

**UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD**

GOOGLE INC.
Petitioner

v.

KONINKLIJKE PHILIPS ELECTRONICS N.V.
Patent Owner

U.S. PATENT NO. 6,772,114
Case No. IPR2017-00437

**PETITION FOR *INTER PARTES* REVIEW OF
U.S. PATENT NO. 6,772,114 (CLAIMS 10-16, 20-21)**

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EXHIBIT LIST

No.	Exhibit Name
Ex. 1001	U.S. Patent No. 6,772,114 (the “114 patent”)
Ex. 1002	Declaration of Dr. Schuyler Quackenbush (“Quackenbush Decl.”).
Ex. 1003	Curriculum Vitae of Dr. Schuyler Quackenbush
Ex. 1004	Published PCT Application No. WO 98/52187 to Tucker (“Tucker”)
Ex. 1005	Rabiner, L.R. and Schafer, R.W. <u>Digital Processing of Speech Signals</u> , Ch. 2, 10-32, Ch. 5, 72-240, Prentice-Hall (1978) (“Rabiner and Schafer”)
Ex. 1006	Smith, S.W., <u>The Scientist and Engineer’s Guide to Digital Signal Processing</u> , Ch. 14, 261-276, Ch. 22, 351-372, Calif. Technical Publishing (1997) (“Smith Textbook”)
Ex. 1007	U.S. Patent No. 4,488,251 to Wischermann (“Wischermann”)
Ex. 1008	Sluijter, R.J. et al., <i>State of the Art and Trends in Speech Coding</i> , Philips J. Res. 49:455-88 (1995) (“Sluijter Article”)
Ex. 1009	Manjunath, S., “Implementation of a Variable Rate Vocoder and its Performance Analysis,” Master of Science Thesis, Virginia Polytechnic Institute (May 1994) (“Manjunath”)
Ex. 1010	CCITT Recommendation G.726, <i>40, 32, 24, 16 kbit/s Adaptive Differential Pulse Code Modulation (ADPCM)</i> , Study Group XV, Geneva, Switzerland (Dec. 14 1990)
Ex. 1011	Boyd, I., <i>Speech Coding for Telecommunications</i> , Electronics & Communication Engineering Journal, 4(5):273-83 (October 1992)
Ex. 1012	Wichman, S., A Comparison of Speech Coding Algorithms ADPCM vs CELP. Department of Electrical Engineering, The University of Texas, Dallas (Dec. 8, 1999)

Ex. 1013	CCITT Recommendation G.728, <i>Coding of Speech at 16 kbits/s Using Low-Delay Code Excited Linear Prediction</i> , Study Group XV, Geneva, Switzerland (Sept. 1, 1992)
Ex. 1014	ITU-T Recommendation G.729, <i>Coding of Speech At 8 kbits/s Using Conjugate-Structure Algebraic-Code-Excited Linear-Prediction (CS-ACELP)</i> (March 19, 1996)
Ex. 1015	ITU-T Recommendation G.722, <i>7 kHz Audio – Coding Within 64 KBIT/S</i> (1993)
Ex. 1016	Paulus, J.W., <i>Wideband Speech Coding with 1-2 Bit Per Sample</i> , DSP International Conference on Digital Signal Processing, Cyprus (June 26-28 1995) (“Paulus 1995”)
Ex. 1017	Paulus, J.W, et al., <i>High Quality Coding of Wide-Band Speech at 24 kbit/s</i> , Proceeding of IEEE Workshop on Speech Coding for Telecommunications, Sainte-Adele, 13-14 (1993)
Ex. 1018	de Iacovo, R.D. et al., <i>A Low Delay Wideband Speech Codec at 16 kbit/s</i> , Signal Processing VI (Proc. EUSIPCO), Brussels, Belgium, 483-85 (1992)
Ex. 1019	Laflamme, C. et al., <i>16 kbps Wideband Speech Coding Technique Based on Algebraic CELP</i> , IEEE ICASSP Paper S1.4, 13-16 (1991)
Ex. 1020	Laflamme, C. et al., <i>9.6 kb/s ACELP Coding of Wideband Speech, Speech and Audio Coding for Wireless and Network Applications</i> (Atal, B. et al., eds.) Kkuwer Academic Publishing, Ch. 19, 147-52 (1993)
Ex. 1021	Ordentlich, E. and Shoham, Y, <i>Low-Delay Code-Excited Linear Predictive Coding of Wideband Speech at 32 KBPS</i> , Proc. IEEE ICASSP Paper S1.3, 9-12 (1991)
Ex. 1022	Lefebvre, R. et al., <i>High quality coding of wideband audio signals using transform coded excitation (TCX)</i> , IEEE ICASSP, 193-96 (1994)

Ex. 1023	Croisier, A. et al., <i>Perfect Channel Splitting by Use of Interpolation/Decimation/Tree Decomposition Techniques</i> ISICS, Patras, Greece, 443-46 (1976)
Ex. 1024	Esteban, D. and Galand, C., <i>Application of Quadrature Mirror Filters to Split Bank Voice Coding Schemes</i> , IEEE ICASSP, 191-95 (1977)
Ex. 1025	Vaidyanathan, P.P., <u>Multirate Systems and Filter Banks</u> , Prentice Hall (1993) (“Vaidyanathan”)
Ex. 1026	van der Waal, R.G. and Veldhuis, N.J., <i>Subband Coding of Stereophonic Digital Audio Signals</i> IEEE ICASSP Paper A1.8, 3601-04 (1989)
Ex. 1027	Paulus, J.W. and Schnitzler, J., <i>16 Bit/s Wideband Speech Coding Based on Unequal Subbands</i> , IEEE, 255-58 (1996) (“Paulus & Schnitzler 1996”)
Ex. 1028	Published European Application No. 0648024 A1 to Wuppermann (“EP ’024 Application”)
Ex. 1029	Pan, J. and Tompkins, W.J., <i>A Real-Time QRS Detection Algorithm</i> , IEEE Transactions on Biomedical Engineering, 32(3):230-36 (1985)
Ex. 1030	U.S. Patent No. 5,269,313 to DePinto (“DePinto”)
Ex. 1031	O’Shaughnessy, D., <u>Speech Communication Human and Machine</u> Addison-Wesley, Ch. 8, 336-79 (1987)
Ex. 1032	File History of U.S. Patent No. 6,772,114 (“’114 Patent File History”)
Ex. 1033	U.S. Patent No. 5,774,837 to Yeldener (“Yeldener”)
Ex. 1034	U.S. Patent No. 5,867,815 to Kondo (“Kondo”)
Ex. 1035	U.S. Patent No. 5,581,652 to Abe (“Abe”)
Ex. 1036	Golomb, S.W., <i>Run-Length Encodings</i> , IEEE Trans. on Information Theory, IT-12(3):399-401 (July 1966)

Ex. 1037	Rice, R. F. and Plaunt, R., <i>Adaptive Variable-Length Coding for Efficient Compression of Spacecraft Television Data</i> , IEEE Trans. on Communication Tech., 19(6):889-97 (Dec. 1971)
Ex. 1038	U.S. Patent No. 5,664,055 to Kroon (“Kroon”)
Ex. 1039	Oppenheim, A.V. and Schafer, R.W., <u>Digital Signal Processing</u> Prentice-Hall, Ch. 1, 6-44 (1975)
Ex. 1040	Philips’ Initial Infringement Contentions Against the ACER Defendants, <i>Koninklijke Philips N.V., U.S. Philips Corporation vs. ACER Inc., ACER America Corporation</i> , Case No. 15-1170-GMS, District of Delaware, (Nov. 10, 2016) (“Philips Infringement Contentions”)

I. INTRODUCTION AND BACKGROUND

Google Inc. (“Google”) respectfully requests *inter partes* review (“IPR”) of Claims 10-16 and 20-21 of U.S. Patent No. 6,772,114 (“the ’114 patent”), Exhibit (“Ex.”) 1001, entitled “High Frequency and Low Frequency Audio Signal Encoding and Decoding System.”

The ’114 patent describes basic principles regarding how one should encode and decode digital audio signals that have been converted from analog speech. Audio encoding techniques compress audio so that it can be sent across the Internet and the airwaves more efficiently: transmitters encode the signals and send them into the ether, and receivers decode the transmitted signals for output (for example, to a speaker). Ex. 1002 (Quackenbush) ¶¶ 33-36.

Audio encoding and decoding balances two goals: optimizing bandwidth and computation efficiency while, at the same time, transmitting high-quality, perceptible audio. Ex. 1002 (Quackenbush) ¶ 37. For decades prior to the filing of the ’114 patent, audio engineering experts worked to achieve these goals, and disclosed numerous audio encoding techniques and principles, including those embodied in the claims of the ’114 patent. Ex. 1002 (Quackenbush) ¶¶ 38-50.

A. The Early Focus on Narrowband (Voiced) Speech Coding

Early speech coding efforts focused on low frequency speech data. This was because most “voiced” speech sounds made by human beings are in the low frequency range, between 0-4 kHz. Ex. 1002 (Quackenbush) ¶¶ 36.

By focusing only on encoding the low frequency range of transmitted speech, one could “optimize the ‘tradeoff between sound quality and data rate’ that is at the heart of speech coding.” Ex. 1002 (Quackenbush) ¶ 37 (quoting Ex. 1006 (Steven W. Smith, “The Scientist and Engineer’s Guide to Digital Signal Processing” (1997) (“Smith Textbook”) at 358)). Several “narrowband” coders—so named because they focused solely on the low frequency range—had been implemented as of the priority date. Ex. 1002 (Quackenbush) ¶¶ 38-45.

These narrowband coders fell into two major types. The first type, known as “waveform” coders, sought to encode the waveform of the speech directly by exploiting the redundancies of the waveform. Ex. 1002 (Quackenbush) ¶ 39. One example of a waveform coder is adaptive differential pulse-code modulation (“ADPCM”), which was standardized in 1990 in International Telecommunications Union (“ITU”) standard G.726. Ex. 1002 (Quackenbush) ¶ 39; Ex. 1010 (G.726 Standard).

The second type, known as “vocoders,” sought to further compress the encoded signals while also preserving the quality of reproduced speech by using

an “excitation signal” and certain parameters that model the vocal tract to synthesize output. Ex. 1002 (Quackenbush) ¶¶ 40-45.

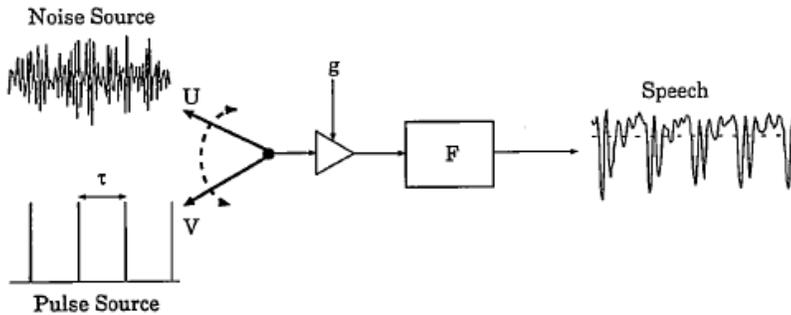


Fig. 1. The source-filter model of speech production.

As shown in the figure above, vocoders have three basic components that are used at the receiver to synthesize speech: a source signal (or “excitation” sequence), a gain parameter “g,” and a filter “F” that are applied to the source signal. Ex. 1002 (Quackenbush) ¶ 41. In early narrowband vocoders, parameters for the “excitation,” gain, and filter at the receiver were coded based on analysis of the input speech signal at the transmitter. *Id.* ¶ 42.

Vocoders typically achieved improved bit rates over waveform coders because they did not encode the entire waveform: they only transmitted the identified code book indices, linear predictive coding (LPC) filter coefficients, and gain information referenced above. Ex. 1002 (Quackenbush) ¶¶ 43-44.

Numerous vocoder variants emerged during the 1990s, including, for example,

those characterized by in the ITU G.728 (LD-CELP) and G.729 (CS-ACELP) standards. *Id.* ¶¶ 43-44.

B. The Increased Demand for Wideband (Voiced and Unvoiced) Speech Coders and Sub-band Coding

Demand for wideband coders that coded frequencies from 0-8 kHz began to increase during the mid-1990s. Ex. 1002 (Quackenbush) ¶¶ 46-50. Narrowband coders ignored perceptible portions of “unvoiced” speech in frequency ranges above 4 kHz, and new applications—including “video conferencing, videophone and loudspeaker telephone”—were requiring “higher quality speech.” Ex. 1008 (Sluijter) at 482. By increasing the speech coding bandwidth beyond 4 kHz and encoding both the voiced and unvoiced portions of speech signals, it was well known that “[s]ignificant improvement in speech quality [could be] gained.” Ex. 1008 (Sluijter) at 482.

As of the mid-1990s, the only wideband coder that had been standardized was the coder characterized in ITU G.722. Ex. 1015 (ITU-T Recommendation G.722). This coder produced high quality speech, but it had a high bit rate because it employed ADPCM *waveform* coding (rather than vocoding) for both the low and high sub-bands. In the low frequency range (0-4 kHz, containing primarily “voiced” speech), the speech data was coded at 48 kbit/s. Speech data was coded at 16 kbit/s in the high frequency range (4-8 kHz, containing primarily

“unvoiced” speech).¹ This resulted in a total bit rate of 64 kbit/s. Ex. 1002 (Quackenbush) ¶¶ 59-60.

