

IPR2024-00948
U.S. Pat. No. 11,050,097

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ASCEND ELEMENTS, INC.

Petitioner,

v.

DUESENFELD GMBH

Patent Owner.

Inter Partes Review No. IPR2024-00948
U.S. Patent No. 11,050,097

**PATENT OWNER RESPONSE
PURSUANT TO 37 C.F.R. § 42.120**

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**PATENT OWNER'S EXHIBIT LIST
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Ex. 2001	Declaration of Vani Dantam in support of Patent Owner's Preliminary Response to the Petition ("Dantam Declaration")
Ex. 2002	Gao Liu et al., <i>Binder Interactions in the Electrodes of the Lithium-ion Batteries</i> , TFUG Conference, February 17, 2009 ("Gao")
Ex. 2003	DE 102012024876 A1 to Electrocyling GmbH ("Electrocyling") (English)
Ex. 2004	U.S. Patent No. 7,198,865 to Sloop ("Ecobat")
Ex. 2005	WO 2010/149611 A1 to LiMotive Company Ltd. ("LiMotive") (English)
Ex. 2006	WO 2010/149611 A1 to LiMotive Company Ltd. ("LiMotive") (German)
Ex. 2007	DE 102012024876 A1 to Electrocyling GmbH ("Electrocyling") (German)
Ex. 2008	Yang et al., <i>Thermal Stability of LiPF₆ Salt and Li-Ion Battery Electrolytes Containing LiPF₆</i> , Journal of Power Sources 161, 573 (2006) (Preprint) ("Yang")
Ex. 2009	Gnanaraj et al., <i>A Detailed Investigation of the Thermal Reactions of LiPF₆ Solution in Organic Carbonates Using ARC and DSC</i> , Journal of the Electrochemical Society, 150(11), A1533 (2003) ("Gnanaraj")
Ex. 2010	Certification of Translation of the Electrocyling Patent
Ex. 2011	Certification of Translation of the Limotive Patent
Ex. 2012	Duesenfeld GmbH Website – Recycling [https://www.duesenfeld.com/recycling_en.html]
Ex. 2013	Ascend Elements Press Release
Ex. 2014	<i>Ascend Elements, Inc.'s Answer to Complaint</i> , Case No. 1-23-cv-01194 (D. Del.)

Ex. 2015	Scheduling Order in Case No. 23-1194-JFM
Ex. 2016	Email from J.Stiel to J.Ploger (dated Dec. 6, 2023)(German)
Ex. 2017	Email from J.Stiel to J.Ploger (dated Dec. 6, 2023)(English)
Ex. 2018	Certification of Translation of Email from J.Stiel to J.Ploger (dated Dec. 6, 2023) and of Kwade, et al. (Ex. 2020, below)
Ex. 2019	Christian Hanish et al., <i>Recycling von Lithium-Ionen-Batterien – das Projekt LithoRec</i> , Recycling und Rohstoffe, January 2012 (“Kwade, et al.”) (German)
Ex. 2020	Christian Hanish et al., <i>Recycling von Lithium-Ionen-Batterien – das Projekt LithoRec</i> , Recycling und Rohstoffe, January 2012 (“Kwade, et al.”) (English)
Ex. 2021	Yang et al., <i>Thermal Stability of LiPF₆ Salt and Li-Ion Battery Electrolytes Containing LiPF₆</i> , Journal of Power Sources 161, 573 (2006)
Ex. 2022	Declaration of Vani Dantam in support of Patent Owner’s Response to the Petition (“Dantam POR Declaration”)
Ex. 2023	<i>Duesenfeld GmbH v. Ascend Elements, Inc.</i> , No. 1:23-cv-01194-JFM (D. Del. Oct. 30, 2024), ECF No. 62
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Ex. 2025	N. Somsuk et al., <i>Design and Development of a Rotary Airlock Valve for using in Continuous Pyrolysis Process to Improve Performance</i> , 2010 International Conference on Manufacturing Science and Technology (ICMST 2010)
Ex. 2026	Water boiling point as function of absolute pressure available at: https://www.engineeringtoolbox.com/water-evacuation-pressure-temperature-d_1686.html

Ex. 2027	DIN 24 800 (English)
Ex. 2028	DIN 24 800 (German)
Ex. 2029	Certificate of Translation for DIN 24 800
Ex. 2030	Bin-Dicator® Installation & Operation Manual (2013)
Ex. 2031	Screenshot of Meyer Rotary Valve Basics video available at: https://www.youtube.com/watch?v=iwjyRePPIt4
Ex. 2032	Boiling point for DMC, available at: https://www.univarsolutions.com/dimethyl-carbonate-5004710?srsltid=AfmBOorjj92rftGG8ShR_L1YJ7zHq_g7jd5HIM9uvXuqBooKXSIVZw8a
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Ex. 2035	U.S. Patent No. 5,405,231 (“Kronberg”)
Ex. 2036	Confidential Appendix C to Declaration of Vani Dantam [PROTECTIVE ORDER MATERIAL]
Ex. 2037	Confidential Appendix D to Declaration of Vani Dantam [PROTECTIVE ORDER MATERIAL]
Ex. 2038	Screenshots of YouTube Duesenfeld plant video found at https://www.youtube.com/watch?v=g1Ij4Emz8XQ (“How to recycle lithium-ion batteries? – Closing the loop in e-mobility”, Dec. 6, 2023)

Ex. 2039	Meyer Rotary Valve Basics Video Transcript, available at: https://www.youtube.com/watch?v=iwjyRePPIt4
Ex. 2040	Declaration of Lydia Grote in support of Patent Owner's Response to the Petition ("Grote POR Declaration") [PROTECTIVE ORDER MATERIAL]
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Ex. 2044	Certification from Braunschweig State Trade Supervisory Office to Duesenfeld (English) [PROTECTIVE ORDER MATERIAL]
Ex. 2045	Translation Certification of Certification from Braunschweig State Trade Supervisory Office to Duesenfeld
Ex. 2046	Duesenfeld GmbH Preliminary Financial Statements 2021 and 2022 (German) [PROTECTIVE ORDER MATERIAL]
Ex. 2047	Duesenfeld GmbH Preliminary Financial Statements 2021 and 2022 (English) [PROTECTIVE ORDER MATERIAL]

Ex. 2048	Translation Certificates - Duesenfeld GmbH Preliminary Financial Statements 2021 and 2022
Ex. 2049	License Agreement [PROTECTIVE ORDER MATERIAL]
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Ex. 2051	Press Release: <i>Seval and Riplastic will be the first industrial operators in Italy for the recycling of lithium-ion batteries</i> , dated June 11, 2024
Ex. 2052	Press Release: <i>Andritz and Duesenfeld sign cooperation agreement for battery recycling</i> , dated February 10, 2025
Ex. 2053	Duesenfeld Brochure: Ecofriendly Recycling of Lithium-Ion Batteries

I. INTRODUCTION

The '097 Patent solved an important problem in battery recycling: how to improve the hazardous process of recycling used batteries in a safer way that is suitable for transport that minimizes the production of toxic byproducts. Ex. 2022, ¶¶49-51, 58-63. Prior methods for recycling battery materials introduced foreign substances that contaminate recoverable materials. *Id.*, ¶58, 52-57. The inventors of the '097 Patent discovered that comminuting (shredding) the batteries and then drying the comminuted material at a pressure at or below 300 hPa could safely inactivate the battery material. *Id.*, ¶¶58-59. Moreover, by performing the drying under 80°C, the inventors were able to suppress the generation of a toxic compound, hydrogen fluoride, which is corrosive, potentially explosive, and extremely hazardous to humans. Ex. 2022, ¶¶47, 58.

Petitioner Ascend Elements, Inc. (“Ascend” or “Petitioner”) challenges Claims 1-3, 7-10, 12, 13, 19 (“the Challenged Claims”) of U.S. Patent No. 11,050,097 (“the '097 Patent”) as allegedly obvious under 35 U.S.C. § 103 in this *inter partes* review proceeding. The Board instituted trial as to all Challenged Claims. Institution Decision (“Decision”), 38.

In its Decision, the Board correctly found that Ascend did not carry its burden under Ground 1. The Board’s ruling was supported by three key findings:

- The Board concluded that Petitioner failed to show that the pre-dryer in U.S. Patent No. 9,780,419 (“Hanisch ’419”) would inactivate the comminuted battery material. Rather, this low temperature pre-dryer removes some quantity of solvent, but is not designed to inactivate the material. Instead, the partially dried material is transferred to a pyrolysis oven, where residual solvent is destroyed. Decision, 13.
- The Board concluded that Petitioner failed to present evidence that a POSITA would have used a vacuum level at or below 300 hPa in connection with the decomposition oven of Hanisch ’419. Decision, 15-16.
- The Board concluded that Petitioner failed to show that Hanisch ’419 discloses a “vacuum installation” connected to the decomposition oven, for purposes of Claim 12. Decision, 19.

The Board nonetheless instituted the IPR, relying on Ground 2 of the Petition. Through Ground 2, Petitioner seeks to combine Hanisch ’419 with the teachings of one or more of U.S. Patent Nos. 5,632,863 to Meador (“Meador”); 9,843,077 to Hayashi et al. (“Hayashi”); or 10,396,408 to Shin et al. (“Shin”). However, a POSITA would not have combined any of these references with Hanisch ’419 to perform vacuum drying below 300 hPa. Ex. 2022, ¶¶111-183. Briefly:

- **Meador** is directed to a battery processing plant that comminutes the batteries

and then runs them through a continuous process for pyrolysis. Ex. 2022, ¶¶112-118. Petitioner's expert confirmed in deposition that the pressure levels in Meador's plant would be about a half-inch of mercury relative to atmospheric pressure, contrary to Petitioner's argument to the Board. Ex. 2024, 68:1-73:4. Meador actually teaches away from vacuum drying at a maximum pressure of 300 hPa. Ex. 2022, ¶¶138-139.

- **Hayashi** neither comminutes batteries, nor inactivates comminuted material. Ex. 2022, ¶¶55, 121-125. Hayashi teaches removing the fluorine from individual battery cells, by adding water to the cells to deliberately provoke the formation of hydrogen fluoride gas, which is then sequestered. Ex. 2022, ¶¶121-123. Hayashi teaches a batch process that cannot be combined with the continuous system of Hanisch '419 to supply the latter's missing vacuum level teaching. Ex. 2022, ¶¶124, 182. And Hayashi teaches away from Hanisch '419, because Hayashi says that batteries must be detoxified before further processing. Ex. 2022, ¶¶162-172.
- **Shin** discloses treatment of whole batteries. Ex. 2022, ¶¶126-128. Shin's reaction reservoir is placed under strong vacuum to remove oxygen, after which the system is filled with nitrogen gas. The batteries are then heated until they rupture, venting poisonous gases. Ex. 2022, ¶128. Shin does not teach processing of the batteries under vacuum – to the contrary, Shin teaches

adding nitrogen gas to the reaction chamber, which would neutralize the vacuum. Ex. 2022, ¶¶173-179.

Accordingly, for the legal and factual reasons set forth herein, all of Petitioner's adopted grounds of unpatentability fail, and the Board should issue a final written decision confirming the patentability of all Challenged Claims.

II. THE '097 PATENT

A. Overview of U.S. Patent No. 11,050,097

The inventions claimed in the '097 patent improved the recycling of batteries by inactivating shredded batteries through the drying process itself, specifically by vacuum drying at a maximum pressure of 300 hPa, and, as in claim 9, preferably at a temperature below 80°C. Ex. 2022, ¶¶58-63. No prior art reference or combination taught this approach. Prior methods introduced foreign substances to inactivate shredded batteries, used only a slight vacuum to ventilate gases, or used high heat during the drying process. *Id.*, ¶¶51-57. Unlike the prior art, the '097 patent does not teach wet processing or adding contaminants to the comminuted material, nor does it teach opening up the entire battery and removing the electrolyte. *Id.*, ¶¶58-63. Instead, the inventors of the '097 patent discovered that additives, as used in the prior art, were unnecessary and contaminated and compromised the quality of the recycled product. *Id.*, ¶¶57-63. The inventors further recognized that avoiding high

heat during the drying process suppressed the formation of toxic gases, particularly hydrogen fluoride. *Id.*, ¶¶58-63; Ex. 1001, 2:5-12.

