

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

U.S. Patent No. 11,673,805

Filed: August 11, 2021

Issued: June 13, 2023

Inventors: Schmidt, *et al.*

TITLE: PROCESS AND PLANT FOR PREPARATION OF HYDROGEN AND
SEPARATION OF CARBON DIOXIDE

Inter Partes Review No. IPR2025-01173

**PETITIONER'S RESPONSE TO PATENT OWNER'S REQUEST FOR
DISCRETIONARY DENIAL OF INSTITUTION**

TABLE OF CONTENTS

I. INTRODUCTION 1

II. *ADVANCED BIONICS* PART I IS NOT SATISFIED 2

 A. Reinertsen and Rytter Were Not Presented 2

 1. The law makes clear that Reinertsen and Rytter were not presented..... 3

 2. The facts do not support Patent Owner’s argument that Reinertsen and Rytter were presented 5

 3. Kresnyak is Not Substantially the Same as Reinertsen or Rytter 9

 B. Darde Was Not Presented 12

III. *ADVANCED BIONICS* PART II IS NOT SATISFIED..... 14

 A. The Examiner Erred by Failing to Recognize That Reinertsen Anticipates the ’805 Patent Claims..... 17

 B. The Examiner Erred by Failing to Recognize the Reinertsen + Darde Combination for Obviousness 18

 C. The Examiner Erred by Failing to Recognize the Rytter + Darde Combination for Obviousness 19

IV. CONCLUSION..... 20

TABLE OF AUTHORITIES

Cases

<i>Advanced Bionics, LLC v. Med-El Elektromedizinische Geräte GMBH</i> , IPR2019-01469, Paper 6 (P.T.A.B. Feb. 13, 2020).....	passim
<i>Azurity Pharms., Inc. v. Helsinn Healthcare SA</i> , IPR2025-00945, Paper 11 (P.T.A.B. Sept. 19, 2025).....	2, 15
<i>Becton, Dickinson & Co. v. B. Braun Melsungen AG</i> , IPR2017-01586, Paper 8 (P.T.A.B. Dec. 15, 2017)	15, 16
<i>Ecto World, LLC v. RAI Strategic Holdings, Inc.</i> , IPR2024-01280, Paper 13 (P.T.A.B. May 19, 2025).....	2, 5, 15, 16
<i>Ecto World, LLC v. RAI Strategic Holdings, Inc.</i> , IPR2024-01280, Paper 16 (P.T.A.B. June 25, 2025).....	5
<i>Kennametal, Inc. v. Ingersoll Cutting Tool Co.</i> , 780 F.3d 1376 (Fed. Cir. 2015)	17
<i>Oticon Medical AB v. Cochlear Ltd.</i> , IPR2019-00975, Paper 15 (P.T.A.B. Oct. 16, 2019)	10, 12, 14
<i>Siemens Mobility, Inc. v. Metrom Rail, LLC</i> , IPR2024-00947, Paper 16 (P.T.A.B. Apr. 4, 2025).....	4, 6
<i>Stone Basket Innovations, LLC v. Cook Med. LLC</i> , 892 F.3d 1175 (Fed. Cir. 2018)	4
<i>Xencor, Inc. v. Merus N.V.</i> , IPR2025-00604, Paper 12 (P.T.A.B. Jul. 17, 2025)	1

Statutes

35 U.S.C. § 325(d)	passim
--------------------------	--------

Rules

M.P.E.P. § 1302.12	4, 6
M.P.E.P. § 609	4, 6
M.P.E.P. § 707.05	4, 6

EXHIBITS CITED

Exhibit	Description
1001	U.S. Patent No. 11,673,805 to Schmidt et al. (“the ’805 patent”)
1002	File History of U.S. Patent No. 11,673,805
1003	Declaration of Prof. Dr. Harald Klein
1004	Curriculum Vitae of Prof. Dr. Harald Klein
1005	U.S. Patent Publication No. 2023/0119784 to Reinertsen et al. (“Reinertsen”)
1006	RESERVED
1007	PCT Publication WO 2014/091098 to Darde et al.
1008	Certified Translation of WO 2014/091098 to Darde et al. (“Darde”)
1009	PCT Publication WO 2019/162236 to Rytter et al. (“Rytter”)
1010	Cotton, B. (2019) “Clean Hydrogen. Part 1: Hydrogen from Natural Gas Through Cost Effective CO ₂ Capture”, dated March 15, 2019, The Chemical Engineer website, available from https://www.thechemicalengineer.com/features/clean-hydrogen-part-1-hydrogen-from-natural-gas-through-cost-effective-co2-capture/ , for download, Published by Institution of Chemical Engineers (Rugby, UK) (“Cotton”)
1011	Patwardhan et al. (2013) “Optimised hydrogen production by steam reforming: part 2”; Digital Refining article 1000841, dated PTQ Q3