Accordingly, the time was ripe to both implement and pursue standardization of a new and improved wideband coder. As of 1995, “[n]ew activities within ITU-T” had already “been started to define a lower bit rate standard for wideband speech.” Ex. 1008 (Sluijter) at 483. This was no surprise. Narrowband vocoders were already achieving bit rates as low as 8 kbit/s as of the mid-1990s. Ex. 1002 (Quackenbush) ¶ 45. Researchers began to realize that the bit rate of wideband coders could be substantially reduced from 64 kbit/s using parameter-based *vocoding* techniques in each sub-band instead of waveform coding techniques. *Id.* ¶¶ 61-63.

Three researchers—Jurgen Paulus, Jurgen Schnitzler, and Roger Tucker—specifically suggested well before the priority date that the use of parameter-based vocoding techniques in wideband, dual sub-band coders could improve the bit rate of encoded wideband speech while also improving sound quality over the narrowband coders. Ex. 1016 (Paulus, “Wideband Speech Coding with 1-2 Bit

¹ The voiced, low band portion was encoded with more bits than unvoiced, high band portion because, as noted above, “the lower subband is perceptually more important than . . . the upper sub-band.” Ex. 1008 (Sluijter) at 482-83.

Per Sample,” DSP International Conference on Digital Signal Processing, June 26-28 1995, Cyprus); Ex. 1027 (Jurgen W. Paulus & Jurgen Schnitzler, “16 KBit/s Wideband Speech Coding Based on Unequal Subbands,” IEEE 1996); Ex. 1004 (Tucker, WO98/52178); Ex. 1002 (Quackenbush) ¶¶ 61-63.

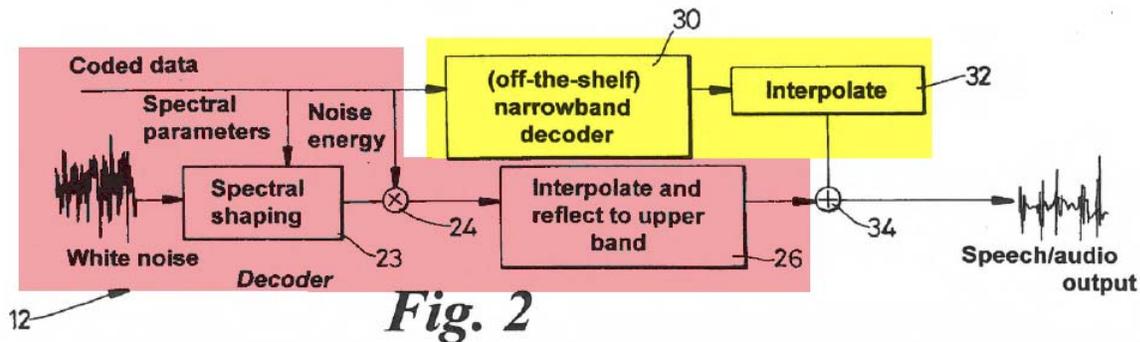
The coders disclosed by these three researchers considered the principles of voice coders discussed above. Each of them employed sub-band coding to facilitate separate coding of a lower frequency (voiced) portion of the signal and a higher frequency (unvoiced) portion of the signal. Each of them encoded a low-frequency portion of the speech signal using known, LPC-based vocoding techniques. Ex. 1002 (Quackenbush) ¶¶ 61-63. And each of these techniques encoded an excitation signal, LPC codes, and gain parameters in the low band. In the high band, by contrast, these coders *did not* encode an excitation signal—instead, they implemented the well-known principle that unvoiced speech can be modeled by random noise, and they merely encoded LPC coefficients and/or gain parameters in that band. *Id.* ¶¶ 61-63. They encoded and transmitted less data in that band because, as discussed above, the high band (unvoiced) portion of the signal is not as perceptually important as the low band (voiced) portion of the signal.

Tucker’s work is the focus of this Petition for *inter partes* review. In a PCT Application (WO 98/52187) (Ex. 1004) (“Tucker”) filed in Europe on May

15, 1997—more than two years before the European filing of the '114 patent on November 16, 1999—Tucker disclosed a transmission system for encoding and decoding speech.² Tucker noted the deficiencies of the G.722 wideband coder, and implemented a vocoder-based approach in each sub-band. Ex. 1004 (Tucker) at 5:8-15.

In the low band (0-4 kHz), Tucker used an “off-the-shelf” narrowband decoder. And in the high-band (4-8 kHz), Tucker modeled the unvoiced portion of the signal using a random, “white noise” signal. That is, Tucker did not encode an excitation signal in the high band. All that was encoded and transmitted were “the estimated energy of the noise component” and “spectral parameters,” such as LPC codes. Ex. 1004 (Tucker) at 12:16-17. These LPC codes were used to shape the white noise signal using a “spectral shaping” filter, and the measured “energy” of the signal was used to further amplify that signal using a multiplier. Tucker’s decoder is shown below, with the components of the low frequency (voiced) decoder highlighted in yellow and the high frequency (unvoiced) portion highlighted in red.

² Tucker’s PCT was also published on November 19, 1998—nearly two years before the November 13, 2000 U.S. filing date of the '114 patent.



The '114 patent is directed toward the exact same principles identified by Tucker over two years earlier. The claimed system uses a wideband audio encoding technique that “split[s]” an audio signal into a low frequency band and a high frequency band. Ex. 1001 at 1:9-13; Ex. 1002 (Quackenbush) ¶ 64. Each portion of the signal—voiced and unvoiced—is then coded using a distinct “coding device.” See Ex. 1001 at 1:9-31. For the low band (voiced) portion of the signal, the invention employs any “known coding [that] is efficient for a signal having a low frequency range.” Ex. 1001 at 2:7-8. For the high band, the '114 patent’s coder models the speech signal using a random “noise signal source” (NSS), and it therefore (like Tucker) does not encode an excitation signal in the high band. Instead, the high band coder encodes only LPC coefficients and gain parameters that are determined by an LPC encoder and signal strength meter, respectively.

During prosecution, Philips did not dispute that that the fundamental aspects of its encoding technique were obvious over the prior art. Instead, it

narrowed the claims during prosecution by importing trivial limitations. These limitations do not save the claims here. As explained below, Tucker, which was not before the PTO during prosecution, anticipates and renders obvious each of the challenged claims.

II. MANDATORY NOTICES

A. Real Party-in-Interest

The real parties-in-interest are Acer Inc., Acer America Corporation, ASUSTek Computer Inc., ASUS Computer International, and Google Inc.

B. Related Matters

The '114 patent is asserted in the following pending cases in the District of Delaware (“the Delaware Actions”): (1) *Koninklijke Philips N.V. et al. v. Acer Inc. et al.*, Case No. 1:15-cv-01170-GMS (D. Del.); (2) *Koninklijke Philips N.V. et al. v. Asustek Computer Inc. et al.*, Case No. 1:15-cv-01125-GMS (D. Del.); (3) *Koninklijke Philips N.V. et al. v. Double Power Technology, Inc. et al.*, Case No. 1:15-cv-01130-GMS (D. Del.); (4) *Koninklijke Philips N.V. et al. v. HTC Corp. et al.*, Case No. 1:15-cv-01126-GMS (D. Del.); (5) *Koninklijke Philips N.V. et al. v. Southern Telecom, Inc.*, Case No. 1:15-cv-01128-GMS (D. Del.); (6) *Koninklijke Philips N.V. et al. v. Visual Land, Inc.*, Case No. 1:15-cv-01127-gms (D. Del.); (7) *Koninklijke Philips N.V. et al. v. Yifang USA, Inc.*, Case No. 1:15-cv-01131-GMS (D. Del.).

C. Lead and Backup Counsel and Service Information

Lead counsel is David Krinsky (No. 72,339); backup counsel are Aaron Maurer (No. 44,911), Christopher Suarez (No. 72,553), and Christopher Geyer (No. 74,346). All of the above are attorneys at Williams & Connolly LLP, 725 Twelfth Street NW, Washington, DC 20005; 202-434-5000 (telephone); 202-434-5029 (fax). Google consents to service by email at dkrinsky@wc.com, amaurer@wc.com, csuarez@wc.com, and cgeyer@wc.com.

III. GROUNDS FOR STANDING, POWER OF ATTORNEY, AND FEES.

Petitioner certifies that the '114 patent is available for *inter partes* review, and that Petitioner is not barred or estopped from requesting this review.

Petitioner is filing a power of attorney and an Exhibit List concurrently with this petition, as well as all required fees. If any additional fees are due at any time through the course of the IPR, the undersigned authorizes the U.S. Patent and Trademark Office to charge such fees to Deposit Account No. 506403.

IV. IDENTIFICATION OF CHALLENGE AND RELIEF REQUESTED

The '114 patent issued from U.S. Application No. 09/710,916, filed on November 13, 2000, which claimed priority to a European application filed on November 16, 1999.

Petitioner challenges claims 10-16 and 20-21 of the '114 patent and requests that (1) claims 10-15 and 20 be found unpatentable as anticipated by

published PCT Application Number WO 98/52187 (“Tucker”) (Ex. 1004); and (2) claims 10-16 and 20-21 be found unpatentable as obvious over Tucker in view of the well-known art to the person of ordinary skill as of the priority date.

A. How the Claims Are Unpatentable

Pursuant to 37 C.F.R. § 42.104(b)(4), an explanation of how the challenged claims of the ’114 patent are unpatentable under the statutory grounds identified above, including the identification of where each element of the claim is found in the prior art, is provided in Section VIII, *infra*.

B. Supporting Evidence

Pursuant to 37 C.F.R. § 42.104(b)(5), the supporting evidence relied upon and the relevance of the evidence to the challenges raised, including identification of specific portions of the evidence that support the challenge, are provided herein. An Exhibit List identifying the exhibits is included. *See supra* at iv. In further support of the proposed grounds of rejection, this Petition is accompanied by the declaration of Dr. Schuyler Quackenbush (“Quackenbush Decl.”) (Ex. 1002).

V. THE '114 PATENT AND PROSECUTION HISTORY

A. The Purported Invention of the '114 Patent

The purported invention of the challenged claims of the '114 patent encodes and decodes audio signals that are split into high and low frequency components.

Figure 1 provides an overview of the claimed invention.

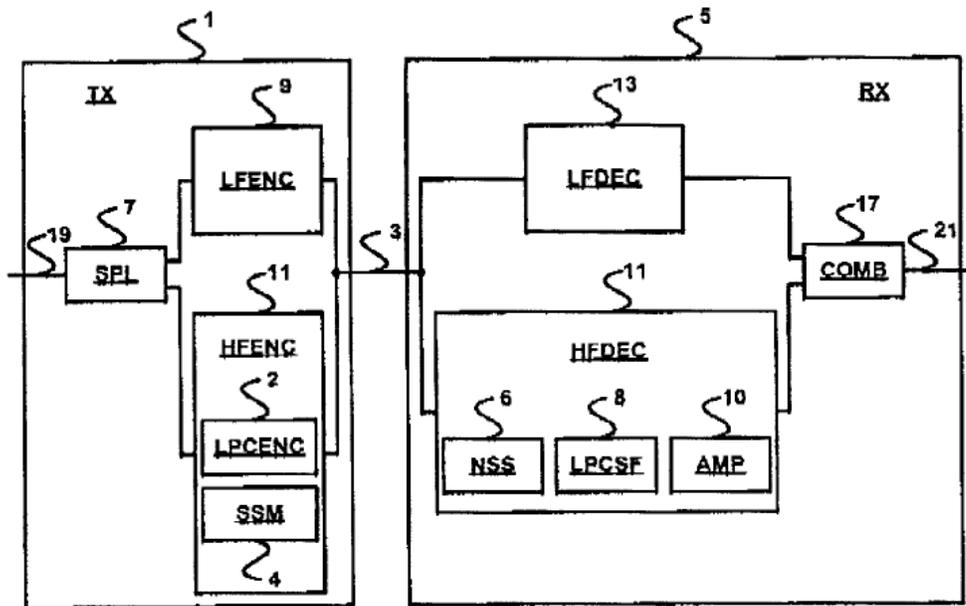


FIG. 1

In the transmitter (encoder), it illustrates a “splitter” (SPL) that “splits up the input signal into a signal that has a low frequency range and is processed by a first coder (‘LFENC’) 9, and a signal that has a high frequency range and is processed by a second coder (‘HFENC’) 11.” Ex. 1001 at 2:57-60. The first coder is generically disclosed, while the second coder utilizes “an LPC coder” (“LPCENC”) (labeled 2) to “determine[] prediction coefficients of the signal that

has a high frequency range,” and “a signal strength meter (“SSM”)” that is used to generate amplification codes. Ex. 1001 at 2:60-63, 3:30-33. The coded signals are passed to a receiver “by a transmission channel 3.” Ex. 1001 at 2:65-66.

The coded signals are then processed by the receiver. A “first decoder (“LCDEC”) 13” processes the “coded signal having a low frequency range.” Ex. 1001 at 2:66-3:1. Meanwhile, a “second decoder (“HFDEC”) 15” decodes the high frequency signal using a second decoder. Ex. 1001 at 3:1-3. This decoder models the unvoiced portion of the speech signal using white noise: it thus comprises a noise signal source (“NSS”) 6. Ex. 1001 at 3:3-4. The high band decoder also includes an LPC synthesis filter (“LPCSF”) 8 (which uses the transmitted LPC codes), and an amplifier (“AMP”) 10 (which uses the transmitted amplification codes). Ex. 1001 at 3:2-5. Once both the low and high band signals have been decoded, the low and high frequency signals “are then combined by a combiner (“COMB”) 17 to an output signal” of the receiver. Ex. 1001 at 3:5-9.

