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Table with 5 columns: APPLICATION NO., FILING DATE, FIRST NAMED INVENTOR, ATTORNEY DOCKET NO., CONFIRMATION NO.
Row 1: 16/682,781, 11/13/2019, Seung Hyeon CHOI, 15438-878, 9318
Row 2: 43850, 7590, 06/30/2022, EXAMINER IQBAL, SYED TAHA
Row 3: Morgan, Lewis & Bockius LLP (SF), ART UNIT 1736, PAPER NUMBER
Row 4: One Market, Spear Street Tower, Suite 2800, NOTIFICATION DATE 06/30/2022, DELIVERY MODE ELECTRONIC
Row 5: San Francisco, CA 94105

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

donald.mixon@morganlewis.com
sfipdocketing@morganlewis.com

**Office Action Summary**

**Application No.**

16/682,781

**Applicant(s)**

CHOI et al.

**Examiner**

SYED T IQBAL

**Art Unit**

1736

**AIA (FITF) Status**

Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)  Responsive to communication(s) filed on 04/18/2022.

A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on \_\_\_\_\_.

2a)  This action is **FINAL**.

2b)  This action is non-final.

3)  An election was made by the applicant in response to a restriction requirement set forth during the interview on \_\_\_\_\_; the restriction requirement and election have been incorporated into this action.

4)  Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims\***

5)  Claim(s) 1-19 is/are pending in the application.

5a) Of the above claim(s) 9-19 is/are withdrawn from consideration.

6)  Claim(s) \_\_\_\_\_ is/are allowed.

7)  Claim(s) 1-8 is/are rejected.

8)  Claim(s) \_\_\_\_\_ is/are objected to.

9)  Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement

\* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see [http://www.uspto.gov/patents/init\\_events/pph/index.jsp](http://www.uspto.gov/patents/init_events/pph/index.jsp) or send an inquiry to [PPHfeedback@uspto.gov](mailto:PPHfeedback@uspto.gov).

**Application Papers**

10)  The specification is objected to by the Examiner.

11)  The drawing(s) filed on 11/13/2019 is/are: a)  accepted or b)  objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

**Priority under 35 U.S.C. § 119**

12)  Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

**Certified copies:**

a)  All    b)  Some\*\*    c)  None of the:

1.  Certified copies of the priority documents have been received.

2.  Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.

3.  Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\*\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1)  Notice of References Cited (PTO-892)

3)  Interview Summary (PTO-413)

Paper No(s)/Mail Date \_\_\_\_\_.

2)  Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b)

4)  Other: \_\_\_\_\_.

Paper No(s)/Mail Date \_\_\_\_\_.

## **DETAILED ACTION**

### ***Notice of Pre-AIA or AIA Status***

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

### ***Election/Restrictions***

Claims 9-19 have been withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected invention, there being no allowable generic or linking claim. Applicant timely traversed the restriction (election) requirement in the reply filed on 04/18/2022.

Applicant argues that there is no serious burden because the claims are drawn to related inventions. Applicant further points out shared or common features between the two sets of claims.

However, this is not a 371 national stage case. The restriction under 35 U.S.C. 121 is proper because the inventions are distinct. The apparatus claims 1-8 cannot be limited by the function or the article worked upon by the apparatus (MPEP §2115). The apparatus and process inventions are distinct because the apparatus as claimed can be used to practice another and materially different process as discussed (MPEP §806.05 (e)).

The restriction requirement is still deemed proper and is therefore made FINAL.

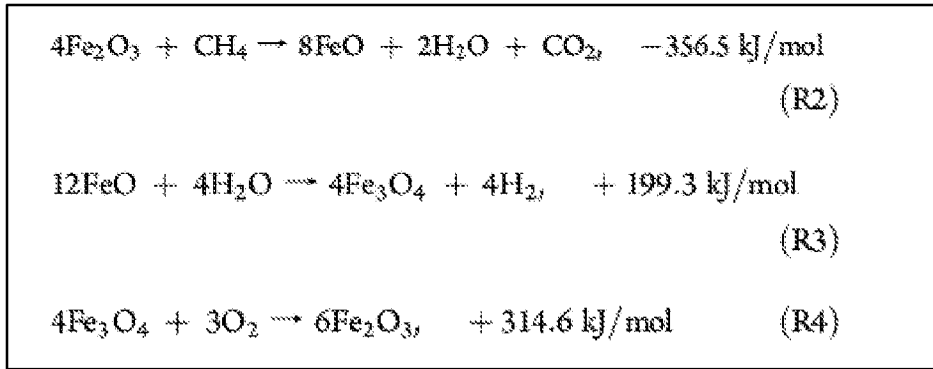
***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

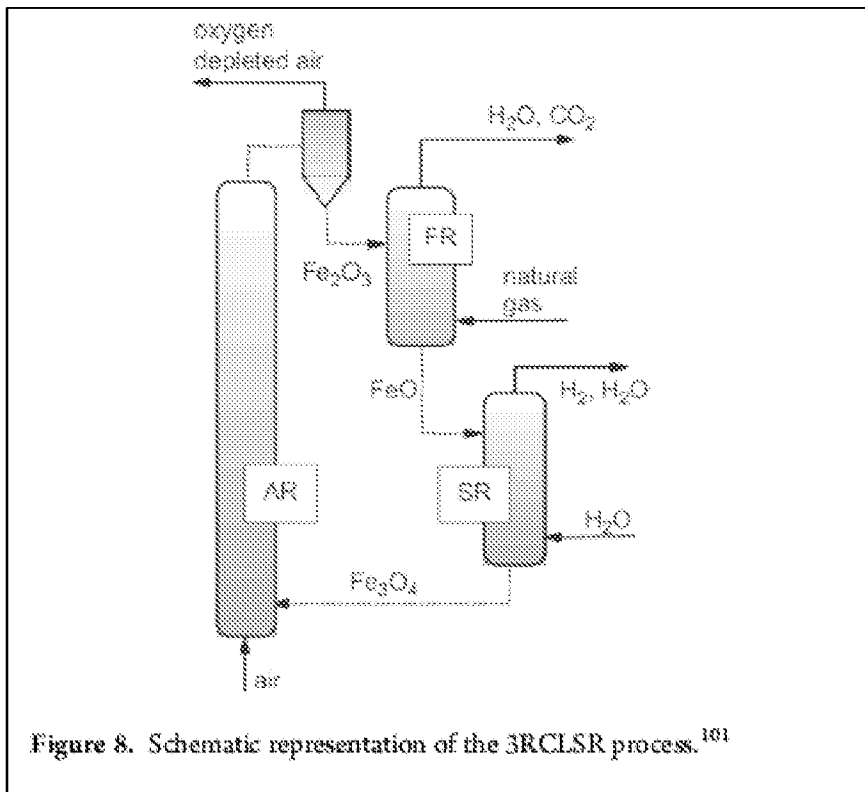
A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

