

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ASCEND ELEMENTS, INC.,
Petitioner,

v.

DUESENFELD GMBH,
Patent Owner.

Case No. PGR2025-00037

U.S. Patent No. 12,119,463

**PETITION FOR POST GRANT REVIEW
OF U.S. PATENT NO. 12,119,463**

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LISTING OF EXHIBITS

Exhibit	Description
1001	U.S. Patent No. 12,119,463 ("463 Patent")
1002	Patent Prosecution History for U.S. Patent No. 12,119,463
1003	Declaration of Marc Juzkow
1004	Japanese Patent App. Pub. JPH10255861 ("Tomioka")
1005	Translation of Tomioka
1006	Certification for translation of Tomioka
1007	Japanese Patent App. Pub. JP2016080284A ("Yosuke")
1008	Translation of Yosuke
1009	Certification for translation of Yosuke
1010	U.S. Patent No. 9,843,077 ("Hayashi")
1011	Kwade et al., <i>LithoRec: Recycling lithium-ion batteries</i> , published in 2012 by Cuvillier Verlag Göttingen ("LithoRec")
1012	Translation of LithoRec
1013	Certification of translation of LithoRec
1014	U.S. Patent Appl. Pub. No. US 2008/0050295 A1 ("Uchida")
1015	Perry et al., <i>Perry's Chemical Engineers' Handbook</i> (7 th Ed.) published in 1997 by McGraw-Hill ("Perry")
1016	U.S. Patent No. 11,050,097 ("097 Patent")
1017	RESERVED
1018	<i>Ascend Elements Inc. v. Duesenfeld GmbH</i> , IPR2024-00948, Paper 10 (Decision Granting Institution of <i>Inter Partes</i> Review for U.S. 11,050,097) ("097 Institution Decision")
1019	<i>Ascend Elements Inc. v. Duesenfeld GmbH</i> , IPR2024-00948, Paper 19 (Patent Owner Response [REDACTED]) ("097 POR")
1020	Declaration of Sylvia Hall-Ellis, Ph.D.
1021	U.S. Patent App. Pub. No. US 2014/0290438 A1 ("Hanisch")
1022	<i>Duesenfeld GmbH v. Ascend Elements Inc.</i> , 1:23-cv-01194-JFM, Stay Order, ECF No. 169 (D. Del. Jan. 17, 2025)
1023	Han et al., <i>Lithium-ion hopping weakens thermal stability of LiPF₆ carbonate electrolytes</i> , Cell Reports Physical Science 5, 101768 (Jan. 17, 2024).
1024	Nitta et al., <i>Li-ion battery materials: present and future</i> , 18 Materials Today 252 (June 2015)
1025	Solef® PVDF Typical Properties, Solvay Brochure

Exhibit	Description
1026	Lu et al., <i>Thermal behavior and decomposition kinetics of six electrolyte salts by thermal analysis</i> , 156 J. Power Sources 555 (2006)
1027	Yang et al., <i>Thermal stability of LiPF₆ salt and Li-ion battery electrolytes containing LiPF₆</i> , 161 J. Power Sources 573 (2006)
1028	U.S. Patent No. 5,691,077
1029	<i>URT Umwelt und Recyclingtechnik GmbH v. Duesenfeld GmbH</i> , IPR2024-00887, Paper 18 (Patent Owner Response [REDACTED])

I. INTRODUCTION

Petitioner requests post grant review and cancellation of claims 1-14 (the "Challenged Claims") of U.S. Patent No. 12,119,463 (the "'463 Patent," EX1001) in accordance with §§321-329 and §42.200 et seq.¹

The '463 Patent discloses an alleged invention for recycling used batteries. But as discussed in detail below, the claims challenged in this petition merely recite previously known practices in the art, such as shredding used batteries and drying out shredded battery material under low temperatures and reduced air pressure to remove electrolyte. (*See, e.g.*, EX1001, Claim 1.)

While the '463 Patent specification purports to have invented the idea of low-temperature, low-pressure drying, such drying was already well known in the art as a beneficial method of recycling lithium-ion batteries, as drying the electrolyte at low temperatures and low pressures reduces the likelihood of the formation of hydrofluoric acid, a toxic gas. (*See, e.g.*, EX1001, 4:11-25; EX1003, ¶67.) For example, EX1005, a Japanese patent application publication to inventor Tomioka ("Tomioka"), discloses evaporating battery electrolyte under low temperatures and pressurized conditions, and the disclosures in Tomioka render obvious '463 Patent

¹ Section cites are to 35 U.S.C. or 37 C.F.R. as context indicates, and unless otherwise noted, all emphasis and annotations are added and quotations omitted.

claims 1-3, 8, and 10-12. Likewise, Tomioka in view of Yosuke, Hayashi, LithoRec, and/or Perry render obvious all the limitations of all remaining dependent claims. As discussed herein, a POSITA would have been motivated to apply the teachings of those references to Tomioka.

Similarly, more than two years before the claimed priority date of the '463 Patent, Christian Hanisch, the named inventor of the '463 Patent, and his colleagues had already disclosed the same method of recycling used batteries, including the comminution of lithium batteries and the drying under vacuum with low temperatures to evaporate the electrolyte. (EX1021, "Hanisch".) Hansich's earlier disclosures in view of the teachings of Hayashi, Yosuke, LithoRec, and Perry render obvious all the limitations of all the Challenged Claims. As discussed herein, a POSITA would have been motivated to apply the teachings of those references to Hanisch.

The prior art cited herein, alone or in combination, in view of the knowledge of a POSITA before the effective filing date of the '463 Patent, renders the claims challenged here unpatentable.

II. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8

A. Real Party-In-Interest

Petitioner Ascend Elements, Inc. is the real party-in-interest.

B. Related Matters

The '463 Patent has been asserted by Duesenfeld in the district court proceeding *Duesenfeld GMBH v. Ascend Elements, Inc.*, Case No. 1:23-cv-01194-JFM (D. Del. Oct. 20, 2023).

C. Lead and Back-up Counsel, and Service Information

Petitioner designates the following counsel:

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Petitioner consents to email service at the email addresses above.

III. PAYMENT OF FEES

The required fee is being paid electronically through P-TACTS.

IV. REQUIREMENTS FOR POST-GRANT REVIEW

A. Grounds for Standing

Pursuant to §42.204(a), Petitioner certifies that the '463 Patent is available for PGR and that Petitioner is not barred or estopped from requesting PGR of the Challenged Claims of the '463 Patent on the grounds identified herein. The '463 Patent issued on 10/15/2024, and this Petition is being filed within nine months of that issue date (03/7/2025).

B. Identification of Challenge

Pursuant to §42.204, Petitioner requests PGR of the Challenged Claims and that the Board cancel the same as unpatentable. The '463 Patent issued from Patent Application No. 16/343,224, filed Apr. 18, 2019, as a national stage entry of PCT

Application No. PCT/EP2017/076113, filed Oct. 12, 2017. The '463 Patent claims priority to a German Patent Application No. 10 2016 120 046.8, filed Oct. 20, 2016.²

1. The Specific Art on Which the Challenge is Based

Petitioner relies upon the following prior art:

Exhibit	Reference	Prior Art Status
1004	Japanese Patent App. Pub. JPH10255861 ("Tomioka")	Post-AIA 102(a)(1)
1021	U.S. Patent App. Pub. No. US 2014 / 0290438 A1 ("Hanisch")	Post-AIA 102(a)(1)
1011	Kwade et al., <i>LithoRec: Recycling lithium-ion batteries</i> , published in 2012 by Cuvillier Verlag Göttingen ("LithoRec")	Post-AIA 102(a)(1)
1007	Japanese Patent App. Pub. JP2016080284A ("Yosuke")	Post-AIA 102(a)(1)
1010	U.S. Patent No. 9,843,077 ("Hayashi")	Post-AIA 102(a)(2)
1015	Perry et al., <i>Perry's Chemical Engineers' Handbook</i> (7th ed.) published in 1997 by McGraw-Hill ("Perry")	Post-AIA 102(a)(1)

² Petitioner takes no position as to the propriety of the priority claims since the art presented herein predates the earliest filing. Petitioner reserves the right to challenge these priority claims.

2. Statutory Grounds on Which the Challenge is Based

Petitioner respectfully requests cancellation of the Challenged Claims on the following grounds:

Ground	Claims	Statutory Basis	Prior Art
1	1-3, 8, 10-12	§103	Tomioka
2	4	§103	Tomioka in view of Yosuke
3	5, 9	§103	Tomioka in view of Hayashi
4	6, 7	§103	Tomioka alone or in view of LithoRec
5	13-14	§103	Tomioka and LithoRec in view of Perry
6	1-3, 5, 9-12	§103	Hanisch in view of Hayashi
7	4	§103	Hanisch in view of Hayashi and Yosuke
8	6	§103	Hanisch in view of Hayashi and LithoRec
9	7, 13, 14	§103	Hanisch in view of Hayashi, LithoRec and/or Perry
10	1-14	§112(b)	(n/a)

The information required by §§42.204(b)(4)-(5) is provided in Section IX.

This Petition is supported by the Declaration of Mr. Juzkow. (EX1003.)

V. BACKGROUND

A. Summary of the '463 Patent

The '463 Patent specification acknowledges that heated drying, deactivation of battery components, and comminution of battery material were all previously known in the art. (EX1001, 1:19-57.) The '463 Patent further admits prior art patent applications already disclosed a battery recycling process comprising comminuting

batteries followed by drying, and that such a process is "well-suited to the efficient recycling of larger amounts of galvanic elements." (EX1001, 1:36-45.) The '463 Patent does not, however, suggest that those earlier disclosed processes are themselves disadvantageous; rather, the alleged problem was that "for partial load operation, the construction of this installation is comparatively complex." (EX1001, 1:36-45.) And the claims of the '463 Patent do not recite limitations directed to a "partial load operation." (EX1003, ¶¶67-68.)

The purportedly novel solution of the '463 Patent is to inactivate comminuted material at least by drying it at relatively low temperatures and pressures. (EX1001, Cl.1.) In the drying step, the comminuted material is dried to evaporate organic carbonate solvents in the electrolyte, such as dimethyl carbonate ("DMC") and/or ethyl methylcarbonate ("EMC"). (EX1001, 4:11-25.) The comminuted material may also be dried at higher temperatures such that the binder that binds the electrochemically active material in the lithium battery largely decomposes. (EX1001, 9:37-43; EX1003, ¶69.)

The Challenged Claims are generally directed to a method for recycling batteries by comminuting the batteries and inactivating the comminuted material using a drying process under reduced pressure and reduced temperature. (EX1003, ¶70.)

The single independent claim 1 is representative of the challenged method claims:

1. A method for treating used lithium batteries, comprising:

receiving, into a comminuting device, used lithium batteries that include a cathode, anode, separator, and electrolyte comprising a fluorine salt and a solvent, the solvent including an organic carbonate;

comminuting the used lithium batteries, by the comminuting device, and obtaining comminuted material as a result; and

inactivating the comminuted material and obtaining inactivated comminuted material as a result, wherein the inactivating includes a drying process, comprising drying the comminuted material by removal of organic carbonate from the electrolyte by vaporizing the organic carbonate at a pressure-temperature above a boiling point of the organic carbonate, the pressure being not more than 300 hPa, and the temperature being not more than 80° C. and lower than a decomposition temperature of the fluorine salt. (EX1001, Cl. 1; EX1003, ¶71.)

The challenged dependent claims add limitations such as specifying the particular substances and amount of those substances to be evaporated; specifying additional pressure limitations; and providing details on additional structural features of the dryer, such as a condenser, an airlock, and an agitator, for example. (EX1003, ¶72.)

B. Prosecution History of the '463 Patent

Application 16/343,224, which issued as the '463 Patent, contained 20 claims following preliminary amendments. (EX1002, 490-494.)

Examiner issued a non-final rejection on 5/25/2021, rejecting claims 1-8 and 17-18 on the ground of nonstatutory double patenting as being unpatentable over the claims of U.S. Patent No. 11,050,097, stating that "[a]lthough the claims at issue are not identical, they are not patentably distinct from each other because the temperature requirement of the instant claim 1 is not recited in the claims of [the '097 Patent]." (EX1002, 288.) The Examiner went on to state that "[d]iscovery of a workable temperature for operation of the prior filed patent would be obvious and routine and therefore not materially distinct." (*Id.*) In response, Applicant filed a terminal disclaimer to the '097 Patent. (EX1002, 257.)

In response to an 11/23/2021 indefiniteness challenge, Applicant amended claim 6—deleting recitation of "an agitator"—but failed to amend claim 7, which depends from claim 6 and relies on claim 6's agitator to provide an antecedent basis. (EX1002, 203.)

In response to a 11/23/2021 final rejection based on US 2018/0013181A1 ("Ho") in combination with US 2016/0049699A1 (the application that issued as Hayashi), Applicant amended claim 1 to require that inactivation occur at a "temperature-pressure above a boiling point of the organic carbonate...and lower

than a decomposition temperature of the fluorine salt" (EX1002, 202), arguing that Hayashi disclosed the "opposite, namely the removal of the organic carbonate and the fluorine salt, together, followed by separation of the two." (EX1002, 209.) Applicant further asserted that Hayashi involved "a pressure-temperature that causes temperature decomposition of the organic solvent and the fluoride salt in the electrolyte." (EX1002, 210.) Applicant, however, did not articulate why Hayashi's disclosure of removing the organic carbonate and the fluorine salt "together" would mean that it did not disclose using temperature "lower than a decomposition temperature of the fluorine salt." Neither Applicant nor Examiner addressed the fact that Hayashi discloses the use of reduced pressure and temperatures including 80°C, 20°C, and 10°C (all of which fall below the reported decomposition temperature of LiPF₆) to volatilize organic carbonate solvents from the electrolyte, while also using water, rather than heating, to decompose LiPF₆. (See EX1010 at [0034], [0036], and Table 1.)

VI. LEVEL OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art ("POSITA") in the field of the '463 Patent would have had at least a Bachelor's degree in electrical engineering, material 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. Additional formal education focusing on processing of lithium batteries

may substitute for practical experience and additional practical experience can substitute for less education. (EX1003, ¶¶31-35.)

VII. CLAIM CONSTRUCTION

Claims are construed "using the same claim construction standard that would be used to construe the claim in a civil action," §42.100(b), which is governed by *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312 (Fed. Cir. 2005). Under the *Phillips* standard, this petition applies the plain and ordinary meaning of the '463 Patent terms, which is "the meaning that the term would have to a [POSITA] in question at the time of the invention." *Id.* at 1313.

Drying. The '463 Patent expressly defines "drying" to mean "the removal of at least one solvent in the conducting salt." (EX1001, 2:44-46.) Petitioner and PO agreed in the related district court proceeding that "drying" as defined by the '097 Patent means "the removal of at least one solvent." Petitioner applies that construction to the active verb "drying" in the Challenged Claims. (See EX1003, ¶36.)