In the “low frequency” encoder depicted above, the ’114 patent generally teaches that the low frequency signal is “down-sampled by a down-sampler (“DNS”) 37” and applied to a generic “narrow-band coder 39.” Ex. 1001 at 3:55-58. The particular implementation of the narrow-band coder “is unimportant to the implementation of the invention” and can be any “coder optimized for a signal having a low frequency range,” including the G.728 and G.729 narrowband

coders that were well-known in the art. Ex. 1001 at 4:56-63. The high frequency signal is encoded by applying it to “a signal strength meter (‘SSM’) which “generates amplification codes,” and to an LPC coder which generates “prediction codes.” Ex. 1001 at 3:31-34; 4:7-9. The outputs of the transmitter include (1) the coded, low-frequency signals from the narrow-band encoder; and (2) the coded signals that resulted from the high-frequency signal, including both the “amplification codes coming from the signal strength meter 31 and the coded signals coming from the LPC coder 33.” Ex. 1001 at 4:62-66.

Figure 3 of the patent depicts a detailed embodiment of the receiver that reconstructs a synthesized audio signal. In the low band (highlighted in yellow), the receiver applies the coded, low frequency signal to a narrow-band decoder (“NBDEC”) 41 and an upsampler 43 (“UPS”) to recover a reconstructed signal. Ex. 1001 at 5:8-11. Any undesired signals in the high frequency range are filtered out “by a low-pass filter (“LPF”) 45, which has a frequency characteristic that can be compared with the low-pass filter 27 in the transmitter.” Ex. 1001 at 5:11-16. In the high band (highlighted in red), the receiver reconstructs the high frequency signal using the prediction coefficients and amplification codes that were transmitted as output from the high band encoder. The receiver generates a “white noise signal” that is passed through a high pass filter 51, followed by an LPC

synthesis filter 55 (which uses the prediction coefficients) and an amplifier 53 (which uses the amplification codes). Ex. 1001 at 5:23-46.

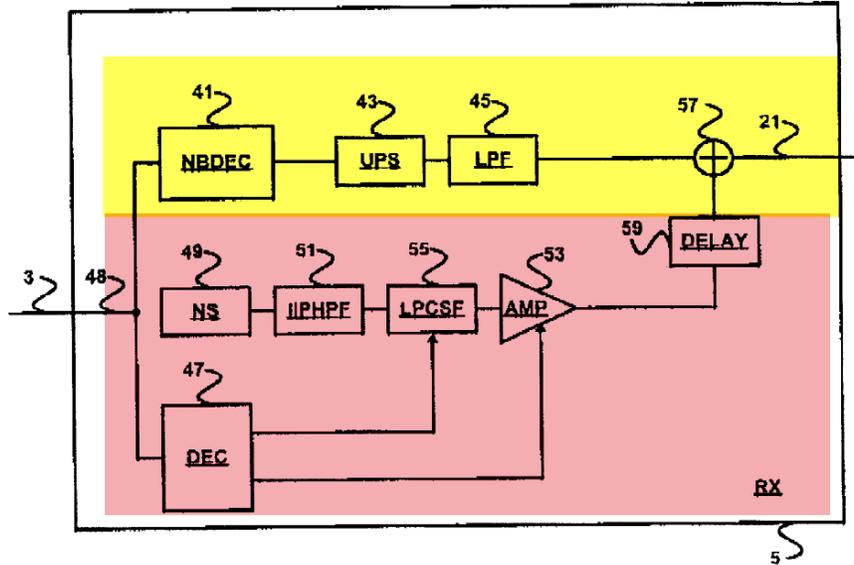


FIG. 3

Once the low frequency and high frequency signals have been reconstructed by each decoder, they are added by a combiner 57 which produces “an output signal that is rendered available on an output 21 of the receiver.” Ex. 1001 at 6:17-22.

B. The Challenged Claims of the '114 Patent

1. Independent Claims 10 and 20.

This Petition challenges independent claims 10 and 20 of the '114 patent. These claims are directed toward the generic concepts of the invention discussed above, including the concepts discussed above by reference to figures 1 and 3 of the '114 patent.

Independent claim 10 claims a transmission system that comprises both a transmitter and a receiver. In the transmitter, the claim requires that a splitter divide the signal into high and low frequency components, and that the transmitter apply generic first and second coders, respectively, to the signal in each of these bands. The claim recites more specific requirements on the receiver side. The first decoder (corresponding to the low-band signal) must “sequentially apply[] a narrow-band decoder, an up-sampler and a low-pass filter to the first coded signal to generate a first reconstructed signal,” and the second decoder (corresponding to the high-band signal) must apply LPC decoding techniques: it “sequentially applies a high-pass filter, a LPC synthesis filter and an amplifier to a noise signal to generate the second reconstructed signal.” Ex. 1001 at 7:50-8:7. The first decoder must apply the above signal processing elements “to the first coded signal” to reconstruct the low frequency signal, and the second decoder must reconstruct the high frequency signal “based on the second coded signal” and “a noise signal.” Ex. 1001 at 7:66-8:7. The claim, recited below, places no other limitations on the types of coders and decoders that are applied to each signal.

10. A transmission system, comprising:
 - a transmitter including
 - a splitter for splitting up a transmission signal into a low frequency signal within a low frequency range and a high frequency signal within a high

frequency range, the low frequency range being lower than the high frequency range, wherein said splitter applies a low-pass filter to the transmission signal to generate the low frequency signal, a first coder for deriving a first coded signal within the first frequency range from the low frequency signal, and a second coder for deriving a second coded signal within the high frequency range from the high frequency signal;

a receiver in electrical communication with said transmitter to receive the first coded signal and the second coded signal, said receiver including a first decoder for sequentially applying a narrow-band decoder, an up-sampler and a low-pass filter to the first coded signal to generate a first reconstructed signal within the first frequency range, and a second decoder, wherein, based on the second coded signal, said second decoder sequentially applies a high-pass filter, a LPC synthesis filter and an amplifier to a noise signal to generate the second reconstructed signal.

Ex. 1001 at 7:50-8:7 (emphasis added).

Independent claim 20 is a receiver-only claim with limitations that are identical to the receiver limitations of claim 10, including the requirements that the decoder for each sub-band applies certain signal processing elements “sequentially” to the signal pertinent to each band. *Compare* Ex. 1001 at 7:63-8:7 (receiver limitations of claim 10), *with id.* at 9:15-10:11 (claim 20). Independent claim 20, unlike claim 10, also includes a combiner that adds the high and low frequency components of the decoded signal after they have been reconstructed by the decoders. *Id.* at 10:10-11.

2. Dependent Claims 11-16 and 21.

Dependent claims 11-16 and 21 each add specific requirements to the transmitter and receiver claimed in independent claims 10 and 20.

a. Claims 11-12 – Specific Encoding Elements In Each Sub-Band

Claims 11-12 depend from claim 10 and both add additional requirements to the transmitter of that claim. While claim 10 recited generic encoders in each band, claims 11 and 12 recite additional details of each sub-band coder. Claim 11 requires that the “first,” low band coder of the transmitter “sequentially applies a down-sampler and a narrow-band coder to generate the first coded signal.” Ex. 1001 at 8:8-11. Claim 12 requires that the “second,” high band encoder of the transmitter perform three steps: “measure[] a signal strength of the high frequency

signal to generate an amplification code,” “determine[] prediction coefficients based on the high frequency signal,” and “code[] the amplification code and the prediction coefficients as components of the second coded signal.” Ex. 1001 at 8:12-21.

b. Claim 13 – Generation and Use of Amplification Codes

Claim 13 depends from claim 10. It adds a requirement that the high band encoder generate amplification codes on the transmitter side, and that the decoder uses those codes to calculate gain applied to the high frequency signal decoded on the receiver side. The claim requires that (1) the “second coder measures a signal strength of the high frequency signal to generate an amplification code”; (2) the “second coder codes the amplification code as one component of the second coded signal”; and (3) “the second decoder uses the amplification code to set” the gain amplifier applied to the signal generated in the high frequency band. Ex. 1001 at 8:22-29 (claim 13).

c. Claim 14 – Generation and Use of Prediction Codes

Claim 14 also depends from claim 10, which as noted above requires application of LPC decoding techniques in the high-band decoder on the receiver side. For this reason, claim 14 is directed toward the high-band encoder that generates LPC “prediction coefficients” that are transmitted to the decoder. A

POSA would understand that prediction coefficients are used by the LPC synthesis filters of the decoder to generate the high frequency signals of the claimed invention. Ex. 1002 (Quackenbush) ¶ 106. Accordingly, claim 14 requires that the high frequency encoder (1) “determines prediction coefficients based on the high frequency signal,” (2) “codes the prediction coefficients as one component of the second coded signal,” and (3) “uses the prediction coefficients to control said LPC synthesis filter.” Ex. 1001 at 8:30-37.

d. Claims 15-16 and 21 – Combining the Decoded Signals of Both Sub-Bands in the Receiver

Claims 15-16 and 21 contain limitations that pertain to the combining (or adding) of the high and low frequency signals decoded at the receiver. Claim 15 depends from claim 10 and claims “a combiner for combining the first reconstructed signal and the second reconstructed signal.” Ex. 1001 at 8:38-41. Claim 20, the independent receiver claim referenced above, also contains this claim element. Ex. 1001 at 10:10-11. Claims 16 and 21 depend respectively from claims 15 and 20. These claims ensure that the added signals are in phase with one another before combining them: specifically, they add a requirement that the “receiver applies a delay to one of the first reconstructed signal and the second reconstructed signal prior to said combiner combining the first reconstructed

signal and the second reconstructed signal.” Ex. 1001 at 8:43-47 (claim 16); 10:13-17 (claim 21).

C. Prosecution History

The '114 patent derived from a U.S. application filed on November 13, 2000 and claims priority to a European Application dated November 16, 1999. Ex. 1001 at [21], [22], [30]. The original application presented nine claims. *See* Ex. 1032 ('114 File History) at 31-33. These claims, like the claims of the issued '114 patent, recited a transmission system that split a signal into low and high frequency bands, encoded and decoded those two bands, and optionally combined the decoded signals at the receiver. *Id.* at 31-32 (original claims 1 and 5). Also like the '114 patent's claims, the original claims of the '916 application were directed toward a generic encoder/decoder in the low band and a coder in the high band that modeled the high band using a noise signal, LPC parameters, and amplification codes. *Id.* at 31 (original claim 1 regenerates the high frequency signal by applying a noise signal to an LPC synthesis filter controlled by prediction coefficients, and original claim 2 generates and uses amplification codes during the reconstruction of that high frequency signal); *see also id.* at 31-32 (claims 4-9).

Philips never argued or suggested during prosecution that any of these core aspects of the '114 patent's claims were either novel or innovative. Ex. 1002

(Quackenbush) ¶¶ 108-19. Throughout prosecution, the examiner rejected the proposed claims of the '114 patent several times over several prior art references. Ex. 1032 ('114 File History) at 73-87 (March 28, 2003 Office Action), 133-43 (Sept. 25, 2003 Office Action), 160-61 (Dec. 12, 2003 Advisory Action). The cited references variously employed sub-band coding in the low and high bands and, like the '114 patent, used a noise signal and principles of linear predictive coding in the high band. Ex. 1002 (Quackenbush) ¶¶ 108-19 (discussing U.S. Patent No. 5,774,837 to Yeldener (Ex. 1033), U.S. Patent No. 5,867,815 to Kondo (Ex. 1034), and U.S. Patent No. 5,581,652 to Abe (Ex. 1035)).

Philips' only recourse was to narrow the proposed claims of the '114 to import trivial limitations. These included the limitations—relevant to independent claims 10 and 20 at issue here—requiring certain signal processing elements to be applied to signals “sequentially” in the low and high band decoders of the receiver. Philips argued that these limitations were not disclosed by the prior art, and the Examiner initially found Philips' arguments “not . . . to be persuasive.” Ex. 1032 ('114 File History) at 161 (Dec. 12, 2003 Advisory Action). But, after Philips filed an appeal brief and rehashed the same arguments, the Examiner relented and allowed the claims. Ex. 1032 ('114 File History) at 168-77 (Appeal Brief). In the notice of allowance, the Examiner parroted Philips' arguments and stated the “prior art of record fail[ed] to teach” (1) a “first decoder

for sequentially applying a narrow-band decoder, an up-sampler and a low-pass filter to the first coded signal to generate a first reconstructed signal”; and (2) a “second decoder [that] sequentially applies a high pass filter, a LPC synthesis filter and an amplifier to a noise signal to generate the second reconstructed signal.” Ex. 1032 (’114 File History) at 189 (Notice of Allowability).

As discussed below, both of these minor claim limitations are expressly disclosed by (or, at minimum, obvious over) the Tucker reference presented in this Petition, which was not before the examiner during prosecution of the ’114 patent.

VI. LEVEL OF SKILL IN THE ART

The person of ordinary skill would have a Master’s degree or better in electrical engineering (or a related discipline) with an emphasis in signal processing and at least 3 years of engineering experience. The person would have experience with signal processing and the design of speech encoding and decoding schemes. Ex. 1002 (Quackenbush) ¶¶ 30-31.

VII. CONSTRUCTION OF THE CHALLENGED CLAIMS

In an *inter partes* review, claim terms in an unexpired patent are interpreted according to their broadest reasonable interpretation (“BRI”) in view of the specification in which they appear. 37 C.F.R. § 42.100(b); Office Patent Trial

Practice Guide, 77 Fed. Reg. 48,756, 48,766 (Aug. 14, 2012); *Cuozzo Speed Technologies, LLC v. Lee*, 136 S. Ct. 2131 (2016).

