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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/728,359	05/18/2021	11009162	047158.100066	6981

132858 7590 **04/28/2021**

Hogan Lovells US LLP
609 Main Street
Suite 4200
Houston, TX 77002

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

U.S. Well Services, LLC, Houston, TX
Jared Oehring, Houston, TX;
Brandon Hinderliter, Houston, TX;
Lon Robinson, Houston, TX;
Alexander James Christinzio, Houston, TX;

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16728359
Filing Date	2019-12-27
First Named Inventor	Jared Oehring
Art Unit	3679
Examiner Name	Aaron Lloyd Lembo
Attorney Docket Number	047158.100066

Change(s) applied to document. /C.M./ 2/24/2021	142	20160341281		2016-11-24	~~Onesubsea IP UK Limited~~ Brunvold et al.	
	143	20050274508		2005-12-15	Folk	
	144	20070131410		2007-06-14	Hill	
	145	20190003329		2019-01-03	Morris	
	146	20090045782		2009-02-19	Datta	
	147	20150097504		2015-04-09	Lamascus	
	148	20170241221		2017-08-24	Seshadri	
	149	20150330172		2015-11-19	Allmaras	
	150	20110166046		2011-07-07	Weaver	
	151	20160265457		2016-09-15	Stephenson	
	152	20190120024		2019-04-25	Oehring	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.L.L./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16728359
	Filing Date	2019-12-27
	First Named Inventor	Jared Oehring
	Art Unit	3679
	Examiner Name	Aaron Lloyd Lembo
	Attorney Docket Number	047158.100066

	131	20170022807		2017-01-26	Dursun	
	132	20160208595		2016-07-21	Tang	
	133	20150075778		2015-03-19	Walters	
	134	20180320483		2018-11-08	Zhang	
	135	20180038216		2018-02-08	Zhang	
	136	20160102537		2016-04-14	Lopez	
	137	20140290768		2014-10-02	Randle	
	138	20140277772		2014-09-18	Lopez	
	139	20170096885		2017-04-06	Oehring	
	140	20070277982		2007-12-06	Shampine	
	141	20170051732		2017-02-23	~~Baker Hughes Incorporated~~ Hemandez et al.	

Change(s) applied to document.

/CM/
2/24/2021

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.L.L./

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

132858 7590 01/21/2021

Hogan Lovells US LLP
609 Main Street
Suite 4200
Houston, TX 77002

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/728,359	12/27/2019	Jared Oehring	047158.100066	6981

TITLE OF INVENTION: SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	04/21/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
LEMBO, AARON LLOYD	3679	166-090100

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 HOGAN LOVELLS US LLP
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE	(B) RESIDENCE: (CITY and STATE OR COUNTRY)
U.S. WELL SERVICES, LLC	Houston, TEXAS

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ☒ Corporation or other private group entity ❑ Government

4a. Fees submitted: ☒ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 501349

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Joe Grdinovac/ Date 2021-04-14

Typed or printed name Joe Grdinovac Registration No. 72224

Electronic Patent Application Fee Transmittal

Application Number:	16728359
Filing Date:	27-Dec-2019
Title of Invention:	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
First Named Inventor/Applicant Name:	Jared Oehring
Filer:	Joe Grdinovac/Karyn Hines
Attorney Docket Number:	047158.100066

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	1501	1	1200	1200

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1200**

Electronic Acknowledgement Receipt

EFS ID:	42443611
Application Number:	16728359
International Application Number:	
Confirmation Number:	6981
Title of Invention:	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Joe Grdinovac/Karyn Hines
Filer Authorized By:	Joe Grdinovac
Attorney Docket Number:	047158.100066
Receipt Date:	14-APR-2021
Filing Date:	27-DEC-2019
Time Stamp:	11:15:35
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$1200
RAM confirmation Number	E20214DB16194918
Deposit Account	501349
Authorized User	Karyn Hines

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	047158-100066-Issue-Fee-2021-04-14.pdf	104293 0c8cca6e0901271d6e7bfd3ad644719a5a7aa429	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30349 56dc49a8bc1b85be1f0e3734736899e232c6d370	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	134642		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/728,359	12/27/2019	Jared Oehring	047158.100066	6981

132858 7590 03/26/2021

Hogan Lovells US LLP
609 Main Street
Suite 4200
Houston, TX 77002

EXAMINER	
LEMBO, AARON LLOYD	

ART UNIT	PAPER NUMBER
3679	

NOTIFICATION DATE	DELIVERY MODE
03/26/2021	ELECTRONIC

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):

hlusdocketing@hoganlovells.com
stephanie.mcdonough@hoganlovells.com

Supplemental ***Notice of Allowability***	**Application No.** 16/728,359	**Applicant(s)** Oehring et al.	
	Examiner AARON L LEMBO	**Art Unit** 3679	**AIA (FITF) Status** Yes

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

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to Claims filed 09/29/2020.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ 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.

3. ☑ The allowed claim(s) is/are 1-8 and 21-26 . As a result of the allowed claim(s), 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** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ 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)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/AARON L LEMBO/
Primary Examiner, Art Unit 3679

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	25	("10221639" | "10408030" | "10408031" | "10740730" | "20080277120" | "20110110793" | "20130284455" | "20160326853" | "20170082033" | "20170212535" | "20170370639" | "20180090914" | "20180181830" | "20180259080" | "20180266217" | "20180284817" | "20180298731" | "20180312738" | "20190154020" | "20190249527" | "3878884" | "5439066" | "6985750" | "9062545" | "9506333").PN.	US-PGPUB; USPAT	OR	ON	2021/03/23 21:26
L2	1	l1 and fitting with hose	US-PGPUB; USPAT	OR	ON	2021/03/23 21:29
S1	1	"16728359"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/20 09:33
S2	204	("10008880" | "10020711" | "10036238" | "10107086" | "10119381" | "10196878" | "10227854" | "10232332" | "10246984" | "10254732" | "10260327" | "10280724" | "10287873" | "10309205" | "10371012" | "10378326" | "10393108" | "10407990" | "10436026" | "1656861" | "1671436" | "20020169523" | "20030056514" | "20030138327" | "20040000077" | "20040040746" | "20040102109" | "20040167738" | "20050061548" | "20050116541" | "20050274508" | "20060052903" | "20070131410" | "20070187163" | "20070201305" | "20070226089" | "20070277982" | "20070278140" | "20080017369" | "20080041596" | "20080112802" | "20080137266" | "20080208478" | "20080217024" | "20080264625" | "20080264649" | "20090045782" | "20090065299" | "20090078410" | "20090093317" | "20090095482" | "20090145611" |	US-PGPUB; USPAT	OR	ON	2020/06/20 09:51

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		"6271637" | "6273193" | "6315523" | "6477852" | "6484490" | "6491098" | "6529135" | "6776227" | "6802690" | "6808303" | "6931310" | "6936947" | "7082993" | "7104233" | "7170262" | "7173399" | "7308933" | "7312593" | "7336514" | "7445041" | "7494263" | "7500642" | "7525264" | "7563076" | "7581379" | "7675189" | "7683499" | "7717193" | "7755310" | "7807048" | "7835140" | "7845413" | "7894757" | "7926562" | "7977824" | "7984757" | "8037936" | "8054084" | "8083504" | "8096354" | "8096891" | "8139383" | "8146665" | "8154419" | "8232892" | "8261528" | "8272439" | "8310272" | "8354817" | "8474521" | "8534235" | "8573303" | "8596056" | "8616005" | "8616274" | "8646521" | "8692408" | "8727068" | "8760657" | "8774972" | "8789601" | "8800652" | "8807960" | "8838341" | "8851860" | "8857506" | "8899940" | "8905056" | "8905138" | "8997904" | "9018881" | "9051822" | "9067182" | "9103193" | "9119326" | "9121257" | "9140110" | "9160168" | "9322239" | "9366114" | "9410410" | "9450385" | "9475020" | "9475021" | "9534473" | "9562420" | "9587649" | "9611728" | "9650871" | "9650879" | "9728354" | "9738461" | "9745840" | "9840901" | "9863228" | "9893500" | "9915128" | "9932799" | "9963961" | "9970278" | "9976351" | "9995218").PN.				
S4	383	S2 or S3	US-PGPUB; USPAT	OR	ON	2020/06/20 10:01
S5	383	S2 or S3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/20 10:01
S6	320	(US-20190316447-$ or US-20190292866-$ or US-20190245348-$ or US-20190211661-$ or US-20190203567-$ or US-20190178235-$ or US-20190169971-$ or US-20190162061-$ or US-20190128080-$ or US-20190120024-$ or US-	US-PGPUB; USPAT	OR	ON	2020/06/20 10:49

20190112910-$ or US-20190100989-$ or US-20190063309-$ or US-20190003329-$ or US-20180320483-$ or US-20180245428-$ or US-20180216455-$ or US-20180156210-$ or US-20180038216-$ or US-20180028992-$ or US-20130025706-$ or US-20170328179-$ or US-20170314979-$ or US-20170021318-$ or US-20170292513-$ or US-20170259227-$).did. or (US-20170241221-$ or US-20170234250-$ or US-20170226842-$ or US-20170159570-$ or US-20170146189-$ or US-20170145918-$ or US-20170114625-$ or US-20170051732-$ or US-20170036872-$ or US-20170022807-$ or US-20160348479-$ or US-20160341281-$ or US-20160319650-$ or US-20160312108-$ or US-20160290563-$ or US-20160290114-$ or US-20160281484-$ or US-20160265457-$ or US-20160230525-$ or US-20160230524-$ or US-20160221220-$ or US-20160208595-$ or US-20160186531-$ or US-20160160889-$ or US-20160105022-$ or US-20160102537-$ or US-20150330172-$).did. or (US-20150314225-$ or US-20150300336-$ or US-20150225113-$ or US-20150217672-$ or US-20150211512-$ or US-20150176386-$ or US-20150159911-$ or US-20150136043-$ or US-20150114652-$ or US-20150097504-$ or US-20150083426-$ or US-20150075778-$ or US-20150053426-$ or US-20150027712-$ or US-20140379300-$ or US-20140290768-$ or US-20140277772-$ or US-20140255214-$ or US-20140251623-$ or US-20140246211-$ or US-20140219824-$ or US-20140124162-$ or US-20140095114-$ or US-20140060658-$ or US-20140054965-$ or US-20140000899-$ or US-20130343858-$).did. or (US-20130341029-$ or US-20130306322-$ or US-20130233542-$ or US-20130175039-$ or US-20130175038-$ or US-20130009469-$ or US-20120247783-$ or US-20120232728-$ or US-20120222865-$ or US-

20120205400-$ or US-20120205301-$ or US-20120127635-$ or US-20120085541-$ or US-20120049625-$ or US-20120018016-$ or US-20110272158-$ or US-20110247878-$ or US-20110166046-$ or US-20110085924-$ or US-20110061855-$ or US-20110017468-$ or US-20110005757-$ or US-20100322802-$ or US-20100303655-$ or US-20100293973-$ or US-20100250139-$ or US-20100172202-$).did. or (US-20100146981-$ or US-20100132949-$ or US-20100051272-$ or US-20100045109-$ or US-20100038907-$ or US-20100019574-$ or US-20090308602-$ or US-20090260826-$ or US-20090200035-$ or US-20090188181-$ or US-20090145611-$ or US-20090095482-$ or US-20090093317-$ or US-20090078410-$ or US-20090065299-$ or US-20090045782-$ or US-20080264649-$ or US-20080264625-$ or US-20080217024-$ or US-20080208478-$ or US-20080137266-$ or US-20080112802-$ or US-20080041596-$ or US-20080017369-$ or US-20070278140-$ or US-20070226089-$ or US-20070201305-$).did. or (US-20070187163-$ or US-20070131410-$ or US-20060052903-$ or US-20050274508-$ or US-20050116541-$ or US-20050061548-$ or US-20040167738-$ or US-20040102109-$ or US-20040040746-$ or US-20040000077-$ or US-20020169523-$ or US-20030056514-$ or US-20030138327-$).did. or (US-10260327-$ or US-10246984-$ or US-10378326-$ or US-9915128-$ or US-10280724-$ or US-9103193-$ or US-9995218-$ or US-9970278-$ or US-9893500-$ or US-9745840-$ or US-9650879-$ or US-10020711-$ or US-9534473-$ or US-9840901-$ or US-9140110-$ or US-10119381-$ or US-10407990-$ or US-10232332-$ or US-9650871-$ or US-10393108-$ or US-10254732-$ or US-9410410-$ or US-10036238-$ or US-9587649-$ or US-10008880-$ or US-10227854-$).did. or (US-8997904-$ or US-9963961-$ or US-8789601-$ or US-

9738461-$ or US-8534235-$ or US-8154419-$ or US-7845413-$ or US-1656861-$ or US-1671436-$ or US-2183364-$ or US-2220622-$ or US-2248051-$ or US-2407796-$ or US-2416848-$ or US-2753940-$ or US-3061039-$ or US-3066503-$ or US-3302069-$ or US-3334495-$ or US-3722595-$ or US-3764233-$ or US-3773140-$ or US-3837179-$ or US-3849662-$ or US-3881551-$ or US-4037431-$ or US-4100822-$).did. or (US-4151575-$ or US-4226299-$ or US-4265266-$ or US-4432064-$ or US-4442665-$ or US-4456092-$ or US-4506982-$ or US-4512387-$ or US-4529887-$ or US-4538916-$ or US-4676063-$ or US-4759674-$ or US-4793386-$ or US-4845981-$ or US-4922463-$ or US-5006044-$ or US-5025861-$ or US-5050673-$ or US-5130628-$ or US-5131472-$ or US-5172009-$ or US-5189388-$ or US-5366324-$ or US-5422550-$ or US-5548093-$ or US-5590976-$ or US-5655361-$).did. or (US-5736838-$ or US-5755096-$ or US-5790972-$ or US-5865247-$ or US-5879137-$ or US-5894888-$ or US-5907970-$ or US-6138764-$ or US-6142878-$ or US-6164910-$ or US-6202702-$ or US-6208098-$ or US-6254462-$ or US-6271637-$ or US-6273193-$ or US-6315523-$ or US-6477852-$ or US-6484490-$ or US-6491098-$ or US-6529135-$ or US-6776227-$ or US-6802690-$ or US-6808303-$ or US-6931310-$ or US-6936947-$ or US-7082993-$ or US-7104233-$).did. or (US-7170262-$ or US-7173399-$ or US-7308933-$ or US-7312593-$ or US-7336514-$ or US-7445041-$ or US-7494263-$ or US-7500642-$ or US-7525264-$ or US-7563076-$ or US-7581379-$ or US-7675189-$ or US-7683499-$ or US-7717193-$ or US-7755310-$ or US-7807048-$ or US-7835140-$ or US-7894757-$ or US-7977824-$ or US-7984757-$ or US-8037936-$ or US-8054084-$ or US-8083504-$ or US-7926562-$ or US-8096891-$ or US-8139383-$ or US-8146665-$).did. or (US-8232892-$ or

		US-8261528-$ or US-8272439-$ or US-8310272-$ or US-8354817-$ or US-8474521-$ or US-8573303-$ or US-8596056-$ or US-8616005-$ or US-8616274-$ or US-8646521-$ or US-8692408-$ or US-8727068-$ or US-8760657-$ or US-8774972-$ or US-8800652-$ or US-8807960-$ or US-8838341-$ or US-8851860-$ or US-8857506-$ or US-8899940-$ or US-8905056-$ or US-8905138-$ or US-9018881-$ or US-9051822-$ or US-9067182-$ or US-9119326-$).did. or (US-9160168-$ or US-9322239-$ or US-9450385-$ or US-9611728-$ or US-9728354-$ or US-9863228-$ or US-9932799-$ or US-9976351-$ or US-10287873-$ or US-10309205-$ or US-10371012-$ or US-10436026-$).did.				
S7	320	(US-20190316447-$ or US-20190292866-$ or US-20190245348-$ or US-20190211661-$ or US-20190203567-$ or US-20190178235-$ or US-20190169971-$ or US-20190162061-$ or US-20190128080-$ or US-20190120024-$ or US-20190112910-$ or US-20190100989-$ or US-20190063309-$ or US-20190003329-$ or US-20180320483-$ or US-20180245428-$ or US-20180216455-$ or US-20180156210-$ or US-20180038216-$ or US-20180028992-$ or US-20130025706-$ or US-20170328179-$ or US-20170314979-$ or US-20170021318-$ or US-20170292513-$ or US-20170259227-$).did. or (US-20170241221-$ or US-20170234250-$ or US-20170226842-$ or US-20170159570-$ or US-20170146189-$ or US-20170145918-$ or US-20170114625-$ or US-20170051732-$ or US-20170036872-$ or US-20170022807-$ or US-20160348479-$ or US-20160341281-$ or US-20160319650-$ or US-20160312108-$ or US-20160290563-$ or US-20160290114-$ or US-20160281484-$ or US-20160265457-$ or US-20160230525-$ or US-20160230524-$ or US-20160221220-$ or US-20160208595-$ or US-20160186531-$	US-PGPUB; USPAT	OR	ON	2020/06/20 10:50

or US-20160160889-$ or US-20160105022-$ or US-20160102537-$ or US-20150330172-$).did. or (US-20150314225-$ or US-20150300336-$ or US-20150225113-$ or US-20150217672-$ or US-20150211512-$ or US-20150176386-$ or US-20150159911-$ or US-20150136043-$ or US-20150114652-$ or US-20150097504-$ or US-20150083426-$ or US-20150075778-$ or US-20150053426-$ or US-20150027712-$ or US-20140379300-$ or US-20140290768-$ or US-20140277772-$ or US-20140255214-$ or US-20140251623-$ or US-20140246211-$ or US-20140219824-$ or US-20140124162-$ or US-20140095114-$ or US-20140060658-$ or US-20140054965-$ or US-20140000899-$ or US-20130343858-$).did. or (US-20130341029-$ or US-20130306322-$ or US-20130233542-$ or US-20130175039-$ or US-20130175038-$ or US-20130009469-$ or US-20120247783-$ or US-20120232728-$ or US-20120222865-$ or US-20120205400-$ or US-20120205301-$ or US-20120127635-$ or US-20120085541-$ or US-20120049625-$ or US-20120018016-$ or US-20110272158-$ or US-20110247878-$ or US-20110166046-$ or US-20110085924-$ or US-20110061855-$ or US-20110017468-$ or US-20110005757-$ or US-20100322802-$ or US-20100303655-$ or US-20100293973-$ or US-20100250139-$ or US-20100172202-$).did. or (US-20100146981-$ or US-20100132949-$ or US-20100051272-$ or US-20100045109-$ or US-20100038907-$ or US-20100019574-$ or US-20090308602-$ or US-20090260826-$ or US-20090200035-$ or US-20090188181-$ or US-20090145611-$ or US-20090095482-$ or US-20090093317-$ or US-20090078410-$ or US-20090065299-$ or US-20090045782-$ or US-20080264649-$ or US-20080264625-$ or US-20080217024-$ or US-20080208478-$ or US-20080137266-$ or US-

20080112802-$ or US-20080041596-$ or US-20080017369-$ or US-20070278140-$ or US-20070226089-$ or US-20070201305-$).did. or (US-20070187163-$ or US-20070131410-$ or US-20060052903-$ or US-20050274508-$ or US-20050116541-$ or US-20050061548-$ or US-20040167738-$ or US-20040102109-$ or US-20040040746-$ or US-20040000077-$ or US-20020169523-$ or US-20030056514-$ or US-20030138327-$).did. or (US-10260327-$ or US-10246984-$ or US-10378326-$ or US-9915128-$ or US-10280724-$ or US-9103193-$ or US-9995218-$ or US-9970278-$ or US-9893500-$ or US-9745840-$ or US-9650879-$ or US-10020711-$ or US-9534473-$ or US-9840901-$ or US-9140110-$ or US-10119381-$ or US-10407990-$ or US-10232332-$ or US-9650871-$ or US-10393108-$ or US-10254732-$ or US-9410410-$ or US-10036238-$ or US-9587649-$ or US-10008880-$ or US-10227854-$).did. or (US-8997904-$ or US-9963961-$ or US-8789601-$ or US-9738461-$ or US-8534235-$ or US-8154419-$ or US-7845413-$ or US-1656861-$ or US-1671436-$ or US-2183364-$ or US-2220622-$ or US-2248051-$ or US-2407796-$ or US-2416848-$ or US-2753940-$ or US-3061039-$ or US-3066503-$ or US-3302069-$ or US-3334495-$ or US-3722595-$ or US-3764233-$ or US-3773140-$ or US-3837179-$ or US-3849662-$ or US-3881551-$ or US-4037431-$ or US-4100822-$).did. or (US-4151575-$ or US-4226299-$ or US-4265266-$ or US-4432064-$ or US-4442665-$ or US-4456092-$ or US-4506982-$ or US-4512387-$ or US-4529887-$ or US-4538916-$ or US-4676063-$ or US-4759674-$ or US-4793386-$ or US-4845981-$ or US-4922463-$ or US-5006044-$ or US-5025861-$ or US-5050673-$ or US-5130628-$ or US-5131472-$ or US-5172009-$ or US-5189388-$ or US-5366324-$ or US-5422550-$ or US-5548093-$ or US-5590976-$ or US-5655361-$).did. or (US-5736838-$ or