Inactivat[e]/[ed]/[ing]/[tion]. As discussed further below in Section IX.J.1, the term "inactivat[e]/[ed]/[ing]/[tion]" as used in the Challenged Claims is indefinite for failing to provide reasonable certainty to a POSITA as to when used battery material is considered "inactivated." (See EX1003, ¶37.) For purposes of applying the prior art, Petitioner adopts PO's proposed construction ("the endpoint

of drying") set forth in the co-pending IPR on the '097 Patent, IPR2024-00948.

(EX1019.) However, the prior art relied on herein meets the definition of "inactivat[ed]" even under the Board's preliminary construction in that proceeding, requiring "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." (EX1018, 12.)

All other terms should be given their plain and ordinary meaning under *Philips* and do not need further construction for the purposes of this Petition.

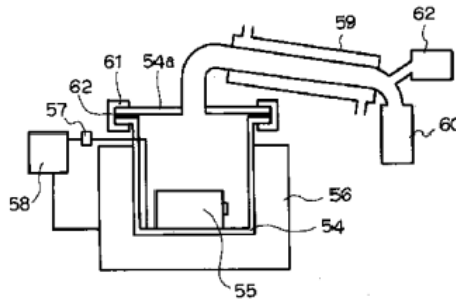
VIII. PRIOR ART OVERVIEW

A. Tomioka (Japanese Patent Application Publication No. JPH10255861)

Tomioka is analogous art to the '463 Patent. It is in the same field of endeavor and is reasonably pertinent to the problems addressed by the '463 Patent. Like the '463 Patent, Tomioka is directed to "a method for processing waste, particularly concerning methods or recycling techniques for used lithium-ion batteries." (EX1005, [0001].) Specifically, Tomioka discloses steps including "dismantling the collected batteries" and "a step of heating the cleaned dismantled parts." (EX1005, [0011]; EX1003, ¶74.)

Figure 19 shows "an example of one embodiment for the removal and recovery of the solvent constituting the electrolyte." (EX1005, at [0090].)

【図19】



(EX1005, at FIG. 19; EX1003, ¶75.)

In Figure 19, "54 is a container body that houses the recovered battery 55," where "56 is a heater for heating the aforementioned container body 54," "59 is a condenser that cools and condenses the generated and evaporated gas, and 60 is a container for recovering the condensed components." (EX1005, at [0090].) Vacuum pump 62 "is attached to the recovery container 60" and the pressure inside the container body 54 "is reduced to about 100 mmHg," such that "the efficiency of removing and recovering the solvent inside the battery can be increased." (EX1005, at [0092].) Tomioka also discloses that the "temperature inside the container body 54 [is] below 40°C." (See EX1005, [0093]; EX1003, ¶¶76-77.)

B. Hanisch (U.S. Patent Application Publication No. US 2014/0290438 A1)

The '463 Patent acknowledges the German priority application for Hanisch (DE 10 2011 110 083) as admitted prior art, noting that Hanisch discloses "a method for recovering active material from a galvanic cell." (EX1001, 1:35-39; EX1003, ¶78.) Although the Hanisch disclosure was before the patent office during

prosecution of the application that issued as the '463 Patent, the Examiner did not rely on or discuss Hanisch in any 102/103 rejections.

Hanisch is analogous art to the '463 Patent. It is in the same field of endeavor and is reasonably pertinent to the problems addressed by the '463 Patent. Like the '463 Patent, Hanisch discloses methods and systems for "retrieving active material, in particular lithium or lithium compounds, from a galvanic cell, which comprises an active material, a support for the active material, a binder for bonding the active material and the support and if necessary an electrolyte." (EX1021, [0001].) Hanisch discloses such a method "with the steps: (a) crushing the cells, in particular under inert gas, so that solid cell fragments are also formed, (b) heating the solid cell fragments up to the decomposition temperature, which is high enough to make the binder decompose and/or evaporate, such that heat treated cell fragments are formed, and (c) classifying the heat treated cell fragments." (EX1021, [0001]; EX1003, ¶79.)

In addition, Hanisch discloses first performing a low-temperature drying process "so that dry cell fragments and drying vapours are formed This has the advantage that the electrolyte solvent can be retrieved. It is therefore advantageous for the drying temperature to be below 100°C., in particular below 80°C." (EX1021, [0025].) Hanisch discloses that its process "is *preferably* performed as continual process and not in batches" (EX1021, [0020]) but does not otherwise disparage or

discourage the use of batch processing or provide any reason why its method could not be performed as a batch process. (EX1003, ¶80.)

C. Yosuke (Japanese Patent Application Publication No. JP2016080284A)

Yosuke is analogous art to the '463 Patent. It is in the same field of endeavor and is reasonably pertinent to the problems addressed by the '463 Patent. Yosuke discloses "a vacuum drying device," system, and method for "battery electrodes." (EX1008, [0001]; EX1003, ¶81.) Yosuke is not cited on the face of the patent, and it was not relied on or discussed by the Examiner.

Yosuke is specifically directed to a method "to accurately determine the completion of vacuum drying" particularly "when drying electrodes for secondary batteries such as lithium-ion batteries." (EX1008, [0004].) Yosuke discloses a "pressure measurement means" that measures the pressure inside the oven of a vacuum drying apparatus, and a "determination means" for "determining whether the pressure measured by the...pressure measurement means has decreased to below or less than a predetermined target pressure." (EX1008, [0007].) The vacuum drying apparatus of Yosuke continues drying for a predetermined time after the pressure reaches a certain threshold value. (EX1008, [0007]; EX1003, ¶82.)

1. Motivation to Combine Yosuke with Tomioka or Hanisch

With respect to claim 4, a POSITA would have been motivated to incorporate Yosuke's teachings of monitoring a progress parameter (such as pressure) during a

drying process into other known drying processes to improve those processes using known and obvious techniques. (EX1003, ¶¶83-87.)

To the extent PO argues that Tomioka does not describe the monitoring of parameters in sufficient detail, a POSITA would have understood that Yosuke teaches such remedial details. (EX1003, ¶¶83-87.) Likewise, while Hanisch discloses a desired end-result of its drying process—the formation of "dry cell fragments and drying vapours" (EX1021, [0025])—without specifying how the process is monitored, a POSITA would have been motivated to incorporate such teachings from Yosuke.

For example, Tomioka, Hanisch, and Yosuke all disclose methods of drying lithium-ion batteries. Tomioka discloses that "it is preferable to conduct a vacuum drying process" prior to an additional heating treatment "to remove the electrolyte." (EX1005, [0014].) Hanisch discloses that crushed battery "cell fragments are dried at a drying temperature, so that dry cell fragments and drying vapours are formed." (EX1021, [0025].) Yosuke similarly describes "a vacuum drying device, a vacuum drying system, a vacuum drying method, and a manufacturing method for battery electrodes," including lithium-ion batteries. (EX1008, [0001], [0004].) Tomioka and Hanisch leave, to a POSITA, remedial steps (e.g., use of a pressure monitor and controller), which are taught by Yosuke. The application of known techniques (e.g., Yosuke's use of a pressure measurement means and controller to determine when to

terminate drying) to improve similar devices (e.g., the drying process disclosed in Tomioka and Hanisch) to provide predictable results in the same way (e.g., to more adequately dry the comminuted material) would have been obvious to a POSITA. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 415-17 (2007). (EX1003, ¶¶83-87.)

A POSITA would have had a reasonable expectation of success implementing Yosuke's teachings in either of Tomioka's/Hanisch's system. (EX1003, ¶¶85-86.) For example, Tomioka discloses with respect to Figure 18 a "controller" 58 "that controls and adjusts the heating by the heater 56 based on information from the temperature measuring device 57." (EX1005, [0090].) Accordingly, Tomioka recognizes the benefits of measuring particular parameters, such as temperature, during the drying process. (*See id.*; EX1003, ¶85.) Similarly, Yosuke recognizes the benefit of monitoring pressure during the drying process "to accurately determine the completion of vacuum drying, thereby suppressing occurrences of excessive drying and insufficient drying." (EX1008, [00004].) Specifically, Yosuke teaches using a "pressure measurement means," a "determination means," and a "vacuum drying control means" to determine when the drying is completed by when the pressure drops below a target pressure, and a POSITA would have found it obvious to incorporate this straightforward teaching of Yosuke into the drying device of Tomioka. (EX1008, [0007]); (EX1003, ¶85.)

Similarly, Hanisch discloses the desired end-result of the low-temperature drying process ("dry cell fragments and drying vapours"), that this drying process takes place "below 80° C," and that "the heating takes place...in a vacuum." (EX1021, [0016], [0025].) A POSITA would have recognized that Yosuke teaches a way to determine when the desired end-result of drying is reached, and a POSITA would have found it obvious to incorporate this straightforward teaching of Yosuke into the drying device of Hanisch. (EX1008, [0007]); (EX1003, ¶86.) This is true whether Hanisch is implemented as a continuous process (in which case the progress parameters offer insight into whether to adjust the speed with which the material moves through Hanisch's pre-dryer) or a batch process (in which case they offer insight into when to terminate a batch).

The addition of features and devices to improve the drying process disclosed in Tomioka/Hanisch (*e.g.*, use of a pressure monitor and controller) include simple modifications to the dryer of Tomioka/Hanisch and would have been obvious and well within the skill of a POSITA. (EX1003, ¶87.)

D. Hayashi (U.S. Patent No. 9,843,077)

Hayashi is a U.S. patent entitled "Method for Processing Fluorine-Containing Electrolyte Solution." Hayashi was published on Oct. 2, 2014, as WO/2014/155784, and was effectively filed before the effective filing date of the '463 Patent. As discussed in Sections V.B and XI.A.1, Hayashi was considered by the Examiner

during prosecution, but it was not examined in the context of the specific grounds presented here and alongside the expert declaration of Mr. Marc Juzkow.

Hayashi is analogous art to the '463 Patent. It is in the same field of endeavor and is reasonably pertinent to the problems addressed by the '463 Patent. Hayashi discloses methods of processing electrolyte solutions used in lithium-ion batteries, including lithium hexafluorophosphate (LiPF_6) and organic solvents such as DMC and EMC. (EX1010, 4:1-23.) Hayashi further discloses processing lithium-ion batteries by, for example, heating the battery containing the electrolyte solution under reduced pressure, such that the organic solvents of the electrolyte are evaporated. (EX1010, 4:33-36.) Hayashi teaches examples in which heating is carried out at pressures "less than or equal to 1 kPa" over temperatures ranging from 80°C to 150°C. (EX1010, 3:20-25.) Hayashi teaches that the organic solvents used in the electrolyte solution of lithium-ion batteries have boiling points of 90°C for dimethyl carbonate and 109°C for ethyl methyl carbonate. (EX1010, 4:38-45.) Hayashi also discloses that reduced pressure in a vacuum can affect the boiling point of these volatile organic solvents, such that they can be evaporated under controlled conditions. (EX1010, 4:38-67; EX1003, ¶¶88-89.)

1. Motivation to Combine Hayashi with Tomioka or Hanisch

A POSITA would have been motivated to incorporate Hayashi's teachings into the drying processes of Tomioka and Hanisch to improve those processes using known and obvious techniques and principles. (EX1003, ¶¶88-100.)

For example, with respect to claims 5 and 9, Tomioka already discloses a low-temperature "vacuum drying process to remove the electrolyte" such that "the efficiency of removing and recovering the solvent inside the battery can be increased." (EX1005, [0014], [0092].) A POSITA would have recognized that Hayashi's teachings of more reduced pressures during the drying process would further increase the efficiency of Tomioka's drying process, including to volatilize particular solvents at lower temperatures. (EX1003, ¶91.) For example, Hayashi teaches that the organic solvents used in the electrolyte solution of lithium-ion batteries have boiling points of 90°C for DMC and 109°C for EMC. (EX1010, 4:38-45.) Hayashi also discloses that reduced pressure in a vacuum can affect the boiling point of these volatile organic solvents, such that they can be evaporated under controlled conditions. (EX1010, 4:38-67.) A POSITA would have recognized that using the further reduced pressures disclosed by Hayashi would have allowed for use of lower temperatures and higher efficiencies in the drying process to volatilize particular solvents. (EX1003, ¶91.) Likewise, with respect to all challenged claims, Hanisch discloses a low-temperature drying process that takes place "below 80° C"

and that "the heating takes place...in a vacuum." (EX1021, [0016], [0025].) While Hanisch is silent on the pressure levels necessary to conduct such low-temperature drying under vacuum, a POSITA would have recognized that Hayashi's teachings of reduced pressures during the drying process would increase the efficiency of Hanisch's drying process, including to volatilize particular solvents at lower temperatures. (EX1003, ¶91.)

Further, a POSITA would have been motivated to apply Hayashi's teachings—in particular, Hayashi's teachings of standard battery compositions, the relationship between pressure and temperature when drying and, accordingly, the benefits of drying under reduced pressure—in implementing Hanisch's lithium battery recycling process. (EX1003, ¶¶92-93.)

For example, Tomioka, Hanisch, and Hayashi disclose methods of processing electrolyte solution such as those used in lithium-ion batteries. Tomioka discloses that "the invention of claim 1 comprises" steps including "dismantling the collected batteries" and "a step of heating the cleaned dismantled parts." (EX1005, [0011].) Tomioka also discloses that "it is preferable to conduct a vacuum drying process" prior to an additional heating treatment "to remove the electrolyte." (EX1005, [0014].) Tomioka also discloses a condenser that "cools and condenses the generated and evaporated gas" during the drying process. (EX1005, [0090].) Hanisch discloses "a method for retrieving active material, in particular lithium or

lithium compounds, from a galvanic cell." (EX1004, [0001].) Further, Hanisch specifies that its invention may be used "for retrieving active materials, in particular lithium and/or lithium bonds, for example from used batteries." (EX1021, [0040].) Hayashi further discloses the composition of common lithium-ion batteries, including, *e.g.*, that "[a]n electrolyte solution used in the lithium ion battery or the like includes a fluorine compound which is an electrolyte (LiPF₆, LiBF₄, or the like) and a volatile organic solvent, and the organic solvent is a flammable substance which is mainly ester carbonates." (EX1010, 1:22-28.) Hayashi similarly describes processing lithium-ion batteries by, for example, heating the battery containing the electrolyte under reduced pressure, such that the organic solvents of the electrode are evaporated. (EX1010, 4:33-36.) Hayashi teaches that the organic solvents used in the electrolyte solution of lithium-ion batteries have boiling points of 90°C for DMC and 109°C for EMC. (EX1010, 4:38-45.) Hayashi also discloses that reduced pressure in a volume can affect the boiling point of these volatile organic solvents, such that they can be evaporated under controlled conditions. (EX1010, 4:38-67.) Hayashi also discloses that, after heating battery cells and vaporizing the generated gas, "[t]he generated gas was condensed in the cooling pipe (4° C.), and was captured in a capturing bottle." (EX1010, 10:27-44; *see also* 9:37-10:26, 10:50-11:7.) (EX1003, ¶¶94-95.)

