

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TOPSOE, INC.,

Petitioner

v.

L'AIR LIQUIDE, SOCIÉTÉ ANONYME POUR L'ETUDE ET
L'EXPLOITATION DES PROCÉDÉS GEORGES CLAUDE,

Patent Owner

Case IPR2025-01173
Patent No 11,673,805

**PATENT OWNER'S REQUEST FOR
DISCRETIONARY DENIAL OF INSTITUTION**

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PATENT OWNER'S EXHIBIT LIST

Exhibit	Shorthand	Description
2001	Darde-US	U.S. Patent Application Pub. No. 2015/0321914
2002		File History of U.S. Patent Application Pub. No. 2015/0321914
2003	Reinertsen-PCT	PCT Publication WO 2021/175662
2004	Reinertsen FW	File History of U.S. Patent Application Pub. No. 2023/0119784
2005		Search Results of Subclasses from Google Patents available online at: https://patents.google.com/?q=(C01B3%2f40+OR+B01D53%2f047+OR+C01B3%2f48+OR+C01B2203%2f0233+OR+C01B2203%2f0244+OR+C01B2203%2f0405+OR+C01+B2203%2f042+OR+C01B2203%2f046+OR+C01B2203%2f1058+OR+C01B2203%2f1241+OR+B01D53%2f002+OR+C01B32%2f50+OR+B01D53%2f22+OR+B01D2256%2f16+OR+B01D2257%2f504+OR+C01B2203%2f0283+OR+C01B2203%2f043+OR+C01B2203%2f0475+OR+C01B2203%2f147+OR+Y02C20%2f40+OR+Y02P20%2f151+OR+C01B3%2f56+OR+C01B3%2f38+OR+C01B3%2f503+OR+C01B3%2f506+OR+C01B2203%2f0261+OR+C01B2203%2f0811+OR+C01B2203%2f1235+OR+C01B3%2f382+OR+F25J3%2f067+OR+F25J3%2f08+OR+C01B2203%2f0833+OR+C01B2203%2f0838)&country=WO,US,EP,JP&before=filing:20221005
2006	Search Printout	Listing of Patent Families in Examiner's Search Printout from the '805 Patent File History
2007	Kresnvak	U.S. Patent Application Pub. No. 2015/0141535
2008	Family 1	Espacenet Listing of Patent Family for WO2006042986A1

Exhibit	Shorthand	Description
2009	Family 2	Espacenet Listing of Patent Family for WO2022178439A1
2010	Family 4	Espacenet Listing of Patent Family for WO2010022162A2
2011	Family 5	Espacenet Listing of Patent Family for WO2007123673A1
2012	Family 6	Espacenet Listing of Patent Family for WO2014005745A1
2013	Family 7	Espacenet Listing of Patent Family for CN113795460A
2014	Family 8	Espacenet Listing of Patent Family for WO2014091097A1
2015	Family 9	Espacenet Listing of Patent Family for JP5677659B2
2016	Family 10	Espacenet Listing of Patent Family for WO2014091098A1
2017	Family 11	Espacenet Listing of Patent Family for WO2015173290A1
2018	Family 14	Espacenet Listing of Patent Family for WO2019162236A1
2019	'805 Patent Family	Espacenet Listing of Patent Family for US11673805B2
2020	L'Air Liquide Publications	Espacenet Listing of Patent Family for US20210155478

Institution should be denied because all of the references relied upon to challenge independent claim 1 were found and considered by the Examiner, and Petitioner has not and cannot show that the Examiner erred.

I. THE PETITION SHOULD BE DENIED UNDER § 325(d)

All of the references Petitioner relies upon to challenge independent claim 1—Darde, Reinertsen, and Rytter—were identified and considered by the Examiner. *See* § I.A.1 below. Yet the Petition contends that Reinertsen and Rytter were “not considered during prosecution.” *See, e.g.,* Pet., 39, 12. That is incorrect. The Examiner’s own search identified Darde, Reinersten, and Rytter, which were included in a distilled listing of just 14 prior art patent families the Examiner plainly considered to be the most-relevant results of his search. *See* § I.A.2 below. The Examiner then selected Darde as the most relevant reference and correctly concluded that Darde did not disclose or suggest “a first endothermic reforming unit configured to be heated by a second autothermal reforming unit nor is there for a plant comprising the same.” Pet., 9 (quoting EX1002, 136) (addressing “US 20150321914,” the US national-stage of the Darde relied upon in the Petition).