		US-5755096-$ or US-5790972-$ or US-5865247-$ or US-5879137-$ or US-5894888-$ or US-5907970-$ or US-6138764-$ or US-6142878-$ or US-6164910-$ or US-6202702-$ or US-6208098-$ or US-6254462-$ or US-6271637-$ or US-6273193-$ or US-6315523-$ or US-6477852-$ or US-6484490-$ or US-6491098-$ or US-6529135-$ or US-6776227-$ or US-6802690-$ or US-6808303-$ or US-6931310-$ or US-6936947-$ or US-7082993-$ or US-7104233-$).did. or (US-7170262-$ or US-7173399-$ or US-7308933-$ or US-7312593-$ or US-7336514-$ or US-7445041-$ or US-7494263-$ or US-7500642-$ or US-7525264-$ or US-7563076-$ or US-7581379-$ or US-7675189-$ or US-7683499-$ or US-7717193-$ or US-7755310-$ or US-7807048-$ or US-7835140-$ or US-7894757-$ or US-7977824-$ or US-7984757-$ or US-8037936-$ or US-8054084-$ or US-8083504-$ or US-7926562-$ or US-8096891-$ or US-8139383-$ or US-8146665-$).did. or (US-8232892-$ or US-8261528-$ or US-8272439-$ or US-8310272-$ or US-8354817-$ or US-8474521-$ or US-8573303-$ or US-8596056-$ or US-8616005-$ or US-8616274-$ or US-8646521-$ or US-8692408-$ or US-8727068-$ or US-8760657-$ or US-8774972-$ or US-8800652-$ or US-8807960-$ or US-8838341-$ or US-8851860-$ or US-8857506-$ or US-8899940-$ or US-8905056-$ or US-8905138-$ or US-9018881-$ or US-9051822-$ or US-9067182-$ or US-9119326-$).did. or (US-9160168-$ or US-9322239-$ or US-9450385-$ or US-9611728-$ or US-9728354-$ or US-9863228-$ or US-9932799-$ or US-9976351-$ or US-10287873-$ or US-10309205-$ or US-10371012-$ or US-10436026-$).did.				
S8	93	fitting and lembo.xa.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2020/06/20 10:50

			DERWENT; IBM_TDB			
S9	22	("20020070014" | "20060159376" | "20090057026" | "20090315276" | "20110308815" | "20190056024" | "2937598" | "3055682" | "3224817" | "3254908" | "4281726" | "4715526" | "5617879" | "6263982" | "6505649" | "6923476" | "8215645" | "9157293").PN. OR ("10669804").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/20 10:50
S10	5	S6 and fitting and electri$4 with pump$4 and union	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/20 10:51
S11	221	("5" "5" adj inch) with (hose diameter) and fractur$4 and pump$4 same (electric$4 and plunger)	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/20 10:55
S12	476	(frac$4 frack$4 fractur$4) and (pump$4 with hose with fitting)	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:38
S13	44	(frac$4 frack$4 fractur$4) and (pump$4 with hose with fitting) and fitting with diameter and hose with diameter	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:41
S14	59	(hydraulic$4 with fractur$4) and (pump$4 with hose with fitting)	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:43
S15	23	(US-20190323337-$ or US-20190248938-$ or US-20190137012-$ or US-20130284278-$ or US-20110272158-$ or US-20080264649-$).did. or (US-9052037-$ or US-9903192-$ or US-9513055-$ or US-10102471-$ or US-9400065-$ or US-10227430-$ or US-9284819-$ or US-9061223-$ or US-9050545-$ or US-8985202-$ or US-9341056-$ or US-9341055-$ or US-8162063-$ or US-10280724-$ or US-9840901-$ or US-8146665-$).did. or (US-2831551-$).did.	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:45
S16	23	S15 and (pump$4 with hose with fitting)	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:45
S17	14	("20060065319" | "20100018911" | "20130240042" | "2610741" | "2661096" | "3748837" | "4051042" | "4836238" | "5230366" | "5433243" | "6390446" | "6719900").PN. OR ("9061223").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:55

S18	3	((US adj well adj services.as.) (oehring.in. hinderliter.in. robinson.in. christinzio.in.)) and fitting with hose with diameter$4 same pump$4	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:57
S19	5	((US adj well adj services.as.) (oehring.in. hinderliter.in. robinson.in. christinzio.in.)) and fitting with hose with diameter$4	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:58
S20	18	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and fitting with hose with diameter$4	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 22:05
S21	8	fitting with hose with diameter$4 and (hose fitting) with pump$4 and union with pump$4	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 22:06
S22	1	union same shank same reducer same fitting same hose	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 22:18
S23	1	union same shank same reducer same fitting and fitting same hose	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 22:18
S24	0	union with shank with reducer and fitting same hose	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 22:18
S25	0	union with shank with reducer	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 22:18
S26	1	union with shank with reducer	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 22:19
S27	0	union same shank same reducer and fitting with hose	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 22:19
S28	326	(US-20190316447-$ or US-20190292866-$ or US-20190245348-$ or US-20190211661-$ or US-20190203567-$ or US-20190178235-$ or US-20190169971-$ or US-20190162061-$ or US-20190128080-$ or US-20190120024-$ or US-	US-PGPUB; USPAT	OR	ON	2020/06/21 22:20

20190112910-$ or US-20190100989-$ or US-20190063309-$ or US-20190003329-$ or US-20180320483-$ or US-20180245428-$ or US-20180216455-$ or US-20180156210-$ or US-20180038216-$ or US-20180028992-$ or US-20130025706-$ or US-20170328179-$ or US-20170314979-$ or US-20170021318-$ or US-20170292513-$ or US-20170259227-$).did. or (US-20170241221-$ or US-20170234250-$ or US-20170226842-$ or US-20170159570-$ or US-20170146189-$ or US-20170145918-$ or US-20170114625-$ or US-20170051732-$ or US-20170036872-$ or US-20170022807-$ or US-20160348479-$ or US-20160341281-$ or US-20160319650-$ or US-20160312108-$ or US-20160290563-$ or US-20160290114-$ or US-20160281484-$ or US-20160265457-$ or US-20160230525-$ or US-20160230524-$ or US-20160221220-$ or US-20160208595-$ or US-20160186531-$ or US-20160160889-$ or US-20160105022-$ or US-20160102537-$ or US-20150330172-$).did. or (US-20150314225-$ or US-20150300336-$ or US-20150225113-$ or US-20150217672-$ or US-20150211512-$ or US-20150176386-$ or US-20150159911-$ or US-20150136043-$ or US-20150114652-$ or US-20150097504-$ or US-20150083426-$ or US-20150075778-$ or US-20150053426-$ or US-20150027712-$ or US-20140379300-$ or US-20140290768-$ or US-20140277772-$ or US-20140255214-$ or US-20140251623-$ or US-20140246211-$ or US-20140219824-$ or US-20140124162-$ or US-20140095114-$ or US-20140060658-$ or US-20140054965-$ or US-20140000899-$ or US-20130343858-$).did. or (US-20130341029-$ or US-20130306322-$ or US-20130233542-$ or US-20130175039-$ or US-20130175038-$ or US-20130009469-$ or US-20120247783-$ or US-20120232728-$ or US-20120222865-$ or US-

20120205400-$ or US-20120205301-$ or US-20120127635-$ or US-20120085541-$ or US-20120049625-$ or US-20120018016-$ or US-20110272158-$ or US-20110247878-$ or US-20110166046-$ or US-20110085924-$ or US-20110061855-$ or US-20110017468-$ or US-20110005757-$ or US-20100322802-$ or US-20100303655-$ or US-20100293973-$ or US-20100250139-$ or US-20100172202-$).did. or (US-20100146981-$ or US-20100132949-$ or US-20100051272-$ or US-20100045109-$ or US-20100038907-$ or US-20100019574-$ or US-20090308602-$ or US-20090260826-$ or US-20090200035-$ or US-20090188181-$ or US-20090145611-$ or US-20090095482-$ or US-20090093317-$ or US-20090078410-$ or US-20090065299-$ or US-20090045782-$ or US-20080264649-$ or US-20080264625-$ or US-20080217024-$ or US-20080208478-$ or US-20080137266-$ or US-20080112802-$ or US-20080041596-$ or US-20080017369-$ or US-20070278140-$ or US-20070226089-$ or US-20070201305-$).did. or (US-20070187163-$ or US-20070131410-$ or US-20060052903-$ or US-20050274508-$ or US-20050116541-$ or US-20050061548-$ or US-20040167738-$ or US-20040102109-$ or US-20040040746-$ or US-20040000077-$ or US-20020169523-$ or US-20030056514-$ or US-20030138327-$ or US-20130284278-$).did. or (US-10260327-$ or US-10246984-$ or US-10378326-$ or US-9915128-$ or US-10280724-$ or US-9103193-$ or US-9995218-$ or US-9970278-$ or US-9893500-$ or US-9745840-$ or US-9650879-$ or US-10020711-$ or US-9534473-$ or US-9840901-$ or US-9140110-$ or US-10119381-$ or US-10407990-$ or US-10232332-$ or US-9650871-$ or US-10393108-$ or US-10254732-$ or US-9410410-$ or US-10036238-$ or US-9587649-$ or US-10008880-$ or US-10227854-$).did. or (US-8997904-$ or

US-9963961-$ or US-8789601-$ or US-9738461-$ or US-8534235-$ or US-8154419-$ or US-7845413-$ or US-1656861-$ or US-1671436-$ or US-2183364-$ or US-2220622-$ or US-2248051-$ or US-2407796-$ or US-2416848-$ or US-2753940-$ or US-3061039-$ or US-3066503-$ or US-3302069-$ or US-3334495-$ or US-3722595-$ or US-3764233-$ or US-3773140-$ or US-3837179-$ or US-3849662-$ or US-3881551-$ or US-4037431-$ or US-4100822-$).did. or (US-4151575-$ or US-4226299-$ or US-4265266-$ or US-4432064-$ or US-4442665-$ or US-4456092-$ or US-4506982-$ or US-4512387-$ or US-4529887-$ or US-4538916-$ or US-4676063-$ or US-4759674-$ or US-4793386-$ or US-4845981-$ or US-4922463-$ or US-5006044-$ or US-5025861-$ or US-5050673-$ or US-5130628-$ or US-5131472-$ or US-5172009-$ or US-5189388-$ or US-5366324-$ or US-5422550-$ or US-5548093-$ or US-5590976-$ or US-5655361-$).did. or (US-5736838-$ or US-5755096-$ or US-5790972-$ or US-5865247-$ or US-5879137-$ or US-5894888-$ or US-5907970-$ or US-6138764-$ or US-6142878-$ or US-6164910-$ or US-6202702-$ or US-6208098-$ or US-6254462-$ or US-6271637-$ or US-6273193-$ or US-6315523-$ or US-6477852-$ or US-6484490-$ or US-6491098-$ or US-6529135-$ or US-6776227-$ or US-6802690-$ or US-6808303-$ or US-6931310-$ or US-6936947-$ or US-7082993-$ or US-7104233-$).did. or (US-7170262-$ or US-7173399-$ or US-7308933-$ or US-7312593-$ or US-7336514-$ or US-7445041-$ or US-7494263-$ or US-7500642-$ or US-7525264-$ or US-7563076-$ or US-7581379-$ or US-7675189-$ or US-7683499-$ or US-7717193-$ or US-7755310-$ or US-7807048-$ or US-7835140-$ or US-7894757-$ or US-7977824-$ or US-7984757-$ or US-8037936-$ or US-8054084-$ or US-8083504-$ or US-7926562-$ or US-8096891-$ or US-8139383-$ or US-

		8146665-$).did. or (US-8232892-$ or US-8261528-$ or US-8272439-$ or US-8310272-$ or US-8354817-$ or US-8474521-$ or US-8573303-$ or US-8596056-$ or US-8616005-$ or US-8616274-$ or US-8646521-$ or US-8692408-$ or US-8727068-$ or US-8760657-$ or US-8774972-$ or US-8800652-$ or US-8807960-$ or US-8838341-$ or US-8851860-$ or US-8857506-$ or US-8899940-$ or US-8905056-$ or US-8905138-$ or US-9018881-$ or US-9051822-$ or US-9067182-$ or US-9119326-$).did. or (US-9160168-$ or US-9322239-$ or US-9450385-$ or US-9611728-$ or US-9728354-$ or US-9863228-$ or US-9932799-$ or US-9976351-$ or US-10287873-$ or US-10309205-$ or US-10371012-$ or US-10436026-$ or US-10669804-$ or US-3055682-$ or US-9513055-$ or US-9061223-$ or US-8091928-$).did.				
S29	14	S28 and fitting with hose	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 22:20
S30	2	hose with fracturing with inches	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 23:16
S31	0	fracturing with pump with S17 adj inches	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 23:18
S32	0	fracturing with pump with S17	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 23:18

S33	322	fracturing with pump with "6"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 23:18
S34	0	fracturing with pump with "6" near2 (inch$4 diameter)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 23:19
S35	2,134	pump with "6" near2 (inch$4 diameter)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 23:19
S36	21	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump with "6" near2 (inch$4 diameter)	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 23:19
S37	0	hose with drop adj out adj rate and fracturing	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/23 08:29
S38	0	hose with drop adj out and fracturing	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/23 08:29
S39	6	hose with dropout and fracturing	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/23 08:29
S40	0	hose with pump with slurry with diameter and fracturing	US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	ON	2020/06/23 08:30

			JPO; DERWENT; IBM_TDB			
S41	109	(hose pump) with slurry with diameter and fracturing	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/23 08:30
S42	0	(hose and pump) with slurry with diameter and fracturing	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/23 08:30
S43	108	(pump) with slurry with diameter and fracturing	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/23 08:31
S44	1	(hose) with slurry with diameter and fracturing	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/23 08:31
S45	47	("10337308" | "10415332" | "10669804" | "20030079875" | "20060065319" | "20110052423" | "20130180722" | "20130284278" | "20130299167" | "20130306322" | "20130317750" | "20140138079" | "20140238683" | "20160258267" | "20160326854" | "20170096885" | "20170130743" | "20170175516" | "20170226838" | "20180045331" | "20180238147" | "20180266412" | "20180291713" | "20180343125" | "20190010793" | "20190112910" | "20190119096" | "20200232454" | "2610741" | "3055682" | "5004400" | "5025861" | "5230366" | "5433243" | "6719900" | "7170262" | "8091928" | "8774972" | "8997904" | "9051822" | "9061223" | "9260253" | "9324049" |	US-PGPUB; USPAT	OR	ON	2020/10/19 13:01

		"9340353" | "9499335" | "9513055" | "9909398").PN.				
S46	7	("10302079" | "20030079875" | "20110052423" | "20130180722" | "20130299167" | "20170159654" | "20170226838").PN.	US-PGPUB; USPAT	OR	ON	2020/10/19 15:42
S47	47	("10337308" | "10415332" | "10669804" | "20030079875" | "20060065319" | "20110052423" | "20130180722" | "20130284278" | "20130299167" | "20130306322" | "20130317750" | "20140138079" | "20140238683" | "20160258267" | "20160326854" | "20170096885" | "20170130743" | "20170175516" | "20170226838" | "20180045331" | "20180238147" | "20180266412" | "20180291713" | "20180343125" | "20190010793" | "20190112910" | "20190119096" | "20200232454" | "2610741" | "3055682" | "5004400" | "5025861" | "5230366" | "5433243" | "6719900" | "7170262" | "8091928" | "8774972" | "8997904" | "9051822" | "9061223" | "9260253" | "9324049" | "9340353" | "9499335" | "9513055" | "9909398").PN.	US-PGPUB; USPAT	OR	ON	2020/10/19 15:42
S48	25	("10184465" | "10627003" | "10669471" | "10695950" | "10711576" | "20080095644" | "20120152716" | "20130189629" | "20130255271" | "20160273456" | "20170043280" | "20170074076" | "20170138171" | "20200047141" | "20200088152" | "5517822" | "6626646" | "6765304" | "8506267" | "8763387" | "8795525" | "9051923" | "9482086" | "9706185" | "9739546").PN.	US-PGPUB; USPAT	OR	ON	2021/01/07 14:15
S49	3	"20170218727"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/07 14:29
S50	1	(S48 S49) and pump$4 same fitting	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2021/01/07 14:32

			DERWENT; IBM_TDB			
S51	0	(S48 S49) and pump$4 with plung$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/07 14:33
S52	22	(S48 S49) and pump$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/07 14:33
S53	1	(pump and reducer and union and shank) same fitting	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:05
S54	0	(pump with fitting) and (reducer and union and shank) same fitting	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:05
S55	272	(pump with fitting) and (reducer with fitting)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:05
S56	5,221	electric$4 with hydraulic$4 with pump and plunger	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:08
S57	10	electric$4 with hydraulic$4 with pump and multi-plunger	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2021/01/08 21:08

			DERWENT; IBM_TDB			
S58	6	electric$4 with hydraulic$4 with pump and (multi-plunger duplex triplex) with pump and pump with fitting and hose with fitting	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:12
S59	12	electric$4 with pump and (multi-plunger duplex triplex) with pump and pump with fitting and hose with fitting and pump with (hydraulic$4 fractur$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:30
S60	11	electric$4 with pump and (multi-plunger duplex triplex) with pump and pump with fitting and pump with hose and hose with fitting and pump with (hydraulic$4 fractur$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:45
S61	42,111	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:54
S62	8	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump and hose and fitting and reduc$4 with fitting and hose with fitting and hose with pump	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:55
S63	5	(US-10563490-$ or US-10760557-$ or US-9316216-$ or US-8469108-$ or US-3652188-$).did.	USPAT	OR	ON	2021/01/08 21:55
S64	8	S62 and reduc$4 with fitting and hose with fitting and hose with pump	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:56
S65	5	S63 and reduc$4 with fitting and hose with fitting and hose with pump	US-PGPUB; USPAT;	OR	ON	2021/01/08 21:56

			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
S66	0	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump and hose and fitting and (union shank reduc$3) with fitting and hose with fitting and hose with pump and (reduc$3 with (union shank))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 22:09
S67	15	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump and hose and fitting and ((reduc$3 with (union shank))(union shank reduc$3) with fitting) and hose with fitting and hose with pump	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 22:10
S68	10	(US-20190055938-$ or US-20060021659-$).did. or (US-10102471-$ or US-9932981-$ or US-10563490-$ or US-10760557-$ or US-9316216-$ or US-8469108-$ or US-3652188-$).did. or (US-20150247497-$).did.	US-PGPUB; USPAT; DERWENT	OR	ON	2021/01/08 22:14
S69	10	S68 and ((reduc$3 with (union shank))(union shank reduc$3) with fitting) and hose with fitting and hose with pump	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 22:14
S70	3	"20170218727"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 22:27
S74	4	("20030000759" | "20140174691" | "20170302218" | "6560131").PN.	US-PGPUB; USPAT	OR	ON	2021/03/04 08:09
S75	3	"20180183219"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/04 14:49

S76	1	("20030000759" | "20140174691" | "20170302218" | "6560131").PN. and pump same (plunger hose fitting)	US-PGPUB; USPAT	OR	ON	2021/03/04 14:51

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S71	7	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump and hose and fitting and reduc$4 with fitting and hose with fitting and hose with pump	USPAT	OR	ON	2021/01/08 21:58
S72	23,674	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump and hose and fitting and (union shank reduc$3) with fitting and hose with fitting and hose with pump reduc$3 with fitting	USPAT	OR	ON	2021/01/08 22:09
S73	0	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump and hose and fitting and (union shank reduc$3) with fitting and hose with fitting and hose with pump and (reduc$3 with (union shank))	USPAT	OR	ON	2021/01/08 22:09

3/23/2021 9:30:26 PM
C:\Users\alembo\Documents\EAST\Workspaces\16 728359 - SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE.wsp

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16728359
Filing Date	2019-12-27
First Named Inventor	Jared OEHRING
Art Unit	3679
Examiner Name	Aaron Lloyd LEMBO
Attorney Docket Number	047158.100066

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	9506333	B2	2016-11-29	Castillo et al.	
	2	3878884		1975-04-22	Raleigh	
	3	9062545	B2	2015-06-23	Roberts et al.	
	4	5439066		1995-08-08	Gipson	
	5	10221639	B2	2019-03-05	Romer et al.	
	6	10408030	B2	2019-09-10	Oehring et al.	
	7	10408031	B2	2019-09-10	Oehring et al.	
	8	6985750	B1	2006-01-10	Vicknair et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.L.L./

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	Application Number	16728359
	Filing Date	2019-12-27
	First Named Inventor	Jared OEHRING
	Art Unit	3679
	Examiner Name	Aaron Lloyd LEMBO
	Attorney Docket Number	047158.100066

	9	10740730	B2	2020-08-11	Altamirano et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20160326853	A1	2016-11-10	Fred et al.	
	2	20190249527	A1	2019-08-15	Kraynek	
	3	20170082033	A1	2017-03-23	Wu et al.	
	4	20170370639	A1	2017-12-28	Barden et al.	
	5	20180312738	A1	2018-11-01	Rutsch et al.	
	6	20180181830	A1	2018-06-28	Laharuka et al.	
	7	20170212535	A1	2017-07-27	Shelman et al.	
	8	20180298731	A1	2018-10-18	Bishop	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.L.L./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16728359
	Filing Date	2019-12-27
	First Named Inventor	Jared OEHRING
	Art Unit	3679
	Examiner Name	Aaron Lloyd LEMBO
	Attorney Docket Number	047158.100066

	9	20110110793	A1	2011-05-11	Leugemors et al.	
	10	20190154020	A1	2019-05-23	Glass	
	11	20080277120	A1	2008-11-13	Hickie	
	12	20180090914	A1	2018-03-29	Johnson et al.	
	13	20180259080	A1	2018-09-13	Dale et al.	
	14	20180284817	A1	2018-10-04	Cook et al.	
	15	20130284455	A1	2013-10-31	Kajaria et al.	
	16	20180266217	A1	2018-09-18	Funkhauser et al.	