Tomioka leaves, to a POSITA, remedial steps (e.g., use of particular pressures while drying or particular pressures and temperatures while condensing the evaporated solvent), which are taught by Hayashi. The application of known techniques (e.g., Hayashi's use of particular pressures while drying or particular pressures and temperatures while condensing the evaporated solvent) to improve similar devices (e.g., the drying process disclosed in Tomioka) to provide predictable results in the same way (e.g., to more adequately dry the comminuted material or more adequately condense the evaporated solvent) would have been obvious to a POSITA. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 415-17 (2007). (EX1003, ¶96.)

A POSITA would have been motivated and would have found it straightforward, obvious, and advantageous to apply Hayashi's teachings to Hanisch. A POSITA would have recognized the advantages of improved electrolyte evaporation at a given temperature when lower ambient pressures are used (EX1010, 4:43-67, Table 1; EX1003, ¶97), the control over toxic hydrogen fluoride production during the heating process (*id.*), and the control over potentially flammable compounds and gasses generated during such heating stages (EX1010, 4:12-36; EX1003, ¶97.) The application of known techniques (e.g., Hayashi's teachings of evaporating electrolyte under pressure) to improve similar devices (e.g., the drying process disclosed in Hanisch) to provide predictable results in the same way (e.g., to

safely and efficiently evaporate electrolyte) would have been obvious to a POSITA.

KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 415-17 (2007). (EX1003, ¶97.)

A POSITA would have had a reasonable expectation of success implementing the pressure elements of the drying system and the pressure and/or temperature elements of the condensing system disclosed in Hayashi with Tomioka's system. (EX1003, ¶98.) For example, Tomioka discloses that "it is preferable to conduct a vacuum drying process to remove the electrolyte." (*See* EX1005, [0014].) Tomioka also discloses that the pressure inside the container body 54 used in its vacuum drying step is "reduced to about 100 mmHg." (*See* EX1005, [0092].) Accordingly, Tomioka recognizes that it is beneficial to vacuum dry the battery material at low pressures to remove the electrolyte. (*See id.*; EX1003, ¶98.) For example, Hanisch already discloses that the dryer is gas-proof and that "the heating takes place...in a vacuum" and that the evaporation of electrolyte preferably occurs "below 80° C." (EX1021, [0016], [0025].) Accordingly, while Hanisch does not specify a particular pressure for its vacuum, Hanisch recognizes the benefits of low-temperature drying and drying under a vacuum. Likewise, Hayashi recognizes the benefit of drying under low vacuum pressures, including disclosing a "method for processing a fluorine-containing electrolyte solution...in which the electrolyte solution is heated at 80°C to 150°C under reduced pressure of less than or equal to 1kPa." (EX1010, 3:20-25; *see also* EX1010, 4:49-5:18; EX1003, ¶99.) Similarly, Tomioka discloses

the benefit of condensing vaporized gases during drying to recover them (EX1005, [0089]-[0093]), and Hayashi provides the specific example of condensing at 4° C. (EX1010, 10:27-44; *see also* 9:37-10:26, 10:50-11:7; EX1003, ¶99.) A POSITA would have found it straightforward and obvious to implement Tomioka or Hanisch by applying these teachings. (EX1003, ¶99.)

The addition of additional features and devices to improve the drying process disclosed in Tomioka (*e.g.*, pressures not exceeding 50 hPa or 30 hPa during the drying process, and/or certain pressure or temperature conditions during condensation) include simple modifications to the dryer of Tomioka and would have been obvious and well within the skill of a POSITA. (EX1003, ¶100.) Similarly, the addition of additional features and devices to improve the drying process disclosed in Hanisch (*e.g.*, battery compositions and vacuum pressure levels) include simple modifications to the pre-dryer of Hanisch and would have been obvious and well within the skill of a POSITA. (*Id.*)

E. LithoRec (Kwade et al. *LithoRec: Recycling Lithium-ion Batteries*)

LithoRec is a 2012 publication describing the results of a project in which "several processes for recycling traction batteries were evaluated." (EX1012, 1.) LithoRec discloses dismantling of the batteries as well as "new approaches to electrolyte recovery,...such as through vacuum condensation and extraction." (EX1012, 1-2.) LithoRec also teaches a drying process that utilizes an airlock to

keep the system "gas-tight to the outside." (EX1012, p. 1, 227; EX1003, ¶101.)

LithoRec was identified by Applicant during prosecution but was not otherwise examined.

1. Motivation to Combine LithoRec with Tomioka or Hanisch

With respect to claims 6-7, a POSITA would have been motivated and would have found it obvious to incorporate LithoRec's teachings of using an airlock into the drying processes of Tomioka and Hanisch to improve those processes using known and obvious techniques. (EX1003, ¶¶102-07.)

For example, Tomioka, Hanisch, and LithoRec all disclose systems for recycling lithium-ion batteries, including shredding the batteries and drying the shredded material to evaporate electrolyte. Tomioka discloses that "the invention of claim 1 comprises" steps including "dismantling the collected batteries" and "a step of heating the cleaned dismantled parts." (EX1005, [0011].) Hanisch discloses "crushing [galvanic] cells...so that solid cell fragments are also formed" and then drying the fragments "at a drying temperature, so that dry cell fragments and drying vapours are formed...[so that] the electrolyte solvent can be retrieved." (EX1021, Abstract, [0001], [0025].) LithoRec similarly describes a "[r]ecycling of lithium-ion batteries' project" in which the batteries are "dismantl[ed]" by "mechanical comminution and separation of the cell" and that "[t]he electrolytes need to be evaporated for the subsequent dry treatment process" to "eliminate[] the potential

hazard of flammable solvents." (EX1012, p. 1:1-13, 222:25-33, 223:6-9, 226:30-33.). (EX1003, ¶103.)

Tomioka and Hanisch leave, to a POSITA, remedial steps (e.g., use of an airlock), which are taught by LithoRec. For example, LithoRec discloses that "[d]rying must take place in a protective gas atmosphere (nitrogen), just like the crushing process beforehand" and that the "dryer gases are circulated in a closed circuit and cleaned using a filter and condenser." (EX1012 at 227.) To facilitate the closed circuit for the nitrogen gas, the comminuted material is fed on the inlet side of the dryer, which is "gas-tight to the outside." (EX1012 at 227.) "After closing, the airlock is inerted with nitrogen." (EX1012 at 227.) The application of known techniques (e.g., LithoRec's implementation of an airlock to keep the system gas-tight) to improve similar devices (e.g., the drying process disclosed in Tomioka/Hanisch) to provide predictable results in the same way (e.g., to more safely feed comminuted material into the dryer) would have been obvious to a POSITA. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 415-17 (2007). (EX1003, ¶104.)

A POSITA would have had a reasonable expectation of success implementing the airlock from LithoRec with Tomioka's and Hanisch's system. (EX1003, ¶¶102-07.) For example, Tomioka discloses that, in the embodiment of Figures 19-20, "54a is the lid, 56 is a heater for heating the...container body 54,...61 is a sealing seal,

and 62 is a fixture that secures the lid 54a to the container body 54." (EX1005, [0090].) Accordingly, Tomioka recognizes that it is beneficial to seal the drying device 54 to ensure that the dryer gasses are contained within the dryer. (*See id.*) Hanisch discloses that its low-temperature dryer is gas-proof and that "heating takes place...in a vacuum." (EX1021, [0016].) Accordingly, Hanisch recognizes the benefits of sealing. Likewise, LithoRec recognizes the benefit of circulating dryer gases within a closed circuit, which is "gas-tight to the outside" and teaches using an airlock for that purpose. (EX1012, 227.) (EX1003, ¶105-06.)

The addition of known features and devices to improve the drying process disclosed in Tomioka and Hanisch (*e.g.*, an airlock) include simple modifications to Tomioka's and Hanisch's dryer and would have been obvious and well within the skill of a POSITA. (EX1003, ¶107.)

F. Perry (Perry et al., *Perry's Chemical Engineers' Handbook* (7th ed.))

Perry is an engineering reference manual titled "Perry's Chemical Engineers' Handbook (Seventh Edition)" by Robert H. Perry and Don W. Green. Perry was published by McGraw-Hill in 1997, before the effective filing date of the '463 Patent. Perry was identified by Applicant during prosecution but was not otherwise examined.

Perry is analogous art to the '463 Patent. It is in the same field of endeavor and is reasonably pertinent to the problems addressed by the '463 Patent. Perry is a

well-known reference manual that teaches, among many other topics, the fundamentals of drying solids. (EX1015, 12-1.) Perry further discloses drying equipment used to dry "wet solids," including dryers designed for continuous processing as well as dryers designed for batch processing. (EX1015, 12-36, 12-37.) Perry also specifically discloses various types of agitated dryers. (EX1015, 12-64-12-76; EX1003, ¶¶108-09.)

1. Motivation to Combine Perry with Hanisch or Tomioka

With respect to claims 7, 13, and 14, a POSITA would have been motivated to incorporate Perry's further teachings of using an agitator during drying to improve Tomioka's and Hanisch's drying processes. (EX1003, ¶¶108-114.)

For example, Tomioka, Hanisch, and Perry disclose methods of drying lithium-ion batteries. Tomioka discloses that "it is preferable to conduct a vacuum drying process to remove the electrolyte" prior to an additional heat treatment. (EX1005, [0014].) Tomioka further discloses that "before vaporizing and dissipating the liquid inside the battery," "it is preferable to carry out a pre-treatment such as vacuum suction drying using, oil rotary pumps with gas collection mechanisms, piston pumps, multi-stage steam ejectors, a Roots pumps, etc." (EX1005, [0037].) Hanisch discloses that "cell fragments are dried at a drying temperature, so that dry cell fragments and drying vapours are formed." (EX1021, [0025].) Similarly, Perry teaches various types of drying equipment used to dry "wet

solids," including dryers designed for continuous processing as well as dryers designed for batch processing. (EX1015, 12-36, 12-37; EX1003, ¶109.) Perry also teaches that "[a]n agitated dryer is defined as one on which the housing enclosing the process is stationary while solids movement is accomplished by an internal mechanical agitator," and that "[m]any forms are in use, including batch and continuous versions." (EX1015, 12-64.)

Tomioka/Hanisch leave, to a POSITA, remedial steps (e.g., use of an agitator), which are taught by Perry, a well-known technical handbook that a POSITA would have known to look to for basic details on drying technology. (EX1003, ¶¶110-12.) The application of known techniques (e.g., Perry's disclosures regarding various agitators for use with dryers) to improve similar devices (e.g., the drying process disclosed in Tomioka/Hanisch) to provide predictable results in the same way (e.g., to more adequately dry the comminuted material) would have been obvious to a POSITA. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 415-17 (2007). (EX1003, ¶112.)

A POSITA would have had a reasonable expectation of success implementing the agitator of Perry with Tomioka's/Hanisch's system. (EX1003, ¶113.). For example, Tomioka discloses that "before vaporizing and dissipating the liquid inside the battery," "it is preferable to carry out a pre-treatment such as vacuum suction drying using, oil rotary pumps with gas collection mechanisms, piston pumps, multi-

stage steam ejectors, a Roots pumps, etc." (EX1005, [0037].) Hanisch discloses that crushed cell fragments are dried "so that dry cell fragments and drying vapours are formed" and that the pre-dryer includes "a circulation pump 32 and a condenser 34 for condensing electrolyte, which can be removed via the pipe 36." (EX1021, [0025], [0044], [0046].) Hanisch further discloses that heating up of cell fragments may take place "in a vacuum." (EX1021, [0016].) Accordingly, a POSITA would have understood that an agitator would have assisted in the drying process of Tomioka/Hanisch and, in particular, using an agitator to speed up the drying process. (*See id.*; EX1003, ¶113.) Accordingly, Perry teaches use of an agitator during drying, and a POSITA would have found it obvious to incorporate this straightforward teaching of Perry into the drying device of Tomioka/Hanisch. (EX1015, 12-64); EX1003, ¶113.)

The addition of additional features and devices to improve the drying process disclosed in Tomioka/Hanisch (*e.g.*, use of an agitator) include simple modifications to the dryer of Tomioka/Hanisch and would have been obvious and well within the skill of a POSITA. (EX1003, ¶114.)

IX. GROUNDS OF UNPATENTABILITY UNDER §§ 103, 112

Although the '463 Patent claims low-temperature and low-pressure drying of comminuted battery material, such method of drying was known prior to the earliest possible priority date of the '463 Patent, and the Challenged Claims would have been

obvious. (EX1003, ¶117.) The Challenged Claims are also invalid as being indefinite. (EX1003, ¶¶115-117.)

A. Ground 1: Claims 1-3, 8, 10-12 Are Rendered Obvious by Tomioka

1. Claim 1

a) Claim 1[pre]: "A method for treating used lithium batteries, comprising:"

Tomioka discloses this limitation. Specifically, Tomioka teaches "a method for processing waste, particularly concerning methods or recycling techniques for used lithium-ion batteries." (See EX1005, [0001]; EX1003, ¶118.)

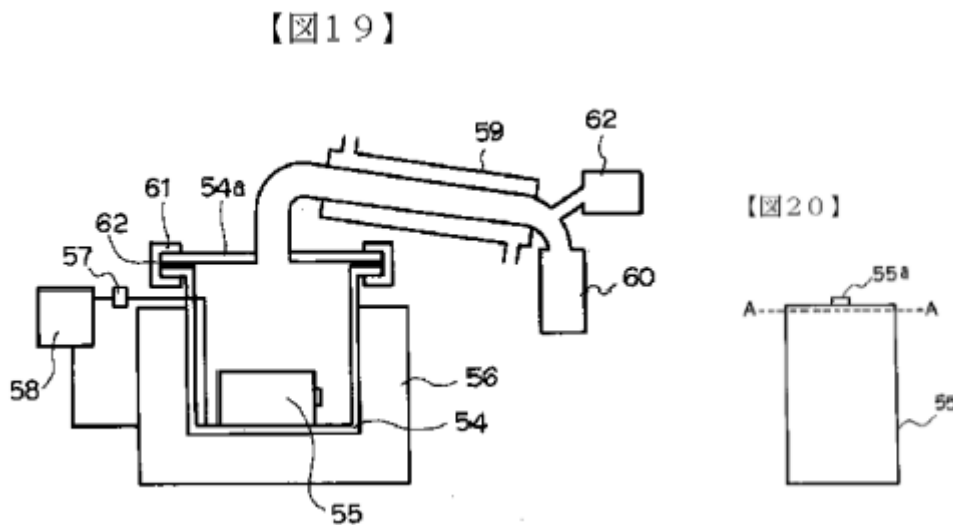
b) Claim 1[a]: "receiving, into a comminuting device, used lithium batteries that include a cathode, anode, separator, and electrolyte comprising a fluorine salt and a solvent, the solvent including an organic carbonate;"

Tomioka renders this limitation obvious. Tomioka discloses used lithium batteries including a cathode, anode, and a separator: a "positive electrode [*i.e.*, anode], negative electrode [*i.e.* cathode], and separator." (EX1005, [0012]; EX1003, ¶119.)