**Claim(s) 1-8 is/are rejected under 35 U.S.C. 103 as being unpatentable over Moghtaderi "Review of the Recent Chemical Looping Process Developments...", in view of Golden et al. US 2002/0058169.**

The Moghtaderi reference shows an array of chemical looping based process concepts (Abstract). The reference shows a reforming system and process that uses a three reactor setup as shown in Fig. 8 and is referred to as "3RCLSR" (three-reactor chemical looping steam reforming process (Pg. 10, left column, last para). In the 3RCLSR process, the oxygen-rich hematite ( $\text{Fe}_2\text{O}_3$ ) is first reduced to wustite ( $\text{FeO}$ ) by oxidizing the natural gas in the fuel reactor (FR) according to the endothermic reaction represented by reaction R2. The wustite is then fed into the steam reactor, while the  $\text{CO}_2$  content of the flue gas is taken for storage after water condensation. The exothermic reaction R3 between wustite and steam in the steam reactor (SR) forms magnetite ( $\text{Fe}_3\text{O}_4$ ) and hydrogen, of which the latter represents the main product of the 3RCLSR process (Pg. 10, left column, last para-right column first para). The magnetite particles are then taken to the air reactor (AR), where they are oxidized and regenerated to the hematite state (reaction R4). The following reactions are referred:



Regarding claim 1, the reference of Moghtaderi shows the configuration of the system as follows:



This Fig showcases a fuel reactor (FR) that receives  $\text{Fe}_2\text{O}_3$  into  $\text{FeO}$  using natural gas. This reactor is considered as a first reactor. The  $\text{FeO}$  is combined with  $\text{H}_2\text{O}$  in the steam reactor (SR). This is considered to be the second reactor. Regarding the concentration of  $\text{H}_2$ , the article worked upon does not limit the structure of the device

(MPEP §2115). This is also true for the composition of the byproduct gas. Similarly, the functional language such as "for reforming", "for separating" and "for reducing" etc. is not considered as limiting in a device claim. See MPEP §2114 II "[A]pparatus claims cover what a device is, not what a device does."

The difference between Moghtaderi and instant claim 1 is a reformer and a separator upstream of the first reactor.

Golden teaches a method and system for producing a hydrogen rich fuel (Abstract). The reference teaches a reformer which produces a hydrogen comprising mixed stream from a hydrocarbon feed and steam. This mixed stream comprises  $\text{CH}_4$  and is separated in a PSA where  $\text{H}_2$  is recovered (Para [0021]).

At the time of filing it would have been obvious for a person of ordinary level of skill in the art to use the reformer and PSA of Golden to generate and separate out the  $\text{CH}_4$  stream required for the system in Fig. 8 of Moghtaderi. One would be motivated to do so to because the reformer of Golden generates a mixed stream of hydrogen and methane. The PSA isolates the hydrogen from the methane.

Regarding claim 2, the Moghtaderi reference teaches a third reactor which converts  $\text{Fe}_3\text{O}_4$  to  $\text{Fe}_2\text{O}_3$  using air (oxygen). See Fig. 8, attached above, with reactor AR. The figure also shows an oxygen depleted air stream exiting the system.

Regarding claim 3, the operating conditions, during the use of the device, do not limit the structure of the device itself (MPEP §2114 II).

Regarding claim 4, the Golden reference teaches a PSA as a separator [0021].

Regarding claim 5, the origin of the steam is considered non limiting to the structure of the device. The claim language does not require a direct stream from the first reactor to the second reactor for transporting steam.

Regarding claims 6-8, the composition of the byproduct gas is not considered to limit the structure of the device. A claim is only limited by positively recited elements. Thus, "[i]nclusion of the material or article worked upon by a structure being claimed does not impart patentability to the claims." See MPEP §2115.

### ***Relevant Prior Art***

US 2001/0055559 teaches a process and system for producing hydrogen using cyclic metal oxide reduction and oxidation (Abstract and Para [0062]). The reference shows Fig. 1 with three reaction zones for hydrogen production with cyclic reduction/oxidation of an oxygen carrier such as Fe<sub>2</sub>O<sub>3</sub> (See Table 1 and [0059]-[0061]).