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	1	2018044307	WO	A1	2018-03-08	Evolution Well Services, LLC		

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Filing Date	2019-12-27
	First Named Inventor	Jared OEHRING
	Art Unit	3679
	Examiner Name	Aaron Lloyd LEMBO
	Attorney Docket Number	047158.100066

	2	2018213925	WO	A1	2018-11-29	Rouse Industries Inc.		
	3	104196613	CN	A	2014-12-10	SJ PETROLEUM MACHINERY CO LTD	English-language abstract	

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	1	Morris et al., 62/526,869; Hydration-Blender Transport and Electric Power Distribution for Fracturing Operation; 28 June 2018; USPTO; see entire document	
	2	Final Office Action mailed February 4, 2021 in US 16/597,014	
	3	International Search Report and Written Opinion mailed February 4, 2021 in PCT/US20/59834	
	4	International Search Report and Written Opinion mailed February 2, 2021 in PCT/US20/58906	
	5	International Search Report and Written Opinion mailed February 3, 2021 in PCT/US20/58899	
	6	Non-Final Office Action mailed January 29, 2021 in US 16/564,185	
	7	Final Office Action mailed January 21, 2021 in US 16/458,696	

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	Attorney Docket Number	047158.100066

	8	Final Office Action mailed January 11, 2021 in US 16/404,283
	9	Non-Final Office Action mailed January 4, 2021 in US 16/522,043
	10	International Search Report and Written Opinion mailed December 14, 2020 in PCT/US2020/53980

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Examiner Signature	/AARON L LEMBO/	Date Considered	03/23/2021

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Attorney Docket Number	047158.100066

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X See attached certification statement.

X The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Taylor P. Evans/	Date (YYYY-MM-DD)	2021-03-10
Name/Print	Taylor P. Evans	Registration Number	60506

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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First Named Inventor	Jared OEHRING
Art Unit	3679
Examiner Name	Aaron Lloyd LEMBO
Attorney Docket Number	047158.100066

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	1	9506333	B2	2016-11-29	Castillo et al.	
	2	3878884		1975-04-22	Raleigh	
	3	9062545	B2	2015-06-23	Roberts et al.	
	4	5439066		1995-08-08	Gipson	
	5	10221639	B2	2019-03-05	Romer et al.	
	6	10408030	B2	2019-09-10	Oehring et al.	
	7	10408031	B2	2019-09-10	Oehring et al.	
	8	6985750	B1	2006-01-10	Vicknair et al.	

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	9	10740730	B2	2020-08-11	Altamirano et al.	

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	1	20160326853	A1	2016-11-10	Fred et al.	
	2	20190249527	A1	2019-08-15	Kraynek	
	3	20170082033	A1	2017-03-23	Wu et al.	
	4	20170370639	A1	2017-12-28	Barden et al.	
	5	20180312738	A1	2018-11-01	Rutsch et al.	
	6	20180181830	A1	2018-06-28	Laharuka et al.	
	7	20170212535	A1	2017-07-27	Shelman et al.	
	8	20180298731	A1	2018-10-18	Bishop	

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Name/Print	Taylor P. Evans	Registration Number	60506

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(19)中华人民共和国国家知识产权局

(12)发明专利申请

(10)申请公布号 CN 104196613 A
(43)申请公布日 2014.12.10

(21)申请号 201410416378.X

(22)申请日 2014.08.22

(71)申请人 中石化石油工程机械有限公司第四机械厂
地址 434020 湖北省荆州市荆州区四机路1号

(72)发明人 李莉莉 吴汉川 许亚彬 彭平生 雷刚 刘灼 范杰 陈勇 王云海

(74)专利代理机构 荆州市技经专利事务所 42219
代理人 韩志刚

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F01P 7/04(2006.01)
F01M 5/00(2006.01)
F02M 31/20(2006.01)
F15B 21/04(2006.01)
F16H 57/04(2010.01)
E21B 43/26(2006.01)

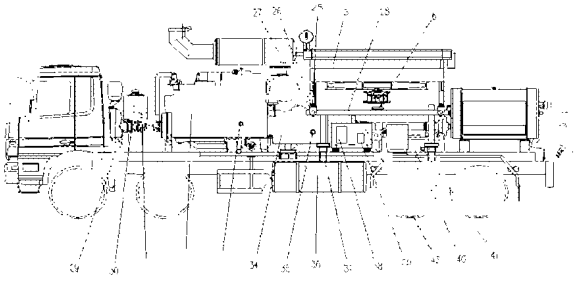
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(54)发明名称

一种压裂车冷却装置

(57)摘要

本发明提供了一种压裂车冷却装置。所述压裂车集成冷却装置的支架用螺栓通过减震垫与连接座和底盘大梁连接架相连接，底盘大梁连接架下方装有控制装置和装有带润滑油油温传感器的润滑油箱，车大梁的下部装有带燃油油温传感器的燃油箱，车大梁的上前部装有带液压油油温传感器的液压油箱，液压油箱的下部装有电控变量液压泵，电控变量液压泵与带有水温传感器的发动机相连接，发动机的另一侧装有带传动箱油温传感器的传动箱。卧式散热器上分别装有发动机水冷却装置、动力端冷却装置、液压冷却装置、燃油冷却装置和传动箱冷却装置。该装置采用卧式结构且集中散热方式，合理布置冷却系统的管路，满足车载压裂设备重量及安装空间的要求。



CN 104196613 A

1. 一种压裂车冷却装置，包括发动机缸套水冷却装置（1）、发动机中冷水冷却装置（2）、卧式散热器（3）、膨胀水箱（4）、液位计（5）、马达（6）、风扇（7）、出水口（8）、动力端冷却装置（9）、液压冷却装置（10）、燃油冷却装置（11）、传动箱冷却装置（12）、支架（24）、减震垫（26）、底盘大梁连接架（28）、电控变量液压泵（29）、液压油箱（30）、发动机（32）、传动箱（34）、燃油箱（36）、可编程控制器（38）、放大器（39）、润滑油箱（40）、压裂车集成冷却装置（42）和控制装置（43），其特征在于：所述压裂车集成冷却装置（42）的支架（24）用螺栓（25）通过减震垫（26）与连接座（27）相连接，连接座（27）焊接在底盘大梁连接架（28）上，底盘大梁连接架（28）下方装有控制装置（43），控制装置（43）的一侧装有带润滑油油温传感器（41）的润滑油箱（40），压裂车大梁的下部装有带燃油油温传感器（37）的燃油箱（36），压裂车大梁的上前部装有带液压油油温传感器（31）的液压油箱（30），液压油箱（30）的下部装有电控变量液压泵（29），电控变量液压泵（29）与带有水温传感器（33）的发动机（32）相连接，发动机（32）的另一侧装有带传动箱油温传感器（35）的传动箱（34）。

2. 根据权利要求 1 所述的压裂车冷却装置，其特征在于：所述的压裂车集成冷却装置（42）在支架（24）的上部装有发动机缸套水冷却装置（1），发动机缸套水冷却装置（1）的上部一侧装有带液位针（5）的膨胀水箱（4），另一侧装有出水口（8），发动机缸套水冷却装置（1）的下部装有发动机中冷水冷却装置（2），发动机中冷水冷却装置（2）的下部装有卧式散热器（3），卧式散热器（3）的下部装有与马达（6）相连接的风扇（7），马达（6）用管线与电控变量液压泵（29）相连接。

3. 根据权利要求 1 或 2 所述的压裂车冷却装置，其特征在于：所述的卧式散热器（3）上分别装有动力端冷却装置（9）、液压冷却装置（10）、燃油冷却装置（11）和传动箱冷却装置（12）。

4. 根据权利要求 1 所述的压裂车冷却装置，其特征在于：所述的发动机中冷水冷却装置（2）左侧开有发动机缸套进水口（13）、中冷器进水口（14）和中冷器出水口（15），卧式散热器（3）左侧面开有润滑油进油口（16）、润滑油出油口（17）、液压油进油口（18）和液压油出油口（19），卧式散热器（3）的右侧面开有传动箱进油口（20）、传动箱出油口（21）、燃油进油口（22）和燃油出油口（23）。

5. 根据权利要求 1 所述的压裂车冷却装置，其特征在于：所述的控制装置（43）内装有可编程控制器（38）和放大器（39），可编程控制器（38）分别用数据线与液压油油温传感器（31）、水温传感器（33）、传动箱油温传感器（35）、燃油箱油温传感器（37）和润滑油油温传感器（41）相连接，放大器（39）用导线与电控变量液压泵（29）相连接。

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一种压裂车冷却装置

技术领域

[0001] 本发明涉及到油井压裂设备领域，特别涉及到一种压裂车冷却装置。

背景技术

[0002] 压裂车冷却装置是压裂车的一个重要组成部分，直接关系到压裂车的整车使用效率。由于国内没有超过2000hp的大功率车用发动机，因此国内的大型压裂设备上的动力配置全部采用进口发动机以及传动箱。而由于国外的道路状况较好，压裂设备的整车长度和质量不受限制，设备多采用拖车结构，因此国外配置的冷却系统采用立式结构；而国内的道路状况不好，限制了压裂车的质量和整车长度，冷却系统如果也采用国外动力配套厂家提供的立式冷却系统，是不能满足车载压裂车关于质量和体积限制，整车的移动性能无法适应我国油田道路工况的要求。

[0003] 压裂车立式冷却系统均为风冷，由车台发动机或底盘发动机提供动力，采用液压马达驱动风扇冷却系统，为压裂车上的发动机缸套水、中冷器水、传动箱油、动力端润滑油和液压油冷却。风扇冷却系统的转速由液压马达决定，主要有两种方式：一种风扇转速始终恒定，另一种风扇有高低速（250rpm和750rpm）两个档位，这两种风扇冷却系统按压裂车设定的转速工作。风扇冷却系统的转速不能根据环境温度的变化和设备使用状况的变化进行调节，冷却系统存在较大的功率浪费。例如在寒冷的冬天或设备使用功率低于额定功率的50％时，系统产生的热量较小，风扇没有必要高速运转而消耗能量。另一方面在风扇马达启动时，风扇转速瞬时增加到额定转速，冲击较大，容易损坏马达花键轴，设备维护保养难度和费用增加。

发明内容

[0004] 本发明的目的在于提供一种压裂车冷却装置，其目的一为：采用卧式结构并集成发动机、传动箱、液压箱、润滑油箱和燃油箱的冷却为一体；目的二为：解决车载设备的重量及体积的限制，使压裂车能有较好的通过行驶性能。

[0005] 为实现上述目的，本发明的技术方案为：

一种压裂车冷却装置，包括发动机缸套水冷却装置、发动机中冷水冷却装置、卧式散热器、膨胀水箱、液位计、马达、风扇、出水口、动力端冷却装置、液压冷却装置、燃油冷却装置、传动箱冷却装置、支架、减震垫、底盘大梁连接架、电控变量液压泵、液压油箱、发动机、传动箱、燃油箱、可编程控制器、放大器、润滑油箱、压裂车集成冷却装置和控制装置，所述压裂车集成冷却装置的支架用螺栓通过减震垫与连接座相连接，连接座焊接在底盘大梁连接架上，底盘大梁连接架下方装有控制装置，控制装置的一侧装有带润滑油油温传感器的润滑油箱，压裂车大梁的下部装有带燃油油温传感器的燃油箱，压裂车大梁的上前部装有带液压油油温传感器的液压油箱，液压油箱的下部装有电控变量液压泵，电控变量液压泵与带有水温传感器的发动机相连接，发动机的另一侧装有带传动箱油温传感器的传动箱。

[0006] 所述的压裂车集成冷却装置在支架的上部装有发动机缸套水冷却装置，发动机

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缸套水冷却装置的上部一侧装有带液位针的膨胀水箱，另一侧装有出水口，发动机缸套水冷却装置的下部装有发动机中冷水冷却装置，发动机中冷水冷却装置的下部装有卧式散热器，卧式散热器的下部装有与电机相连接的风扇，马达用管线与电控变量液压泵相连接。

[0007] 所述的卧式散热器上分别装有发动机水冷却装置、动力端冷却装置、液压冷却装置、燃油冷却装置和传动箱冷却装置。

[0008] 所述的发动机中冷水冷却装置左侧开有发动机缸套进水口、中冷水进水口和中冷水出水口，卧式散热器左侧面开有润滑油进油口、润滑油出油口、液压油进油口和液压油出油口，卧式散热器的右侧面开有传动箱进油口、传动箱出油口、燃油进油口和燃油出油口。

[0009] 所述的控制装置内装有可编程控制器和放大器，可编程控制器分别用数据线与液压油油温传感器、水温传感器、传动箱油温传感器、燃油箱油温传感器和润滑油油温传感器相连接，放大器用导线与电控变量液压泵相连接。

[0010] 本发明的积极效果为：

1、该装置采用卧式结构，采用液压系统驱动，传动平稳，控制可靠；采用集中散热方式，在满足系统冷却能力的基础上，合理布置冷却系统的管路，减轻冷却系统的重量，满足车载压裂设备质量及安装空间的要求，使车载压裂设备在国内油田具有良好的通过行驶性，从而加快大型压裂设备国产化的步伐；

2、在发动机、动力端润滑、传动箱、液压油箱和燃油箱处分别设有温度传感器，与可编程控制器、电控变量液压泵相联，实现风扇、马达的无级调速及温度自动控制，降低了发动机的功率损耗，从而达到节能的目的；无级调速使设备启动时风扇更平稳，延长了风扇驱动轴寿命。

附图说明

[0011] 图 1、压裂车冷却装置结构示意图；

图 2、压裂车集成冷却装置主视图；

图 3、卧式散热器俯视图；

图 4、压裂车集成冷却装置左视图；

图 5、压裂车集成冷却装置右视图；

图 6、压裂车冷却装置控制流程框图。

具体实施方式

[0012] 下面结合附图 1-6 进一步说明本发明的具体实施方式。

[0013] 参见图 1-6，工作前，首先检查支架 24 是否用螺栓 25 与焊在底盘大梁连接架 28 上的连接座 27 连接牢固，同时检查减震垫 26 是否装好，在控制装置 43 中的可编程控制器 38 内输入液压油油温传感器 31、水温传感器 33、传动箱传感器 35、燃油油温传感器 37 和润滑油油温传感器 41 的参数控制值。工作时，发动机缸套水冷却装置 1 中的冷却水由发动机缸套进水口 13 进入发动机 32 中进行内部循环，然后再进入卧式散热器 3 中，通过散热通道将水中热量散发，使水冷却，最后从出水口 8 中排出。发动机中冷水冷却装置 2 的冷却水从中冷水进水口 14 进入发动机 32 中进行内部循环，然后再进入卧式散热器 3 中，通过散热通道将水中热量散发，最后从中冷水出水口 15 中排出。压裂车集成冷却装置 42 上部所装的膨

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胀水箱 4，用于发动机缸套水冷却装置 1 和发动机中冷水冷却装置 2 的补水及排出冷却水中的气体，安装的液位计 5 用于观察冷却系统内的水位的高低。润滑油箱 40 中的润滑油从润滑油进油口 16 进入动力端冷却装置 9 中散热，散热后润滑油由润滑油出油口 17 流回到润滑油箱 40 中。液压油箱 30 中的液压油从液压油进油口 18 进入液压冷却装置 10 中散热，散热后的液压油由液压油出油口 19 流回到液压油箱 30 中。传动箱 34 中的油从传动箱进油口 20 进入传动箱冷却装置 12 中散热，散热后由传动箱出油口 21 流回传动箱 34 中。燃油箱 36 中的燃油从燃油进油口 22 进入燃油冷却装置 11 中散热，散热后由燃油出油口 23 流回燃油箱 36 中。

[0014] 压裂车冷却装置通过安装在液压油箱 30 上的液压油油温传感器 31 感应液压冷却装置 10 中的温度，通过安装在发动机 32 上的水温传感器 33 感应发动机缸套水冷却装置 1、发动机中冷水冷却装置 2 中的温度，通过安装在传动箱 34 上的传动箱油温传感器 35 感应传动箱冷却装置 12 中的温度，通过安装在燃油箱 36 上的燃油箱油温传感器 37 感应燃油冷却装置 11 中的温度，通过安装在润滑油箱 40 上的润滑油油温传感器 41 感应动力端冷却装置 9 中的温度。压裂车工作时，上述五个温度传感器分别测量发动机水温、燃油系统油温、动力端润滑油温、传动箱油温和液压油温，并将测量数值通过数据线输入可编程控制器 38 中，可编程控制器 38 接收到 5 个不同介质的温度模拟信号后，通过对 5 个温度值进行上、下限分析比较后，输出所需的电压信号，通过放大器 39 将可编程控制器 38 输出的电压信号转换成电流信号，并经导线输出至电控变量液压泵 29 处，此时电控变量液压泵 29 根据需要驱动卧式散热器 3 上的马达 6，且带动风扇 7 转动，开始对动力端冷却装置 9、液压冷却装置 10、发动机缸套水冷却装置 1、发动机中冷水冷却装置 2、燃油冷却装置 11 和传动箱冷却装置 12 进行散热冷却。通过调节电控变量液压泵 29 的流量，即可改变卧式散热器 3 上的马达 6 和风扇 7 的转速，从而实现马达 6 和风扇 7 转速的自动控制。

[0015] 以上所述仅是本发明的非限定实施方式，对于本领域的普通技术人员来说，在不脱离本发明创造构思和不作出创造性劳动的前提下，还可以做出若干变形和改进，这些都属于本发明的保护范围。