The inventors employed this drying process to generate dried, shredded battery material, which was chemically inert and could be safely stored and shipped. Shredded material is rendered “inactivated” after the drying process is complete. Ex. 2022, ¶¶58-63; Ex. 1001, 8:54-55 (“The drying of the comminuted material results in inactivated comminuted material.”). The ’097 patent describes and claims methods and installations that provide an efficient, low-cost way of recovering spent battery material with high purity and rendering it safe for transport by inactivating the comminuted battery material using a vacuum drying process. Ex. 1001, 1:63-2:4, 1:64-2:12; Ex. 2022, ¶¶59, 61-63.

The specification teaches how to obtain inactivated comminuted material that is suitable for transport. Ex. 1001, 1:64-2:12. The specification emphasizes drying under low pressure, while avoiding high temperatures. Ex. 1001, 3:7-9 (“It is beneficial if the drying occurs at a maximum pressure of 300 hPa, in particular a maximum of 100 hPa.”); *id.*, 5:7-8 (“The drying preferably occurs at a maximum temperature of 80° C.: this produces almost no hydrogen fluoride.”). These conditions contribute to safe inactivation of electrolytes and associated solvents without forming hydrogen fluoride. Ex. 2022, ¶¶58-59; Ex. 1001, 3:9-14.

The comminuted material is dried until its electrolyte content is low enough that the material becomes inactivated. Ex. 2022, ¶¶58-63; Ex. 1001, 4:5-7. The inactivated comminuted material is safe for transport, and thus can be filled into a transport container and safely shipped. Ex. 2022, ¶60; Ex. 1001, 8:56-58.

B. Challenged claims

Claim 1 of the '097 patent recites:

1. A method for the treatment of used batteries, comprising the steps:
 - (a) comminuting the batteries such that comminuted material is obtained;
 - (b) inactivating the comminuted material such that an inactivated comminuted material is obtained, wherein the inactivating step is performed during or after the comminuting step; and
 - (c) filling a transport container with the inactivated comminuted material;wherein the inactivating step is performed by drying the comminuted material, and
wherein the drying occurs at a maximum pressure of 300 hPa.

Ex. 1001, 10:45-59.

Dependent Claims 2-3 and 7-10 add additional limitations. *Id.*, 10:60-11:47. Dependent Claim 9, which is specifically discussed herein, recites: “The method according to claim 1 wherein drying occurs at a temperature of less than 80° C.” Ex. 1001, 11:26-27.

Independent claim 12 recites:

12. A battery processing installation for treatment of used batteries, comprising:
 - (a) a comminution unit configured to comminute the batteries such that comminuted material is obtained;
 - (b) an inactivation device comprising a drying device configured to inactivate the comminuted material, wherein the inactivation device is configured to perform the inactivating step during or after the comminuting step of the comminution unit;
 - (c) a filling device configured to fill a test transport container with the inactivated comminuted material; and
 - (d) a vacuum installation connected to the drying device and configured to generate a vacuum in the drying device.

Ex. 1001, 11:50-62.

Dependent Claims 13 and 19 add additional limitations. Ex. 1001, 11:62-12:62.

III. PERSON OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art (“POSITA”) in the field of the ’097 patent would have had at least a Bachelor’s degree in electrical engineering, materials science, chemical engineering, or an equivalent field, as well as at least 2 to 3 years of academic or industry experience in the recycling or processing of lithium-ion batteries. *See* Ex. 2022, ¶17. Patent Owner disagrees with Petitioner’s contention

regarding the appropriate level of skill in the art in the field of the '097 patent. *See* Ex. 2022, ¶¶18-23. The Board adopted Patent Owner's assessment of the level of ordinary skill in the art and declined to adopt Petitioner's proposed assessment, which would have required a Master's degree and three to five years of experience. *See* Decision, 7-8. Patent Owner's proposed definition of a POSITA aligns more closely with the skill level of the inventors, who included graduate students who did not yet have advanced degrees. Ex. 2022, ¶¶17-23.

IV. CLAIM CONSTRUCTION

In *inter partes* review proceedings, the words of the claim are given their ordinary and customary meaning as understood by persons of ordinary skill in the art at the time of the invention. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-13 (Fed. Cir. 2005) (en banc); 37 C.F.R. 42.100(b); 83 Fed. Reg. 197 (Oct. 11, 2018).

In its Decision, the Board did not expressly construe any claim terms. Decision, 9. However, the Board described its preliminary understanding of the term **“inactivating”** to “require the removal of sufficient amounts of dimethyl carbonate and/or ethyl methyl carbonate from the comminuted material to make an electrochemical reaction either no longer possible or only possible to a negligibly small extent.” *Id.*, 12.

Patent Owner disagrees with the Board's proposed construction. Duesenfeld and Ascend jointly agreed in the pending litigation that the following terms should be understood to have their plain and ordinary meaning:

- **“drying the comminuted material”** (claims 1, 2, 7, 13) should have its plain and ordinary meaning, which is removing at least one solvent from the comminuted material.
- **“drying device configured to inactivate the comminuted material”** (claim 12) shall have its plain and ordinary meaning, which is a device configured to produce inactivated comminuted material as a result of drying.

Ex. 2023.

As properly construed by the District Court, inactivation is the “result” of drying. *Id.* The patent specification recites various metrics for determining if that result has been reached, such as if no flammable gas can form above the dried material (Ex. 1001, 3:49-4:4); or if no electrochemical reaction is possible in the dried material (4:5-18); or if there is no build-up of heat (4:19-27); or if the electrolyte concentration is below a specified threshold (4:28-36). The Board erroneously picked among these metrics and selected a single metric as defining the endpoint of inactivation (*i.e.*, that no electrochemical reaction is possible).

Decision, 12. Selecting that metric, to the exclusion of the others, is error, and violates at least two canons of claim construction.

First, it is improper to limit the scope of a claim term to a single embodiment in the specification. *Liebel-Flarsheim Co. v. Medrad, Inc.*, 358 F.3d 898, 906 (Fed. Cir. 2004) (“Even when the specification describes only a single embodiment, the claims of the patent will not be read restrictively unless the patentee has demonstrated a clear intention to limit the claim scope using ‘words or expressions of manifest exclusion or restriction.’”). Second, the Board’s ruling runs counter to the doctrine of claim differentiation. Dependent claim 2 specifies that the material is “dried until an electrolyte content in the comminuted material is so low that an electrochemical reaction is impossible.” Ex. 1001 at Claim 2. And dependent claim 7 specifies that the comminuted material is inactivated if no explosive gas forms in the transport container. *Id.*, Claim 7. Presumptively, Claim 1 is broad enough to encompass at least all these metrics. *Phillips*, 415 F.3d at 1314–15.

The Board should adopt the District Court’s construction and recognize that inactivation is the endpoint result of drying, but not specify the particular metric of drying that must be reached.

V. LEGAL STANDARDS

“In an IPR, the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid*

Tech., Inc., 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring IPR petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)). To prevail in its challenge to Patent Owner’s claims, Petitioner must demonstrate by a preponderance of the evidence that the claims are unpatentable. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d). “To satisfy its burden of proving obviousness, a petitioner cannot employ mere conclusory statements.” *In re Magnum Oil Tools Int’l Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016). And “conclusory expert testimony is inadequate to support an obviousness determination” *TQ Delta, LLC v. Cisco Systems, Inc.*, 942 F.3d 1352, 1359 (Fed. Cir. 2019); *Xerox Corp. v. Bytemark, Inc.*, IPR2022-00624, Paper 9, 15-16 (P.T.A.B. Aug. 24, 2022) (precedential) (declining to credit to expert testimony that “merely repeats, verbatim, the conclusory assertion for which it is offered to support.”) (emphasis in original); 37 C.F.R. § 42.65(a).

VI. PETITIONER FAILS TO SHOW THAT THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Ground 1 — The petition fails to prove that Hanisch ’419 alone or in combination with Dunagan renders the Challenged Claims unpatentable

The Board determined in its Decision that Petitioner failed to carry its burden with respect to all Challenged Claims under Ground 1. Decision, 9. As discussed below, the Board should confirm its preliminary determination that these references do not demonstrate the Challenged Claims are obvious.

1. Overview of Hanisch '419

Hanisch '419 is directed to a multi-step, continuous process for recovery of active materials from lithium-based batteries. Ex. 1004, 1:8-10, 1:42-45. Hanisch '419 teaches comminuting batteries with a “cell crushing device 12.” Ex. 1004, 5:40, Fig. 1 (#12); Ex. 2022, ¶¶67. An inert gas tank 22 provides an inert atmosphere (*e.g.*, nitrogen) in the cell crushing device. Ex. 1004 at Fig. 1; 5:43-45. The liquid fraction from the cells is removed and fed into a stirred reactor 26. The comminuted battery material without the liquid fraction is then fed into a “pre-dryer 28.” Ex. 1004, 5:54, Fig. 1 (#28). The pre-dryer is set to a temperature below 100°C, and preferably below 80°C. *Id.*, 4:45-5, 5:58-59. The pre-dryer is coupled to a “condenser 34.” *Id.*, 5:60, Fig. 1 (#34). This pre-dryer evaporates electrolyte solvents from the battery material, and the solvents are recovered through the condenser. *Id.*, 4:1-4, 5:59-61; Ex. 2022, ¶70.

After the pre-dryer, the comminuted material is fed into a high temperature oven, whereby the material is heated to a temperature of “at least 350°C” to decompose the binder, allowing separation of the active materials from the supports of the galvanic cells. Ex. 1004, 4:25-28; *see also id.*, 1:8-31, 6:8-11, Fig. 1 (#44); Ex. 2022, ¶68.

The high temperature oven is operated “under inert gas or in a vacuum.” Ex. 1004, 4:6-8; Ex. 2022, ¶68. The stated purpose of using inert gas or vacuum is to

prevent the copper supports from oxidizing. Ex. 1004, 4:8-10; Ex. 2022, ¶68. By preventing this oxidization, Hanisch '419 teaches that the anode and cathode can be processed together to facilitate recovery of copper “with a high degree of purity.” Ex. 1004, 4:8-18. Thus, Hanisch '419 discloses using inert gas or vacuum to reduce the amount of oxygen in the oven and thereby avoid oxidizing the material during pyrolysis. *Id.*; Ex. 2022, ¶68.

Hanisch '419 also teaches that merely heating the comminuted material to the decomposition temperature is insufficient to separate the active materials from the foil supports and therefore teaches a further step of “air jet sieving” to separate the active materials from the supports. *Id.*, 6:14-24; *see also id.*, 2:39-47; Ex. 2022, ¶¶67, 69.

Hanisch '419 teaches that its recycling process should be continuous. *Id.*, 3:27-28 (“The method according to the invention is preferably performed as a continual process and not in batches.”). A POSITA would understand that using a continuous process is beneficial in the context of Hanisch '419 because it avoids creating accumulations of comminuted battery material, which can undergo unwanted and potentially hazardous chemical reactions. Ex. 2022, ¶¶72, 78-79. By feeding the shredded material directly into the pre-dryer and then continuously into the pyrolytic furnace, the system of Hanisch '419 avoids the build-up of hazardous material. *Id.*, ¶¶78-79.

Hanisch '419 does not disclose any vacuum pump connected to either the pre-dryer or the decomposition oven, and it does not disclose the vacuum strength to use in any step of the process. Ex. 2004, Figure 1; Ex. 2022, ¶73. Hanisch '419 describes using inert gas or vacuum solely in the context of reducing the amount of oxygen present in the decomposition furnace so that the copper does not oxidize. Ex. 2022, ¶68. There is no condenser coupled to the high temperature oven, confirming that electrolyte solvents are not recovered from that oven. *Id.*, ¶73. Hanisch '419 is not concerned with, and does not address, drying comminuted battery material for the purpose of inactivating it and rendering it safe for transport. Ex. 2022, ¶ 71.

