantageously detect the environmental audio input. (EX1007, 9:45-10:7, FIG. 5; EX1010, 7:10-13, 22:20-27.)

**X. CLAIMS 13, 14, AND 41-50 ARE RENDERED OBVIOUS BY
ANDERSON IN VIEW OF LYNCH AND IRVIN**

A. Summary of Irvin

236. Irvin is a U.S. patent that was filed on Feb. 21, 2000, and issued on March 7, 2006. (EX1009.) I understand Irvin is thus prior art to the '355 patent under at least 35 U.S.C. §§102(a) and (e).

237. Irvin discloses wireless headsets with "automatic on/off capabilities to maximize battery life," such as headset 100 shown in FIG. 1:

**FIG. 1**

(EX1009, Abstract, 1:13-51, FIG. 1.)

238. Irvin’s headset is head-worn: it is “secur[ed] ... to the user’s head,” *e.g.*, via retaining member 140. (EX1009, 3:35-39.) Irvin’s headset automatically transitions from an inactive state (*e.g.*, a non-functional state), or a sleep state, to an active state (*e.g.*, a fully functional state) when mounted on the user’s head, and vice versa. (EX1009, Abstract, 2:16-51, 8:11-50, 9:40-43.) Communications circuit 230 of the wireless headset provides a wireless communications interface

232 and an audio interface 234; these elements can be enabled by a power control circuit 210 in the active state, and disabled by the power control circuit in the inactive state (in which the entire communications circuit 230 is disconnected) or the sleep state (in which the wireless communications interface 232 portion remains enabled). (EX1009, 3:28-4:10, 8:11-9:39, FIG. 2A.) FIG. 2A illustrates:

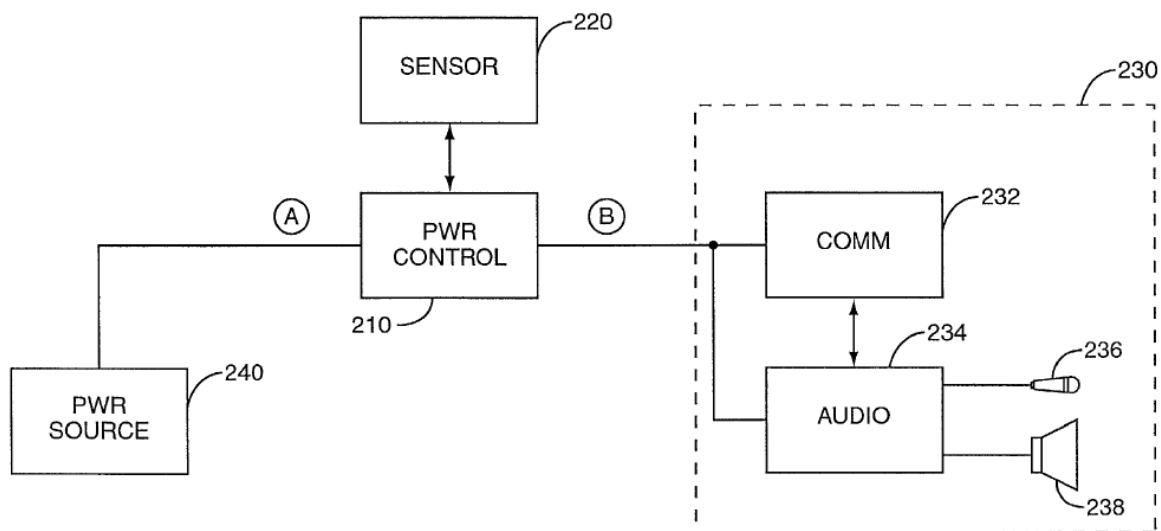


FIG. 2A

(EX1009, FIG. 2A.)

239. A sensor 220, such as a contact sensor or a proximity sensor, can be used to determine when to transition from an inactive state to an active state.

(EX1009, Abstract, 2:16-51, 5:1-6:67.) As one example, a proximity sensor 220 is

used by the power control circuit 210 to detect when the headset is mounted on the user's head. (EX1009, Abstract, 2:16-51, 6:3-19.) FIG. 4D illustrates:

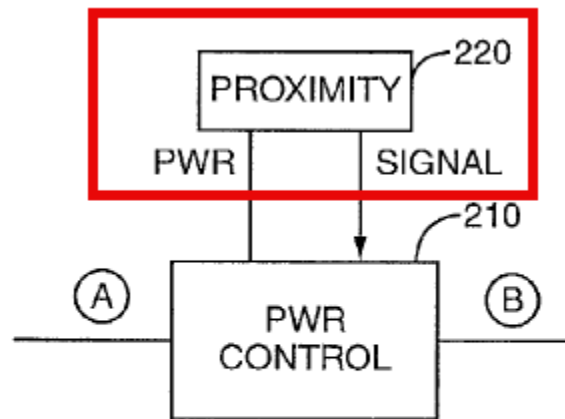
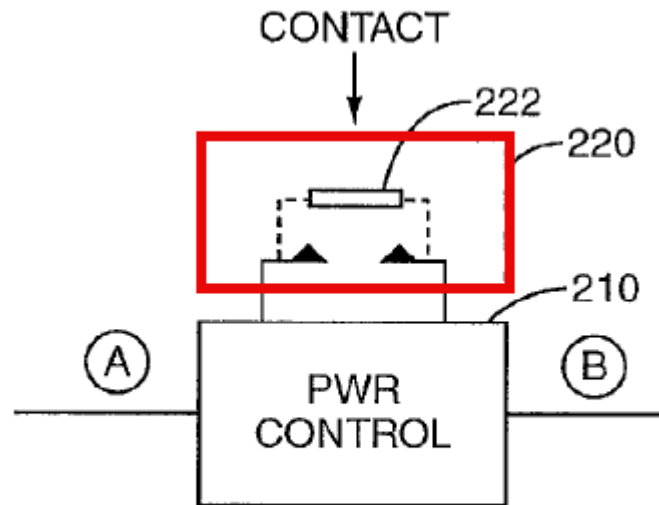


FIG. 4D

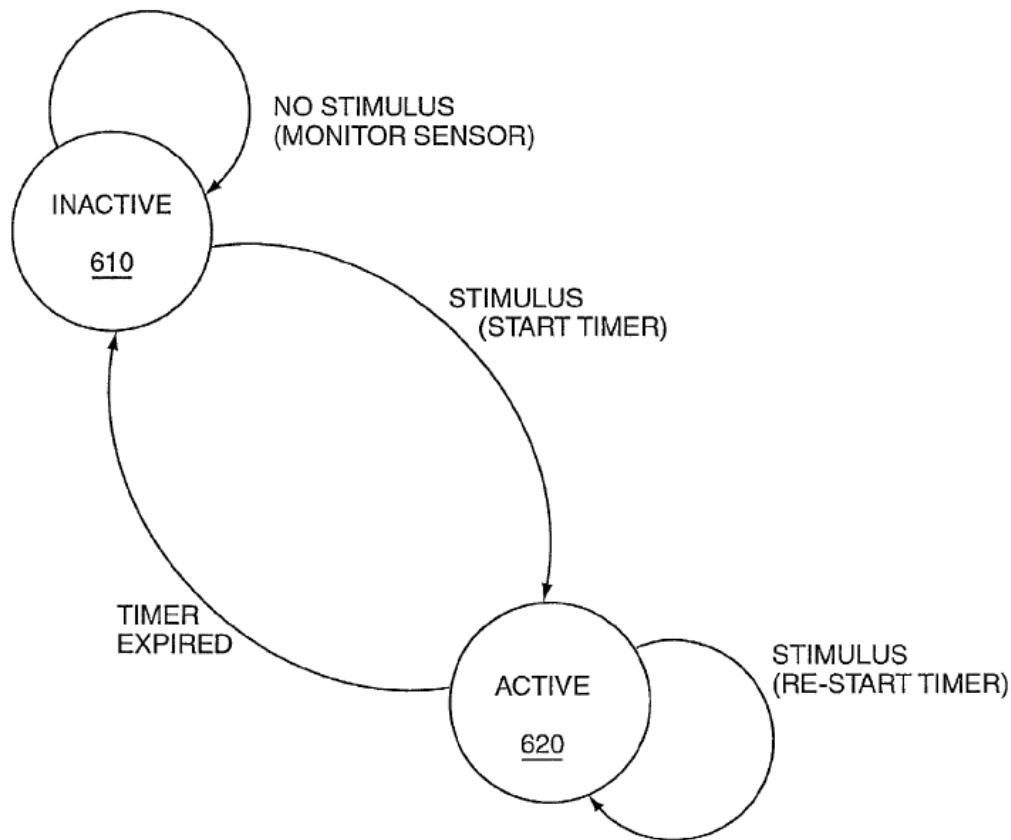
(EX1009, FIG. 4D (annotated).)

