

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SUMITOMO ELECTRIC INDUSTRIES, LTD.,
Petitioner,

v.

UNITED TECHNOLOGIES CORPORATION,
Patent Owner.

Case IPR2017-00966
Patent 9,166,243 B2

Before CHRISTOPHER L. CRUMBLEY, JON B. TORNQUIST, and
JEFFREY W. ABRAHAM, *Administrative Patent Judges*.

CRUMBLEY, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318 and 37 C.F.R. § 42.73

I. INTRODUCTION

In this *inter partes* review trial, instituted pursuant to 35 U.S.C. § 314, Petitioner Sumitomo Electric Industries, Ltd. (“SEI”) challenges the patentability of claims 1–4, 8–13, 16, and 17 of U.S. Patent No. 9,166,243 B2 (Ex. 1001, “the ’243 patent”), owned by United Technologies Corporation (“UTC”).

We have jurisdiction under 35 U.S.C. § 6(b). This Final Written Decision, issued pursuant to 35 U.S.C. § 318(a), addresses issues and arguments raised during trial. For the reasons discussed below, we determine that SEI has not proven, by a preponderance of the evidence, that claims 1–4, 8–13, 16, and 17 of the ’243 patent are unpatentable.

A. Procedural History

On February 23, 2017, SEI requested an *inter partes* review of claims 1–4, 8–13, 16, and 17 of the ’243 patent. Paper 2, “Pet.” UTC filed a Patent Owner Preliminary Response. Paper 6. In a Decision on Institution of *Inter Partes* Review (Paper 7, “Dec. on Inst.”), we instituted trial as to all challenged claims on the following grounds of unpatentability:

1. Whether claims 1–4, 8–13, 16, and 17 are unpatentable under 35 U.S.C. § 103(a),¹ as having been obvious over the combined disclosures of JP228,² JP659,³ and JP029;⁴ and
2. Whether claims 1–4, 8–13, 16, and 17 are unpatentable under 35 U.S.C. § 103(a), as having been obvious over the combined disclosures of JP228, JP659, JP029, and Perry.⁵

Dec. on Inst. 27.

Following institution, UTC filed a Patent Owner Response (Paper 13, “PO Resp.”), and SEI filed a Reply (Paper 16, “Pet. Reply”).

SEI supported its Petition with the Declaration of Toru Kato. Ex. 1025. UTC took cross-examination of Dr. Kato via deposition, and filed the transcript in the record. Ex. 2022. With its Reply, SEI submitted a

¹ The relevant sections of the Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112–29, took effect on March 16, 2013. Because the application to which the ’243 patent claims priority was filed before that date, our citations to Title 35 are to its pre-AIA version.

² Japan Examined Patent Application Publication S54-19228, published July 13, 1979 (Ex. 1003). An English translation of Exhibit 1003 was submitted as Exhibit 1004; citations to “JP228” herein are to the translation.

³ Japan Unexamined Patent Application Publication H02-148659, published June 7, 1990 (Ex. 1005). An English translation of Exhibit 1005 was submitted as Exhibit 1006; citations to “JP659” herein are to the translation.

⁴ Japan Unexamined Patent Application Publication 2006-156029, published June 15, 2006 (Ex. 1008). An English translation of Exhibit 1008 was submitted as Exhibit 1009; citations to “JP029” herein are to the translation.

⁵ U.S. Patent Application Pub. No. 2008/0292938 A1 to Perry et al., published Nov. 27, 2008 (Ex. 1007).

Supplemental Declaration of Dr. Kato (Ex. 1058), and also provided a Supplemental Declaration of James Yagaeshi (Ex. 1066).

With its Patent Owner Response, UTC submitted the Declaration of Dr. Fikile Brushett. Ex. 2048. SEI took cross-examination testimony of Dr. Brushett via deposition, and submitted the transcript. Ex. 1069.

During trial, a dispute arose regarding the English translation of JP228 (Ex. 1004), which we address at further length below. In response to a request from UTC, we authorized UTC to file the declaration of David Baldwin (Ex. 2050), which included as Exhibit A a prior declaration by Mr. Baldwin regarding the translation of JP228. In our Order authorizing the filing, we noted that Exhibit A would be accepted solely for the limited purpose of establishing Mr. Baldwin's credibility, not as independent evidence of the proper translation of JP228. Paper 19.

UTC filed a Motion to Exclude certain evidence submitted by SEI with its Reply (Paper 21, "Mot."), to which SEI filed an Opposition (Paper 23, "Mot. Opp.") and UTC filed a Reply (Paper 25, "Mot. Reply").

An oral hearing was held on May 10, 2018, and a transcript of the oral hearing is available in the record. Paper 28 ("Tr.").

B. The '243 Patent

The '243 patent, titled "Flow Battery With Interdigitated Flow Field," issued October 20, 2015, from U.S. Patent Application No. 13/513,651 ("the '651 application"), filed on June 4, 2012. Ex. 1001, (54), (45), (21), (86). The '651 application was a national stage filing of PCT application PCT/US2009/068681, filed December 18, 2009. *Id.* at (86), (22).

As UTC acknowledges, flow batteries, and specifically redox flow batteries (“RFBs”), have been known for over 40 years. Paper 6, 3. Typical flow batteries use the flow of an electrolyte over an electrode to convert chemical energy stored in the electrolyte into electrical energy. Ex. 1001, 1:13–20. Conversely, the electrolyte may be pumped in reverse to convert excess electrical energy into stored chemical energy. *Id.* As such, the ’243 patent states that flow batteries have great potential in renewable resource generation such as wind power, to store energy production that exceeds customer demand. *Id.* at 1:17–20.