Ascend concedes that Hanisch '419 was considered by the Office during examination of the '097 patent. *See* Pet., 17; *see also* Ex. 1001. Indeed, it was raised by the Examiner. *See* Ex. 1002, at 213 & 330.

2. Claim 1[b]: The low temperature pre-dryer of Hanisch '419 alone or in view of a POSITA does not teach “inactivating the comminuted material such that an inactivated comminuted material is obtained”

The Board correctly determined that the low-temperature pre-dryer of Hanisch '419, either alone or in combination with the view of a POSITA, does not teach “inactivating the comminuted material such than an inactivated comminuted material is obtained.” Decision, 13.

The pre-dryer of Hanisch '419 is configured to remove some quantity of electrolyte solvent that has not already been removed through stirred reactor 26 prior to the material entering the high temperature oven. Ex. 2022, ¶77; Ex. 1004, 4:3-4 (“This has the advantage that the electrolyte solvent can be retrieved.”).

The pre-dryer is run on a continuous basis, not as a batch process. *Id.*, 3:27-28. A POSITA would have understood that using a continuous process is beneficial in the context of Hanisch '419 because it avoids build-up of piles of comminuted battery material, which could undergo unwanted and potentially hazardous chemical reactions. Ex. 2022, ¶79.

Hanisch '419 does not teach running the pre-dryer under vacuum. While the Board ruled that the disclosure at 3:6-8 refers to the pre-dryer, *see* Decision at 15, Patent Owner disagrees. There is no teaching that links the use of a vacuum to the pre-dryer, there is no depiction of a vacuum in Figure 1, and the teaching of the use of a vacuum at 4:6-8 is expressly directed to the high temperature oven. Ex. 2022, ¶¶82; 87-94. Regardless, there is no teaching of any vacuum levels to be used. *Id.*

To the contrary, a POSITA would have understood that the pre-dryer is actually run at an overpressure. Ex. 2022, ¶¶82, 93, 101. This is evident from the fact that the pre-dryer is coupled to the shredder 12. *See* Ex. 1004 at Fig. 1. There is no gas flow blocking mechanism between the pre-dryer and the shredder, and thus the two devices are at the same pressure. Ex. 2022, ¶¶82, 93. The shredder is

coupled to a nitrogen tank 22, for rendering inert the atmosphere in the shredder.

Id. A POSITA would recognize the importance of maintaining an overpressure in the shredder, to prevent oxygen from infiltrating the shredder, which could otherwise cause an explosion, given the presence of electrolyte and sparks from the metal-on-metal crushing. *Id.* And because the shredder would be maintained at an overpressure, so would the pre-dryer, because they are coupled. *Id.*

Hanisch '419 is not concerned with inactivating battery material at the pre-dryer, for several reasons. Foremost, the battery material goes from the pre-dryer to the decomposition oven, where it is subjected to temperatures of 400°C to 600°C. Ex. 1004, 6:8-10. The residual solvent that remains in the comminuted battery material after the pre-dryer will be destroyed in this furnace. Ex. 2022, ¶81. Accordingly, there is no need to take the caution and incur the cost of drying the material to the endpoint result of inactivation. *Id.*

Furthermore, Hanisch '419 provides none of the details needed to teach how to inactivate battery material in the pre-dryer. Hanisch '419 does not disclose the duration of the pre-dry process, the pressures to use in the pre-dryer, how to determine whether the material is sufficiently dry, the different electrolyte solvents to be evaporated, or the drying conditions needed to fully evaporate those different solvents. *Id.*, ¶83. And the pre-dryer is run as a continuous process, making it difficult to maintain control over the pressure due to the leaky nature of the

continuous processing equipment as compared with batch processing. *Id.*, ¶84.

Further, Hanisch '419 provides no rationale for taking these precautions to ensure inactivation where the remaining electrolyte solvent will be pyrolyzed and destroyed in the very next step—the decomposition oven—anyway. Ex. 2022, ¶81.

Thus, the Board correctly determined that the pre-dryer of Hanisch '419 does not meet the “inactivating” requirement of the claims. Ex. 2022, ¶75.

3. Claim 1[e]: Hanisch '419 alone or in view of a POSITA does not teach “wherein the drying occurs at a maximum pressure of 300 hPa”

Patent Owner agrees with the Board’s determination that Petitioner failed to show a POSITA “would have understood that the pressure of a ‘vacuum’ is below 300 hPa” in the Hanisch '419 process. Decision, 16.

Petitioner does not contend that Hanisch '419 discloses any particular level of vacuum. Ex. 1003, ¶113. Petitioner instead attempts to rely on the “common knowledge” of a POSITA to fill this gap, *see id.*, which is improper. *K/S Himpp v. Hear-Wear Techs., LLC*, 751 F.3d 1362, 1365 (Fed. Cir. 2014) (affirming Board decision where “Board declined to accept a conclusory assertion from a third party about general knowledge in the art *without evidence on the record*, particularly where it is an important structural limitation that is not evidently and indisputably within the common knowledge of those skilled in the art”); *Unified Pats. Inc. v.*

Velos Media, LLC, No. IPR2019-00883, 2019 WL 6999079, at *5 (P.T.A.B. Nov. 15, 2019) (“We, therefore, agree with Velos that expert testimony regarding the restricted placement limitation cannot take the place of disclosure from patents or printed publications.”) (citing August 2018 Trial Practice Guide Update at 5). Further, none of the prior art references relied on by Petitioner disclose a continuous process run at a vacuum level of less than 300 hPa or less, *see* Section VI.B.4, *infra*; Ex. 2022, ¶¶130-139. Thus, contrary to Petitioner’s insistence that running a continuous process at 300 hPa or less would be “common knowledge,” Petitioner identified no such evidence. Ex. 2022, ¶¶87-94. This supposed “common knowledge” is contradicted by Meador. *See* Section VI.B.4.b.i(1), *infra*.

The Petition also relies on similarly general and conclusory opinions from Petitioner’s expert for the proposition that a POSITA would have understood that the pressure of the vacuum would be below 300 hPa. *See* Petition, 30-32 *citing* Ex. 1003, ¶¶70, 111-116 (supplementing prior art teaching with matters that would allegedly be obvious to a POSITA). But Petitioner’s expert provides *no evidence* to support his conclusory testimony; those statements are therefore also not entitled to any weight. *Xerox Corp.*, IPR2022-00624, Paper 9 at 15.

Petitioner’s position is not only unsupported, it is also incorrect. Hanisch ’419 expressly teaches that its recycling process should be conducted in a continuous manner. Ex. 1004, 3:27-28. Hanisch ’419 does not disclose any of the

sealing mechanisms needed to run a continuous process under vacuum. Ex. 2022,

¶92. A POSITA would know that there are mechanisms that can be employed to maintain a vacuum in a continuous manufacturing process. *Id.* For example, water seals can be used to maintain a vacuum in a continuous process, as taught by Meador. Ex. 2022, ¶¶114-116; *see also* Ex. 1011, 4:50-53. However, such seals can only maintain a slight vacuum. Ex. 2022, ¶112; Ex. 1011, 3:26 (“slight vacuum”). Meador’s continuous system ran only a “slight vacuum” at a negative pressure of 12 hPa to 34 hPa, which is an absolute pressure of 979 hPa to 1001 hPa at sea level. Ex. 2022, ¶¶118-120; Ex. 1011, 5:18-19, 5:61-63, 6:56-59.

Petitioner’s expert, Dr. van Schalkwijk, conceded in his deposition that the continuous processing systems he had observed did not use intense vacuums due to the energy required and the danger of blowing particulates. Ex. 2024, 106:25-107:19. Dr. van Schalkwijk further testified that a negative pressure relative to ambient of half an inch of mercury (*i.e.*, the slight vacuum of 979 hPa to 1001 hPa at sea level) would be sufficient to provide the airflow to support a continuous system. Ex. 2024, 69:20-70:19.

The vacuum in Hanisch ’419 is not for the purpose of evaporating electrolytes. Ex. 2022, ¶144. Rather, the vacuum in the decomposition oven of Hanisch ’419 prevents oxygen from entering the continuous furnace system disclosed in Hanisch ’419, to avoid the oxidation of the copper supports. Ex. 1004,

4:6-18. A POSITA would not want to use any stronger vacuum than was necessary for the continuous furnace system disclosed in Hanisch '419 because it would unnecessarily waste resources. Ex. 2022, ¶¶145-146. Hanisch '419 specifically identifies the goal to “keep energy consumption as low as possible.” Ex. 1004, 4:51; Ex. 2022, ¶146.

A POSITA would have understood maintaining a stronger vacuum in the continuous furnace system of Hanisch '419 to be energy intensive and therefore costly, as the vacuum pump would have to work much harder to keep up with the constant flow of external air into the furnace. Ex. 2022, ¶¶145-146; *see also* Ex. 2024, 107:5-19 (testifying to incentives to avoid a strong vacuum). By nature, a continuous furnace system is leaky, and it becomes increasingly difficult to maintain stronger pressures as vacuum increases. Ex. 2022, ¶¶145-146. Hanisch '419 does not depict any mechanisms for maintaining a vacuum in the continuous system it teaches; these systems may exist in some form (*see, e.g.*, the water seals in Meador, or a rotary airlock), are limited in their functionality, and are generally leaky. *Compare* Ex. 1011, 4:50-53 *with* Ex. 1004 at Fig. 1 (absence of seals); *see also* Ex. 2025, 72; Ex. 2022, ¶¶153-157. A POSITA would have understood that attempting to maintain a pressure below 300 hPa would accelerate vacuum motor fatigue and burnout. Ex. 2022, ¶¶145-146. A POSITA would have seen little benefit in using a vacuum below 300 hPa in Hanisch '419 where there is no need

to hasten evaporation of the electrolyte solvent, as it will be pyrolyzed rapidly in the furnace. Ex. 1004, 6:8-10; Ex. 2022, ¶¶145-146.

In sum, the Board should confirm its preliminary determination that Petitioner's reliance on Hanisch '419 and knowledge of a POSITA for Claim 1 on this Ground is unsupported. The weight of the evidence instead shows that a POSITA would not have been motivated to dry the comminuted material in the pre-dryer as claimed, or to use a vacuum of 300 hPa or less in the pyrolysis oven of Hanisch '419. Ex. 2022, ¶¶71-94, 108, 144-146. Because the Petition fails to meet its burden for Claim 1, the Petition further fails to meet its burden to show that Hanisch '419 alone teaches all limitations of any of the challenged claims that depend from Claim 1, namely Claims 2, 3, 7, 8, 9 and 10.

4. Claim 9: Hanisch '419 alone does not render obvious “The method according to claim 1 wherein drying occurs at a temperature of less than 80° C”

Petitioner has not established that Hanisch '419, in combination with the knowledge of a POSITA, renders Claim 9 obvious. Neither the pre-dryer nor the high temperature decomposition oven of Hanisch '419 teaches the requirement of Claim 9 that “drying occurs at a temperature of less than 80°C.” Ex. 2022, ¶95.

Petitioner relies *solely* on Hanisch '419 and knowledge of a POSITA concerning the pre-dryer to allegedly meet this limitation. Petition, 36-37. The Board has already correctly determined that the low temperature “pre-dryer”

disclosed in Hanisch '419 does not render the Challenged Claims obvious.

Decision, 13.

The low temperature “pre-dryer” disclosed in Hanisch '419 is just that: a *pre*-dryer. Ex. 2022, ¶95. It is not designed to remove sufficient vapor to inactivate the comminuted battery material, as explained above. *See supra* § VI.A.2; Ex. 2022, ¶80, 85.

Petitioner is therefore left only with the high temperature furnace of Hanisch '419 for the inactivation element. However, the high temperature decomposition oven—whose temperatures range from 400°C to 600°C—indisputably fails to teach drying at a temperature less than 80°C. Ex. 1004, 6:8-10; Ex. 2022, ¶96. Indeed, Petitioner offers no evidence to suggest that the high temperature oven of Hanisch '419 could meet this limitation. Thus, neither the pre-dryer of Hanisch '419 nor its decomposition oven discloses Claim 9. Ex. 2022, ¶¶95-96.