Exhibit	Description
	2013, available for download from http://www.digitalrefining.com/article/1000841 (“Patwardhan”)
1012	RESERVED
1013	RESERVED
1014	RESERVED
1015	RESERVED
1016	Appl, M. (1997) Ammonia Methanol Hydrogen Carbon Monoxide, Modern Production Technologies, A Review; published by Nitrogen-The Journal of the World Nitrogen and Methanol Industries, an imprint of British Sulphur Publishing, a division of CRU Publishing Ltd. (London, England) (“Appl”)
1017	Aasberg-Petersen et al. (2011) “Natural gas to synthesis gas – Catalysts and catalytic processes,” J. Natural Gas Science and Engineering, 3:423-459 (“Aasberg-Petersen”)
1018	Technology Handbook (Air Liquide, Engineering and Construction. Ed.) February 2018, version 2, available for download at https://www.scribd.com/document/386431469/Air-Liquide-Technology-Handbook-March-2018 , 108 pages (“Technology Handbook”)
1019	Riquarts et al. (1985) “Gas separation using pressure swing absorption plants,” in Linde Reports on Science and Technology, No. 40, (LindeAktiengesellschaft), ISSN:0942-5268 (“Riquarts”)

Exhibit	Description
1020	Xu et al. (2014) “An Improved CO ₂ Separation and Purification System Based on Cryogenic Separation and Distillation Theory,” <i>Energies</i> (ISSN 1996-1073), 7, 3484-3502; MDPI (Basel, CH) doi:10.3390/en7053484 (“Xu”)
1021	Keshavarz et al. (2019) “Cryogenic CO ₂ Capture,” in <i>Sustainable Agriculture Reviews</i> 38, (Inamuddin et al., Eds.), ISBN 978-3-030-29337-6 (eBook), Springer Nature Switzerland AG (“Keshavarz”)
1022	File history for UK patent application GB2592681 corresponding to UK application 2003317.1, filed March 6, 2020, priority document for U.S. Patent Publication No. 2023/0119784 to Reinertsen et al.
1023	File history for UK patent application GB2592695 corresponding to UK application 2010174.7, filed July 2, 2020, priority document for U.S. Patent Publication No. 2023/0119784 to Reinertsen et al.
1024	U.S. Patent Application No. 2012/0291484 to Terrien et al. (“Terrien”)
1025	RESERVED
1026	K. Aasberg-Petersen et al. (2004) “Synthesis gas production for FT synthesis,” Chapter 4 in <i>Studies in Surface Science and Catalysis</i> , vol 152, pages 258-405 (“Aasberg-Petersen II”)
1027	J. R. Rostrup-Nielsen (1993) “Production of Synthesis Gas,” <i>Catalysis Today</i> , volume 18, pages 305-324
1028	J. R. Rostrup-Nielsen (2002) “Syngas in perspective,” <i>Catalysis Today</i> , volume 71, pages 243-247

Exhibit	Description
1029	U.S. Patent App. No. 17/399,277, Transaction Report, printed from USPTO Patent Center, September 25, 2025
1030	U.S. Patent App. No. 16/682,781, Office Action, June 30, 2022

I. INTRODUCTION

Patent Owner's Request for Discretionary Denial of Institution ("RDD") should be denied because none of the discretionary denial factors outlined in the Office's March 26, 2025 Interim Processes for Workload Management are met, and discretionary denial is not warranted. The '805 patent has not been previously adjudicated, issued only two years ago, and early institution of IPR challenges promotes robust and predictable patent rights, weighing against discretionary denial. *See, e.g., Xencor, Inc. v. Merus N.V.*, IPR2025-00604, Paper 12 at 2 (P.T.A.B. Jul. 17, 2025). Patent Owner instead relies on speculative inferences that ignore established Patent Office procedure and precedent regarding what constitutes "considered" art under 35 U.S.C. § 325(d). The Board and Federal Circuit require clear, objective indicia of prior art consideration to ensure predictability and administrability, thereby avoiding the type of speculative, post-hoc arguments Patent Owner now presents.

Contrary to Patent Owner's suggestion, discretionary issues are appropriately raised here, not in the Petition. The Interim Director Discretionary Process states: "A petitioner should raise any discretionary issues in its opposition to a patent owner's discretionary denial brief, including issues related to 35 U.S.C. § 325(d) The petition should not address discretionary issues." § III.A., available at <https://www.uspto.gov/patents/ptab/interim-director-discretionary->

process. These procedures are consistent with *Ecto World*, which requires a petitioner to explain any material error under *Advanced Bionics* part two, but does not require doing so in the petition. *Ecto World, LLC v. RAI Strategic Holdings, Inc.*, IPR2024-01280, Paper 13 at 4-6 (P.T.A.B May 19, 2025) (precedential). Recent Director decisions have rejected § 325(d) discretionary denial requests where material error was shown in the petitioner’s opposition briefing, rather than in the petition. *See, e.g., Azurity Pharms., Inc. v. Helsinn Healthcare SA*, IPR2025-00945, Paper 11 at 2-3 (P.T.A.B. Sept. 19, 2025).

II. ADVANCED BIONICS PART I IS NOT SATISFIED

Under the first part of *Advanced Bionics*, the same or substantially the same art or arguments were not presented to the Office. The Examiner made no substantive rejections on anticipation or obviousness grounds during prosecution. EX1002 at 133-37. Contrary to Patent Owner’s assertions, neither the same or substantially similar art nor the arguments now presented were previously before the Office. Thus, *Becton Dickinson* factors (a), (b), and (d) are not met.