240. As another example, a contact sensor 220 (*e.g.*, a contact switch) can be used to detect when the headset is in physical contact with the user. (EX1009, Abstract, 2:16-51, 6:3-19.) FIG. 4C illustrates:

**FIG. 4C**

(EX1009, FIG. 4C (annotated).)

241. The device transitions between the inactive state 610 and the active state 620 based on a stimulus signal provided by the sensor (*e.g.*, indicating the device is worn), as shown in FIG. 6:

**FIG. 6**

(EX1009, 8:11-50, FIG. 6.)

242. Irvin is analogous art to the '355 patent at least because it is directed to the same field of endeavor: wearable devices with electrical components, including those that provide audio output. (EX1001, Abstract; 3:37-47; EX1009, 3:28-45.) Irvin is reasonably pertinent to the problems faced by the '355 patent inventors, because Irvin and the '355 patent both relate to how to determine when a wearable device is being used or worn by the user, so that the device can be

controlled accordingly. (EX1001, 92:41-93:57; EX1009, 2:16-51.) Additionally, both Irvin and the '355 patent strive to minimize power consumption, and thus maximize the battery life, of the wearable device. (EX1001, 70:31-42; EX1009, 2:16-51.)

243. I understand that Irvin was not cited during prosecution of the '355 patent.

B. Motivation to Combine with Reasonable Expectation of Success

244. A POSITA would have been motivated to combine the teachings of Anderson and Lynch with those of Irvin to meet the claim limitations. Anderson discloses that that battery life (and thus power consumption) is a concern for its hearing aid device: “[e]arpiece power consumption is preferably minimized to extend battery life”. (EX1010, 6:55-57.) Similarly, as the POSITA would have recognized, minimizing power consumption improves usability by permitting longer periods of use without having to replace or recharge the battery; and can permit smaller and lighter batteries to be used, enhancing ergonomics and safety for head-worn devices. And as Irvin notes, “battery life is a key component of operator convenience,” and “it is important that wireless headset design incorporates provisions maximizing battery life.” (EX1009, 2:1-5.)

245. Anderson proposes earpiece designs that reduce power usage, and further proposes mitigating the problem through “use of a rechargeable battery”;

but this is an imperfect solution, at least because Anderson's device cannot be used while the battery is being charged. (EX1010, 22:35-39.) The POSITA would have recognized it as advantageous to apply techniques to further improve Anderson's battery life and reduce the time spent charging the battery, during which the device is non-operational. This is especially so for hearing aid devices, where periods of non-use can pose health and safety risks by rendering a user unable to hear.

246. The POSITA would have looked to Irvin, which teaches reducing the power consumption of a wireless head-worn device by automatically transitioning to and from an inactive state, or a low-power sleep state, based on user activity. (EX1009, 2:8-51.) Irvin discloses that a wireless headset includes a sensor "responsive to a natural stimulus associated with a person preparing to use the wireless headset." (EX1009, 2:16-28.) The sensor can sense, *e.g.*, motion, physical orientation, or user proximity. (EX1009, 2:27-28.) The POSITA would have been motivated to combine the head-worn device of Anderson and Lynch, with Irvin's teachings of using a sensor to detect user activity, in order to realize improvements in usability, reliability, and power consumption promised by Irvin. (EX1009, 1:13-2:51.) For example, Irvin's sensor eliminates the need for mechanical switching, instead automatically transitioning to a fully active state only when needed (*e.g.*, when the user is using or wearing the device), and transitioning to an inactive state or sleep state when not in use (*e.g.*, after the

device is removed). (EX1009, 1:13-2:51.) By using a sensor to determine when the device is in use (*e.g.*, in motion, and/or being worn), Irvin teaches implementing a power save function in a way that is reliable, convenient, hands-free, and requires minimal user intervention. (EX1009, 1:13-2:51.) This would represent an improvement over Anderson and Lynch, neither of which teaches any such feature; to the contrary, Anderson discloses using physical keys to turn the device on and off. (EX1010, 21:20-25, 22:14-20.)

247. Irvin's sensor 220 can be, *e.g.*, a contact sensor (such as a contact switch) or a proximity sensor. (EX1009, 2:27-28, 5:1-6:33.) The POSITA would have been motivated to combine either of these sensor types with Anderson and Lynch. Sensor 220 "may be based on a variety of technologies," and "the particular sensor 220 employed may be tuned or configured such that only stimulus consistent with actual use actuates the sensor, thus avoiding inadvertent or unintended enabling of the wireless headset 100." (EX1009, 5:1-17.) Accordingly, the POSITA would have been motivated to employ whichever "particular sensor" is best suited for the "actual use" of the hearing aid device, in order to avoid inadvertent enabling of the hearing aid.

248. The POSITA would have been motivated to combine Irvin's proximity sensor or contact sensor with the Anderson/Lynch hearing aid. For some cases, such as when the user is able to apply sufficient force to a contact

sensor, using the contact sensor to detect “when the user places the wireless headset” (*e.g.*, Anderson’s headset 21 with Lynch’s ALD Cap) on their head may provide the most reliable indication that the hearing aid is in use. (EX1009, 6:3-8.) In other cases, such as where the hearing aid is particularly lightweight or where the user cannot apply sufficient force, a contact sensor may falsely detect that the device is not being used; but a proximity sensor would not, making the proximity sensor preferable.

249. The POSITA would have had a reasonable expectation of success in making the combination. Anderson, Lynch, and Irvin all involve head-worn devices with analogous components (*e.g.*, batteries, programmable logic devices (*e.g.*, ASICs), power electronics, sensors microphones, speakers) and head-worn headset form factors; and Anderson already contemplates that the device includes “[m]any sensors” that provide “a variety of information for different applications”. (EX1010, 2:55-59, 24:23-26; EX1008, FIG. 4; EX1009, 3:28-4:38, 8:4-10, FIG. 2A.) The combination thus would have involved the application of known methods to analogous and well-understood components. Moreover, Irvin emphasizes its broad applicability to “any type of device supporting interactive communications with a user,” and specifically provides instruction for integrating its sensors with a headset, such as by “[i]deally” placing sensor 220 in the earpiece, in a retaining member, or in a retaining pad—analogous to headset components of

Anderson (earpiece 22, headset 21) and Lynch (ALD Cap 600). (EX1009, 3:29-32, 6:10-13, FIG. 1B.) These disclosures underscore that the POSITA would have had a reasonable expectation of success in combining Irvin's teachings with the hearing aid of Anderson/Lynch.