Tomioka also discloses that the batteries include electrolyte comprising a fluorine salt and a solvent, the solvent including an organic carbonate. For example, Tomioka discloses that the "electrolyte components" of the batteries may include "lithium hexafluorophosphate [*i.e.*, fluorine salt], ethylene carbonate, and dimethyl

carbonate [*i.e.*, organic carbonate solvent]." (See EX1005, [0012]; *see also id.*, [0037]; (EX1003, ¶120.)

Tomioka also renders obvious receiving the used lithium batteries into a comminuting device. For example, Tomioka discloses dismantling batteries, where "dismantling means cutting the outer casing of the individual battery or the battery pack to extract the electrode element components...and, if necessary, cutting them into strip-like pieces." (See EX1005, [0012]; *see also id.*, [0093].) Further, Figures 19 and 20 depict an embodiment of the invention in which the battery is comminuted, and the electrolyte is dried under pressurized conditions. Figures 19 and 20 are shown below.



(EX1005, Figs. 19, 20; EX1003, ¶121.)

Tomioka explains that Figure 20 is "an explanatory diagram to describe another embodiment of the dismantling and separation of recovered batteries."

(EX1005, [0093].) Tomioka further states that "by carrying out the extraction and recovery of the solvent within the battery during the separation and recovery of the battery body as well as after the discharge processing and during the battery dismantling process, the working environment and safety for battery disassembly operations are significantly improved." (EX1005, [0094].) As discussed further below with respect to claim 8, a POSITA would have found it obvious to dismantle and dry batteries within the same container based on Tomioka's disclosures of the safety advantages. Accordingly, a POSITA would have understood Tomioka to render obvious receiving the used batteries into a comminuting device. (EX1003, ¶¶121-22.)

Tomioka also discloses that, in one embodiment, a battery pack may be passed between "several rolls that have different rotational speeds," such that "shear forces and twisting actions are simultaneously applied by the rotating rollers to break and peel off the resin package, thereby separating the enclosed battery body." (*See* EX1005, [0026]; *see also id.* at [0025]-[0030].) To the extent that PO argues that Tomioka's disclosures of "dismantling" the batteries by "cutting" them does not disclose this limitation, it would have been obvious to a POSITA to look to Tomioka's other disclosures of comminuting the used batteries, including by receiving the used batteries into the comminuting device disclosed by Tomioka with

rotating rollers. (*See* EX1005, [0025]-[0030]; EX1003, ¶¶123-24; *see also id.* ¶¶ 39-66.)

c) Claim 1[b]: "comminuting the used lithium batteries, by the comminuting device, and obtaining comminuted material as a result; and"

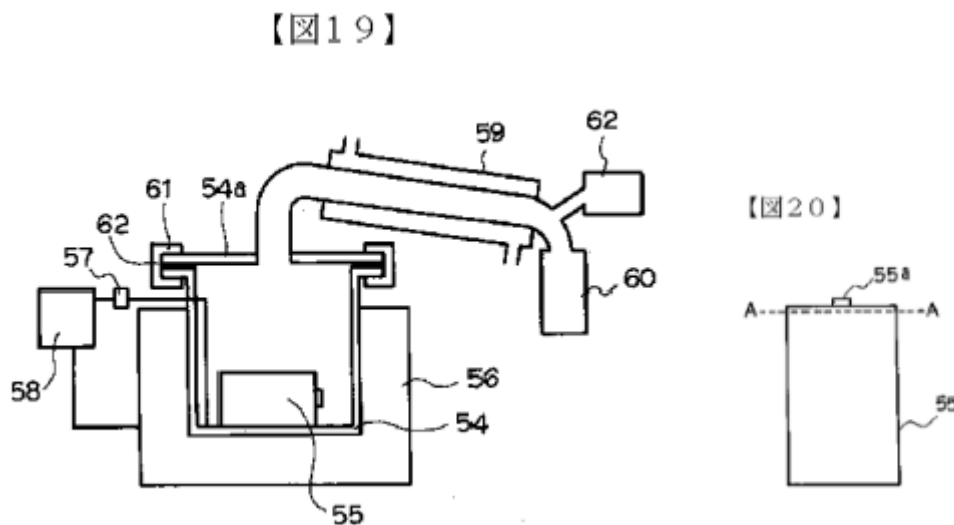
Tomioka renders this limitation obvious. As explained above with respect to element 1[a], Tomioka renders obvious receiving the used batteries into a comminuting device that will perform the cutting and/or rolling disclosed by Tomioka. (*See* EX1005, [0012], [0093].) The comminuting device comminutes the used lithium batteries, either through cutting or with rotating rollers and obtains comminuted material as a result. (EX1003, ¶125.)

d) Claim 1[c]: "inactivating the comminuted material and obtaining inactivated comminuted material as a result,"

Tomioka discloses this limitation. In particular, Tomioka discloses the use of a vacuum drying step "to remove the electrolyte." (*See* EX1005, [0014].) Because Tomioka discloses "remov[ing] the electrolyte," a POSITA would have understood Tomioka discloses this limitation under any construction for "inactivating." For example, the dried material is inactivated because it is "the endpoint of drying" and, because the electrolyte (including EMC and DMC) is "remove[d]," a POSITA would have understood that an electrochemical reaction is no longer possible. Thus, a

POSITA would have understood Tomioka's dryer to produce inactivated comminuted material. (EX1003, ¶126.)

Tomioka's vacuum drying step inactivates the comminuted material by the evaporation of sufficient portions of the electrolyte. For example, in one embodiment, Tomioka discloses that "it is preferable to conduct a vacuum drying process to remove the electrolyte." (See EX1005, [0014].) Figures 19-20 of Tomioka depict a container body 54 for vacuum drying and a cylindrical secondary battery 55:



(EX1005, Figs. 19, 20, [0090], [0092].)

Tomioka discloses that the container body 54 is heated to "below 40°C," and that through the embodiments of Figures 19 and 20, the solvent is "vaporized for condensation and recovery." (EX1005, Figs. 19, 20, [0092], [0093].) Tomioka also discloses that the pressure inside "the container body 54 is reduced to about 100

mmHg," and that "the efficiency of removing and recovering the solvent inside the battery can be increased." (EX1005, Fig. 19, [0092].) Tomioka further discloses that when "the solvent was recovered in the embodiment shown in FIG. 20 (with temperature inside the container body 54 being below 40°C), the recovery rate was 99%." (EX1005, [0093].) Accordingly, a POSITA would have understood that through the drying embodiment disclosed in Figure 19 of Tomioka, 99% of the solvent is evaporated and recovered from the batteries. (EX1003, ¶¶127-28.)

Because Tomioka discloses that the solvent is evaporated and recovered at a rate of 99% in Tomioka's vacuum drying embodiments, a POSITA would have understood that Tomioka's vacuum drying discloses inactivating the comminuted material. (EX1003, ¶129.)

e) Claim 1[d]: "wherein the inactivating includes a drying process, comprising drying the comminuted material by removal of organic carbonate from the electrolyte by vaporizing the organic carbonate at a pressure-temperature above a boiling point of the organic carbonate,"

Tomioka discloses this limitation. As defined by the '463 patent, the "drying" process is understood to mean "the removal of at least one solvent." Because Tomioka discloses removing the solvent, Tomioka discloses this limitation. Tomioka discloses that "it is preferable to conduct a vacuum drying process to remove the electrolyte." (See EX1005, [0014].) As discussed above with respect to limitation 1[c] as to the embodiments shown in Figures 19 and 20, Tomioka

discloses that the container body 54 is heated to "below 40°C," and that through the embodiments of Figures 19 and 20, the solvent is "vaporized for condensation and recovery." (EX1005, Figs. 19, 20, [0092], [0093]; EX1003, ¶¶130.) Tomioka also discloses that the pressure inside "the container body 54 is reduced to about 100 mmHg," and that "the efficiency of removing and recovering the solvent inside the battery can be increased." (EX1005, Fig. 19, [0092].) At 40°C and 100 mmHg, the relevant pressure-temperature boiling point of DMC, for example, can be calculated as 39°C and the relevant pressure-temperature boiling point of EMC can be calculated as [37.2°C](#). (EX1003, ¶¶131-36.) Because an exposure temperature of 39°C-40°C is at or higher than the pressure-temperature boiling point of DMC of 39°C and EMC of [37.2°C](#), Tomioka discloses removal of organic carbonate from the electrolyte by vaporizing the organic carbonate at a pressure-temperature above a boiling point of the organic carbonate. (EX1003, ¶137.)

f) Claim 1[e]: "the pressure being not more than 300 hPa, and the temperature being not more than 80° C. and lower than a decomposition temperature of the fluorine salt."

Tomioka discloses this limitation. For example, Tomioka discloses that the pressure inside the container body 54 used in its vacuum drying step is "reduced to about 100 mmHg." (See EX1005, [0092].) A pressure of 100 mmHg is equivalent

to a pressure of 133.32 hPa. (EX1003, ¶138.) Tomioka also discloses that the container body 54 is heated to less than 40°C. (*See* EX1005, [0092]; EX1003, ¶138.)

A POSITA would have understood that 40°C is less than a decomposition temperature of a fluorine salt, which depends on the conditions in which the fluorine salt exists, dissolved in a solvent(s) or dry, but in all cases is higher than 40°C. (EX1003, ¶139.) The least thermally stable of the common lithium-ion electrolyte salts is LiPF₆, which is stable up to 80°C. (*Id.*)

2. Claim 2: "The method according to claim 1, wherein: the organic solvent comprises dimethyl carbonate, or ethyl methylcarbonate, or both; and the drying process further continues the drying until the vaporizing removes at least 90 percent by weight of the dimethyl carbonate, or ethyl methylcarbonate, or both, from the electrolyte."

Tomioka renders this limitation obvious. Tomioka discloses that the organic solvent comprises at least "dimethyl carbonate." (EX1005, [0037].) Tomioka also discloses that the drying process further continues the drying until the vaporizing removes at least 90 percent by weight of the dimethyl carbonate, where Tomioka discloses that when "the solvent was recovered using the embodiment illustrated in FIG. 20 (with the temperature inside the container body 54 being below 40°C), the recovery rate was 99%." (EX1005, [0093].) A POSITA would have understood that Tomioka's disclosure that the "recovery rate was 99%" indicates that 99% of the solvent was vaporized and condensed back down to a liquid by the condenser. Further, to the extent that PO argues that Tomioka discloses vaporization and

condensation of solvent by volume as compared to by weight, a POSITA would have understood that the densities of methyl ethyl carbonate, dimethyl carbonate and diethyl carbonate are all within 1.00 +/- 0.07 g/ml. At 1 g/ml, weight % and volume % are essentially the same. (EX1003, ¶140.)

3. Claim 3: "The method according to claim 1, further comprising: capturing and condensing gases created from the vaporizing of organic carbonate in the electrolyte during the drying process."

Tomioka renders this limitation obvious. For example, Tomioka discloses "removal and recovery" of the solvent in the electrolyte by "opening a portion of the battery through cutting and then vaporizing the liquid inside the battery to allow it to evaporate, with the generated evaporated gas being cooled and condensed for recovery." (EX1005, [0089].) In the embodiments depicted in Figures 19-20, Tomioka also discloses a condenser 59 that "cools and condenses the generated and evaporated gas, and 60 is a container for recovering the condensed components." (EX1005, [0090], [0093]; EX1003, ¶141).

4. Claim 8: "The method according to claim 1, wherein: comminuting the used lithium batteries is performed within a container; and the drying is performed within the container."

Tomioka renders this limitation obvious. For the reasons explained above with respect to limitation 1[a], Tomioka renders obvious comminuting the used batteries in a comminution device. (*See* EX1005, [0012]; *see also id.*, [0093], Figs. 19-20.) Tomioka explains that Figure 20 is "an explanatory diagram to describe

another embodiment of the dismantling and separation of recovered batteries" and that "when the solvent was recovered using the embodiment illustrated in Fig. 20 (with the temperature inside the container body 54 being below 40°C), the recovery rate was 99%, and the risk of ignition during the battery dismantling operation was eliminated." (EX1005, [0093].) Tomioka further states that "*by carrying out the extraction and recovery of the solvent within the battery during the separation and recovery of the battery body* as well as after the discharge processing and during the battery dismantling process, the working environment and safety for battery disassembly operations are significantly improved." (EX1005, [0094].) A POSITA would have understood Tomioka to be explaining that dismantling the batteries and drying the batteries as part of a single process significantly improves the working environment and safety because an inert atmosphere can be used during both comminution and drying, which will prevent thermal runaway. Batteries are most susceptible to thermal runaway during the comminuting and drying phases of processing, and performing those operations all during a single process would lead to fewer risks. A POSITA thus would have found it obvious to dismantle and dry batteries within the same container in light of Tomioka. (EX1003, ¶¶142-45.)

5. Claim 10: "The method according to claim 1, wherein comminuting of the used lithium batteries is configured such that the comminuted material includes components of comminuted material, and at least 90% by weight of the components of the

comminuted material have a sieve size that is not more than 50 mm."

Tomioka renders this limitation obvious. Tomioka claim 9 "relates to the method for processing waste as described in Claim 1 or Claim 2, wherein the step of peeling and separating the active material layer of the electrode element part is on a mesh of 10 mm or smaller and involves applying vibration." (EX1005, [0041]; *see also id.*, [0011]). While Tomioka discloses a "dismantling" step prior to heating that a POSITA would have understood to comprise comminution, a POSITA would have understood that "peeling and separating the active material layer" would result in comminuted material that includes components of comminuted material. (EX1003, ¶146.) A POSITA would have further understood that, because Tomioka discloses a net having a mesh size of 10 mm or less, at least 90% by weight of the components of the comminuted material would have a sieve size that is not more than 50 mm. (EX1003, ¶¶146-47.) Specifically, a POSITA would have understood that the intent in separating and pulverizing the material and setting the net mesh size to be 10 mm or less would be to capture 90% or more of the materials in the sieve size of 10 mm or less. (EX1003, ¶¶146-47.) Thus, certainly then, a POSITA would have found it obvious that at least 90% by weight of the components of the separated and pulverized material of Tomioka would have a sieve size that is not more than 50 mm. (EX1003, ¶¶146-48.)

To the extent that PO argues that Tomioka's disclosure of peeling and separating the active material layer is not comminution, a POSITA would have found it obvious to combine Tomioka's disclosures of dismantling the used batteries to create comminuted material and Tomioka's disclosures of creating comminuted material with a sieve size of 10 mm or less. Specifically, a POSITA would have found it advantageous to dismantle the material such that it had a sieve size of 10 mm or less, as the electrolyte would be dried from smaller pieces of comminuted material faster. Thus, Tomioka renders this limitation obvious. (EX1003, ¶¶146-48.)

6. Claim 11: "The method according to claim 1, wherein receiving the used lithium-ion batteries further includes receiving used lithium-ion batteries that further comprise carrier foil and binder that binds active material to the carrier foil, and the temperature of the vaporizing pressure-temperature being not more than 80° C., lower than a decomposition temperature of the binder, and lower than the decomposition temperature of the fluorine salt."