The ’243 patent discloses an RFB having the general structure shown in Figure 1 of the ’243 patent:

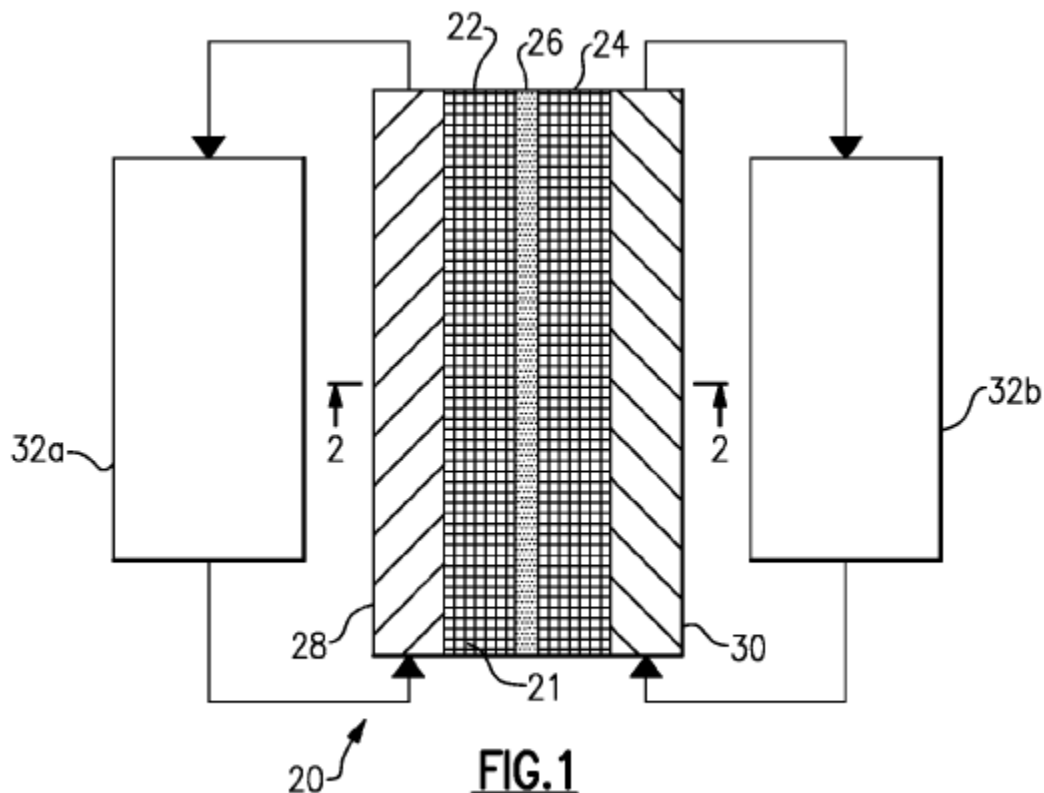


Figure 1 of the '243 patent depicts flow battery 20 with first liquid-porous electrode 22 and second liquid-porous electrode 24, separated by membrane 26. A first electrolyte liquid flows from first storage tank 32a through first flow field 28 adjacent to first electrode 22, while second electrolyte liquid flows from second storage tank 32b through second flow field 30 adjacent to second electrode 24. *Id.* at 2:30–67.

The flow fields of the '243 patent have a particular structure and are known as interdigitated flow fields (“IFFs”). In an IFF, the electrolyte flows through parallel channels in a plate, but the channels are at least partially blocked, causing the electrolyte to flow out of the channels and permeate the electrode before returning to an adjacent channel. *Id.* at 3:50–59. According to the '243 patent, the use of an IFF provides a lower pressure drop in the electrolyte flow than if the liquid merely flows through the channel without entering the electrode. *Id.* at 3:59–64. Figure 3 of the '243 patent depicts partially obstructed, interdigitated flow fields:

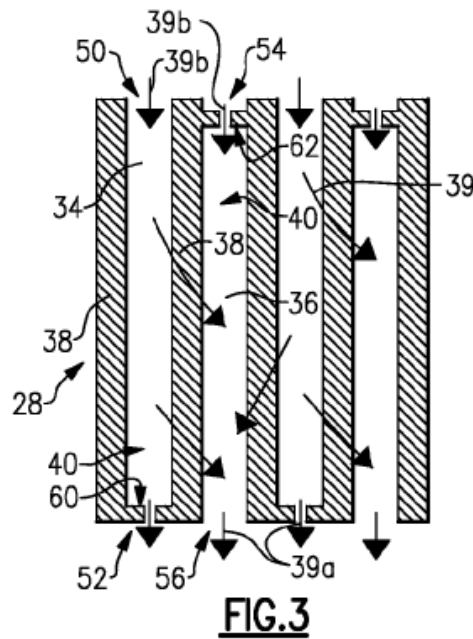


Figure 3 of the '243 patent depicts flow field 28 having second channels 36 interdigitated with first channels 34. The first channels have inlets 50 and partially blocked outlets 52, while the second channels have partially blocked inlets 54 and outlets 56. Liquid electrolyte flows into the first channels but is obstructed by the partial blockage, causing flow 38 into the adjacent second channels. *Id.* at 3:13–64.

C. Illustrative Claim

Of the challenged claims, claims 1, 13, and 16 are independent.

Claim 1 is reproduced below:

1. A redox flow battery comprising:
 - a first liquid-porous electrode;
 - a second liquid-porous electrode spaced apart from the first liquid-porous electrode;
 - an ion-exchange membrane arranged between the first liquid-porous electrode and the second liquid-porous electrode;

first and second flow fields adjacent the respective first liquid-porous electrode and second liquid-porous electrode, each of the first and second flow fields including first channels having at least partially blocked outlets and second channels having at least partially blocked inlets, and the second channels are interdigitated with the first channels; and
a positive electrolyte storage tank connected in a positive recirculation loop with one of the first or second flow fields and a negative electrolyte storage tank connected in a negative recirculation loop with the other of the first or second flow fields.

Ex. 1001, 5:36–54. Claim 13 is a method claim counterpart to the apparatus of claim 1, comprising the steps of providing the battery of claim 1 and “restricting flow of a liquid electrolyte through the first channels using the at least partially blocked outlets of the first channels to force flow of the liquid electrolyte through the adjacent respective first liquid-porous electrode or second liquid-porous electrode into an adjacent second channel.” *Id.* at 6:38–62. Claim 16 is an apparatus claim largely similar in structure to claim 1, but recites that the redox flow battery comprises at least one cell containing the various limitations of claim 1.

II. ANALYSIS

A. Claim Construction

In an *inter partes* review, we construe claims by applying the broadest reasonable interpretation in light of the specification. 37 C.F.R. § 42.100(b); *see also In re Cuozzo Speed Techs., LLC*, 136 S. Ct. 2131 (2016). Only those terms in controversy need to be construed, however, and only to the extent necessary to resolve the controversy. *See Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

For purposes of our Decision on Institution, SEI asked that we construe the term *block*, which appears in the independent claims as “partially block[]” and in claim 4 as “fully block” (Pet. 15), and also that we clarify that claim 16’s limitation of “at least one cell including . . . first and second electrolyte storage tanks” means that the tanks are in the battery as a whole, not necessarily within a cell. *Id.* at 16. We determined that construction of these terms was not necessary to determine whether to institute trial (Dec. on Inst. 8), and neither party returned to these claim terms during the instituted trial.