5. Claim 12[d]: Hanisch '419 alone or in combination with Dunagan does not render obvious “a vacuum installation connected to the drying device and configured to generate a vacuum in the drying device”

Petitioner contends that Hanisch '419 teaches this claim element, referring back to the reasons discussed as to claim element 1.[e]. Petition, 39. As discussed above for claim element 1.[e], Patent Owner agrees with the Board’s determination that Petitioner failed to show a POSITA “would have understood that the pressure

of a ‘vacuum’ is below 300 hPa” in the Hanisch ’419 battery recycling process.

Decision, 15-16.

Petitioner’s remaining arguments focus almost entirely on the Hanisch ’419 pre-dryer for this claim element. But as the Board already found, Petitioner failed to show that the pre-dryer is a drying device that inactivates comminuted material. Decision, 13. Therefore, Petitioner is left only to allege that the Hanisch ’419 decomposition oven is connected to a vacuum installation. However, the Board correctly determined that Petitioner failed to show “that Hanisch teaches or suggests a vacuum installation attached to Hanisch’s decomposition oven.” Decision, 19. Indeed, a POSITA would recognize that the pre-dryer is run at an overpressure, not under vacuum. Ex. 2022, ¶¶82, 93.

Hanisch ’419 does not disclose a “vacuum installation” connected to the decomposition oven. *See* Ex. 1004, Fig. 1 (showing no connected structures labeled with a vacuum pump or anything similar); Ex. 2022, ¶¶98-105, 109. Hanisch ’419 discloses a circulation pump 32 and condenser 34 connected to the *pre-dryer*, but not to the decomposition oven. Ex. 1004, Fig. 1; Ex. 2022, ¶¶102-104. Further, Hanisch ’419 says nothing further about this equipment, identifying it only in a “List of reference numbers.” Ex. 1004, 6:43-54. Indeed, there is no vacuum pump referenced in the entire patent. Ex. 2022, ¶73.

As the Board noted, Petitioner’s expert provides no testimony to support the purported need for a vacuum installation “connected to” the decomposition oven. Petitioner’s expert argues that a POSITA “would have understood the circulation pump and condenser of Hanisch to be a ‘vacuum installation.’” Petition, 39-40 (citing Ex. 1003, ¶¶136-137). A circulation pump and a condenser are not a vacuum installation. Ex. 2022, ¶¶97-105. Regardless, as the Board already found, the circulation pump and condenser are attached to the pre-dryer and not the decomposition oven. Ex. 1004, 5:59-61, Fig. 1. Petitioner’s expert cannot fill gaps in the prior art with speculation. *See Unified Pats.*, 2019 WL 6999079, at *5.

In sum, Petitioner’s arguments on Ground 1 are unsupported and the Board should confirm its determination that Petitioner failed to meet its burden on Ground 1. Ex. 2022, ¶106-110. Because Petitioner fails to establish that Hanisch ’419 alone teaches all limitations of Claim 12, Petitioner further fails to establish that Hanisch ’419 alone or in view of a POSITA teaches all limitations of Claims 13 and 19, which depend from Claim 12.

B. Ground 2 — The Petition fails to prove that Hanisch ’419 in view of Dunagan, Meador, Shin, and/or Hayashi renders the Challenged Claims unpatentable

The only substantive difference between Grounds 1 and 2 is the addition in Ground 2 of three secondary references—Meador (Ex. 1011), Hayashi (Ex. 1006), and Shin (Ex. 1010)—each of which Petitioner seeks to combine with Hanisch

'419 for the sole purpose of arguing that claim elements 1[e] and 12[d] (regarding the claimed vacuum drying step) would have been obvious.¹ For other claim elements, the Petition simply refers back to the arguments of Ground 1.² *See generally*, Petition, 41-43.

As shown below, each of Meador, Hayashi, and Shin fails to render claim elements 1[e] and 12[d] obvious, and in any case fail to cure the deficiencies of Hanisch '419 discussed above regarding other claim elements not addressed by Petitioner in Ground 2.

1. Overview of Meador

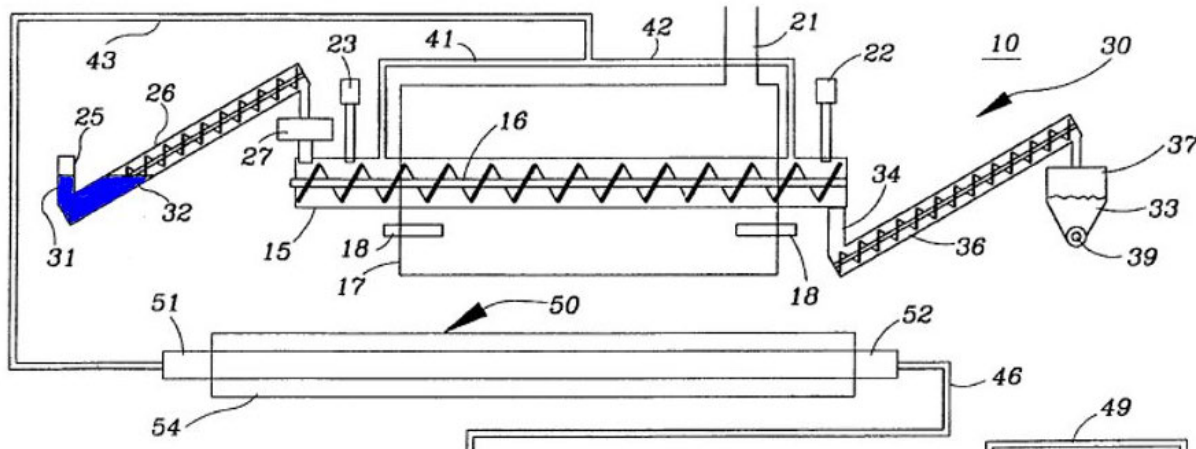
Meador is directed to a high temperature, continuous pyrolysis process for reclaiming components of spent batteries. Ex. 1011, 3:11-16, 4:9-16.

In order to allow for a continuous process that is conducted under vacuum, Meador teaches using water seals that permit a slight vacuum to be maintained in the system. Ex. 2022, ¶¶114-116. As depicted in Figure 1, batteries are introduced

¹ Ascend concedes that Meador and Hayashi were submitted to the Office during examination. *See* Petition, 19-20; *see also* Ex. 1001. Meador, like Hanisch '419, was actively discussed during the Office Actions during the prosecution of the '097 patent. *See* Ex. 1002, 192; *see also id.*, 213 & 330. Although not actively discussed during prosecution, Hayashi was also submitted to the Office (Ex. 1002, 583) and is merely duplicative of the information contained within Meador and Hanisch '419.

² The Petition does reargue the Hanisch '419/Dunagan combination for Ground 2, *see* Pet., 42, but makes no substantive distinction from the argument in Ground 1.

into the system through hopper 25, and fall down to enter an upwardly-directed screw conveyor 26. Ex. 1011, Fig. 1; Ex. 2022, ¶114. A liquid, such as water, fills this low point in the entryway, rising up to level 32 in the hopper and the screw conveyor, as annotated in solid blue in the figure below:



Ex. 1011, Fig. 1 (annotated and cropped);³ *see also id.*, 4:50-53. (“A liquid 31, such as, water is maintained at level 32 in the hopper 25 and screw conveyor 26 to exclude oxygen or air entering into the crusher 27 and then, into the pyrolysis chamber 15.”)

Once the batteries fall through the water seal and are conveyed up the screw, they fall into a crusher 27, and then fall into a pyrolysis chamber 15, through which they are conveyed with screw 16. Ex. 1011, 4:43-48 & Fig. 1; Ex. 2022, ¶115.

Vacuum pump 70 creates a “slight vacuum to withdraw the off-gases for further

³ Meador additionally teaches that a water seal may be used at the recovery auger. Ex. 1011, 3:37-38.

processing.” Ex. 1011, 3:26-27. Off-gases are vented through flow lines 41 and 42 and condensed with a cooling jacket 54. Ex. 1011, 5:1-12. The solid battery materials exit the pyrolytic chamber, and are collected with another screw conveyor 36. Ex. 2022, ¶115.

Meador additionally discloses that the output end of the process should be sealed, either with another water seal or with a pressure switch (specifically, the Bin-Dicator device). Ex. 1011, 3:37-40, 6:1-7; Ex. 2022, ¶116.

The pyrolytic chamber is maintained at a temperature range of 350°F to 650°F. Ex. 1011, 5:59-60; Ex. 2022, ¶117.

The crux of the dispute about Meador—to the extent any remains after Dr. van Schalkwijk’s deposition—centers on the description of the vacuum level to use. Meador says: “The vacuum pump 70 maintains a vacuum on pyrolysis chamber 15 of approximately one-half inch of mercury (five inches of water).” Ex. 1011, 5:61-63. Claim 4 of Meador additionally recites that “the vacuum is about one-half to one inch of mercury.” Ex. 1011, 6:58-59. Converted, these figures range from about 12 hPa to 34 hPa. Ex. 2022, ¶118. Dr. van Schalkwijk initially appeared in his declaration to interpret these figures as the absolute vacuum level inside the pyrolysis chamber. *Id.*, ¶119. However, in his deposition, upon realizing that the water seals would boil off at such a low pressure, Dr. van Schalkwijk testified that the more reasonable interpretation of Meador is that it

discloses a negative pressure *relative to ambient pressure*. Ex. 2024, 72:22-73:4, 114:5-13. He agreed in deposition that the proper interpretation is that Meador's furnace is run at "approximately 29.5 inches of mercury," which equates to a pressure of about 999 hPa. Ex. 2024, 71:1-6; Ex. 2022, ¶120. Thus, according to Ascend's own expert, Meador lacks the fundamental teaching that Ascend purports to rely on.

2. Overview of Hayashi

Hayashi discloses techniques for removing the fluorine from within intact lithium batteries, so that the remaining electrolyte solvent and the other battery materials can thereafter be more safely recovered. Ex. 1006, 11:59-12:11.

Hayashi deliberately forms hydrogen fluoride by adding water to the cells of a lithium battery. *See id.*, 5:33-35. Once the hydrogen fluoride forms, it is captured either in a "water cooling trap" as calcium fluoride (*i.e.*, wet processing), or the hydrogen fluoride passes through a solid, layered calcium-containing structure, by which the hydrogen fluoride is sequestered in the form of calcium fluoride (*i.e.*, dry processing). *See id.*, 6:1-8:3 (esp. 6:27-31) & 8:5-49 (esp. 8:5-17).

Hayashi teaches processing a single cell of a battery at a time (*i.e.*, in a batch process, not in a continuous process). Ex. 1006, 9:37-40. Each cell being treated is about 1.6 kg. *Id.*, 11:38-39. The single cell is heated as a whole by immersing it in an oil bath. *Id.*, 9:40-44. The safety valve of the cell is removed, water is

added, and a pipe is placed on top of the opening for ventilating the generated vapors. *Id.*, 4:31-33; *see also id.*, 9:37-47; Ex. 2022, ¶¶121-125.

To promote the volatilization and exhaust of the fluorine and other solvents, the heated battery cell is subject to vacuum pressures. Ex. 1006, 4:60-5:21. In Hayashi's examples, the pressures employed ranged from 50 hPa to 200 hPa, with a preference for lower pressures. *Id.*, 4:48-5:18; 9:34-10:60

Contrary to Hanisch '419, Hayashi teaches that batteries must be detoxified first before the battery materials can be recycled, such as by comminution. Ex. 1006, 11:58-12:11; Ex. 2022, ¶125.

3. Overview of Shin

Shin is directed to a process for processing whole batteries, which are ruptured under high heat, and subsequently comminuted. Shin discloses a heavily reinforced mobile unit into which whole batteries are introduced, comprising a "reaction reservoir 30" where batteries are processed. Ex. 1010, Figs. 1 & 4.

