

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

QSC AUDIO PRODUCTS, LLC,
Petitioner,

v.

CREST AUDIO, INC.,
Patent Owner.

Case IPR2014-00127
Patent 6,023,153

Before MIRIAM L. QUINN, GLENN J. PERRY, and BRYAN F. MOORE,
Administrative Patent Judges.

PERRY, *Administrative Patent Judge.*

FINAL WRITTEN DECISION
Inter partes review
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

Petitioner, QSC Audio Products, LLC (“QSC” or “Petitioner”), filed a Petition (Paper 3, “Pet.”) to institute an *inter partes* review of claims 1–22 (all claims) of U.S. Patent No. 6,023,153 (Ex. 1001, “the ’153 patent”) pursuant to 35 U.S.C. §§ 311–319. Petitioner indicates that the ’153 patent is being asserted in *Crest Audio, Inc. v. QSC Audio Products, LLC*, 3:12-cv-755-FKB, filed in the United States District Court for the Southern District of Mississippi, Jackson Division, on November 7, 2012.

On May 2, 2014 we granted the Petition as to claims 1–22 of the ’153 patent and instituted trial on two grounds of unpatentability as set forth below. Paper 12, “Dec. on Inst.”

Claims	Grounds	Reference
Claims 1–22	§ 103	APA ¹ and Hancock ²
Claims 1–22	§ 103	APA and Gordon ³

Patent Owner, Crest Audio, Inc. (“Crest” or “Patent Owner”) argues in the Response that Hancock and Gordon are not published references

¹ The Admitted Prior Art (“APA”) includes ’153 patent Figures 1 and 2, along with corresponding description. It also includes subject matter incorporated by reference into the ’153 patent including the subject matter of U.S. Patent Nos.: 5,461,303 (“the ’303 patent”) issued January 31, 1994; 5,502,630 (“the ’630 patent”) issued July 19, 1994; 5,614,810 (“the ’810 patent”) issued February 14, 1994; and 5,637,988 (“the ’988 patent”) issued June 7, 1995.

² Jon Hancock, *A Class D Amplifier Using MOSFETs with Reduced Minority Carrier Lifetime*, Audio Engineering Society Preprint 2958 (E-5), 1990 (Exhibit 1002, “Hancock”).

³ Jay Gordon, *The Characteristics of Conventional and Switching Power Supplies in Analog Signal Processing*, Audio Engineering Society Preprint 3889 (G-5), 1994 (Exhibit 1003, “Gordon”).

(Paper 21, “Resp.”), and filed a Motion to Exclude (Paper 34, “Motion” or “Mot.”), seeking to exclude them as evidence. Patent Owner did not make any substantive arguments regarding the subject matter alleged to be taught by Hancock or Gordon. Nor did it challenge Petitioner’s characterization of the APA. *See* Resp. Petitioner replied (Paper 25, “Reply”) to Patent Owner’s Response, and opposed (Paper 37, “Opposition”) Patent Owner’s Motion to Exclude. Oral Argument was held on January 27, 2015. Paper 42, “Tr.”

The Board has jurisdiction under 35 U.S.C. § 6(c). In this Final Written Decision, issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73, we determine Petitioner has demonstrated by a preponderance of the evidence that all claims for which trial was instituted, claims 1–22, are unpatentable.

II. THE ’153 PATENT (Ex. 1001)

Figures 1 and 2 of the ’153 patent are labeled “PRIOR ART.” Figure 1 is reproduced below.

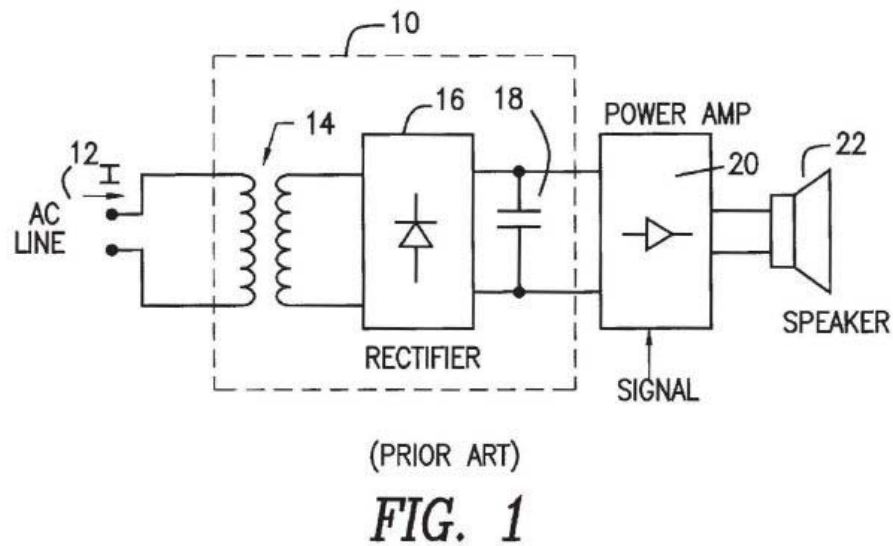


Figure 1 is a schematic diagram showing an audio amplifier circuit employing a linear power supply. Ex. 1001, 3:15–17. The “BACKGROUND OF THE INVENTION” portion of the ’153 patent explains that an audio amplifier, such as shown in Figure 1, has design and operational disadvantages. AC line transformer 14 is typically very large and heavy due to the relatively low frequency of the AC line. Filter capacitor 18 must have a relatively high value of capacitance, possibly requiring multiple capacitors. Ex. 1001, 1:33–39. An operational disadvantage is illustrated by Figure 5 of the ’153 patent, reproduced below.

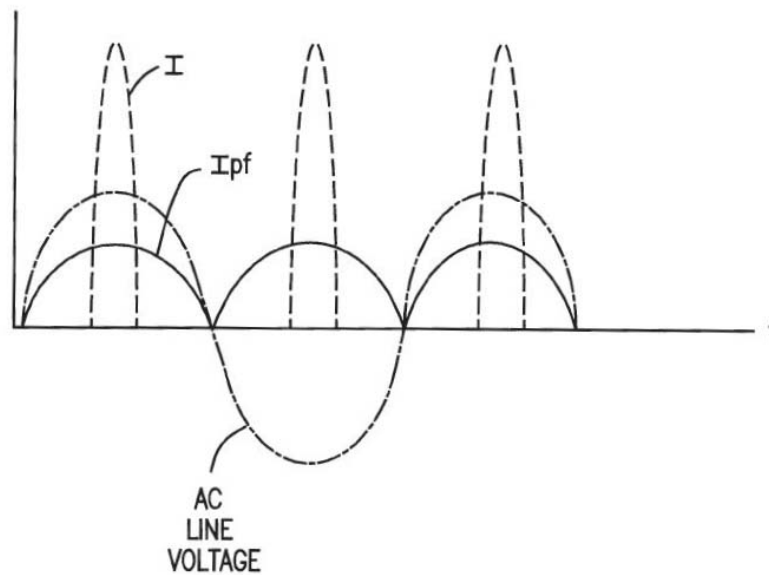


Figure 5 of the '153 patent is a graphical representation of a relationship between line voltage and input current waveforms. When using a conventional switching power supply, the waveform (spiked waveform referenced “I”) of current drawn from the power supply does not match the waveform (sine waveform referenced “AC LINE VOLTAGE”) of the input line voltage. This waveform mismatch causes harmonics to be generated, which result in distortion and noise. *Id.* at 1:40–50.