A. Reinertsen and Rytter Were Not Presented

Neither Reinertsen (EX1005) nor Rytter (EX1009) was listed on an IDS, on the Notice of References Cited (PTO-892), or as “art made of record” in any Office Action or other official correspondence. There is no mention of these references in the prosecution history, except potentially as family publication numbers in the

Examiner’s search report among numerous other references. EX1002 at 141-42.

Patent Owner’s argument that the Examiner “meaningfully considered” these references, based on speculation from search logs, is unsupported by law or fact.

Patent Owner’s argument also contravenes policy. The requirement for clear, objective indicia of prior art consideration by the Office—such as listing on a PTO-892 form or an Information Disclosure Statement (IDS)—serves a critical function. This standard ensures predictability and administrability in patent examination, preventing speculative, post-hoc inquiries into an examiner's subjective thought processes. Without such objective standards, any reference, no matter how tangentially related or buried in search logs, could be argued to have been “considered,” leading to perpetual uncertainty regarding prior art review and the validity of granted patents. Patent Owner’s approach would thus introduce significant uncertainty into the patent system, is a policy outlier, and is not supported by any Board or Federal Circuit precedent regarding what constitutes “consideration” under § 325(d).

1. The law makes clear that Reinertsen and Rytter were not presented

The rules for when an examiner has “considered” a reference are specifically designed to avoid speculative interpretations. The M.P.E.P. requires that “[a]ll references which have been cited by the examiner during the prosecution . . . must

be listed on either a form PTO-892 or on an Information Disclosure Statement (PTO/SB/08) and initialed.” M.P.E.P. § 1302.12; *see also* M.P.E.P. § 707.05 (examiner should list on a PTO-892 all references relied upon in any Office action); M.P.E.P. § 609 (examiner initials on IDS indicate consideration). A reference listed on the face of a patent is presumed to have been considered by the examiner. *Stone Basket Innovations, LLC v. Cook Med. LLC*, 892 F.3d 1175, 1179 (Fed. Cir. 2018). However, as *Siemens Mobility* unequivocally states, “[a] reference appearing only on the examiner’s search report has not been ‘made of record.’ An examiner does not make a reference of record solely by including the reference in a search query.” *Siemens Mobility, Inc. v. Metrom Rail, LLC*, IPR2024-00947, Paper 16 at 11-12 (P.T.A.B. Apr. 4, 2025).¹

The guidance provided in *Siemens Mobility* forecloses Patent Owner’s search-history inference. Patent Owner misreads *Siemens Mobility* to argue that its “unusual circumstances” language can somehow negate this holding. *See, id.* at 11. It does not. At most, this qualifying language suggests a limited and undefined exception, not a general rule, and the decision offers no example or explanation of what such circumstances might include. More importantly, the preceding sentence

¹ A Delegated Review Panel that included Chief Judge Scott Boalick and Vice Chief Judge Michael Kim issued the decision in *Siemens Mobility*.

explicitly clarifies this purported exception: “We conclude that an examiner does not make a reference ‘of record’ solely by including the reference in a search query.” *Id.* Thus, an “unusual circumstance” cannot simply be a reference appearing in a search result. *See, id.*

Likewise, Patent Owner’s reliance on *Ecto World* in arguing that even a single citation in a lengthy IDS implies a reference was “presented” under § 325(d) is unpersuasive. Patent Owner’s RDD at 8. The facts in *Ecto World* are inapposite because, for the ’805 patent, these references were not cited in an IDS, on a PTO-892 form, or in any office action. Even in *Ecto World*, the Board on remand found that the Examiner did not substantively consider the reference *despite* its appearance on the IDS. *Ecto World, LLC v. RAI Strategic Holdings, Inc.*, IPR2024-01280, Paper 16 at 13 (P.T.A.B. Jun. 25, 2025) (“Other than initials on a lengthy IDS, nothing in the record indicates that the Examiner substantively considered [the references].”). The Board in *Ecto World* chose not to exercise its discretion under § 325(d) (*id.* at 15), and the Director should likewise not discretionarily deny here: Reinertsen and Rytter were not “presented to the Office.”

2. The facts do not support Patent Owner’s argument that Reinertsen and Rytter were presented

Beyond the legal requirements, the factual record demonstrates that Reinertsen and Rytter were not “considered.” Patent Owner has failed to provide

any evidence that “*reliably indicate[s]*” the Examiner considered these references. *Siemens Mobility* at 11-12. Without any direct evidence to support its claim, Patent Owner instead asks the Director to draw multiple speculative inferences from circumstantial evidence, even as it contradicts its own asserted “only reasonable” conclusion. As shown below, it is doubtful that the Examiner could have considered Reinertsen and Rytter beyond a cursory glance at their cover pages, if any review occurred at all. A mere glance at cover pages, however, does not constitute “consideration” under § 325(d). *Siemens Mobility*; M.P.E.P. §§ 1302.12, 609. The M.P.E.P. recommends that “pertinent features of references which are not used as a basis for rejection be pointed out briefly.” M.P.E.P. § 707.05(c). The Examiner’s failure to identify any such features for Reinertsen and Rytter further confirms they were not substantively considered.