The unit is purged of oxygen. To do this, Shin teaches using a high vacuum of 10^{-4} torr (*i.e.*, about 0.00013 hPa), running a rotary pump for about 5 minutes. Ex. 1010, 8:4-15; Ex. 2022, ¶127. After the oxygen is purged, then Shin teaches filling the reaction reservoir with nitrogen. Ex. 1010, 8:16-17; Ex. 2022, ¶127.

The system is then heated to 470°C to 550°C. Ex. 1010, 8:28-31. This heat causes the batteries to rupture, resulting in “discharged poisonous gas.” Ex. 1010, 8:62-66.

Shin discloses no attempt to maintain a vacuum during processing. Ex. 2022, ¶¶126-128. Whereas a high vacuum is initially generated to purge the oxygen, the interior atmosphere is subsequently filled with nitrogen and the discharged gases from the ruptured batteries. Ex. 2022, ¶127. Shin makes no mention of a vacuum once the processing of the batteries begins. Ex. 2022, ¶¶126-128, 175-176. Dr. van Schalkwijk does not provide any opinion as to the vacuum level in Shin, at any point in the processing. Ex. 1003, ¶¶148-152.

Shin does not attempt to suppress the formation of toxic gases, but rather focuses on exhausting these gases. Ex. 1010, 4:4-9; Ex. 2022, ¶177. Shin teaches crushing and grinding the batteries after the heat-treatment process. *Id.*, 9:21-26 & Fig. 5 (Step S80); Ex. 2022, ¶177.

4. Claim 1[e]: Hanisch ’419 alone or in view of Hayashi, Meador, or Shin does not render obvious “wherein the drying occurs at a maximum pressure of 300 hPa”

a. Hanisch ’419 alone or in view of a POSITA does not disclose this limitation.

Petitioner’s arguments relying solely on Hanisch ’419 and/or in view of a POSITA fail for the same reasons discussed above in Ground 1. *See* Section VI-A.

b. A POSITA would not combine Hanisch '419 and Dunagan with Meador, Shin, or Hayashi

Petitioner seeks to combine Meador, Hayashi, or Shin with Hanisch '419 and Dunagan for the sole purpose of arguing that claim elements 1[e] and 12[d] regarding the claimed vacuum drying step would have been obvious. However, these references teach away from combining with Hanisch '419.

The discussion below focuses on the combination of Hayashi, Meador, or Shin with the teachings in Hanisch '419 regarding the high temperature decomposition furnace. As explained above, *supra* § VI.A.2, the Board has already and correctly determined that the low temperature “pre-dryer” of Hanisch '419 does not teach inactivation. Thus, the following discussion primarily addresses the decomposition furnace of Hanisch '419 that the Board has preliminarily determined does achieve inactivation.

i. A POSITA would not be motivated to combine Meador with Hanisch '419

(1) A POSITA would have understood that Meador does not teach using a vacuum level of less than 300 hPa

Ascend's challenge based on Meador is premised on its interpretation that Meador teaches the use of a pyrolysis chamber operating at a vacuum at “about one-half to one inch of mercury,” which is “the mathematical equivalent of pressures ranging from approximately 16 to 33 hPa.” Petition, 44. However, Ascend's expert no longer stands behind that interpretation.

A fundamental problem with Ascend's interpretation is that at this low pressure range, the water seals would boil off. Ex, 2022, ¶¶132-134. At Ascend's asserted pressure range, the boiling point for water would be between about 9°C to 27°C (or 48°F to 80°F). *Id.*, ¶¶132-133. Meador's water seals would boil away, leaving the system inoperable. *Id.*, ¶134. In his deposition, Dr. van Schalkwijk acknowledged that the water seal in Meador's system would boil at "a low temperature" between 15°C and 20°C if the absolute pressure were 0.5 inches of mercury. Ex. 2024, 61:8-19.

Additionally, under Ascend's interpretation of the pressure, the water seal would have to be over 32 feet high to withstand the pressure differential. Ex. 2022, ¶135. A three-story water seal is clearly not shown in Meador. Ex. 1011, Fig. 1. And the water seal would be badly distorted with the ambient atmosphere pressing down on the intake side of the seal, and pressing up the water on the side near the pyrolysis chamber. Ex. 2022, ¶¶136. But both Figure 1 and the supporting text confirm that the water level is the same on both ends of the water seal. Ex. 1011 at Fig. 1 & 4:50-53; Ex. 2022, ¶136.

In his deposition, faced with the problem of the water seals boiling off, Dr. van Schalkwijk acknowledged that his original opinion cannot stand. He first admitted that Meador "doesn't say what the absolute pressure is." Ex. 2024, 68:18-20. He testified that if the stated half-inch of mercury was the absolute

pressure, that would be a “very, very, you know, intense vacuum.” *Id.*, 68:22-69:2.

And he considered whether the stated half-inch of mercury was just a “slight vacuum” relative to ambient. *Id.*, 69:2-5 (“Or is that a slight vacuum of, really, instead of 30 inches of mercury, which is atmospheric pressure, only 29 and a half?”). He weighed these alternative interpretations: “But, in any case, one is a very intense vacuum, one is a slight vacuum.” *Id.*, 69:9-10.

Dr. van Schalkwijk agreed that a “slight” vacuum of a half-inch mercury relative to ambient is the proper reading of Meador, explaining that this slight relative pressure differential would be sufficient for Meador’s purposes. *Id.*, 70:5-9 (“A half-inch of mercury difference in pressure, that small, slight vacuum, as I termed it, is still enough to move a lot of air, push it out of the system, without intense use of the vacuum pump.”). He agreed that under this “slight” negative pressure, then the pressure inside Meador’s pyrolysis chamber “would be approximately 29.5 inches of mercury.” *Id.*, 71:1-6. He agreed that this slight relative pressure was the correct interpretation, noting that “the pressure being very slightly below atmospheric, the issue of water boiling at a low temperature isn’t a problem.” *Id.*, 72:10-13. Again, when asked to confirm whether “it makes sense to you to interpret this as a relative pressure, not an absolute pressure,” Dr. van Schalkwijk affirmed: “A relative pressure, because that makes sense because of the water.” *Id.*, 72:22-73:4.

When Ascend’s counsel attempted to revisit the issue, Dr. van Schalkwijk stood by his new interpretation of Meador:

“When I was trying to decide whether that was an absolute pressure or a relative pressure, I looked at the structure of the system and saw the water, and said, I can’t have water evaporating and going into the system this much. So this has to be a – a gentle vacuum, which is why I called it a slight vacuum in my declaration. And a slight vacuum is good enough to make a good, constant airflow.”

Id., 112:25-114:13.

Dr. van Schalkwijk’s interpretation is consistent with Meador’s disclosure, which states that the vacuum should be “slight.” Ex. 1011, 3:24-26. But Ascend’s asserted pressure range is not “slight.” Ex. 2022, ¶137. According to the treatise submitted by Petitioner URT in IPR2024-00887, a “rough” vacuum is categorized as having a range from 1000 hPa to 1 hPa, and a “medium” vacuum level is categorized as having a range from 1 hPa to 0.001 hPa. Ex. 2027, 1; Ex. 2022, ¶137. If Meador’s vacuum was operated at an absolute pressure of 12-34 hPa, this would be at the low end of the “rough” vacuum, and nearly a “medium” vacuum. Ex. 2022, ¶137. A POSITA would not characterize this as a “slight” vacuum. Ex. 2022, ¶¶137-138.

Thus, Ascend’s own expert agreed that Meador’s stated vacuum pressure of a half-inch of mercury represents a negative pressure relative to atmospheric pressure. *Id.*, 70:5-19, 72:17-73:4. Because atmospheric pressure is about 30

inches of mercury, he agreed that the absolute pressure in Meador's system would be about 29.5 inches of mercury. *Id.*, 71:1-6. That absolute pressure equates to about 999 hPa. Ex. 2022, ¶120.

Accordingly, contrary to Petitioner's arguments, Meador does not teach vacuum drying "at a maximum pressure of 300 hPa," as claimed in the '097 patent. Ex. 1001, 10:58-59. Meador only teaches using a negative pressure of 12 hPa to 34 hPa (*i.e.*, at an absolute pressure of 979 hPa to 1001 hPa, if at sea level). Ex. 2022, ¶¶138-139. Thus, Meador teaches away from using a vacuum level as strong as 300 hPa in a continuous process. *Id.*, ¶¶138-139.

(2) A POSITA would not combine Meador with the system of Hanisch '419 to teach a vacuum level of less than 300 hPa

Furthermore, the purposes of the vacuum in Meador and Hanisch are divergent. In Meador, the vacuum is used to prevent untreated exhaust gases from being released into the environment and to enable liquids and gases to be recycled. Ex. 1011, 3:25-26 & 4:2-8. However, in Hanisch '419, the organic carbonate solvents are already partially extracted through the low temperature dryer. Ex. 1004, 5:54-61. Expressly, Hanisch's high temperature furnace is not using the vacuum to recover solvents, which have already partially been recovered, and with the remaining solvents being destroyed in the decomposition furnace. Ex. 1004, 6:8-13. The temperatures in Hanisch's decomposition furnace (*i.e.*, 350°C to

800°C) are far in excess of the temperatures that would be needed to volatilize the organic carbonate solvents in lithium batteries, like DMC and EMC (*i.e.*, 90°C and 107°C, respectively). Ex. 2022, ¶144. There would be no need to employ a vacuum below 300 hPa to facilitate the evaporation of these organic solvents, because those solvents would already be destroyed by the pyrolytic heat of Hanisch's decomposition furnace – the vacuum would not meaningfully enhance the decomposition, which is driven by heat. *Id.*

Under these conditions, maintaining a vacuum below 300 hPa would be:

- **costly** (to engineer seals to maintain the vacuum, which would need to be far more resilient than those taught by Meador – see *infra* section VI.B.4.b.(2).ii(1)); Ex. 2022, ¶145;
- **unnecessary** (because the solvents in Hanisch '419 are destroyed by pyrolysis; *id.*); and
- **counterproductive** (because the seals are fault-prone, and would be a failure point for the facility, and because maintaining such vacuum levels would lead to vacuum motor fatigue and burnout – see *infra* section VI.B.4.b.(2).ii(1)). Ex. 2022, ¶145; Ex. 2024, 107:2-19.

Dr. van Schalkwijk testified that a “slight” vacuum of a half-inch of mercury relative to atmospheric pressure “is still enough to move a lot of air, push it out of the system, without intense use of the vacuum pump.” Ex. 2024, 70:5-9. A POSITA would have understood that Hanisch '419 is generally concerned with keeping “energy consumption as low as possible.” Ex. 1004, 4:51-54. A POSITA would have understood that the time and energy it takes a pump to attain vacuum

increases exponentially with the strength of the vacuum. Ex. 2022, ¶146. Thus, there is a strong incentive to use as weak a vacuum as possible to achieve the goals of the facility. Ex. 2022, ¶143-147.

Meador teaches that in a continuous processing system, where material is entering and exiting the pyrolysis chamber that is maintained under vacuum, a slight underpressure of a half-inch of mercury is appropriate. Ex. 2022, ¶¶138-139. A POSITA would understand from Meador that the highest vacuum level that would be practicable in a continuous system would be a negative pressure of about 34 hPa, which is far weaker than the vacuum levels claimed in the '097 patent. Ex. 1011, 5:61-63; Ex. 2022, ¶¶138-139. Thus, a POSITA would not be taught by Meador to apply a vacuum level below 300 hPa in the continuous system taught by Hanisch '419. Ex. 2022, ¶¶138-139.

ii. Hayashi teaches away from Hanisch '419 and a POSITA would not be motivated to combine these references

Petitioner has not met its burden of establishing claim 1[e] is rendered obvious by Hayashi. In its Decision, the Board noted that the pressure limitation of claim element 1[e] is not met by Hanisch '419 alone, but that a POSITA would have learned the “maximum pressure of 300 hPa” limitation from Hayashi. However, a POSITA would not have been motivated to combine Hanisch '419 with the teachings of Hayashi. To the contrary, Hayashi teaches away.