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to SYED TAHA IQBAL whose telephone number is (571)270-5857. The examiner can normally be reached M-F; 7-5.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an

interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at <http://www.uspto.gov/interviewpractice>.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Keith Walker can be reached on (571) 272-3458. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: <https://patentcenter.uspto.gov>. Visit <https://www.uspto.gov/patents/apply/patent-center> for more information about Patent Center and <https://www.uspto.gov/patents/docx> for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/SYED T IQBAL/  
Examiner, Art Unit 1736

/STEVEN J BOS/  
Primary Examiner, Art Unit 1736

<b>Notice of References Cited</b>	Application/Control No. 16/682,781	Applicant(s)/Patent Under Reexamination CHOI et al.	
	Examiner SYED T IQBAL	Art Unit 1736	Page 1 of 1

**U.S. PATENT DOCUMENTS**

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20020058169-A1	05-2002	Golden, Timothy Christopher	H01M8/0668	423/650
*	B	US-20010055559-A1	12-2001	Sanfilippo, Domenico	C01B3/386	423/652
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					


**FOREIGN PATENT DOCUMENTS**

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

**NON-PATENT DOCUMENTS**

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	Moghtaderi, "Review of the Recent Chemical Looping Process Developments for Novel Energy and Fuel Applications" Energy Fuels 2012, 26, 15-40 (Year: 2012)
	V	
	W	
	X	

\*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)  
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

<b>Search Notes</b> 	<b>Application/Control No.</b> 16/682,781	<b>Applicant(s)/Patent Under Reexamination</b> CHOI et al.
	<b>Examiner</b> SYED T IQBAL	<b>Art Unit</b> 1736

CPC - Searched*		
Symbol	Date	Examiner
C01B3/063 OR B01D53/047 OR B01J19/245 OR C01B3/34 OR C01B3/56 OR B01D2256/16 OR B01D2257/502 OR B01D2257/7025 OR C01B2203/0216 OR C01B2203/043 OR C01B2203/1241 OR C01B2203/14 OR C21B2100/22 OR Y02C20/20 OR Y02E60/36 OR C01B3/061 OR C01B2203/0233 OR C01B3/045 OR C01B3/50 OR C01B2203/0205 OR C01B3/40 OR B01J23/94 OR C01B2203/042 OR C01B2203/1047 OR C01B2203/1205 OR C01B2203/148 OR Y02P20/52 OR Y02P20/584	06/18/2022	Syed Iqbal


CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

\* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
class subclass search	06/18/2022	Syed Iqbal
inventor name search	06/18/2022	Syed Iqbal
iq.ip.com	06/18/2022	Syed Iqbal
EPO JPO and Derwent searched	06/18/2022	Syed Iqbal
Google Patents and Google Scholar searched	06/18/2022	Syed Iqbal

/SYED T IQBAL/ Examiner, Art Unit 1736	
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<b><i>Search Notes</i></b> 	<b>Application/Control No.</b> 16/682,781	<b>Applicant(s)/Patent Under Reexamination</b> CHOI et al.
	<b>Examiner</b> SYED T IQBAL	<b>Art Unit</b> 1736

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/SYED T IQBAL/ Examiner, Art Unit 1736	
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CERTIFICATE OF EFS FILING UNDER 37 CFR §1.8

I hereby certify that this correspondence is being electronically transmitted to the United States Patent and Trademark Office, Commissioner for Patents, via the EFS pursuant to 37 CFR §1.8 on the below date:

Date: July 30, 2020 Name: Scott W. Brim (Reg. No. 51,500) Signature: /Scott W. Brim/



<b>SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b> (Not for submission under 37 CFR 1.99)	Application Number	16/682,781
	Filing Date	November 13, 2019
	First Named Inventor	Seung Hyeon CHOI et al.
	Title	SYSTEM AND METHOD FOR PRODUCING HYDROGEN USING BY PRODUCT GAS
	Art Unit	1736
	Confirmation Number	9318
	Examiner Name	Syed Taha Iqbal
Attorney Docket No.	15438-878	

In accordance with the duty of disclosure, Applicant(s) hereby cites the following references:

**FOREIGN PATENT REFERENCES**

EXAMINER INITIAL		DOCUMENT NUMBER <small>Number-Kind Code (if known)</small>	DATE	COUNTRY	TRANSLATION YES OR NO
	A1	1093822	01/20/1981	CA	
	A2	2002-212575 A	07/31/2002	JP	Abstract
	A3	10-1386418 B1	04/21/2014	KR	Abstract

**OTHER ART – NON PATENT LITERATURE DOCUMENTS**

EXAMINER INITIAL	Include name of author, title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	
A4	European Extended Search Report issued on April 30, 2020 from the corresponding European Application No. 19209091, 7 pp.	
A5	Wei-Hsin Chen et al., "Hydrogen production from steam reforming of coke oven gas and its utility for indirect reduction of iron oxides in blast furnace", International Journal of Hydrogen Energy, Elsevier Science Publishers B.V., Barking, GB, vol. 37, no. 16, May 6, 2020, pages 11748-11758, XP028405616 [retrieved on May 11, 2012].	
A6	Wei-Hsin Chen et al., "Thermodynamic analysis of the partial oxidation of coke oven gas for indirect reduction of iron oxides in a blast furnace", Energy, Elsevier, Amsterdam, NL, vol. 86, May 28, 2015, pages 758-771, XP029225453.	

**1. PRIORITY INFORMATION:**

This application claims priority under 35 USC §120 to the following United States patent application(s): \_\_\_\_\_. In accordance with 37 CFR §1.98(d), copies of the references cited herein which were submitted to, or cited by, the office, in compliance with 37 CFR §1.98(a)-(c) in the earlier application are not provided herewith. The Examiner is directed to those references cited in all Information Disclosure Statements filed in the priority United States patent application(s) cited above in addition to the references cited herein.

**2. CERTIFICATIONS: (CHECK ALL THAT APPLY)**

**A. Certifications For 37 CFR §1.97(c) or 37 CFR §1.97(d):**

Applicant hereby certifies pursuant to 37 CFR §1.97(e)(1) that each item of information in this Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this Information Disclosure Statement.

Examiner Signature	<u>/SYED T IQBAL/</u>	Date Considered	<u>06/18/2022</u>
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Information Disclosure Statement

Application No. 16/682,781

Attorney Docket No. 15438-878

Applicant hereby certifies pursuant to 37 CFR §1.97(e)(2) that no item of information contained in this Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the undersigned after making reasonable inquiry, no item of information contained in this Statement was known to any individual designated in 37 CFR §1.56(c), more than three months prior to the filing of this Information Disclosure Statement.