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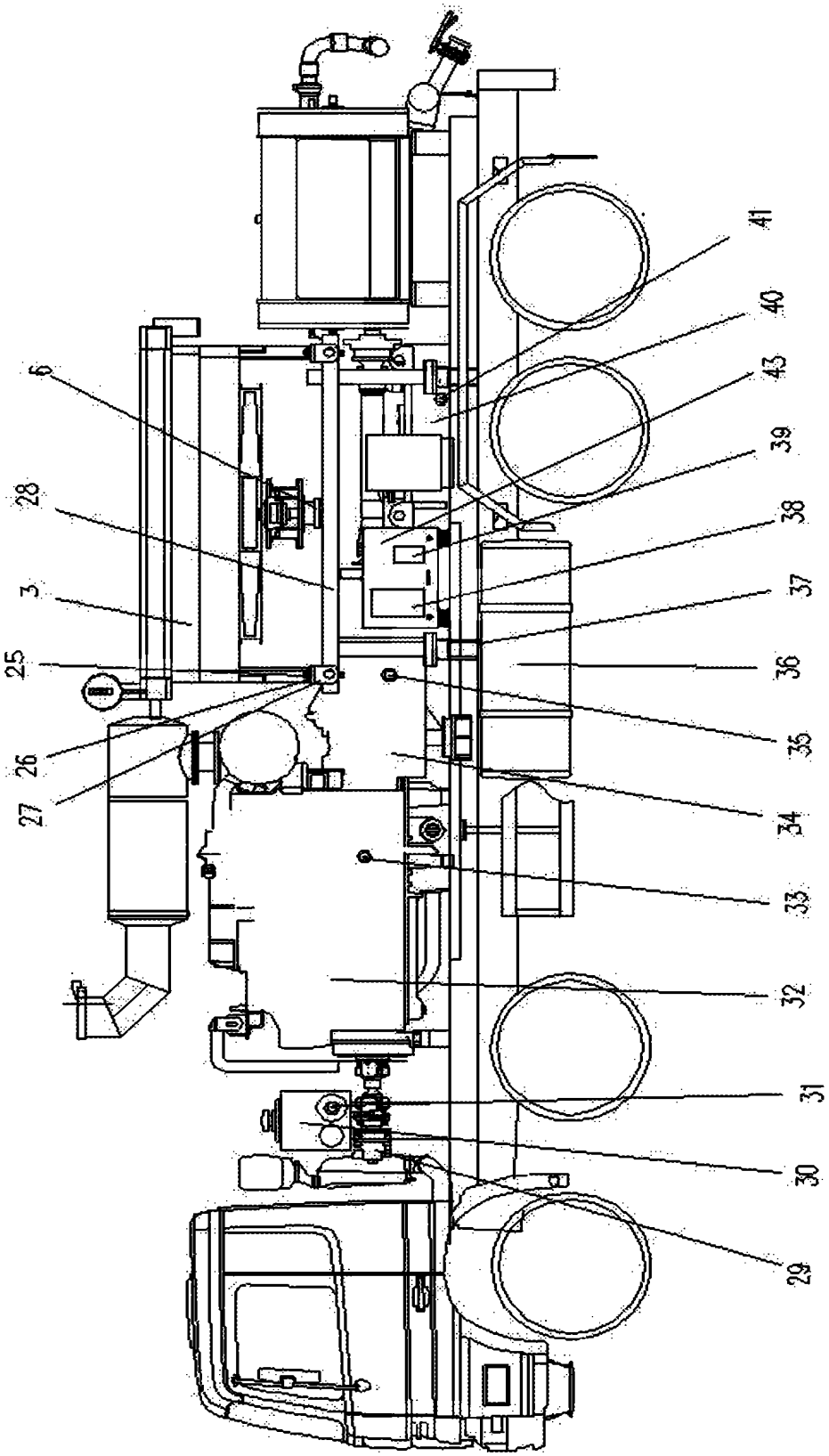


图 1

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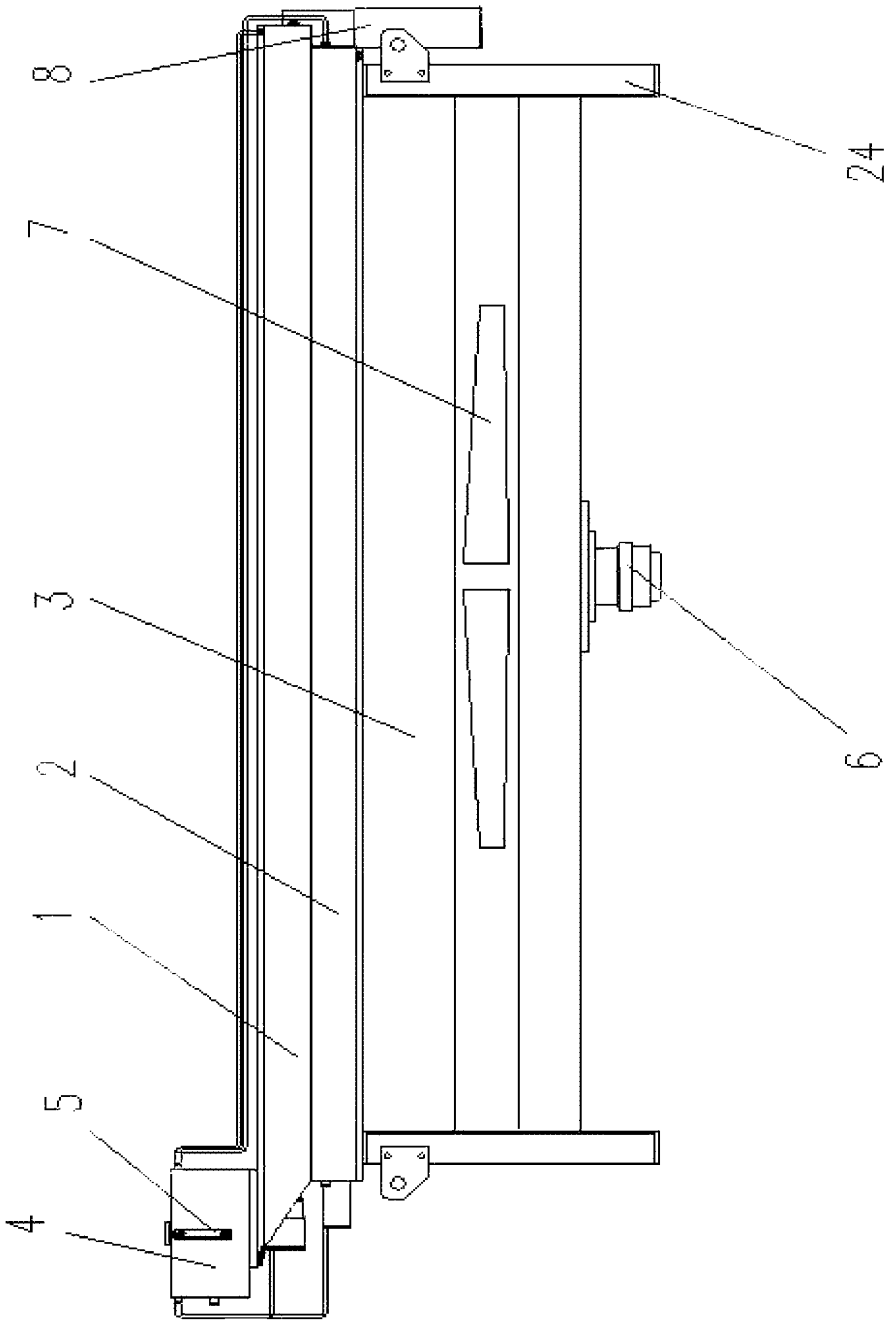


图 2

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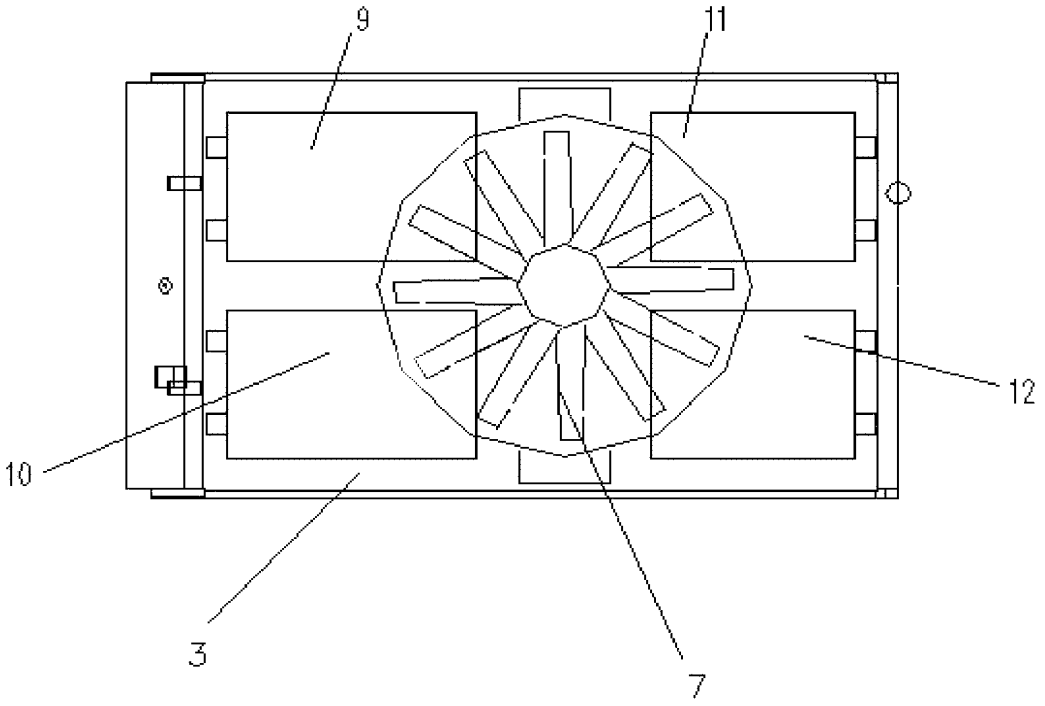


图 3

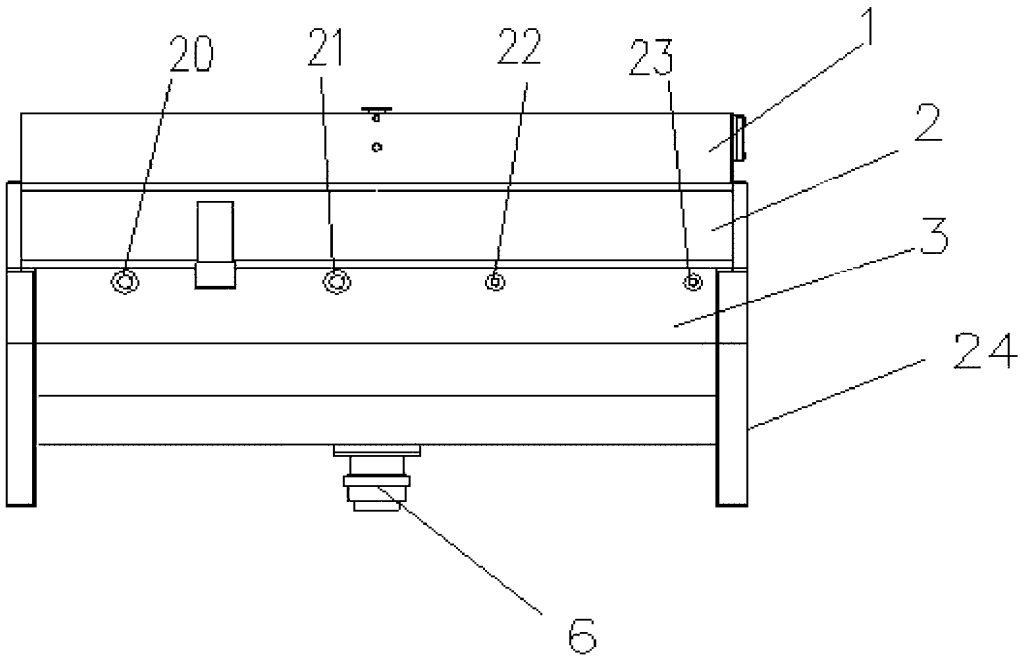


图 4

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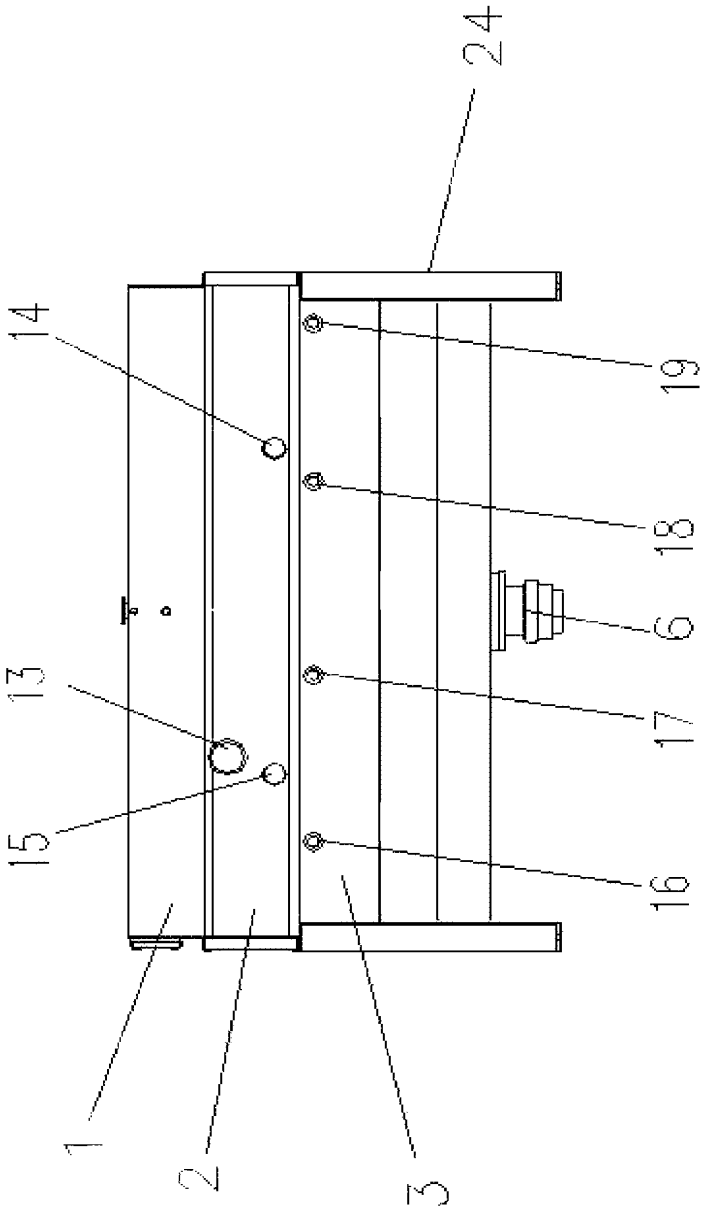


图 5

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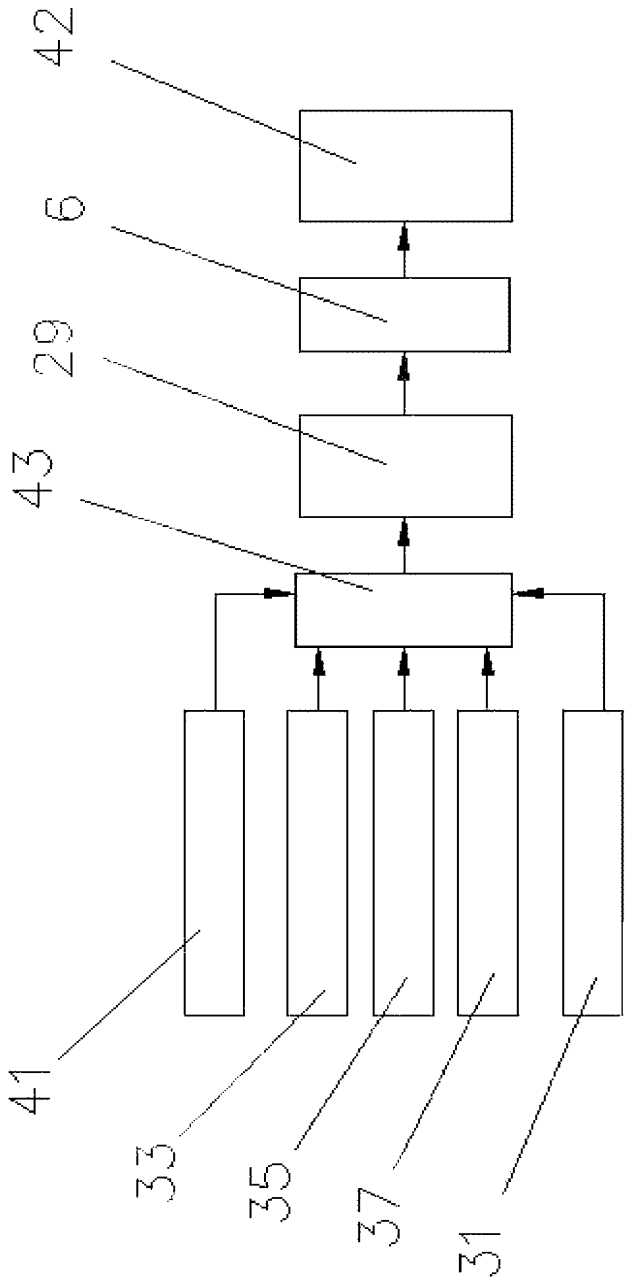


图 6

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Espacenet

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Cooling device of fracturing truck

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Classification: - international: ***E21B43/26; F01M5/00; F01P7/04; F02M31/20; F15B21/04; F16H57/04***
- cooperative: **E21B43/2607 (EP)**

Application number: CN201410416378 20140822 Global Dossier

Priority number(s): CN201410416378 20140822

Abstract of CN104196613 (A)

The invention provides a cooling device of a fracturing truck. A support of the integrated cooling device of the fracturing truck is connected with a connection base and a chassis crossbeam connection frame through a shock pad by means of a bolt, a control device and a lubrication oil tank provided with a lubrication oil temperature sensor are arranged below the chassis crossbeam connection frame, a fuel tank provided with a fuel temperature sensor is arranged at the lower portion a truck crossbeam, the upper front portion of the truck crossbeam is provided with a hydraulic oil tank provided with a hydraulic oil temperature sensor, an electrically-controlled volume adjustable hydraulic pump is arranged at the lower portion of the hydraulic oil tank, the electrically-controlled volume adjustable hydraulic pump is connected with an engine provided with a water temperature sensor, and the other side of the engine is provided with a transmission tank provided with a transmission tank oil temperature sensor. A horizontal heat sink is respectively provided with an engine water-cooling device, a power end cooling device, a hydraulic cooling device, a fuel cooling device and a transmission tank cooling device. According to the cooling device of the fracturing truck, a horizontal structure and a concentrated heat dissipation mode are adopted, a pipeline of a cooling system is arranged reasonably, and the requirements for the weight and installation space of vehicle-mounted fracturing equipment are met.

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To: TAYLOR P. EVANS
HOGAN LOVELLS US LLP
609 MAIN STREET, SUITE 4200
HOUSTON, TX 77002

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Date of mailing *(day/month/year)*	04 FEB 2021
Applicant's or agent's file reference: 047168.500068	FOR FURTHER ACTION See paragraphs 1 and 4 below
International application No.: PCT/US 20/59834	International filing date *(day/month/year)*: 10 November 2020 (10.11.2020)
Applicant: U.S. WELL SERVICES, LLC	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   How? Directly to the International Bureau preferably through ePCT, or on paper to:
   The International Bureau of WIPO, 34, chemin des Colombettes, 1211 Geneva 20, Switzerland

   For more detailed instructions, see the *PCT Applicant's Guide*, International Phase, paragraphs 9.004 – 9.011.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ With regard to any protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:
   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with any request to forward the texts of both the protest and the decision thereon to the designated Offices.
   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

   Shortly after the expiration of 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

   Within 19 months from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later); otherwise, the applicant must, within 20 months from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices. In respect of other designated Offices, the time limit of 30 months (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

   Within 22 months from the priority date, the applicant may request that a supplementary international search be carried out by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Lee Young Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/220 (revised January 2020)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION
047158.500069	see Form PCT/ISA/220 as well as, where applicable, item 5 below.

International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/US 20/59634	10 November 2020 (10.11.2020)	18 November 2019 (18.11.2019)

Applicant
U.S. WELL SERVICES, LLC

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the language, the international search was carried out on the basis of:

☒ the international application in the language in which it was filed.

☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

b. ☐ This international search report has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

c. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, see Box No. I.