Also according to the “BACKGROUND OF THE INVENTION,” audio amplifiers were known to use a switching-type power supply 11, as shown in Figure 2 of the '153 patent, reproduced below. *Id.* at 1:63–65.

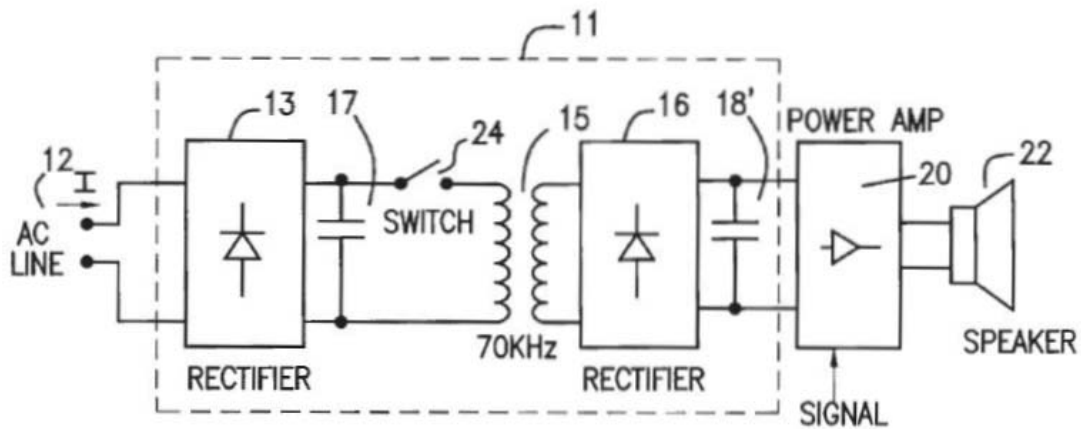


Figure 2 of the '153 patent is a schematic diagram of a prior art audio amplifier circuit employing a switching power supply according to the prior art. *Id.* at 3:19–21.

The improvement taught by the '153 patent is to add power factor correction circuit 30 to the power supply as shown at the left side of Figure 4 of the '153 patent, reproduced below. Ex. 1001, 3:37–41.

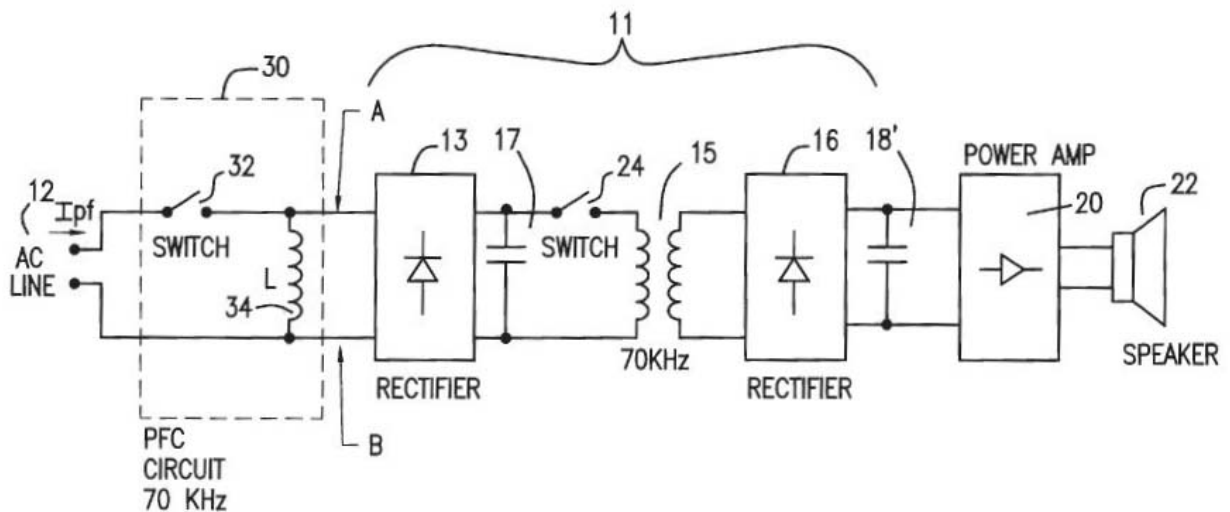


Figure 4 of the '153 patent is a schematic diagram of the claimed audio amplifier circuit including power factor correction. Ex. 1001, 3:25–27. According to the '153 patent, power factor correction circuits including “boost” configurations were known, but not used in audio amplifiers. *Id.* at

2:11–21, 3:42–61. Rather than explain in detail what was well-known at the writing of the '153 patent, the '153 patent incorporated by reference the disclosures of four U.S. patents describing power factor correction circuits, including their circuit configurations and how to operate them:

It is understood that the switch 32 and inductor 34 are arranged in a boost configuration and that the power factor correction circuit 30 operates in a manner well known in the art for providing power factor correction of an AC line. See for example, U.S. Pat. Nos.: 5,461,303, 5,502,630, 5,614,810, and 5,637,988, the entire disclosures of which are hereby incorporated by reference.

Ex. 1001, 3:55–61.

During prosecution of the application resulting in the '153 patent, Applicant argued that the cited references, although teaching power factor correction, did not provide any “motivation” to combine such circuits with an audio amplifier. Ex. 1006, 55. The '153 patent issued, at least in part, as a result of these statements.

Independent claims 1 and 9, reproduced below, are illustrative of the claimed subject matter.

1. An audio amplifier for receiving input current and sinusoidal line voltage from an AC source, and delivering audio output power to a load, the audio amplifier comprising:

a power factor correction circuit for receiving the line voltage from the AC source, the power factor correction circuit including a control circuit operable to cause the wave shape of the input current drawn from the AC source to substantially correspond to the wave shape of the line voltage by producing an intermediate source of voltage at a substantially higher potential than the line voltage of the AC source;

a DC power supply coupled to the power factor correction circuit and operable to convert the intermediate source of voltage into a regulated DC source of power; and

an audio power amplifier coupled to the DC power supply and operable to convert the DC source of power into the audio output power for delivery to the load.

9. An audio amplifier for receiving input current and sinusoidal line voltage from an AC source, and delivering audio output power to a load, the audio amplifier comprising:

a power factor correction circuit for receiving the line voltage from the AC source and controlling the phase of the input current drawn from the AC source to substantially correspond to the phase of the line voltage, the power factor correction circuit producing an intermediate source of voltage;

a DC power supply coupled to the power factor correction circuit and operable to convert the intermediate source of voltage into a regulated DC source of power; and

an audio power amplifier coupled to the DC power supply and operable to convert the DC source of power into the audio output power for delivery to the load.