Perhaps overlooking that the Examiner had indeed identified Reinertsen and Rytter, Petitioner fails to offer any analysis under 35 U.S.C. § 325(d). Regardless, the record makes clear that the Examiner did consider Petitioner’s three prior art references. The issue then is whether the Examiner erred. Petitioner does not

contend that the Examiner erred in concluding that Darde does not disclose or suggest those features. The Examiner correctly determined that Darde did not.

Instead, Petitioner sidesteps the need to assess “the claimed invention as a whole” to imply that the Examiner should have relied on Reinertsen and Rytter for disclosure of the particular features that Darde lacked. In doing so, Petitioner downplays the fact that Reinertsen and Rytter fail to suggest those features *in combination with* the rest of the claimed features and, in fact, include language that undermine Petitioner’s proposed combination. Ultimately, Petitioner provides only generic “motivations” for its desired combination, ignores the fact that Reinertsen and Rytter already address the problems those alleged motivations purportedly seek to solve, and fails to address the teachings of Reinertsen and Rytter that undermine the proposed combinations. In sum, Petitioner *wishes* the Examiner had reached a different conclusion, but has not and cannot show that the Examiner erred.

A. Petitioner’s Primary References Were Considered by the Office

The Board has the discretion to deny institution when the same or substantially the same prior art or arguments previously were presented to the Office. 35 U.S.C. § 325(d). *Advanced Bionics, LLC v. Med-El Elektromedizinische Geräte GmbH*, set form the two-part test in determining whether to exercise of discretion to deny institution under Section 325(d):

- (1) whether the petition presents the same or substantially the same art or arguments previously presented to the Office; and
- (2) if either condition of the first part of the framework is satisfied, whether the ***petitioner has demonstrated*** that the Office erred in a manner material to patentability of the challenged claims.

IPR2019-01469, Paper 6 at 8 (PTAB Feb. 6, 2020) (precedential) (emphasis added).

These factors “should be read broadly . . . to apply to any situation in which a petition relies on the same or substantially the same art or arguments previously presented to the Office during a proceeding pertaining to the challenged patent.” *Advanced Bionics*, Paper 6 at 10. As affirmatively shown below, the first prong of the *Advanced Bionics* test is met here because the references relied on in the Petition are the same or substantially the same art previously presented to the Office.

The Petition advances three grounds for challenging the sole independent claim of the '805 Patent: (1) Reinertsen (U.S. Pat. Pub. 2023/0119784) alone, (2) Reinertsen in view of Darde (WO 2014/091098), and (3) Rytter (WO 2019/162236) in view of Darde. Petitioner acknowledges that “Darde was considered in the file history of the '805 Patent,” but contends that “it was not considered in the context of combinations with Reinertsen [or] Rytter.” Pet., 12-13. But that is incorrect; the Examiner plainly considered Darde, Reinertsen, and Rytter.

1. Darde was Considered

Petitioner concedes the '805 Patent was allowed over “US20150321914 (U.S. national stage of Darde (EX1007)).” Pet., 9; EX1002, 69 (submitted in an IDS), 138 (cited in form PTO-892). The U.S. national stage of Darde (EX2001 - “Darde-US”) is “substantially the same art” as there are no meaningful differences between it and Darde . EX2002, 63-124, 134-141 (Darde-US is an English translation of Darde that “add[s] no new subject matter”); *See Intel Corp. v. Inst. of Microelectronics of the Chinese Acad. of Sciences*, IPR201900834, Paper 11 at 8–12 (PTAB Oct. 4, 2019) (finding no material differences between domestic patent and PCT counterpart).

Further, during examination, the Office found that Darde does not teach or suggest “a first endothermic reforming unit configured to be heated by a second autothermal reforming unit nor is there for a plant comprising same.” EX1002, 136; Pet., 39. Petitioner does not assert that Darde teaches the features identified as missing during examination. Thus, Petitioner’s use of Darde for any teaching other than those which the Examiner identified as missing presents significant overlap with the Examiner’s use of Darde. Thus, factors (a), (b), and (d) favor exercising discretion to deny institution with respect to Darde.