C. Claim 13

1. **[Preamble] *A head-worn personal electronic apparatus as recited in claim 1,***

250. See claim 1.

2. **[A] *wherein the head-worn personal electronic apparatus comprises: a radiation detector configured to capture radiation data,***

251. Irvin discloses that its proximity sensor 220 can be an “active or passive [infrared] sensor,” which the POSITA would have understood to include a detector for detecting capturing infrared radiation data (*i.e.*, an amount of infrared radiation detected by the infrared sensor). (*See* EX1001, 104:30-33; EX1009, 6:22-24; EX1015, 216-17.) The POSITA would have combined Irvin's proximity sensor 220 with the head-worn personal electronic apparatus of Anderson in view of Lynch as described in Section IX.A such that the apparatus includes the proximity sensor.

3. [B] *wherein the electronic circuitry is configured to process at least the radiation data captured by the radiation detector, and*

252. Irvin teaches that electronic circuitry processes data received from sensor 220 (*e.g.*, an active or passive infrared proximity sensor indicating the distance to the user's head) to enable or disable the headset's electronic circuitry based on whether the headset is being worn:

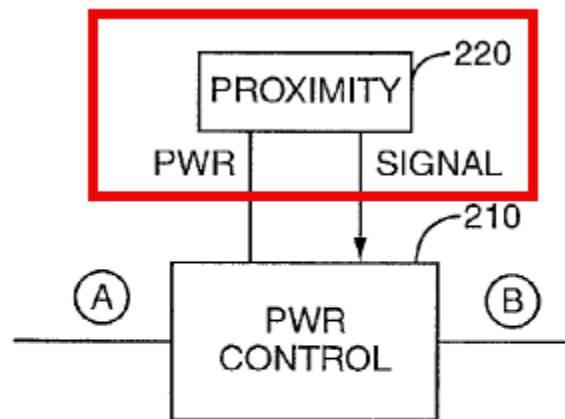


FIG. 4D

(EX1009, 4:3-10, 4:39-49, 6:20-33, FIG. 4D (annotated).)

253. For example, communications circuit 230 transitions to an active state 620 after the sensor 220 indicates a stimulus (*e.g.*, infrared radiation data indicating that the device is worn); and transitions to an inactive state 610 or a sleep state 720 after the indication is no longer provided. (EX1009, 8:11-9:39; FIG. 6, FIG. 7.)

The POSITA would have understood that in the combination, the electronic

circuitry would be implemented by Anderson's RPU (*e.g.*, DSP 645) and/or earpiece (*e.g.*, ASIC 845), at least because Anderson discloses that these are the components configured to interface with various sensors. (EX1010, 24:23-26.)

4. [C] *wherein the electronic circuitry is configured to determine whether the head-worn personal electronic apparatus is being worn by a user based on at least the processed radiation data.*

254. See element [B].

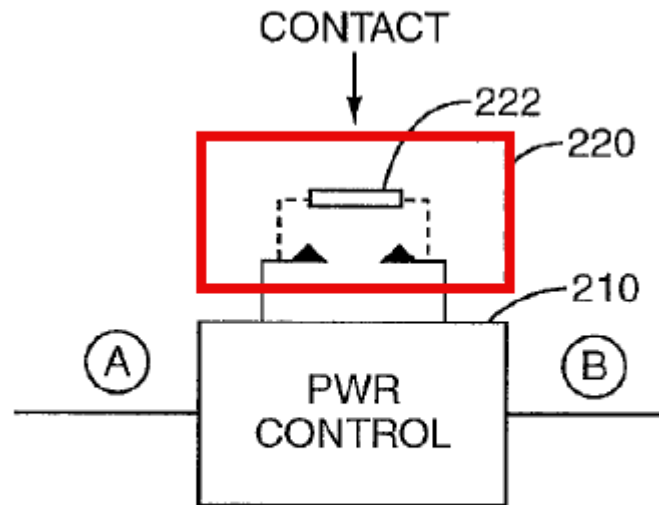
D. Claim 14

1. [Preamble] *A head-worn personal electronic apparatus as recited in claim 1,*

255. See claim 1.

2. [A] *wherein the head-worn personal electronic apparatus includes a force sensor configured to receive a user input based at least on sensing force applied to the force sensor, and*

256. Irvin teaches that electronic circuitry processes data received from contact sensor 220 (*e.g.*, a contact switch activated by the application of force) to enable or disable the headset's electronic circuitry based on whether the headset is being worn:

**FIG. 4C**

(EX1009, 4:3-10, 4:39-49, 6:20-33, FIG. 4C (annotated).)

257. Irvin's communications circuit 230 transitions to an active state 620 after the contact sensor 220 indicates a stimulus (*e.g.*, that force has been applied to the contact switch); and transitions to an inactive state 610 or a sleep state 720 after the indication is no longer provided. (EX1009, 8:11-9:39; FIG. 6, FIG. 7.) The POSITA would have understood that in the combination, the electronic circuitry would be implemented by Anderson's RPU (*e.g.*, DSP 645) and/or earpiece (*e.g.*, ASIC 845), at least because Anderson discloses that these are the components configured to interface with various sensors. (EX1010, 24:23-26.)

3. [B] *wherein the force sensor is configured to detect the user input, the detected user input operating to alter at least an operation of the head-worn wearable electronic device.*

258. Irvin teaches that the contact sensor 220 is a contact switch that is “actuated when the user places the wireless headset 100 on their body,” and is “ideally” placed in the earpiece 130, in the retaining member 140, or in the retaining pad 150, as shown in FIG. 1:

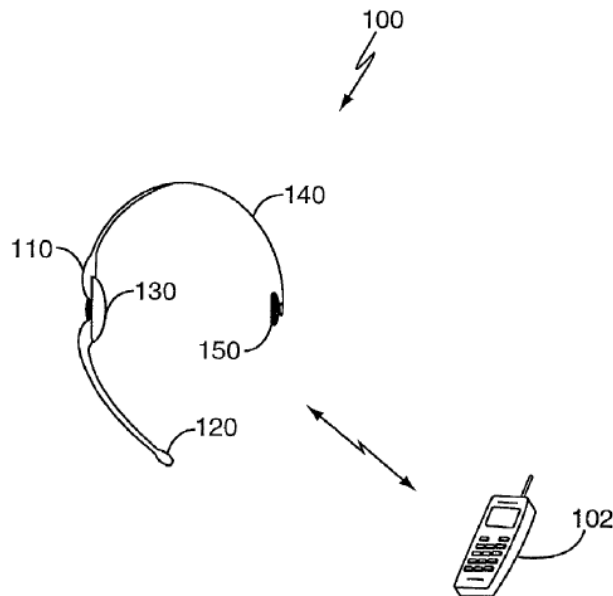


FIG. 1

(EX1009, 6:3-13, FIG. 1.)

259. These elements correspond to headset components of Anderson (*e.g.*, earpiece 22, headset 21) and Lynch (*e.g.*, ALD Cap 600), such that in combination

with Anderson and Lynch, the contact switch will be activated when the user places the headset on his or her head. In the combination, the POSITA would have understood the contact switch to be a force sensor configured to detect user input (*i.e.*, application of force against the switch by the user's head). The POSITA would further understand the user input to alter an operation of the combined head-worn apparatus, at least by entering or exiting the inactive state or sleep state as described for [A].