Patent Owner has failed to explain the absence of Reinertsen and Rytter from a PTO-892 listing, any examiner-initialed IDS, or any Office action, which is dispositive under M.P.E.P. §§ 1302.12, 609, 707.05, and *Siemens Mobility*. Furthermore, Patent Owner’s timestamp narrative is speculative and internally inconsistent. The search log indicates 570 of the 919 total “hits” were recorded in the **final three minutes** of the alleged 9-hour window (EX1002 at 149-51, searches L12 through L15). This leaves no plausible time for the “meaningful consideration” Patent Owner posits, let alone for family consolidation, identifying

commonly owned art, and comparative analysis. This timeline also conflicts with the Examiner's documented workload on the file that same day (October 5, 2022), which included IDS processing and drafting the Office Action. EX1029 at 2. The Examiner would have had to complete these tasks after 8:00 PM, following the supposed 9 hours spent searching and analyzing hundreds of results (including the 570 hits from the final minutes of searching). EX1002 at 150-51. This workload makes Patent Owner's proposed timeline implausible.

Additional facts further support the conclusion that Reinertsen and Rytter were not considered. First, the Examiner had multiple opportunities to consider Reinertsen and Rytter, yet there is no evidence he did. Specifically, the Examiner did not make these references of record at any of the following points:

- In October 2022, on a PTO-892 form after the initial search. EX1002 at 138.
- In October 2022, by initialing or adding the references to Patent Owner's IDS form PTO/SB/08. *Id.* at 153.
- In October 2022, by noting any relevant prior art from the search in the body of the Office Action. *Id.* at 133-37.
- In January 2023, by correcting the PTO-892 form after re-running the search before issuing the Notice of Allowance. *Id.* at 162-90.

If the Examiner had identified and substantively evaluated Reinertsen and Rytter as the most pertinent art, as Patent Owner claims (RDD at 6), he would have

made them of record at any of these times, in accordance with standard examination procedure. There is simply no support for Patent Owner's assertion that the only reasonable inference is that the Examiner considered these references. Rather, the most logical conclusion is that the Examiner did not consider Reinertsen and Rytter.

Second, Patent Owner speculates that the Examiner "distilled" the search results to identify 14 patent families. Patent Owner's RDD at 1, 6. However, the search report lists only 50 results and provides no evidence that the Examiner investigated family relationships. EX1002 at 141-42. De-duplicating and researching common ownership to compile 14 patent families would have required significant time, precluding substantive review of the references. Patent Owner relies on EX2006, which purports to identify 14 references by various criteria, but this exhibit was not prepared by the Examiner, is not part of the prosecution history, and is misleading. Patent Owner also fails to disclose how much time it or its attorneys spent performing this "distillation" or preparing the exhibit.

Third, the Examiner's practice in other cases is instructive. In a contemporaneous matter, the same Examiner listed search results he considered "relevant prior art" on the PTO-892 form, consistent with Office procedures. EX1030 at 7. This contrast further supports that the Examiner's failure to identify

Reinertsen or Rytter as relevant prior art while examining the '805 patent application means he did not consider these references.

In sum, Patent Owner has not reliably shown that Reinertsen and Rytter were “presented to the Office” under *Advanced Bionics*. At best, the Examiner’s search results allow for multiple factual inferences, but the *least* likely is that the Examiner considered Reinertsen and Rytter.

3. Kresnyak is Not Substantially the Same as Reinertsen or Rytter

Patent Owner contends that Reinertsen and Rytter are cumulative of U.S. Patent Pub. No. 2015/0141535 A1 (“Kresnyak”). EX2007. Specifically, Patent Owner asserts that the '805 patent’s cross-heating element-allegedly absent from Darde-US (*i.e.*, “a first endothermic reforming unit configured to be heated by a second autothermal reforming unit”) appears in Kresnyak, rendering Reinertsen and Rytter cumulative as to that element. Patent Owner’s RDD at 9. However, the Examiner never cited or discussed Kresnyak in the Office Action, Notice of Allowance, or any other communication of record.

If the Examiner had carefully reviewed Kresnyak and recognized any disclosure of the cross-heating element, as Patent Owner suggests, he would have addressed whether a motivation existed to combine Darde-US with Kresnyak for a § 103 rejection. The Examiner’s decision not to reject the claims based on a Darde-

Kresnyak combination, despite the strong grounds as explained in the Petition, confirms that Reinertsen and Rytter are not cumulative of Kresnyak. Alternatively, the Examiner either overlooked Kresnyak or failed to appreciate its teachings. In either scenario, the Board should now consider Reinertsen and Rytter.

Regardless of the Examiner's actions, Reinertsen and Rytter differ significantly from Kresnyak. The Board has held that denial under § 325(d) is improper when the petitioned art and previously cited references employ different structures for different purposes, and when the cited art addresses a problem closer to that of the challenged patent. *Oticon Medical AB v. Cochlear Ltd.*, IPR2019-00975, Paper 15 at 15-16 (P.T.A.B. Oct. 16, 2019) (precedential as to §§ II.B and II.C). Here, Reinertsen and Rytter, like the '805 patent and Darde, focus on efficient hydrogen production. EX1001, Title, Abstract; EX1007, Abstract; EX1005, EX1009, Abstract. These references, like the '805 patent, arrange unit operations to maximize hydrogen yield and enable CO₂ capture and handling.