2. Rytter and Reinertsen Were Considered

Rytter (“WO2019162236A1”) and the PCT publication of Reinertsen (“WO2021175662A1” (EX2003) – Reinertsen-PCT) were explicitly cited by the

Examiner in the search history printout reflecting a small, selected subset of references identified by the Examiner's search. *See* EX1002, 141-142.¹

The Examiner's selection of Ryder and Reinertsen-PCT in a short list of *results* of his search means these references were considered by the Office during the prosecution of the '805 Patent. The Examiner's search notes indicate that his October 5, 2022 prior art search was limited to 33 sub-classes. EX1002, 139. As of this date, the selected sub-classes provided a pool of 136,372 references. EX2005, 1. The Examiner narrowed this pool of references via 17 different search queries, which resulted in 919 cumulatively references or "hits." *See* EX1002, 144-152 (752 "Hits" from general L1-L15 search queries and 162 "Hits" from the narrowing (N1-N2) search queries). Of these narrowed references, the Examiner identified the 50 most relevant references in a printout that indicates "how the search ... was limited" (*i.e.*, what references were considered). MPEP 719.05 (a complete search history in the form of a printout must be included in the application file any time a limited electronic search was performed.")). Taking away the national stage counterparts of the '805 Patent itself, Applicant's co-owned publications that were not prior art, and the duplicative national stage filings of the listed publications, the Examiner's identified references span just 14 patent families, as shown in the table below:

¹ There are no meaningful differences between Reinertsen and its PCT. EX2004, 384-386, 419 (Reinertsen is a U.S. National Stage that "do[es] not add new matter").

	Publication No.	Title	Priority	Inventor
[1]	WO2006042986A1	Method for producing a syngas having a h2/co ratio less than 2.5	10/20/2004	Wentink
[2]	WO2022178439A1	Improved gas reformer for producing hydrogen	2/22/2021	Ravikumar
[3]	DE102012112705A1	Process for producing methanol from carbon dioxide	12/20/2012	Schlichting
[4]	WO2010022162A2	Systems and processes for producing ultrapure, high pressure hydrogen	8/21/2008	Allam
[5]	WO2007123673A1	Carbon dioxide and hydrogen production method from synthesis gas	4/3/2006	Howard
[6]	WO2014005745A1	Process for recovering hydrogen and capturing carbon dioxide	7/4/2012	Terrien
[7]	CN113795460A	ATR-based hydrogen method and equipment	5/2/2019	Christensen
[8]	WO2014091097A1	Method for producing hydrogen by reforming hydrocarbons using steam, combined with carbon dioxide capture and steam production	12/13/2012	Darde II
[9]	JP5677659B2	Integrated gas purifier	12/11/2008	Hardman
[10]	WO2014091098A1	Method for producing hydrogen by reforming hydrocarbons using steam, combined with carbon dioxide capture and steam production	12/13/2012	Darde
[11]	WO2015173290A1	Process for generating hydrogen from a fischer-tropsch off-gas	5/15/2014	Chambron
[12]	WO2021175662A1	Hydrogen and/or ammonia production process	3/6/2020	Reinertsen
[13]	AU768779B2	Process for preparing a H2-rich gas and a CO2-rich gas at high pressure	9/16/1998	Grislingas
[14]	WO2019162236A1	Gas processing	2/20/2018	Rytter

EX2006, 10; *see also id.*, 1-9; EX2008-EX2020. As shown above, Darde, Ryder and Reinertsen-PCT account for three of just fourteen unique references which “determine[d] the scope of the search.” EX1002, 170. The Office’s identification of such a small number of references (14) from the total pool of references returned by the examiner’s general (752) and narrow (162) searches leave room for only one reasonable inference: the Examiner identified and substantively evaluated Darde, Reinertsen, and Rytter as the most pertinent art. *See* EX1002, 139-142, 144-152.