Throughout this Petition, as required by the rules governing it, Google applies the BRI of claim terms appropriate for these proceedings. The BRI appropriate for these proceedings may be different than a claim construction appropriate in the district court. The USPTO requires BRI, as the patentee is given opportunity to amend their claims in this proceeding. *See, e.g.*, Office Patent Trial Practice Guide, 77 Fed. Reg. 48,764 (Aug. 14, 2012) (“Since patent owners have the opportunity to amend their claims during IPR, PGR, and CBM trials, unlike in district court proceedings, they are able to resolve ambiguities and overbreadth through this interpretive approach, producing clear and defensible patents at the lowest cost point in the system.”). Thus, the claim interpretations presented in this Petition do not necessarily reflect the claim constructions that Google believes should be adopted by a district court under *Phillips v. AWH*. The BRI applied in this Petition is based in part on Google’s understanding of the patentee’s apparent constructions in the Delaware Actions; Google does not concede that constructions offered in this Petition, including constructions derived from the patentee’s apparent interpretations in the claims, should be adopted by the district court or would be reasonable applications of the rules in *Phillips*, which are different than the rules applicable in this proceeding.

A. “second decoder sequentially applies a high-pass filter, a LPC synthesis filter and an amplifier to a noise signal” (claim 20)

The broadest reasonable interpretation of this limitation is “applying a high-pass filter, a LPC synthesis filter and an amplifier to a noise signal one at a time.” This does not necessarily require they be applied in the recited order.

This interpretation is consistent with the plain language of the limitation, which is directed toward ensuring that each of the recited signal processing elements is applied to a noise signal in a sequence. The language of the claim requires that each element be performed and that the elements be performed “sequentially,” but the claim contains no limiting language (such as “first,” “next,” “then,” etc.) that requires a particular ordering. Likewise, nothing in the specification purports to limit the sequence to the precise order recited in the claims. Indeed, the specification itself does not contain the word “sequentially,” let alone define it as requiring a particular ordering.

To be sure, the specification describes an embodiment wherein the recited elements are applied in the recited order. *See* Ex. 1001 at 5:23-36, Fig. 3 (disclosing high-pass filter, LPC synthesis filter, and amplifier applied to the noise signal in the recited order). But the specification makes clear that this describes the preferred embodiment of the invention. Ex. 1001 at 2:51-52 (noting that the specification recites the “PRESENTLY PREFERRED EMBODIMENT”;

id. at 6:28-29 (noting that “the embodiments of the invention disclosed herein are presently considered to be preferred”). Basic principles of claim construction dictate that “it is improper to read limitations from a preferred embodiment described in the specification—even if it is the only embodiment—into the claims absent a clear indication in the intrinsic record that the patentee intended the claims to be so limited.” *Epos Techs Ltd. v. Pegasus Techs. Ltd.*, 766 F.3d 1338, 1341 (Fed. Cir. 2014) (internal quotation marks omitted) (emphasis added). Here, the indication is just the opposite: the specification makes clear that “various changes and modifications can be made” to the preferred embodiment “without departing from the spirit and scope of the invention.” Ex. 1001 at 6:28-31.

The proposed BRI construction of this limitation is also correct because the POSA would have understood that the high pass filter, LPC synthesis filter, and amplifier to a noise signal could be applied in any order. As Dr. Quackenbush explains, because the three recited components are linear time invariant, the POSA would recognize that the order in which they are applied to a noise signal does not affect the output signal. Ex. 1002 (Quackenbush) ¶¶ 117-19. Indeed, Philips alleges in a parallel district court proceeding that “the order in which the high-pass filter, LPC synthesis filter, and amplifier are applied is insubstantial.” Ex. 1040 (Philips Infringement Contentions) at 16 (Appendix I p.6).

VIII. DETAILED EXPLANATION OF GROUNDS FOR INVALIDITY

Pursuant to 37 C.F.R. § 42.104(b), the cited prior art anticipates or renders obvious the challenged claims of the '114 patent. As explained below, PCT Application Number WO 98/52187 (“Tucker”) anticipates claims 10-15 and 20 of the '114 patent; Tucker also, at minimum, renders claims 10-16 and 20-21 of the '114 patent obvious in view of the well-known art and the knowledge of the person of ordinary skill. Tucker published on November 19, 1998, meaning that it published more than one year before the U.S. Filing Date of the '114 patent, which was November 13, 2000. Tucker is therefore prior art under 35 U.S.C. § 102(b).³

³ L. Rabiner and R.W. Schafer, ‘Digital Processing of Speech Signals’, Prentice Hall, 1978 (Ex. 1005) is incorporated by reference into the disclosures of Tucker. Ex. 1004 (Tucker) at 20:13-17 (“[A]ttention is directed to L. Rabiner and R.W. Schafer, ‘Digital Processing of Speech Signals’, Prentice Hall, 1978, the contents of which are incorporated herein by reference.”). Tucker sufficiently identifies the precise edition and printing of the Rabiner and Schafer text and would have placed the person of ordinary skill on notice that the entire book was incorporated by reference into the disclosures of Tucker. *See Advanced Display Sys., Inc. v. Kent State Univ.*, 212 F.3d 1272, 1282 (Fed Cir. 2000).

Tucker, like the '114 patent, discloses a transmission system that encodes and decodes wideband speech signals. Ex. 1004 (Tucker) at 1:3-6 (the '114 patent “relates to audio coding systems . . . and methods for coding audio signals at low bit rates”); Ex. 1002 (Quackenbush) ¶¶ 120-27. The '114 patent’s transmission system wished to achieve “efficiency” in coding both the low and high bands, while at the same time, coding those bands in a way that produced perceptible speech output. Ex. 1001 at 1:60-62, 2:7-13; Ex. 1002 (Quackenbush) ¶¶ 120-27. Tucker’s transmission system was likewise “concerned with a solution to the problem of coding at very low bit rates whilst preserving a high level of intelligibility and quality, and also of providing a coding system which operates well at low bit rates with both speech and music.” Ex. 1004 (Tucker) at 1:16-22.

This Petition focuses on the first embodiment of Tucker. In that embodiment, Tucker implements a wideband transmission system that is meant to improve speech coding efficiency using the very same principles and techniques that are used in the '114 patent. Tucker’s transmission system, like the '114 patent, discloses an audio transmission system that “split[s] the signal into lower and upper sub-bands”—a “common way of implementing a wideband system.”

Ex. 1004 (Tucker) at 3:5-6; *see also id.* at 6:6-7 (reciting “means for decomposing said audio signal into an upper and a lower sub-band signal”).

By coding the two sub-bands separately, Tucker “allow[s] the upper sub-band”—which contains more noisy, unvoiced content—“to be encoded with fewer bits” than the lower sub-band—which contains the voiced content. Ex. 1004 (Tucker) at 3:5-7. In other words, like the ’114 patent, Tucker encodes the high frequency sub-band at a lower bit rate than the low frequency band.

Tucker encodes the voiced content of the low band at a higher bit rate because, as explained above, voiced content is more important to speech perceptibility than high frequency content. Ex. 1002 (Quackenbush) ¶¶ 120-27. The encoding of such low frequency signals (typically in the 0-4 kHz range), as also explained above, had long been the focus of speech coding efforts before the priority date, and there were numerous “narrowband” coders—particularly CELP coders such as G.728 and G.729—that were in the art in the mid-to-late 1990s. Ex. 1002 (Quackenbush) ¶¶ 38-45. Thus, the coding employed in the low band was not the focus of Tucker’s invention: his transmission system encodes the low frequency band using any known coding scheme that works well for the 0-4 kHz frequency band. Ex. 1004 (Tucker) at 4:28-5:1; Ex. 1002 (Quackenbush) ¶ 123. The encoder that Tucker uses in the low band (highlighted in yellow below) generically refers to any “off-the-shelf” narrowband encoder.

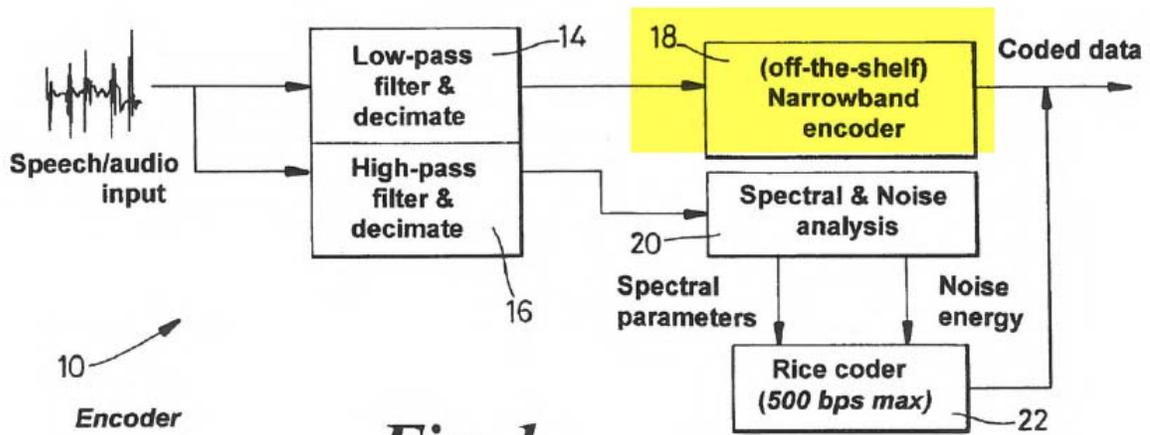


Fig. 1

The '114 patent identically teaches that the encoder in the low band can be any “normal coder,” and it also emphasizes that “[t]he type or operation of [the] narrow-band coder is unimportant to the implementation of the invention.” Ex. 1001 at 4:58-62.

The “key and original concept” of Tucker’s system pertained to “the encoding of the upper band.” Ex. 1004 (Tucker) at 12:19-20. This key concept was that Tucker’s high band encoding is “completely parametric”: unlike typical coding schemes known in the art at the time, it simply transmitted the coded representations of a gain parameter (i.e. noise energy) and LPC coefficients (i.e. spectral parameters) to the decoder. Ex. 1004 (Tucker) at 12:19-20; Ex. 1002 (Quackenbush) ¶¶ 124-27. A “spectral and noise analysis” is used to generate these parameters Tucker’s high band encoder (highlighted in Figure 1 below).

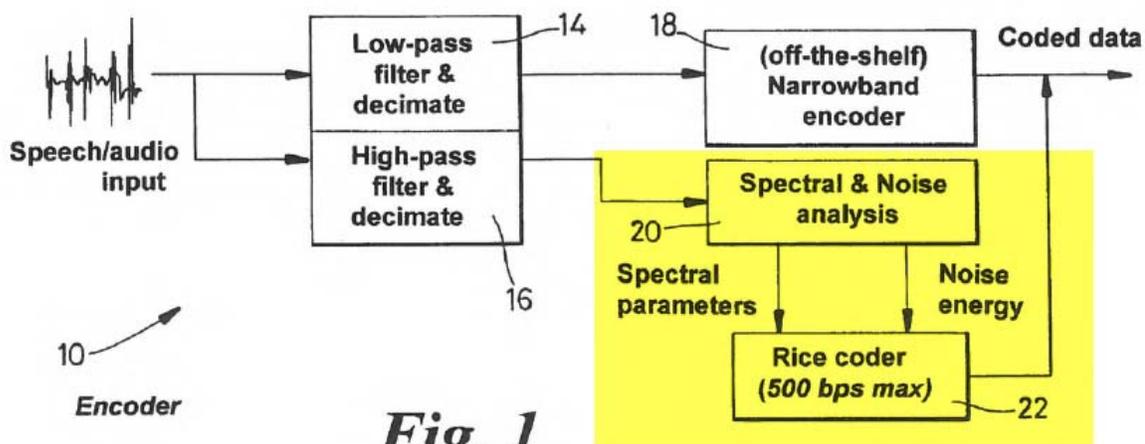
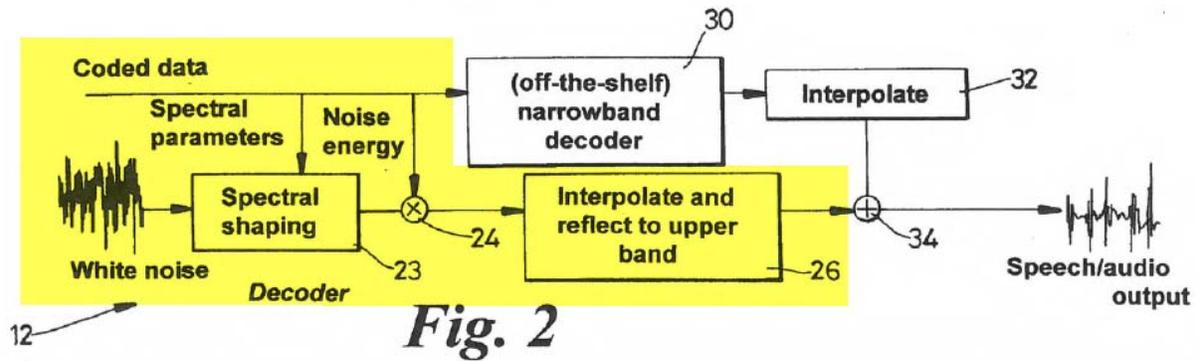


Fig. 1

The “spectral parameters” and “noise energy” would have been understood by the POSA to have been equivalent to “prediction codes” and “amplification codes,” respectively, as those terms are understood in the context of the ’114 patent. Ex. 1002 (Quackenbush) ¶ 126.

Critically, the above illustration shows that Tucker’s high band encoder did not encode or transmit a coded representation of the LPC excitation signal—“no attempt [was] made” in Tucker’s system “to encode the excitation signal” that would be applied in Tucker’s high band decoder. Ex. 1004 (Tucker) at 12:20-21. No encoding of the excitation was necessary because—in an identical fashion to the ’114 patent—Tucker’s excitation signal in the high band is provided by a random noise generator. Ex. 1004 (Tucker) at 12:20-21. The use of the random “white noise” generator in Tucker’s high band decoder, as well as the transmitted parameters, are illustrated in the highlighted portion of Tucker’s figure 2 below.