E. Claim 41

1. **[Preamble] *A head-worn personal electronic apparatus as recited in claim 17,***

260. See claim 17.

2. **[A] *wherein the head-worn personal electronic apparatus comprises: a radiation emitter at least partially contained within the head-worn personal electronic apparatus and configured to at least direct radiation towards the user when at least the head-worn personal electronic apparatus of the head-worn personal electronic apparatus is being worn; and***

261. See claim 13[A]. Irvin discloses that its proximity sensor 220 can be an *active* infrared sensor. (EX1009, 6:22-24.) The POSITA would have understood this disclosure of Irvin to include sensors that “put out energy in the environment,” *i.e.*, “emit near-infrared energy and measure whether any significant amount of the IR light is returned” to determine whether an object is present. (See EX1015, 196, 216-217.) For example, the infrared radiation can be emitted by an

LED. (EX1015, 216.) Further, the POSITA would have understood active infrared sensors to be among the most popular types of proximity sensors.

(EX1015, 210.) Accordingly, in the combination, the POSITA would have understood the apparatus to include an active infrared sensor with an emitter (*e.g.*, an LED) configured to emit infrared radiation toward the user when the headset is worn; and to measure an amount of IR radiation reflected toward the sensor by the user.

3. ***[B] a radiation detector at least partially contained within the head-worn personal electronic apparatus and configured to detect radiation reflected back from the user when at least the head-worn personal electronic apparatus of the head-worn personal electronic apparatus is being worn,***

262. See element [A]. The POSITA would have understood the active infrared sensor in the combination to emit infrared radiation toward the user, and to measure an amount of IR radiation reflected toward the sensor by the user, with a “significant amount of the IR light” reflected indicating that the user is present and thus that the apparatus is being worn. (EX1015, 216.)

4. ***[C] wherein the radiation detector is operatively connected to the electronic circuitry, and wherein electronic circuitry within the head-worn personal electronic apparatus is configured to facilitate determining whether the head-worn personal electronic apparatus of the head-worn personal electronic apparatus is being worn by the user based on at least the detected radiation.***

263. Irvin's communications circuit 230 transitions to an active state 620 after the proximity sensor 220 indicates a stimulus (*e.g.*, that an infrared sensor detects reflected infrared radiation indicating that the user is wearing the device); and transitions to an inactive state 610 or a sleep state 720 after the indication is no longer provided. (EX1009, 8:11-9:39; FIG. 6, FIG. 7; EX1015, 216-217.) The POSITA would have understood that in the combination, the electronic circuitry would be implemented by Anderson's RPU (*e.g.*, DSP 645) and/or earpiece (*e.g.*, ASIC 845), at least because Anderson discloses that these are the components configured to interface with various sensors. (EX1010, 24:23-26.)

F. Claim 42

1. ***[Preamble] A head-worn personal electronic apparatus as recited in claim 41,***

264. See claim 41.

2. ***[A] wherein the detected radiation is at least infrared radiation.***

265. See claim 41[A].

G. Claim 43

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 17,*

266. See claim 17.

2. **[A]** *wherein the head-worn personal electronic apparatus comprises: a radiation detector configured to capture radiation data,*

267. See claim 13[A].

3. **[B]** *wherein the electronic circuitry is configured to process at least the radiation data captured by the radiation detector.*

268. See claim 13[B].

H. Claim 44

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 43,*

269. See claim 43.

2. **[A]** *wherein the electronic circuitry is configured to determine whether the head-worn personal electronic apparatus is being worn by a user based on at least the processed radiation data.*

270. See claim 13[C].

I. Claim 45

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 44,*

271. See claim 44.

2. [A] *wherein the radiation detector comprises a photodetector.*

272. The POSITA would have understood Irvin's infrared sensor to comprise a photodetector because infrared sensors are configured to detect infrared radiation, such as emitted from an infrared LED; and the POSITA would have understood a photodetector to be a device configured to detect such radiated energy. (EX1023, 577; EX1009, 6:22-24; *see* EX1015, 216-217.) This is consistent with the '355 patent, in which an infrared photodiode capturing reflected infrared radiation is described as an infrared detector. (EX1001, 94:15-23.) Similarly, the '355 patent discloses (via its incorporation of the disclosure of U.S. Patent No. 7,500,746 (EX1018)) that one "suitable" photodetector is the Sharp PD100MCOMP photodiode, an infrared sensor whose peak sensitivity is to infrared radiation of 820 nanometers. (EX1001, 2:22-26; EX1018, 37:52-59; EX1019, 1, 3.) Similarly, I understand that for claim 45, Patent Owner has taken the position in the parallel litigation that "the radiation detector comprises an infrared detector configured to sense infrared light using a photodetector." (EX1024, 354.)

J. Claim 46

1. [Preamble] *A head-worn personal electronic apparatus as recited in claim 17,*

273. See claim 17.

2. ***[A] wherein the head-worn personal electronic apparatus comprises a force sensor configured to receive a user input based at least on sensing force applied to the force sensor.***

274. See claim 14[A].

K. Claim 47

1. ***[Preamble] A head-worn personal electronic apparatus as recited in claim 46,***

275. See claim 46.

2. ***[A] wherein the force sensor is configured to detect the user input, the detected user input operating to alter at least an operation of the head-worn wearable electronic device.***

276. See claim 14[B].

L. Claim 48

1. ***[Preamble] A head-worn personal electronic apparatus as recited in claim 47,***

277. See claim 47.

2. ***[A] wherein the at least one operation of the head-worn personal electronic apparatus being altered concerns control of the audio output being provided to the user.***

278. See claim 14[B]. In the combination, the operation of the apparatus being altered includes entering or exiting an inactive or sleep state based on the sensor 220, as described for claim 14[A]. The POSITA would have understood these operations to include controlling the audio output being provided to the user, at least because the POSITA would have understood audio output to be disabled in

the inactive state (in which the audio interface 234 of the communications circuit 230 is disconnected from the power source), and re-enabled in the active state, based on sensor 220. (EX1009, 2:17-23, 3:53-4:2, 8:11-50, FIG. 8.)

M. Claim 49

1. **[Preamble] *A head-worn personal electronic apparatus as recited in claim 17,***

279. See claim 17.

2. ***[A] wherein the head-worn personal electronic apparatus comprises: a light detector configured to capture light data, the light detector being electrically connected to the electronic circuitry, and the electronic circuitry being configured to process at least the light data captured by the light detector.***

280. See claim 41[C] and claim 43. The claimed light detector is met by Irvin's infrared radiation detector, and the claimed light data is met by Irvin's infrared radiation data. This is because the POSITA would have understood infrared (IR) radiation to be a form of light (*i.e.*, non-visible light having a wavelength in the infrared spectrum). (See EX1015, 216 ("Infrared sensors ... emit near-infrared energy and measure whether any significant amount of the ***IR light*** is returned")(emphasis added); EX1020, 455 ("[a]t the ends of the visible spectrum are invisible ***infrared*** and ultraviolet ***lights***")(emphasis added); EX1021, 1237 (defining "light" to include electromagnetic radiation from infrared sources); EX1022, 697 (same).) Similarly, I understand that for claim 49, Patent Owner has

taken the position in the parallel litigation that “the light detector is used to detect the presence of light (e.g., *infrared* and/or visible *light*)”. (EX1024, 354 (emphasis added).)