In the *Siemens Mobility v. Metrom Rail*, a non-precedential Delegated Director Review decision, the Board considered whether a reference “included as part of one search query” was deemed previously presented under § 325(d). IPR2024-00947, Paper 16, 6 (April 4, 2025). The Board concluded “that an examiner does not make a reference ‘of record’ solely by including the reference in a search *query*.” *Id.*, 11 (emphasis added). The Board noted that “absent unusual circumstances” ‘art made of record’ is “generally limited” to references cited in an IDS or form PTO-892. *Id.* That decision has not been designated as precedential or informative. Moreover, the circumstances here are materially different.

In *Siemens*, the reference was identified in a single one of 28 search *queries* that added the search code “URPN” (to search references that the listed patents cited) as illustrated below. *Siemens*, IPR2024-00947, Paper 13 (Req. for DR), 9.

S9	24	("20040006413" "20040182970" "20050110628" "20060015224" "20060080009" "4196412" "5437422" "5452870" "6112142" "6609049" "6688561" "6824110" "6845953" "6853888" "6863246" "6865454" "6903658" "6957131" "6996461" "7036774" "7089093" "7236860").PN. OR ("8478463") URPN.	US- PGPUB; USPAT; USOCR	AND	OFF	2015/12/11 12:33
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Here, the Examiner included Ryder and Reinertsen-PCT in a small list of prior art distilled from a much-larger collection of references that would have **resulted** from the Examiner’s multiple search queries.

The search results show the Examiner here searched for and analyzed references more than 9 hours. EX1002, 144-151 (first search at “10:55 AM” and last search at “08:00 PM”). During that span, the Examiner retrieved 919 ‘hits’ and selected from those references just 14 non-duplicative prior art patent families. *Id.*, 141-142. The three references primarily relied on in Petitioner grounds were among those 14 references. That is, of the 136,372 references in the searched sub-classes, the Examiner identified in a small list each of the references the Petitioner deems to be most pertinent. It would defy logic to infer that the 14 patent families identified by such an exacting search were not previously presented under 35 U.S.C. § 325(d).

To illustrate, in *Ecto World*, a single reference in an IDS with over 1,000 other references was sufficient to satisfy the first part of the *Advanced Bionics* framework. IPR2024-01280, Paper 13, at 2, 4 (May 19, 2025). Here, the primary prior art in Petitioner’s grounds accounts for three of fourteen (>20%) unique patent families that were selected from over 100,000 references. The only reasonable inference is that the Examiner meaningfully considered these references. That these references were not listed in a PTO-892 form shows only that the Examiner determined that Darde was “nearest to the subject matter defined in the claims,” and that Reinertsen and Rytter were not. MPEP § 705.05; *see also* MPEP § 1302.12.

Thus, the circumstances here demonstrate that all of Darde, Reinertsen, and Rytter were plainly considered by the Examiner under 35 U.S.C. § 325(d).

3. *Even If Reinertsen and Rytter Are Deemed to Have Not Been Before the Examiner, They Are Cumulative*

Petitioner focuses on Reinertsen and Rytter for the element the Examiner concluded Darde did not disclose or suggest, namely “a first endothermic reforming unit configured to be heated by a second autothermal reforming unit nor is there for a plant comprising same.” Pet., 9 (citing EX1002, 136). But that was before the Examiner in US- 20150141535-A1 (Kresnyak), which was cited in the same PTO-892 form with Darde. EX1002, 138. Kresnyak expressly discloses an embodiment “SMR and ATR unit operations ... amalgamated into an integrated unit operation whereby the heat energy created by the ATR 24 becomes the indirect heat energy required by the SMR reactor tubes 25.” EX2007, ¶[0071]. Thus, despite also citing a reference disclosing the feature noted to be missing from Darde, the Examiner still determined the claims to be patentable. For the element driving Petitioner’s reliance on Reinertsen and Rytter, both are therefore cumulative of art before the Examiner.

B. The Examiner Did Not Err

The Examiner here correctly determined that Darde does not disclose or suggest “a first endothermic reforming unit configured to be heated by a second autothermal reforming unit nor is there for a plant comprising the same.” Pet., 9 (quoting EX1002, 136) (specifically addressing Darde-US). Petitioner does not dispute this conclusion.