**B. For Patent Term Adjustment Purposes:**

For purposes of 37 CFR §1.704(d)(i) or 37 CFR §1.704(d)(ii), Applicant is hereby submitting concurrently with this Information Disclosure Statement a completed Form PTO/SB/133 that certifies that each item of information contained in this Information Disclosure Statement was first cited in any communication from a patent office in a counterpart foreign or international application or from the Office or is a communication that was issued by a patent office in a counterpart foreign or international application or by the Office, and that this communication was not received by any individual designated in 37 CFR §1.56(c) more than thirty days prior to the filing of this Information Disclosure Statement.

**3. FEE INFORMATION: (CHECK IF FEE REQUIRED)**

Applicant has calculated a processing fee in the amount of \_\_\_\_\_ to be due under 37 CFR §1.17(p) in connection with the filing of this Information Disclosure Statement. Applicant authorizes charging the fee to Deposit Account 23-1925.

The Director is hereby authorized to charge any fee deficiency associated with the filing of this Information Disclosure Statement to Deposit Account 23-1925.

Pursuant to the undersigned attorney's obligation and duties under 37 CFR §§ 1.56 and 1.98(a)(3) and (c), either English language abstracts, partial translations, or full translations are included for patent documents which are not in English for the express purpose of providing a concise explanation of the references to the Patent and Trademark Office with the opportunity to evaluate the same. Applicant respectfully requests the Examiner's consideration of the above reference(s) and entry thereof into the record of this application.

By submitting this Statement, Applicant is attempting to fully comply with the duty of candor and good faith mandated by 37 CFR §1.56. As such, this Statement is not intended to constitute an admission that any of the enclosed references, or other information referred to therein, constitutes "prior art" or is otherwise "material to patentability," as that phrase is defined in 37 CFR §1.56(a).

Respectfully submitted,

July 30, 2020 \_\_\_\_\_  
Date

/Scott W. Brim/  
\_\_\_\_\_  
Scott W. Brim (Reg. No. 51,500)

Examiner Signature	/SYED T IQBAL/	Date Considered	06/18/2022
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# Web Search History

date, time	web site	search string
6/12/2022 10:50:03 PM	Google Patents (old)	reformer ferric oxide reduction oxidation hydrogen concentration
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6/12/2022 10:50:10 PM	Google Scholar	reformer ferric oxide reduction oxidation hydrogen concentration
6/12/2022 11:11:29 PM	Google Patents (old)	reformer syngas ferric oxide reduction oxidation hydrogen concentration
6/12/2022 11:11:29 PM	Google	reformer syngas ferric oxide reduction oxidation hydrogen concentration
6/12/2022 11:11:55 PM	Google Scholar	reformer syngas ferric oxide reduction oxidation hydrogen concentration
6/14/2022 12:29:58 AM	Google Patents (old)	reformer syngas reducing ferric oxide oxidize ferrous oxide with oxygen
6/14/2022 12:29:58 AM	Google	reformer syngas reducing ferric oxide oxidize ferrous oxide with oxygen
6/14/2022 9:24:23 PM	Google Scholar	reformer syngas reducing ferric oxide oxidize ferrous oxide with oxygen
6/15/2022 4:32:31 PM	Google Patents (old)	steam reformer loop with psa FeO
6/16/2022 11:29:30 PM	Google Patents (old)	steam reformer h2 psa Fe2O3 reducer FeO oxidation O2 Fe3O4
6/16/2022 11:29:30 PM	Google	steam reformer h2 psa Fe2O3 reducer FeO oxidation O2 Fe3O4
6/16/2022 11:29:38 PM	Google Scholar	steam reformer h2 psa Fe2O3 reducer FeO oxidation O2 Fe3O4
6/17/2022 5:38:32 PM	Google Patents	<b>Keyword Group 1</b> [reformer producing methane and psa h2 separation]
6/17/2022 5:41:48 PM	Google Patents	<b>Keyword Group 1</b> [making methane steel making byproduct gas]
6/17/2022 11:13:02 PM	Google Patents (old)	3RCLSR
6/17/2022 11:13:09 PM	Google Patents	<b>Keyword Group 1</b> [3RCLSR]
6/17/2022 11:13:19 PM	Google Scholar	3RCLSR with PSA and steam reformer
6/17/2022 11:17:55 PM	Google Patents	<b>Keyword Group 1</b> [methane production reformer and PSA separation]

<b>date, time</b>	<b>web site</b>	<b>search string</b>
6/17/2022 11:33:51 PM	Google Patents	<b>Keyword Group 1</b> [methane generation reformer and PSA separation]
6/17/2022 11:34:36 PM	Google Patents	<b>Keyword Group 1</b> [methane generation reformer]

CERTIFICATE OF EFS FILING UNDER 37 CFR §1.8

I hereby certify that this correspondence is being electronically transmitted to the United States Patent and Trademark Office, Commissioner for Patents, via the EFS pursuant to 37 CFR §1.8 on the below date:

Date: November 13, 2019 Name: Robert D. Shereda, Ph.D. (Reg. No. 72,408) Signature: /Robert D. Shereda/



<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b> (Not for submission under 37 CFR 1.99)	Application Number	TBA
	Filing Date	Herewith
	First Named Inventor	Seung Hyeon CHOI et al.
	Art Unit	TBA
	Confirmation Number	TBA
	Examiner Name	TBA
	Attorney Docket No.	15438-878

In accordance with the duty of disclosure, Applicant(s) hereby cites the following references:

**US PATENT REFERENCES**

EXAMINER INITIAL	DOCUMENT NUMBER <small>Number-Kind Code (if known)</small>	DATE	NAME
	A1		

**FOREIGN PATENT REFERENCES**

EXAMINER INITIAL	DOCUMENT NUMBER <small>Number-Kind Code (if known)</small>	DATE	COUNTRY	TRANSLATION YES OR NO
	KR 20160066623 (A)	06/13/2016	KR	Abstract

**OTHER ART – NON PATENT LITERATURE DOCUMENTS**

EXAMINER INITIAL	Include name of author, title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.
	A3

**1. PRIORITY INFORMATION:**

- This application claims priority under 35 USC §120 to the following United States patent application(s): [INSERT SERIAL NO. OR BLANK]. In accordance with 37 CFR §1.98(d), copies of the references cited herein which were submitted to, or cited by, the office, in compliance with 37 CFR §1.98(a)-(c) in the earlier application are not provided herewith. The Examiner is directed to those references cited in all Information Disclosure Statements filed in the priority United States patent application(s) cited above in addition to the references cited herein.