The insight that led Tucker to model the high band using a white noise signal was based on the understanding that “unvoiced” sounds in the high band are less perceptually significant than the “voiced” sounds. Ex. 1002 (Quackenbush) ¶¶ 125-27. The high band speech could thus be encoded with more compression than the low band speech without an appreciable decrease in sound quality: as Tucker explained, his system “does not attempt to fully reproduce the upper sub-band, but still provides an encoding that considerably enhances the quality (and intelligibility for speech) of the main bandlimited signal.” Ex. 1004 (Tucker) at 12:4-7. Tucker explained that an “increase in intelligibility” could be realized by “better encoding of the *unvoiced* fricatives and plosives.” Ex. 1004 (Tucker) at 4:10-12 (emphasis added). Based on the principles well-known in the art since the 1970s (and explained above), Tucker realized that an improved encoding would model the “upper band” (which contains such unvoiced sounds) using only random noise. Ex. 1004 (Tucker) at 4:13-14. The spectral parameters (or LPC coefficients) referenced above can then

be applied to this randomly generated “[w]hite noise,” which “alone is used to drive the all-pole filter” (23) in Tucker’s high band decoder. Ex 1004 (Tucker) at 12:16-18. And once the white noise signal is shaped using the filter at the receiver, the signal is also amplified using an energy value (or amplification code) generated in the transmitter. Ex. 1004 (Tucker) at 14:18-21.

A. Ground 1: Claims 10-15 and 20 Are Anticipated By Tucker

Tucker anticipates claims 10-15 and 20 of the ’114 patent because, as explained below, Tucker discloses each and every limitation of those claims.

1. Claim 10

Each limitation of claim 10 of the ’114 patent is disclosed by Tucker, as explained in the claim chart below.

Claim 10	<i>Tucker</i>
10. (preamble) A transmission system, comprising	To the extent the preamble is limiting, Tucker discloses a transmission system for audio coding and decoding. It discloses that the “invention relates to audio coding systems.” Ex. 1004 (Tucker) at 1:3-6; <i>id.</i> at 6:2-5 (disclosing “an audio coding system for encoding and decoding an audio signal”) Ex. 1002 (Quackenbush) ¶ 128.
a transmitter including:	Tucker teaches a transmitter. <i>See</i> Ex. 1004 (Tucker at 15:1 (referring to the invention as a “storage/transmission mechanism”); <i>id.</i> at 38:11-13 (claims referring to “coding means” that “provide an encoded signal for storage and/or transmission”).

Tucker teaches an encoder (labeled 10 and shown in Figure 1), that would be understood by the POSA as the “coding means” that acts as a transmitter to transmit coded data (such as the energy value and spectral parameters) in accordance with the invention. Ex. 1004 (Tucker) at 12:16-17.

Ex. 1002 (Quackenbush) ¶ 129.

a splitter for splitting up a transmission signal into a low frequency signal within a low frequency range and a high frequency signal within a high frequency range, the low frequency range being lower than the high frequency range

Tucker’s encoder teaches a splitter that splits a transmission signal into a low and high frequency range. Ex. 1004 (Tucker) at 13:20-24 (“the input audio signal passes to a low-pass filter 14 where it is low pass filtered to form a lower sub-band signal,” and “also to a high-pass filter 16 where it is high pass filtered to form an upper sub-band signal”). The person of ordinary skill would understand that these teachings describe a splitter that splits the input signal into a “low frequency range” and a “high frequency range” because they apply a low pass filter (14) and high pass filter (16) to the signal, as shown in the encoder of Figure 1 below.

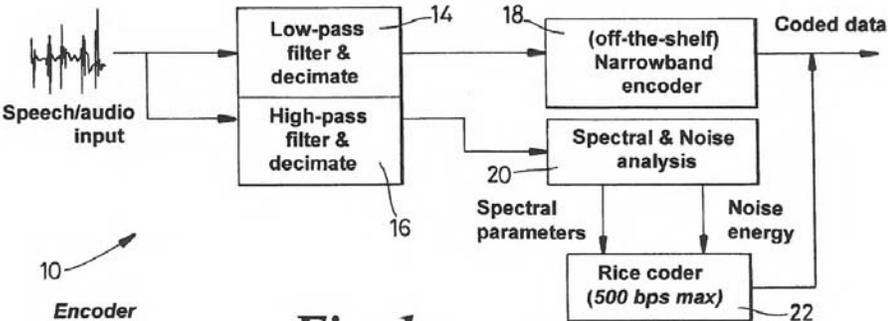
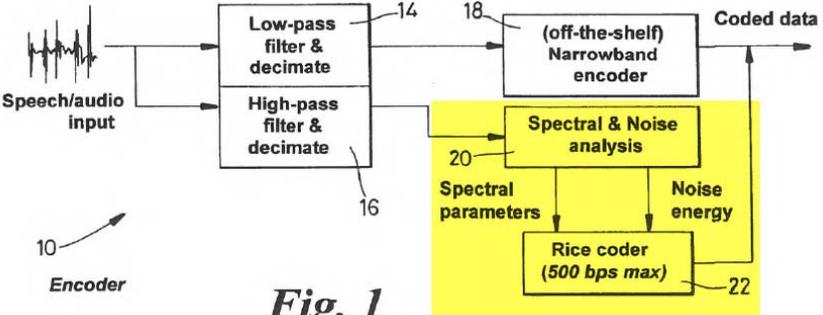


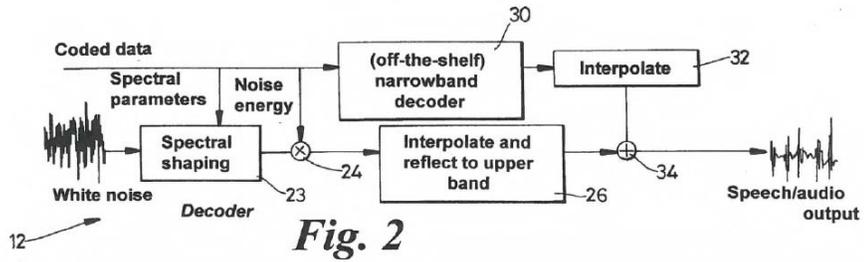
Fig. 1

Tucker teaches that the low frequency range is lower than the high frequency range because Tucker teaches that the lower band could encode a 0-4 kHz range and the high band can encode a 4-8 kHz range. Ex. 1004 (Tucker) at 13:11-14 (referring to an “existing narrowband (4 kHz) coder” in the low band); *id.* at 15:10-11 (teaching that one could “improve the quality” of this existing 0-4 kHz coder “by extending the input bandwidth” to “the 4-8 kHz region” using “the wideband extension” taught in Tucker).

	<p>Ex. 1002 (Quackenbush) ¶¶ 130-31.</p>
<p>a first coder for deriving a first coded signal within the first frequency range from the low frequency signal, and</p>	<p>Tucker teaches “a first coder for deriving a first coded signal within a first frequency range from the low frequency signal.”</p> <p>After the low-frequency signal has been generated by the splitter using the low-pass filter, a first coder derives a first coded signal by (1) decimating (or downsampling) the signal; and (2) applying an “off-the-shelf” “narrowband encoder” to the signal. Ex. 1002 (Quackenbush) ¶¶ 132-33.</p> <p>Ex. 1004 (Tucker) at 13:20-22 (noting that the signal is “decimated” (or downsampled) after it is “low pass filtered to form a lower-sub-band signal”); at 14:5-6 (“[t]he lower sub-band signal is supplied to a narrowband encoder 18”); <i>id.</i> at 4:28-5:1 (noting that the narrowband encoder “for the lower band” can be an “off-the-shelf component”); <i>id.</i> at 14:5-7 (noting that the “narrowband encoder 18” shown in Figure 1 below “may be a vocoder or a waveband encoder”); <i>id.</i> at Fig. 1 (showing that the low-pass filtered (low frequency) signal is decimated at 14 and then applied to the off-the-shelf narrowband encoder at 18).</p> <p>Fig. 1</p> <p>Ex. 1002 (Quackenbush) ¶¶ 132-33.</p>
<p>a second coder for deriving a second coded signal within the high frequency range</p>	<p>Tucker also teaches a “second coder for deriving a second coded signal within the high frequency range from the high frequency signal.” Ex. 1004 (Tucker) at 6:10-13 (teaching “upper sub-band coding means for encoding at least the non-</p>

<p>from the high frequency signal</p>	<p>periodic component of [the] upper sub-band signal according to a source-filter model”).</p> <p>The upper sub-band coding means (“second coder”) employs two primary components, including an “upper-sub band analyser 20” and a “Rice coder.” <i>See</i> Ex. 1004 (Tucker) at 14:5-21; <i>id.</i> at Fig. 1 (highlighting the components of the second coder)</p>  <p style="text-align: center;">Fig. 1</p> <p><i>See also</i> Ex. 1004 (Tucker) at 7:10-15 (noting that these two components generate and transmit representations of (1) “an upper sub-band energy or gain value”; and (2) “one or more upper sub-band spectral parameters,” which “preferably comprise second order LPC coefficients”)</p> <p>The second coder derives its coding from the high frequency signal. <i>See</i> Ex. 1004 (Tucker) at Fig. 1 (showing interconnection between the “high pass filter” and the “spectral & noise” analysis used to generate the parameters that are coded by the rice coder); <i>id.</i> at 14:5-10 (referring to the “spectral & noise analys[er]” as an “upper sub-band analyser” that “<i>analyses the spectrum of the upper sub-band to determine parametric coefficients and its noise component</i>” (emphasis added).</p> <p>Ex. 1002 (Quackenbush) ¶¶ 134-37.</p>
<p>a receiver in electrical communication with said transmitter to</p>	<p>Tucker teaches a receiver (labeled 12 and shown in Figure 2 below) that is in electrical communication with the transmitter of Figure 1.</p>

receive the first coded signal and the second coded signal, said receiver including



In the context of Tucker’s primary embodiment, the person of ordinary skill would understand that the decoder of Figure 2 is the receiver that receives coded data from this transmitter. *See* Ex. 1004 (Tucker) at 6:26-7:2 (noting that “it is preferred for the decoder means to comprise lower sub-band decoding means and upper sub-band decoding means, for *receiving* and decoding the encoded lower and upper sub-band signals respectively” (emphasis added)); 13:18-19 (“Figures 1 and 2 illustrate an encoder 10 and decoder 12 respectively for a first embodiment of the codec.”); *see also* 6:13-16, 9:21-10:2.

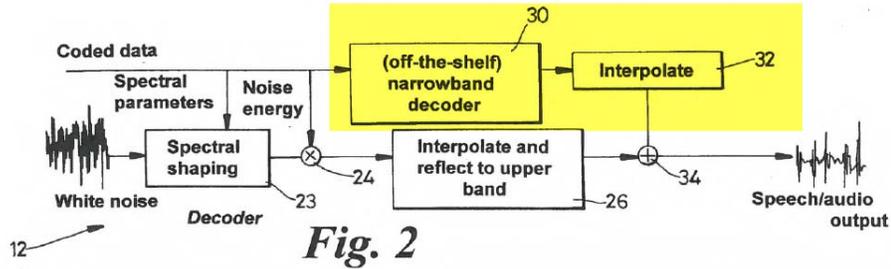
The POSA would also understand that there is an electrical interconnection between the transmitter and receiver so that the receiver may receive both the first and second coded signal based on the above disclosures and figures 1 and 2 of Tucker. *See* Ex. 1004 (Tucker) at Figs. 1, 2 (showing that identical “[c]oded data” from the transmitter/coder exits figure 1 and then enters the decoder/receiver of figure 2).

Ex. 1002 (Quackenbush) ¶¶ 138-39.

a first decoder for sequentially applying a narrow-band decoder, an up-sampler and a low-pass filter to the first coded signal to generate a first reconstructed signal within the

Tucker’s receiver 12 contains a first decoder that forms a first reconstructed signal within the first frequency range (the low band) based on the first coded signal. This “first decoder” reconstructs the signal in the low band by applying multiple signal processing elements to the first coded signal: an “off-the shelf” narrowband decoder followed by an interpolator as shown in the highlighted portion of Figure 2.

first frequency range, and



See Ex. 1004 (Tucker) at 14:23-26 (noting that the “encoded data representing the lower sub-band signal passes to a narrowband decoder 30 which decodes the lower sub-band signal which is [then] interpolated at 32”); *id.* at 14:25-27 (the decoded signal “is interpolated at 32 and then recombined at 34” (see Figure 2 below) “to form the synthesized” (or reconstructed) “output signal”); *id.* at Fig. 2 (showing that the interpolated low-band signal is applied to the adder 34 before the receiver generates “[s]peech/audio output”)

This sequence of a narrow-band decoder followed by an interpolator would be understood by the POSA to teach sequential application of a narrow-band decoder, an up-sampler, and a low-pass filter to the first coded signal to generate the first reconstructed signal in the low band. Ex. 1002 (Quackenbush) ¶¶ 140-43. This is because Tucker teaches (and the POSA would understand) that an interpolator sequentially applies an up-sampler and a low-pass filter to a signal. Ex. 1002 (Quackenbush) ¶¶ 54-55. It was well-known in the art as of the priority date that an interpolator comprises an up-sampler followed by a low-pass filter. *Id.* ¶¶ 55.