Nor does Petitioner directly explain why the Examiner erred in any other way. At best, Petitioner *implies* an error based on its contention that Reinertsen and Rytter (1) were not before the Examiner and (2) do disclose a first endothermic reforming unit configured to be heated by a second autothermal reforming unit. But both were considered by the Examiner. And, as explained below, neither reference suggests, much less discloses, the combination of endothermic and autothermal reforming units *in combination with* the other elements of the claimed system. Thus, the only reasonable inference is that the Examiner decided that a rejection of the claims over a combination of Darde and Reinertsen or Rytter was not strong enough to make.

Even “[i]f reasonable minds can disagree regarding the purported treatment of the art or arguments, it cannot be said that the Office erred in a manner material to patentability.” *Id.*, 9. The Board has emphasized that “this framework reflects a commitment to defer to previous Office evaluations of the evidence of record unless material error is shown.” *Id.* That deference is appropriate here.

1. Petitioner Fails to Demonstrate that the Office Erred

At the outset, it is incumbent upon Petitioner to demonstrate that the Examiner erred. *Advanced Bionics*, Paper 6 at 8. Petitioner neglected to mention that the Examiner’s own search identified Reinertsen and Rytter as two of just 14 unique patent families. And Petitioner has made no effort to explain why the Examiner’s conclusions regarding Darde were incorrect. Thus, should Petitioner attempt such a

showing in response to this paper, Patent Owner respectfully requests leave to file a reply to address Petitioner's arguments.

2. *The Examiner Correctly Determined that Reinertsen Does Not Anticipate Claim 1*

Reinertsen fails to disclose *all elements* of independent claim 1 *arranged as in the claim*. To anticipate claim 1, Reinertsen must “disclose all elements of the claim within the four corners of the document,” and it must “disclose those elements ‘arranged as in the claim.’” *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008) (quoting *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 1548 (Fed. Cir. 1983)). Reinertsen does not.

For example, claim 1 of the '805 Patent recites [Element 1.5] “(e) separating hydrogen from the fourth synthesis gas stream by pressure swing adsorption ...” and [Element 1.6] “(f) separating carbon dioxide from the first residual gas stream obtained in step (e) by cryogenic carbon dioxide separation...” EX1001, 15:15-35.

The Petition points to Reinertsen's Figure 4 as allegedly anticipating claim 1. *See, e.g.*, Pet. 20-22, 24, 25, 27, 29-32, 34-37. But Reinertsen's Figure 4 does not separate hydrogen by pressure swing adsorption or “PSA.” *See, e.g.*, Pet., 33 (“[I]n Figure 4, Reinertsen discloses producing a hydrogen stream 121 by hydrogen separation using a Pd-membrane 12.”); *see also* EX1005, [0109] (“Pd-membrane”). Thus, the embodiment of Reinertsen's Figure 4 does not anticipate claim 1.

To attempt to plug that gap, the Petition takes general passages out of context to misleadingly suggest that Reinertsen might disclose substituting PSA for Pd-membrane hydrogen separation *in the embodiment of Reinertsen's Figure 4*. But Reinertsen does not. More specifically, the Petition points to Reinertsen's mention that "[e]mbodiments may alternatively use PSA to separate hydrogen from the gas output from the WGS reactor." Pet., 34 (citing EX1005, ¶¶[0081], [0085]). The Petition also points to a sentence stating that "[p]referably, the hydrogen separation process comprises a PSA process." Pet., 34 (quoting EX1005, ¶[0012]).

Petitioner's reliance on these statements is both misleading and insufficient. Neither statement bears any relation to the embodiment of Figure 4. The second, "preferably" statement appears in the summary and is preceded with "[p]referably, the hydrogen separation process ... [uses] a Paladium membrane ... [not PSA]." EX1005, ¶[0011]. The first, "alternatively" statement on its face refers to *other embodiments*. And Petitioner fails to mention that, in those *other embodiments*, Reinertsen's system uses amine separation for CO₂ before the PSA separation for hydrogen—which is both opposite to the order and lacks the requisite cryogenic separation of claim 1 here. *See, e.g.*, EX2005, Figure 2 and ¶[0103] ("Amine type separation process 8 separates CO₂ ..."). Notably, Figure 2—the only disclosed system with PSA—is a "Comparative Example" as a contrast for Reinertsen's Embodiment Examples 1-12 (*all* of which use Pd-membrane). EX1005, Figure 10.