**2. CERTIFICATIONS: (CHECK ALL THAT APPLY)**

**A. Certifications For 37 CFR §1.97(c) or 37 CFR §1.97(d):**

- Applicant hereby certifies pursuant to 37 CFR §1.97(e)(1) that each item of information in this Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this Information Disclosure Statement.
- Applicant hereby certifies pursuant to 37 CFR §1.97(e)(2) that no item of information contained in this Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the undersigned after making reasonable inquiry, no item of information contained in this Statement was known to any individual designated in 37 CFR §1.56(c), more than three months prior to the filing of this Information Disclosure Statement.

Examiner Signature	/SYED T IQBAL/	Date Considered	06/18/2022
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Information Disclosure Statement

Application No.

Attorney Docket No.

**B. For Patent Term Adjustment Purposes:**

For purposes of 37 CFR §1.704(d)(i) or 37 CFR §1.704(d)(ii), Applicant is hereby submitting concurrently with this Information Disclosure Statement a completed Form PTO/SB/133 that certifies that each item of information contained in this Information Disclosure Statement was first cited in any communication from a patent office in a counterpart foreign or international application or from the Office or is a communication that was issued by a patent office in a counterpart foreign or international application or by the Office, and that this communication was not received by any individual designated in 37 CFR §1.56(c) more than thirty days prior to the filing of this Information Disclosure Statement.

**3. FEE INFORMATION: (CHECK IF FEE REQUIRED)**

Applicant has calculated a processing fee in the amount of \_\_\_\_\_ to be due under 37 CFR §1.17(p) in connection with the filing of this Information Disclosure Statement. Applicant authorizes charging the fee to Deposit Account 23-1925.

The Director is hereby authorized to charge any fee deficiency associated with the filing of this Information Disclosure Statement to Deposit Account 23-1925.

Pursuant to the undersigned attorney's obligation and duties under 37 CFR §§ 1.56 and 1.98(a)(3) and (c), either English language abstracts, partial translations, or full translations are included for patent documents which are not in English for the express purpose of providing a concise explanation of the references to the Patent and Trademark Office with the opportunity to evaluate the same. Applicant respectfully requests the Examiner's consideration of the above reference(s) and entry thereof into the record of this application.

By submitting this Statement, Applicant is attempting to fully comply with the duty of candor and good faith mandated by 37 CFR §1.56. As such, this Statement is not intended to constitute an admission that any of the enclosed references, or other information referred to therein, constitutes "prior art" or is otherwise "material to patentability," as that phrase is defined in 37 CFR §1.56(a).

Respectfully submitted,

November 13, 2019  
Date

/Robert D. Shereda/  
Robert D. Shereda, Ph.D.  
(Reg. No. 72,408)

Examiner Signature	/SYED T IQBAL/	Date Considered	06/18/2022
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PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	98	((CHOI-Seung-Hyeon) (LEE-Kyung-Moon) (PARK-Jung-Joo) (PARK-Hoon-Mo) (HAN-Gwang-Woo) (BAE-Joong-Myeon) (OH-Ji-Woo)).inv.	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/12 10:48 PM
L2	1	((CHOI-Seung-Hyeon) (LEE-Kyung-Moon) (PARK-Jung-Joo) (PARK-Hoon-Mo) (HAN-Gwang-Woo) (BAE-Joong-Myeon) (OH-Ji-Woo)).inv. AND ((ferrous iron ferric) ADJ oxide)	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/13 11:26 PM
L3	22	((CHOI-Seung-Hyeon) (LEE-Kyung-Moon) (PARK-Jung-Joo) (PARK-Hoon-Mo) (HAN-Gwang-Woo) (BAE-Joong-Myeon) (OH-Ji-Woo)).inv. AND reform\$4	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/14 12:40 AM
L4	4	((CHOI-Seung-Hyeon) (LEE-Kyung-Moon) (PARK-Jung-Joo) (PARK-Hoon-Mo) (HAN-Gwang-Woo) (BAE-Joong-Myeon) (OH-Ji-Woo)).inv. AND reform\$4 AND (third WITH (reactor unit))	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/14 01:06 AM
L5	543	(C01B3/063 OR B01D53/047 OR B01J19/245 OR C01B3/34 OR C01B3/56 OR B01D2256/16 OR B01D2257/502 OR B01D2257/7025 OR C01B2203/0216 OR C01B2203/043 OR C01B2203/1241 OR C01B2203/14 OR C21B2100/22 OR Y02C20/20 OR Y02E60/36 OR C01B3/061 OR C01B2203/0233 OR C01B3/045 OR C01B3/50 OR	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/14 08:31 AM