We also declined to construe *redox flow battery* pursuant to UTC’s request in its Preliminary Response, because we determined that the preambles of the independent claims were not limiting in their scope. *Id.* at 8–9. In its Patent Owner Response, UTC contends that the preambles are indeed limiting, and asks that we construe *redox flow battery* as follows:

a battery for selectively storing and discharging electric energy, in which a cell drives a reversible redox reaction, in which, upon charging, the electrical energy supplied causes a chemical reduction reaction in one electrolyte and an oxidation reaction in the other electrolyte, and upon discharging, the chemical energy contained in the electrolyte is released in the reverse reactions and electrical energy can be drawn from the electrodes.

PO Resp. 18.

We will only construe a claim term appearing in the preamble of a claim as limiting if it is necessary to “give life, meaning, and vitality” to the claim. *Pitney Bowes, Inc. v. Hewlett-Packard Co.*, 182 F.3d 1298, 1305 (Fed. Cir. 1999) (citing *Kropa v. Robie*, 187 F.2d 150, 152 (CCPA 1951)).

[A] preamble may be limiting if: “it recites essential structure or steps”; claims “depend[] on a particular disputed preamble phrase for antecedent basis”; the preamble “is essential to understand limitations or terms in the claim body”; the preamble “recit[es] additional structure or steps underscored as important by the specification”; or there was “clear reliance on the preamble during prosecution to distinguish the claimed invention from the prior art.”

Georgetown Rail Equip. Co. v. Holland L.P., 867 F.3d 1228, 1236 (Fed. Cir. 2017) (citing *Catalina Mktg. Int’l, Inc. v. Coolsavings.com, Inc.*, 289 F.3d 801, 808 (Fed. Cir. 2002)).

UTC’s argument is that the preamble—specifically, the recitation of *redox flow battery*—is limiting because it “breathe[s] life” into the remainder of the claim. PO Resp. 13 (citing *Catalina Mktg.*, 289 F.3d at 808). As evidence, UTC cites the prosecution history of the ’243 patent, specifically an amendment wherein storage tanks and recirculation loops were added to the claims as positive recitations, to distinguish over a prior art reference. *Id.* at 14. UTC argues that this makes clear that the claims are intended to be directed to redox flow batteries, making the preamble limiting.

We disagree. As the Federal Circuit has observed, “[a] preamble is not a claim limitation if the claim body ‘defines a structurally complete invention . . . and uses the preamble only to state a purpose or intended use for the invention.’” *Georgetown Rail*, 867 F.3d at 1236 (citing *Rowe v. Dror*, 112 F.3d 473, 478 (Fed. Cir. 1997)). The fact that the claims were amended to include storage tanks and recirculation loops actually cuts against UTC’s position, as the claim as amended describes a structurally

complete invention and reliance on the preamble for this structure is unnecessary.

UTC also points to the fact that the Examiner amended the preamble during prosecution, from merely reciting a “flow battery” to a “redox flow battery.” PO Resp. 15. While “clear reliance on the preamble during prosecution to distinguish the claimed invention from the prior art” (*Catalina Mktg.*, 289 F.3d at 809) may be a reason to view the preamble as limiting, UTC directs us to no evidence here that the Examiner intended the amendment to distinguish the claims from the prior art. Indeed, as UTC acknowledges in its Response, a person of ordinary skill in the art would have understood the ’243 patent to use “‘redox flow battery’ and ‘flow battery’ *to mean the same thing.*” PO Resp. 13 (emphasis added). If, as UTC concedes, the Examiner’s amendment merely substituted one synonym for another, the amendment could not have changed the scope of the claim or distinguished over the prior art. For these reasons, we conclude that the preamble of the claims is not limiting, and, therefore, we need not construe the term *redox flow battery*.

B. UTC’s Motion to Exclude

Before turning to the merits of the parties’ arguments, we first determine the scope of the record by addressing UTC’s Motion to Exclude. In its Motion, UTC seeks to exclude Exhibit 1066, which is the Supplemental Declaration of James Yagaeshi. Mot. 2. For the following reasons, we *deny* the motion.

At the outset, we note that motions to exclude in an *inter partes* review are intended to address evidentiary challenges to the admissibility of

evidence. Our Rule 42.64 provides that a motion to exclude is necessary to preserve any objection, and refers to those objections as “objections to the admissibility” of evidence. See 37 C.F.R. § 42.64(a), (c). The Board’s Trial Practice Guide further explains that a motion to exclude “must explain why the evidence is not admissible.” See Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48,767. In other words, objections to the timing of late-arising evidence or procedural infirmities are not proper for a motion to exclude.

For this reason, the objections raised in UTC’s motion to exclude are improper. *First*, UTC argues that Exhibit 1066 is untimely under 37 C.F.R. § 42.63(b), which requires a translation of a foreign-language document to be filed with the document. Mot. 5. By UTC’s reasoning, because the Supplemental Declaration revisits Mr. Yagaeshi’s prior translation, but was not submitted *with* the foreign-language document, it violates the Board’s rules. *Id.* As this is clearly a procedural objection to the timing of the evidence, as opposed to its admissibility, we deny the motion to exclude on this basis. In any event, even if it were procedurally proper, we would not exclude the Supplemental Declaration on this basis. The Board’s Rule requires only that the original foreign-language document be accompanied by a translation, and there is no dispute that is what happened here. We see nothing in Rule 42.63(b) that prohibits a party to revisit, or even modify, its translation at a later date, given sufficient notice and opportunity to respond by the opposing party. Here, we granted UTC the opportunity to submit its own responsive declaration and address the translation issue at the oral hearing, and UTC did so.

Second, UTC argues that Exhibit 1066 should be excluded as impermissible new evidence because 35 U.S.C. § 312(a)(3) requires petitioners to provide all evidence supporting the grounds of unpatentability with the petition. Mot 5. Again, this sort of objection is improper in a motion to exclude, but even considered on its merits, we find it unpersuasive. The statute does not prohibit the introduction of evidence by petitioners subsequent to the petition; to the contrary, the Federal Circuit has stated that “the introduction of new evidence in the course of the trial is to be expected in *inter partes* review trial proceedings . . . as long as the opposing party is given notice of the evidence and an opportunity to respond to it.” *Genzyme Therapeutic Prod. Ltd. P’ship v. Biomarin Pharm. Inc.*, 825 F.3d 1360, 1367 (Fed. Cir. 2016). While new evidence amounting to “changing theories in midstream” during the course of an *inter partes* review is not permitted, we do not consider the modification to Mr. Yagaeshi’s initial translation to rise to such a level.