Tomioka renders this limitation obvious. For example, in one example, Tomioka discloses receiving batteries that include a current collector layer. (EX1005, [0022]; *see also id.*, [0023], [0053], [0060].) A POSITA would have understood that the current collector layer comprises a carrier foil. (EX1003, ¶149.) Tomioka further discloses that the used batteries include "binder components." (EX1005, [0014].) A POSITA would have understood that the binder binds the active material to the carrier foil, also known as current collector foil. (EX1003,

¶¶150-151.) As discussed above with respect to limitation 1[e], Tomioka discloses that the pressure inside the container body 54 used in its vacuum drying step is "reduced to about 100 mmHg." (See EX1005, [0092].) A pressure of 100 mmHg is equivalent to a pressure of 133.32 hPa. (EX1003, ¶152.) Tomioka also discloses that the container body 54 is heated to below 40°C (See EX1005, [0092].) As discussed with respect to limitation 1[e], a POSITA would have understood that this pressure-temperature is less than the decomposition temperature of the fluorine salt. (EX1003, ¶152.) A POSITA also would have understood that this pressure-temperature is lower than a decomposition temperature of the binder. For example, common binders such as PVdF and fluorinated rubber decompose at temperatures around 300°C - 400°C, which is supported by Tomioka's disclosures. (See EX1005, [0015].) (EX1003, ¶153.) Accordingly, a POSITA would have understood that by heating the comminuted material to a temperature of less than 40°C, at a pressure of about 133.32 hPa, this pressure-temperature would be much lower than a decomposition temperature of a binder. (EX1003, ¶153.)

7. Claim 12: "The method according to claim 11, further comprising a high temperature drying of the inactivated comminuted material, the high temperature drying being configured to decompose binder."

Tomioka renders this limitation obvious. In particular, Tomioka describes that after the vacuum drying step, "to achieve the separation (decomposition) of the binder from the electrode elements and to remove any remaining solvents or binder

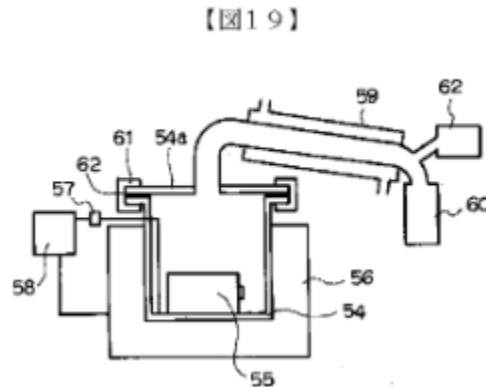
components, a heat treatment is performed at a temperature of approximately 40°C to 400°C." (EX1005, [0014]; *see also id.*, [0039]-[0040].) A POSITA would have understood that Tomioka's heating treatment step "to achieve the separation (decomposition) of the binder" at temperatures up to 400°C comprises a high temperature drying of the inactivated comminuted material configured to decompose binder, which a POSITA would have understood would be around 300°C - 400°C for common binders such as PVdF and fluorinated rubber, as supported by Tomioka. (See EX1005, [0015]; EX1003, ¶154.)

B. Ground 2: Claim 4 Is Rendered Obvious by Tomioka in View of Yosuke

1. Claim 4: "The method according to claim 1, further comprising: performing the drying within an interior of a drying device; continuous monitoring, by a controller, of at least one progress parameter that is indicative of a progress of the drying, the at least one progress parameter comprising a pressure in the interior of the drying device or a pressure of a gas flow out of the interior of the drying device drying process, and not terminating the drying process until the progress parameter reaches a pre-determined progress parameter threshold value."

Tomioka in view of Yosuke renders this limitation obvious. Tomioka discloses that the drying is performed within an interior of a drying device. For example, as explained above with respect to claim 1, Tomioka discloses in the embodiments depicted by Figures 19-20 a "container body" 54 that contains "recovered battery 55" and in which the drying is performed. (EX1005, [0090], [0092], [0093]; EX1003, ¶155.)

Tomioka also discloses a "controller" 58 "that controls and adjusts the heating by heater 56 based on the information from the...temperature measuring device 57." (EX1005, [0090].) Figure 19, including item 58, is also shown below.



(EX1005, Figs. 18, 19; EX1003, ¶156.)

Yosuke also discloses performing the drying within an interior of a drying device. For example, Yosuke discloses a drying oven where lithium-ion batteries are to be dried. (EX1008, [0004], [0007], [0024].) Yosuke further discloses continuous monitoring, by a controller, of at least one progress parameter that is indicative of progress of the drying, the at least one progress parameter comprising a pressure in the interior of the drying device or a pressure of a gas flow out of the interior of the drying device drying process. For example, Yosuke discloses "a pressure measurement means...for measuring the pressure inside the...drying furnace." (EX1008, [0007]; EX1003, ¶156.)

Yosuke further discloses not terminating the drying process until the progress parameter reaches a pre-determined progress parameter threshold value. For

example, Yosuke explains that the claimed apparatus also includes a "determination means...for determining whether the pressure measured by the aforementioned pressure measurement means has decreased to below or less than a predetermined target pressure." (EX1008, [0007]). Yosuke also teaches of a "vacuum drying control means...for continuing vacuum drying for a predetermined first period after it is determined by the aforementioned determination means that the pressure measured by the aforementioned pressure measurement means is below or less than the aforementioned target pressure," as well as a "judgment means...for determining that the vacuum drying of the aforementioned object to be dried is complete when the pressure measured by the pressure measurement means after the aforementioned first period is determined by the aforementioned determination means to be below or less than the aforementioned target pressure." (EX1008, [0007]). Accordingly, Yosuke discloses a controller (*e.g.*, the disclosed pressure measurement means, determination means, vacuum drying control means, and/or judgment means, alone or collectively) that continuously monitors the progress parameter of pressure interior to the drying device and does not terminate drying until the pressure "has decreased to below or less than a predetermined target pressure." (EX1003, ¶¶157-58.) Therefore, Tomioka in view of Yosuke renders obvious claim 4.

C. Ground 3: Claims 5 and 9 Are Rendered Obvious by Tomioka in View of Hayashi

1. Claim 5: "The method according to claim 1, wherein the [the] pressure is not more than 30 hPa for at least 50% of a duration of the drying, or the pressure does not exceed 50 hPa during the drying, or both."

Tomioka in view of Hayashi renders this limitation obvious. In particular, Hayashi discloses that the pressure is not more than 30 hPa for at least 50% of a duration of the drying, or the pressure does not exceed 50 hPa during the drying, or both. Hayashi discloses a "method for processing fluorine-containing electrolyte solution...in which the electrolyte solution is heated at 80°C to 150°C under reduced pressure of 5 kPa to ordinary pressure." (EX1010, 3:13-19.) 5 kPa is equivalent to 50 hPa, and accordingly, Hayashi discloses drying at 50 hPa during the drying. (EX1003, ¶159.) Hayashi further discloses a "method for processing a fluorine-containing electrolyte solution...in which the electrolyte solution is heated at 80°C to 150°C under reduced pressure of less than or equal to 1kPa." (EX1010, 3:20-25; *see also id.*, 4:49-5:18.) 1 kPa is equivalent to 10 hPa. Accordingly, Hayashi discloses drying at 10 hPa. (EX1003, ¶160-61.) The additional context from claims 1, 5, and 7 demonstrates that the drying pressure disclosed in Hayashi remains at that reduced pressure of less than or equal to 1kPa during the entirety of the drying process. Claim 7 depends from claim 1 ultimately and claims a gasification step wherein the "electrolyte solution is heated at 80 C. to 150 C. under the reduced pressure of less than or equal to 1 kPa, thereby the volatile components are gasified."

(EX1010, Cl. 5.) Because claim 7 of Hayashi specifies that "thereby the volatile components are gasified" through use of the "reduced pressure of less than or equal to 1kPa," a POSITA would have understood that Hayashi teaches using the reduced pressure for the entire period of drying, so as to "gasify" the "volatile components." (EX1003, ¶¶159-162.)

2. Claim 9: "The method according to claim 3 wherein condensing is performed at an ambient pressure, or condensing is performed at a temperature within a temperature range that extends from 0° C. to 50° C., or both."

Tomioka in view of Hayashi renders this limitation obvious. For example, Hayashi discloses that, after heating battery cells and vaporizing the generated gas, "[t]he generated gas was condensed in the cooling pipe (4° C.), and was captured in a capturing bottle." (EX1010, 10:27-44; *see also* 9:37-10:26, 10:50-11:7.) Accordingly, because Hayashi discloses condensing performed at 4° C, Hayashi discloses that the condensing is performed at a temperature range that extends from 0° C. to 50° C. (EX1003, ¶163.)

D. Ground 4: Claims 6 and 7 Are Rendered Obvious by Tomioka in View of LithoRec

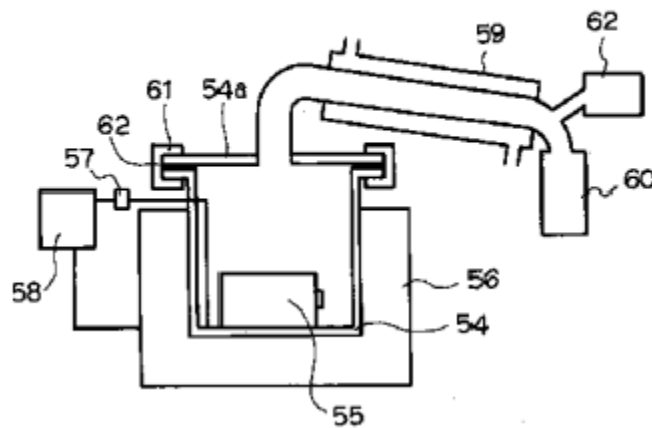
1. Claim 6: "The method according to claim 1, further comprising: feeding the comminuted material, through an airlock, into an interior of a drying device; and performing the drying within the interior of the drying device."

Tomioka alone or in in view of LithoRec renders this limitation obvious. As discussed above with respect to claim 4, Tomioka discloses that the comminuted

material is fed into the interior of a drying device, and the drying is performed within the interior of the drying device. (EX1003, ¶164.)

For example, in Figure 19, Tomioka shows a lid 54a to the drying device, 61 is a sealing seal, and 62 is a fixture that secures the lid 54a to the container body 54:

【図19】



(EX1005, Fig. 19, [0090].) The lid, sealing seal, and fixture secure the lid and reduce the amount of gas introduced into the dryer, so as to make the drying device gas-tight, consistent with the '463 Patent's description of an airlock. (EX1001, 11:33-38, 13:17-21.) Accordingly, Tomioka discloses and/or renders obvious this limitation. (EX1003, ¶165.)

To the extent that PO argues that Tomioka does not disclose an airlock, Tomioka in view of LithoRec renders this limitation obvious. LithoRec discloses that the comminuted material is fed into the interior of a drying device through an airlock. For example, LithoRec discloses that "[d]rying must take place in a

protective gas atmosphere (nitrogen), just like the crushing process beforehand" and that the "dryer gases are circulated in a closed circuit and cleaned using a filter and condenser." (EX1012, 227.) To facilitate the closed circuit for the nitrogen gas, the comminuted material is fed on the inlet side of the dryer, which is "gas-tight to the outside." (*Id.*) "After closing, the airlock is inerted with nitrogen." (*Id.*) The cell packs are then fed through a buffer container, through a rotary valve, through a tubular screw conveyor, and into the dryer. (*Id.*) Accordingly, a POSITA would have understood LithoRec to disclose that the comminuted material is fed on the inlet side of the dryer, through a gas-tight inlet or airlock and into the dryer. (*Id.*; EX1003, ¶¶166-67.)

2. Claim 7: "The method according to claim 6, further comprising: vacuum sucking away of gases created from vaporized organic carbonate during the drying process and/or wherein the batteries comprise current collector foils having a coating material and movement using the agitator is conducted such that at least 50% by weight of the coating material of comminuted material is sucked away."

Tomioka alone or in view of LithoRec renders this limitation obvious. Specifically, Tomioka discloses vacuum sucking away of gases created from vaporized organic carbonate during the drying process. For example, Tomioka discloses that "it is preferable to conduct a vacuum drying process to remove the electrolyte" prior to an additional heat treatment. (EX1005, [0014].) Tomioka further discloses that "before vaporizing and dissipating the liquid inside the

battery," "it is preferable to carry out a pre-treatment such as vacuum suction drying using, oil rotary pumps with gas collection mechanisms, piston pumps, multi-stage steam ejectors, a Roots pumps, etc." (EX1005, [0037].) In the embodiment of Figure 19, Tomioka discloses that "a vacuum pump 62 is attached to the recovery container 60 side, and when the interior of the container body 54 is reduced to about 100 mmHg, the efficiency of removing and recovering the solvent inside the battery can be increased." (EX1005, [0092]; EX1003, ¶¶168-169.)

E. Ground 5: Claims 13 and 14 Are Rendered Obvious by Tomioka in view of Perry

1. Claim 13: "The method according to claim 1, further comprising: moving by an agitator, over a duration of the drying, a not yet inactivated comminuted material among the comminuted material, or a mixture of inactivated comminuted material and not yet inactivated comminuted material, or both; and supplying, during the drying, a vaporization heat to the comminuted material, wherein the supplying includes the agitator supplying at least 35% of said vaporization heat."

Tomioka in view of Perry renders this limitation obvious. As explained above with respect to limitation 1[c]-1[d], Tomioka discloses supplying, during the drying, a vaporization heat to the comminuted material. (EX1003, ¶¶170-71.)

A POSITA would have been motivated to apply Perry's teachings of using an agitator in a drying device because a POSITA would have understood that agitators are generally beneficial for increasing the efficiency with which material is dried within a dryer. In general, a POSITA would have understood that agitators are

useful to incorporate into dryers, as moving the material assists in efficiently drying the material. (EX1003, ¶¶172-73.)

Perry teaches a multitude of different types of agitated dryers, such that a POSITA would have a menu of options to choose from. (EX1015, 12-64-12-71.) Perry defines an agitated dryer as "one on which the housing enclosing the process is stationary while solids movement is accomplished by an internal mechanical agitator." (EX1015, 12-64.) Perry states that "[t]he more common type of vacuum rotary dryer consists of a stationary cylindrical shell, mounted horizontally, in which a set of agitator blades mounted on a revolving central shaft stirs the solids being treated." (EX1015, 12-65.) Through Perry, a POSITA would have identified an appropriate agitated dryer for inclusion in Tomioka's drying apparatus to improve the rate of drying. (EX1003, ¶¶174-75.) A POSITA would have understood that one benefit to using an agitated dryer is the additional heat generated by an agitator, particularly a high-powered agitator. (EX1003, ¶¶176-182.) For example, Perry discloses that, for particular agitator dryers, "[t]he heat- and mass- transfer mechanisms are similar to those in batch tray dryers, except that constant turning over and mixing of the solids significantly improves drying rates." (EX1015, 12-67.) A POSITA would have understood that the improved drying rates provided by agitator dryers are due in part to the additional heat contributed by the agitator in "constant[ly] turning over and mixing of the solids." (See EX1015, 12-67; EX1003,

¶178.) Such "constant[] turning over and mixing" comprises "moving by an agitator, over a duration of the drying, a not yet inactivated comminuted material among the comminuted material, or a mixture of inactivated comminuted material and not yet inactivated comminuted material, or both."