In contrast, Kresnyak aims to produce hydrocarbon fuels by generating syngas with an improved carbon monoxide to hydrogen ratio for liquid fuels and valorizing by-products. EX2007, Abstract. Its process modifies the hydrocarbon production sequence, including the Fischer-Tropsch process, to maximize fuel efficiency—not hydrogen production.

The purposes of Reinertsen/Rytter and Kresnyak are incompatible. A process focused on hydrogen capture would not divert hydrogen from syngas to produce hydrocarbons via Fischer-Tropsch, as Kresnyak does. EX2007 at [0058]. Thus, Kresnyak's approach is unsuitable for the objectives of the '805 patent.

Because Kresnyak pursues a different objective, its teachings diverge from those of Reinertsen and Rytter and are not cumulative with respect to the '805 patent. The specific ATR-heated GHR architecture in Reinertsen and Rytter is distinct from Kresnyak's SMR/ATR heat-integration motif. Reinertsen and Rytter's GHR/ATR integration reduces reformer exit temperature and enables immediate water-gas shift (WGS), increasing hydrogen content in syngas with only moderate cooling. EX1005 at [0074]; EX1009 at 10:33-35. Kresnyak does not teach the advantage of optimizing a dual reformer process for WGS. In fact, Kresnyak discourages WGS in fuel production because CO is valuable for liquid fuel synthesis, and WGS would lower CO. EX2007 at [0053].

Reinertsen and Rytter also disclose features directly relevant to hydrogen production and CO₂ separation in the '805 patent, which Kresnyak lacks. For example, Reinertsen and Rytter describe gas stream compositions matching those in the '805 claims, intentionally depleting CO via WGS to produce a gas rich in hydrogen and CO₂ with minimal CO before hydrogen separation, demonstrating a hydrogen-first objective. EX1005 at [0077]. In contrast, Kresnyak targets a H₂:CO

ratio near 1:2 to maximize liquid hydrocarbon synthesis and thus avoids CO-consuming WGS processes. EX2007 at [0070], [0074].


Kresnyak addresses hydrogen production and CO₂ separation only as optional by-products of hydrocarbon production. It provides generic, optional CO₂ removal processes and does not, like Reinertsen and Rytter, contemplate cryogenic CO₂ separation. EX2007 at [0068], [0080].

In summary, Reinertsen and Rytter employ different structures and serve different purposes than Kresnyak, meeting the standard in *Oticon Medical AB*. Reinertsen and Rytter address the same problem as the '805 patent—efficient hydrogen production with CO₂ separation—while Kresnyak does not. Even where process elements overlap, their use and objectives differ. Thus, Reinertsen and Rytter are not substantially the same as Kresnyak.

B. Darde Was Not Presented

Patent Owner claims the Examiner “selected Darde as the most relevant reference.” Patent Owner’s RDD at 1. However, at the time of this “selection,” only two patent references were of record, both identified by Patent Owner. EX1002 at 153. Notably, the reference identified on the IDS was not Darde (EX1007), but rather Darde-US (EX2001). Patent Owner incorrectly asserts that no “meaningful differences” exist between Darde-US and Darde. In fact, Darde-US

omits Darde's sole figure, which is critical to understanding the arrangement of system components and the motivation to combine Darde with other art.


 US 20150321914A1

(19) **United States**
 (12) **Patent Application Publication** (10) **Pub. No.:** US 2015/0321914 A1
DARDE et al. (43) **Pub. Date:** Nov. 12, 2015

(54) **METHOD FOR PRODUCING HYDROGEN BY REFORMING HYDROCARBONS USING STEAM COMBINED WITH CARBON DIOXIDE CAPTURE AND STEAM PRODUCTION** (52) **U.S. CL.**
 CPC: *C01B 3/48* (2013.01); *B01J 19/245* (2013.01); *C01B 5/00* (2013.01); *B01J 22/1924* (2013.01); *B01J 22/19/00/03* (2013.01); *B01J 22/19/00/62* (2013.01); *C01B 2203/0233* (2013.01); *C01B 2203/0235* (2013.01); *C01B 2203/042* (2013.01); *C01B 2203/044* (2013.01); *C01B 2203/0473* (2013.01); *C01B 2203/0883* (2013.01)

(71) Applicant: **L'AIR LIQUIDE, SOCIÉTÉ ANONYME POUR L'ÉTUDE ET L'EXPLOITATION DES PROCÉDÉS GEORGES CLAUDE**, Paris (FR)

(72) Inventors: **Arthur DARDE**, Paris (FR); **Mathieu LECLERC**, Paris (FR); **Thomas MOREL**, Noney Le Grand (FR)

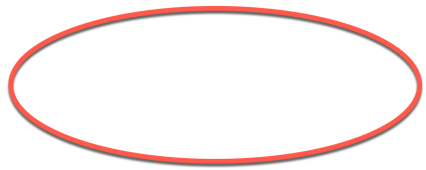
(21) Appl. No.: 14/651,122
 (22) PCT Filed: Oct. 31, 2013
 (86) PCT No.: PCT/FR2013/052613
 § 371 (c)(1), (2) Date: Jun. 10, 2015

(30) Foreign Application Priority Data
 Dec. 13, 2012 (FR) 1262002

Publication Classification

(51) **Int. Cl.**
C01B 3/48 (2006.01)
C01B 5/00 (2006.01)
B01J 19/24 (2006.01)

(57) **ABSTRACT**
 A method for producing hydrogen by reforming hydrocarbons using steam, combined with carbon dioxide capture and steam production, which involves mixing the hydrocarbons to be reformed with steam in order to produce a feedstock for reforming, generating a syngas; the syngas produced is cooled, enriched with H₂ and CO₂, and then cooled; the condensates of the method are separated from the syngas in order to be used in the method, the saturated syngas being treated by adsorption with pressure modulation so as to produce hydrogen and a gaseous effluent containing CO₂ that is captured in a CPU unit. The condensates from the cooling of the syngas at the outlet of the shift reactor are used in the method for producing impure steam supplying the mixing point; the CPU unit also produces CPU condensates that are recycled to be treated jointly with the condensates of the method.