Each of independent claims 1 and 9 is directed to a combination including a power factor correction circuit, a DC power supply, and an audio amplifier. They use slightly different language to characterize the use of power factor correction. Claim 1 characterizes the power factor correction

circuit as causing the “wave shape” of the input current drawn from the AC source substantially to correspond to the “wave shape” of the line voltage by producing an intermediate source of voltage at a substantially higher potential than the line voltage of the AC source. Claim 9 characterizes the power factor correction circuit as matching the “phase” of the input current to the line voltage.

III. MOTION TO EXCLUDE

Patent Owner argued in its Response (Paper 21) and in its Motion to Exclude that Hancock and Gordon are not “printed publications” under the patent law, and that they should be excluded from evidence. The Motion also asks that we exclude paragraphs 11 and 19 of the Santi Declaration (Ex. 1004) and portions of the Cordell Deposition (Ex. 1008).

A. Critical Date

The ’153 patent issued from application 09/151,140 filed on September 10, 1998. The application identifies related U.S. Provisional Application 60/059,591 filed on September 23, 1997, the critical date. Ex. 1001, filed code elements [21], [22], [60]. Therefore, to be considered “prior art,” the asserted references must have an effective date that predates the critical date of September 23, 1997.

B. Authentication

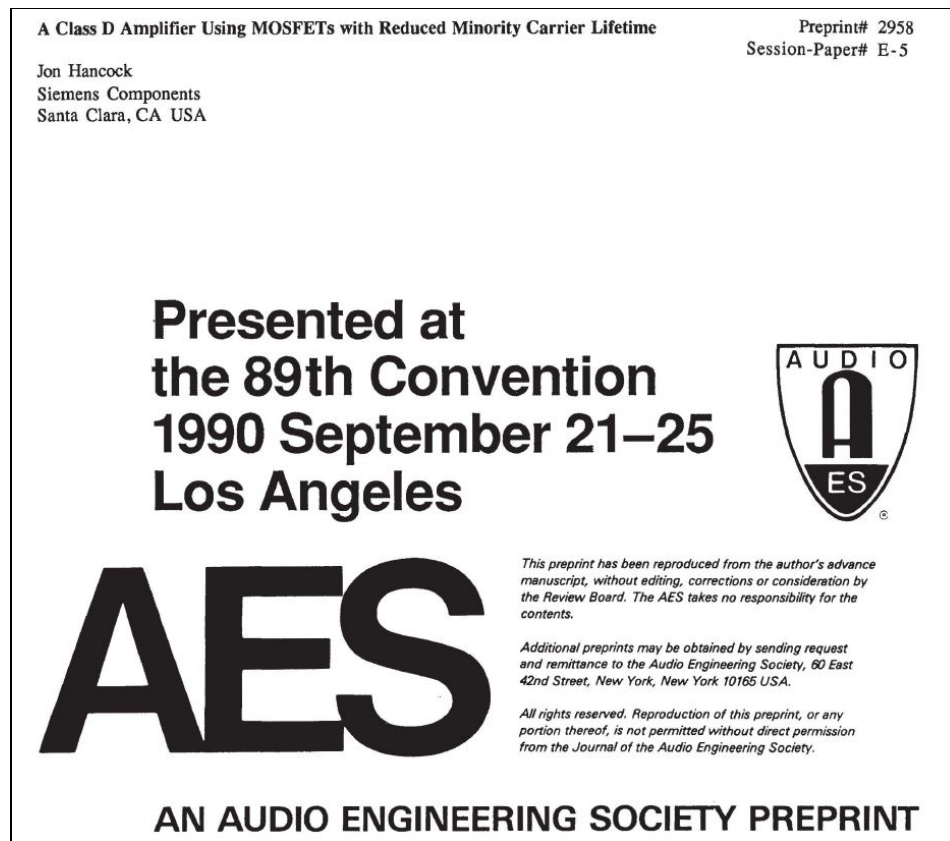
Patent Owner argues that Fed. R. Evid. 901⁴ and 902⁵ prevent our consideration of Hancock and Gordon because they are not authenticated as “publications” under the patent law. Mot. 1. Authenticating rules are

⁴ Authenticating or Identifying Evidence.

⁵ Evidence that is Self-Authenticating.

intended to ensure that documents are what they purport to be. Fed. R. Evid. 901(a). One example of evidence that satisfies the authentication requirement is stated in Fed. R. Evid. 901(b)(4): “[t]he appearance, contents, substance, internal patterns, or other distinctive characteristic of the item, taken together with all the circumstances.”

The cover pages of Hancock and Gordon bear similar identifying markings and qualifiers. As an example, we consider the Hancock cover page, reproduced below. Ex. 1002, 1.



The cover page: 1) bears two distinctive logos of the Audio Engineering Society (AES); 2) states that the document is a “preprint” produced from an author’s advance manuscript; 3) states a unique number assigned to the preprint; 4) identifies a particular session of an AES Convention at which it was “presented;” 5) bears dates of the AES Convention at which the paper

was presented; and 6) states how additional preprints may be obtained. See also Ex. 1003, 1 (cover page of Gordon depicting the same information).

With regard to the dates of the relevant AES Conventions, according to Hancock's cover page, the 89th AES Convention took place from September 21–25, 1990. Ex. 1002, 1. And according to Gordon's cover page, the 97th AES Convention took place from November 10–13, 1994. Ex. 1003, 1.

Petitioner provides declaration testimony of Jessica King (Ex. 2002, "King Declaration"), librarian at the law firm of Petitioner's Counsel, demonstrating that one can purchase and download copies of AES papers from the "AES E-Library" website. King Declaration, 2. Jessica King testifies that she purchased and downloaded copies of Hancock and Gordon from that website. *Id.* at 2–3. She further testifies that "search results" show that AES indicates publication dates for Hancock and Gordon as being September 1, 1990, and November 1, 1994, respectively. *Id.* at 2–3.

Patent Owner argues that these search results do not authenticate Hancock and Gordon because they are inadmissible hearsay under Fed. R. Evid. 802. Mot. 3. According to Patent Owner, a "preprint" is not "self-authenticating" as a publication under Rule 902, and, therefore, Petitioner must produce evidence sufficient to support a finding that a "preprint" is, indeed, a "printed publication." *Id.* at 2.

Petitioner disagrees and argues that to authenticate each of Hancock and Gordon Petitioner simply "must produce evidence sufficient to support a finding that the item is what the [Petitioner] claims it is." Paper 37, 1 (citing Fed. R. Evid. 901(a)). In support of this position, Petitioner points to the layout, AES logo, and boilerplate language on the front pages of Hancock

and Gordon to authenticate these exhibits under Rule 901(b)(4). Paper 37, 2–4. Furthermore, the various indicia on the Hancock and Gordon cover pages match the indicia found on the Cordell paper (Ex. 1009) presented at the 72nd AES Convention, as testified to by Patent Owner’s expert. See Ex. 1009, 1.