Third, UTC objects to Exhibit 1066 as an “ambush” that violates our Rule 42.123(b), pertaining to the submission of supplemental information. Mot. 7. According to UTC, SEI should have first sought authorization to file a motion to submit the Supplemental Declaration as supplemental information, and then only submitted the declaration if the motion was granted. *Id.* Instead, it appears SEI presented UTC with the Supplemental Declaration shortly before SEI’s deposition of Dr. Brushett, and then filed the Supplemental Declaration with its Reply. *Id.* at 8. Again, this is a procedural objection that should have been raised outside a motion to exclude; indeed, UTC did so in this case, by contacting the Board regarding

the Supplemental Declaration and its desire to submit the Declaration of Mr. Baldwin. See Paper 19. Having submitted the Declaration and addressed the translation issue at oral hearing, we consider any potential prejudice to UTC caused by the alleged “ambush” to have been minimized. Even if proper for a motion to exclude, we would deny UTC’s objection on this basis.

For these reasons, we *deny* UTC’s motion to exclude Exhibit 1066.

C. Obviousness over JP228, JP659, and JP029

SEI contends that claims 1–4, 8–13, 16, and 17 are unpatentable under 35 U.S.C. § 103(a), as they would have been obvious over the combined disclosures of JP228, JP659, and JP029. Pet. 31–39. An obviousness inquiry involves four underlying determinations: the scope and content of the prior art; the differences between the prior art and the claims at issue; the level of ordinary skill; and any objective indicia of nonobviousness.

Graham v. John Deere Co., 383 U.S. 1, 17 (1966). In cases where “all claim limitations are found in a number of prior art references,” a party challenging a claim as obvious must show “that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.” *Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1361 (Fed. Cir. 2007). While the reason to combine need not be explicitly stated in the prior art, the challenger must “articulate[] reasoning with some rational underpinning to support the legal conclusion of obviousness.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418–20 (2007).

1. The Level of Skill

The parties are generally in agreement as to the level of ordinary skill in the art, though both also state that there is no need for the Board to set forth a level of skill. PO Resp. 12; Pet. Reply 7. As the dispute between the parties turns on a determination of whether a person of ordinary skill in the art would have had reason to combine the references, we believe a finding as to the level of ordinary skill would be helpful to our analysis.

The parties' proposed recitations of the level of skill are as follows:

Petitioner SEI's Proposal	Patent Owner UTC's Proposal
A person with a degree in chemistry, physics, chemical engineering, electrical engineering or mechanical engineering, who also has at least one year of education or experience in flow cell structure design. Pet. Reply 8	A person that has 1) a bachelor's degree in chemistry or chemical engineering and 2) and at least two years' experience designing RFB systems, testing RFB systems, or a combination of designing and testing RFB systems so as to obtain functional knowledge of RFB system structure and operation. PO Resp. 12 (citing Ex. 2048 ¶ 45).

SEI contends that the person of ordinary skill should not be limited to only a degree in chemistry or chemical engineering, because the claimed features of the flow batteries are not directed to chemistry. Pet. Reply 7. We agree, and adopt SEI's definition of the relevant educational background. While the parties differ as to the number of years of experience in working with flow batteries, we do not consider the difference (one versus two years) to be significant. We find that a person of ordinary skill in the art at the time of invention would be a person with a degree in chemistry, physics, chemical engineering, electrical engineering, or mechanical

engineering, who has at least one year of experience designing or testing flow batteries so as to obtain functional knowledge of their structure and operation. We have reviewed the level of skill reflected in the prior art and consider it consistent with this definition. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

2. JP228

SEI refers to JP228 as its “principal reference,” and asserts that it discloses “flow type electrolytic cells” with IFFs, as claimed. Pet. 21. JP228 generally discusses flow type electrolytic cells with porous electrodes having a plurality of inflow and outflow paths for the electrolytic solution. Ex. 1004, 2. The cell is for “continuously performing electrolysis” by causing an electrolyte in which a substance to be electrolyzed is dissolved to flow over the electrodes. *Id.* JP228 refers to several uses of such flow type electrolytic cells, such as “organic synthesis, heavy-metal recovery, fuel cells, electroanalysis, [and] electrodialysis.” *Id.* The invention modifies traditional parallel flow electrolytic cells—in which the electrolyte flows along the surface of the electrode—by using flow channels to manage flow of the electrolyte over the electrode surface. *Id.* at 2, 4. Figure 5 of JP228 illustrates such channels:

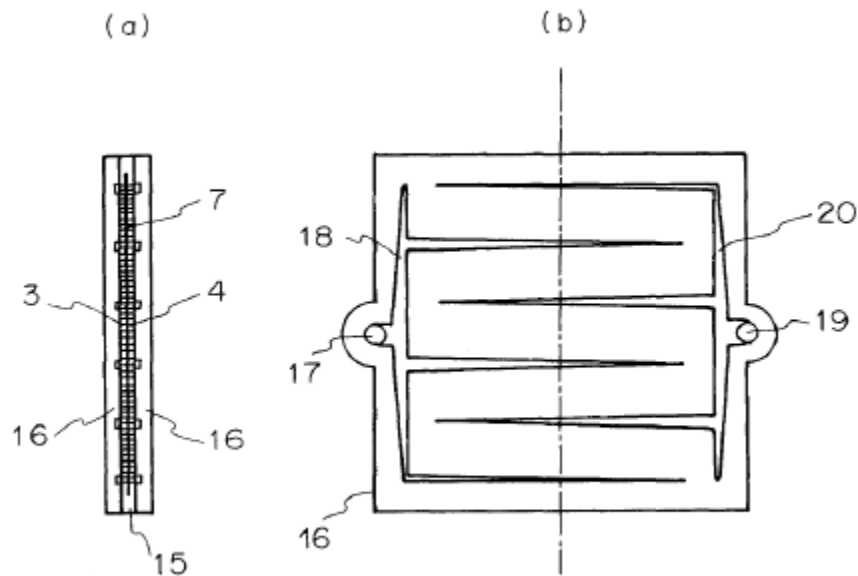


Figure 5(b) of JP228 depicts pressing plates 16 having grooves 18 and 20, and inflow and outflow holes 17 and 19. *Id.* at 5. The grooves thus define “two groups of branches” such that “electrolyte flows evenly over the entire surface of the porous electrodes 3 and 4.” *Id.* at 5–6. According to SEI, these channels define a “plurality of interdigitated inflow paths and outflow paths,” and the ends of channels 18 and 20 are fully blocked. Pet. 23.