Beyond the POSA’s understanding, Tucker itself teaches that an “interpolator” sequentially applies an up-sampler and a low pass filter via the Rabiner textbook, which as noted above is incorporated by reference into Tucker. Ex. 1005 (Rabiner & Schafer (1978)) at 30 (diagram below showing that interpolation involves upsampling (increasing the sampling rate) followed by lowpass filtering); Ex. 1002 (Quackenbush) ¶ 142 & n.7.

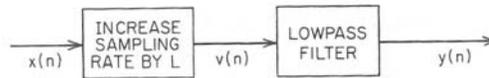


Fig. 2.12 Block diagram representation of interpolation.

Given the above teachings the POSA would understand that the low band encoder of Tucker sequentially applies the narrow-band decoder, up-sampler and low-pass filter to the low band signal to generate the first (low-band) reconstructed signal. Ex. 1002 (Quackenbush) ¶¶ 141-43.

a second decoder, wherein, based on the second coded signal, said second decoder sequentially applies a high-pass filter, a LPC synthesis filter and an amplifier to a noise signal to generate the second reconstructed signal.

Tucker teaches a “second decoder” or high band decoder that sequentially applies each of a high pass filter, an LPC synthesis filter, and an amplifier to a noise signal. The components of Tucker’s “second” (or high band) decoder are highlighted in yellow below.

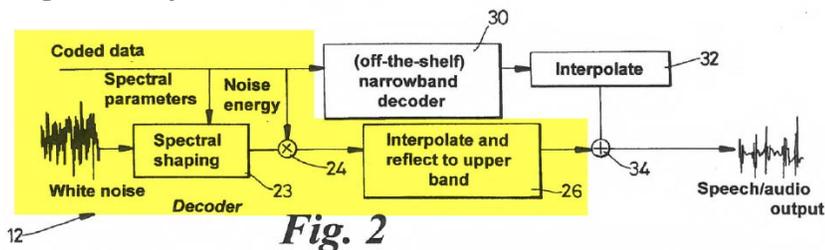
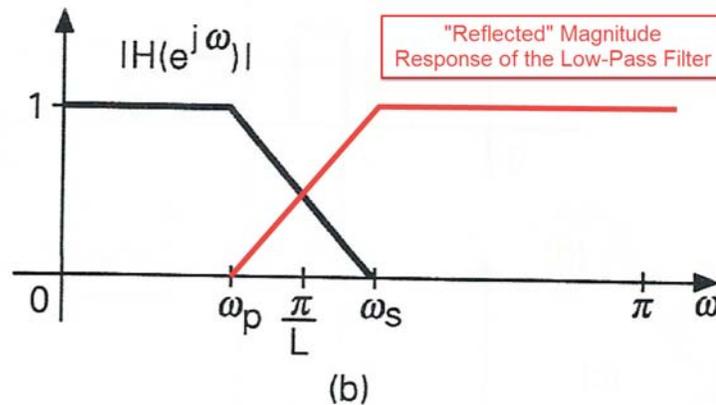


Fig. 2

The figure above confirms that, in Tucker’s “second decoder,” a “spectral shaping filter” 23, gain multiplier 24, and a processor 26 are applied in sequence to a white noise signal. The POSA would understand that this is a teaching that a high-pass filter, LPC synthesis filter, and an amplifier are applied sequentially to a noise signal based on the construction of “sequentially” recited above. *See supra* Section VII.A.; Ex. 1002 (Quackenbush) ¶¶ 117-19, 144-55.

First, Tucker’s disclosure of a “processor 26” confirms that a “high pass filter” is among the components sequentially applied to the white noise signal. This processor interpolates (upsamples) the signal and “reflect[s]” the signal to the “upper band,” as shown in Figure 2. The POSA would understand that the teaching of “reflecting to the upper band” is a teaching that one should apply a “reflected” low pass filter (i.e., a high

pass filter) to the signal, as illustrated below.⁴ Ex. 1002 (Quackenbush) ¶¶ 150-52.



Second, Tucker’s disclosure of a “spectral shaping” filter 23 confirms that an LPC synthesis filter is among the components “sequentially applied” to the noise signal. The “all pole filter” or “spectral shaping” filter (labeled 23) would be understood to be an LPC synthesis filter as that term is understood in the context of the ’114 patent because LPC synthesis filters are “controlled by,” for example “LPC parameters.” Ex. 1002 (Quackenbush) ¶ 148; Ex. 1001 at 2:3-4; *id.* at 5:34-39. Tucker’s “spectral shaping” filter is controlled by “LPC coefficients” that are “applied to” the filter. Ex. 1004 (Tucker) at 14:16-18, 15:13-18; *see also id.* at 7:13-15. And the filter is an LPC *synthesis* filter because it is used “to produce a *synthesized* non-harmonic upper sub-band signal.” Ex. 1004 (Tucker) at 14:18-21.

⁴ Though interpolation typically involves application of a low pass filter to a signal, a “reflected” low pass filter is understood in the art to be a high pass filter. Ex. 1002 (Quackenbush) ¶¶ 150-51. Thus, the “interpolation” procedure invoked by the processor 26 in Tucker would be understood to apply a high pass filter to the signal. *Id.*

Third, Tucker’s teaching of a gain multiplier 24 confirms that an amplifier is among the components “sequentially applied” to the noise signal. Tucker teaches that the high band decoder “adjust[s]” the gain of the signal “in accordance with the noise energy value at 24.” Ex. 1004 (Tucker) at 14:20-21. Component 24 would be understood by the POSA to be a gain multiplier—or, equivalently, an amplifier. Ex. 1002 (Quackenbush) ¶ 149; Ex. 1025 (Vaidyanathan) at 1 (symbolically equating gain parameter with an amplifier).

Given the above teachings, Tucker teaches that a high pass filter, an LPC synthesis filter, and an amplifier are applied sequentially to a white noise signal. *See supra* Section VII.A. These components are applied to the noise signal one at a time to generate “a second reconstructed signal” (i.e., a decoded signal in the high band), as confirmed by Figure 2 and the other teachings of Tucker. Ex. 1002 (Quackenbush) ¶¶ 144-54. Ex. 1004 (Tucker) at Fig. 2, 14:21-23, 14:26-27.

The reconstructed signal derived from the components discussed above is based on the second coded signal. The second coded, signal, as noted above, comprised “spectral parameters” and “noise energy,” and these parameters are used within the spectral shaping filter 23 (or LPC synthesis filter) and multiplier 24 (or amplifier) of the high band decoder that are each applied in sequence to the white noise excitation. *See* Ex. 1004 (Tucker) at 14:16-18 (explaining that “the spectral parameters are obtained from the coded data *and applied to [the] spectral shape filter 23*” (emphasis added)); *id.* at 14:18-21 (noting that the signal’s “*gain is adjusted in accordance with the noise energy value at 24*” (emphasis added)).

The second decoder forms a reconstructed signal within the second frequency range (i.e., the high band). *See* Ex. 1004 (Tucker) at 14:21-23 (noting that the “synthesized” or reconstructed signal “passes to a processor 26 which interpolates the signal and reflects it to the upper sub-band”).

	Ex. 1002 (Quackenbush) ¶ 155.
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2. Claim 11

Claim 11 depends from claim 10, which is anticipated by Tucker for the reasons described above. *See supra* Section VII.A.1. Claim 11 adds a limitation requiring that the “first coder sequentially applies a downsampler and a narrow-band coder to generate the first coded signal.” As shown in the claim chart below, the “first coder” of Tucker sequentially “decimates” (or downsamples) and applies a generic narrowband coder to the low band signal.

Claim 11	<i>Tucker</i>
<p>11. The transmission system of claim 10, wherein said first coder sequentially applies a downsampler and a narrow-band coder to generate the first coded signal</p>	<p>Tucker also discloses a system wherein the first coder sequentially applies a downsampler and a narrowband coder to the lower sub-band signal.</p> <p>The two components of the first coder, as noted above, include a “decimator” or downsampler, followed by an off-the-shelf narrowband encoder (Ex. 1002 (Quackenbush) ¶¶ 132-33); Ex. 1004 (Tucker) at 13:20-22 (noting that the signal is “decimated” (or downsampled) after it is “low pass filtered to form a lower-sub-band signal”); at 14:5-6 (“[t]he lower sub-band signal is supplied to a narrowband encoder 18”); <i>id.</i> at Fig. 1 (highlighting components of the “first coder” and showing that the low-pass filtered (low frequency) signal is decimated at 14 and then applied to the off-the-shelf narrowband encoder at 18).</p>

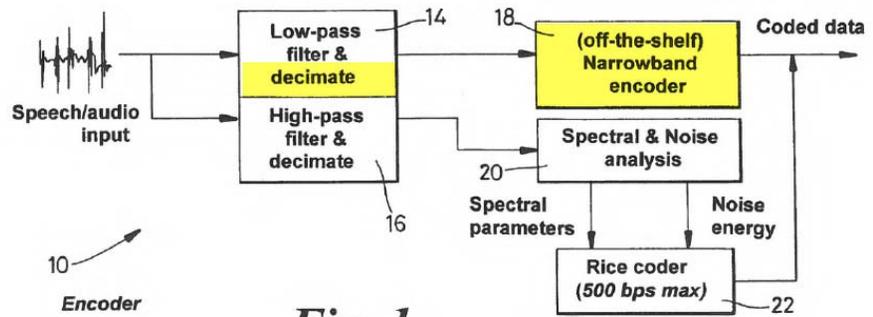


Fig. 1

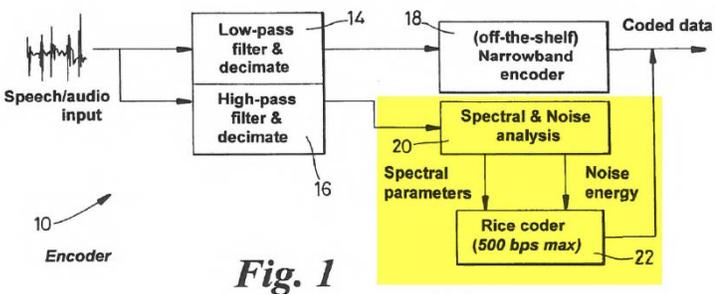
The POSA would have understood that the “decimate” operation described in Tucker was equivalent to a downsampling operation—both refer to processes that reduce the sampling rate of a signal. Ex. 1002 (Quackenbush) ¶ 157 (citing Ex. 1005 (Rabiner & Schafer 1978) at 26-27; Ex 1025 (Vaidyanathan 1993) at 100-01 (“Only those samples . . . which occur at time equal to multiples of M are retained by the decimator The decimator is also called a *downsampler*, *subsampler*, *sampling rate compressor*, or merely a *compressor*.”)).

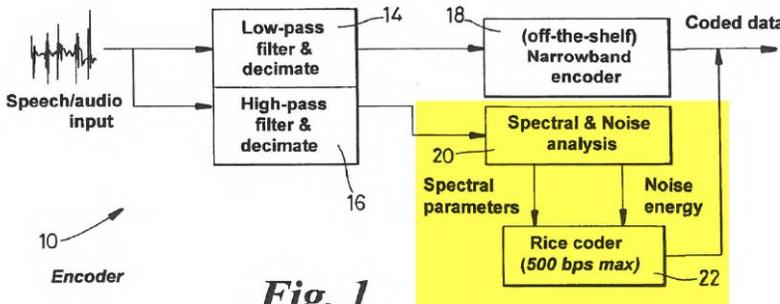
Given these teachings, Tucker’s “first coder” sequentially applies a downsampler and a narrowband coder to generate the first coded signal.

Ex. 1002 (Quackenbush) ¶¶ 156-57.

3. Claim 12

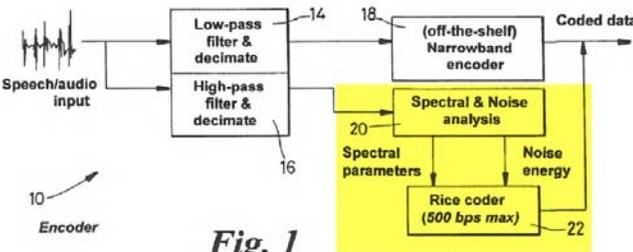
Claim 12 depends from claim 10, which is anticipated by Tucker for the reasons described above. *See supra* Section VIII.A. Claim 12 adds several limitations regarding the “second” (high band) coder that are also disclosed by Tucker as shown in the chart below.