Patent Owner’s arguments conflate two separate issues — 1) whether Hancock and Gordon are authentic, and 2) whether they constitute publications under the patent law. Hancock and Gordon include the AES logo and their respective layouts are the same. The cover pages further identify a specific address for AES for the purpose of obtaining additional preprints, and state that reproduction of the articles is prohibited without permission from the Journal of the Audio Engineering Society. Exs. 1002 and 1003. There is no dispute that these documents are preprints of papers intended for presentation at their respective AES conventions. Therefore, having considered and weighed the distinctive characteristics of the articles and the circumstances surrounding their retrieval from the AES E-Library, we find that Hancock and Gordon are what they appear to be—papers categorized by the Audio Engineering Society as “preprints.” Petitioner has met its authentication burden under Fed. R. Evid. 901 and 902. Whether the self-authenticated “preprints” qualify as “publications” under the patent law is a separate matter.

C. Hearsay

Because the only grounds of unpatentability a petitioner may raise in an *inter partes* review are those based on prior art consisting of patents or printed publications (35 U.S.C. § 311(b)), we must determine whether Hancock and Gordon were published before September 23, 1997, the critical date. To prove the publication date of Hancock and Gordon, Petitioner

relies on the information printed on the cover page of each of the preprints, namely that they were “presented” at AES conventions in 1990 (Hancock) and 1994 (Gordon). *See* Pet. 4.

Patent Owner argues that Hancock and Gordon should be excluded because the statements of dates on the respective cover pages, e.g., “presented at the 97th Convention 1994 November 10-13” on the cover of Gordon, are hearsay evidence attempting to establish a date of publication. Mot. 4–6 (citing Fed. R. Evid. 802).

Petitioner argues that Patent Owner’s challenges under Fed. R. Evid. 802 fail because the statements are not hearsay—Hancock and Gordon have been authenticated as “conference papers that were published as of the dates shown on the cover[pages, and] Petitioner is not relying on the statements that appear on the face of the [] papers for the truth of the matter asserted.” Opposition 7. Alternatively, Petitioner argues that, even if the statements were hearsay, they would come within the ancient documents (Fed. R. Evid. 803(16)) or the residual hearsay (Fed. R. Evid. 807) exceptions to the hearsay rule.⁶ *Id.* at 9–11.

We are not persuaded by Petitioner’s argument that the statements are not hearsay. Although Hancock and Gordon have been authenticated as preprints maintained by AES, Petitioner relies on the truth of the matter asserted on the face of the preprints, i.e., that they were presented at the AES convention on the date stated on the cover page. Without these statements, there is no evidence that each of Hancock and Gordon were actually available, as printed publications, at those conventions or on any other particular date. We note that Patent Owner does not argue that these

⁶ As of the date of this decision, both documents are more than 20 years old.

documents were not associated with their respective AES conventions. The question for us to decide is whether Petitioner has provided sufficient evidence and argument showing that the statements relied on are admissible under an exception to the hearsay rule. We find that, in this situation, the statements should not be excluded as hearsay, because they come within two separate exceptions to the hearsay rule.

At least the Hancock preprint qualifies as an ancient document subject to Fed. R. Evid. 803 (C)(16), which applies to documents to be at least 20 years old whose authenticity is established. Per our discussion above, Hancock and Gordon are authenticated. The Hancock preprint purports to have been presented September 21, 25, 1990, more than 20 years ago. Ex. 1002, 1. The Gordon preprint purports to have been presented November 10-13, 1994, more than 20 years ago from the time of this decision (but not more than 20 years ago from the time of the Decision to Institute). Ex. 1003, 1.

Both the Hancock and Gordon preprints also meet the circumstances outlined in Fed. R. Evid. 807, the residual exception to hearsay. To qualify for the residual exception under Fed. R. Evid. 807, four requirements must be met: 1) the statement has equivalent circumstantial guarantees of trustworthiness; 2) it is offered as evidence of a material fact; 3) it is more probative on the point for which it is offered than any other evidence that the proponent can obtain through reasonable efforts; and 4) admitting will best serve the purposes of these rules and the interests of justice. Fed. R. Evid. 807.

Petitioner argues persuasively that the four requirements are met. Opposition, 10–11. For example, Petitioner argues circumstantial

guarantees of trustworthiness by virtue of all the indicia on the cover pages of the documents showing it is a genuine preprint of the AES obtained from the organization's repository of similarly categorized preprints. *Id.*

Petitioner also argues that the statements are evidence of a material fact: convention dates set forth on the preprints. *Id.* Furthermore, Petitioner argues that the dates on the cover pages are more probative than other documents Petitioner has obtained through reasonable efforts. *Id.* (pointing to the website listing of alleged publication dates that Patent Owner has challenged as inadmissible hearsay). Finally, Petitioner argues, and we agree, that admitting the statements as evidence of the date of publication serve the interest of justice. *Id.* Although we recognize that Petitioner had other avenues of proving these statements were not hearsay, such as by obtaining evidence from AES regarding the custody of its electronic documents, our concern with ensuring trustworthiness and accuracy of documents admitted in evidence has been alleviated. For example, Petitioner has provided AES website documents (also self-authenticated) that corroborate similar dates as those stated on the cover page of the references. Furthermore, the dates of the documents cited within the references are all before the date of the stated presentation of the documents. Yet another fact we consider is that the cover pages of all the AES preprints submitted into evidence have similar characteristic layouts (format), the same information, and sufficient detail regarding the AES convention and the manner in which the preprints may be obtained. *See also* Ex. 1008, 90:18–92:10 (Mr. Cordell testifying that his own article was sold and distributed by AES at the AES convention at which he presented the paper).

Based on the foregoing, and after a careful review of the proffered

evidence and arguments, we find that the statements on the cover page of Hancock and Gordon regarding presentation of the preprint at the particular AES convention are admissible.

D. Declaration Testimony of Enrico Santi, Ph.D. (Ex. 1004)

Petitioner presented the declaration testimony of Enrico Santi, Ph.D. (Ex. 1004) regarding Hancock and Gordon. Paragraphs 11 and 19 of the Santi Declaration state that Hancock and Gordon were presented to the AES Society at the 89th and 97th Conventions, respectively. Ex. 1004 ¶¶ 11, 19. Patent Owner took the deposition of Dr. Santi and notes that he explained during that deposition that an AES “preprint” is not the same as an AES journal publication. Resp. 3–4. In particular, a “preprint” has not undergone peer review. Ex. 1001 pp 104-105.

Patent Owner asks that we exclude paragraphs 11 and 19 of the Santi Declaration (Exhibit 1004) under Fed. R. Evid. 602 and 401–402. Mot. 6. Patent Owner argues that Dr. Santi lacks personal knowledge to provide any insight as to whether Hancock or Gordon were presented at all, much less on the dates he contends that they were presented in paragraphs 11 and 19 of Exhibit 1004. Therefore, according to Patent Owner, these paragraphs should be excluded under Fed. R. Evid. 602, which states that a witness may not testify to a matter unless evidence is introduced sufficient to support a finding that the witness has personal knowledge of the matter.

Petitioner argues that Patent Owner’s challenge to paragraphs 11 and 19 of Dr. Santi’s declaration (Ex. 1004) fails because Rule 703 permits an expert witness to rely on dates printed on documents on which the expert opines. Paper 37, 11–12.