2. ☐ Certain claims were found unsearchable (see Box No. II).

3. ☐ Unity of invention is lacking (see Box No. III).

4. With regard to the title,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the drawings,

a. the figure of the drawings to be published with the abstract is Figure No. 1

☒ as suggested by the applicant.

☐ as selected by this Authority, because the applicant failed to suggest a figure.

☐ as selected by this Authority, because this figure better characterizes the invention.

b. ☐ none of the figures is to be published with the abstract.

Form PCT/ISA/210 (first sheet) (July 2019)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 20/59834

A. CLASSIFICATION OF SUBJECT MATTER
IPC - E21B 43/26 (2021.01)
CPC - E21B 43/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2014/0290768 A1 (FTS International Services, LLC) 2 October 2014 (02.10.2014) Entire document especially para [0025]-[0031] and figs. 1A-3	1-15
Y	US 2018/0298731 A1 (MGB Oilfield Solutions, L.L.C.) 18 October 2018 (18.10.2018) Entire document especially para [0072]-[0083] and fig. 1	1-15
Y	US 2014/0277772 A1 (Schlumberger Technology Corporation) 18 September 2014 (18.09.2014) Entire document especially para [0034], [0048] and figs. 1-7	4
Y	US 2018/0259080 A1 (Dale et al.) 13 September 2018 (13.09.2018) Entire document especially para [0044]-[0045], [0074]-[0075] and fig. 1	5, 10
Y	US 2018/0284817 A1 (FMC Technologies, Inc.) 4 October 2018 (04.10.2018) Entire document especially para [0017], [0026], [0029], [0031], [0043] and figs. 2-5	6, 7, 9
A	US 2013/0284455 A1 (GE Oil & Gas Pressure Control LP) 31 October 2013 (31.10.2013) Entire document	1-15
A	US 2018/0266217 A1 (Halliburton Energy Services, Inc) 20 September 2018 (20.09.2018) Entire document	1-15
A	US 2016/0102537 A1 (Schlumberger Technology Corporation) 14 April 2016 (14.04.2016) Entire document	1-15

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 January 2021 (04.01.2021)	04 FEB 2021
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Lee Young Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/210 (second sheet) (July 2019)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: TAYLOR P. EVANS
HOGAN LOVELLS US LLP
609 MAIN STREET, SUITE 4200
HOUSTON, TX 77002

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	04 FEB 2021
Applicant's or agent's file reference 047158.500069	FOR FURTHER ACTION See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 20/59834	10 November 2020 (10.11.2020)	18 November 2019 (18.11.2019)

International Patent Classification (IPC) or both national classification and IPC
IPC - E21B 43/26 (2021.01)
CPC - E21B 43/26

Applicant U.S. WELL SERVICES, LLC

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	4 January 2021 (04.01.2021)	Lee Young PCT Help Desk Telephone No. 571-272-4300

Form PCT/ISA/237 (cover sheet) (revised January 2019)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/59834

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(b)).

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/59834

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement**

1. **Statement**

Novelty (N)	Claims	1-15	YES
	Claims	None	NO
Inventive step (IS)	Claims	None	YES
	Claims	1-15	NO
Industrial applicability (IA)	Claims	1-15	YES
	Claims	None	NO

2. Citations and explanations:

Claims 1-3, 8 and 11-15 lack an inventive step under PCT Article 33(3) as being obvious over US 2014/0290768 A1 to FTS International Services, LLC (hereinafter 'FTS') in view of US 2018/0298731 A1 to MGB Oilfield Solutions, L.L.C. (hereinafter 'MGB')

Regarding Claim 1, FTS teaches a hydraulic fracturing valve control system (See figs. 1A-3; para [0025]) comprising:
an electric powered, plunger hydraulic fracturing pump (102 - "pumps", fig. 1A; para [0029] - powered by electric motor);
a manifold (104 - "manifold", fig. 1A) coupled to the hydraulic fracturing pump (See fig. 1A; para [0025], [0033]);
a valve (108 - "isolation valves", fig., 1A) associated with the manifold (See fig. 1A; para [0025]), the valve being operable to move between an open position, a closed position, and a plurality of intermediate positions (para [0027], [0038] - "open", "closed", "intermediate position"; valves 108 are operable to move between the open position, the closed position and will move into a number of intermediate positions during a transition from open to closed);
a valve actuator (122 - "actuation means", fig. 1B; para [0026]), coupled to the valve (See fig. 1B), the valve actuator being an electric actuator (para [0026]-[0027], [0030]) that is remotely controllable in response to one or more operational aspects of the hydraulic fracturing pump (para [0025], [0031]; See fig. 1C); and
a control interface (116 - "control panel", fig. 1C; para [0031]), the control interface forming at least a portion of a control system (114 - "treater truck", fig. 1A, 1C), the control interface being accessible from a location remote from the hydraulic fracturing pump and outside of a zone of pressure formed by the hydraulic fracturing pump during operation (See fig. 1A; para [0025], [0031]) but does not specifically teach wherein the hydraulic fracturing pump is a multi-plunger hydraulic fracturing pump.
Further, MGB teaches a hydraulic fracturing valve control system (See fig. 1; para [0072]-[0073]) comprising an electric powered, multi-plunger hydraulic fracturing pump (12 - "frac pumps", fig. 1; "triplex or quintuplex pumps"; para [0075] - "electric"). Accordingly, it would have been obvious to one of ordinary skill in the art to have the pump of FTS be a multi-plunger pump like that of MGB in order to increase the capacity of the pumps.

Regarding Claim 2, the modified FTS teaches the hydraulic fracturing valve control system of claim 1, further comprising: an interconnect box (120 - "limit switch", fig. 1B; para [0027]) configured to receive a control signal from the control interface and to relay the control signal to the hydraulic fracturing pump (intended use; the limit switch 120 is in communication with the pump 102 and truck 114 and is capable of relaying a signal in either direction).

Regarding Claim 3, the modified FTS teaches the hydraulic fracturing valve control system of claim 2, wherein the interconnect box (120 - "limit switch", fig. 1B) is arranged at a data van or the manifold (See figs. 1A and 1C; switch 120 is at valve 108 which is at the manifold 104).

Regarding Claim 8, the modified FTS teaches the hydraulic fracturing valve control system of claim 1, but does not specifically teach wherein operational power for the valve actuator is provided via the hydraulic fracturing pump. Further, MGB teaches a hydraulic fracturing valve control system (See fig. 1; para [0072]-[0073]) wherein operation power for a valve actuator (para [0079] - "actuator") is provided via a hydraulic fracturing pump (para [0079] - actuator receives power from motor or pneumatic source affixed to valve 103 which is a part of frac pumps 105). Accordingly, it would have been obvious to one of ordinary skill in the art to have the power for the valve actuator to be provided from the hydraulic fracturing pump in order to reduce the complexity of the wellsite layout by reducing the number of cables.

-*-Continued in Supplemental Box-*

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/59834

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
-*-Supplemental Box - Box V.2 - Citations and Explanations-*-

Regarding Claim 11, FTS teaches a hydraulic fracturing valve control system (See figs. 1A-3; para [0025]) comprising:
a plurality of electric powered, plunger hydraulic fracturing pumps (102 - "pumps", fig. 1A; para [0029] - powered by electric motor);
a manifold (104 - "manifold", fig. 1A) coupled to the plurality of hydraulic fracturing pumps (See fig. 1A; para [0025], [0033]);
a plurality of valves (108 - "isolation valves", fig., 1A) associated with the manifold (See fig. 1A; para [0025]), each valve of the plurality of valves being operable to move between an open position, a closed position, and a plurality of intermediate positions (para [0027], [0038] - "open", "closed", "intermediate position"; valves 108 are operable to move between the open position, the closed position and will move into a number of intermediate positions during a transition from open to closed);
a plurality of valve actuators (122 - "actuation means", fig. 1B; para [0026]), coupled to respective valves of the plurality of valves (See fig. 1B), each of the valve actuators being electric actuators (para [0026]-[0027], [0030]) configured to be remotely controllable in response to one or more operational aspects of at least one hydraulic fracturing pump of the plurality of hydraulic fracturing pumps (para [0025], [0031]; See fig. 1C); and
a control interface (116 - "control panel", fig. 1C; para [0031]), the control interface forming at least a portion of a control system (114 - "treater truck", fig. 1A, 1C), the control interface being accessible from a location remote from the plurality of hydraulic fracturing pumps and outside of a zone of pressure formed by the plurality of hydraulic fracturing pumps during operation (See fig. 1A; para [0025], [0031]) but does not specifically teach wherein the fracturing pu mps are multi-plunger pumps.
Further, MGB teaches a hydraulic fracturing valve control system (See fig. 1; para [0072]-[0073]) comprising an electric powered, multi-plunger hydraulic fracturing pump (12 - "frac pumps", fig. 1; "triplex or quintuplex pumps", para [0075] - "electric"). Accordingly, it would have been obvious to one of ordinary skill in the art to have the pump of FTS be a multi-plunger pump like that of MGB in order to increase the capacity of the pumps.

Regarding Claim 12, the modified FTS teaches the hydraulic fracturing valve control system of claim 11, and FTS further teaches wherein each hydraulic fracturing pump of the plurality of hydraulic fracturing pumps (102 - "pumps", fig. 1A) is associated with a single respective valve actuator of the plurality of valve actuators (See figs. 1A-B; see how each pump 102 has a valve 108 and each valve 108 has an actuator 122), the respective hydraulic fracturing pump relaying a control signal to the single respective valve actuator (See fig. 1A; para [0027]-[0029]).

Regarding Claim 13, the modified FTS teaches the hydraulic fracturing valve control system of claim 11, and FTS further teaches wherein a first hydraulic fracturing pump of the plurality of hydraulic fracturing pumps (See fig. 1A; See pump 102 on lower right of figure) is coupled to the control interface via a first connection (See fig. 1A; see connection cord that extends from lower right pump 102, around wellhead 112 and connects to truck 114) and the first hydraulic fracturing pump of the plurality of hydraulic fracturing pumps (See fig. 1A; See pump 102 on lower right of figure) is coupled to a first valve actuator (See figs. 1A-B; see top of lower right valve 108 that has actuating means 122 on top) of the plurality of valve actuators via a second connection (See fig. 2; see connection tube that connects lower right pump 102 to lower right valve 108 and thus to actuator 122), different from the first connection (See fig. 1A).

Regarding Claim 14, the modified FTS teaches the hydraulic fracturing valve control system of claim 11, and FTS further teaches the system further comprising: an interconnect box (120 - "limit switch", fig. 1B) configured to transmit a control signal from the control interface to at least one hydraulic fracturing pump of the plurality of hydraulic fracturing pumps (intended use; the limit switch 120 is in communication with the pump 102 and truck 114 and is capable of relaying a signal in either direction), the interconnect box being positioned at the manifold (See figs. 1A and 1C; switch 120 is at valve 108 which is at the manifold 104).

Regarding Claim 15, the modified FTS teaches the hydraulic fracturing valve control system of claim 11, but does not specifically teach where operational power for each valve actuator of the plurality of valve actuators is provided by a respective hydraulic fracturing pump of the plurality of hydraulic fracturing pumps. Further, MGB teaches a hydraulic fracturing valve control system (See fig. 1; para [0072]-[0073]) wherein operation power for a valve actuator (para [0079] - "actuator") is provided via a hydraulic fracturing pump (para [0079] - actuator receives power from motor or pneumatic source affixed to valve 103 which is a part of frac pumps 105). Accordingly, it would have been obvious to one of ordinary skill in the art to have the power for each respective valve actuator to be provided from the respective hydraulic fracturing pump in order to reduce the complexity of the wellsite layout by reducing the number of cables.

Claim 4 lacks an inventive step under PCT Article 33(3) as being obvious over FTS in view of MGB in view of US 2014/0277772 A1 to Schlumberger Technology Corporation (hereinafter 'Schlumberger')

Regarding Claim 4, the modified FTS teaches the hydraulic fracturing valve control system of claim 2, but does not specifically teach wherein an Ethernet connection extends between the interconnect box and the hydraulic fracturing pump. Further, Schlumberger teaches a hydraulic fracturing valve control system (See figs. 1-7; para [0034]) comprising a connection (108 - "communications device", fig. 7) extending between an interconnect box (para [0048] - "switch") and a hydraulic fracturing pump (30 - "pumps", fig. 1); wherein the connection is an ethernet connection (para [0048]). Accordingly, it would have been obvious to one of ordinary skill in the art to use the ethernet connection taught by Schlumberger on the valve control system of FTS in order to ensure there is no interference in the communication between the valve and the control system.

-*-Continued in next Supplemental Box-*-

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/59834

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
-*-Supplemental Box - Box V.2 - Citations and Explanations-*-

Claims 5 and 10 lack an inventive step under PCT Article 33(3) as being obvious over FTS in view of MGB in view of US 2018/0259080 A1 to Dale et al. (hereinafter 'Dale')

Regarding Claim 5, the modified FTS teaches the hydraulic fracturing valve control system of claim 1, but does not specifically teach the system further comprising: an external power source, the external power source providing operational power to the valve actuator in response to a control signal from the control interface. Further, Dale teaches a hydraulic fracturing valve control system (See fig. 1; para [0044]-[0045]) comprising an external power source (para [0074]-[0075] - "batteries") providing operational power to a valve actuator (30 - "valve actuation assembly", fig. 1) in response to a control signal from a control interface (40 - "control system", fig. 1; para [0074]). Accordingly, it would have been obvious to one of ordinary skill in the art to use the external power source of Dale on the valve actuator of the modified FTS in order to provide backup power to the valves to allow closing in the event of main power loss.

Regarding Claim 10, the modified FTS teaches the hydraulic fracturing valve control system of claim 1, but does not specifically teach the system further comprising: a battery backup electrically coupled to the valve actuator, the battery backup providing operational energy to the valve actuator. Further, Dale teaches a hydraulic fracturing valve control system (See fig. 1; para [0044]-[0045]) comprising an a battery backup (para [0074]-[0075] - "batteries") electrically coupled to a valve actuator (30 - "valve actuation assembly", fig. 1) providing operational energy to the valve actuator (para [0074]). Accordingly, it would have been obvious to one of ordinary skill in the art to use the external power source of Dale on the valve actuator of the modified FTS in order to provide backup power to the valves to allow closing in the event of main power loss.

Claims 6, 7 and 9 lack an inventive step under PCT Article 33(3) as being obvious over FTS in view of MGB in view of US 2018/0284817 A1 to FMC Technologies, Inc. (hereinafter 'FMC')

Regarding Claim 6, the modified FTS teaches the hydraulic fracturing valve control system of claim 1, but does not specifically teach the system further comprising: a valve control distribution box, arranged at the manifold, configured to receive control signals from the hydraulic fracturing pump, the valve control distribution box relaying the control signals to the valve actuator. Further, FMC teaches a hydraulic fracturing control valve system (See figs. 2-5; para [0017], [0029]) comprising a valve control distribution box (204 - "auxiliary modular skid", fig. 2; para [0026]; See fig. 5), arranged at a manifold (See fig. 2; arranged with the rest of frac manifold system 200), configured to receive control signals from a hydraulic fracturing pump (intended use: para [0036], [0038]), the valve control distribution box relaying the control signals to a valve actuator (para [0031], [0043] - "actuators"). Accordingly, it would have been obvious to one of ordinary skill in the art to use the valve control distribution box as taught by FMC on the manifold of FTS in order to ensure the appropriate signal is distributed to the appropriate actuator of the valve control system.

Regarding Claim 7, the modified FTS teaches the hydraulic fracturing valve control system of claim 1, but does not specifically teach the system further comprising: a manifold valve control system, the manifold valve control system being communicatively coupled to the control interface and configured to receive control signals from the control interface, the manifold valve control system relaying the control signals to the valve actuator. Further, FMC teaches a hydraulic fracturing control valve system (See figs. 2-5; para [0017], [0029]) comprising a manifold valve control system (204 - "auxiliary modular skid", fig. 2; para [0026]; See fig. 5), the manifold valve control system relaying the control signals to a valve actuator (para [0031], [0043] - "actuators"). Accordingly, it would have been obvious to one of ordinary skill in the art to use the manifold valve control system of FMC on the manifold taught by FTS such that the manifold valve control system is coupled to the control interface and configured to receive control signals therefrom in order to allow an operator control over different portions of the manifold while staying safe outside the zone of pressure.

Regarding Claim 9, the modified FTS teaches the hydraulic fracturing valve control system of claim 1, but does not specifically teach the system further comprising: a standalone manifold valve control interface, the standalone manifold valve control interface transmitting control signals to the valve actuator. Further, FMC teaches a hydraulic fracturing control valve system (See figs. 2-5; para [0017], [0029]) comprising a standalone manifold valve control interface (204 - "auxiliary modular skid", fig. 2; para [0026]; See fig. 5; universal power and control unit of fig. 5 and located on skid 204 of fig. 2 is capable of controlling the manifold by itself), the standalone manifold valve control interface transmitting control signals to a valve actuator (para [0031], [0043] - "actuators"). Accordingly, it would have been obvious to one of ordinary skill in the art to use the standalone manifold valve control system of FMC on the manifold taught by FTS in order to allow an operator to remotely control different portions of the manifold while staying safe outside the zone of pressure.

Claims 1-15 have industrial applicability as defined by PCT Article 33(2)-(3) because the subject matter can be made or used by industry.

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To: TAYLOR P. EVANS
HOGAN LOVELLS US LLP
609 MAIN STREET, SUITE 4200
HOUSTON, TX 77002

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Applicant's or agent's file reference 047158.500065	Date of mailing (day/month/year) 14DEC 2020 FOR FURTHER ACTION See paragraphs 1 and 4 below
International application No. PCT/US2020/053980	International filing date (day/month/year) 02 October 2020
Applicant U.S. WELL SERVICES, LLC	

1 ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

Filing of amendments and statement under Article 19:
The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

How? Directly to the International Bureau preferably through ePCT, or on paper to:
The International Bureau of WIPO, 34, chemin des Colombettes, 1211 Geneva 20, Switzerland
(Facsimile No.: +41 22 338 82 70)

For more detailed instructions, see the *PCT Applicant's Guide*, International Phase, paragraphs 9.004 – 9.011.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ With regard to any protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with any request to forward the texts of both the protest and the decision thereon to the designated Offices.

☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. Reminders

The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

Shortly after the expiration of 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

Within 19 months from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later); otherwise, the applicant must, within 20 months from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices. In respect of other designated Offices, the time limit of 30 months (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

Within 22 months from the priority date, the applicant may request that a supplementary international search be carried out by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the ISA/US Mail Stop PCT, Attn. ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine R. Copenheaver Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/220 (revised January 2019)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference		FOR FURTHER ACTION
047158.500065		see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/US2020/053980	02 October 2020	03 October 2019
Applicant		
U.S. WELL SERVICES, LLC		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the language, the international search was carried out on the basis of:

☒ the international application in the language in which it was filed.

☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

b. ☐ This international search report has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43.6bis(a)).

c. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, see Box No. I.

2. ☐ Certain claims were found unsearchable (see Box No. II).

3. ☐ Unity of invention is lacking (see Box No. III).

4. With regard to the title,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the drawings,

a. the figure of the drawings to be published with the abstract is Figure No. 1

☒ as suggested by the applicant.

☐ as selected by this Authority, because the applicant failed to suggest a figure.

☐ as selected by this Authority, because this figure better characterizes the invention.

b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2020/053980

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - E21B 43/26; B01F 15/02; E21B 41/00; F04B 17/03 (2020.01)
CPC - E21B 43/26; B01F 15/00538; F04B 17/03 (2020.08)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

see Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

see Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

see Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2018/044307 A1 (EVOLUTION WELL SERVICES, LLC) 08 March 2018 (08.03.2018) entire document	1, 3-11, 13-15
A	US 2012/0255734 A1 (COLI et al) 11 October 2012 (11.10.2012) entire document	1-15
A	US 2014/0096974 A1 (COLI et al) 10 April 2014 (10.04.2014) entire document	1-15
A	US 2016/0258267 A1 (STEWART & STEVENSON, LLC) 08 September 2016 (08.09.2016) entire document	1-15

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 November 2020	14 DEC 2020
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine R. Copenheaver Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/210 (second sheet) (July 2019)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: TAYLOR P. EVANS
HOGAN LOVELLS US LLP
609 MAIN STREET, SUITE 4200
HOUSTON, TX 77002

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	14 DEC 2020
Applicant's or agent's file reference 047158.500065	FOR FURTHER ACTION See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2020/053980	02 October 2020	03 October 2019

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - E21B 43/26; B01F 15/02; E21B 41/00; F04B 17/03 (2020.01)
CPC - E21B 43/26; B01F 15/00538; F04B 17/03 (2020.08)

Applicant U.S. WELL SERVICES, LLC

1. This opinion contains indications relating to the following items:

- [X] Box No. I **Basis** of the opinion
- [ ] Box No. II **Priority**
- [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [ ] Box No. IV Lack of unity of invention
- [X] Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI Certain documents cited
- [ ] Box No. VII Certain defects in the international application
- [ ] Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	23 November 2020	Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 Telephone No. 571-272-4300

Form PCT/ISA/237 (cover sheet) (revised January 2019)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2020/053980

Box No. I **Basis of this opinion**

1. With regard to the language, this opinion has been established on the **basis of**:

☒ the international application in the language in which it was **filed.**

☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(b)).