(1) The continuous processing requirement of Hanisch imposes constraints on the pressure ranges that would be compatible

Hanisch '419 is a continuous process, and must be operated with mechanisms and under conditions compatible with that continuous process. Ex. 1004, 3:27-28. In Hanisch '419, material flows laterally along a pyrolytic oven and is continuously removed via a discharge pipe. Ex. 1004, 6:8-13 & Fig 1 (#44). Hanisch '419 does not say what kind of devices could be used to allow this continuous flow of materials into and out of the vacuum system, nor what vacuum levels could be sustained in this system. Ex. 2022, ¶¶149-150. To allow battery material to enter and exit this oven continuously, it would be difficult to maintain a strong vacuum (rather than a slight underpressure), which is what Meador teaches. Ex. 1011, 5:61-63; Ex. 2022, ¶¶138-139, 150.

A POSITA would understand that there are limited options for mechanisms to allow the flow of solid material, like comminuted batteries, into and out of a chamber that is under vacuum, and that these various mechanisms are constrained in the range of vacuum pressures they can withstand. Ex. 2022, ¶150.

Water seals. One option for maintaining a vacuum in a continuous process is a water seal, such as in Meador. Ex. 2022, ¶132-134, 151; Ex. 1011, 4:50-53. However, a water seal would not work in the context of the Hanisch '419 patent. Ex. 2022, ¶151. First, Hanisch '419 deals with shredded lithium batteries. *Id.*

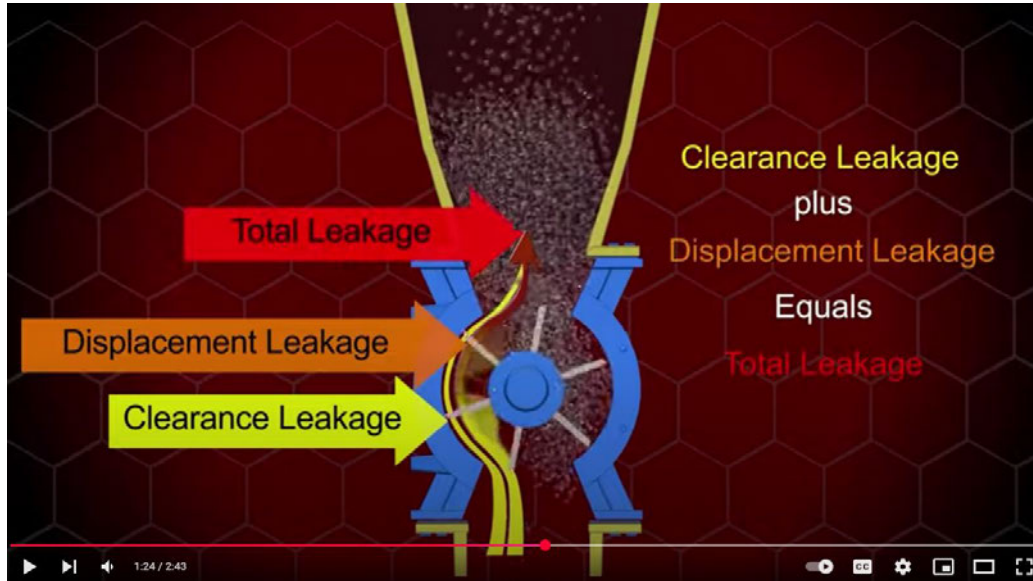
Dropping lithium batteries through a water seal would be hazardous, because the LiPF_6 could hydrolyze and create toxic hydrogen fluoride (or aqueous hydrofluoric acid). *Id.* Moreover, a water seal is incompatible with low pressures, because the water would boil off (*see* Section VI.B.4.b.i(1), *supra*); Ex. 2022, ¶¶132-134, 151.

Pressure switches. Meador also describes the use of pressure switches to allow solid material to flow through a continuous process that is maintained under vacuum. However, as the Bin-Dicator device featured in Meador confirms, these devices are designed to be used at or near atmospheric pressure. Ex. 2022, ¶¶140-142, 160; Ex. 2030, 3 (“The Bin-Dicator control is a pressure actuated switch for use with free flowing bulk materials at atmospheric pressures.”). If a stronger vacuum is used, the material will not displace properly through the port that is secured by the pressure switch. *Id.*

Rotary airlocks. A more suitable mechanism for allowing solid material to continuously enter and exit a vacuum chamber would be a rotary airlock. Ex. 2022, ¶152. Solid items are allowed to pass through the rotary valve, and a limited vacuum can be maintained within an inner chamber. *Id.*; Ex. 2036.

Rotary airlock valves are leaky. As depicted below, a rotary valve separates two regions of different pressures. Ex. 2022, ¶153. Solid material falls downward through a rotating set of vanes which are precisely machined to minimize air loss as the vanes spin around the valve. *Id.* However, air is able to escape around the

edges of the vanes (*i.e.*, clearance leakage), and quantities of air pass through in the pockets defined by the vanes (*i.e.*, displacement leakage):



Id.; Ex. 2031. The leaks become pronounced over the usage of the airlock, because the hard and jagged material being conveyed (*e.g.*, the comminuted battery material) will damage the vanes, exacerbating the leakage. *Id.*, ¶154.

Furthermore, these devices are heat-sensitive, owing to the exacting tolerances of the vanes, and the expansion and contraction of the blades as they are heated and cooled. *Id.* Thus, these devices are not designed to handle strong vacuum levels.

As the vacuum differential increases, the leakage increases, which causes the vacuum pump to work harder, causing burnout of the vacuum pump. Ex. 2022, ¶¶156-157. The concerns of leakage are well-documented. Ex. 2025, 71; Ex. 2022, ¶¶84, 155, 156.

Rotary airlocks would be challenging in the context of the Hanisch '419 patent. The battery material is coarse, and so the material would not fill the pockets of the rotary valve fully, leading to high displacement leakage. Ex. 2022, ¶156; Ex. 2025, 75. The material is irregularly-shaped, jagged, metallic pieces, which would damage the vanes, causing further leakage. Ex. 2022, ¶156. The working environment is hot, which requires additional clearance to account for expansion of the blade material, which also exacerbates leakage. *Id.*

Thus, while a POSITA would likely turn to a rotary airlock as the right mechanism for allowing a continuous flow of shredded battery material into the system of Hanisch '419, a POSITA would be highly focused on combatting leakage. Ex. 2022, ¶157. The most straightforward way to do that would be to use as low a vacuum differential as possible. *Id.*

Particularly in the context of Hanisch '419, it would be essential to minimize leakage, to avoid the entry of oxygen. The higher the pressure differential between the vacuum chamber and the incoming stream, the higher the leakage of the rotary airlock or indeed any continuous airlock. Ex. 2022, ¶157. Thus, more and more oxygen would bypass the airlock as the pressure differential increases. *Id.*, ¶158. This would run counter to the goals of Hanisch '419 to exclude oxygen, to avoid oxidizing the copper and aluminum foils. *Id.*; Ex. 1004, 4:6-18. Thus, a POSITA would want to use as low a vacuum differential as possible in Hanisch '419,

particularly if the POSITA was using rotary airlocks or other such continuous flow devices. *Id.*, ¶¶158-159. As Dr. van Schalkwijk testified, a negative pressure of half an inch of mercury (*i.e.*, 17 hPa) would be “still enough to move a lot of air, push it out of the system without intense use of the vacuum pump.” Ex. 2024, 70:7-9. Thus, a POSITA would be motivated use a negative pressure, relative to ambient, of about a half-inch of mercury (*i.e.*, about 17 hPa) to do the job, as Meador teaches. Ex. 1011, 5:61-63; Ex. 2022, ¶¶158-159.

(2) Hayashi’s batch process is incompatible with Hanisch ’419, and its pressure ranges are uninformative

Given the constraints of Hanisch’s system imposed by its continuous architecture, and the limited mechanisms to maintain a continuous flow of material into a vacuum chamber, a POSITA would not look to Hayashi to learn the appropriate vacuum levels to use in Hanisch’s system. Ex. 2022, ¶¶162-172.

Hayashi is a batch process. Ex. 2022, ¶162. Hayashi teaches processing a single battery cell in a heating bath, adding water to the cell to deliberately trigger the release of hydrogen fluoride gas, and then withdrawing these vapors with a pipe under vacuum. Ex. 1006, 4:24-47. Hayashi says nothing about how to permit a continuous flow of solid materials into a chamber while maintaining a vacuum. Ex. 2022, ¶162. A POSITA would not look to vacuum levels from a

batch process to inform how to determine the pressure levels to maintain in a continuous process. *Id.*

The vacuum levels in Hayashi are strong, with working examples ranging from 50 hPa to 200 hPa, with a preference for stronger vacuum levels. Ex. 1006, 4:48-5:17, 9:33-10:60; Ex. 2022, ¶162. A POSITA would recognize that these vacuum levels are stronger than the levels that would be compatible with the requirement in Hanisch '419 to allow battery materials to continually enter and exit the system while maintaining some level of vacuum. Ex. 2022, ¶162. The vacuum levels taught in Hayashi are far stronger than a water seal or a pressure switch (as taught in Meador) would allow to be maintained. Ex. 2022, ¶¶132-134, 162. The vacuum levels taught in Hayashi also exceed the typical vacuum levels that could be maintained with a continuous air lock. Ex. 2022, ¶¶159, 162; Ex. 2036.

Petitioner has provided no evidence that the pressure levels in Hayashi's batch process would be compatible with the continuous process in Hanisch '419. To the contrary, Dr. van Schalkwijk testified that a slight vacuum, such as "a half inch of mercury difference in pressure" (*i.e.*, 17 hPa negative pressure relative to ambient) would be sufficient to "still move a lot of air, push it out of the system without intense use of the vacuum pump," to support a continuous system like that in Meador. Ex. 2024, 70:7-9. Nor does Petitioner suggest that a POSITA would

try to alter the continuous process of Hanisch '419 and change it into a batch process, like in Hayashi.

By disclosing vacuum levels that are incompatible with the architecture of the system of Hanisch '419, Hayashi teaches away. *Adidas AG v. Nike, Inc.*, 963 F.3d 1355, 1359 (Fed. Cir. 2020), *cert. denied*, 141 S. Ct. 1376 (2021) (such “[f]undamental differences between the references are central to [the] motivation to combine inquiry.”); *McGinley v. Franklin Sports, Inc.*, 262 F.3d 1339, 1354 (Fed. Cir. 2001) (“[i]f references taken in combination would produce a ‘seemingly inoperative device,’ we have held that such references teach away from the combination and thus cannot serve as predicates for a prima facie case of obviousness.”); *Nichia Corp. v. Everlight Americas, Inc.*, 855 F.3d 1328, 1339 (Fed. Cir. 2017) (affirming finding of no motivation to combine, because “the references disclose different structures, resolve dissimilar problems, and propose dissimilar solutions.”).

(3) A POSITA would not look to Hayashi to learn advantages of improved electrolyte evaporation at a given temperature when lower ambient pressures are used

In its Decision, the Board credited Petitioner’s argument that a POSITA would have combined Hanisch '419 with Hayashi “because of the advantages of improved electrolyte evaporation at a given temperature when lower ambient

pressures are used.” Decision, 23. However, there would be no motivation for a POSITA to make this inquiry.

Hanisch ’419 uses a pyrolysis oven. Ex. 1004, 4:6-27, 6:8-10. Given this 400°C-600°C environment, there is no need to seek “improved electrolyte evaporation.” Ex. 2022, ¶164. A POSITA would understand that the solvents are pyrolyzed, with no need to find ways in the literature to improve this evaporation. *Id.*

Nor would a POSITA have sought to combine Hayashi’s pressures with the pre-dryer of Hanisch ’419. Ex. 2022, ¶165. Hanisch ’419 shows no mechanism for blocking airflow between the pre-dryer and the shredder 12. *Id.* Applying Hayashi’s vacuum levels to the pre-dryer would likewise impose a strong negative pressure in the shredder 12, which would overwhelm the nitrogen tank 22 that is attempting to maintain an inert atmosphere in the shredder, sucking away the inert atmosphere. Ex. 2022, ¶165. And this negative pressure would draw oxygen from the ambient environment into the shredder, which, in the presence of electrolyte solvents and sparks from the metal-on-metal crushing, would create an unacceptable explosion risk. Ex. 2022, ¶¶82, 93, 165.