We agree with Petitioner that experts regularly rely on printed documents, notwithstanding their admissibility. However, we understand that Dr. Santi did not personally attend the conventions at which the Hancock and Gordon papers are purported to have been presented. We, therefore, take no further meaning from paragraphs 11 and 19 than Dr. Santi observed the same text on the cover sheets that we observe — that these documents are “preprints” purported to have been presented at convention session numbers stated on their respective cover sheets. We do not take these paragraphs as evidence that Dr. Santi observed their presentation or otherwise knows that presentations were carried out as described on the cover sheets. The panel draws its own conclusions from the totality of the evidence.

E. Deposition of Robert Cordell (Ex. 1008)

Robert Cordell is Patent Owner’s expert declarant in related *inter partes* reviews IPR2014-00129 and IPR2014-00131. Petitioner relies upon the deposition of Robert Cordell (Ex. 1008) as establishing the customary practice of the AES at its conventions regarding “preprints.”

Mr. Cordell testifies that he joined the AES in 1973 or 1974 and then attended 30–40% of its conventions which were held two or three times per year. Ex. 1008,18. Mr. Cordell, like Hancock and Gordon, made presentations at various AES conventions. *Id.* at 2. According to Mr. Cordell, his own “talks”⁷ were preceded by the AES making available “preprints” (for a fee) to convention participants before they entered the convention session for the talk. *Id.* at 4–12. According to Mr. Cordell,

⁷ One of Mr. Cordell’s papers was made of record as Exhibit 1009. It bears markings on its cover sheet similar to those found on Hancock and Gordon.

preprints were usually made available. *Id.* at 19.

Petitioner argues that the Cordell testimony supports Petitioner's argument that it was the custom and practice of the AES to make available to convention participants preprints of papers being presented at the convention. Reply 10.

Patent Owner argues that Cordell's testimony that some preprints were made available does not establish that all preprints were made available. Mot. 8. Patent Owner further argues that although Cordell testifies that he attended some AES conventions where preprints were made available, there is no evidence in the record that he attended the particular conventions at which the Gordon and Hancock papers were presented. Patent Owner also argues that the Cordell testimony is irrelevant (Rule 401) to the issue of whether Hancock and Gordon were actually disseminated or otherwise made available on the dates Petitioner claims they were available. *Id.*

Petitioner argues that Patent Owner's challenge to its own expert's sworn testimony (Ex. 1008) fails because it relies on a rule that is not applicable and because the basis for Patent Owner's challenge goes to the weight and not to the admissibility of Mr. Cordell's testimony. Opposition 1. Petitioner further argues that Patent Owner's challenge under Rule 401 is misplaced. We agree with Petitioner.

The testimony of Mr. Cordell is relevant. Although Mr. Cordell attended AES conventions other than the 89th (Hancock) and 97th (Gordon) conventions, his experience as stated in his deposition is relevant and probative of the business practices of the AES. Cordell testified that he attended a number of AES conventions and that preprints were usually made

available via an “on-site bookstore” that sold preprints of papers scheduled for presentation. For example, Cordell testified that at the 72nd convention, the AES had a counter at which preprints could be purchased. Mr. Cordell testified that he attended 30–40% of the AES conventions since he became a member in 1973 or 1974 including the 64th and 70th AES conventions, and that the AES gave him free copies of preprints of his own papers so that he could distribute them to friends. Ex. 1008, 96:18–97:23 Thus, the Cordell testimony provides relevant information probative of the business practices of AES with regard to the dissemination of preprints at AES conventions.

Patent Owner argues that even if not irrelevant under Rule 401, the Cordell testimony, probative of the AES business practices, is outweighed by being confusing, vague, and speculative. We disagree. This is not a jury trial. The panel is not confused by the testimony and is in a position to appropriately weigh Mr. Cordell’s testimony along with the other evidence of record. The Board, sitting as a non-jury tribunal with administrative expertise, is well-positioned to determine and assign appropriate weight to evidence presented. *Gnosis S.P.A. v. S. Alabama Medical Science Foundation*, Case IPR2013-00118, slip op. at 43 (PTAB June 20, 2014) (Paper 64). See also *Donnelly Garment Co. v. NLRB*, 123 F.2d 215, 224 (8th Cir. 1941) (“One who is capable of ruling accurately upon the admissibility of evidence is equally capable of sifting it accurately after it has been received.”).

F. Conclusion

For reasons stated above, Patent Owner's Motion to Exclude is denied.

IV. ANALYSIS OF CLAIM CHALLENGES

A. Hancock and Gordon are publications

Patent Owner argues that Hancock and Gordon are not "publications" within the meaning of the patent law. The touchstone of whether a particular document is a publication under the patent law is whether it was available to those of ordinary skill in the art to which it pertains.

The evidence, including the Cordell deposition testimony, strongly suggests that it is the custom and practice of the AES to prepare and distribute preprints of its convention presentations at a facility at the convention.

The evidence further suggests that the AES makes available for purchase, via its library website, copies of convention presentations after they have been presented so that all interested persons may obtain copies of documents presented at its conventions.

We conclude from the totality of evidence that the Hancock and Gordon preprints were made available to attendees of their respective AES Conventions. We further conclude that the Hancock and Gordon AES conventions took place prior to the critical date. Thus, the preprints were accessible to those of ordinary skill as of their respective convention dates, well before the critical date. We, therefore, conclude that Hancock and Gordon are publications within the meaning of the patent law.

We note that Patent Owner challenged the sufficiency of the evidence presented by Petitioner, but did not offer any evidence that Hancock and

Gordon are not publications. Based on the evidence and arguments presented on the record before us, we conclude that Petitioner has shown by a preponderance of the evidence that Hancock and Gordon are publications within the meaning of the patent law.

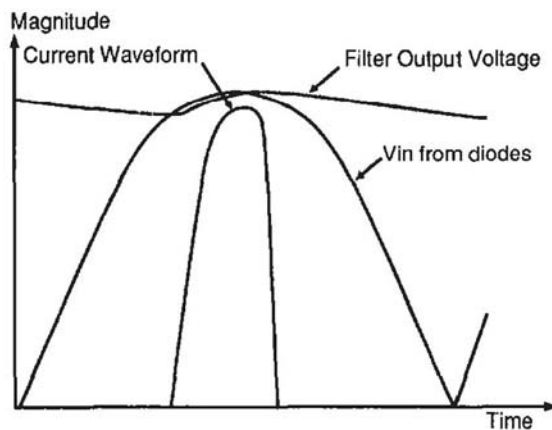
B. Independent Claims 1 and 9

Our substantive inquiry focuses on whether the record before us presents sufficient evidence that, at the time of the '153 patent invention, it would have been obvious to a person of ordinary skill in the relevant art to use a known power factor correction circuit in combination with a known switching power supply in an audio amplifier. The preponderance of the evidence presented leads us to that conclusion.