L6	25	<p>C01B2203/0205 OR  C01B3/40 OR  B01J23/94 OR  C01B2203/042 OR  C01B2203/1047 OR  C01B2203/1205 OR  C01B2203/148 OR  Y02P20/52 OR  Y02P20/584).cpc. AND  (reform\$3) AND (third  WITH (unit reactor  reformer)) AND (oxide  WITH (ferrous ferric  iron))</p> <p>(C01B3/063 OR  B01D53/047 OR  B01J19/245 OR  C01B3/34 OR  C01B3/56 OR  B01D2256/16 OR  B01D2257/502 OR  B01D2257/7025 OR  C01B2203/0216 OR  C01B2203/043 OR  C01B2203/1241 OR  C01B2203/14 OR  C21B2100/22 OR  Y02C20/20 OR  Y02E60/36 OR  C01B3/061 OR  C01B2203/0233 OR  C01B3/045 OR  C01B3/50 OR  C01B2203/0205 OR  C01B3/40 OR  B01J23/94 OR  C01B2203/042 OR  C01B2203/1047 OR  C01B2203/1205 OR  C01B2203/148 OR  Y02P20/52 OR  Y02P20/584).cpc. AND  (reform\$3) AND (third  WITH (unit reactor  reformer)) SAME (oxide  WITH (ferrous ferric  iron) SAME (oxygen  o.sub.2))</p>	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/14 11:10 AM
L7	25	<p>(C01B3/063 OR  B01D53/047 OR  B01J19/245 OR  C01B3/34 OR  C01B3/56 OR  B01D2256/16 OR  B01D2257/502 OR  B01D2257/7025 OR  C01B2203/0216 OR</p>	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/14 11:10 AM

L8	0	<p>C01B2203/043 OR  C01B2203/1241 OR  C01B2203/14 OR  C21B2100/22 OR  Y02C20/20 OR  Y02E60/36 OR  C01B3/061 OR  C01B2203/0233 OR  C01B3/045 OR  C01B3/50 OR  C01B2203/0205 OR  C01B3/40 OR  B01J23/94 OR  C01B2203/042 OR  C01B2203/1047 OR  C01B2203/1205 OR  C01B2203/148 OR  Y02P20/52 OR  Y02P20/584).cpc. AND  (reform\$3) AND ((third  WITH (unit reactor  reformer)) SAME (oxide  WITH (ferrous ferric  iron) SAME (oxygen  o.sub.2)))</p> <p>(C01B3/063 OR  B01D53/047 OR  B01J19/245 OR  C01B3/34 OR  C01B3/56 OR  B01D2256/16 OR  B01D2257/502 OR  B01D2257/7025 OR  C01B2203/0216 OR  C01B2203/043 OR  C01B2203/1241 OR  C01B2203/14 OR  C21B2100/22 OR  Y02C20/20 OR  Y02E60/36 OR  C01B3/061 OR  C01B2203/0233 OR  C01B3/045 OR  C01B3/50 OR  C01B2203/0205 OR  C01B3/40 OR  B01J23/94 OR  C01B2203/042 OR  C01B2203/1047 OR  C01B2203/1205 OR  C01B2203/148 OR  Y02P20/52 OR  Y02P20/584).cpc. AND  (reform\$3) AND ((third  WITH (unit reactor  reformer)) SAME (oxide  WITH (ferrous ferric  iron) SAME (oxygen</p>	(EPO; JPO; DERWENT)	OR	ON	ON	2022/06/14 11:10 AM
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L9	1	o.sub.2))) "7767191"	(EPO; JPO; DERWENT)	OR	ON	ON	2022/06/14 12:01 PM
L10	45	"7767191"	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/14 12:02 PM
L11	3	((US-20120171588-A1 OR US-20120159841- A1).did. AND PGPB.dbnm.) OR ((US- 7767191-B2).did. AND USPT.dbnm.)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 09:06 PM
L12	1721	(C01B3/063 OR B01D53/047 OR B01J19/245 OR C01B3/34 OR C01B3/56 OR B01D2256/16 OR B01D2257/502 OR B01D2257/7025 OR C01B2203/0216 OR C01B2203/043 OR C01B2203/1241 OR C01B2203/14 OR C21B2100/22 OR Y02C20/20 OR Y02E60/36 OR C01B3/061 OR C01B2203/0233 OR C01B3/045 OR C01B3/50 OR C01B2203/0205 OR C01B3/40 OR B01J23/94 OR C01B2203/042 OR C01B2203/1047 OR C01B2203/1205 OR C01B2203/148 OR Y02P20/52 OR Y02P20/584).cpc. AND (reform\$3) AND ((methane natural reducer reducing) SAME (scrub\$4 separat\$4)) AND ((oxide WITH (ferrous ferric iron)) (FeO Fe.sub.2O.sub.3	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/15 10:22 AM

L13	1210	<p>Fe.sub.3O.sub.4))  (C01B3/063 OR  B01D53/047 OR  B01J19/245 OR  C01B3/34 OR  C01B3/56 OR  B01D2256/16 OR  B01D2257/502 OR  B01D2257/7025 OR  C01B2203/0216 OR  C01B2203/043 OR  C01B2203/1241 OR  C01B2203/14 OR  C21B2100/22 OR  Y02C20/20 OR  Y02E60/36 OR  C01B3/061 OR  C01B2203/0233 OR  C01B3/045 OR  C01B3/50 OR  C01B2203/0205 OR  C01B3/40 OR  B01J23/94 OR  C01B2203/042 OR  C01B2203/1047 OR  C01B2203/1205 OR  C01B2203/148 OR  Y02P20/52 OR  Y02P20/584).cpc. AND  (reform\$3) same2  ((methane natural  reducer reducing)  SAME (scrub\$4  separat\$4)) AND  ((oxide WITH (ferrous  ferric iron)) (FeO  Fe.sub.2O.sub.3  Fe.sub.3O.sub.4))</p>	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/15 11:29 AM
L14	1210	<p>(C01B3/063 OR  B01D53/047 OR  B01J19/245 OR  C01B3/34 OR  C01B3/56 OR  B01D2256/16 OR  B01D2257/502 OR  B01D2257/7025 OR  C01B2203/0216 OR  C01B2203/043 OR  C01B2203/1241 OR  C01B2203/14 OR  C21B2100/22 OR  Y02C20/20 OR  Y02E60/36 OR  C01B3/061 OR  C01B2203/0233 OR  C01B3/045 OR  C01B3/50 OR</p>	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/15 11:29 AM