N. Claim 50

1. [Preamble] *A head-worn personal electronic apparatus as recited in claim 49,*

281. See claim 49.

2. [A] *wherein the light detector comprises a photodetector.*

282. See claim 45[A] and claim 49[A].

XI. CLAIMS 15, 16, 77-82, 85, AND 86 ARE RENDERED OBVIOUS BY ANDERSON IN VIEW OF LYNCH, NEMIROVSKI, AND IRVIN

A. Motivation to Combine with Reasonable Expectation of Success

283. The POSITA would have been motivated to combine the teachings of Anderson with the teachings of Lynch, Nemirovski, and Irvin, with a reasonable expectation of success, for the reasons described in Sections V.C, VIII.B, and IX.B.

B. Claim 15

1. [Preamble] *A head-worn personal electronic apparatus as recited in claim 14,*

284. See claim 14.

2. ***[A] wherein the head-worn personal electronic apparatus comprises: a first microphone at least partially contained within the head-worn personal electronic apparatus, the first microphone being positioned to pick up at least audio input from at least the user; and***

285. See claim 7[A].

3. ***[B] a second microphone at least partially contained within the head-worn personal electronic apparatus, the second microphone being positioned to pick up at least environmental audio input associated with an environment around the head-worn personal electronic apparatus,***

286. See claim 7[B].

4. ***[C] wherein the electronic circuitry is configured to modify the customized audio output signals to be output to the user via the at least one speaker to cancel at least a portion of noise associated with the environment, the modification of the customized audio output signals being dependent at least in part on the environmental audio input picked-up via the second microphone.***

287. See claim 60[C].

C. Claim 16

1. ***[Preamble] A head-worn personal electronic apparatus as recited in claim 15,***

288. See claim 15.

2. ***[A] wherein the head-worn personal electronic apparatus comprises: a radiation detector configured to capture radiation data,***

289. See claim 13[A].

3. ***[B] wherein the electronic circuitry is configured to process at least the radiation data captured by the radiation detector, and configured to determine whether the head-worn personal electronic apparatus is being worn by a user based on at least the processed radiation data.***

290. See claim 13[B] and claim 13[C].

D. Claim 77

1. ***[Preamble] A head-worn personal electronic apparatus operable to at least output customized audio output, comprising:***

291. See claim 1[Preamble].

2. ***[A] at least one speaker, the at least one speaker being configured to be wearable proximate to an ear of a user;***

292. See claim 1[A].

3. ***[B] a wireless receiver configured to wirelessly receive customized audio output signals for the user, the customized audio output signals having been customized based on at least predetermined hearing characteristics associated with the user such that the customized audio output signals at least compensate for the hearing impairment regarding the user's ability to hear;***

293. See claim 17[B].

4. ***[C] electronic circuitry including at least an integrated circuit, the electronic circuitry being configured to output the customized audio output signals to the at least one speaker;***

294. See claim 17[C].

5. ***[D] a force sensor at least partially contained within the head-worn personal electronic apparatus and configured to receive a user input based at least on sensing force applied to the force sensor, the force sensor is configured to detect the user input, the detected user input operating to alter at least an operation of the head-worn wearable electronic device;***

295. See claim 14[A] and claim 14[B].

6. ***[E] a first microphone configured to pick up at least audio input from at least the user, the first microphone being at least partially in the head-worn personal electronic apparatus and is positioned to be directed towards the user when the head-worn personal electronic apparatus is being worn by the user; and***

296. See claim 7[A].

7. ***[F] a second microphone configured to pick up at least ambient sound input associated with an environment in the vicinity of the head-worn personal electronic apparatus, the second microphone being positioned to be directed away from the user when the head-worn wearable electronic device is being worn by the user;***

297. See claim 7[B].

8. ***[G] wherein the at least one speaker is configured to generate at least a portion of the customized audio output for the user in accordance with at least the portion of the customized audio output signals.***

298. See claim 1[G].

E. Claim 78

1. ***[Preamble] A head-worn personal electronic apparatus as recited in claim 77,***

299. See claim 77.

2. ***[A] wherein the head-worn personal electronic apparatus comprises: a radiation detector configured to capture radiation data,***

300. See claim 13[A].

3. ***[B] wherein the electronic circuitry is configured to process at least the radiation data captured by the radiation detector, and configured to determine whether the head-worn personal electronic apparatus is being worn by a user based on at least the processed radiation data.***

301. See claim 13[B] and claim 13[C].

F. Claim 79

1. ***[Preamble] A head-worn personal electronic apparatus as recited in claim 77,***

302. See claim 77.

2. ***[A] wherein the head-worn personal electronic apparatus wherein the head-worn personal electronic device is configured to receive a voice input via the first microphone, determine a requested operation from the voice input using voice recognition, and control an operation by the head-worn personal electronic device based on the requested operation.***

303. See claim 54[B].

G. Claim 80

1. ***[Preamble] A head-worn personal electronic apparatus as recited in claim 77,***

304. See claim 77.

2. *[A] wherein the electronic circuitry is configured to modify the customized audio output signals to be output to the user via the at least one speaker to cancel at least a portion of noise associated with the environment, the modification of the customized audio output signals being dependent at least in part on the ambient sound input picked-up via the second microphone.*

305. See claim 15[C].

H. Claim 81

1. *[Preamble] A head-worn personal electronic apparatus as recited in claim 77,*

306. See claim 77.

2. *[A] wherein the ambient sound input picked-up from at least the second microphone is used at least for noise cancelation, and at least a portion of the ambient sound input picked-up from the second microphone is subtracted from the audio picked-up from the first microphone.*

307. See claim 40[C].

I. Claim 82

1. *[Preamble] A head-worn personal electronic apparatus as recited in claim 77,*

308. See claim 77.

2. *[A] wherein the electronic circuitry is configured to: determine an ambient noise level based on at least the ambient sound input; and*

309. See claim 12[D].

3. **[B]** *modify at least a portion of the audio sound picked-up via the first microphone, with the modification being at least in part dependent on the ambient noise level.*

310. See claim 12[E].

J. Claim 85

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 77,*

311. See claim 77.

2. **[A]** *wherein the electronic circuitry is configured to: produce an ambient audio output signal based on at least the ambient sound input; and*

312. See claim 9[A].

3. **[B]** *provide at least the ambient audio output signal to the at least one speaker.*

313. See claim 9[B].

K. Claim 86

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 85,*

314. See claim 85.

2. **[A]** *wherein the electronic circuitry is configured to: determine an ambient noise level based on at least the ambient sound input,*

315. See claim 10[A].

3. **[B]** *wherein the ambient audio output signal is dependent on the ambient noise level.*

316. See claim 10[B].

XII. CLAIMS 25-28 ARE RENDERED OBVIOUS BY ANDERSON IN VIEW OF LYNCH, BODLEY AND IRVIN

A. Motivation to Combine with Reasonable Expectation of Success

317. The POSITA would have been motivated to combine the teachings of Anderson with the teachings of Lynch, Bodley, and Irvin, with a reasonable expectation of success, for the reasons described in Sections V.C, VI.B, and IX.B.

B. Claim 25

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 19,*

318. See claim 19.

2. **[A]** *wherein the head-worn personal electronic apparatus comprises: a sensor at least partially contained within the head-worn personal electronic structure and configured to sense data indicative of whether the head-worn personal electronic apparatus is being worn by the user.*

319. See claim 14.

C. Claim 26

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 25,*

320. See claim 25.

2. ***[A] wherein the head-worn personal electronic apparatus is configured to at least alter operation of the head-worn personal electronic apparatus based at least in part on the sensed data from the sensor.***

321. See claim 14[B].

D. Claim 27

1. ***[Preamble] A head-worn personal electronic apparatus as recited in claim 26,***

322. See claim 26.

2. ***[A] wherein the operation of the head-worn personal electronic apparatus being altered concerns control of the audio output being provided to the user.***

323. See claim 48[A].

E. Claim 28

1. ***[Preamble] A head-worn personal electronic apparatus as recited in claim 26,***

324. See claim 26.

2. ***[A] wherein the operation of the head-worn personal electronic apparatus being altered concerns operation of the head-worn personal electronic apparatus in a lower power operation.***

325. See claim 14[B].

XIII. CLAIMS 61-64 ARE RENDERED OBVIOUS BY ANDERSON IN VIEW OF LYNCH, NEMIROVSKI, BODLEY, AND ZADESKY

A. Motivation to Combine with Reasonable Expectation of Success

326. The POSITA would have been motivated to combine the teachings of Anderson with the teachings of Lynch, Nemirovski, Bodley, and Zadesky, with a reasonable expectation of success, for the reasons described in Sections V.C, VI.B, VII.B, and VIII.B.