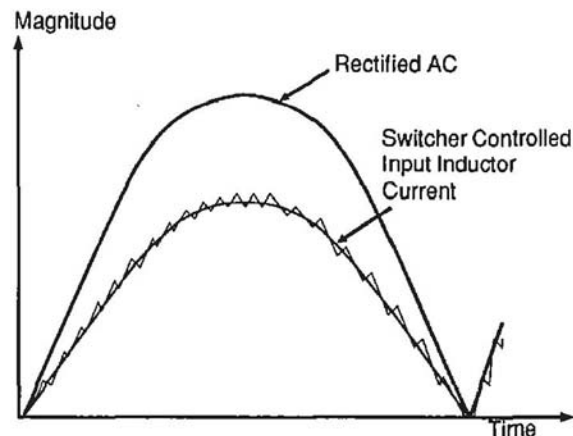
Neither Hancock nor Gordon were before the Examiner during prosecution of the '153 patent. We are persuaded that both these references provide sufficient rationale for using power factor correction in an audio amplifier having a switching power supply. Pet. 13–16. In fact, both are technical papers presented at respective conferences directed to audio engineers and describe audio amplifiers. Pet. 13, 40. Further, because both address the problem of distortion caused by waveform mismatch, and teach the solution of providing power factor correction in the context of an audio amplifier, these papers are evidence that a person of ordinary skill in the art would have been motivated to apply a power factor correction solution to the audio amplifiers known in the art at the time of the invention, and as disclosed in the Background of the Invention of the '153 patent.

For example, Hancock states that “[a]s for all buck converters, input

current ripple is fairly high, and has a high harmonic content.” Ex. 1002, 2.⁸
Hancock’s Figures 27 and 28 (*Id.* at 17) are reproduced below.



Hancock Figure 27 shows a mismatch of voltage and current waveforms.

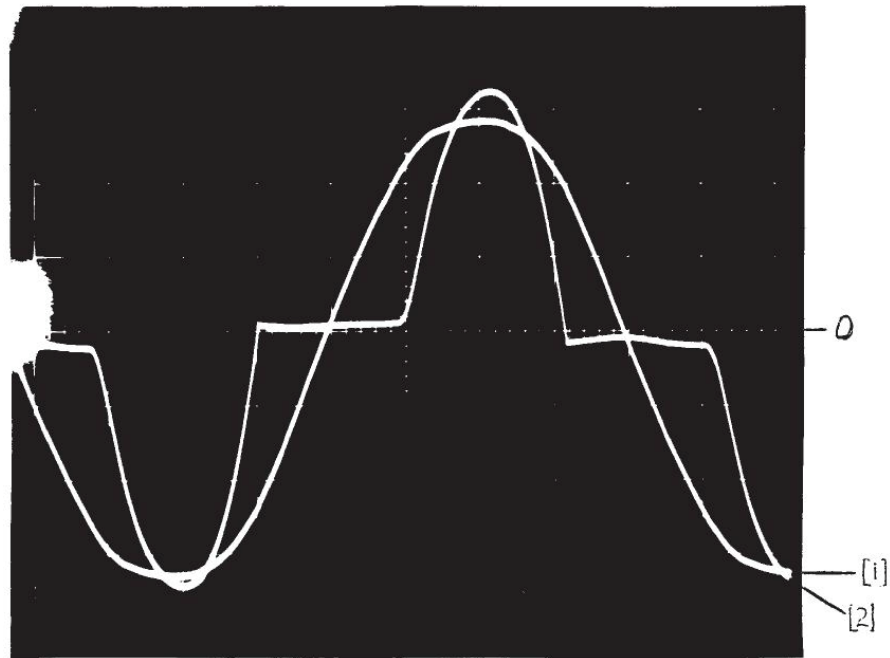


Hancock Figure 28 demonstrates a match in wave shape and phase achieved by the addition of a power factor correction circuit.

An example of voltage and current mismatch is shown in Hancock’s Figure 27. Ex. 1002, 2 Hancock further recognizes the mismatch in a section titled “Power Factor – the problem with capacitor input power supplies.” *Id.* at 6. In that section, Hancock states that “power factor has long been a concern and specified parameter.” *Id.* at 7. The Hancock solution is to provide a “pre-regulator” (power factor correction) which aligns the voltage and current waveforms in shape and phase. *Id.*

Gordon’s Figure 4 reproduced below, also demonstrates the problem of mismatch between the input voltage and drawn current waveforms.

⁸ For exhibits, we refer to page numbers of the Exhibit, not to page numbers of any separately numbered pages within the exhibit.



Gordon's Figure 4 is a graphical representation of power supply voltage and current in an audio amplifier. Ex. 1003, 20. Given the admitted prior art and the description in both Gordon and Hancock of the use of power factor correction in an audio amplifier, the preponderance of evidence establishes that claims 1 and 9 would have been obvious as of the critical date based on the combination of either APA and Hancock or APA and Gordon.

C. Claims 2 and 16

Claims 2 and 16 depend respectively from claims 1 and 9, and recite structure and operation of the power factor correction circuit. Specifically, these claims require the power factor circuit to include a boost circuit having an inductor and a switching transistor. The switching transistor must have a controlled duty cycle that is substantially greater than the frequency of the AC source, and must produce an intermediate voltage having peaks that are

substantially higher than the peak voltages of the AC source. *See* claims 2 and 16.

The '153 patent specification admits that boost power factor correction circuits and their operation were well-known. Ex. 1001, 3:55–61. According to Petitioner's declarant, Dr. Santi, claims 2 and 16 recite features of a well-known power factor correction circuit. Ex. 1004 ¶¶ 73–74, 76.

Hancock describes a boost converter power factor correction circuit that includes a switching transistor and an inductor. Ex. 1002, 6. "Typically a boost or flyback converter is used as a pre-regulator to charge a 360 V bus." *Id.*; *see* Ex. 1004 ¶ 74. Hancock's Figure 28 shows that the power factor correction circuit biases the transistor on and off at a rate that is substantially greater than the frequency of the AC source. Ex. 1004 ¶ 74. Hancock indicates that the intermediate source of voltage has peak voltages (360 Volts) that are substantially higher than peak voltages of the AC source (90–260 VAC). Ex. 1002, 6.

Based on the foregoing, we are persuaded that Hancock discloses the limitations recited in claims 2 and 16. We are further persuaded that Gordon also teaches these limitations. For example, Gordon describes buck and boost power supply configurations beginning at page 9 of Exhibit 1003.

In view of the above, the preponderance of evidence establishes that claims 2 and 16 would have been obvious as of the critical date based on either the APA when considered with Hancock or the APA when considered with Gordon.

D. Claims 3 and 17

Claims 3 and 17 require that the boost power factor correction circuit be switched at a frequency of about 70 KHz.

Patent Owner admits in the specification that the use of a 70kHz switching frequency was known. Ex. 1001, 2:16–18. This admission is echoed by Petitioner’s declarant. Ex. 1004 ¶¶ 78–80. We also note that the ’153 patent incorporates by reference the ’303 patent in asserting that operation of the power factor correction circuit was well-known in the art. Ex. 1001, 3:55–61. We note that the incorporated subject matter includes description of a useful frequency range of 48–500 kHz for a power factor correction circuit. ’303 patent, 3:60. Ex. 3001.