3. ☐ With regard to any **nucleotide and/or amino acid** sequence disclosed in the international application, this opinion has been established on the basis of a sequence listing:

a ☐ forming part of the international application as filed:

☐ in the form of an Annex C/ST.25 text file.

☐ on paper or in the form of an image file.

b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

☐ in the form of an Annex C/ST.25 **text file (Rule 13*ter*.1(a)).**

☐ on paper or in the form of **an image file (Rule 13*ter*.1(b)** and Administrative Instructions, Section 713).

4 ☐ In addition, in the case that more than one version or copy **of a sequence listing** has been filed or furnished, **the** required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does **not** go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2020/053980

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	2, 12	YES
	Claims	1, 3-11, 13-15	NO
Inventive step (IS)	Claims	2, 12	YES
	Claims	1, 3-11, 13-15	NO
Industrial applicability (IA)	Claims	1-15	YES
	Claims	None	NO

2. Citations and explanations:

Claims 1, 3-11, and 13-15 lack novelty under PCT Article 33(2) as being anticipated by Evolution Well Services, Llc (hereinafter Evolution).

Regarding claim 1, Evolution discloses a hydraulic fracturing system (see FIG. 7B), comprising:
a support structure (trailer 710) having a first area (front end 720) at a first height (see FIG. 7B) and a second area (back end 722) at a second height (see FIG. 7B), the first and second areas (FIG. 7B) adjacent one another (see FIG. 7B);
an electric powered, multi-plunger pump (two pumps 702A and 702B) with an odd number of plungers (Other embodiments may include other types of plunger style pumps, such as triplex pumps [0078]), arranged in the first area (FIG. 7B), the electric powered pump (702A) coupled to a well (well-site; [0078]), via outlet piping (suction hoses; [0074]), and powered by at least one electric motor (the prime mover 704 may be a dual shaft electric motor [0076]), also arranged in the first area (FIG. 7B);
a variable frequency drive (VFD) (variable frequency drives (VFDs) [0074]), arranged in the second area (FIG. 7B) connected to the at least one electric motor (the prime mover 704 may be a dual shaft electric motor [0076]) the VFD ([0074]) configured to control at least a speed of the at least one electric motor ([0076]); and
a transformer (The fracturing pump trailer power and control system 706 may comprise one or more electric drives, transformers [0075]), arranged in the second area (FIG. 7B), the transformer ([0075]) positioned within an enclosure (see FIG. 7B) with the VFD ([0074]), the transformer ([0075]) configured to distribute power for operation of the electric powered pump (pumps 702A).

Regarding claim 3, Evolution discloses the hydraulic fracturing system of claim 1, further comprising:
a work platform (see FIG. 7B) proximate the enclosure in the second area (FIG. 7B), the work platform (FIG. 7B) providing access to the enclosure (FIG. 7B).

Regarding claim 4, Evolution discloses the hydraulic fracturing system of claim 1, further comprising:
a cooling system (Other embodiments of the drive power transports 104 may use an air conditioning units and/or water cooling to regulate the temperature of the VFDs [0043]) for the enclosure (FIG. 7B), the cooling system ([0043]) being a liquid cooling system ([0043]) thermally coupled to at least one of the VFD ([0074]) or the transformer ([0075]).

Regarding claim 5, Evolution discloses the hydraulic fracturing system of claim 4, wherein the liquid cooling system ([0043]) includes water (water cooling [0043]) or glycol.

Regarding claim 6, Evolution discloses the hydraulic fracturing system of claim 1, wherein the electric powered, multi-plunger pump (702A) is a septuplex pump having seven plungers (in one embodiment, each of the pumps 702A and 702B may be quintiplex pumps located on a single transport. Other embodiments may include other types of plunger style pumps, such as triplex pumps [0078]).

Regarding claim 7, Evolution discloses the hydraulic fracturing system of claim 1, wherein the electric powered, multi-plunger pump (702A) includes at least one of 9 plungers or 11 plungers (in one embodiment, each of the pumps 702A and 702B may be quintiplex pumps located on a single transport. Other embodiments may include other types of plunger style pumps, such as triplex pumps [0078]).

Regarding claim 8, Evolution discloses the hydraulic fracturing system of claim 1, wherein the electric powered, multi-plunger pump (702A) includes more than 5 plungers (in one embodiment, each of the pumps 702A and 702B may be quintiplex pumps located on a single transport. Other embodiments may include other types of plunger style pumps, such as triplex pumps [0078]).

Regarding claim 9, Evolution discloses the hydraulic fracturing system of claim 1, wherein a first end (see FIG. 7B) is opposite a second end (see FIG. 7B) and the second end (FIG. 7B) includes a hitch (trailer hitch [0080]) for coupling to a prime mover (prime mover 704 [0080]).

Regarding claim 10, Evolution discloses the hydraulic fracturing system of claim 1, wherein the electric powered, multiplunger pump (702A) is a single pump (see FIG. 7B) and a first pump output meets or a exceeds a second pump output associated with two quintuplex pumps (each of the pumps 702A and 702B may be quintiplex pumps; see [0076]).

Form PCT/ISA/237 (Box No. V) (revised January 2019)

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:

Regarding claim 11, Evolution discloses a hydraulic fracturing system (see FIG. 7B), comprising:
an electric powered, multi-plunger pump (two pumps 702A and 702B), arranged on a support structure (trailer 710), the electric powered multi-plunger pump (two pumps 702A and 702B) powered by at least one electric motor (the prime mover 704 may be a dual shaft electric motor [0076]);
a variable frequency drive (VFD) (variable frequency drives (VFDs) [0074]), arranged on the support structure (trailer 710), connected to the at least one electric motor (704) to control a speed of the at least one electric motor (704), the VFD (704) positioned separate from the electric powered, multi-plunger pump (702A) and within an enclosure (see FIG. 7B); and
a transformer (The fracturing pump trailer power and control system 708 may comprise one or more electric drives, transformers [0075]), arranged on the support structure (710) configured to distribute power for operation of the electric powered, multi-plunger pump (702A), the power being received from at least one generator (The prime mover 704 may be driven by at least one variable frequency drive that is rated to a maximum of about 5,000 HP and may receive electric power generated from the mobile source of electric power [0076]) at a voltage higher than an operating voltage of the electric powered pump (702A), the transformer ([0075]) positioned within the enclosure (FIG. 7B);
wherein the electric powered, multi-plunger pump (702A) includes an odd number of plungers (Other embodiments may include other types of plunger style pumps, such as triplex pumps [0076]) configured to reduce kinematic flow ripple.

Regarding claim 13, Evolution discloses the hydraulic fracturing system of claim 11, further comprising: a work platform (see FIG. 7B) proximate the enclosure (FIG. 7B), the work platform (FIG. 7B) providing access to the enclosure (FIG. 7B), wherein the work platform (FIG. 7B) is positioned at an elevation (see FIG. 7B) greater than the electric powered, multi-plunger pump (702A).

Regarding claim 14, Evolution discloses the hydraulic fracturing system of claim 11, wherein the electric powered, multiplunger pump (702A) is a septuplex pump having seven plungers (in one embodiment, each of the pumps 702A and 702B may be quintiplex pumps located on a single transport. Other embodiments may include other types of plunger style pumps, such as triplex pumps [0076]).

Regarding claim 15, Evolution discloses the hydraulic fracturing system of claim 11, wherein a first length (see FIG. 7B) of the support structure (FIG. 7B) is less than or equal to a second length (see FIG. 7B) of a second support structure (see FIG. 7B) associated with two quintiplex pumps (each of the pumps 702A and 702B may be quintiplex pumps; see [0076]).

Claims 2 and 12 meet the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest:

Regarding claim 2, the prior art of record, individually or in combination, does not teach or fairly suggest the hydraulic fracturing system of claim 1, further comprising: a slide out platform integrated into the first area, the slide out platform being driven between a retracted position and a deployed position, wherein the deployed position provides a work area proximate the electric powered, multi-plunger pump.

The following prior art is made of record to support and further define the reasons that claim 2 meets the criteria set out in PCT Article 33 (2)-(3):
Regarding claim 2, Evolution discloses a support structure (trailer 710), an electric powered, multi-plunger pump (two pumps 702A and 702B), a variable frequency drive (VFD) (variable frequency drives (VFDs) [0074]), and a transformer (The fracturing pump trailer power and control system 708 may comprise one or more electric drives, transformers [0075]); but fails to explicitly disclose the hydraulic fracturing system, further comprising: a slide out platform integrated into the first area, the slide out platform being driven between a retracted position and a deployed position, wherein the deployed position provides a work area proximate the electric powered, multi-plunger pump.

Regarding claim 12, the prior art of record, individually or in combination, does not teach or fairly suggest the hydraulic fracturing system of claim 11, further comprising: a slide out platform proximate the electric powered, multi-plunger pump being driven between a retracted position and a deployed position, wherein the deployed position provides a work area proximate the electric powered, multi-plunger pump.

The following prior art is made of record to support and further define the reasons that claim 12 meets the criteria set out in PCT Article 33 (2)-(3):
Regarding claim 12, Evolution discloses a support structure (trailer 710), an electric powered, multi-plunger pump (two pumps 702A and 702B), a variable frequency drive (VFD) (variable frequency drives (VFDs) [0074]), and a transformer (The fracturing pump trailer power and control system 708 may comprise one or more electric drives, transformers [0075]); but fails to explicitly disclose the hydraulic fracturing system further comprising: a slide out platform proximate the electric powered, multi-plunger pump being driven between a retracted position and a deployed position, wherein the deployed position provides a work area proximate the electric powered, multi-plunger pump.

Claims 1-15 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.

Search History:

Limited Classification Search

The Patent Analyst performed a limited classification search within the following US, IPC, CPC, ECLA, or F-Term classification areas:

CPC Class/Subclass(es): E21B 43/26; B01F 15/00538; F04B 17/03 (2020.08)

IPC (8) Class/Subclass(es): E21B 43/26; B01F 15/02; E21B 41/00; F04B 17/03 (2020.01)

U.S. Class/Subclass(es): 166/358; 166/177.5; 166/305.1

See Global Search Results.

Global Patent Literature Text Search

The Patent Analyst performed the following global text search, which was not limited by classification but may or may not have been limited by other criteria:

Questel Orbit: https://www.orbit.com

#	Search query	Results
1	(62910163 OR 17060647)/PN/AP/PR	0
2	((WELL P SERVICES)/PA/OPA/PAH/OWR/REAS)	373
3	((WELL P SERVICES)/IN/OIN/INH/INV)	0
4	(((LON P ROBINSON))/PA/OPA/PAH/OWR/REAS OR ((JARED P OEHRING))/PA/OPA/PAH/OWR/REAS OR ((BRANDON P HINDERLITER))/PA/OPA/PAH/OWR/REAS)	33
5	((PUMP?) AND ((VARIABLE W FREQUENCY W DRIVE?) OR VFW))/TI/AB/TX	6547
6	((PUMP?) AND ((VARIABLE W FREQUENCY W DRIVE?) OR VFW) AND (TRANSFORMER?))/TI/AB/TX	1271
7	((PUMP?) AND ((VARIABLE W FREQUENCY W DRIVE?) OR VFW) AND (TRANSFORMER?) AND (FRAC+))/TI/AB/TX	309
8	((MULTI-PLUNGER W PUMP?) AND ((VARIABLE W FREQUENCY W DRIVE?) OR VFW) AND (TRANSFORMER?) AND (FRAC+ OR FRAC?))/TI/AB/TX	2
9	((PUMP?) AND ((VARIABLE W FREQUENCY W DRIVE?) OR VFW) AND (TRANSFORMER?) AND (FRAC+) AND (FIRST W AREA?))/TI/AB/TX	9
10	..CITBF NOSOURCE SS 9 1-2	42
11	((PUMP?) AND ((VARIABLE W FREQUENCY W DRIVE?) OR VFW?) AND (TRANSFORMER?) AND (FRAC+) AND ((FIRST OR PRIMARY) W AREA?))/TI/AB/TX	10
12	11 NOT 9	1
13	((PUMP?) AND ((VARIABLE W FREQUENCY W DRIVE?) OR VFW?) AND (TRANSFORMER?) AND (FRAC+) AND ((FIRST OR PRIMARY) W HEIGHT?))/TI/AB/TX	1
14	((PUMP?) AND ((VARIABLE W FREQUENCY W DRIVE?) OR VFW?) AND (TRANSFORMER?) AND (FRAC+))/TI/AB/TX	310

15	((PUMP?) AND ((VARIABLE W FREQUENCY W DRIVE?) OR VFW?) AND (TRANSFORMER?) AND (FRAC+))/TI/AB/TX AND PD <= 2019-10-02	263
16	((PUMP?) AND ((VARIABLE W FREQUENCY W DRIVE?) OR VFW?) AND (TRANSFORMER?) AND (FRAC+) AND SLIDE)/TI/AB/TX	62
17	((PUMP?) AND ((VARIABLE W FREQUENCY W DRIVE?) OR VFW?) AND (TRANSFORMER?) AND (FRAC+) AND (SLIDE W OUT W PLATFORM?))/TI/AB/TX	2
18	((PUMP?) AND ((VARIABLE W FREQUENCY W DRIVE?) OR VFW?) AND (TRANSFORMER?) AND (FRAC+) AND (SLIDE+ S PLATFORM?))/TI/AB/TX	9
19	((PUMP?) AND ((VARIABLE W FREQUENCY W DRIVE?) OR VFW?) AND (TRANSFORMER?) AND (FRAC+) AND (WORK W PLATFORM?))/TI/AB/TX	3
20	((PUMP?) AND ((VARIABLE W FREQUENCY W DRIVE?) OR VFW?) AND (TRANSFORMER?) AND (FRAC+) AND (COOLING W SYSTEM?))/TI/AB/TX	79
21	((SEPTUPLEX W PUMP?) AND ((VARIABLE W FREQUENCY W DRIVE?) OR VFW?) AND (TRANSFORMER?) AND (FRAC+))/TI/AB/TX	0
22	((PUMP?) AND (FRAC+) AND (SLIDE+ S PLATFORM?))/TI/AB/TX	2294
23	((PUMP?) AND (FRAC+) AND (SLIDE W OUT W PLATFORM?))/TI/AB/TX	3
24	(WO201844307 OR US20120255734 OR US0120255734 OR US20160258267 OR US0160258267 OR US20140096974 OR US0140096974)/PN/AP/PR	4
25	(166305100)/PCL	1953
26	(166177500)/PCL	259
27	(166358000)/PCL	263
28	(E21B-043/26)/CPC	7148
29	(E21B-043/26)/IPC	12173
30	(E21B-043/26 OR F04B-017/03 OR B01F-015/00/538)/CPC	11981
31	(B01F-015/02 OR E21B-041/00 OR E21B-043/26 OR F04B-017/03)/IPC	77614

Google Patents: https://patents.google.com

#	Search query	Results
1	"support structure" pump "variable frequency drive" transformer "first area" "second area"	4

Computer Accessed Text Databases Searched

The Patent Analyst searched the following computer accessed text databases:

Google: https://www.google.com/

#	Search query	Results
1	"support structure" pump "variable frequency drive" transformer "first area" "second area"	257

Date search was completed: 23 November 2020

TT/DD

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To: TAYLOR P. EVANS
HOGAN LOVELLS US LLP
609 MAIN STREET, SUITE 4200
HOUSTON, TX 77002

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Date of mailing *(day/month/year)*	03 FEB 2021
Applicant's or agent's file reference 047158.500067	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/US 20/58899	International filing date *(day/month/year)* 04 November 2020 (04.11.2020)
Applicant U.S. WELL SERVICES, LLC	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   How? Directly to the International Bureau preferably through ePCT, or on paper to:
   The International Bureau of WIPO, 34, chemin des Colombettes, 1211 Geneva 20, Switzerland

   For more detailed instructions, see the *PCT Applicant's Guide*, International Phase, paragraphs 9.004 – 9.011.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ **With regard to any protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:
   - ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with any request to forward the texts of both the protest and the decision thereon to the designated Offices.
   - ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   The applicant may **submit comments on an informal basis on the written opinion of the International Searching Authority** to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

   Shortly after the expiration of **18 months from the priority date, the international application will be published** by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for **entry into the national phase** before those designated Offices. In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

   Within **22 months from the priority date, the applicant may request that a supplementary international search be carried out** by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Lee Young Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/220 (revised January 2020)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference		FOR FURTHER ACTION
047158.500067		see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/US 20/58899	04 November 2020 (04.11.2020)	04 November 2019 (04.11.2019)
Applicant U.S. WELL SERVICES, LLC		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language**, the international search was carried out on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

   b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

   c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (see Box No. II).

3. ☐ **Unity of invention is lacking** (see Box No. III).

4. With regard to the **title**,

   ☒ the text is approved as submitted by the applicant.

   ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

   ☒ the text is approved as submitted by the applicant.

   ☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,

   a. the figure of the **drawings** to be published with the abstract is Figure No. 1

   ☐ as suggested by the applicant.

   ☒ as selected by this Authority, because the applicant failed to suggest a figure.

   ☐ as selected by this Authority, because this figure better characterizes the invention.

   b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 20/58899

A. CLASSIFICATION OF SUBJECT MATTER
IPC - E21B 43/26 (2020.01)
CPC - E21B 43/2607, E21B 43/26, H02J 3/007

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2019/0245348 A1 (U.S. Well Services, Inc.) 08 August 2019 (08.08.2019) Entire document especially para [0043]-[0057] and fig. 1	1-15
A	US 2010/0038907 A1 (Hunt et al.) 18 February 2010 (18.02.2010) Entire document especially para [0025]-[0028], [0060]-[0068] and figs. 1 and 13	1-15
A	WO 2018/213925 A1 (Rouse Industries Inc.) 29 November 2018 (29.11.2018) Entire document	1-15
A	US 2016/0177675 A1 (Evolution Well Services, LLC) 23 June 2016 (23.06.2016) Entire document	1-15
A	US 2016/0298731 A1 (MGB Oilfield Solutions, L.L.C.) 18 October 2018 (18.10.2018) Entire document	1-15

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 December 2020	03 FEB 2021
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Lee Young Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/210 (second sheet) (July 2019)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: TAYLOR P. EVANS
HOGAN LOVELLS US LLP
609 MAIN STREET, SUITE 4200
HOUSTON, TX 77002

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	03 FEB 2021
Applicant's or agent's file reference 047158.500067	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 20/58899	04 November 2020 (04.11.2020)	04 November 2019 (04.11.2019)

International Patent Classification (IPC) or both national classification and IPC
IPC - E21B 43/26 (2020.01)
CPC - E21B 43/2607, E21B 43/26, H02J 3/007

Applicant U.S. WELL SERVICES, LLC

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	22 December 2020	Lee Young PCT Help Desk Telephone No. 571-272-4300

Form PCT/ISA/237 (cover sheet) (revised January 2019)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No
PCT/US 20/58899

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(b)).

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/58899

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-15	YES
	Claims	None	NO
Inventive step (IS)	Claims	1-15	YES
	Claims	None	NO
Industrial applicability (IA)	Claims	1-15	YES
	Claims	None	NO

2. Citations and explanations:
Claims 1-15 meet the criteria set forth under PCT Article 33(2)-(3) because, as will be shown, the prior art does not teach, nor does it fairly suggest, the claimed limitations.