Topsoe Inc. v. L'Air Liquide, SA
 IPR2025-01173 | L'Air EX2001
 Page 1 of 9

EX2001: Darde-US (annotated)

(12) DEMANDE INTERNATIONALE PUBLIÉE EN VERTU DU TRAITÉ DE COOPÉRATION EN MATIÈRE DE BREVETS (PCT)

(19) Organisation Mondiale de la Propriété Intellectuelle
 Bureau international


 (10) Numéro de publication internationale
WO 2014/091098 A1

(43) Date de la publication internationale
 19 juin 2014 (19.06.2014) **WIPO | PCT**

(51) Classification internationale des brevets :
C01B 3/48 (2006.01) *C01B 5/00* (2006.01)

(21) Numéro de la demande internationale : PCT/FR2013/052613

(22) Date de dépôt international : 31 octobre 2013 (31.10.2013)

(25) Langue de dépôt : français
 (26) Langue de publication : français

(30) Données relatives à la priorité :
 1262002 13 décembre 2012 (13.12.2012) FR

(71) Déposant : **L'AIR LIQUIDE, SOCIÉTÉ ANONYME POUR L'ÉTUDE ET L'EXPLOITATION DES PROCÉDÉS GEORGES CLAUDE** [FR;FR]; 75, Quai Jorisy, F-75007 Paris (FR)

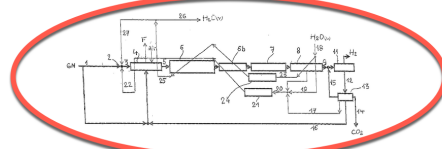
(72) Inventeurs : **DARDE, Arthur**; 32 boulevard Saint-Marcel, F-75005 Paris (FR); **LECLERC, Mathieu**; 7 rue des Orcaux, F-75020 Paris (FR); **MOREL, Thomas**; 28 rue Pierre Curie, F-94360 Bry sur Marne (FR)

(74) Mandataire : **CONAN, Philippe**; L'air Liquide S.A., 75, Quai d'Orsay, F-75007 Paris (FR)

(84) États désignés (sauf indication contraire, pour tout titre de protection régionale disponible) : AR, PO, BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SZ, TZ, UG, ZM, ZW, eurases (AM, AZ, BY, KG, KZ, RU, TJ, TM), eurapan (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LI, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BI, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG)

Déclarations en vertu de la règle 4.17 :
 — relative à la qualité d'inventeur (règle 4.17.a))
 Publiée :
 — avec rapport de recherche internationale (Art. 21(3))

(54) **Titre :** METHOD FOR PRODUCING HYDROGEN BY REFORMING HYDROCARBONS USING STEAM, COMBINED WITH CARBON DIOXIDE CAPTURE AND STEAM PRODUCTION
 (54) **Titre :** PROCÉDÉ POUR UNE PRODUCTION D'HYDROGÈNE PAR REFORMAGE D'HYDROCARBURES UTILISANT DE LA VAPEUR, ASSOCIÉ À UNE CAPTURE DE DIOXYDE DE CARBONE ET À UNE PRODUCTION DE VAPEUR



(57) **Abstract :** The present invention concerns a method for producing hydrogen by reforming hydrocarbons using steam, combined with carbon dioxide capture and steam production, which involves mixing the hydrocarbons to be reformed with steam in order to produce a feedstock for reforming, generating a synthesis gas (essentially H₂, CO, but also CO₂, excess steam, residual CH₄ and impurities); the synthesis gas produced is cooled, and enriched with H₂ and CO₂ by converting CO with steam; the enriched synthesis gas is cooled, the condensates of the method are separated from the synthesis gas in order to be used in the method, the saturated synthesis gas being treated by adsorption with pressure modulation so as to produce hydrogen and a gaseous effluent containing CO₂ that is captured in a CO₂-purifying CPU unit. The condensates from the cooling of the synthesis gas at the outlet of the shift reactor are used in the method for producing impure steam supplying the mixing point; the CPU unit also produces CPU condensates that are recycled to be treated jointly with the condensates of the method.

(57) **Abrégé :**

[Suite sur la page suivante]
 IPR2025-01173, Topsoe Ex. 1007
 Page 1 of 25

EX1007: Darde (annotated)

Without any figure, the Examiner could not have fully understood Darde-US or the arrangement of system components, nor would a POSA have been as motivated to combine Darde-US with other relevant art. Both Petitioner and Dr. Klein directly rely on Darde's sole figure to explain its teachings—something impossible with Darde-US. The absence of this figure materially affected the examination and allowance of the application, especially given the limited time the Examiner devoted to the file.