The '463 Patent provides as an example embodiment a dryer with agitators having "a power output of at least 4 kW, in the present case 5 kW, per cubic metre of drying volume" and that such "mechanical output is largely converted into thermal energy." (EX1001, 15:18-28.) The '463 Patent also states that "[t]he agitator is preferably used to supply at least 35%, in particular at least 50%, of a vaporisation heat required for the drying of the comminuted material" and that "[t]he agitator preferably has a power output of at least 1 kilowatt per cubic meter of volume of the drying device." (EX1001, 8:4-15; EX1003, ¶179.)

Perry provides examples of common agitator dryers at the time, including the drive in kW for the dryer.

TABLE 12-27 Standard Rotary Vacuum Dryers*

Diameter, m	Length, m	Heating surface, m ²	Working capacity, m ³ /h	Agitator speed, r/min	Drive, kW	Weight, kg	Purchase price (1995)	
							Carbon steel	Stainless steel (304)
0.46	0.49	0.836	0.028	7½	1.12	540	\$ 43,000	\$ 53,000
0.61	1.8	3.72	0.283	7½	1.12	1,680	105,000	130,000
0.91	3.0	10.2	0.991	6	3.73	3,860	145,000	180,000
0.91	4.6	15.3	1.42	6	3.73	5,530	180,000	205,000
1.2	6.1	29.2	3.57	6	7.46	11,340	270,000	380,000
1.5	7.6	48.1	6.94	6	18.7	15,880	305,000	440,000
1.5	9.1	57.7	8.33	6	22.4	19,050	330,000	465,000

(EX1015, Table 12-27; EX1003, ¶180.) As shown above, agitated dryers with drives in kW ranging from 1.12 all the way to 22.4 kW were known in the art. Perry defines an "agitated dryer" as "one on which the housing enclosing the process is stationary

while solids movement is accomplished by an internal mechanical agitator," and accordingly, a POSITA would have understood that the motor drives listed in the table above power the agitator. (EX1015, 12-64.) A POSITA would have understood that if a dryer had a motor drive powered to up to 22.4 kW, the agitator would be sufficiently high powered to supply at least 35% of the vaporization heat to the comminuted material. Choosing an appropriately high-powered motor such that the agitator could supply such vaporization heat would have been a straightforward and obvious design choice available to a POSITA from a menu of options, as demonstrated by Perry. (EX1003, ¶181.)

Accordingly, it would have been obvious to a POSITA that an appropriately high-powered agitator could supply at least 35% of the vaporization heat to the comminuted material during drying, as supported by Perry's teachings. (EX1003, ¶¶181-82.)

2. Claim 14: "The method according to claim 1, further comprising: performing the drying within an interior of a drying device; and agitating, by an agitator, the inactivated comminuted material when removing the inactivated comminuted material from the drying device."

Tomioka in view of Perry renders this limitation obvious. As explained above with respect to claim 4, Tomioka discloses performing the drying within an interior of a drying device. Further, as explained above with respect to claim 7, Perry teaches a multitude of agitator types that a POSITA would have known to use in designing

a dryer. For example, Perry discloses dryers that require agitation or rotation "during emptying to convey product to the discharge nozzles." (EX1015, 12-65.) A POSITA would have found it generally beneficial to use an agitator to facilitate material transport toward the exterior of the dryer during discharge. Further, a POSITA would have found it particularly beneficial to utilize an agitator during discharge with certain dryer designs where material may sit on the edges of the dryer, such as with cylindrical designs. As such, Tomioka in view of Perry renders this limitation obvious. (EX1003, ¶¶183-85.)

F. Ground 6: Claims 1-3, 5 and 9-12 Are Disclosed or Rendered Obvious by Hanisch in view of Hayashi

1. Claim 1

a) Claim 1[pre]: "A method for treating used lithium batteries, comprising:"

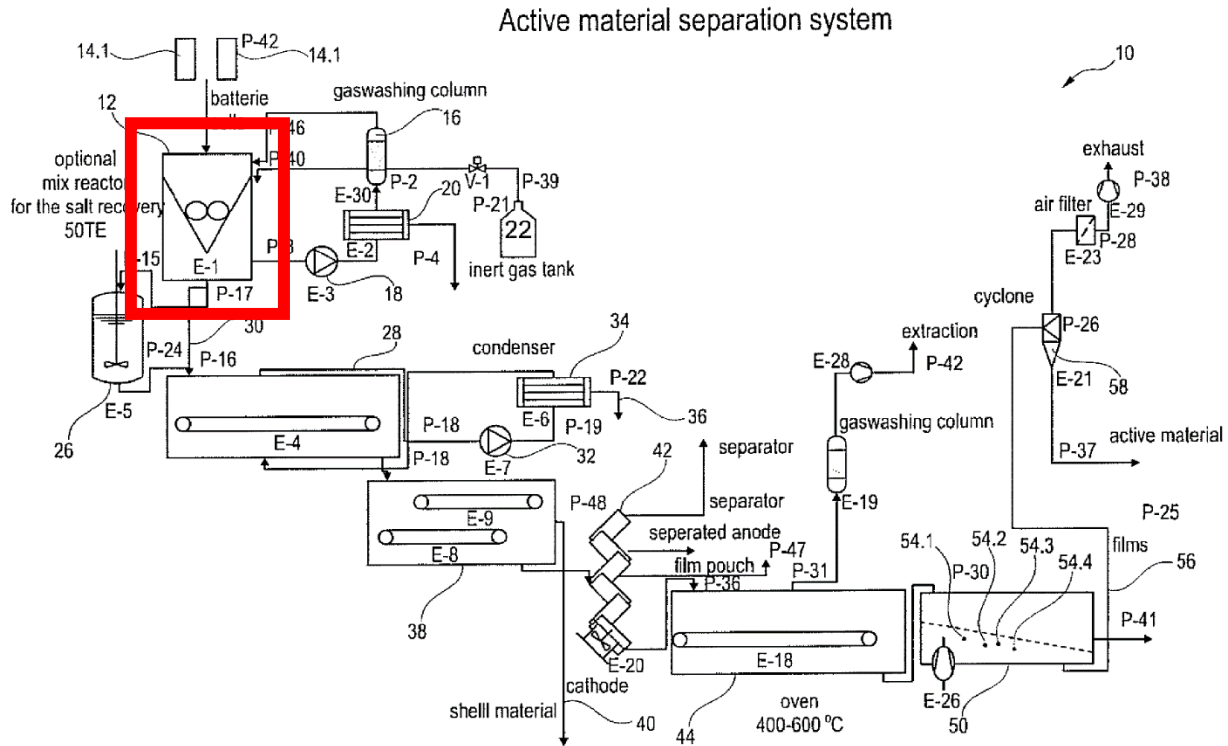
Hanisch discloses this limitation: "[t]he invention concerns a method for retrieving active material, in particular lithium or lithium compounds, from a galvanic cell..." (*see* EX1021, [0001]) and "the object of the invention is to improve the retrieval of lithium or lithium compounds, from old batteries or accumulators." (*See* EX1021, [0004]; EX1003, ¶186.)

b) Claim 1[a]: "receiving, into a comminuting device, used lithium batteries that include a cathode, anode, separator, and electrolyte comprising a fluorine salt and a solvent, the solvent including an organic carbonate;"

Hanisch alone and/or in view of Hayashi discloses this limitation. The '463 Patent itself admits that Hanisch teaches a method in which "galvanic cells are initially mechanically comminuted." (*See* EX1001, 1:43-45; EX1003, ¶187.)

Hanisch discloses the "galvanic cells preferably always comprise at least one anode and at least one cathode" (EX1021, [0024]; *see also id.*, [0017] (disclosing lithium).) The galvanic cell further comprises, "a support for the active material, a binder for bonding the active material and the support and if necessary an electrolyte." (EX1021, [0002].) A POSITA would have understood that a typical lithium battery in the early 2010's timeframe includes separator and an electrolyte, with the electrolyte comprising a fluorine salt and solvent having an organic carbonate. (EX1003, ¶188.) Common examples of organic carbonate solvents included EMC and/or DMC. (EX1003, ¶60.)

Hanisch teaches receiving the used battery material into a comminution device. Specifically, Fig. 1 discloses "a cell crushing device 12, to which galvanic cells 14.1, 14.2,...are supplied." (EX1021, [0044].) Hanisch explains that "the crushing of cells is understood in particular to mean cutting, shattering, chaffing or squashing." (EX1021, [0015]; EX1003, ¶¶189-90.)



(EX1021, Fig. 1.)

To the extent that further disclosure of the battery composition is necessary, Hayashi discloses that "[a]n electrolyte solution used in the lithium ion battery or the like includes a fluorine compound which is an electrolyte (LiPF_6 , LiBF_4 , or the like) and a volatile organic solvent, and the organic solvent is a flammable substance which is mainly ester carbonates." (EX1010, 1:22-28.) A POSITA would have understood that Hanisch's battery recycling method would have included standard lithium battery components, such as electrolyte and organic solvent, as taught by Hayashi. (EX1003, ¶188; *see also id.* ¶¶ 39-66.)

c) Claim 1[b]: "comminuting the used lithium batteries, by the comminuting device, and obtaining comminuted material as a result; and"

Hanisch discloses this limitation for the reasons explained above with respect to limitation 1[a], including that, as noted previously, the '097 Patent itself admits that Hanisch teaches a method in which "galvanic cells are initially mechanically comminuted." (EX1003, ¶191.)

d) Claim 1[c]: "inactivating the comminuted material and obtaining inactivated comminuted material as a result,"

Hanisch discloses this limitation. In particular, Hanisch discloses the use of a first-stage pre-dryer that heats the comminuted material to a "drying temperature, so that *dry cell fragments* and drying vapours are formed...." (EX1021, [0025].) While Hanisch does not disclose a specific amount of time to dry material in this stage, Hanisch discloses the desired end result—the formation of "dry" cell fragments and "drying vapours." (EX1003, ¶192.) Thus, under PO's construction of "inactivated" as the "endpoint of drying," Hanisch discloses this limitation. Likewise, because "dry" cell fragments inherently means there is little to no liquid remaining (i.e., substantially all the EMC and DMC were removed as "drying vapours"), a POSITA would have thus understood Hanisch's pre-dryer results in "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." (EX1003, ¶192.) Thus,

Hanisch's pre-dryer produces inactivated comminuted material under any understanding of "inactivat[ion]." (EX1003, ¶192.)

e) Claim 1[d]: "wherein the inactivating includes a drying process, comprising drying the comminuted material by removal of organic carbonate from the electrolyte by vaporizing the organic carbonate at a pressure-temperature above a boiling point of the organic carbonate,"

Hanisch discloses this limitation: "the cell fragments are dried at a drying temperature, so that dry cell fragments and drying vapours are formed, whereby the drying vapours are at least partly condensed. This has the advantage that the electrolyte solvent can be retrieved." (EX1021, [0025].) Thus, Hanisch discloses removing (more than) one solvent from the comminuted material. (EX1003, ¶192.) Hanisch further discloses that the pre-dryer inactivates crushed cell fragments at a temperature "below 80° C" (EX1021, [0025]), and that "the heating takes place...in a vacuum." (*Id.*, [0016].)

Thus, a POSITA would have understood that Hanisch discloses vaporizing the electrolyte for the purpose of "at least partly condens[ing]" the "drying vapours" for retrieval. (EX1003, ¶193.) A POSITA would have further understood Hanisch's disclosure that "heating takes place...in a vacuum" along with its disclosure that the heating temperature is "below 80° C" as disclosing vaporizing the electrolyte (e.g., the "organic carbonate") at a pressure-temperature above its boiling point. (EX1003, ¶193.)

For example, Hayashi explains that organic carbonates (e.g., EMC, DMC) reach vapor pressure at temperatures below 80° C (e.g., at 70° C) with pressures below 300 hPa (e.g., "10kPa", which is equal to 100 hPa):

TABLE 1

[Atmospheric Pressure Conversion Temperature]

Actual Tem- perature	Pressure					
	Atmospheric Pressure 101.3 kPa	15 kPa	10 kPa	5 kPa	1 kPa	0.1 kPa
0° C.	0° C.	49° C.	58° C.	74° C.	108° C.	152° C.
10° C.	10° C.	60° C.	70° C.	86° C.	120° C.	166° C.
20° C.	20° C.	71° C.	81° C.	98° C.	134° C.	180° C.
80° C.	80° C.	139° C.	151° C.	170° C.	210° C.	262° C.
150° C.	150° C.	217° C.	230° C.	251° C.	297° C.	354° C.

(EX1010, Table 1.)

At 80°C (as disclosed by Hanisch) and 100 hPa (as disclosed by Hayashi), the relevant pressure-temperature boiling point of DMC, for example, can be calculated as 32.7°C, and for EMC as 30.8°C (EX1003, ¶194.). Because the exposure temperature of 80°C is higher than the pressure-temperature boiling point of DMC of 32.7°C and of EMC's 30.8°C, Hanisch in view of Hayashi renders obvious removal of organic carbonates from the electrolyte by vaporizing the organic carbonate at a pressure-temperature above a boiling point of the organic carbonate. (EX1003, ¶194.)

f) Claim 1[e]: "the pressure being not more than 300 hPa, and the temperature being not more than 80° C. and lower than a decomposition temperature of the fluorine salt."

Hanisch in view of Hayashi discloses this limitation. Hanisch discloses drying the crushed cell fragments in a "pre-dryer" at temperatures "below 80° C" to form "drying vapours" from the electrolyte solvent to then condensate and retrieve the electrolyte. (EX1021, [0025].) Insofar as the temperature for thermal decomposition of, e.g., LiPF_6 , is above 80° C, Hanisch thus discloses drying at a temperature below the decomposition temperature of the fluorine salt. (EX1003, ¶195.)

In addition, Hanisch teaches that "the heating up takes place...in a vacuum." (EX1021, [0016].) As a POSITA would have recognized, using a vacuum of less than 300 hPa would be a routine application of the natural thermodynamic properties of EMC and/or DMC, which specify that, in order to sufficiently vaporize these substances at temperatures "below 80° C," the pressure must be sufficiently low. (EX1003, ¶196.)

Further, as discussed above, Hayashi discloses that organic carbonates (e.g., EMC, DMC) will reach vapor pressure at temperatures below 80° C (e.g., at 70° C) with pressures below 300 hPa (e.g., "10kPa," which is equal to 100 hPa). (EX1010, 4:38-5:3, Table 1.) A POSITA therefore would have been motivated to apply these

teachings of Hayashi—that a vacuum level of 100 hPA allows for low-temperature vaporization—in implementing Hanisch's pre-dryer. (EX1003, ¶197.)

2. Claim 2: "The method according to claim 1, wherein: the organic solvent comprises dimethyl carbonate, or ethyl methylcarbonate, or both; and the drying process further continues the drying until the vaporizing removes at least 90 percent by weight of the dimethyl carbonate, or ethyl methylcarbonate, or both, from the electrolyte.