Based on the evidence and the record before us, we conclude that Petitioner has established by a preponderance of evidence that claims 3 and 17 would have been obvious based on either APA and Hancock or APA and Gordon.

E. Claims 4, 8, 18, and 22

Claims 4, 8, 18, and 22 each require an intermediate voltage range (boosted voltage produced by the power factor correction circuit) of 400–500 volts. We are persuaded by Petitioner’s evidence that one of ordinary skill in the art would have considered the use of an intermediate voltage of “about 400–500 volts.” Pet. 28–29, 31–32, 38, 39.

Neither Hancock nor Gordon explicitly states the claimed range. Both Hancock and Gordon, however, describe intermediate voltages that are substantially higher than the input voltage. Gordon describes an embodiment providing an intermediate voltage of 382 volts. Hancock describes an embodiment providing an intermediate voltage of 360 volts.

We have reviewed the '153 patent and find that the range of about 400–500 volts is stated without any explanation as to why it might be critical. The only explanation about the intermediate voltage is that it be substantially higher than the input voltage in order for the power factor correction circuit to provide the desired benefit. Ex. 1001, 3:1–3. No data or explanation specific to the range of about 400–500 volts is provided.

One of ordinary skill in the art would have considered the specific intermediate voltage to be a result-effective variable that can be optimized. *In re Antonie*, 559 F.2d 618, 620 (CCPA 1977) (holding that a determination that the discovery of optimum values of a variable in a known process would have been within the level of ordinary skill in the art must be supported by a showing that the variable is result-effective); *see also In re Geisler*, 116 F.3d 1465, 1470 (Fed. Cir. 1997) (“‘[I]t is not inventive to discover the optimum or workable ranges by routine experimentation.’ Only if the ‘results of optimizing a variable’ are ‘unexpectedly good’ can a patent be obtained for the claimed critical range.” (internal citations omitted)). Patent Owner has not demonstrated that the results are unexpectedly good at 400–500 volts.” We find that the voltages described by Gordon and Hancock are encompassed by the claimed range as both 382 and 360 volts are rounded to “about” 400 volts, the lower voltage in the claimed range. We also are not persuaded as to the patentable distinction based on the claimed voltage range, and, therefore, find that the claimed intermediate range of about 400–500 volts would have been obvious to a person of ordinary skill in the art in view of the disclosed voltages in Gordon and Hancock.

Based on the evidence and the record before us, we are persuaded that Petitioner has established by a preponderance of evidence that claims 4, 8,

18, and 22 would have been obvious as of the critical date based on the combination of either APA and Hancock or APA and Gordon.

F. Claims 5 and 19

Claims 5 and 19 are similar and depend respectively from claims 1 and 9. Illustrative claim 5 reads as follows:

The audio amplifier of claim 1, wherein the power factor correction circuit or the DC power supply includes a rectifier and a storage capacitor coupled to the intermediate source of voltage such that a preliminary DC source of power is available across the storage capacitor, the DC power supply converting the preliminary source of DC power into the regulated DC source of power.

Figure 2 of the '153 patent, reproduced above, shows an embodiment of a DC power supply (without power factor correction). The Figure 2 (APA) embodiment includes rectifier 13 and storage capacitor 17 within DC switching power supply 11, albeit not connected to an intermediate voltage (no power factor correction is shown). The '153 patent specification admits that the switching power supply operates in a well-known manner. Ex. 1001, 1:63–2:10. The '303 patent, incorporated into the '153 patent specification, shows a power factor correction circuit in its Figure 1 that includes rectifier 16 and capacitor 18 providing an intermediate voltage to a load 32. Figure 7 of the '630 patent, also incorporated by reference into the '153 patent specification, shows a power factor correction circuit including plurality of diode rectifiers CR20–28 and capacitor C2 providing an intermediate voltage at terminal T3.

Petitioner's declarant, Dr. Santi, testifies that a power factor correction circuit or a switching power supply that includes a rectifier and a

capacitor is well-known in the art. *See* Ex. 1004 ¶¶ 85–86.

Furthermore, Gordon describes a boost circuit known to have a rectifier diode and storage capacitor. Ex. 1003, 10–11, Figs. 16–17.

The Hancock boost circuit (referred to as a “pre-regulator”) also has a rectifier and a storage capacitor. Ex. 1002, 6.

Based on the evidence and the record before us, we conclude that Petitioner has established by a preponderance of evidence that claims 5 and 19 would have been obvious as of the critical date based on the combination of either APA and Hancock or APA and Gordon.

G. Claims 6 and 20

Claims 6 and 20 both require that the power supply be a switching power supply. The ’153 patent specification admits that switching power supplies were known at the time of invention. For example, the APA Figure 2 shows switching power supply 11. *See* Ex. 1004 ¶ 88. Furthermore, Hancock discloses the use of a switching power supply. *See id.*; Ex. 1002, 6. According to Petitioner’s declarant, the use of a switching power supply was well known in the art. Ex. 1004 ¶¶ 88–89. This is confirmed by the specification of the ’153 patent, which admits that the details of a “switching power supply . . . are known in the art.” Ex. 1001, 3:42–44. We are persuaded by Petitioner’s evidence that it would have been obvious for a person of ordinary skill in the art to use a switching power supply for the DC power supply, because switching power supplies were well known for use in audio amplifiers. *See* Ex. 1004 ¶¶ 88–89.

With respect to Gordon, we also are persuaded that it discloses the use of a switching power supply. *Id.*; Ex. 1003, 6.

Based on the evidence and the record before us, we find that Petitioner has established by a preponderance of evidence that claims 6 and 20 would have been obvious as of the critical date based on the combination of either APA and Hancock or APA and Gordon.

H. Claims 7 and 21

Claims 7 and 21 require that the power supply be a resonant power supply. We note that the '153 patent specification admits that resonant power supplies were known at the time of the invention: “It is preferred that the switching power supply 11 be a resonant switching power supply, the details of which are known in the art.” Ex. 1001, 3:41–43. Thus, claims 7 and 21 are directed to known features.

Hancock also discloses use of a resonant switching power supply: “Fig. 29 shows the basic power switch circuit for one type of quasi-resonant power supply” Ex. 1002, 6. Hancock points out that “[a]lmost any kind of PWM supply may be built as an equivalent resonant circuit.” *Id.*

According to Petitioner’s declarant, the APA discloses the use of a resonant switching power supply. Ex. 1004 ¶¶ 91–93. We are persuaded by Petitioner’s evidence that it would have been obvious for a person of ordinary skill in the art to use a resonant switching power supply for the DC power supply, because resonant switching power supplies were well known for use in audio amplifiers. *See id.* ¶¶ 92–93.

Given that the APA describes a resonant power supply, and that both Hancock and Gordon combine a conventional power supply with a power factor correction circuit, we conclude that Petitioner has established by a preponderance of evidence that claims 7 and 21 would have been obvious as

of the critical date based on the combination of either APA and Hancock or APA and Gordon.

I. Claim 10

Claim 10 requires that the power factor correction circuit include a control circuit, at least one switching transistor, and an inductor configured in a boost arrangement, the control circuit operating to minimize harmonic distortion at the AC source.