In any event, the record is clear: neither Darde nor Darde-US was considered in combination with Reinertsen or Rytter. Both Reinertsen and Rytter serve as primary references that disclose all or nearly all claim elements, including “a first endothermic reforming unit configured to be heated by a second autothermal reforming unit.” Even if the Examiner had considered Darde, the Examiner did not evaluate the dual reformer configuration taught by Reinertsen or Rytter in combination with Darde. Therefore, denial under § 325(d) is unwarranted. See *Oticon Medical AB*, IPR2019-00975, Paper 15 at 19.

In sum, the Examiner did not consider Reinertsen or Rytter, and these references are not cumulative of Kresnyak. The Examiner also did not consider Darde alone or in combination with Reinertsen and Rytter. Because the same art or arguments were not previously presented, *Advanced Bionics* part 1 is not satisfied.

III. *ADVANCED BIONICS* PART II IS NOT SATISFIED

Even if Patent Owner could satisfy the first prong of the § 325(d) test (which it cannot), the Examiner materially erred under the second prong by failing to substantively apply the Reinertsen and Rytter references to issue anticipation and obviousness rejections.

Procedurally, Patent Owner’s suggestion that Petitioner was required to show examiner error in the petition itself (Patent Owner’s RDD at 1, 10, citing *Advanced Bionics*) is not only incorrect, but directly contrary to the Office’s rules

and recent Director decisions. The Interim Director Discretionary Process is unequivocal: “A petitioner should raise any discretionary issues in its opposition to a patent owner’s discretionary denial brief The petition should not address discretionary issues.” *Interim Director Discretionary Process* § III.A. This is not a mere procedural preference—it is a requirement designed to ensure orderly and efficient resolution of discretionary issues. *Ecto World* confirms that a petitioner must explain material error with reference to *Becton Dickinson* factors (c), (e), and (f), but does not require that analysis in the petition. *Ecto World*, IPR2024-01280, Paper 13 at 4-6. In fact, the initial institution denial in *Ecto World* occurred before the then-Acting Director issued the Interim Processes for PTAB Workload Management establishing the discretionary denial briefing procedure. *See, Ecto World* (decided Mar. 6, 2025). Accordingly, Director decisions this year have accepted and relied on petitioners’ oppositions—not petitions—to find material error and withhold § 325(d) application. *See, Azurity Pharms., Inc.*, IPR2025-00945, Paper 11 at 2-3. Petitioner has properly followed the new procedure.

On substance, the record demonstrates material error under *Advanced Bionics*’ second part. The Examiner did not apply any prior art rejection and failed to consider, list, or apply Reinertsen or Rytter, primary references that (1) anticipate and/or (2) render obvious the claims with Darde. As recognized in *Ecto World*, a petitioner may show material error where the asserted prior art was not a

basis for rejection, is not substantially the same as art the examiner applied and includes specific teachings that affect patentability. *Ecto World*, IPR2024-01280, Paper 13 at 5, 8 n.9. This is precisely the case here: the Examiner’s failure to apply the most relevant art—Reinertsen and Rytter, which anticipate or render obvious the claims—constitutes material error.

Regarding the relevant *Becton Dickinson* factors for the second *Advanced Bionics* prong, the record contains no discussion of how the Examiner may have applied Reinertsen or Rytter (factor (c)). Patent Owner concedes that the Examiner allowed the claims without addressing Reinertsen or Rytter. This is a classic example of “overlooked” art that warrants review (factor (e)). And the Petition presents a compelling case that the ’805 patent claims are unpatentable, warranting reconsideration of any prior art or arguments already considered (factor (f)).

Patent Owner devotes much of its RDD to improperly arguing the merits of the Petition’s grounds. *See* Interim Director Discretionary Process, USPTO (Aug. 27, 2025) (“a patent owner should not treat a discretionary denial brief as an additional opportunity for merits briefing.”) To the extent the Board considers Patent Owner’s merits arguments, they only highlight the presence of complex legal and factual issues that compel institution of *inter partes* review.

As shown below, Patent Owner's merits challenge is unavailing and relies on incomplete and misleading characterizations of Reinertsen, Rytter, and Petitioner's arguments.

A. The Examiner Erred by Failing to Recognize That Reinertsen Anticipates the '805 Patent Claims

Patent Owner improperly interprets Reinertsen in a piecemeal manner, claiming it fails to disclose certain features of claim 1, such as hydrogen separation by PSA and cryogenic carbon dioxide separation. Patent Owner's RDD at 11. In reality, Reinertsen explicitly describes both alternatives: Figure 4 shows hydrogen separation using a Pd-membrane upstream of cryogenic CO₂ separation, and the specification states, "[e]mbodiments may alternatively use PSA to separate hydrogen from the gas output from the WGS reactor" (EX1005 at [0081], [0085]), with a clear preference for PSA: "[p]referably, the hydrogen separation process comprises a PSA process" (EX1005 at [0012]). These alternatives apply broadly to the invention, not just to a specific embodiment. For example, claim 7 of Reinertsen recites PSA generally for the claimed hydrogen production processes. EX1005 at 28. A POSA, viewing Reinertsen as a whole, would immediately recognize PSA separation as a suitable alternative to the Pd-membrane separation in Figure 4. See EX1003 at ¶¶146-148; *see also, Kennametal, Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376, 1381 (Fed. Cir. 2015) (a reference can anticipate

a claim even if it “d[oes] not expressly spell out’ all the limitations arranged or combined as in the claim” if the claimed arrangement or combination is readily apparent) (internal citations omitted). Reinertsen, when properly considered, clearly discloses every limitation of claim 1.