Hanisch in view of Hayashi discloses and/or renders obvious this limitation. Hanisch discloses a method of treating used lithium batteries according to claim 1. *See, supra*, Section IX.F.1. In particular, Hanisch discloses a "pre-dryer" drying process in which "cell fragments are dried at a drying temperature, so that *dry cell fragments and drying vapours are formed*,...[so] that the electrolyte solvent can be retrieved." (EX1021, [0025].) While Hanisch does not specify an amount of time for drying, Hanisch specifies the desired end result: "*dry cell fragments*" and electrolyte "*drying vapours*" that are used to recover the electrolyte. *Id.*; *see also* EX1003, ¶198.). Because the resulting material is "dry," a POSITA would have understood Hanisch's pre-dryer as necessarily removing substantially all (*i.e.*, close to 100%) of the liquid electrolyte from the comminuted material. (EX1003, ¶198.) A POSITA thus would have understood, or at least found it obvious, that more than 90% by weight of the DMC and/or EMC must be removed in order to result in "dry cell fragments." (EX1003, ¶198.)

To the extent that further disclosure of the electrolyte composition is required, Hayashi discloses that common organic solvents in the electrolyte for lithium-ion batteries include dimethyl carbonate and ethyl methylcarbonate. (EX1010, 4:11-18; (EX1003, ¶199).

3. Claim 3: "The method according to claim 1, further comprising: capturing and condensing gases created from the vaporizing of organic carbonate in the electrolyte during the drying process."

Hanisch discloses this limitation. In particular, Hanisch discloses that one purpose of the "pre-dryer" drying process is to create "drying vapours...whereby the drying vapours are at least partly condensed. This has the advantage that the electrolyte solvent can be retrieved." (EX1021, [0025]; EX1003, ¶200.)

4. Claim 5: "The method according to claim 1, wherein the [the] pressure is not more than 30 hPa for at least 50% of a duration of the drying, or the pressure does not exceed 50 hPa during the drying, or both."

Hanisch in view of Hayashi renders this limitation obvious. Hanisch discloses drying in the pre-dryer at temperatures "below 80° C." (EX1021, [0025].) Hayashi further discloses this limitation for the reasons explained in Section IX.C.1. (EX1003, ¶201.)

5. Claim 9: "The method according to claim 3 wherein condensing is performed at an ambient pressure, or condensing is

performed at a temperature within a temperature range that extends from 0° C. to 50° C., or both."

Hanisch in view of Hayashi renders this limitation obvious. Hayashi discloses this limitation for the reasons explained in Section IX.C.2. (EX1003, ¶202.)

6. Claim 10: "The method according to claim 1, wherein comminuting of the used lithium batteries is configured such that the comminuted material includes components of comminuted material, and at least 90% by weight of the components of the comminuted material have a sieve size that is not more than 50 mm."

Hanisch discloses this limitation. In particular, Hanisch discloses using "air jet sieving" for comminuted particles and that "[t]he mesh size of the sieve is preferably a maximum of 250 µm [0.250 mm], in particular a maximum of 100 µm [0.100 mm]." (EX1021, [0023]; EX1003, ¶203.) Hanisch expressly teaches that the mesh size is chosen to ensure that it corresponds to the diameter of more than 90% of the active material found in the lithium battery. (EX1021, [0022]; (EX1003, ¶203.)

7. Claim 11: "The method according to claim 1, wherein receiving the used lithium-ion batteries further includes receiving used lithium-ion batteries that further comprise carrier foil and binder that binds active material to the carrier foil, and the temperature of the vaporizing pressure-temperature being not more than 80° C., lower than a decomposition temperature of the binder, and lower than the decomposition temperature of the fluorine salt."

Hanisch discloses this limitation. A galvanic cell "comprises an active material, a support for the active material, *a binder for bonding the active material*

and the support and if necessary an electrolyte..." (EX1021, [0001]; *see also id.*, [0002].) Hanisch further discloses that "aluminum foil is frequently used as the support" (EX1021, [0010]) and the "support of the active material is understood in particular to mean a *support foil* upon which the active material is placed in the form of particles.... The binder can, for example, be polyvinylidene fluoride (PVDF)." (EX1021, [0018].) This is consistent with the '463 patent's description of the "carrier foil," as referring to "a carrier foil to which the active material is applied in the form of particles" such as "aluminium or an aluminium alloy" and the binder "contain[ing] polyvinylidene fluoride." (EX1001, 9:46-52; EX1003, ¶204.)

Hanisch further discloses drying at "below 80° C" and that the "[t]he decomposition temperature [of the binder] is preferably at least 350° C. and at the most 800° C." (EX1021, [0025], [0028].) Accordingly, a POSITA would have understood that Hanisch's disclosure of drying at "below 80° C" is lower than a decomposition temperature of the binder, which Hanisch discloses as between 350° C and 800° C, and lower than the decomposition temperature of the fluorine salt, which is above 80°C. (EX1003, ¶205.)

8. Claim 12: "The method according to claim 11, further comprising a high temperature drying of the inactivated comminuted material, the high temperature drying being configured to decompose binder."

Hanisch discloses this limitation. Hanisch discloses "heating the solid cell fragments up to the decomposition temperature, which is high enough to make the

binder decompose and/or evaporate." (EX1021, [0001], [0002].) This is "based on the knowledge that the heating of the cell fragments up to the decomposition temperature would theoretically have to be enough to destroy the binder." (EX1021, [0011].) Hanisch further discloses that "[t]he decomposition temperature is preferably at least 350° C, and at the most 800° C. It has been found that at these temperatures the binder is certain to decompose." (EX1021, [0028]; EX1003, ¶206.)

G. Ground 7: Claim 4 Is Rendered Obvious by Hanisch in view of Hayashi and/or Yosuke

1. Claim 4: "The method according to claim 1, further comprising: performing the drying within an interior of a drying device; continuous monitoring, by a controller, of at least one progress parameter that is indicative of a progress of the drying, the at least one progress parameter comprising a pressure in the interior of the drying device or a pressure of a gas flow out of the interior of the drying device drying process, and not terminating the drying process until the progress parameter reaches a pre-determined progress parameter threshold value."

Hanisch in view of Yosuke renders this limitation obvious. Hanisch discloses drying performed within an interior of a drying device. For example, Hanisch discloses drying crushed cell fragments in a "gas-proof" "pre-dryer" until a desired end-result, when "dry cell fragments and drying vapours are formed." (EX1021, [0016], [0025], [0046]; EX1003, ¶207.)

Yosuke discloses this limitation for the reasons explained in Section IX.B.1.

H. Ground 8: Claim 6 Is Rendered Obvious by Hanisch in View of Hayashi and/or in further view of LithoRec

1. Claim 6: "The method according to claim 1, further comprising: feeding the comminuted material, through an airlock, into an interior of a drying device; and performing the drying within the interior of the drying device.

Hanisch in view of Hayashi renders obvious claim 1 and LithoRec renders this further limitation obvious. As discussed above with respect to claim 4, Hanisch discloses that the comminuted material is fed into the interior of a drying device (the "pre-dryer"), and the drying is performed within that device. Hanisch further discloses that "heating up of solid cell fragments is understood to mean heating up in gas-proof container, so that oxygen, for example, is prevented from the [*sic*] entering. In particular, the heating up takes place...in a vacuum." (EX1021, [0016].). A POSITA would have understood that using an airlock is an obvious and well-known method of making the pre-dryer "gas-proof" (and for the heating up to take place "in a vacuum"). (EX1003, ¶208.)

To the extent that further disclosure of an airlock is necessary, LithoRec discloses this limitation for the reasons explained above in Section IX.D.1. (EX1003, ¶209.)

I. Ground 9: Claims 7, 13, 14 Are Rendered Obvious by Hanisch in view of Hayashi and in further view of LithoRec and/or Perry

1. Claim 7: "The method according to claim 6, further comprising: vacuum sucking away of gases created from vaporized organic carbonate during the drying process and/or wherein the batteries comprise current collector foils having a coating material

and movement using the agitator is conducted such that at least 50% by weight of the coating material of comminuted material is sucked away."

Hanisch in view of Hayashi and LithoRec render obvious claim 6 and Perry render this further limitation obvious. Specifically, Hanisch discloses vaporizing and removing electrolyte "drying vapours" within a "pre-dryer." (EX1021, [0025].) This "has the advantage that the electrolyte solvent can be retrieved." [*Id.*] A POSITA would have understood that this retrieval of drying vapours necessarily requires "vacuum sucking" the vapors created during drying. (EX1003, ¶210.)

In addition, Hanisch discloses separating "current collecting foils" from the active material using an "air jet sieve" so "[t]he foil fraction (aluminum and copper)...can be obtained...and used again," and that this separation and collection allows for retrieval of active material, and support material with "a very high degree of purity." (EX1021, [0009]-[0010], [0013], [0024], [0049].) Hanisch contemplates reducing impurities to no more than 1% and down to even .03%. (*Id.*; *see also* EX1003, ¶211.) Hanisch further contemplates using the air flow from the air jet sieve with a particle speed "that is high enough for the impact to bring about a high level of separation." (EX1021, [0031]; EX1003, ¶211.) Hanisch further discloses that "as a result of the air flow, the electrode fragments are whirled up and then placed under mechanical stress [which] assists in the separation of support foil and coating." (EX1021, [0049].; EX1003, ¶211.) A POSITA would have thus

understood Hanisch to disclose sucking away more than 50% by weight of the coating material in order to separate active material and support foil "with a high degree of purity." (EX1003, ¶211.)

Perry further discloses and/or renders obvious the agitator for moving the comminuted material during drying for the reasons discussed in Section IX.E.1 above. (EX1003, ¶212.)

2. Claim 13: "The method according to claim 1, further comprising: moving by an agitator, over a duration of the drying, a not yet inactivated comminuted material among the comminuted material, or a mixture of inactivated comminuted material and not yet inactivated comminuted material, or both; and supplying, during the drying, a vaporization heat to the comminuted material, wherein the supplying includes the agitator supplying at least 35% of said vaporization heat."

Hanisch in combination with Hayashi and Perry renders this limitation obvious. As explained above with respect to claim 7, Hanisch in view of Perry renders obvious an agitator for moving, over a duration of the drying, a not yet inactivated comminuted material among the comminuted material, or a mixture of inactivated comminuted material and not yet inactivated comminuted material, or both. (EX1003, ¶213.) Perry further discloses this limitation for the reasons explained above in Section IX.E.1.

3. Claim 14: "The method according to claim 1, further comprising: performing the drying within an interior of a drying device; and agitating, by an agitator, the inactivated comminuted

material when removing the inactivated comminuted material from the drying device."

Hanisch in combination with Perry renders this limitation obvious. As explained above with respect to claim 6, Hanisch discloses performing the drying within an interior of a drying device. (EX1003, ¶214.) Perry further discloses this limitation for the reasons explained above in Section IX.E.2.

J. Ground 10: All Challenged Claims are invalid for indefiniteness

All Challenged Claims are invalid under §112(b) for being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor regards as the invention. (EX1003, ¶215.)

1. All Challenged Claims – "inactivating the comminuted material and obtaining inactivated comminuted material as a result"

As recited in independent claim 1, the meaning of this step is not reasonably clear because a POSITA would not understand from the '463 Patent when comminuted material is considered "inactivated." Further, PO compounds this confusion in statements to the Patent Office about "inactivating" in related patents.

Claim 1 explains that "the inactivating includes a drying process, comprising drying the comminuted material by removal of organic carbonate from the electrolyte by vaporizing the organic carbonate." However, the "inactivating" is not limited to the drying process—it merely "includes" the drying process, suggesting that some portion of the inactivating could be performed by other unclaimed means.

Thus, *as claimed*, it is unclear whether "inactivat[ion]" can simply be the end result of drying or if it requires some unidentified metric.

The specification further muddies this apparent distinction (between "drying" and "inactivating"), by teaching how long to dry comminuted material but not how a POSITA would know that comminuted material has reached the point of inactivation. (*See, e.g.*, EX1001, 7:21-29, 7:30-34, 7:39-42; 7:7-13.) Moreover, in IPR proceedings for U.S. Patent No. 11,050,097 ("the '097 Patent")—against which the '463 Patent is terminally disclaimed, and which includes the same inventor, and a similar specification and claims—PO (1) complained that the Board "selected a single metric as defining the endpoint of inactivation" (thereby implying that "inactivated" is not a single state of being but encompasses a range) (EX1019, 9), and (2) expressly disavowed any notion that the specification's disclosed metrics for drying times, *or any metrics*, should govern the construction of "inactivating". (EX1019, 10 (asking the Board to "recognize that inactivation is the endpoint result of drying, but not specify the particular metric of drying that must be reached))). And PO's position in that proceeding is further at odds with its construction for the same term in a separate concurrent proceeding for the '097 patent. There, PO argued that "inactivated" should *not* be defined synonymously with drying but that it must be understood as "safe for transport." ([097URT POR], 9.) Given all the inconsistencies in PO's position before the Patent Office in a related patent, and the

'463 Patent's specification's lack of meaningful guidance, a POSITA would have no reasonable certainty as to when comminuted material is considered "inactivated."

By PO's own admission, there are various metrics by which *drying* may be measured, including whether there is a build-up of heat in the material (*see* EX1001, 7:21-29); the maximum value by weight of the electrolyte (*see* EX1001, 7:30-34); whether the content of the dimethyl carbonate reaches a certain threshold by volume (*see* EX1001, 7:39-42); or whether an electrolyte content is so low that an electrochemical reaction is impossible. (EX1001, 7:7-13.) These are all different metrics by which to measure whether drying is complete, but none of these various metrics indicate whether the dried material is inactivated. PO argues that the measure of inactivation should be "the endpoint result of drying," but as these varying examples demonstrate, the endpoint of drying can be very different depending on the goal and the particular threshold sought to be reached for the dried material, and none of those thresholds necessarily indicate whether the material is inactivated.

Accordingly, a POSITA would not have been able to ascertain the scope of this claim with reasonable certainty, and therefore claim 1 (and all Asserted Claims) are invalid for indefiniteness. (EX1003, ¶¶216-19.)

2. Claim 7. "wherein...movement using the agitator is conducted such that at least 50% by weight of the coating material of comminuted material is sucked away."

Claim 7 depends from claim 6 (which depends from claim 1) and recites "wherein...movement using *the agitator* is conducted such that at least 50% by weight of the coating material of comminuted material is sucked away." Neither claim 1 nor claim 6 recites an "agitator" and thus claim 7 lacks antecedent basis.