(4) A POSITA would not look to Hayashi to achieve the attenuation of toxic hydrogen fluoride production during the heating process

In its Decision, the Board credited Petitioner's argument that a POSITA would have combined Hanisch '419 with Hayashi to advance "the attenuation of toxic hydrogen fluoride production during the heating process." Decision, 23. However, Hayashi teaches the opposite of this goal. Hayashi deliberately provokes the formation of toxic HF gas. Ex. 1006, 4:38-48; Ex. 2022, ¶167. If a POSITA had been motivated to attenuate HF production, Hayashi would have taught away from this goal, and not been considered. Ex. 2022, ¶167.

Dr. van Schalkwijk states that "[i]t has long been understood in the art that battery recycling processes, including those for lithium-ion batteries, should avoid conditions that could lead to explosion, fire, and/or release of toxic compounds." Ex. 1003, ¶68. But Hayashi does the opposite: Hayashi provokes the release of toxic fluorine gas from the single battery cell being treated. Ex. 1006, 4:24-48; Ex. 2022, ¶167. This teaches away from Hanisch '419.

Furthermore, Dr. van Schalkwijk's opinion about lower temperatures is directed to hydrolysis. Ex. 1003, ¶68 ("Thus, lower temperatures reduce the rate of the LiPF₆ hydrolysis reaction that forms toxic HF, thereby slowing HF formation."). But Hanisch '419 does not concern the use of water, and instead relies on high heat to decompose the binder. Ex. 2022, ¶67.

(5) A POSITA would not look to Hayashi to achieve control over potentially flammable compounds and gasses generated during heating

In its Decision, the Board credited Petitioner's argument that a POSITA would have combined Hanisch '419 with Hayashi to promote "the control over potentially flammable compounds and gasses generated during such heating." Decision, 23. However, Hayashi teaches nothing about how to control the gasses in Hanisch '419. Hanisch '419 overcomes the problem of flammable compounds by pyrolyzing them. Ex. 1004, 6:7-10. Hanisch '419 is not concerned with managing flammable compounds; the focus of Hanisch is avoiding oxidation of the copper and aluminum supports. Ex. 1004, 4:6-18; Ex. 2022, ¶169. Because the potentially flammable compounds are pyrolyzed in Hanisch '419, a POSITA would not have been motivated to look to Hayashi for ways to achieve control over this flammability concern (because it is not a concern). Ex. 2022, ¶169.

Nor would a POSITA have combined Hayashi with the pre-dryer of Hanisch '419 to address the problem of controlling potentially hazardous compounds. As explained above in Section VI.A.2, *supra*, applying Hayashi's vacuum levels to the pre-dryer would exacerbate the risk of flammability, by overwhelming the nitrogen tank 22, depleting the inert atmosphere, and drawing oxygen into the shredder 12, which would create a heightened risk of explosion. Ex. 1004, Fig. 1; Ex. 2022, ¶¶165, 170.

(6) The fundamental premise of Hayashi teaches away from Hanisch '419

Hayashi's overall goal teaches away from Hanisch '419, and thus the two references would not be combined. The basic premise of Hayashi is that batteries need to be detoxified before the metals can be recycled. Ex. 1006, 11:59-12:11; Ex. 2022, ¶171. In particular, Hayashi teaches the importance of removing the LiPF_6 from the batteries by introducing water to hydrolyze the LiPF_6 into hydrogen fluoride, which is off-gassed and then sequestered. Ex. 1006, 5:19-25; Ex. 2022, ¶171. Hayashi's approach is the opposite of the system of Hanisch '419, which teaches that such pre-treatment is not necessary. Rather, Hanisch '419 instructs that the batteries can be comminuted directly, while still containing the LiPF_6 . Ex. 1004, Fig 1; Ex. 2022, ¶171.

Moreover, Hayashi uses vacuum to promote the evaporation of electrolyte solvent. Ex. 1006, 4:38-5:21; Ex. 2022, ¶172. By contrast, Hanisch '419 uses vacuum to reduce the amount of oxygen in the decomposition furnace. Ex. 1004, 4:6-18; Ex. 2022, ¶172. A POSITA would not have applied the teachings of Hayashi to the different problem at issue in Hanisch '419. Ex. 2022, ¶172; *see Allergan, Inc. v. Sandoz Inc.*, 796 F.3d 1293, 1305 (Fed. Cir. 2015) ("A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference,

or would be led in a direction divergent from the path that was taken by the applicant.”) (citation omitted); *Tec Air, Inc. v. Denso Mfg. Mich. Inc.*, 192 F.3d 1353, 1360 (Fed. Cir. 1999) (“There is no suggestion to combine . . . if a reference teaches away from its combination with another source.”).

Petitioner also fails to explain how a POSITA would have been motivated to combine Hayashi with Hanisch '419 with a reasonable expectation of success in reaching the claimed invention. The batch process of Hayashi is fundamentally incompatible with the continuous system of Hanisch '419, *see* Section VI.B.4.b.i(2), *supra*. Hanisch '419 destroys any remaining solvents in the decomposition furnace. Ex. 2022, ¶81. Hanisch '419 does not attempt to recover any of the solvents that are removed in the decomposition furnace. Ex. 2022, ¶104. There is no need to use reduced pressures in the decomposition furnace of Hanisch '419 to evaporate the solvents, because the pyrolytic temperatures of the furnace, themselves, are more than sufficient to evaporate (and destroy) the solvents. Ex. 2022, ¶81. Therefore, there would be no need to turn to the teachings of Hayashi to use vacuum pressures to enable the evaporation and recovery of the solvents. Ex. 2022, ¶169. Hayashi's attempt to recover solvents cannot be applied to Hanisch '419 because the solvents would be destroyed in the 400°C to 600°C furnace of Hanisch '419. *Id.*

A POSITA would also not be motivated to combine the extremely slow and expensive single battery cell processing approach taught in Hayashi with the multi-step, continuous processing technique used in Hanisch '419 which has the stated goal of improved efficiency. Ex. 2022, ¶¶66-72, 124; *Virtek Vision Int'l ULC v. Assembly Guidance Sys., Inc.*, 97 F.4th 882, 886-87 (Fed. Cir. 2024) (“Obviousness concerns whether a skilled artisan not only *could have made* but *would have been motivated to make* the combinations or modifications of prior art to arrive at the claimed invention.”) (citation omitted, emphasis in original).

iii. Shin teaches away from Hanisch '419 and a POSITA would not be motivated to combine

Shin does not teach processing batteries at a pressure of less than 300 hPa. Notably, neither Petitioner nor Dr. van Schalkwijk recite any pressure taught by Shin. Petition, 20-21 & 44; Ex. 1003, ¶¶80-81 & ¶¶148-152.

Shin teaches using a high vacuum to initially purge the reaction reservoir of oxygen. Ex. 2022, ¶¶174. Shin teaches using a high vacuum of 10^{-4} torr (*i.e.*, about 0.00013 hPa), running a rotary pump for about 5 minutes. *Id.*; Ex. 1010, 8:4-12. “As a result, the oxygen in the treatment space S1 may be removed and the explosion possibility may be maximally suppressed in a heat treatment step.” *Id.*, Ex. 1010, 8:12-15.

This vacuum is not maintained through the processing of the batteries. Ex. 2022, ¶¶175-176. To the contrary, after the oxygen is purged, Shin teaches pumping nitrogen into the chamber. *Id.*; Ex. 1010, 8:16-17 (“In this [purged] state, the inert gas is injected into the treatment space S1 of the reaction reservoir 30 through the gas inlet 42.”). More gas is contributed to the system as the heat treatment progresses and the batteries rupture, emitting poisonous gas. *Id.*, 8:28-31 & 8:62-66; Ex. 2022, ¶¶175-176.

Shin does not attempt to suppress the formation of toxic gases, but rather focuses on exhausting these gases. *Id.*, 4:4-9; Ex. 2022, ¶177. Shin teaches crushing and grinding the batteries after the heat-treatment process. *Id.*, 9:21-26 & Fig. 5 (Step S80) ; Ex. 2022, ¶177.

Shin describes itself as a continuous process. Ex. 1010, 3:41-46. However, Shin is not a continuous process in the sense of Hanisch ’419. Ex. 2022, ¶178. Shin’s process is only continuous in the sense that small consumer product batteries can be fed into the reaction reservoir in a serial manner during the course of a processing run. *Id.*, 8:28-34 (“the heat treatment is performed while inputting approximately 10 waste batteries per minute through the inlet 33.”). A “gas blocking door 34” prevents poisonous gas from escaping when new batteries are introduced. *Id.*, 8:42-51. However, this is all done in the context of a single batch, after which the accumulated battery material is removed from the reaction

reservoir and transferred to a crusher. *Id.*, 9:21-26. Thus, Shin's approach is essentially performed on a batch basis, not a continuous process, like in Hanisch '419. Ex. 2022, ¶178. Petitioner's expert, Dr. van Schalkwijk, acknowledged during his deposition that Shin performs batch processing. Ex. 2024, 89:25-91:14.

Thus, there is no teaching in Shin to vacuum dry comminuted batteries at a pressure of less than 300 hPa. Ex. 2022, ¶176.

Shin cannot be combined with Hanisch '419, because the approaches are fundamentally incompatible. Ex. 2022, ¶179. Whereas Shin ruptures whole batteries under high heat, Hanisch '419 comminutes the batteries first. *Id.* While Shin initially uses a high vacuum to purge oxygen, it negates that vacuum by flooding the chamber with nitrogen gas; by contrast, Hanisch '419 states that the processing may be carried out under vacuum, which is not taught in Shin. *Id.* There is no reason that a POSITA, when contemplating Hanisch '419, would turn to Shin for its teachings. *Id.*

5. Claim 12[d]: Hanisch '419 alone or in view of Hayashi, Meador, or Shin does not render obvious “a vacuum installation connected to the drying device and configured to generate a vacuum in the drying device”

Neither Meador, nor Hayashi, nor Shin can be combined with Hanisch '419 to teach “a vacuum installation connected to the drying device and configured to generate a vacuum in the drying device.”

Meador's system cannot be combined with Hanisch '419 to teach a vacuum installation. Meador's system uses water seals to allow battery material to continuously flow into the pyrolytic chamber. Ex. 1011, 4:50-53. However, Meador's system is directed to processing of batteries with aqueous electrolyte solutions (and well as lithium batteries that have been pre-treated with aqueous KOH). Ex. 2022, ¶181; Ex. 1011, 3:22-23 & 3:51-54. Thus, those batteries are compatible with the water seals taught by Meador. Ex. 2022, ¶181. By contrast, Hanisch '419 teaches a system for processing lithium batteries, in which the lithium batteries are comminuted and processed directly. Ex. 1004, 3:19-4:18 & Fig. 1. These lithium batteries would react with the water seals of Meador, releasing toxic hydrofluoric acid, and potentially exploding or corroding the equipment. Ex. 2022, ¶181. Thus, it would be hazardous to combine Meador's vacuum system with Hanisch '419, and a POSITA would not be motivated to make this combination. *Arctic Cat Inc. v. Bombadier Recreational Prods., Inc.*, 876 F.3d 1350, 1362 (Fed. Cir. 2017) (upholding finding of no motivation to combine in view of hazards). Petitioner's expert, Dr. van Schalkwijk, confirmed during his deposition that exposing lithium ion batteries to water is dangerous, regardless of whether they had been discharged prior to that exposure, describing that exposure as "not an advisable thing to do." Ex. 2024, 77:3-13.