B. Claim 61

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 60,*

327. See claim 60.

2. **[A]** *wherein the head-worn personal electronic apparatus comprises: a user input device supported by the head-worn personal electronic apparatus, the user input device being configured to receive a user input, the user input device is based on at least capacitive effect, wherein the user input being received induces at least a capacitive change to produce at least an electrical response.*

328. See claim 6[A]. Zadesky discloses that its sensing of user touch input on the touch surface, as described for claim 6[A], is based on “capacitive sensing.” (EX1006, 2:29-34.) Such capacitive touchpads were in “popular” use as input devices by the priority date. (EX1016, 5, 138.) The POSITA would have understood the touch surface (a user input device) to be based on a capacitive effect in that it receives the user touch input, which induces a capacitive change

and produces an electrical response (*i.e.*, output signals provided to the RPU). (See EX1016, 1, 5, 138-139.)

C. Claim 62

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 61,*

329. See claim 61.

2. **[A]** *wherein the electronic circuitry is electrically connected to the user input device to receive user input data from the user input device, and wherein the head-worn personal electronic apparatus is configured to distinguish at least whether the user input pertains to a forward sliding action or a backward sliding action with respect to the user input device using at least the electronic circuitry and the user input data.*

330. See claim 24[A].

D. Claim 63

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 61,*

331. See claim 61.

2. **[A]** *wherein the head-worn wearable electronic device includes an accelerometer.*

332. Anderson discloses that a “[s]elf-contained user-carried inertial navigation package[]” with an accelerometer can reside in or be attached to the RPU to provide user location information. (EX1010, 25:51-65.)

E. Claim 64

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 63,*

333. See claim 63.

2. **[A]** *wherein the head-worn personal electronic apparatus comprises: a radiation sensor, operatively connected to the rechargeable battery, at least partially contained within the head-worn personal electronic apparatus and configured to sense radiation.*

334. See claim 13. Irvin discloses that the proximity sensor 220 in the combination can be an active infrared radiation sensor configured to sense infrared radiation. (EX1009, 6:20-24.) The POSITA would have understood that such an active sensor “put[s] out energy into the environment” and thus must be operatively connected to a power source; in the combination, the power source is Anderson’s battery, which may be a rechargeable battery. (See EX1015, 196; EX1010, 6:55-57, FIG. 8.)

XIV. CLAIMS 65-72, 75, 76, 87-92, AND 95-100 ARE RENDERED OBVIOUS BY ANDERSON IN VIEW OF LYNCH, NEMIROVSKI, BODLEY, AND IRVIN

A. Motivation to Combine with Reasonable Expectation of Success

335. The POSITA would have been motivated to combine the teachings of Anderson with the teachings of Lynch, Nemirovski, Bodley, and Irvin, with a

reasonable expectation of success, for the reasons described in Sections V.C, VI.B, VII.B, and VIII.B.

B. Claim 65

1. ***[Preamble] A head-worn personal electronic apparatus operable to at least output customized audio output, comprising:***

336. See claim 1[Preamble].

2. ***[A]at least one speaker, the at least one speaker being configured to be wearable proximate to an ear of a user;***

337. See claim 1[A].

3. ***[B]a wireless receiver configured to wirelessly receive customized audio output signals for the user, the customized audio output signals having been customized based on at least predetermined hearing characteristics associated with the user such that the customized audio output signals at least compensate for the hearing impairment regarding the user's ability to hear;***

338. See claim 17[B].

4. ***[C]electronic circuitry including at least an integrated circuit, the electronic circuitry being configured to output the customized audio output signals to the at least one speaker;***

339. See claim 17[C].

5. ***[D]a touch sensitive surface at least partially contained within the head-worn personal electronic apparatus and configured to sense a touch input associated with the user, wherein the sensed touch input operating to at least alter operation of the head-worn electronic personal audio apparatus;***

340. See claim 3[A].

6. *[E] a sensor at least partially contained within the head-worn personal electronic structure and configured to sense data indicative of whether the head-worn personal electronic apparatus is being worn by the user, the head-worn personal electronic apparatus is configured to at least alter operation of the head-worn personal electronic apparatus based at least in part on the sensed data from the sensor;*

341. See claim 14[A] and claim 14[B].

7. *[F] a first microphone configured to pick up at least audio input from at least the user, the first microphone being at least partially in the head-worn personal electronic apparatus and is positioned to be directed towards the user when the head-worn personal electronic apparatus is being worn by the user; and*

342. See claim 7[A].

8. *[G] a second microphone configured to pick up at least ambient sound input associated with an environment in the vicinity of the head-worn personal electronic apparatus, the second microphone being positioned to be directed away from the user when the head-worn wearable electronic device is being worn by the user,*

343. See claim 7[B].

9. *[H] wherein the at least one speaker is configured to generate at least a portion of the customized audio output for the user in accordance with at least the portion of the customized audio output signals.*

344. See claim 1[G].

C. Claim 66

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 65,*

345. See claim 65.

2. **[A]** *wherein the sensor comprises a radiation detector configured to capture radiation data, and*

346. See claim 13[A].

3. **[B]** *wherein the electronic circuitry is configured to process at least the radiation data captured by the radiation detector, and configured to determine whether the head-worn personal electronic apparatus is being worn by a user based on at least the processed radiation data.*

347. See claim 13[B].

D. Claim 67

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 65,*

348. See claim 65.

2. **[A]** *wherein the head-worn personal electronic apparatus wherein the head-worn personal electronic device is configured to receive a voice input via the first microphone, determine a requested operation from the voice input using voice recognition, and control an operation by the head-worn personal electronic device based on the requested operation.*

349. See claim 54[B].

E. Claim 68

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 65,*

350. See claim 65.

2. **[A]** *wherein the electronic circuitry is configured to modify the customized audio output signals to be output to the user via the at least one speaker to cancel at least a portion of noise associated with the environment, the modification of the customized audio output signals being dependent at least in part on the ambient sound input picked-up via the second microphone.*

351. See claim 15[C].

F. Claim 69

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 65,*

352. See claim 65.

2. **[A]** *wherein the ambient sound picked-up from at least the second microphone is used at least for noise cancelation, and at least a portion of the ambient sound picked-up from the second microphone is subtracted from the audio picked-up from the first microphone.*

353. See claim 40[C].

G. Claim 70

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 65,*

354. See claim 65.

2. **[A]** *wherein the electronic circuitry is configured to: determine an ambient noise level based on at least the ambient sound input; and*

355. See claim 12[D].

3. **[B]** *modify at least a portion of the audio sound picked-up via the first microphone, with the modification being at least in part dependent on the ambient noise level.*

356. See claim 12[E].

H. Claim 71

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 65,*

357. See claim 65.

2. **[A]** *wherein head-worn personal electronic apparatus is configured to support voice calls to the user, and*