B. The Examiner Erred by Failing to Recognize the Reinertsen + Darde Combination for Obviousness

Patent Owner fails to provide evidence challenging the motivations to combine Reinertsen and Darde, instead characterizing them as “generic and circular” based on a misreading of Reinertsen that ignores its full disclosure.

Both Reinertsen and Darde address the same problem in the art: efficient hydrogen production with reduced CO₂ emissions. EX1005 at [0002]; EX1008 at 6:28-33. Each reference implements a combination of hydrogen separation and cryogenic CO₂ separation to generate hydrogen while capturing CO₂. EX1005 at [0012], [0101]-[0109]; EX1008 at 8:10-11.

Patent Owner concedes that both references disclose PSA for hydrogen separation but argues that Reinertsen does not specifically exemplify PSA upstream of cryogenic CO₂ separation. However, as explained above, explicit exemplification is not legally required, and this argument fails when considering Reinertsen with Darde.

A POSA would select PSA as one of two predictable options explicitly disclosed in Reinertsen, representing a choice from a finite set of well-known design alternatives to achieve the recognized goal of hydrogen production with reduced CO₂ emissions. EX1003 at ¶¶168-172. The art recognized that this configuration provides benefits from implementing hydrogen separation and carbon capture in gas reforming. EX1005 at [0012], [0101]-[0109]; EX1003 at ¶¶169, 228, 321. Darde, for example, expressly teaches PSA upstream of cryogenic CO₂ separation to reduce CO₂ emissions, providing clear motivation to adopt this configuration for efficient CO₂ capture. EX1008 at 8:10-11, 16:7. The Petition therefore demonstrates the obviousness of claim 1 over Reinertsen and Darde.

C. The Examiner Erred by Failing to Recognize the Rytter + Darde Combination for Obviousness

Patent Owner fails to provide any evidence challenging the motivations to combine Rytter and Darde. As demonstrated in the Petition, the teachings of these references, when considered together, render their combination obvious.

Rytter and Darde both implement known gas reforming and separation processes to produce hydrogen by gas reforming with reduced CO₂ emissions. EX1003 at ¶¶231-41; EX1009 at 3:17-18; EX1008 at 7:2-12.

Patent Owner acknowledges that both references disclose PSA hydrogen separation and cryogenic CO₂ separation but argues that Rytter does not

specifically exemplify PSA upstream of cryogenic CO₂ separation. As explained above, explicit exemplification is not required. Rytter, when properly interpreted in view of Darde, supports this configuration.

The separation processes and their order in Rytter present a finite set of six practical permutations for H₂/CO₂ separation from a shifted gas. EX1009 at 12:19-20, 20:6-10; EX1003 at ¶¶234-237. A POSA would select the sequence of H₂ and CO₂ separation processes and would be motivated to substitute hydrogen separation—specifically PSA upstream of CO₂ separation, as taught in Darde—into Rytter’s process. This choice represents one of a finite number of predictable solutions to achieve a residual gas with desirable CO₂ content and pressure for cryogenic CO₂ capture. EX1003 at ¶¶234-237. The art recognized the performance benefits of combining hydrogen separation and carbon capture in gas reforming, including the effectiveness of PSA for hydrogen separation and the advantages of dual reforming configurations (e.g., GHR and ATR) with hydrogen separation and cryogenic CO₂ separation. EX1003 at ¶¶169-170, 228, 321. The Petition demonstrates the obviousness of claim 1 over Rytter and Darde.

IV. CONCLUSION

For these reasons, discretionary denial is not appropriate, and the Petition should be referred to the Board for consideration on the merits.

Respectfully submitted,

The logo for Leydig, featuring the word "Leydig" in a bold, sans-serif font. The letter "i" in "Leydig" has a small blue star above it.

/Aaron R. Feigelson/

Aaron R. Feigelson, Reg. No. 59,022

Leydig, Voit & Mayer, Ltd.

Two Prudential Plaza, Suite 4900

180 North Stetson Avenue

Chicago, Illinois 60601-6745

Telephone: (312) 616-5600

Facsimile: (312) 616-5700

Email: afeigelson@leydig.com

Date: October 9, 2025

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6(e), I certify that on this 9th day of October, 2025, a true and correct copy of the foregoing **PETITIONER’S RESPONSE TO PATENT OWNER’S REQUEST FOR DISCRETIONARY DENIAL OF INSTITUTION** was served by electronic mail on Patent Owner’s lead and backup counsel at the following email addresses:

Eagle H. Robinson
eagle.robinson@nortonrosefulbright.com

Chad Wallis
chad.wallis@nortonrosefulbright.com

Allen E. White
allen.white@airliquide.com

Justin K. Murray
justin.murray@airliquide.com

Date: October 9, 2025

/Aaron R. Feigelson/
Aaron R. Feigelson, Reg. No. 59,022