Reinertsen also explains in several places—ignored by Petitioner—why PSA hydrogen separation is used only *after* CO₂ separation in Reinertsen’s system. *See, e.g.,* EX1005, [0056] (“PSA processes may also result in CO₂ being released at low pressure ... so there is a subsequent need for compression and cooling. Still, it can be feasible to use PSA for some hydrogen production plants [such as Figure 2 in which CO₂ is separated *before* PSA hydrogen separation].”). Critically, Reinertsen also explains that while “embodiments include the reforming process shown in FIG. 1 [relied on for Claim Elements 1.2 and 1.3], embodiments also include *alternatively* using any other type of reforming process ... [e.g.,] *only* using an autothermal reformer or *only* using a gas-heated reformer.” EX2005, ¶[0075]. Thus, the “other embodiments” with PSA explicitly need not include the reformers of Reinertsen’s Figure 1 that Petitioner relies on for its mapping of Claim Elements 1.2 and 1.3.

Reinertsen thus does not anticipate claim 1, which Petitioner tacitly concedes. *See* Pet., 41 (“may nonetheless argue that the specific combination of PSA upstream of cryogenic CO₂ separation is not specifically exemplified in Reinertsen.”). The Examiner thus did not err in allowing the claims over Reinertsen.

3. *The Examiner Correctly Determined that Reinertsen and Darde Do Not Render Obvious Claim 1*

Perhaps recognizing the foregoing deficiency in its anticipation ground, Petitioner also includes Ground 2, contending it would have been obvious to modify Reinertsen’s Figure 4 embodiment with Darde to include PSA hydrogen separation

upstream of cryogenic CO₂ separation. Pet., 39-44. But Petitioner’s purported motivations for the combination are generic and circular. Specifically, Petitioner argues that because Reinertsen and Darde both produce hydrogen with reduced CO₂ emissions, and because Darde describes cryogenic CO₂ separation after PSA hydrogen separation, then it would have been obvious in view of Darde to “select PSA as one of the finite options disclosed in Reinertsen (i.e., PSA and Pd-membrane).” Pet., 41-42. But Petitioner neglects Reinertsen’s disclosure of absorption and membrane separation for CO₂. EX1005, ¶[0082]. Petitioner also *assumes* that PSA and Pd-membrane are alternate approaches for the embodiment of Reinertsen’s Figure 4. However, as explained above in Section I.B.2, Reinertsen instead discloses either amine CO₂ separation followed by PSA hydrogen separation or Pd-membrane hydrogen separation followed by cryogenic CO₂ separation. Thus, Petitioner’s first motivation—PSA better than Pd-membrane—would have instead led a POSITA to select amine CO₂ separation followed by PSA hydrogen separation. But that does not meet claim 1.

Second, Petitioner points to “performance benefits achieved by implementing hydrogen separation and carbon capture in gas reforming.” Pet., 42-43. But this is utterly generic, and would not have motivated a POSITA to modify Reinertsen because it already implements hydrogen separation and carbon capture. *See, e.g.*, Pet., 41 (“Reinertsen and Darde use a combination of hydrogen separation and CO₂

separation”); *see also Ex parte Rinkevich*, Appeal No. 2007-1317, slip op. at 8-9 (BPAI May 29, 2007) (a POSITA “would not have reasonably looked at [a secondary reference] to solve a problem already solved by [the primary one].”).