The prior art is exemplified by (1) US 2019/0245348 A1 to U.S. Well Services, Inc. (hereinafter 'US') and (2) US 2010/0038907 A1 to Hunt et al. (hereinafter 'Hunt')

(1) US teaches a fracturing system (See fig. 1; para [0043]), comprising:
a generator (104A-E - "generators", fig. 1) having a specific set point (para [0047] - the ideal output power for the generator 104A-E is the set point);
a microgrid (See fig. 1; see components between generators 104A-E and pump 112 including switch gears 108A-C and breakers 122A-B) comprising:
a first circuit breaker (122A - "breaker", fig. 1); and
a second circuit breaker (122B - "breaker", fig. 1), wherein the first and second circuit breakers are connected to a common bus for load sharing (para [0047] - "Switch gear tie breakers 122A, 122B allow the switch gear to act as a single bus"); and
one or more fracturing system components (1212 - "pumps", fig. 1) configured to receive power from the microgrid (See fig. 1; para [0044]-[0045]).

(2) Hunt teaches a system (See figs. 1 and 13; para [0025], [0060]), comprising:
a generator (1315 - "generator", fig. 13) having a specific set point (para [0061] - the ideal output power for the generator 1315 is the set point);
a power storage system (para [0027]-[0028] - "excess power is stored using energy storage devices including, for example, flywheel, hydroelectric, and geothermal energy storage devices. Other energy storage devices include battery banks, superconducting magnetic energy storage, etc.") comprising a chargeable power storage device (para [0028] - "flywheels, battery banks etc.);
a microgrid comprising (See fig. 13; para [0060]):
a first circuit breaker (1336 - "circuit breakers", fig. 13), wherein the generator provides power to the microgrid via the first circuit breaker (See fig. 13; para [0067]-[0068]); and
a second circuit breaker (1336 - "circuit breakers", fig. 13. See fig. 13; breakers 1336 includes at least three circuit breakers 1336), wherein the power storage system is electrically coupled to the second circuit breaker (See fig. 13) to controllably supply power to or receive power from the microgrid via the second circuit breaker, wherein the first and second circuit breakers are connected to a common bus for load sharing (1340 - "generator power bus", fig. 13); and
one or more system components (1380 - "local load", fig. 13; 190 - local load", fig. 1) configured to receive power from the microgrid (para [0027], [0062]).

-*-Continued in Supplemental Box-*-

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/58899

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
-*-Supplemental Box - Box V.2 - Citations and Explanations-*-

Regarding Claim 1, US teaches a fracturing system (See fig. 1; para [0043]), comprising:
a generator (104A-E - "generators", fig. 1) having a specific set point (para [0047] - the ideal output power for the generator 104A-E is the set point);
a microgrid (See fig. 1; see components between generators 104A-E and pump 112 including switch gears 108A-C and breakers 122A-B) comprising:
a first circuit breaker (122A - "breaker", fig. 1); and
a second circuit breaker (122B - "breaker", fig. 1), wherein the first and second circuit breakers are connected to a common bus for load sharing (para [0047] - "Switch gear tie breakers 122A, 122B allow the switch gear to act as a single bus"); and
one or more fracturing system components (1212 - "pumps", fig. 1) configured to receive power from the microgrid (See fig. 1; para [0044]-[0045]), but does not specifically teach wherein the system comprises a power storage system comprising a chargeable power storage device; wherein the generator provides power to the microgrid via the first circuit breaker; wherein the power storage system is electrically coupled to the second circuit breaker to controllably supply power to or receive power from the microgrid via the second circuit breaker; and
wherein the power storage system charges when the first and second circuit breakers are both closed, and the power storage system stops charging when the one or more fracturing system components requires power, and the power storage system discharges power to the microgrid when a load requirement of the one or more fracturing system components is above the set point.
Further, Hunt teaches a system (See figs. 1 and 13; para [0025], [0060]), comprising:
a generator (1315 - "generator", fig. 13) having a specific set point (para [0061] - the ideal output power for the generator 1315 is the set point);
a power storage system (para [0027]-[0028] - "excess power is stored using energy storage devices including, for example, flywheel, hydroelectric, and geothermal energy storage devices. Other energy storage devices include battery banks, superconducting magnetic energy storage, etc.") comprising a chargeable power storage device (para [0028] - "flywheels, battery banks etc.);
a microgrid comprising (See fig. 13; para [0060]):
a first circuit breaker (1336 - "circuit breakers", fig. 13), wherein the generator provides power to the microgrid via the first circuit breaker (See fig. 13; para [0067]-[0068]); and
a second circuit breaker (1336 - "circuit breakers", fig. 13; See fig. 13; breakers 1336 includes at least three circuit breakers 1336), wherein the power storage system is electrically coupled to the second circuit breaker (See fig. 13) to controllably supply power to or receive power from the microgrid via the second circuit breaker, wherein the first and second circuit breakers are connected to a common bus for load sharing (1340 - "generator power bus", fig. 13); and
one or more system components (1380 - "local load", fig. 13; 190 - local load", fig. 1) configured to receive power from the microgrid (para [0027], [0062]).
However, any combination of the above references fails to teach wherein the power storage system is electrically coupled to the second circuit breaker to controllably supply power to or receive power from the microgrid via the second circuit breaker, and wherein the power storage system charges when the first and second circuit breakers are both closed, and the power storage system stops charging when the one or more fracturing system components requires power, and the power storage system discharges power to the microgrid when a load requirement of the one or more fracturing system components is above the set point. Further, the system of Hunt is not a fracturing system, and thus would not be analogous to the fracturing system of US for a combination that would meet the requirements. Accordingly, the prior art does not teach or fairly suggest individually or in combination the fracturing system as claimed.

Regarding Claims 2-7, the prior art does not specifically teach or fairly suggest individually or in combination the fracturing systems as claimed since they are dependent on claim 1.

-*-Continued in next Supplemental Box-*-

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No
PCT/US 20/58899

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
-*-Supplemental Box - Box V.2 - Citations and Explanations-*-

Regarding Claim 8, US teaches a fracturing system (See fig. 1; para [0043]), comprising:
a generator (104A-E - "generators", fig. 1) set at a specific set point (para [0047] - the ideal output power for the generator 104A-E is the set point);
a microgrid (See fig. 1; see components between generators 104A-E and pump 112 including switch gears 108A-C);
one or more fracturing system components (1212 - "pumps", fig. 1) configured to receive power from the microgrid (See fig. 1; para [0044]-[0045]);
an incoming breaker (122A - "breaker", fig. 1); and
an outgoing breaker (122B - "breaker", fig. 1), but does not specifically teach the system comprising a power storage system comprising a chargeable power storage device, wherein the power storage system receives power from the generator; wherein the microgrid is configured to receive power from the power storage system; wherein the incoming breaker is coupled between the generator and the chargeable power storage device; wherein the outgoing breaker is between the chargeable power storage device and the microgrid; wherein during conditions in which the one or more fracturing system components require a load below the set point, the power storage system is charged by the generator; and
wherein during conditions in which the one or more fracturing system components require a load above the set point, the one or more fracturing system components are powered by both the generator and the power storage system.
Further, Hunt teaches a system (See figs. 1 and 13; para [0025], [0060]), comprising:
a generator (1315 - "generator", fig. 13) set at a specific set point (para [0061] - the ideal output power for the generator 1315 is the set point);
a power storage system (para [0027]-[0028] - "excess power is stored using energy storage devices including, for example, flywheel, hydroelectric, and geothermal energy storage devices. Other energy storage devices include battery banks, superconducting magnetic energy storage, etc.") comprising a chargeable power storage device (para [0028] - "flywheels, battery banks etc."), wherein the power storage system receives power from the generator (para [0027]-[0028]);
a microgrid (See fig. 13; para [0060]) configured to receive power from the power storage system (para [0027]-[0028]);
one or more system components (1380 - "local load", fig. 13, 190 - local load", fig. 1) configured to receive power from the microgrid (para [0027], [0062]);
an incoming breaker (1336 - "circuit breakers", fig. 13); and
an outgoing breaker (1336 - "circuit breakers", fig. 13; See fig. 13; breakers 1336 includes at least three circuit breakers 1336), wherein during conditions in which the one or more system components require a load below the set point, the power storage system is charged by the generator (para [0027]-[0028]); and
wherein during conditions in which the one or more system components require a load above the set point, the one or more system components are powered by both the generator and the power storage system (para [0027]-[0028]) but does not specifically teach wherein wherein the incoming breaker is coupled between the generator and the chargeable power storage device; wherein the outgoing breaker is between the chargeable power storage device and the microgrid. Further, the system of Hunt is not a fracturing system, and thus would not be analogous to the fracturing system of US for a combination that would meet the requirements. Accordingly, the prior art does not teach or fairly suggest individually or in combination the fracturing system as claimed.

Regarding Claims 9-14, the prior art does not specifically teach or fairly suggest individually or in combination the fracturing systems as claimed since they are dependent on claim 8.

Regarding Claim 15, US teaches a method of powering a fracturing system (See fig. 1; para [0043]), comprising:
supplying power to one or more components (1212 - "pumps", fig. 1) of the fracturing system from a generator (104A-E - "generators", fig. 1); but does not specifically teach wherein the method comprises
charging a power storage system from the generator during one or more conditions in which the load requirement of the one or more components of the fracturing system is below the set point of the generator; and
supplying power to the one or more components of the fracturing system from both the generator and the power storage system during one or more conditions in which the load requirement of the one or more components of the fracturing system is above the set point of the generator.
Further, Hunt teaches a method of powering a system (See figs. 1 and 13; para [0025], [0060]), comprising:
supplying power to one or more components (1380 - "local load", fig. 13; 190 - local load", fig. 1) of the system from a generator (1315 - "generator", fig. 13);
charging a power storage system (para [0027]-[0028] - "excess power is stored using energy storage devices including, for example, flywheel, hydroelectric, and geothermal energy storage devices. Other energy storage devices include battery banks, superconducting magnetic energy storage, etc.") from the generator during one or more conditions in which the load requirement of the one or more components of the system is below the set point of the generator (para [0027]-[0028], [0065]-[0068]); and
supplying power to the one or more components of the system from both the generator and the power storage system during one or more conditions in which the load requirement of the one or more components of the system is above the set point of the generator (para [0027]-[0028], [0065]-[0068]).
However, the system of Hunt is not a fracturing system, and thus would not be analogous to the fracturing system of US for a combination that would meet the requirements. Accordingly, the prior art does not teach or fairly suggest individually or in combination the method as claimed.

Claims 1-15 have industrial applicability as defined by PCT Article 33(2)-(3) because the subject matter can be made or used by industry.

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To: TAYLOR P. EVANS
HOGAN LOVELLS US LLP
609 MAIN STREET, SUITE 4200
HOUSTON, TX 77002

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Applicant's or agent's file reference 047158-500068	Date of mailing *(day/month/year)* 02 FEB 2021 **FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/US 20/58906	International filing date *(day/month/year)* 04 November 2020 (04.11.2020)
Applicant U.S. WELL SERVICES, LLC	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   How? Directly to the International Bureau preferably through ePCT, or on paper to:
   The International Bureau of WIPO, 34, chemin des Colombettes, 1211 Geneva 20, Switzerland

   For more detailed instructions, see the *PCT Applicant's Guide*, International Phase, paragraphs 9.004 – 9.011.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ **With regard to any protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:
   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with any request to forward the texts of both the protest and the decision thereon to the designated Offices.
   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   The applicant may **submit comments on an informal basis on the written opinion of the International Searching Authority** to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

   Shortly after the expiration of **18 months from the priority date, the international application will be published** by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for **entry into the national phase** before those designated Offices. In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

   Within **22 months from the priority date, the applicant may request that a supplementary international search be carried out** by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Lee Young Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/220 (revised January 2020)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference		FOR FURTHER ACTION
047158-500068		see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/US 20/58906	04 November 2020 (04.11.2020)	04 November 2019 (04.11.2019)
Applicant U.S. WELL SERVICES, LLC		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of:

☒ the international application in the language in which it was filed.

☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (see Box No. II).

3. ☐ **Unity of invention is lacking** (see Box No. III).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,

a. the figure of the **drawings** to be published with the abstract is Figure No. 1

☐ as suggested by the applicant.

☒ as selected by this Authority, because the applicant failed to suggest a figure.

☐ as selected by this Authority, because this figure better characterizes the invention.

b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 20/58906

A. CLASSIFICATION OF SUBJECT MATTER
IPC - E21B 43/26 (2020.01)
CPC - E21B 43/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2017/0030178 A1 (US Well Services LLC) 2 February 2017 (02.02.2017) Entire document especially para [0026], [0038], [0042] and figs. 1A, 4 and 8	10, 14-15
---		-----
Y		1-4, 6-9, 11, 13
---		-----
A		5, 12
Y	CN 104196613 A (SJ Petroleum Machinery Co Ltd Sinopec) 10 December 2014 (10.12.2014) Entire document especially para [0026] and figs. 1 and 3	1-4, 6-9, 13
---		-----
A		5
Y	US 2011/0110793 A1 (Leugemors et al.) 12 May 2011 (12.05.2011) Entire document especially para [0008], [0010], [0012], [0038] and fig. 2	4, 11
Y	US 2019/0154020 A1 (Supreme Electrical Services, Inc. dba Lime Instruments) 23 May 2019 (23.05.2019) Entire document especially para [0115] and fig. 3A	3
A	US 2008/0277120 A1 (Hickie) 13 November 2010 (13.11.2010) Entire document especially para [0047], [0055]-[0058]	5, 12
A	US 2014/0251623 A1 (Prostim Labs, LLC) 11 September 2014 (11.09.2014) Entire document	1-15
A	US 2016/0258267 A1 (Stewart & Stevenson, LLC) 8 September 2016 (08.09.2016) Entire document	1-15

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 December 2020	02 FEB 2021
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Lee Young Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/210 (second sheet) (July 2019)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: TAYLOR P. EVANS
HOGAN LOVELLS US LLP
609 MAIN STREET, SUITE 4200
HOUSTON, TX 77002

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	02 FEB 2021
Applicant's or agent's file reference 047158-500068	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 20/58906	04 November 2020 (04.11.2020)	04 November 2019 (04.11.2019)

International Patent Classification (IPC) or both national classification and IPC

IPC - E21B 43/26 (2020.01)

CPC - E21B 43/26

Applicant U.S. WELL SERVICES, LLC

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	17 December 2020	Lee Young PCT Help Desk Telephone No. 571-272-4300

Form PCT/ISA/237 (cover sheet) (revised January 2019)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/58906

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(b)).

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/58906

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-9, 11-15	YES
	Claims	10	NO
Inventive step (IS)	Claims	5, 12	YES
	Claims	1-4, 6-11, 13-15	NO
Industrial applicability (IA)	Claims	1-15	YES
	Claims	None	NO

2. Citations and explanations:

Claims 10 lack novelty under PCT Article 33(2) as being anticipated by US 2017/0030178 A1 to US Well Services LLC (hereinafter 'US')

Regarding Claim 10, US teaches a compact fracturing system (See figs. 1A, 4 and 8; para [0026], [0038], [0042]), comprising:
an electronic system (See fig. 8; para [0042]) providing power, controls, or both to one or more components of the compact fracturing system (para [0042]), the electronic system comprising:
a transformer (56F - "transformer", fig. 7; see transformer house 130G; para [0029]);
electronic motor controls (See fig. 8; see VFD house 132G; variable frequency drive is therein which is part of what controls system); and
a housing (130G, 132G - " house", fig. 8), wherein the electronic motor controls and the transformer are housed within the housing (See fig. 8; para [0042]).

Claims 14-15 lack an inventive step under PCT Article 33(3) as being obvious over US

Regarding Claim 14, US teaches the compact fracturing system of claim 10, further comprising a motor drive (39 - "motor", fig. 1; para [0026]) but does not specifically teach the motor drive being a 3,000 hydraulic horsepower motor drive. However, design decisions regarding the hydraulic horsepower of a motor fall within the ordinary skill in the art of one designing a compact fracturing system. Accordingly, it would have been obvious to one of ordinary skill in the art to have utilized routine experimentation and design choices in order to have chosen an appropriate hydraulic horsepower as claimed thereby ensuring the motor can drive the pumps with enough power to raise fluids from the well.

Regarding Claim 15, US teaches a method of hydraulic fracturing (See figs. 1A, 4 and 8; para [0026], [0038], [0042]), comprising:
positioning a compact frac pump trailer (See figs. 1A and 4; see trailer 114C of pump system 36) at a pump site (See fig. 1A and 4); and
powering a pump (36 - " pump", figs. 1A and 4) via an electronics system (See fig. 8; para [0042]), the electronics system comprising a transformer (56F - "transformer", fig. 7; see transformer house 130G) and electronic motor controls (See fig. 8; see VFD house 132G; variable frequency drive is therein which is part of what controls system), the transformer and the electronic motor controls housed together (See fig. 8) but does not specifically teach the compact frac pump trailer having a length below 37 feet. However, design decisions regarding the length of a truck fall within the ordinary skill in the art of one designing a compact fracturing system. Accordingly, it would have been obvious to one of ordinary skill in the art to have utilized routine experimentation and design choices in order to have chosen an appropriate length for the truck as claimed thereby allowing all of the components to compactly fit around the wellsite.

Claims 1-2, 6-9 and 13 lack an inventive step under PCT Article 33(3) as being obvious over US in view of CN 104196613 A to SJ Petroleum Machinery Co Ltd Sinopec (hereinafter 'SJ')

Regarding Claim 1, US teaches a compact fracturing system (See figs. 1A, 4 and 8; para [0026], [0038], [0042]), comprising:
a pump truck (See figs. 1A and 4; see trailer 114C of pump system 36 - note that para [0007] of the subject specification states that "pump truck" and "pump trailer" are equivalent expressions);
an electronic system (See fig. 8; para [0042]), comprising:
a transformer (56F - "transformer", fig. 7; see transformer house 130G; para [0029]);
electronic motor controls (para [0042]) housed together with the transformer (para [0042]); and
a variable-frequency drive (VFD) (See fig. 8; see VFD house 132G; variable frequency drive is therein); but does not specifically teach wherein the truck has a length of at most 40 feet or wherein the system comprises a lubrication system comprising a plurality of sensors, the lubrication system compatible with oil lubrication.
However, design decisions regarding the length of a truck fall within the ordinary skill in the art of one designing a compact fracturing system. Accordingly, it would have been obvious to one of ordinary skill in the art to have utilized routine experimentation and design choices in order to have chosen an appropriate length for the truck as claimed thereby allowing all of the components to compactly fit around the wellsite.
Further, SJ teaches a compact fracturing system (See fig. 1; para [0026]) comprising a lubrication system (collectively 40 - "lubricating oil", 31, 33, 35, 37, 41 - "sensors", 16 - "inlet", 17 - "outlet", fig. 1; as well as "lubricating oil" - para [0026]-[0027], line 197) comprising a plurality of sensors (31, 33, 35, 37, 41 - "sensors", fig. 1, the lubrication system compatible with oil lubrication ("lubricating oil" - para [0026], line 197; para [0027]). Accordingly, it would have been obvious to one of ordinary skill in the art to use the lubrication system of SJ on the compact fracturing system of US in order to reduce the likelihood of the fracturing system overheating due to friction.
-*-Continued in Supplemental Box-*-

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/58906

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
-*-Supplemental Box - Box V.2 - Citations and Explanations-*-

Regarding Claim 2, the modified US teaches the compact fracturing system of claim 1, further comprising a motor drive (39 - "motor", fig. 1; para [0026]) but does not specifically teach wherein the motor drive is at least a 3,000 hydraulic horsepower drive. However, design decisions regarding the hydraulic horsepower of a motor fall within the ordinary skill in the art of one designing a compact fracturing system. Accordingly, it would have been obvious to one of ordinary skill in the art to have utilized routine experimentation and design choices in order to have chosen an appropriate hydraulic horsepower as claimed thereby ensuring the motor can drive the pumps with enough power to raise fluids from the well.

Regarding Claim 6, the modified US teaches the compact fracturing system of claim 1, but does not specifically teach wherein the pump truck has a length of at most 37 feet. However, design decisions regarding the length of a truck fall within the ordinary skill in the art of one designing a compact fracturing system. Accordingly, it would have been obvious to one of ordinary skill in the art to have utilized routine experimentation and design choices in order to have chosen an appropriate length for the truck as claimed thereby allowing all of the components to compactly fit around the wellsite.