358. See claim 4[A].

3. **[B]** *wherein the at least one operation of the head-worn personal electronic apparatus being altered concerns at least accepting or declining a voice call to the user.*

359. See claim 4[B].

I. Claim 72

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 65,*

360. See claim 65.

2. **[A]** *wherein the at least one operation of the head-worn personal electronic apparatus being altered concerns control of the customized audio output being provided to the user.*

361. See claim 5[A].

J. Claim 75

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 65,*

362. See claim 65.

2. **[A]** *wherein the electronic circuitry is configured to: produce an ambient audio output signal based on at least the ambient sound input; and*

363. See claim 9[A].

3. **[B]** *provide at least the ambient audio output signal to the at least one speaker.*

364. See claim 9[B].

K. Claim 76

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 75,*

365. See claim 75.

2. **[A]** *wherein the electronic circuitry is configured to: determine an ambient noise level based on at least the ambient sound input,*

366. See claim 10[A].

3. **[B]** *wherein the ambient audio output signal is dependent on the ambient noise level.*

367. See claim 10[B].

L. Claim 87

1. **[Preamble]** *A head-worn personal electronic apparatus operable to at least output customized audio output, comprising:*

368. See claim 1[Preamble].

2. **[A]** *at least one speaker, the at least one speaker being configured to be wearable proximate to an ear of a user;*

369. See claim 1[A].

3. **[B]** *a wireless receiver configured to wirelessly receive customized audio output signals for the user, the customized audio output signals having been customized based on at least predetermined hearing characteristics associated with the user such that the customized audio output signals at least compensate for the hearing impairment regarding the user's ability to hear;*

370. See claim 17[B].

4. **[C]** *electronic circuitry including at least an integrated circuit, the electronic circuitry being configured to output the customized audio output signals to the at least one speaker;*

371. See claim 17[C].

5. **[D]** *a user input device at least partially contained within the head-worn personal electronic apparatus and configured to receive a user input, the user input operating to alter at least an operation of the head-worn wearable electronic device;*

372. See claim 3.

6. ***[E] a radiation detector at least partially contained within the head-worn personal electronic structure and configured to capture radiation data indicative of whether the head-worn personal electronic apparatus is being worn by the user, the head-worn personal electronic apparatus is configured to at least alter operation of the head-worn personal electronic apparatus based at least in part on the captured radiation data;***

373. See claim 65[E].

7. ***[F] a first microphone at least partially contained within the head-worn personal electronic apparatus, the first microphone being positioned to pick up at least audio input from at least the user; and***

374. See claim 15[A].

8. ***[G] a second microphone at least partially contained within the head-worn personal electronic apparatus, the second microphone being positioned to pick up at least environmental audio input associated with an environment around the head-worn personal electronic apparatus,***

375. See claim 15[B].

9. ***[H] wherein the at least one speaker is configured to generate at least a portion of the customized audio output for the user in accordance with at least the portion of the customized audio output signals.***

376. See claim 1[G].

M. Claim 88

1. ***[Preamble] A head-worn personal electronic apparatus as recited in claim 87,***

377. See claim 87.

2. *[A] wherein the head-worn personal electronic apparatus wherein the head-worn personal electronic device is configured to receive a voice input via the first microphone, determine a requested operation from the voice input using voice recognition, and control an operation by the head-worn personal electronic device based on the requested operation.*

378. See claim 54[B].

N. Claim 89

1. *[Preamble] A head-worn personal electronic apparatus as recited in claim 87,*

379. See claim 87.

2. *[A] wherein the electronic circuitry is configured to modify the customized audio output signals to be output to the user via the at least one speaker to cancel at least a portion of noise associated with the environment, the modification of the customized audio output signals being dependent at least in part on the ambient sound input picked-up via the second microphone.*

380. See claim 15[C].

O. Claim 90

1. *[Preamble] A head-worn personal electronic apparatus as recited in claim 87,*

381. See claim 87.

2. ***[A] wherein the ambient sound input picked-up from at least the second microphone is used at least for noise cancelation, and at least a portion of the ambient sound input picked-up from the second microphone is subtracted from the audio picked-up from the first microphone.***

382. See claim 40[C].

P. Claim 91

1. ***[Preamble] A head-worn personal electronic apparatus as recited in claim 87,***

383. See claim 87.

2. ***[A] wherein the electronic circuitry is configured to: determine an ambient noise level based on at least the ambient sound input; and***

384. See claim 12[D].

3. ***[B] modify at least a portion of the audio sound picked-up via the first microphone, with the modification being at least in part dependent on the ambient noise level.***

385. See claim 12[E].

Q. Claim 92

1. ***[Preamble] A head-worn personal electronic apparatus as recited in claim 87,***

386. See claim 87.

2. ***[A] wherein the electronic circuitry is configured to: determine an environmental sound level based on at least the environmental audio input; and***

387. See claim 38[C].

3. **[B]** *amplify at least a portion of the audio input from the first microphone, with the amplification being at least in part dependent on the environmental sound level.*

388. See claim 38[D].

R. Claim 95

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 87,*

389. See claim 87.

2. **[A]** *wherein the electronic circuitry is configured to: produce an ambient audio output signal based on at least the ambient sound input; and*

390. See claim 9[A].

3. **[B]** *provide at least the ambient audio output signal to the at least one speaker.*

391. See claim 9[B].

S. Claim 96

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 95,*

392. See claim 95.

2. **[A]** *wherein the electronic circuitry is configured to: determine an ambient noise level based on at least the ambient sound input,*

393. See claim 10[A].

3. **[B]** *wherein the ambient audio output signal is dependent on the ambient noise level.*

394. See claim 10[B].

T. Claim 97

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 87,*

395. See claim 87.

2. **[A]** *wherein head-worn personal electronic apparatus is configured to support voice calls to the user, and*

396. See claim 4[A].

3. **[B]** *wherein the at least one operation of the head-worn personal electronic apparatus being altered concerns at least accepting or declining a voice call to the user.*

397. See claim 4[B].

U. Claim 98

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 87,*

398. See claim 87.

2. **[A]** *wherein the at least one operation of the head-worn personal electronic apparatus being altered concerns control of the customized audio output being provided to the user.*

399. See claim 5[A].

V. Claim 99

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 87,*

400. See claim 87.

2. **[A]** *wherein the head-worn personal electronic apparatus is configured to provide audio alerts to the user via the at least one speaker, and*

401. See claim 51[A].

3. **[B]** *wherein the audio alerts are dependent on one or more user preference settings.*

402. See claim 52[A].

W. Claim 100

1. **[Preamble]** *A head-worn personal electronic apparatus as recited in claim 87,*

403. See claim 87.

2. **[A]** *wherein the electronic circuitry is configured to modify the customized audio output signals to be output to the user via the at least one speaker to cancel at least a portion of noise associated with the environment, the modification of the customized audio output signals being dependent at least in part on the environmental audio input picked-up via the second microphone,*

404. See claim 15[C].

3. *[B] wherein, when the head-worn personal electronic apparatus is being worn by the user, the first microphone is positioned to be directed more towards the user's mouth than is the second microphone, and*

405. See claim 7[A].

4. *[C] wherein, when the head-worn personal electronic apparatus is being worn by the user, the second microphone is directed more away from the user's mouth than is the first microphone.*

406. See claim 7[B].

XV. CLAIM 55 IS RENDERED OBVIOUS BY ANDERSON IN VIEW OF LYNCH, IRVIN, AND HOROWITZ

A. Summary of Horowitz

407. Horowitz is an electronics textbook published in 1989, setting forth a “definitive volume teaching the art of the subject.” (EX1011, *xix*.) I understand Horowitz is thus prior art to the ’355 patent under at least 35 U.S.C. §§102(a) and (b).