L15	625	C01B2203/0205 OR C01B3/40 OR B01J23/94 OR C01B2203/042 OR C01B2203/1047 OR C01B2203/1205 OR C01B2203/148 OR Y02P20/52 OR Y02P20/584).cpc. AND ((reform\$3) same2 ((methane natural reducer reducing) SAME (scrub\$4 separat\$4))) AND ((oxide WITH (ferrous ferric iron)) (FeO Fe.sub.2O.sub.3 Fe.sub.3O.sub.4)) (C01B2203/0233 OR C01B2203/1241).cpc. AND ((reform\$3) same2 ((methane natural reducer reducing) SAME (scrub\$4 separat\$4))) AND ((oxide WITH (ferrous ferric iron)) (FeO Fe.sub.2O.sub.3 Fe.sub.3O.sub.4))	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/15 11:34 AM
L16	216	(C01B2203/0233 OR C01B2203/1241).cpc. AND ((reform\$3) same2 ((methane natural reducer reducing) SAME (scrub\$4 separat\$4))) AND ((oxide WITH (ferrous ferric iron)) (FeO Fe.sub.2O.sub.3 Fe.sub.3O.sub.4))	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/15 11:50 AM
L17	187	(C01B2203/0233 OR C01B2203/1241).cpc. AND ((reform\$3) same2 ((methane natural reducer reducing) SAME (PSA swing))) AND ((oxide WITH (ferrous ferric iron)) (FeO Fe.sub.2O.sub.3 Fe.sub.3O.sub.4))	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/15 02:24 PM
L18	152	(C01B2203/0233 OR C01B2203/1241).cpc. AND ((reform\$3) SAME ((methane natural reducer reducing) SAME (PSA swing))) AND ((oxide WITH	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/15 04:32 PM

L19	144	(ferrous ferric iron) (FeO AND Fe.sub.2O.sub.3 AND Fe.sub.3O.sub.4)) (C01B2203/0233 OR C01B2203/1241).cpc. AND ((reform\$3) SAME ((methane natural reducer ) SAME (PSA swing))) AND ((oxide WITH (ferrous ferric iron)) (FeO AND Fe.sub.2O.sub.3 AND Fe.sub.3O.sub.4))	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/16 01:31 AM
L20	127	(C01B2203/0233 OR C01B2203/1241).cpc. AND ((reform\$3) SAME ((methane natural reducer ) SAME (PSA swing))) AND ((oxide WITH (ferrous ferric iron)) (FeO AND Fe.sub.2O.sub.3 AND Fe.sub.3O.sub.4))	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/16 03:50 PM
L21	28	(C01B2203/0233 OR C01B2203/1241).cpc. AND ((reform\$3) SAME ((methane natural reducer ) SAME (PSA swing))) AND ((oxide WITH (ferrous ferric iron)) (FeO AND Fe.sub.2O.sub.3 AND Fe.sub.3O.sub.4)) AND (steam ADJ reform\$4)	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/16 03:52 PM
L22	188	(C01B2203/0233 OR C01B2203/1241).cpc. AND ((reform\$3) SAME ((methane natural reducer ) ) ) AND ((oxide WITH (ferrous ferric iron)) (FeO AND Fe.sub.2O.sub.3 AND Fe.sub.3O.sub.4)) AND (steam ADJ reform\$4) AND loop	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/16 07:37 PM
L23	1	(C01B2203/0233 OR C01B2203/1241).cpc. AND ((reform\$3) SAME ((methane natural reducer ) ) ) AND ( (FeO AND Fe.sub.2O.sub.3 AND Fe.sub.3O.sub.4)) AND (steam ADJ	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/16 10:59 PM

L24	6	reform\$4) AND loop AND (Psa swing SAME (hydrogen H.sub.2)) AND PSa SAME reduc\$\$ (C01B2203/0233 OR C01B2203/1241).cpc. AND ((reform\$3) SAME ((methane natural reducer ) ) ) AND ( (FeO AND Fe.sub.2O.sub.3 AND Fe.sub.3O.sub.4)) AND (steam ADJ reform\$4) AND (Psa swing SAME (hydrogen H.sub.2)) AND PSa SAME reduc\$\$	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/16 11:34 PM
L25	0	(C01B2203/0233 OR C01B2203/1241).cpc. AND 3RCLSR AND (steam ADJ reform\$4) AND (Psa swing SAME (hydrogen H.sub.2))	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/17 11:08 PM
L26	11	(B01D2257/7025 AND C01B2203/1241).cpc. AND reformer AND (steam ADJ reform\$4) AND (Psa swing SAME (hydrogen H.sub.2))	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/17 11:37 PM
L27	11	(B01D2257/7025 AND C01B2203/1241).cpc. AND reformer AND (steam ADJ reform\$4) AND (Psa swing SAME (hydrogen H.sub.2)) AND (methane (CH.sub.4) (natural ADJ gas))	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/17 11:40 PM
L28	15	(B01D2257/7025 AND C01B2203/1241).cpc. AND reformer AND (Psa swing SAME (hydrogen H.sub.2)) AND (methane (CH.sub.4) (natural ADJ gas))	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/17 11:42 PM

### PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	25	(C01B3/063 OR B01D53/047 OR B01J19/245 OR C01B3/34 OR C01B3/56 OR	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/14 12:01 PM