We note that the '153 patent specification admits that boost-configuration circuits were well-known at the time of invention. Ex. 1001, 3:55–61. Petitioner's declarant also testifies that boost circuits were known. Ex. 1004 ¶¶ 26, 46, 98–100.

Furthermore, Hancock states that without power factor correction, input AC current spikes “result[] in high harmonic content.” Ex. 1002, 6. The power factor correction circuit described by Hancock minimizes that harmonic content. Ex. 1004 ¶ 99.

Turning to Gordon, it discloses that “harmonics due to the non-sinusoidal shape of the input current” are a problem that causes poor power factor, and states that “power factor is low, and input current harmonics are high.” Ex. 1003, 7, 10. Gordon further explains that a “boost converter” power factor correction circuit results in an “absence of harmonics.” *Id.* at 10; Ex. 1004 ¶ 100.

Thus, we are persuaded that both Gordon and Hancock demonstrate that it was known to use a power factor correction circuit in an audio amplifier.

Based on the evidence and the record before us, we are persuaded that Petitioner has established by a preponderance of evidence that claim 10

would have been obvious as of the critical date based on the combination of either APA and Hancock or APA and Gordon.

J. Claim 11

Claim 11 requires that the power factor correction circuit include a control circuit operating to minimize the root-mean-square (RMS) value of the input current drawn from the AC source.

According to Petitioner's declarant, a power factor correction circuit inherently minimizes the RMS value of the input current; that is its function. Ex. 1004 ¶ 103.

With regard to Hancock, Figure 28 shows a power factor correction circuit causing input current to match input voltage and minimize the RMS value of the input current. Ex. 1004 ¶ 103. Furthermore, Gordon notes that "use of power factor correction allows the switching power supply to draw less current." Ex. 1003, 10.

Based on the evidence and the record before us, we are persuaded that Petitioner has established by a preponderance of evidence that claim 11 would have been obvious as of the critical date based on the combination of either APA and Hancock or APA and Gordon.

K. Claim 12

Claim 12 requires that the power factor correction circuit include a control circuit operating to maximize power transfer characteristics from the AC source to the load.

According to Petitioner's declarant, a power factor correction circuit, such as the one described in Hancock and Gordon, inherently maximizes power transfer characteristics from the AC source to the load. Ex. 1004 ¶ 107. Furthermore, Hancock's Figure 28 shows a power factor correction

circuit causing input current to match input voltage and, thus, maximize power factor. *Id.* As Petitioner’s declarant testifies, maximizing power transfer characteristics from the AC source to the load is the very point of using a power factor correction circuit. See Ex. 1004 ¶¶ 107–109. We are further persuaded by Petitioner’s argument that the ’153 patent specification relies on the well-known circuit configurations and operation details of power factor correction. Pet. 16.

Based on the evidence and the record before us, we are persuaded that Petitioner has established by a preponderance of evidence that claim 12 would have been obvious as of the critical date based on the combination of either APA and Hancock or APA and Gordon.

L. Claim 13

Claim 13 requires that the power factor correction circuit include a control circuit operating to maintain the maximized power transfer characteristics from the AC source to the load at a substantially constant level irrespective of variations in RMS voltage and frequency of the AC source.

According to Petitioner’s declarant, a power factor correction circuit inherently maintains maximized power transfer characteristics from the AC source to the load at a substantially constant level irrespective of variations in RMS voltage and frequency of the AC source. Ex. 1004 ¶ 111.

Hancock discloses that the DC power supply can operate between 90 and 260 VAC, and that the secondary regulator sees a “relatively stabilized voltage.” Ex. 1002, 6.

Gordon states that with a power factor correction circuit, “[t]his design can operate from both US and European line voltages,” which vary in both voltage and frequency. Ex. 1003, 10; see Ex. 1004 ¶¶ 25, 114.

Based on the evidence and the record before us, we are persuaded that Petitioner has established by a preponderance of evidence that claim 13 would have been obvious as of the critical date based on the combination of either APA and Hancock or APA and Gordon.

M. Claim 14

Claim 14 requires that the power factor correction circuit operate to maintain its power transfer characteristics from the AC source to the load at a substantially constant level, despite RMS voltage variations of about 20% at the AC source. According to Petitioner’s declarant, a power factor correction circuit inherently maintains power transfer characteristics from the AC source to the load at a substantially constant level despite RMS voltage variations of about 20% at the AC source. Ex. 1004 ¶ 111.

Hancock discloses a switching power supply that operates over a range of 90–260 VAC, a range much greater than a variation of twenty percent, and provides a “relatively stabilized voltage.” See Ex. 1002, 6; Ex. 1004 ¶¶ 114–115.

Gordon describes a switching power supply with an input voltage range of “105 – 125 VAC,” which is about 20 percent. Ex. 1003, 7. Gordon states that with a power factor correction circuit, “[t]his design can operate from both US and European line voltages,” which differ by more than 20 percent. *Id.* at 10; Ex. 1004 ¶¶ 25, 114.

Based on the evidence and the record before us, we are persuaded that Petitioner has established by a preponderance of evidence that claim 14

would have been obvious as of the critical date based on the combination of either APA and Hancock or APA and Gordon.

N. Claim 15

Claim 15 requires that the power factor correction circuit maintain power transfer characteristics from the AC source to the load at a substantially constant level, despite frequency variations of the AC source from about 50 to 60 Hz. According to Petitioner's declarant, a power factor correction circuit inherently maintains power transfer characteristics from the AC source to the load despite frequency variation of the AC source from about 50 to 60 Hz. Pet. 37 citing Ex. 1004 ¶¶ 117–118.

Hancock discloses a power supply that can produce a relatively stabilized voltage for the secondary converter over an input voltage that varies in frequency from 50–60Hz. Ex. 1002, 6; Ex. 1004 ¶ 117.

Gordon describes a power supply with power factor correction that operates on U.S. line voltages (60 Hz.) and European voltages (50 Hz.). Ex. 1003, 10.

According to Petitioner's declarant, Dr. Santi, a person of ordinary skill in the art would have considered the subject matter of claim 15 to have been obvious, because it was commonplace to design power supplies and power factor correction circuits to operate with 50 Hz and 60 Hz AC sources. Ex. 1004 ¶ 116.

Based on the evidence presented and the record before us, we are persuaded that Petitioner has established by a preponderance of evidence that claim 15 would have been obvious as of the critical date based on the combination of either APA and Hancock or APA and Gordon.

V. CONCLUSIONS

For the reasons set forth above, we are persuaded that Petitioner has shown by a preponderance of the evidence that:

- (1) Hancock and Gordon are prior art printed publications;
- (2) claims 1–22 are unpatentable under 35 U.S.C. § 103(a) as obvious over APA and Hancock;
- (3) claims 1–22 are unpatentable under 35 U.S.C. § 103(a) as obvious over APA and Gordon;

VI. ORDER

Accordingly, it is
ORDERED that Patent Owner's Motion to Exclude is DENIED;
FURTHER ORDERED that claims 1–22 of U.S. Patent 6,023,153 have been shown to be unpatentable; and

FURTHER ORDERED that because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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Patent 6,023,153

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