a. The Translation Dispute

During trial, a dispute arose between the parties as to the correct translation of a portion of JP228. The original translation submitted by Petitioner, in describing an experiment to study the current distribution in JP228’s cell, states that “the current value A was read when the potential

became -0.4V (versus saturated calomel electrode).” Ex. 1004, 4:13–14.⁶ In its Response, UTC argued that this potential of -0.4V leads to the cell having an overpotential of 930 mV, implying that the exemplary cell of JP228 is not a flow battery. PO Resp. 28–29.

Following UTC’s response, SEI submitted a Supplemental Declaration from its translator Mr. Yagaeshi, in which he testifies that the character preceding “0.4V” in JP228 appears to be a dash, not a minus sign, and provides examples of other places in the translation where the dash was translated as a hyphen. Ex. 1066 ¶¶ 9–12. Mr. Yagaeshi then states that “the dash preceding 0.4 appears to be a typographical error” (*id.* ¶ 13), although it is unclear whether he is contending that the dash in the original document is an error, or if his translation was in error. Mr. Yagaeshi also points out other places in JP228 in which a plus or minus sign was used in the figures, where they are placed within circles. *Id.* at 4.

With our authorization, UTC submitted a responsive declaration from David Baldwin, a translator with 22 years of experience in Japanese-English translation. Ex. 2050 ¶ 4. Mr. Baldwin testifies that the Japanese character preceding the disputed dash or minus sign is a “grammar particle,” which means that grammatically, a dash or hyphen would not make sense in the sentence and that the character can only be interpreted as a minus sign. *Id.* ¶ 13. Mr. Baldwin argues that Mr. Yagaeshi’s interpretation of the symbol as a dash would lead to the translation “when the potential became – 0.4 V,”

⁶ The original Japanese passage appears on page 2 of Exhibit 1003, at line

19: *cm*の点での電位が－0.4 V（対飽和甘こう電極）.

which is not grammatically correct. *Id.* ¶ 16. Mr. Baldwin also testifies that he believes Mr. Yagaeshi's reference to the positive and negative signs placed in circles in the figures is in error, because the machine used in 1976 to create the figures was "likely very different" than the typewriter used for the text of JP228. *Id.* ¶ 18.

UTC submitted a prior translation of JP228 by Mr. Baldwin. Ex. 2050, Exhibit A. Mr. Baldwin testifies that this translation was produced in or around November 2016, prior to seeing Mr. Yagaeshi's translation and before the filing of SEI's Petition. *Id.* ¶ 19. Because of the late timing of this submission, we do not consider it proper to rely on the prior translation itself as independent evidence of the proper translation of JP228 (*see* Paper 19), but the fact that Mr. Baldwin's testimony in this *inter partes* review is consistent with his prior, pre-dispute translation is evidence that his testimony has not changed in view of Mr. Yagaeshi's translation or the parties' arguments in this *inter partes* review.

On this record, we determine that Mr. Baldwin's translation of the character as a minus sign, which is consistent with Mr. Yagaeshi's original translation, makes more grammatical sense in the context of the sentence. We take note of the fact that SEI only changed its position on the translation—and asked Mr. Yagaeshi to correct his prior translation—once UTC made arguments based on the original translation that might be detrimental to SEI's case. While it is conceivable that SEI only became aware of the alleged error once UTC called attention to it in the Response, we consider it fair to hold SEI to its original interpretation, especially given that that original interpretation is in agreement with Mr. Baldwin's

translation, which has remained consistent since at least 2016. For these reasons, we will interpret the disputed passage of JP228 to read “the potential was negative 0.4V.”

b. Whether JP228 Discloses Redox Flow Batteries

The parties also dispute the disclosure of JP228, in particular whether its discussion of “flow type electrolytic cells” would be understood by the person of ordinary skill to include RFBs. As summarized above, JP228’s “Detailed Description of the Invention” begins as follows:

The present invention relates to a flow type electrolytic cell for continuously performing electrolysis by causing an electrolyte, in which a substance to be electrolyzed is dissolved, to flow, wherein the electrolytic current can be increased by selecting a flow path in the electrolytic cell that averages the current distribution inside the electrolytic cell.

Flow type electrolytic cells are widely used for organic synthesis, heavy-metal recovery, fuel cells, electroanalysis, electrodialysis, etc.

Ex. 1004, 2:6–11. Notably, in its list of uses for flow type electrolytic cells, JP228 does not mention RFBs, or flow batteries at all.

Dr. Kato testifies that the disclosure of “flow-type electrolytic cells” in JP228 would be understood by a person of ordinary skill in the art to include redox flow batteries. Ex. 1025 ¶ 206. Dr. Kato notes that the list of types of flow-type electrolytic cells in JP228 includes both embodiments where current is applied to cause a chemical reaction (*e.g.*, organic synthesis), as well as one wherein a chemical reaction produces electric current (fuel cells). Ex. 1025 ¶ 208. From this, Dr. Kato concludes that “flow-type electrolytic cells” is used broadly in JP228 and would include

RFBs. *Id.* Dr. Kato also states that JP228 describes the structure of its cell using terms that are consistent with an RFB. *Id.* ¶ 213. With respect to the example cell recited in JP228 (Ex. 1004, 4:3–5:14), Dr. Kato testifies that it would be understood to be an RFB, because it uses ferrous sulfate and ferric sulfate as electrolytes. Ex. 1025 ¶¶ 211–212.

In response, UTC provides the testimony of Dr. Brushett, who disagrees that a person of ordinary skill would have understood JP228 to pertain to RFBs. Ex. 2048 ¶¶ 61–86. While Dr. Brushett acknowledges that JP228 lists as examples of “flow type electrolytic cells” both cells for producing a chemical reaction (energy consumption) as well as cells for energy generation (*id.* ¶ 63), he argues that all the cells listed in JP228 are what he calls “one-way cells” because their reactions are intended to be run in only one direction. *Id.* ¶¶ 34–36. According to Dr. Brushett, JP228 is entirely silent as to what he calls “two-way cells” such as RFBs, which are designed to run their electrochemical reactions reversibly. *Id.* ¶¶ 37–38, 65 (“[T]he disclosure of some types of one-way cells *using* electricity, and different types of one-way cells *producing* electricity, does not amount to a disclosure of cells that *both* use and produce electricity . . .”).