N2	1	B01D2256/16 OR B01D2257/502 OR B01D2257/7025 OR C01B2203/0216 OR C01B2203/043 OR C01B2203/1241 OR C01B2203/14 OR C21B2100/22 OR Y02C20/20 OR Y02E60/36 OR C01B3/061 OR C01B2203/0233 OR C01B3/045 OR C01B3/50 OR C01B2203/0205 OR C01B3/40 OR B01J23/94 OR C01B2203/042 OR C01B2203/1047 OR C01B2203/1205 OR C01B2203/148 OR Y02P20/52 OR Y02P20/584).cpc. AND (reform\$3) AND ((third WITH (unit reactor reformer)) SAME (oxide WITH (ferrous ferric iron) SAME (oxygen o.sub.2))) ((CHOI-Seung-Hyeon) (LEE-Kyung-Moon) (PARK-Jung-Joo) (PARK-Hoon-Mo) (HAN-Gwang-Woo) (BAE-Joong-Myeon) (OH-Ji-Woo)).inv. AND ((ferrous iron ferric) ADJ oxide)	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/14 12:01 PM
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Publication Number	Application Number	Title	Priority Date	Application Date	Publ'n Date
EP3663258A1	EP19209091	System and met	12/4/2018	11/14/2019	6/10/2020
KR20200067410A	KR20180154229A	Method And Sy:	12/4/2018	12/4/2018	6/12/2020
CN111268644A	CN201911140090A	System and met	12/4/2018	11/20/2019	6/12/2020
JP2020090431A	JP2019066812A	Hydrogen manu	12/4/2018	3/29/2019	6/11/2020
EP3663258B1	EP19209091	System and met	12/4/2018	11/14/2019	9/22/2021
CN109761192A	CN201910173435A	A kind of produ	3/7/2019	3/7/2019	5/17/2019
US20160039669	US14781056	Method for Pro	3/29/2013	3/31/2014	2/11/2016
EP2978710B1	EP14713514	Method for pro	3/29/2013	3/31/2014	10/2/2019
IPCOM000187595D		Process for Proc			9/11/2009
US20170217770	US15490301	Method for Pro	3/29/2013	4/18/2017	8/3/2017
US10899610	US15490301	Method for pro	3/29/2013	4/18/2017	1/26/2021
US20060188435	US11122662	Method and ap	2/7/2005	5/5/2005	8/24/2006
EP1690826A2	EP06001972	Method and ap	2/7/2005	1/31/2006	8/16/2006
EP1690826B1	EP06001972	Apparatus for th	2/7/2005	1/31/2006	8/13/2014
US7510696	US11122662	Method and ap	2/7/2005	5/5/2005	3/31/2009
EP0837034B1	EP96914461	Process and equ	5/31/1995	5/27/1996	3/29/2006
CN105762386A	CN201610075115A	Integration Of R	9/8/2009	9/8/2010	7/13/2016
US10513436	US15375692	Production of p	12/10/2015	12/12/2016	12/24/2019
EP0837034A1	EP96914461	Process and equ	5/31/1995	5/27/1996	4/22/1998
US10022693	US15647084	Systems and me	2/27/2014	7/11/2017	7/17/2018
US20050232859	US11085583	Process for the	3/23/2004	3/22/2005	10/20/2005
US20070258878	US11754672	Process for the	3/23/2004	5/29/2007	11/8/2007
US20180065101	US15647084	Systems and me	2/27/2014	7/11/2017	3/8/2018
EP1580162A2	EP05102195	Process for the	3/23/2004	3/18/2005	9/28/2005
US20150238915	US14634319	Systems and me	2/27/2014	2/27/2015	8/27/2015
CN109652604A	CN201910093157A	A method of cer	1/30/2019	1/30/2019	4/19/2019
US7404942	US11754672	Process for the	3/23/2004	5/29/2007	7/29/2008
US20090000194	US12160803	Systems and Me	1/12/2006	1/12/2007	1/1/2009
CN1931707A	CN200610015115A	Pure hydrogen p	8/3/2006	8/3/2006	3/21/2007
US20080315158	US11993889	Process For Obt	6/24/2005	6/20/2006	12/25/2008
US8075870	US11993889	Process for obta	6/24/2005	6/20/2006	12/13/2011
EP1973992A2	EP07716591	Systems and me	1/12/2006	1/12/2007	10/1/2008
WO2007082089A2	PCTUS2007000956	Systems and me	1/12/2006	1/12/2007	7/19/2007
US20050037245	US10917269	Method for hyd	8/11/2003	8/11/2004	2/17/2005
US3246978	US19630274126	Fluid bed proce:	4/19/1963	4/19/1963	4/19/1966
US6428763	US9532583	Process for the	3/31/1998	3/22/2000	8/6/2002
EP1914197A1	EP06794037	Method of obta	6/24/2005	6/20/2006	4/23/2008
US20080166291	US12007254	Reactor and prc	1/8/2007	1/8/2008	7/10/2008
US20010055559	US9810561	Process for the	3/17/2000	3/19/2001	12/27/2001
EP1134187A2	EP01201044	Process for the	3/17/2000	3/15/2001	9/19/2001
US7914765	US12007254	Reactor and prc	1/8/2007	1/8/2008	3/29/2011
US6875411	US9810561	Process for the	3/17/2000	3/19/2001	4/5/2005
CN1184455A	CN96193913A	Process and equ	5/31/1995	5/27/1996	6/10/1998
CN105132025B	CN201510467554A	Carbon-containi	9/26/2008	9/28/2009	2/6/2018
CN112744785A	CN202011637018A	Chemical chain	12/31/2020	12/31/2020	5/4/2021
US20140144082	US14091654	Methods of Con	1/12/2006	11/27/2013	5/29/2014

US20020132155	US10015879	Manufacturing i	10/7/1997	10/30/2001	9/19/2002
US20120171588	US13394572	Integration of re	9/8/2009	9/8/2010	7/5/2012
EP2475613B1	EP10760504	Integration of re	9/8/2009	9/8/2010	5/3/2017
WO2008083466A1	PCTCA2008000016	Reactor and pro	1/8/2007	1/8/2008	7/17/2008