408. Relevant to this proceeding, Horowitz includes, in a chapter titled “Foundations,” disclosure of switches (“mundane but important devices [that] seem to wind up in most electronic equipment”), including Hall effect switches. (EX1011, 53-55.) Horowitz further discloses, in a chapter titled “Digital Meets Analog,” the use of Hall effect switches to implement switching circuits and overcome “bounce” problems common to mechanical switches (EX1011, 575-

577.) Horowitz provides specific instructions, including schematics and instrumentation diagrams, for implementing switches into practical electronic circuits. (EX1011, 575-577.)

409. Horowitz is analogous art to the '355 patent at least because it is a “definitive volume” in the same general field of endeavor (devices with electronic circuits) as the '355 patent; and provides disclosures analogous to those of the '355 patent. (EX1011, *xix*; EX1001, Abstract.) Horowitz provides specific guidance for implementing circuits and components analogous to those disclosed in the '355 patent, and in particular for interfacing digital input and output devices; and is thus reasonably pertinent to the problem of wearable electronic devices with electronic components faced by the inventor of the '355 patent. (EX1001, Abstract; EX1011, 565, *see* 565-671.)

B. Motivation to Combine with Reasonable Expectation of Success

410. The POSITA would have been motivated to combine the teachings of Anderson, Lynch, and Irvin, as described in Section IX.B, with the teachings of Horowitz, and would had a reasonable expectation of success in doing so.

411. Irvin teaches the integration of sensor 220 into a wearable headset device, such as the wearable hearing aid of the combination of Anderson, Lynch, and Irvin; including the implementation of sensor 220 as a contact sensor with a contact switch that closes when brought into physical contact with the user, as

described in Section IX.A and IX.B, and for claim 14. (EX1009, 6:3-19, FIG. 4C.) However, Irvin omits implementation detail for the contact switch, including the type of switch preferably used, or how to overcome mechanical bouncing and other problems common to contact switches. Accordingly, the POSITA would have been motivated to look to other teachings of how to implement contact sensor 220.

412. The POSITA would have consulted well-known and authoritative literature in the art, such as Horowitz, for guidance. This is particularly because Horowitz is a comprehensive and widely used textbook in the same general field (electronic circuits) as Anderson, Lynch, Irvin and the '355 patent, setting forth a “definitive volume teaching the art of the subject.” (EX1011, *xix*.) For example, Horowitz includes specific passages guiding the POSITA’s implementation of switching components in circuits where digital components interface with analog elements, such as Anderson’s earpiece and Irvin’s contact sensor 220. (EX1011, 53-55, 575-577.)

413. Horowitz explains options for implementing contact switches; for example, Horowitz discloses that a Hall effect switch is a commercially available type of electromechanical switch; and that such Hall effect switches advantageously produce a “debounced logic output” that overcomes mechanical bounce problems that “wreak havoc” in some contact switch circuits. (EX1011, 53-55.) Horowitz further discloses that such Hall effect switches are “magnetically

operated solid-state switches” that advantageously “last just about forever” since they have “have no mechanical contact assembly to wear out”. (EX1011, 576-577.) These advantages in durability are particularly well suited for combination with Irvin, which seeks to provide a “reliable mechanism” for on/off control of the headset; and for wearable devices in general, which are subject to daily wear and exposure to the elements. (EX1009, 1:29-31.) The POSITA would thus have been motivated to combine Horowitz’s teachings of such Hall effect switches with those of Anderson, Lynch, and Irvin to implement the contact switch 220 and realize the advantages described by Horowitz.

414. The POSITA would have had a reasonable expectation of success in making the combination. For example, Horowitz discloses that Hall effect switches are commercially available in a “complete assembly” that operates at a standard logic-level voltage (5 volts), and produces a logic output suitable for interfacing with TTL and CMOS circuitry common to digital circuits. (EX1011, 577.) Horowitz additionally provides charts, tables, and schematics for implementing circuits such as Irvin’s control switch 220, including with specific component numbers, removing guesswork from the implementation. (*See* EX1011, 565-671.) And Irvin provides additional guidance, including block diagrams for integrating contact sensor 220 into circuits for controlling wireless headsets such as in Anderson and Lynch. (EX1009, FIGS. 1-5, 8.) The

combination would thus have been predictable, involving the combination of known methods and components, with specific implementation guidance provided.

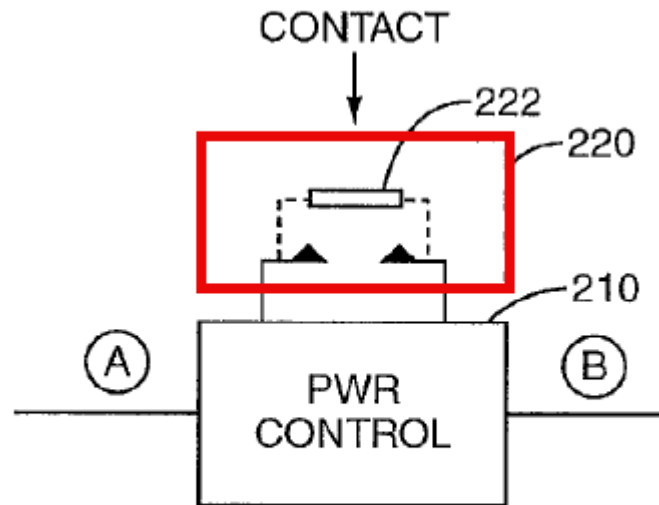
C. Claim 55

- a. ***[Preamble] A head-worn personal electronic apparatus as recited in claim 17,***

415. See claim 17.

- b. ***[A] wherein the head-worn personal electronic apparatus comprises: a Hall effect detector at least partially contained within the head-worn personal electronic apparatus and configured to capture data associated with a magnetic characteristic.***

416. This element is met as described for claim 14. That is, in combination with Anderson and Lynch, Irvin teaches that electronic circuitry processes data received from contact sensor 220 in the combined apparatus (*e.g.*, a contact switch activated by the application of force) to enable or disable the headset's electronic circuitry based on whether the headset is being worn, as shown in FIG. 4C:

**FIG. 4C**

(EX1009, 4:3-10, 4:39-49, 6:20-33, FIG. 4C (annotated).)

417. In the combination of Anderson, Lynch, and Irvin with Horowitz as described in Section XIV.B, Irvin's contact sensor 220 would be implemented in the combined apparatus using a Hall effect switch as disclosed by Horowitz. The POSITA would have been motivated to make the combination as described in Section XIV.B. As Horowitz discloses, the Hall effect switch is a magnetically operated solid-state switch that can be advantageously used in place of a mechanical switch such as the contact switch disclosed in Irvin. (EX1011, 576-577; EX1009, 6:3-10, FIG. 4C.)

418. Because the Hall effect sensor operates based on the principles of the well-known Hall effect, The POSITA would have understood the Hall effect

switch to comprise a Hall effect detector for detecting a voltage generated in the switch by the Hall effect, *i.e.*, by the presence of an electrical current in a magnetic field. (*See* EX1013, 709-713.) The POSITA would similarly understand the Hall effect switch to capture data associated with a magnetic characteristic, *e.g.*, the voltage produced as a function of the applied magnetic field, as characterized by the Hall effect. (*See* EX1013, 709-713.)

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 3rd of April, 2026 in Los Angeles, California.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Chris Kyriakakis', with a stylized flourish at the end.

Chris Kyriakakis