Dr. Brushett also disagrees with Dr. Kato’s additional reasons for concluding that the cells of JP228 encompass RFBs. The structural aspects of the JP228 cells, such as flow plates and membranes, are not particular to RFBs but are also present in one-way electrochemical cells. *Id.* ¶¶ 68–74. And Dr. Brushett testifies that the use of ferrous sulfate and ferric sulfate as electrolytes in JP228’s example cell does not signify that the cell is an RFB, because these electrolytes may also find use in other types of electrolytic

cells. *Id.* ¶ 80 (citing Ex. 2019, 1:1–22 (heavy metal recovery), Ex. 2036, Abstract (metal extraction), Ex. 2037, 337 (iron-air batteries)).

Finally, Dr. Brushett directs us to the potential of the positive electrode in JP228’s exemplary cell, which is -0.4V. Ex. 2048 ¶ 76. Dr. Brushett explains that this potential implies that the cell has an overpotential of 930 mV, which is outside the range at which it is desirable to run an RFB. *Id.* ¶¶ 76–77. According to Dr. Brushett, while a high overpotential might be desirable in a one-way cell to maximize reactant conversion, it would decrease the energy efficiency of the cell, which is particularly undesirable in the context of RFBs. *Id.* ¶ 79. Dr. Brushett cites a 2011 review of RFBs, which notes that they are typically operated at overpotentials of less than 150 mV. *Id.* ¶ 77 (citing Ex. 2035, 1148). Based on Dr. Brushett’s opinions, UTC argues that a person of ordinary skill in the art would not have understood JP228 to pertain to, or suggest, RFBs. PO Resp. 21.

We find that a person of ordinary skill in the art would not have understood JP228 to pertain to RFBs. The record contains insufficient support for SEI’s assertion that the term “‘electrolytic cell’ is used broadly, and would encompass RFBs.” Pet. 22. SEI and Dr. Kato provide scant support for this assertion, and there are logical gaps in SEI’s supporting analysis. For example, as UTC correctly notes, the mere fact that RFBs *may* use the electrolytes recited in JP228 does not mean everything that uses those electrolytes *are* RFBs.⁷ We also find particularly noteworthy UTC’s

⁷ SEI argues in its Reply that it is the *combination* of the particular iron electrolytes with the structure of Figures 2a, 3, and 5 that proves that JP228’s example is an RFB, and that UTC has not explained how the other

argument that the overpotential of the JP228 exemplary cell is well outside the range of what is practical for an RFB, as this strongly indicates that what is disclosed in JP228 is not what SEI alleges.

Having reviewed the testimony of both experts, we are left with the conclusion that a person of ordinary skill in the art reading JP228 would not have understood it to disclose RFBs as SEI contends. The reference contains no explicit reference to RFBs; no mention of any of the structural features that are unique to RFBs, such as recirculation loops; nor does it address any of the challenges the prior art confirms are particular to the field of RFBs, such as pressure loss. Ex. 1006, 4. These facts, in combination with the overpotential issue raised by UTC, convince us that a preponderance of the evidence does not support the conclusion that JP228 reasonably would have been understood to encompass RFBs.

3. JP659

JP659 discloses a “liquid flow type electrolytic cell” which may be used in an RFB. Ex. 1006, 2. The electrolytes used in the battery are stored in tanks and circulated through the cell using a pump. *Id.* at 8. The reference recognizes a problem of electrolyte pressure loss that is encountered when electrolyte is pumped across the electrode of a flow

uses it proposes, such as metal recovery, would be used in such a structure. Pet. Reply 17 (“How would metal be recovered from porous electrodes?”). But it is SEI, not UTC, that bears the burden of proof on the disclosure of JP228, and this combination theory was not adequately set forth in the Petition. And, in any event, SEI’s rhetorical questions are unsupported by Dr. Kato’s testimony and do not address uses UTC notes such as iron-air batteries, or why the electrodes of JP228 would be unsuitable for this purpose.

battery, which may be addressed by increasing the thickness of the electrode. *Id.* at 4. Increasing the thickness of the electrode also increases cost, however, so JP659 seeks to address the problem of pressure loss by including a plurality of liquid flow grooves in the collector plate. *Id.* at 8–9. The grooves of the collector plate are in parallel (*see id.* at Fig 1(a)); JP659 does not include interdigitated grooves.

4. JP029

JP029 discloses a carbon electrode material for use in a vanadium RFB. Ex. 1009, 2. The flow battery is depicted as having electrolyte tanks, pumps, and circulation pipes in communication with the battery cell. *Id.* at Fig. 1. The electrolyte is pumped across the electrode, disposed between a bipolar plate and a membrane. *Id.* ¶¶ 4–5. JP029 does not disclose any grooves or channels in the surface of the bipolar plate.

5. *The Proposed Combination*

There is no real dispute between the parties as to whether the collected prior art discloses all elements of the challenged claims. For example, SEI sets forth how JP228 discloses the claimed porous electrodes, membrane, and flow fields with channels, and JP659 and JP028 disclose the claimed storage tanks and recirculation loops. Pet. 32–33. UTC does not dispute any of these assertions.

Rather, the focus of the parties’ dispute, and the determinative issue before us, is whether a person of ordinary skill in the art would have combined the disclosures of the references in the manner SEI asserts.⁸ SEI

⁸ In its Reply, SEI characterizes UTC’s argument against the combination as being one of nonanalogous art. Pet. Reply 8 (“A main thrust of UTC’s

contends that a person of ordinary skill in the art would have had reason to combine the disclosures of JP228, JP659, and JP029, because they all pertain to redox flow batteries. Pet. 30 (“[I]t would have been obvious to combine features of JP’228, JP’659 and JP’029 in the ways discussed below . . . because they all pertain to [RFBs].”⁹). As a result, SEI asserts, the artisan would have had reason to substitute the flow field structures of one cell into another, similar cell with predictable results. *Id.* With respect to the specific combination that would have been made, SEI contends that the person of ordinary skill either would have connected the cell of JP228 to tanks and recirculation loops of JP659 or JP029, or substituted the IFFs of JP228 for the flow fields disclosed in JP659 and JP029. *Id.* at 31. Either combination would allegedly result in an RFB cell having an IFF. Dr. Kato generally supports these assertions, but does not expand on what is set forth in the Petition. Ex. 1025 ¶¶ 272–273.