Hayashi's vacuum system cannot be combined with Hanisch '419 because it is a batch system, and it provides no mechanism for allowing a continuous flow of battery material to enter and exit a chamber under vacuum, as set forth in Section VI.B.4.b.ii(2), *supra*; Ex. 2022, ¶182. Moreover, applying a vacuum to the pre-dryer of Hanisch '419 would exacerbate the risk of explosion, by overwhelming the nitrogen tank, sucking off the inert atmosphere in the shredder, and pulling in oxygen from the environment that would ignite the electrolyte solvents in the spark-prone shredder. Ex. 2022, ¶182. Nor would there be a need to employ Hayashi's vacuum levels in the decomposition furnace of Hanisch '419, because those electrolyte solvents would be pyrolyzed, with no need for a vacuum to promote evaporation. *Id.*

Shin's system cannot be combined with Hanisch '419 because Shin does not teach processing battery materials under vacuum. Ex. 2022, ¶183. Shin's apparatus creates a vacuum only temporarily, for the limited purpose of purging oxygen. *Id.*; Ex. 1010, 8:4-15. Once the oxygen is purged, the system is flooded with nitrogen gas, negating the vacuum. Ex. 2022, ¶183; Ex. 1010, 8:16-22. Despite calling itself a "continuous heat treatment" system, Shin does not allow battery material to continually enter a vacuum chamber, as called for by Hanisch '419. Ex. 2022, ¶183. The vacuum system of Shin cannot be combined with

Hanisch '419 because it is not adapted to the continuous flow architecture described by Hanisch '419. *Id.*

C. Objective indicia of non-obviousness support patentability

1. Secondary considerations compel a finding of non-obviousness

Even where the teachings of the prior art “point in the direction of” the claimed subject matter, objective evidence of nonobviousness may lead to a conclusion that the challenged claims would not have been obvious. *In re Piasecki*, 745 F.2d 1468, 1474–75 (Fed. Cir. 1984); *Transocean Offshore Deepwater Drilling, Inc. v. Maersk Drilling USA, Inc.*, 699 F.3d 1340, 1349 (Fed. Cir. 2012).

Here, secondary indicia of non-obviousness, including long-felt need, unexpected results, commercial success, and licensing, also confirm patentability. Ex. 2022, ¶¶184-191; Ex. 2040, ¶¶2-12.

2. Long-felt but unmet need and unexpected results

Prior to the '097 invention, many companies tried and failed to develop a process for inactivating depleted rechargeable batteries for safe storage and transport. Companies proposed mixing various additional chemicals with the comminuted material to mitigate known hazards relating to the comminuted material, including: flame retardants (Ex. 2005, 7-8); aqueous solution or a deactivating powder (Ex. 2003, 5:[0034]-[0035]); mineral acids (Ex. 1006, 5:18-52); brine solutions (Ex. 1018, 5:4-11); and pressurized solvents (Ex. 2011, 3:3-5);

see also Ex. 2022, ¶185. However, adding foreign substances to the comminuted battery material had deleterious effects on the recycling process. *See* Ex. 1001, 2:6-12; Ex. 2025, ¶185. Moreover, given that treatment with aqueous solutions can cause partial electrolysis and produce toxic gases, the need for safe battery processing in such conditions was well recognized. Ex. 1006, 1:26-29; Ex. 2022, ¶185.

The '097 patent addresses these long-standing needs by offering an elegant solution that allows batteries to be comminuted directly, and then inactivated by drying at a pressure below 300 hPa. Ex. 2022, ¶¶185-187. Preferably, and as recited in Claim 9, the drying is done at temperatures below 80°C, which has the advantage of avoiding the creation of toxic gases such as hydrogen fluoride. *Id.* By avoiding the need to add foreign substances, the claims of the '097 patent beneficially eliminate contaminants from the recycling process. *See, e.g.,* Ex. 1001, 1:63-2:4, 2:5-12. By safely inactivating electrolytes and associated solvents without forming hydrogen fluoride, the '097 patent achieved a safer and more efficient way of recovering spent battery material with high purity and rendering it safe for transport. Ex. 2022, ¶¶185-187. The '097 patent offers a deceptively simple solution to what was a stubborn problem in the industry; only with a hindsight bias would this seem obvious. Ex. 2022, ¶186.

The '097 invention also provided unexpected results. As discussed above, prior battery recycling approaches added foreign substances or high temperatures that introduced serious hazards, *e.g.*, freezing, incineration, melting, adding reactants, and shredding in water. *See also* Ex. 2022, ¶¶51-57, 185. The '097 patent took a completely different and unexpected approach to preventing these hazards—avoiding creating the hazards in the first place. Ex. 2022, ¶¶185-187. The advantages and benefits of vacuum drying at pressures below 300 hPa without treating with foreign substances were superior because solvents can be recovered at a purity of over 99%, the energy requirement is low, the drying time is short, no waste gas scrubbing is necessary, no toxic filter materials have to be disposed of, no chemicals are needed, and the lithium is present in the black mass as LiPF_6 and not as a breakdown product. *Id.*, ¶187.

3. Duesenfeld's battery recycling processes practice the challenged claims

Duesenfeld operates a battery comminution facility at its Wendeburg Plant. Ex. 2040, ¶¶6-8. The Wendeburg Plant practices the '097 claimed invention. Ex. 2022, ¶¶188-191; Ex. 2037 (claim chart). Indeed, the Wendeburg Plant represents one of the preferred embodiments disclosed in the '097 patent. Ex. 1001, 3:4-12 (“According to a preferred embodiment, the drying occurs under vacuum. The size of the vacuum is preferably selected such that the vapour pressure of dimethyl

carbonate at 80°C., especially at 70°C., is not reached. It is beneficial if the drying occurs at a maximum pressure of 300 hPa, in particular a maximum of 100 hPa. At such low pressures, considerable parts of most electrolytes vaporise, especially dimethyl carbonate and ethyl methyl carbonate, and do so at temperatures of less than 80°C.”); Ex. 2022, ¶190.

4. Duesenfeld’s battery recycling processes have been commercially successful

Duesenfeld’s battery recycling processes have been commercially successful. Ex. 2040, ¶¶9-12. For example, [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

and all batteries processed were shredded and then were dried at conditions of a temperature of less than 80°C and at a pressure of less than 300 hPa, after which the black mass was shipped in transport containers to customers. Ex. 2040, ¶9.

Duesenfeld has also successfully licensed the claimed technology. Ex. 2040, ¶¶10-11. Specifically, [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]; Ex. 2051 (June 11, 2024 Seval S.r.l. and RiPlastic S.p.A. press release). Seval touts in its press release that “Thanks to this process, the treatment of lithium-ion batteries is carried out at a low temperature in complete safety, with emissions largely below the most stringent thresholds and no hydrogen fluoride release, producing a black mass with an excellent level of purity, rich in nickel, cobalt and lithium, as well as noble metals like aluminum, copper, iron. The technology also allows us to achieve a very high recovery rate as required by the new European Regulation 2023/1542.” *Id.* [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

In addition, Duesenfeld’s consulting business is on a growth trajectory, having recently entered into a cooperation agreement with Andritz AG, one of the

largest plant manufacturers in the world. Ex. 2040, ¶12; Ex. 2052. Pursuant to this cooperation agreement, Duesenfeld is disclosing its technology to ANDRITZ, which will build a new reference plant for Duesenfeld, which will expand Duesenfeld's throughput and permit Duesenfeld to showcase its technology. Ex. 2040, ¶12.

5. Rebuttable presumption of nexus

To be accorded substantial weight, the evidence of the secondary considerations must include a showing of nexus. *In re GPAC Inc.*, 57 F.3d 1573, 1580 (Fed. Cir. 1995). There is a rebuttable presumption of nexus when the patentee shows that the asserted objective evidence is tied to a specific product and that product is the invention disclosed and claimed in the patent. *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1329 (Fed. Cir. 2016); *SightSound Techs., LLC v. Apple, Inc.*, 809 F.3d 1307, 1319 (Fed. Cir. 2015) (“If a product both embodies the claimed features and is coextensive with the claims at issue, a nexus is presumed.”); *see also Teva Pharms. USA, Inc. v. Sandoz, Inc.*, 723 F.3d 1363, 1372 (Fed. Cir. 2013) (there is a “presumption of a nexus” when a product is “coextensive” with a patent claim).

Here, Duesenfeld is entitled to the rebuttable presumption of a nexus between the objective evidence of nonobviousness and the Challenged Claims because the evidence is tied to a specific process, Duesenfeld's battery recycling

process at its Wendeburg Plant, and that process is the invention disclosed and claimed in the Challenged Claims. Ex. 2040; Ex. 2022, ¶¶188-189; & Ex. 2037 (Confidential Appx. D).

Even if Petitioner could somehow rebut the presumption of a nexus, “the patent owner is still afforded an opportunity to prove nexus by showing that the evidence of secondary considerations is the ‘direct result of the unique characteristics of the claimed invention.’” *Volvo Penta of the Ams., LLC v. Brunswick Corp.*, 81 F.4th 1202, 1210 (Fed. Cir. 2023) (citing *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373–74 (Fed. Cir. 2019) (quoting *In re Huang*, 100 F.3d 135, 140 (Fed. Cir. 1996))). A nexus analysis is not confined to the claimed novel features. *Id.* (citing *WBIP*, 829 F.3d at 1330 (stating that “proof of nexus is not limited to only when objective evidence is tied to the supposedly ‘new’ feature(s)”). Instead, “the invention as a whole” should be considered, rather than on a “limitation-by limitation” basis. *Id.* (citing *Chemours, Co. FC v. Daikin Indus.*, 4 F.4th 1370, 1377 (Fed. Cir. 2021); *Yita LLC v. MacNeil IP LLC*, 69 F.4th 1356, 1364 (Fed. Cir. 2023) (discussing *WBIP*)).

The evidence shows that the “unique characteristics of the claimed invention” of the ’097 patent are driving the commercial success of Duesenfeld’s battery recycling processes. *Volvo*, 81 F.4th at 1210. Advertisements for Duesenfeld’s battery recycling processes tout the benefits of the patented ’097

“vacuum drying” technology. Ex. 2053 (Duesenfeld Brochure), 3 (“we have developed and licensed processes that do not require melting down or high-temperature treatment of batteries”), 3 (“Patent: Drying below 80 degrees Celsius is only possible with the Duesenfeld patented process”); 5 (“During mechanical shredding and inactivation of the batteries, the drying process takes place below 80°C and at a low vacuum; Only under these conditions is no exhaust gas scrubbing necessary. Only in this temperature range can also the solvents of the electrolyte, the graphite and the lithium be recovered in a purity so that they can be reused. Through this technology, Duesenfeld combines environmental friendliness with maximum economic efficiency.”); Ex. 2012 (Duesenfeld website https://www.duesenfeld.com/recycling_en.html) (“... A low process temperature prevents the formation of toxic gases, so no exhaust gas scrubbing is necessary. The separated solvent has a very high purity level because the production of hydrogen fluoride from reaction products is avoided.”).

“Th[is] prominence of the patented technology in ... advertising creates an inference that links the ... invention to this success.” *Gambro Lundia AB v. Baxter Healthcare Corp.*, 110 F.3d 1573, 1579 (Fed. Cir. 1997). Thus, there is a strong nexus between the ’097 patent and the success of Duesenfeld’s battery recycling processes.

VII. CONCLUSION

For the foregoing reasons, the Petition fails to establish by a preponderance of the evidence that the Challenged Claims are unpatentable. Accordingly, the Challenged Claims should be confirmed under 35 U.S.C. § 316.

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WORD COUNT CERTIFICATION

Pursuant to 37 C.F.R. § 42.24(d), Patent Owner certifies that this Patent Owner Response has a total of 13,935 words as counted by Microsoft Word, exclusive of the cover page, table of contents, table of authorities, mandatory notices under § 42.8, certificate of service, word count, appendix of exhibits or claim listing, and signature block (37 C.F.R. § 42.24(a)). The word count includes include all other text, including headings, footnotes, and quotations. This is within the 14,000-word limit allowed under § 42.24(a)(1)(i).

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CERTIFICATE OF SERVICE

I hereby certify that on February 14, 2025, a copy of this Patent Owner Response, including all accompanying attachments, appendices, and exhibits, has been served in its entirety via e-mail on Attorneys for Petitioner at the following e-mail addresses:

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