While claims 13 and 14 recite "an agitator," claim 6 does not. Indeed, claim 6 was amended during prosecution to *remove* the recitation of an agitator because the Examiner found claim 6 indefinite as drafted. (EX1002, 221, 203.) Thus, it is unclear whether claim 7 was intended to introduce a new recitation of an agitator (without explanation for what is being agitated), or whether claim 7 was intended to depend from either of claims 13 or 14 (added later in prosecution)—all of which would give the claims vastly differing scopes. For example, claim 13's agitator is used "over a duration of the drying" to move "not yet inactivated" material or a mixture of inactivated and not yet inactivated material, indicating that the agitator is used *within* the drying device. On the other hand, claim 14 includes an agitator that is used "when removing the inactivated comminuted material from the drying device," which includes an agitator sitting external to the drying device that agitates only inactivated material after the drying. Because claim 7 includes no such limitations, it is unclear whether the agitator is within the drying device; at the edge

of the drying device; or someplace else entirely. Because the term "the agitator" lacks antecedent basis, a person of ordinary skill in the art would not understand the meaning of the term as used in the claimed limitation. (*See* MPEP, § 2173.05(e) (explaining indefiniteness for lack of antecedent basis); EX1003, ¶¶220-22.)

For purposes of interpreting these claims for the prior art rejections identified above (grounds 1-9), Petitioner interprets "the agitator" as referring to an agitator either within or exterior to the dryer.

3. Claim 10. The method according to claim 1, wherein comminuting of the used lithium batteries is configured such that the comminuted material includes components of comminuted material, and at least 90% by weight of the components of the comminuted material have a sieve size that is not more than 50 mm

Claim 10 is indefinite because a POSITA would not have known with reasonable certainty what "components of comminuted material" means relative to "comminuted material" and therefore would not have known what denominator to use in calculating the "90% by weight" limitation. The only example in the '463 specification that mentions this limitation merely restates the claim language. (EX1001, 4:61-65). Although the specification suggests that the claim "should be understood to mean that 90% by weight of the components fall through a sieve which has a mesh width of 50 mm (or the respective given width)", this definition fails to explain what differentiates the "components" of comminuted material from the entirety of "comminuted material." It is therefore unclear how a POSITA would

calculate this percentage—i.e., whether it requires measuring 90% by weight of all the comminuted material (rendering "components of comminuted material" superfluous) or whether it requires measuring 90% by weight of some undescribed subset of material. (EX1003, ¶223.)

X. SECONDARY CONSIDERATIONS

While PO has not yet raised secondary considerations of nonobviousness as to the '463 patent, PO did raise such allegations with respect to the '097 Patent in a prior IPR proceeding. *See Ascend Elements, Inc. v. Duesenfeld GmbH*, Case No. IPR2024-00948 (P.T.A.B. Feb. 14, 2025) (Paper 20, 55-62). While not formally related, the '463 Patent is terminal disclaimed against the '097 Patent. Petitioner thus addresses PO's alleged secondary considerations evidence cited in the Patent Owner Response in IPR2024-00948, none of which overcome the art and arguments in this Petition.

A. Long-felt but unmet need and unexpected results

Duesenfeld alleges that "[p]rior to the '097 invention, many companies tried and failed to develop a process for inactivating depleted rechargeable batteries for safe storage and transport." (EX1019, 55-56.) But this contention is based on the '097 Patent's assertion that prior art techniques had disadvantages (EX1019, 55-56, citing EX1016, 1:26-29, 2:6-1) and not any *objective* evidence that others tried and failed to safely recycle used batteries.

As to unexpected results, Duesenfeld argues that '097 Patent "took a completely different and unexpected approach to preventing...hazards – avoiding creating the hazards in the first place." (EX1019, 57.) But nowhere does Duesenfeld provide evidence that the results of using low-temperature, low-pressure drying were unexpected; as demonstrated in this Petition, such results and advantages of using low-pressure and low-temperature drying were well-known in the prior art. (EX1003, ¶224.)

As demonstrated by the prior art referenced herein, *supra* §IX, any purported problems, solutions or unexpected results in the '463 Patent were already well known. (*See generally* EX1003.)

B. Commercial success

PO argues that its plant practices the '097 Patent and that its battery recycling processes have been commercially successful. (EX1019, 58.)

However, "[c]ommercial success is 'usually shown by significant sales in a relevant market.'" *Ecolochem, Inc. v. Southern Cal. Edison Co.*, 227 F.3d 1361, 1377 (Fed. Cir. 2000)). Mere evidence of revenue and profitability is not sufficient to show commercial success, as this requires evidence that sales are a "substantial quantity in th[e] market" or "evidence of market share, growth in the market share, or that the accused products replaced earlier products sold by others." *Two Moms & a Toy, Ltd. Liab. Co. v. Int'l Playthings, Ltd. Liab. Co.*, No. 10-cv-02271-PAB-BNB,

2012 U.S. Dist. LEXIS 152840, at *70-72 (D. Colo. Oct. 24, 2012) (rejecting evidence of more than \$2 million in additional revenue and profitability as insufficient for commercial success). PO's arguments with respect to the '097 Patent (filed under seal in that proceeding) fail to provide any evidence that the limited data produced in that proceeding evidences "significant" revenue in this market, that PO's process has considerable market share, or any growth in its market share. (EX1019, 58.) This is insufficient to show commercial success.

PO is not entitled to a rebuttable presumption of nexus since it has failed to prove commercial success. *See Crocs, Inc. v. U.S. Int'l Trade Comm'n*, 598 F.3d 1294, 1310–11 (Fed. Cir. 2010) (presumption of nexus requires proving both that "there is commercial success, and that the product that is commercially successful is the invention disclosed and claimed in the patent."). But even if it had shown commercial success, PO fails to prove a nexus to the claimed invention. First, PO's attempts to establish a "presumption of nexus" fails because PO makes no showing that its "battery recycling process" (EX1019, 60) both "embodies the claimed features ***and is coextensive with them.***" *Volvo Penta of the Ams., LLC v. Brunswick Corp.*, 81 F.4th 1202, 1211 (Fed. Cir. 2023) ("coextensiveness is a separate requirement"). Indeed, because PO fails to address any alleged coextensiveness, its request for a presumption fails as a matter of law. *Id.* (finding no presumption when PO made only a single statement regarding coextensiveness). Second, PO did not

establish nexus because it does not show the alleged success of its battery recycling plant is the "direct result of the unique characteristics of the claimed invention—as opposed to other economic and commercial factors unrelated to the quality of the patented subject matter." *In re DBC*, 545 F.3d 1373, 1384 (Fed. Cir. 2008) (noting a failure to show a nexus where patentee "has done little more than submit evidence of sales"). Finally, as shown throughout this Petition, the features of the claimed invention that PO highlights (pressures below 300 hPa at temperatures less than 80° C, as noted in EX1019, 58) were known in the prior art, rendering any purported commercial success irrelevant. *See Ormco Corp. v. Align Tech., Inc.*, 463 F.3d 1299, 1312 (Fed. Cir. 2006) ("[I]f the feature that creates the commercial success was known in the prior art, the success is not pertinent.").

PO presents evidence of licenses with two Italian companies, but there is no evidence relating those licenses to the '463 Patent, precluding a finding of non-obviousness based on those licenses. Moreover, PO offers no evidence to "demonstrate that the licensing program was successful because of the merits of the claimed invention as opposed to 'business decisions to avoid litigation, [] prior business relationships, or for other economic reasons.'" *Cole Kepro Int'l, LLC v. VSR Induss.*, 695 F. App'x 566, 572 (Fed. Cir. 2017) (quoting *In re Antor Media Corp.*, 689 F.3d 1282, 1294 (Fed. Cir. 2012)) (affirming Board finding of

obviousness despite PO submission of nine licenses). Absent such evidence, PO's arguments fail as a matter of law.

XI. THE BOARD SHOULD NOT EXERCISE ITS DISCRETION TO DENY INSTITUTION

A. §325(d)

Considering the two-part framework discussed in *Advanced Bionics, LLC v. Med-El Elektromedizinische Gerate GMBH*, IPR2019-01469, Pap. 6, *8-9, the Board should not exercise its §325(d) discretion to deny institution.

1. Neither the art nor the arguments are the same/substantially the same as those considered during prosecution

Tomiooka and Yosuke were not cited, let alone considered, in the prosecution of the '463 Patent. While Applicant listed LithoRec and Perry on an IDS in the prosecution of the '463 Patent, Applicant did not explain their significance and Examiner did not apply or analyze them in any rejection or notice of allowance for the '463 Patent. Similarly, although a version of Hanisch was before the patent office during prosecution of the application that issued as the '463 Patent, the Examiner did not rely on or discuss Hanisch in any 102/103 rejections.

Hayashi was the basis for the examiner's final rejection dated November 23, 2021. Specifically, the examiner relied on Hayashi as a secondary reference disclosing "a method step of inactivating pertaining to the electrolyte undergoing a pressure and temperature to be vaporized." (EX1002, 222.) However, the Office

did not consider the Grounds presented herein nor the accompanying arguments as to any of the challenged claims. Moreover, the Office did not have the benefit of the additional evidence and facts presented in this petition, including the Juzkow Declaration (EX1003) and supporting references, that explain the state of the prior art, the knowledge and understanding of a POSITA, and why the challenged claims are unpatentable in view of the prior art. And the Board grants institution when a petition sets forth obviousness theories that were not considered during prosecution, even when the prior art overlaps with record references. *See, e.g., Nvidia Corp. v. Invensas Corp.*, IPR2020-00602, Paper 11, at 15-20 (PTAB Sept. 3, 2020). Discretionary denial is thus unwarranted because the first prong of the *Advanced Bionics* test is not met.

Further, the Office committed material error in failing to consider numerous aspects of the disclosures in at least Hayashi, and discretionary denial is not warranted. The Board has made clear that "[i]f the record of the Office's previous consideration of the art is not well-developed or silent, then a petitioner may show the Office erred by overlooking something persuasive...." *Advanced Bionics*, Paper 6 at 10.

Hayashi was considered, but as noted above (*see* Section V.B.), neither the Examiner nor Applicant considered or addressed the disclosures of Hayashi in the context of the grounds asserted in this Petition, including in view of the expert

declaration of Mr. Marc Juzkow. Specifically, neither Applicant nor Examiner addressed the fact that Hayashi discloses the use of reduced pressure and temperatures including 80°C, 20°C, and 10°C (all of which fall below the reported decomposition temperature of LiPF₆) to volatilize organic carbonate solvents from the electrolyte, while using water vapor, instead of heating, to decompose LiPF₆. (See EX1010, at 4:48-58, 5:19-25, and Table 1.)

Similarly, the indefiniteness arguments in Ground 10 are not the same/substantially the same as the arguments considered during prosecution. Accordingly, no arguments regarding indefiniteness are revisited here. *See Lifescan Global Corp. v Ikeda Food Research Co.*, PGR2019-00032, Paper 11 at 14.

Therefore, because prior art and arguments presented herein have never been before the Office, because the combinations proposed herein have never been presented to the Office, and because the new prior art presented herein squarely addresses the limitations deemed missing from the previously applied prior art, it cannot be said that "the same or substantially the same art previously was presented to the Office" or "the same or substantially the same arguments were presented to the Office." The Board should not exercise its discretion to deny institution under §325(d).

B. §324(a)

Petitioner respectfully submits that co-pending district court proceedings do not warrant the exercise of discretion under §324(a) to deny institution under the factors identified in *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020). While there is a parallel district court action involving the challenged claims, discretionary denial would not be appropriate at least because of (i) Petitioner's *Sotera* stipulation, which weighs strongly against discretionary denial; (ii) the compelling evidence of unpatentability; and (iii) the relatively nascent stage of the parallel district court proceedings, which lack a trial date and moreover have been stayed.

1. Whether the Court Granted a Stay or Evidence Exists That One May be Granted If a Proceeding Is Instituted

The '463 Patent is asserted in a parallel district court proceeding: *Duesenfeld GMBH v. Ascend Elements, Inc.*, Case No. 1:23-cv-01194-JFM (D. Del.) (the "Parallel Proceeding"). The Court has already issued a stay in that proceeding, pending resolution of instituted *inter partes* review proceedings against U.S. Pat. No. 11,050,097, also asserted in the Parallel Proceeding. (EX1022, 1.) The Final Written Decision in IPR2024-00948 is due on November 22, 2025.

2. Proximity of the Court's Trial Date to the Board's Projected Statutory Deadline for a Final Written Decision

If this Petition is instituted, the Statutory Deadline for a Final Written Decision will be 12 months from the date that it was instituted—i.e., roughly fall 2026. No trial date has been set in the Parallel Proceeding, and as noted above, the stay in the Parallel Proceeding is currently expected to continue through at least November 2025.

3. Investment in the Parallel Proceeding by the Court and the Parties

As of the date of filing, and because the Parallel Proceeding is stayed, Petitioner has not yet answered PO's First Amended Complaint raising allegations as to the '463 Patent, the parties have engaged in some fact discovery relating to the '097 Patent but have not yet exchanged contentions relating to the '463 Patent, the parties have not engaged in any claim construction proceedings relative to the '463 Patent, and the Court has not addressed any substantive issues relating to the '463 Patent, including claim construction.

4. Overlap between Issues Raised in the Petition and in the Parallel Proceeding

The challenged claims cited in this Petition overlap with those in the Parallel Proceeding. However, Petitioner hereby stipulates that if a PGR is instituted on the grounds set forth in this Petition, it will not pursue in the Parallel Proceeding the specific grounds asserted in the Petition against the challenged claims, or any other

ground that could have been reasonably raised in the Petition against the challenged claims. *See Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 at 13-14, 18-19 (PTAB Dec. 1, 2020). This stipulation weighs heavily against discretionary denial.

5. Whether the Petitioner and the Defendant in the Parallel Proceeding Are the Same Party

Petitioner is the defendant in the Parallel Proceeding. While this factor weighs slightly in favor of denial, it is overcome by the other factors.

6. Other Circumstances That Impact the Board's Exercise of Discretion, Including the Merits

Petitioner submits that the Grounds presented in this petition are compelling theories of invalidity that, "if unrebutted in trial, would plainly lead to a conclusion that one or more claims are unpatentable by a preponderance of the evidence." The merits of the petition thus favor institution.

XII. CONCLUSION

Petitioner respectfully requests institution and a final written decision finding the Challenged Claims unpatentable.

Respectfully submitted,

Dated: March 7, 2025



Andrew D. Gish (Reg. # 67,562)

CERTIFICATE OF WORD COUNT

The undersigned certifies pursuant to 37 C.F.R. §42.24(a) and (d) that the foregoing Petition for Post Grant Review complies with the word count limits set forth in 37 C.F.R. §42.24(a)(1)(ii). Excluding the parts of the Petition exempted by 37 C.F.R. §42.24(a)(1), this Petition contains 18,138 words as determined using the word count feature in Microsoft Word, which was used to prepare this Petition.

Dated: March 7, 2025



Andrew D. Gish (Reg. # 67,562)

CERTIFICATE OF SERVICE

The undersigned hereby confirms that on March 7, 2025 the foregoing Petition for Post Grant Review and associated exhibits were caused to be served, via overnight courier on the Patent Owner at the correspondence address of record for U.S. Pat. No. 12,119,463.

Courtesy copies were also served via email on Patent Owner's counsel of record in a related district court action styled *Duesenfeld GMBH v. Ascend Elements, Inc.*, Case No. Case 1:23-cv-01194-JFM (D. Del. Oct. 20, 2023):

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