UTC challenges the combinations proposed by SEI. First, UTC contends that a person of ordinary skill would not have had reason to add the storage tanks and recirculation loops of JP659 or JP029 to the cells of JP228, because JP228 only discloses “one-way systems” that would have no reason to use recirculation. PO Resp. 35–41. With regard to SEI’s second

argument is that JP228 and Perry are not analogous art.”). SEI does not indicate where in the briefing UTC made a nonanalogous art argument, however, and at oral hearing UTC’s counsel explicitly disclaimed such an argument. Tr. 18:9–10.

⁹ The Petition and Dr. Kato state that the references all pertain to “RBCs.” Pet. 30; Ex. 1025 ¶ 273. In his Supplemental Declaration, Dr. Kato corrects this to “RFBs.” Ex. 1058 ¶ 10.

combination, UTC argues that SEI has failed to explain why a person of ordinary skill would have had any reason to incorporate JP228's IFFs into the RFBs of JP659 or JP029, given that JP228 does not discuss RFBs and their "unique functions and challenges." *Id.* at 41–51. For example, UTC cites the testimony of Dr. Brushett, who explains the importance of energy efficiency to RFBs, and the fact that the IFFs of JP228 would be expected to lead to significant pressure loss and therefore reduced energy efficiency. Ex. 2048 ¶¶ 118–122.

While UTC and Dr. Brushett set forth substantial evidence that pressure loss caused by IFFs was a known problem and would have been considered disadvantageous in RFBs, we need not resolve the parties' dispute over these facts to resolve the case before us. This is because SEI's proposed reason to make either of its combinations rests on a flawed foundation; namely, the assertion that JP228 pertains to RFBs. *See* Pet. 30–31. As we have discussed above, we disagree with this characterization of JP228. But because of their flawed premise that JP228 discloses redox flow batteries, SEI and Dr. Kato set forth only a cursory explanation of the reason to combine, one that does not explain the motivation to modify the prior art systems other than stating "it would have been obvious to combine features" of the prior art because they all "pertain to [RFBs]." *Id.*; *see* Ex. 1025 ¶ 273. SEI provides no analysis of the problems the skilled artisan would have sought to solve, the potential trade-offs in battery efficiency that would have to be addressed, or any expectation of success.

We note that, in its Reply, SEI attempts to remedy this flaw in its Petition by articulating "Additional Reasons to Combine," such as that

JP228's structures are consistent with, and useable in, flow batteries (Pet. Reply 14–15), and why a person of ordinary skill would have considered fuel cells (which are explicitly disclosed in JP228) to be pertinent to RFBs (*id.* at 12–13). SEI also argues in its Reply, for the first time, that the problem to be solved by the skilled artisan was “improving the flow characteristics and power density of known flow batteries, as represented by JP659 and JP029,” and that IFFs as shown in JP228 would have been “one of a few, know[n] flow patterns for membrane type cells.” *Id.* at 7.

When asked at oral hearing where these reasons to combine were presented in the Petition, counsel for SEI first referred to the Reply (Tr. 12:25–14:11), then in rebuttal time directed the Board to a general discussion in the Petition of JP228 (*id.* at 40:2–25). Counsel then conceded that the Petition “didn’t articulate [the reason to combine] exactly in that way that we did in the reply.” *Id.* at 41:24–25. This significantly understates the difference between the cursory reason to combine articulated in the Petition and the explanations provided in the Reply, which are in essence entirely new theories why a person of ordinary skill in the art would have combined the references.

“Unlike district court litigation—where parties have greater freedom to revise and develop their arguments over time and in response to newly discovered material—the expedited nature of IPRs bring with it an obligation for petitioners to make their case in their petition to institute.” *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369 (Fed. Cir. 2016). As participants in an adjudication under the Administrative Procedure Act, parties in an *inter partes* review must be

given notice of the “matters of fact and law asserted,” and the opportunity to meaningfully respond. *See Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1080 (Fed. Cir. 2015). For this reason, petitioners may not assert, and we may not base our decision on, late-arising factual assertions or theories. *See Dell Inc. v. Accelaron, LLC*, 818 F.3d 1293, 1301 (Fed. Cir. 2016). While it may be permissible in some cases for a petitioner to “merely expand on a previously argued rationale” (*Ericsson Inc. v. Intellectual Ventures I LLC*, No. 2017-1521, 2018 WL 4055815, at *6 (Fed. Cir. Aug. 27, 2018)), we cannot rely on “an entirely new rationale to explain why one of skill in the art would have been motivated to combine” the prior art. *Intelligent Bio-Systems*, 821 F.3d at 1370.

Here, the only rationale to combine presented by SEI in the Petition is based on the faulty factual assertion that JP228, JP659, and JP029 all pertain to the same field of RFBs. As we have discussed above, this theory is unpersuasive, and SEI’s proposed reason to combine is deficient on this basis.

6. Conclusion

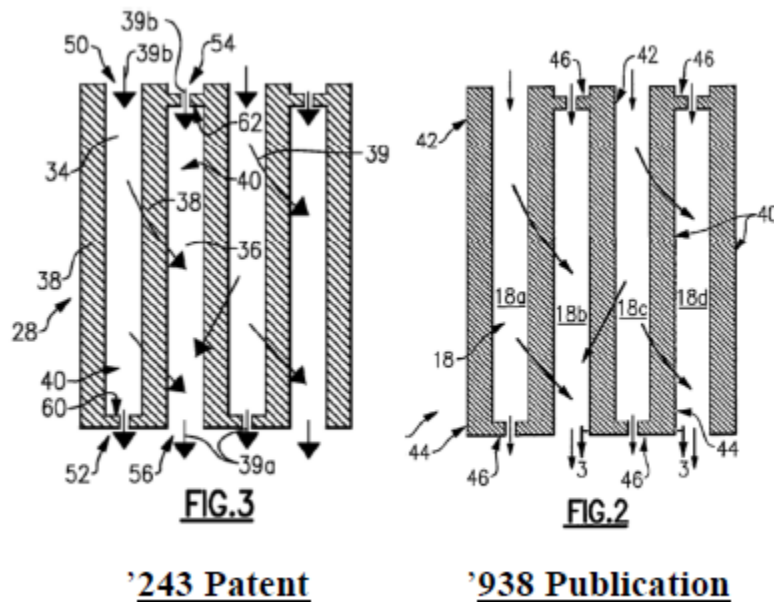
We find that SEI has not proven by a preponderance of the evidence that a person of ordinary skill in the art would have combined JP228, JP659, and JP029 in the manner proposed. As such, we cannot conclude that the subject matter of claims 1–4, 8–13, 16, and 17 would have been obvious over these references.