Claim 12	Tucker
<p>12. The transmission system of claim 10, wherein said second coder measures a signal strength of the high frequency signal to generate an amplification code</p>	<p>The “second coder” measures a signal strength of the high frequency signal to generate an amplification code as part of its “spectral & noise analysis” because this analysis “measures the noise energy” of the upper band signal to generate gain parameters that are applied at the receiver.</p>  <p style="text-align: center;">Fig. 1</p> <p>Tucker measures the “noise energy” of the signal in the upper sub-band, which would be understood to be equivalent to measuring a signal’s strength. Ex. 1002 (Quackenbush) ¶¶ 161; Ex. 1004 (Tucker) at 7:16-19 (noting that “noise energy” is measured by an “upper sub-band” analyzer and that this component “<i>measur[es] the noise energy in [the] upper sub-band . . . to deduce said upper sub-band energy or gain value</i>” (emphasis added); <i>see id.</i> at 14:7-10 (noting that the “upper sub-band analyser 20 . . . analyses the spectrum of the upper sub-band to determine parametric coefficients and <i>its noise component</i>”).</p> <p>The “noise energy” measurement is used to generate an amplification code. <i>See</i> Ex. 1004 (Tucker) at 7:16-19, 12:19-23 (noting that the “upper band” encodes “an energy parameter” (also referred to as a “noise energy” parameter in Tucker’s Figure 1 and other disclosures); <i>see also id.</i> at 15:21-16:3.</p> <p>Fig. 1 (above) confirms that a “noise analysis” is performed on the high band signal and that this generates “noise energy” parameters.</p>

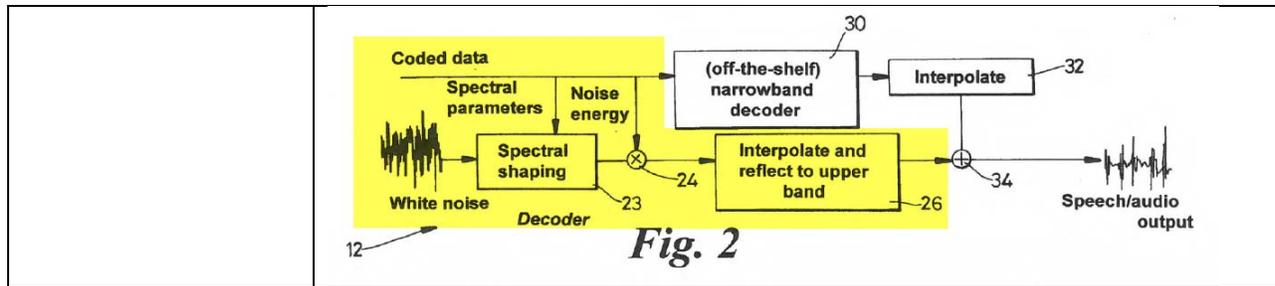
<p>wherein said second coder determines prediction coefficients based on the high frequency signal; and</p>	<p>Ex. 1002 (Quackenbush) ¶¶ 159-61.</p> <p>The “second coder” of Tucker determines prediction coefficients based on the high frequency signal using its “spectral & noise analysis” (or “upper sub-band analyser”). Ex. 1004 (Tucker) at 14:7-9 (noting that the encoder measures “spectral parameters” to “determine parametric coefficients”); <i>id</i> at 15:12-18 (noting that the “spectral analysis derives two LPC coefficients using the standard autocorrelation method,” and these “LPC coefficients are converted into reflection coefficients”).</p> <p>The person of ordinary skill would understand that the LPC coefficients are “prediction coefficients” within the scope of the ’114 patent based on common understandings in the art. Ex. 1002 (Quackenbush) ¶ 162. Indeed, the ’114 patent itself notes that an “LPC coder” “determines . . . prediction coefficients.” Ex. 1001 at 2:61-63 (emphasis added). Ex. 1002 (Quackenbush) ¶ 162.</p>
<p>wherein the second coded signal codes the amplification code and the prediction coefficients as components of the second coded signal</p>	<p>The second coder codes the amplification code (“noise energy” in the figure below) and the prediction coefficients (LPC codes or “spectral parameters” in the figure below) as components of the second coded signal. The figure below confirms that these components are coded as components of the second coded signal using a “Rice coder.” Ex. 1004 (Tucker) at 14:11-15 (“The spectral parameters and the log of the noise energy value are quantised, subtracted from their previous values (i.e. differentially encoded) and supplied to a Rice coder 22 for coding.”)</p>  <p style="text-align: center;">Fig. 1</p> <p>Ex. 1002 (Quackenbush) ¶ 163.</p>

4. Claim 13

Claim 13 depends from claim 10, which is anticipated by Tucker for the reasons described above. *See supra* Section VIII.A.1. It recites additional limitations that require the second coder to (1) measure a signal strength of the high frequency signal to generate an amplification code; (2) code the amplification code as a component of the second coded signal; and (3) use the amplification code to set the amplifier in the high band decoder. Each of these limitations is also taught by Tucker.

Claim 13	<i>Tucker</i>
<p>13. The transmission system of claim 10, wherein said second coder measures a signal strength of the high frequency signal to generate an amplification code</p>	<p>The “second coder” measures a signal strength of the high frequency signal to generate an amplification code as part of its “spectral & noise analysis” because this analysis “measures the noise energy” of the upper band signal to generate gain parameters that are applied at the receiver. <i>See supra</i> Section VIII.A.3 (claim 12 discussion of same limitation); Ex. 1002 (Quackenbush) ¶¶ 159-61.</p> <p>Tucker’s measurement of the “noise energy,” as noted above, would be understood as equivalent to a measurement of the signal strength of the high band signal. Ex. 1002 (Quackenbush) ¶¶ 165-66; Ex. 1004 (Tucker) at 7:16-19, 14:7-10.</p>  <p style="text-align: center;"><i>Fig. 1</i></p>

	<p>The “noise energy” measurement is used to generate an amplification code, as noted above. Ex. 1004 (Tucker) at 7:16-19, 12:19-23 (noting that the “upper band” encodes “an energy parameter” (also referred to as a “noise energy” parameter in Tucker’s Figure 1 and other disclosures); <i>see also id.</i> at 15:21-16:3.</p> <p>Ex. 1002 (Quackenbush) ¶¶ 164-66.</p>
<p>wherein said second coder codes the amplification code as one component of the second coded signal; and</p>	<p>The “second coder” of Tucker codes the amplification code (“noise energy”) as one component of its coded signal in the high band. Ex. 1004 (Tucker) at 7:16-19, 12:19-23 (noting that the “upper band” encodes “an energy parameter” (also referred to as a “noise energy” parameter in Tucker’s Figure 1 and other disclosures); <i>id.</i> at 14:11-15 (“The spectral parameters and the log of the noise energy value are quantized, subtracted from their previous values (i.e. differentially encoded) and supplied to a Rice coder 22 for coding.”); <i>see also id.</i> at 15:21-16:3.</p> <p><i>See also</i> Fig. 1 (showing “noise energy” being fed as one component of the signal coded by the Rice coder, which outputs the “coded data” for the second coder).</p> <p>Ex. 1002 (Quackenbush) ¶¶ 163, 165.</p>
<p>wherein said second decoder uses the amplification code to set said amplifier</p>	<p>The second, high band decoder of Tucker uses the amplification code (“noise energy”) to set its amplifier.</p> <p>Tucker’s amplifier—shown as a multiplier 24 in Figure 2 below—“adjusts the gain” of the signal “<i>in accordance with the noise energy value.</i>” Ex. 1004 (Tucker) at 14:20-21 (emphasis added); <i>see also</i> Fig. 2 (showing that “[n]oise energy” is an input to the amplifier 23). Thus, the measured “noise energy” (or amplification code) is used to “set” the amplifier. Ex. 1002 (Quackenbush) ¶ 166.</p>



5. Claim 14

Claim 14 depends from claim 10, which is anticipated by Tucker for the reasons described above. *See supra* Section VIII.A.1. It recites limitations that require the second coder to (1) determine prediction coefficients based on the high frequency signal; (2) code the prediction coefficients as a component of the second coded signal; and (3) use the prediction codes to control the LPC synthesis filter. Each of these limitations is again taught by Tucker.

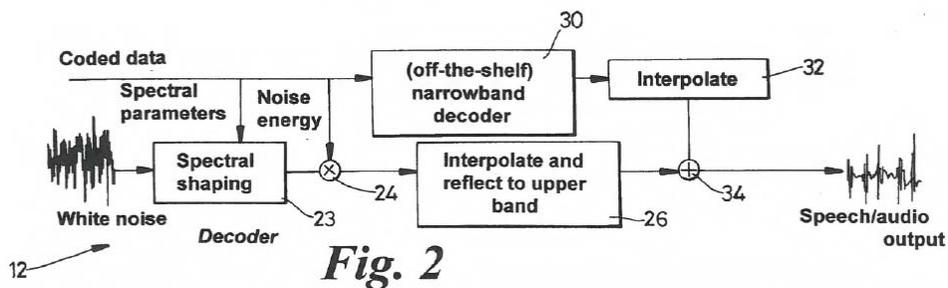
Claim 14	<i>Tucker</i>
<p>14. The transmission system of claim 10, wherein said second coder determines prediction coefficients based on the high frequency signal;</p>	<p>As noted above, the “second coder” of Tucker determines prediction coefficients (“LPC coefficients”) based on the high frequency signal using its “spectral & noise analysis” (or “upper sub-band analyser”). <i>See supra</i> Section VIII.A.3 (second limitation of claim 12). Ex. 1004 (Tucker) at 14:7-9, 15:12-18.</p> <p>The person of ordinary skill would understand that the LPC coefficients are “prediction coefficients” within the scope of the ’114 patent based on common understandings in the art. Ex. 1002 (Quackenbush) ¶ 162. Indeed, the ’114 patent itself notes that an “LPC coder” “determines . . . prediction coefficients.” Ex. 1001 at 2:61-63 (emphasis added).</p> <p>Ex. 1002 (Quackenbush) ¶¶ 167-69.</p>

<p>wherein said second coder codes the prediction coefficients as one component of the second coded signal; and</p>	<p>The “second coder” of Tucker codes the prediction coefficients (“spectral parameters”) as one component of its coded signal in the high band. Ex. 1004 (Tucker) at 14:11-15 (“The spectral parameters and the log of the noise energy value are quantized, subtracted from their previous values (i.e. differentially encoded) and supplied to a Rice coder 22 for coding.”); <i>see also id.</i> at 15:21-16:3.</p> <p><i>See also</i> Fig. 1 (showing “spectral parameters” being fed as one component of the signal coded by the Rice coder, which outputs the “coded data” for the second coder).</p> <p>Ex. 1002 (Quackenbush) ¶¶ 163, 168.</p>
<p>wherein said second decoder uses the prediction coefficients to control said LPC synthesis filter</p>	<p>Tucker’s second decoder uses the prediction coefficients (“spectral parameters”) to control its LPC synthesis filter (“spectral shaping filter).</p> <p>Figure 2 confirms that “spectral parameters”—including LPC coefficients—are applied to the “spectral shaping” filter in the high band. Ex. 1004 (Tucker) at 14:16-18 (emphasis added). Ex. 1002 (Quackenbush) ¶ 169. It is understood that the “spectral shaping” filter taught in Tucker is equivalent to an LPC synthesis filter discussed above. Ex. 1002 (Quackenbush) ¶ 148.</p> <div data-bbox="511 1270 1339 1522" data-label="Diagram"> <p style="text-align: center;">Fig. 2</p> </div>

6. Claim 15

Claim 15 depends from claim 10, which is anticipated by Tucker for the reasons described above. *See supra* Section VIII.A.1. It adds the limitation of “a

combiner for combining the first reconstructed signal and the second reconstructed signal.” Tucker teaches this limitation because it teaches an adder 34 that “recombine[s]” the decoded low and high band signals to generate the “[s]peech/audio output” shown in Figure 2 below. Ex. 1002 (Quackenbush) ¶¶ 170-71.



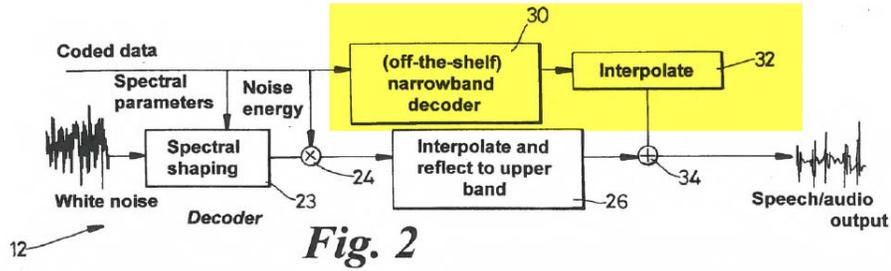
7. Independent Claim 20

Independent Claim 20 is a receiver-only claim. The preamble, first decoder limitation, and second decoder limitation of this claim are identical to the receiver limitations of independent claim 10 discussed above. Ex. 1002 (Quackenbush) ¶ 102. These limitations are thus anticipated for the same reasons given above with respect to claim 10. *See supra* Section VIII.A.1 (receiver limitations); Ex. 1002 (Quackenbush) ¶¶ 138-55. Claim 20 also contains a limitation requiring “a combiner for combining the first reconstructed signal and the second reconstructed signal.” Tucker discloses such a combiner (or adder) in its receiver, as described in the discussion of claim 15 above. *See supra* Section VIII.A.6.; Ex. 1002 (Quackenbush) ¶¶ 170-71. The collective limitations of claim 20 are

therefore anticipated for those reasons and for the reasons given in the claim chart below. Ex. 1002 (Quackenbush) ¶¶ 138-55, 172-73.

Claim 20	<i>Tucker</i>
<p>20. (preamble) A receiver, comprising</p>	<p>To the extent the preamble is limiting, Tucker teaches a receiver (labeled 12 and shown in Figure 2 below) that is in electrical communication with the transmitter of Figure 1.</p> <p style="text-align: center;">Fig. 2</p> <p>In the context of Tucker’s primary embodiment, the person of ordinary skill would understand that the decoder of Figure 2 is the receiver that receives coded data from this transmitter. <i>See</i> Ex. 1004 (Tucker) at 6:26-7:2 (noting that “it is preferred for the decoder means to comprise lower sub-band decoding means and upper sub-band decoding means, for <i>receiving</i> and decoding the encoded lower and upper sub-band signals respectively” (emphasis added)); 13:18-19 (“Figures 1 and 2 illustrate an encoder 10 and decoder 12 respectively for a first embodiment of the codec.”); <i>see also</i> 6:13-16, 9:21-10:2.</p> <p>Ex. 1002 (Quackenbush) ¶¶ 138-39.</p>
<p>a first decoder receiving a first coded signal with a low frequency range, said first decoder for sequentially applying a narrow-band decoder, an up-</p>	<p>Tucker’s receiver 12 contains a first decoder that forms a first reconstructed signal within the first frequency range (the low band) based on the first coded signal. This “first decoder” reconstructs the signal in the low band by applying two processing elements to the first coded signal: an “off-the-shelf” narrowband decoder followed by an interpolator as shown in the highlighted portion of Figure 2.</p>

sampler and a low-pass filter to the first coded signal to generate a first reconstructed signal within the first frequency range, and



See Ex. 1004 (Tucker) at 14:23-26 (noting that the “encoded data representing the lower sub-band signal passes to a narrowband decoder 30 which decodes the lower sub-band signal which is [then] interpolated at 32”); *id.* at 14:25-27 (the decoded signal “is interpolated at 32 and then recombined at 34” (see Figure 2 below) “to form the synthesized” (or reconstructed) “output signal”); *id.* at Fig. 2 (showing that the interpolated low-band signal is applied to the adder 34 before the receiver generates “[s]peech/audio output”).