The Petition finally pays lip service to PSA hydrogen separation specifically, but relies entirely on unsupported conclusions from its expert. Pet., 42-43 (citing EX1003, ¶¶169-170 (expert not citing any documentary support for motivations)). The Petition ultimately alleges just two benefits: “(i) the capability for generating high purity H₂ at a useful pressure, and (ii) the practical robustness and ease of implementation of PSA with gas reforming and cryogenic CO₂ separation.” Pet., 43. But Petitioner fails to define “useful pressure” or compare the performance of PSA to that of membrane separation. *Id.* Reinertsen uses membrane separation to already obtain hydrogen at useful pressure (membrane that “leav[es] hydrogen at a [elevated] pressure ... comparable to the process gas”). EX1005, ¶¶[0083], [0084]. Reinertsen also shows “the practical robustness and ease of implementation of [Pd-membrane hydrogen separation] with gas reforming and cryogenic CO₂ separation.” And, with Reinertsen’s Pd-membrane, “hydrogen is [already] obtained with high purity.” EX1005, ¶[0062] (often >99.9%). Petitioner’s “motivations” therefore add nothing to Reinertsen, and would not lead a POSITA to modify Reinertsen. Indeed, Reinertsen also expressly explains in the context of an ammonia synthesis loop that

a plant using PSA for hydrogen separation was “*not* favorably designed for separating a pure CO₂-stream for storage.” EX1005, ¶[0094].

Finally, Petitioner blatantly neglects the complexity of the respective Reinertsen and Darde systems. For example, the properties of Reinertsen’s WGS reactor and Pd-membrane are carefully selected to work together, such that switching to PSA separation would also require changes to the WGS reactor scheme. EX1005, ¶[0080]; *see also id.*, ¶[0081] (suggesting use of PSA [as in Figure 2 with amine CO₂ separation before PSA for hydrogen] would likely require different and more WGS reactors). Similarly, Reinertsen makes clear that its Pd-membrane hydrogen separation is important for cryogenic CO₂ separation, namely that “the CO₂ gas can be separated from the H₂/CO₂ mixture *at an elevated pressure*, [such that] *significant compression work can be avoided*.” EX1005, ¶[0087]. On the other hand, Darde takes an *opposite* approach that of Reinertsen—specifically noting that [t]he PSA offgas [from which CO₂ is separated in Darde] ... is available at a [very low] pressure below 2 bar(a).” *Id.*, ¶[0024]. Petitioner neglects these differences, relying instead on a sweeping conclusion of its expert that “Reinertsen with Darde would be compatible with similar process conditions (e.g., pressures, flow rates, temperatures).” Pet., 44 (citing EX1003, ¶¶172, 227 (not addressing any Reinertsen or Darde pressure, flow rate, or temperature needs)). Petitioner thus cannot show the Examiner erred in allowing the claims over Reinertsen and Darde.

4. *The Examiner Correctly Determined that Rytter and Darde Do Not Render Obvious Claim 1*

The portions of Rytter relied upon by Petitioner are largely cumulative of Reinertsen. *E.g., compare* EX1005, Figure 1 *with* EX1009, Figure 1. For example, Petitioner relies upon Rytter’s Figure 3, which is nearly identical to Reinertsen’s Figure 2 addressed above (with CO₂ separation *preceding* PSA hydrogen separation). The Petition concedes that “Rytter discloses CO₂ separation (13) occurs upstream of H₂ separation (15) in ... FIGURE 3,” but points to Rytter’s statement that “[e]mbodiments also include the hydrogen being separated from the gas mixture before the carbon dioxide is separated ..., or ... at the same time in a single process.” Pet., 59 (citing EX1009, p. 20/35, ll. 8-10). But this does not suggest that the order might be reversed *with* cryogenic CO₂ separation *after* PSA hydrogen separation. Rytter—like Reinertsen—also discloses Pd-membrane hydrogen separation (EX1009, p. 12/35, ll. 10-20), and other methods of separating CO₂, such as absorption, adsorption, and membranes. *Id.*, p. 11/35, ll. 30 – p. 12/35, ll. 29.

Moreover, Petitioner’s purported motivations for the combination are generic and circular. Petitioner first argues that because Rytter and Darde both produce hydrogen with reduced CO₂ emissions, and because Darde describes cryogenic CO₂ separation after PSA hydrogen separation, then it would have been obvious in view of Darde to “incorporate [some, but only some] aspects from Darde into the reforming process in Rytter to reduce CO₂ emissions by cryogenic capture.” Pet.,

59. But neither of the premise or motivation are specific to cryogenic CO₂ separation and, thus, would not have led a POSITA to both (1) separate CO₂ after separating hydrogen and (2) use cryogenic CO₂ separation instead of amine CO₂ separation. To the contrary, as in Reinertsen, Rytter's one specific disclosure of CO₂ separation downstream of hydrogen separation uses membrane hydrogen separation *instead of* PSA. EX1009, p. 12/35, ll. 19-20 ("By combining solid *membranes* and liquid *membranes* it is also possible to achieve a rapid permeation of CO₂, while H₂ is kept back."); *contra id.*, p. 12/35, ll. 21-29 (separately describing PSA).