D. Obviousness over JP228, JP659, JP029, and Perry

SEI also challenges claims 1–4, 8–13, 16, and 17 as unpatentable under 35 U.S.C. § 103(a), as having been obvious over the combined

disclosures of JP228, JP659, JP029, and Perry. Pet. 39–41. According to SEI, Perry discloses membrane-type fuel cells having substantially the same IFF structure as those claimed in the '243 patent, likely due to the overlap in inventorship. *Id.* at 25, 39.

Perry discloses flow fields including “entrance channels hav[ing] fully open inlets and fully closed outlets and the exit channels hav[ing] fully closed inlets and fully open outlets.” Ex. 1007 ¶ 3. According to Perry, the closed outlets of the entrance channels force the reactant gas used in the fuel cell to flow out of the channel, through a gas distribution layer, and into an adjacent exit channel. *Id.* SEI provides a side-by-side comparison of the flow fields of Figure 2 of Perry and Figure 3 of the '243 patent:



Pet. 26. These figures demonstrate the similar structure of the interdigitated flow fields of Perry and the '243 patent, including channels with partially blocked inlets or outlets.

SEI concedes that the primary focus of Perry is on the use of its flow fields with a gas reactant, but contends that claim 18 of Perry, which recites a method for “controlling fluid flow through a fuel cell” is broader because “fluid” encompasses both liquids and gases. *Id.* SEI contends that a person of ordinary skill in the art would have had reason to use the IFFs of Perry in the flow batteries of JP228, JP659, and JP029, “because the flow structures and methods in such cells are in the same or a closely analogous field of endeavor.” Pet. 31. Dr. Kato echoes, but does not expand on, this assertion in his testimony. Ex. 1025 ¶ 274. SEI argues that to the extent that the combination of JP228, JP659, and JP029 does not disclose the particular structure of the IFFs claimed, the structure is found in Perry’s disclosure. Pet. 39.

We found above that SEI has not proven that a person of ordinary skill in the art would have combined JP228, JP659, and JP029; the addition of Perry to this combination does not remedy this lack of proof. SEI does not argue that Perry provides a reason to combine the Japanese references distinct from those found unpersuasive above. Rather, SEI argues only that a person of ordinary skill would have combined the membrane-type fuel cells of Perry with the Japanese references, “because of the close similarity of membrane-type fuel cells and RFBs, and because the flow structures and methods in such cells are in the same or closely analogous field of endeavor.” Pet. 31. Again, SEI does not expand upon this single sentence in its Petition, which is insufficient to address the lack of proof discussed in the prior section regarding the combination of JP228, JP658, and JP029.

Nor does the Petition provide a sufficient independent reason to combine Perry with any of the Japanese references. For example, SEI does not explain with any particularity how the alleged “close similarity”¹⁰ of the fuel cells of Perry to the RFBs of JP659 and JP029 would have suggested to a person of ordinary skill in the art that the flow fields of a fuel cell would improve an RFB. Nor does SEI demonstrate that there would have been a reasonable expectation of success in arriving at the claimed invention. And in response, UTC and Dr. Brushett set forth reasons why a person of ordinary skill would have considered fuel cell IFFs incompatible with RFBs, including that Perry’s fuel cell IFFs are designed for a gas (hydrogen/oxygen) system while RFBs use liquid electrolytes, and that the use of a fuel cell IFF would exacerbate the pressure loss problems of an RFB. Pet. 46–52; Ex. 2048 ¶¶ 123–133. Dr. Kato does not provide any supplemental testimony in response to these contentions, and SEI merely argues that Perry and RFBs are analogous art.¹¹ Pet. Reply 8–13. But the fact that references are analogous art only means that they *may* be combined for purposes of obviousness; it does not necessarily mean that a person of ordinary skill in the art *would* have had reason to combine them. To establish obviousness, a petitioner must show “some articulated reasoning

¹⁰ Dr. Kato testifies that, like RFBs, fuel cells have two electrodes with a membrane between them, typically use porous carbon electrodes, and use a fluid fuel and fluid oxidizer to create a flow of current at the electrodes. Ex. 1025 ¶¶ 131–148.

¹¹ As discussed above, we do not understand UTC’s argument to be that the references are nonanalogous art, but rather that SEI has failed to articulate sufficient reason to combine.

with some rational underpinning to support the legal conclusion of obviousness.” *KSR*, 550 U.S. at 418. This, SEI has not done. As a result, we find that SEI has not proven by a preponderance of the evidence that a person of ordinary skill would have combined JP228, JP659, JP029, and Perry in the manner proposed.

III. CONCLUSION

For the foregoing reasons, we determine that SEI has not demonstrated by a preponderance of the evidence that claims 1–4, 8–13, 16, and 17 of the ’243 patent are unpatentable under 35 U.S.C. § 103(a) as having been obvious over the combined disclosures of JP228, JP659, JP029, or the combined disclosures of JP228, JP659, JP029, and Perry.

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.

IV. ORDER

Accordingly, it is:

ORDERED that UTC’s Motion to Exclude (Paper 21) is *denied*;

FURTHER ORDERED that claims 1–4, 8–13, 16, and 17 of U.S. Patent No. 9,166,243 B2 are *not unpatentable*; and

FURTHER ORDERED that, pursuant to 35 U.S.C. § 318(b), upon expiration of the time for appeal of this decision, or the termination of any such appeal, a certificate shall issue confirming the patentability of claims 1–4, 8–13, 16, and 17 of U.S. Patent No. 9,166,243 B2.

IPR2017-00966
Patent 9,166,243 B2

PETITIONER:

John S. Goetz
John Pegram
FISH & RICHARDSON P.C.
goetz@fr.com
peggram@fr.com

PATENT OWNER:

Theodore Olds
Matthew Koziarz
CARLSON, GASKEY & OLDS, P.C.
tolds@cgolaw.com
mkoziarz@cgolaw.com