This disclosure of a narrow-band decoder followed by an interpolator would be understood by the POSA to teach sequential application of a narrow-band decoder, an up-sampler, and a low-pass filter to the first coded signal to generate the first reconstructed signal in the low band. This is because the POSA would understand, as discussed above, that an interpolator applies an up-sampler followed by a low-pass filter to a signal (the components are applied one at a time). Ex. 1002 (Quackenbush) ¶¶ 140-43.

Tucker expressly teaches that an “interpolator” sequentially applies an up-sampler and a low pass filter via the Rabiner textbook, which as noted above is incorporated by reference into Tucker. Ex. 1005 (Rabiner & Schafer 1978) at 30 (diagram below showing that interpolation involves upsampling (increasing the sampling rate) followed by lowpass filtering); Ex. 1002 (Quackenbush) ¶¶ 142-43.

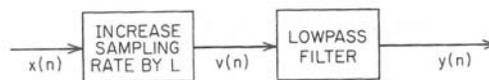


Fig. 2.12 Block diagram representation of interpolation.

Apart from Rabiner’s teachings, the POSA would generally understand that Tucker’s teaching of an interpolator teaches an upsampler followed by a low-pass filter. Ex. 1002 (Quackenbush) ¶¶ 54-55, 142-43.

Given the above teachings the POSA would understand that the low band encoder of Tucker sequentially applies the narrow-band decoder, up-sampler and low-pass filter to the low band signal to generate the first (low-band) reconstructed signal. Ex. 1002 (Quackenbush) ¶¶ 140-43, 172-73.

a second decoder, wherein, based on the second coded signal, said second decoder sequentially applies a high-pass filter, a LPC synthesis filter and an amplifier to a noise signal to generate the second reconstructed signal.

Tucker teaches a “second decoder” or high band decoder that sequentially applies each of a high pass filter, an LPC synthesis filter, and an amplifier to a noise signal. The components of Tucker’s “second” (or high band) decoder are highlighted in yellow below.

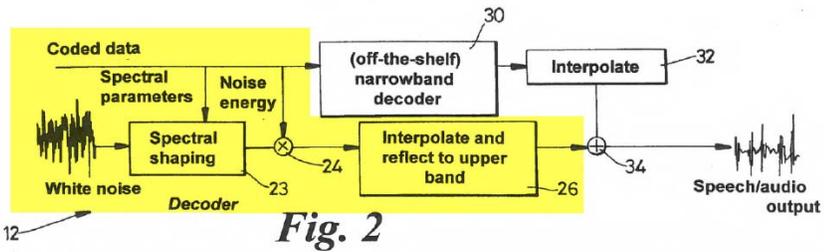
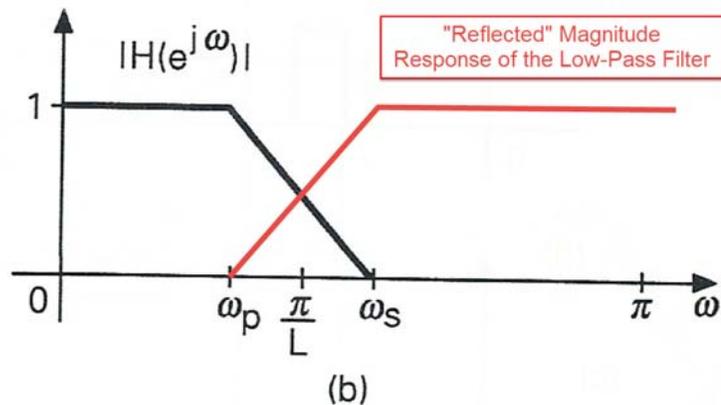


Fig. 2

The figure above confirms that, in Tucker’s “second decoder,” a “spectral shaping filter” 23, gain multiplier 24, and a processor 26 are applied sequentially to a white noise signal. See supra Section VII.A. The POSA would understand that this is a teaching that a high-pass filter, LPC synthesis filter, and an amplifier are applied sequentially to a noise signal. Ex. 1002 (Quackenbush) ¶¶ 144-55.

First, Tucker’s disclosure of a “processor 26” confirms that a “high pass filter” is among the components sequentially applied to the white noise signal. This processor interpolates (upsamples) the signal and “reflect[s]” the signal to the “upper band,” as shown in Figure 2. The POSA would understand that the teaching of “reflecting to the upper band” is a teaching that one should apply a “reflected” low pass filter (i.e., a high pass filter) to the signal, as illustrated below. Ex. 1002 (Quackenbush) ¶¶ 150-52; supra, footnote 4.



Second, Tucker’s disclosure of a “spectral shaping” filter 23 confirms that an LPC synthesis filter is among the components “sequentially applied” to the noise signal. The “all pole filter” or “spectral shaping” filter (labeled 23) would be understood to be an LPC synthesis filter as that term is understood in the context of the ’114 patent because LPC synthesis filters are “controlled by,” for example “LPC parameters.” Ex. 1002 (Quackenbush) ¶¶ 148; Ex. 1001 at 2:3-4; *id.* at 5:34-39. Tucker’s “spectral shaping” filter is controlled by “LPC coefficients” that are “applied to” the filter. Ex. 1004 (Tucker) at 14:16-18, 15:13-18; *see also id.* at 7:13-15. And the filter is an LPC *synthesis* filter because it is used “to produce a *synthesized* non-harmonic upper sub-band signal.” Ex. 1004 (Tucker) at 14:18-21.

Third, Tucker’s teaching of a gain multiplier 24 confirms that an amplifier is among the components “sequentially applied” to the noise signal. Tucker teaches that the high band decoder “adjust[s]” the gain of the signal “in accordance with the noise energy value at 24.” Ex. 1004 (Tucker) at 14:20-21. Component 24 would be understood by the POSA to be a gain multiplier—or, equivalently, an amplifier. Ex. 1002 (Quackenbush) ¶ 149; Ex. 1025 (Vaidyanathan) at 1.

Given the above teachings, Tucker teaches that a high pass filter, an LPC synthesis filter, and an amplifier are sequentially applied to a white noise signal. *See supra* Section VII.A. These components are applied to the noise signal one

	<p>at a time to generate “a second reconstructed signal” (i.e., a decoded signal in the high band), as confirmed by Figure 2 and the other teachings of Tucker. Ex. 1004 (Tucker) at Fig. 2, 14:21-23, 14:26-27.</p> <p>The reconstructed signal derived from the components discussed above is based on the second coded signal. The second coded, signal, as noted above, comprised “spectral parameters” and “noise energy,” and these parameters are used within the spectral shaping filter 23 (or LPC synthesis filter) and multiplier 24 (or amplifier) of the high band decoder that are applied sequentially to the white noise excitation. See Ex. 1004 (Tucker) at 14:16-18 (explaining that “the spectral parameters are obtained from the coded data <i>and applied to [the] spectral shape filter 23</i>” (emphasis added)); <i>id.</i> at 14:18-21 (noting that the signal’s “<i>gain is adjusted in accordance with the noise energy value at 24</i>” (emphasis added)).</p> <p>The second decoder forms a reconstructed signal within the second frequency range (i.e., the high band). See Ex. 1004 (Tucker) at 14:18-21 (noting that the “synthesized” or reconstructed signal “passes to a processor 26 which interpolates the signal and reflects it to the upper sub-band”).</p> <p>Ex. 1002 (Quackenbush) ¶ 155.</p>
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B. Ground 2: Claims 10-16 and 20-21 Are Obvious Over Tucker in View of the Well-Known Art

As explained below, the person of ordinary skill would have, at minimum, found each and every limitation of claims 10-16 and 20-21 of the ’114 patent to have been obvious over Tucker in view of the knowledge of the person of ordinary skill.

1. Claims 10-15 and 20

As discussed above, both of independent claims 10 and 20 have a limitation requiring that the “second decoder sequentially applies a high-pass filter, a LPC synthesis filter and an amplifier to a noise signal to generate the second reconstructed signal.” In its infringement contentions in the co-pending district court litigation, Philips suggested that this limitation is met not literally but under the doctrine of equivalents. Discussing an accused product in which Philips recognized that it had no basis to argue that there was a decoder having the recited elements in the recited order, Philips asserted that elements in a *different* order would “perform[] substantially the same function (decoding a second coded signal within a high frequency range that is higher the low frequency range) in substantially the same way (applying a high-pass filter, a LPC synthesis filter, and an amplifier to a noise signal) to yield substantially the same result (generating a second reconstructed signal within the high frequency range).” Ex. 1040 (Philips Infringement Contentions) at 16-17 (Appendix I pp. 6-7) (emphases added).

That recited ordering is not the ordering discussed in Tucker, which discloses that its LPC synthesis filter (“spectral shaping filter” 23) is applied to the noise signal first, followed by its amplifier (“multiplier” 24), followed by its high pass filter (“reflect to the high band” operation performed by the “processor” 26). Thus, if the “sequentially applies” claim language of claim 5 required a

particular ordering—*i.e.*, that the high pass filter, LPC synthesis filter, and amplifier be applied to the noise signal in precisely the recited order in the claim (as opposed to being applied sequentially, but not necessarily in the recited order), Tucker does not expressly disclose the claim limitation.

If the order matters, however, the claims would still have been obvious. As the POSA would have understood, the precise order that the decoder applies these three components to the noise signal does not affect the output of the transmission system. Ex. 1002 (Quackenbush) ¶¶ 119, 177. Philips alleges in connection with its equivalence contentions that “the order in which the high-pass filter, LPC synthesis filter, and amplifier are applied is *insubstantial*” and different orderings of these components from the ordering of claim 5 are “*equivalent to*” that ordering. Ex. 1040 (I Philips Infringement Contentions) at 16-17 (Appendix I pp. 6-7) (emphases added). The mere rearrangement of an “insubstantial” ordering of recited components into an allegedly “equivalent” ordering cannot possibly be a basis for patentability. Philips’ admission is further underscored by the fact that nothing in the ’114 patent’s specification suggests that there is any particular benefit or advantage to the ordering of components claimed in the ’114 patent. As discussed above, the addition of the “sequential application” limitations was not part of the original claim language of the ’114 patent and was added simply in an effort to overcome rejections. *See supra* Section V.C.

(prosecution history). The word “sequential” does not even appear in the patent’s written description.

Dr. Quackenbush confirms that the ordering of the high pass filter, LPC synthesis filter, and amplifier is inconsequential to patentability. As he explained, each of these three components would have been understood by the POSA to have been components of linear time-invariant systems, also known as linear shift-invariant since they process sampled digital sequences. Ex. 1002 (Quackenbush) ¶ 119, 177. Therefore, the application of the components to a noise signal produces the same result regardless of their ordering. *Id.* Thus, a POSA would understand that the order of Tucker’s application of spectral shaping, gain adjustment, and high pass filter to the noise signal is not material to the output that is ultimately produced by the high band decoder. *Id.* For this reason, Tucker’s disclosure renders the limitation obvious. *KSR v. Teleflex*, 550 U.S. 398, 417 (2007) (highlighting the “instructive” principle that a patent is “obvious” when “[the] patent ‘simply arranges old elements with each performing the same function it had been known to perform and yields no more than one would expect’” (quoting *Sakraida v. Ag Pro, Inc.*, 425 U.S. 273, 282 (1976))).

2. Claims 16 and 21

Claims 16 and 21 both relate to combining the reconstructed signals of the low and high bands at the receiver and would have been obvious over Tucker in

view of the well-known art and knowledge of the POSA. Claims 16 and 21 depend from claims 15 and 20, respectively, which are anticipated or rendered obvious for the reasons given above. *See supra* Sections VIII.A.6, VIII.A.7. They add the requirement that each combiner “appl[y] a delay to one of the first reconstructed signal prior to said combiner combining the first reconstructed signal and the second reconstructed signal.”

The additional concept of applying a delay to one of the signals so that the signals are aligned in phase before adding them is not expressly taught in Tucker, but would have been obvious. Tucker was concerned about the two bands being “aligned,” Ex. 1004 (Tucker) at 13:3-7, and the POSA would have understood that delaying one of the two signals could serve that purpose. Ex. 1002 (Quackenbush) ¶¶ 178-81. *cf. id.* ¶¶ 80-81 (noting the need to align signals in phase before subtracting them). Applying such delays to align them was a fundamental concept in the art, and the POSA would have been motivated to align the signal before adding it to ensure that the signals were added without distortion. Ex. 1002 (Quackenbush) ¶¶ 178-81.

IX. CONCLUSION

With this Petition, Petitioner has established a reasonable likelihood that the challenged claims of the ’114 patent will be found unpatentable. Petitioner therefore respectfully requests that *inter partes* review of the ’114 patent be

CERTIFICATE OF SERVICE
(37 C.F.R. §§ 42.6(e) and 42.105(a))

The undersigned hereby certifies that the above-captioned “PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO. 6,772,114” and true copies of Exhibit Nos. 1001 to 1040 were served on December 8, 2016, at the official correspondence address for the attorney of record for the ’913 patent as shown in USPTO PAIR via FedEx:

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