Second, Petitioner contends that "[a] POSA would have readily been aware that the processes and order of H₂/CO₂ separation steps are selectable, as recognized in Rytter, depending on the goals and requirements of the overall process." Pet., 60 (citing EX1002, ¶¶235-237). To support this contention, Petitioner begins from a premise that Rytter discloses only six practical permutations for H₂/CO₂ separation. Pet., 60. But this is demonstrably false because Petitioner ignores that Rytter also discloses absorption and membranes for CO₂ separation, which would increase the number of permutations to 14. Regardless, Petitioner fails to proffer a motivation specific to PSA (H₂)→cryogenic (CO₂) as one of six possibilities, much less 14.

Petitioner continues that this would be mere routine optimization based on a finite number of possibilities. Pet., 61. But Petitioner fails to explain what would be optimized, or how reversing both of Rytter's separation steps and methods to

achieve Darde's PSA (H₂)→cryogenic (CO₂) configuration would have improved Rytter. Petitioner instead points to nonspecific "performance benefits achieved by implementing hydrogen separation and carbon capture in gas reforming." Pet., 62. But this again is utterly generic, and would not have motivated a POSITA to modify Rytter because it already implements hydrogen separation and carbon capture. *See, e.g.,* Pet., 41 ("Rytter and Darde implement a similar combination of hydrogen separation and CO₂ separation"); *see also Rinkevich*, Appeal No. 2007-1317, slip op. at 8-9. The Petition seeks to further support the reversal of Rytter's separation order and methods by pointing to Rytter's own disclosure of the benefits of its use of a GHR and an ATR. Pet., 62 (quoting EX1009, p. 16/35, ll. 10-16). But this is has nothing to do with benefits a POSITA would expect from modifying Rytter's separation steps with Darde's. If anything, that Rytter achieves these benefits would discourage a POSITA from any modification.

Petitioner again blatantly neglects the complexity of the respective Rytter and Darde systems. Rytter—like Reinertsen—explains that the properties of its WGS reactor and Pd-membrane are carefully selected to work with one another, such that using PSA hydrogen separation would also require changes to the WGS reactor scheme. EX1009, p. 11/35, ll. 25-29. Similarly, Rytter—like Reinertsen—makes clear that its Pd-membrane hydrogen separation is important to its cryogenic CO₂ separation, namely that "the CO₂ gas can be separated from the H₂/CO₂ mixture *at*

an elevated pressure, [such that] significant compression work can be avoided.

EX1009, p. 13/35, ll. 2-4. On the other hand, Darde takes an *opposite* approach that of Rytter—specifically noting that [t]he PSA offgas [from which CO₂ is separated in Darde] ... is available at a [very low] pressure below 2 bar(a).” *Id.*, ¶[0024]. Petitioner neglects these differences, relying instead on a sweeping conclusion of its expert that the two “would be compatible with similar process conditions (e.g., pressures, flow rates, temperatures).” Pet., 44 (citing EX1003, ¶¶172, 227 (not addressing any Rytter or Darde pressure, flow rate, or temperature needs)).

Critically, nowhere does the Petition allege any motivation specific to modifying Rytter to use PSA hydrogen separation followed by cryogenic CO₂ separation. That alone is fatal to Petitioner’s Rytter-Darde combination. Petitioner thus cannot show the Examiner erred in allowing the claims over Rytter and Darde.

II. CONCLUSION

For the foregoing reasons, institution should be denied.

Dated: September 9, 2025

Respectfully submitted,

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Lead Counsel for Patent Owner

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6(e), the undersigned certifies that on September 9, 2025, a complete copy of the foregoing Patent Owner's Request for Discretionary Denial of Institution was served on Petitioner via email (by consent), at the following email address(s):

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