Regarding Claim 7, the modified US teaches the compact fracturing system of claim 1, wherein the electronic system (para [[0042]) further comprises a housing (130G, 132G - "house", fig. 8), the transformer and electric motor controls housed within the housing (See fig. 8; para [0042]).

Regarding Claim 8, the modified US teaches the compact fracturing system of claim 1, but does not specifically teach the system further comprising a rear mounted power end lube cooler. Further, SJ teaches a compact fracturing system (See fig. 1; para [0026]) comprising a lubrication system (collectively 40 - "lubricating oil", 31, 33, 35, 37, 41 - "sensors", 16 - "inlet", 17 - "outlet", fig. 1; as well as "lubricating oil" - para [0026], line 197) and a rear mounted power end lube cooler (9 - "power end cooling device", fig. 3; para [0026], line 197-199; See how cooling device 9 is adjacent heat radiator 3 in fig. 3 which is on the rear portion of the trailer in fig. 1). Accordingly, it would have been obvious to one of ordinary skill in the art to use the rear mounted power end lube cooler of SJ on the system of US in order to ensure the lubricating medium does not become too hot itself to properly lubricate the system.

Regarding Claim 9, the modified US teaches the compact fracturing system of claim 1, but does not specifically teach the system further comprising a variable speed cooler motor. Further, SJ teaches a compact fracturing system (See fig. 1; para [0026]) comprising a lubrication system (collectively 40 - "lubricating oil", 31, 33, 35, 37, 41 - "sensors", 16 - "inlet", 17 - "outlet", fig. 1; as well as "lubricating oil" - para [0026], line 197) and a variable speed cooler motor (6 - "motor", figs. 1-2; para [0005], [0010], [0027] - "By adjusting the flow rate of the electronically controlled variable hydraulic pump 29, the rotational speeds of the motor 6 and the fan 7 on the horizontal radiator 3 can be changed, thereby achieving automatic control of the rotational speeds of the motor 6 and the fan 7"). Accordingly, it would have been obvious to one of ordinary skill in the art to use the variable speed cooler motor of SJ on the fracturing system of US in order to allow an operator or controller to enact a specific amount of cooling on the system.

Regarding Claim 13, US teaches the compact fracturing system of claim 10, but does not specifically teach the system further comprising a variable speed cooler motor. Further, SJ teaches a compact fracturing system (See fig. 1; para [0026]) comprising a lubrication system (collectively 40 - "lubricating oil", 31, 33, 35, 37, 41 - "sensors", 16 - "inlet", 17 - "outlet", fig. 1; as well as "lubricating oil" - para [0026], line 197) and a variable speed cooler motor (6 - "motor", figs. 1-2; para [0005], [0010], [0027] - "By adjusting the flow rate of the electronically controlled variable hydraulic pump 29, the rotational speeds of the motor 6 and the fan 7 on the horizontal radiator 3 can be changed, thereby achieving automatic control of the rotational speeds of the motor 6 and the fan 7"). Accordingly, it would have been obvious to one of ordinary skill in the art to use the variable speed cooler motor of SJ on the fracturing system of US in order to allow an operator or controller to enact a specific amount of cooling on the system.

Claim 11 lacks an inventive step under PCT Article 33(3) as being obvious over US in view of US 2011/0110793 A1 to Leugemors et al. (hereinafter 'Leugemors')

Regarding Claim 11, Leugemors teaches the compact fracturing system of claim 10, but does not specifically teach further comprising a regulated suction stabilizer. Further, Leugemors teaches a fracturing system (See fig. 2; para [0008], [0010], [0012], [0038]) comprising a pump (102 - "pump", fig. 2) and a regulated suction stabilizer (110 - "stabilizer device", fig. 2; para [0037]). Accordingly, it would have been obvious to one of ordinary skill in the art to use the regulated suction stabilizer of Leugemors on the system of the modified US in order to improve the flow stability of the fluid exiting the pump.

Claim 3 lacks an inventive step under PCT Article 33(3) as being obvious over US in view of SJ in view of US 2019/0154020 A1 to Supreme Electrical Services, Inc. dba Lime Instruments (hereinafter 'Supreme')

Regarding Claim 3, the modified US teaches the compact fracturing system of claim 1, further comprising a pump (36 - "pump", figs. 1A, 4; para [0026]-[0027]) but does not specifically teach wherein the pump is a quintuplex pump. Further, Supreme teaches a compact fracturing system (See fig. 3A; para [0115]) comprising quintuplex pump (306 - "pumps", fig. 3A; para [0115] - "quintuplex"). Accordingly, it would have been obvious to one of ordinary skill in the art to use the quintuplex pumps of Supreme in place of the pumps of US in order to increase the possible flowrate of each pump.

-*-Continued in next Supplemental Box-*-

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/58906

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
-*-Supplemental Box - Box V.2 - Citations and Explanations-*-

Claim 4 lacks an inventive step under PCT Article 33(3) as being obvious over US in view of SJ in view of Leugemors

Regarding Claim 4, the modified US teaches the compact fracturing system of claim 1, but does not specifically teach the system further comprising a regulated suction stabilizer. Further, Leugemors teaches a fracturing system (See fig. 2; para [0008], [0010], [0012], [0038]) comprising a pump (102 - "pump", fig. 2) and a regulated suction stabilizer (110 - "stabilizer device", fig. 2; para [0037]). Accordingly, it would have been obvious to one of ordinary skill in the art to use the regulated suction stabilizer of Leugemors on the system of the modified US in order to improve the flow stability of the fluid exiting the pump.

Claims 5 and 12 meet the criteria set forth under PCT Article 33(2)-(3) because, as will be shown, the prior art does not teach, nor does it fairly suggest, the claimed limitations.

The prior art is exemplified by (1) US, (2) SJ and (3) US 2008/0277120 A1 to Hickie (hereinafter 'Hickie')

(1) US teaches a compact fracturing system (See figs. 1A, 4 and 8; para [0026], [0038], [0042]), comprising:
a pump truck (See figs. 1A and 4; see trailer 114C of pump system 36);
an electronic system (See fig. 8; para [0042]), comprising:
a transformer (56F - "transformer", fig. 7; see transformer house 130G);
electronic motor controls (para [0042]) housed together with the transformer (para [0042]); and
a variable-frequency drive (VFD) (See fig. 8; see VFD house 132G; variable frequency drive is therein).

(2) SJ teaches a compact fracturing system (See fig. 1; para [0026]) comprising a lubrication system (collectively 40 - "lubricating oil", 31, 33, 35, 37, 41 - "sensors", 16 - "inlet", 17 - "outlet", fig. 1; as well as "lubricating oil" - para [0026], line 197) comprising a plurality of sensors (31, 33, 35, 37, 41 - "sensors", fig. 1, the lubrication system compatible with oil lubrication ("lubricating oil" - para [0026], line 197).

(3) Hickie teaches a fracturing system (See fig. 6; para [0047]) comprising a lubrication system (380 - "lubricator tube") wherein the lubrication system is a stroke based packing lubrication system (See figs. 16-18; para [0055]-[0058]).

Regarding Claim 5, the modified US teaches the compact fracturing system of claim 1, but does not specifically teach wherein the lubrication system is a stroke based packing lubrication system. Further, Hickie teaches a fracturing system (See figs. 6, 16-18; para [0047]) comprising a lubrication system (380 - "lubricator tube", fig. 16) wherein the lubrication system is a stroke based packing lubrication system (See figs. 16-18; para [0055]-[0058]). However, the lubrication system of Hickie is designed to be located on top of a wellhead and is used to lubricate tubulars as they enter and exit a wellbore, whereas the lubrication system of the modified US is located on a trailer of the fracturing system, not directly connected to a wellhead and is used to lubricate components on the trailer that supports equipment around the wellhead. Thus, there is no motivation to combine the two lubrication systems. Accordingly, the prior art does not teach or fairly suggest individually or in combination the compact fracturing system as claimed.

Regarding Claim 12, US teaches the compact fracturing system of claim 10, but does not specifically teach the system further comprising a stroke based lubrication system compatible with oil lubricant. Further, Hickie teaches a fracturing system (See figs. 6, 16-18; para [0047]) comprising a lubrication system (380 - "lubricator tube", fig. 16) wherein the lubrication system is a stroke based packing lubrication system (See figs. 16-18; para [0055]-[0058]). However, the lubrication system of Hickie is designed to be located on top of a wellhead and is used to lubricate tubulars as they enter and exit a wellbore, whereas the lubrication system of the modified US is located on a trailer of the fracturing system, not directly connected to a wellhead and is used to lubricate components on the trailer that supports equipment around the wellhead. Accordingly, the prior art does not teach or fairly suggest individually or in combination the compact fracturing system as claimed.

Claims 1-15 have industrial applicability as defined by PCT Article 33(2)-(3) because the subject matter can be made or used by industry.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

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08 March 2018 (08.03.2018)

WIPO | PCT

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F04B 17/03 (2006.01) *F16D 3/06* (2006.01)
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F04B 23/04 (2006.01) *F04D 29/044* (2006.01)
F16D 1/06 (2006.01) *F04D 29/053* (2006.01)
F16D 1/08 (2006.01)

(21) International Application Number:
PCT/US2016/049777

(22) International Filing Date:
31 August 2016 (31.08.2016)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant: **EVOLUTION WELL SERVICES, LLC** [US/US]; 3 Hughes Landing, 1780 Hughes Landing Boulevard, Suite 125, The Woodlands, TX 77380 (US).

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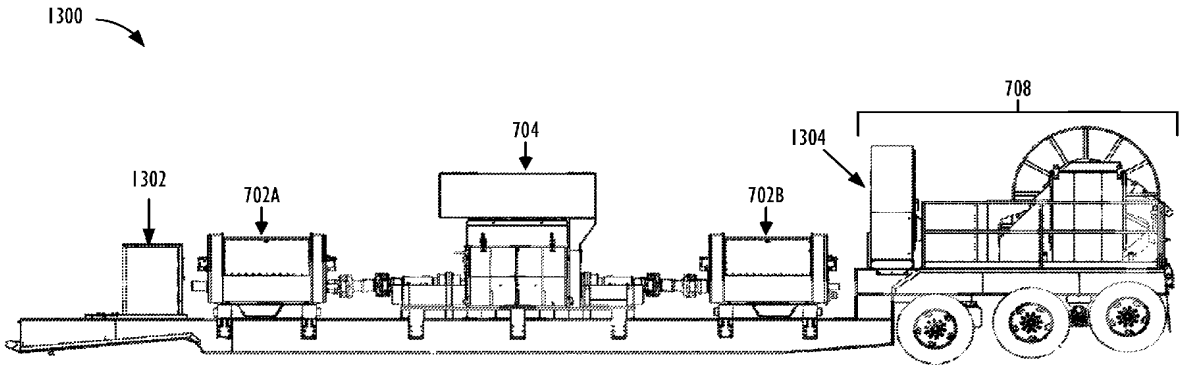


FIG. 13

(57) Abstract: Providing pressurized fracturing fluid with a fracturing pump transport comprising a first fracturing pump and a second fracturing pump that are coupled on opposite sides of a dual shaft electric motor. A first drive line assembly comprising a first engagement coupling that allows for selective engagement and/or disengagement of the first fracturing pump with the dual shaft electric motor. A second drive line assembly comprising a second engagement coupling that allows for selective engagement and/or disengagement of the second fracturing pump with the dual shaft electric motor. The fracturing pump transport also comprising an engagement panel that allows for selective engagement or disengagement at the first engagement coupling based on receiving a remote command.

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MOBILE FRACTURING PUMP TRANSPORT FOR HYDRAULIC FRACTURING OF SUBSURFACE GEOLOGICAL FORMATIONS

BACKGROUND

[0001] Hydraulic fracturing has been commonly used by the oil and gas industry to stimulate production of hydrocarbon wells, such as oil and/or gas wells. Hydraulic fracturing, sometimes called "fracing" or "fracking" is the process of injecting fracturing fluid, which is typically a mixture of water, sand, and chemicals, into the subsurface to fracture the subsurface geological formations and release otherwise encapsulated hydrocarbon reserves. The fracturing fluid is typically pumped into a wellbore at a relatively high pressure sufficient to cause fissures within the underground geological formations. Specifically, once inside the wellbore, the pressurized fracturing fluid is pressure pumped down and then out into the subsurface geological formation to fracture the underground formation. A fluid mixture that may include water, various chemical additives, and proppants (e.g., sand or ceramic materials) can be pumped into the underground formation to fracture and promote the extraction of the hydrocarbon reserves, such as oil and/or gas. For example, the fracturing fluid may comprise a liquid petroleum gas, linear gelled water, gelled water, gelled oil, slick water, slick oil, poly emulsion, foam/emulsion, liquid carbon dioxide (CO_2), nitrogen gas (N_2), and/or binary fluid and acid.

[0002] Implementing large-scale fracturing operations at well sites typically requires extensive investment in equipment, labor, and fuel. For instance, a typical fracturing operation uses a variety of fracturing equipment, numerous personnel to operate and maintain the fracturing equipment, relatively large amounts of fuel to power the fracturing operations, and relatively large volumes of fracturing fluids. As such, planning for fracturing operations is often complex and encompasses a variety of logistical challenges that include minimizing the on-site area or "footprint" of the fracturing operations, providing adequate power and/or fuel to continuously power the fracturing operations, increasing the efficiency of the hydraulic fracturing equipment, and reducing any environmental impact resulting from fracturing operations. Thus, numerous innovations and improvements of existing fracturing technology are needed to address the variety of complex and logistical challenges faced in today's fracturing operations.

SUMMARY

[0001] The following presents a simplified summary of the disclosed subject matter in order to provide a basic understanding of some aspects of the subject matter disclosed herein. This summary is not an exhaustive overview of the technology disclosed herein. It is not intended to identify key or critical elements of the invention or to delineate the scope of the invention. Its sole purpose is to present some concepts in a simplified form as a prelude to the more detailed description that is discussed later.

[0002] A system for pumping and pressurizing fracturing fluid, the system comprising: a mobile transport, an electric prime mover that comprises a shaft and mounted on the mobile transport, a drive line assembly, a fracturing pump mounted on the mobile transport that is coupled to an end of the shaft via the drive line assembly. The drive line assembly comprises an engagement coupling configured to selectively engage and/or disengage the fracturing pump and the electric prime mover, and an engagement panel mounted on the mobile transport and configured to receive a remote command and trigger, in response to the remote command, engagement and/or disengagement of the fracturing pump and the electric prime mover.

[0003] A fracturing pump transport comprising: a first fracturing pump, a second fracturing pump, a dual shaft electric motor that comprises a shaft having a first end and a second end, a first drive line assembly that comprises a first engagement coupling that allows for selective engagement and/or disengagement of the first fracturing pump with the first end of the shaft, a second drive line assembly that comprises a second engagement coupling that allows for selective engagement and/or disengagement of the second fracturing pump with the second end of the shaft, and an engagement panel that allows for selective engagement and/or disengagement at the first engagement coupling, selective engagement and/or disengagement of at the second engagement coupling, or both based on receiving a remote command.

[0004] A method for pumping and pressurizing fracturing fluid, the method comprising: receiving an engagement and/or disengagement command from a location remote to a fracturing pump transport, engaging and/or dis-engaging, in response to receiving the engagement command, a first fracturing pump mounted on the fracturing pump transport with a dual shaft electric prime mover mounted on the fracturing pump transport using a first drive line assembly, wherein the first drive line assembly comprises an engagement coupling that allows for selective engagement between the first fracturing pump and the dual shaft electric prime mover, and driving a second

fracturing pump mounted on the fracturing pump transport with the dual shaft electric prime mover after either engaging and/or disengaging the first fracturing pump from the dual shaft electric prime mover using the first drive line assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] For a more complete understanding of this disclosure, reference is now made to the following brief description, taken in connection with the accompanying drawings and detailed description, wherein like reference numerals represent like parts.

[0006] FIG. 1 is a schematic diagram of an embodiment of a well site, where various embodiments may operate within.

[0007] FIG. 2 is a schematic diagram an embodiment of a well site that includes a mobile source of electricity that comprises three transports for a mobile fracturing system.

[0008] FIG. 3 is a schematic diagram an embodiment of a well site that includes two wellheads and two data vans.

[0009] FIG. 4A is a schematic diagram of an embodiment of the gas turbine generator transport.

[0010] FIG. 4B is a schematic diagram of an embodiment of the gas turbine generator transport.

[0011] FIG. 5A is a schematic diagram of an embodiment of an inlet and exhaust transport.

[0012] FIG. 5B is a schematic diagram of an embodiment of an inlet and exhaust transport.

[0013] FIG. 5C is a schematic diagram of an embodiment of an inlet and exhaust transport that includes a sliding air inlet filter housing.

[0014] FIG. 6 is a schematic diagram of an embodiment of the two transport mobile electric power source when in operational mode.

[0015] FIG. 7A is a schematic diagram of an embodiment of a fracturing pump transport powered by the mobile source of electricity.

[0016] FIG. 7B is a schematic diagram of an embodiment of a fracturing pump transport powered by the mobile source of electricity.

[0017] FIG. 8A is a schematic diagram of an embodiment of a blender transport that includes an electric blender.

[0018] FIG. 8B is a schematic diagram of an embodiment of a blender transport that includes an electric blender.

[0019] FIG. 9A of an embodiment of a blender transport that includes an electric blender with enclosed mixer hoppers.

[0020] FIG. 9B of an embodiment of a blender transport that includes an electric blender with enclosed mixer hoppers.

[0021] FIG. 10 is a schematic diagram of an embodiment of a control network system used to monitor, control, and communicate with a variety of control systems located at one or more well sites.

[0022] FIG. 11 is a flow chart of an embodiment of a method to provide a mobile source of electricity for fracturing operations.

[0023] FIG. 12 is a flow chart of an embodiment of a method to pump fracturing fluid into a wellhead.

[0024] FIG. 13 is a schematic diagram of an embodiment of a fracturing pump transport configured to remotely engage and/or disengage one or more pumps from the prime mover.

[0025] FIG. 14A is a schematic diagram of an embodiment of a drive line assembly that includes an engagement coupling located in an engagement position.

[0026] FIG. 14B is a schematic diagram of an embodiment of a drive line assembly that includes an engagement coupling located in a disengagement position.

[0027] FIG. 15A is a schematic diagram of an embodiment of an engagement panel configured to cause remote engagement and/or disengagement of one or more pumps with a prime mover.

[0028] FIG. 15B is a schematic diagram of an embodiment of a hydraulic control bank located within an engagement panel.

[0029] While certain embodiments will be described in connection with the illustrative embodiments shown herein, the invention is not limited to those embodiments. On the contrary, all alternatives, modifications, and equivalents are included within the spirit and scope of the invention as defined by the claims. In the drawing figures, which are not to scale, the same reference numerals are used throughout the description and in the drawing figures for components and elements having the same structure, and primed reference numerals are used for components and elements having a similar function and construction to those components and elements having the same unprimed reference numerals.

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DETAILED DESCRIPTION

[0030] As used herein, the term "transport" refers to any transportation assembly, including, but not limited to, a trailer, truck, skid, and/or barge used to transport relatively heavy structures, such as fracturing equipment.

[0031] As used herein, the term "trailer" refers to a transportation assembly used to transport relatively heavy structures, such as fracturing equipment that can be attached and/or detached from a transportation vehicle used to pull or move the trailer. In one embodiment, the trailer may include the mounts and manifold systems to connect the trailer to other fracturing equipment within a fracturing system or fleet.

[0032] As used herein, the term "lay-down trailer" refers to a trailer that includes two sections with different vertical heights. One of the sections or the upper section is positioned at or above the trailer axles and another section or the lower section is positioned at or below the trailer axles. In one embodiment the main trailer beams of the lay-down trailer may be resting on the ground when in operational mode and/or when uncoupled from a transportation vehicle, such as a tractor.

[0033] As used herein, the term "gas turbine generator" refers to both the gas turbine and the generator sections of a gas-turbine generator transport. The gas turbine generator receives hydrocarbon fuel, such as natural gas, and converts the hydrocarbon fuel into electricity.

[0034] As used herein, the term "inlet plenum" may be interchanged and generally referred to as "inlet", "air intake," and "intake plenum," throughout this disclosure. Additionally, the term "exhaust collector" may be interchanged throughout and generally referred to as "exhaust diffuser" and "exhaust plenum" throughout this disclosure.

[0035] As used herein, the term "gas turbine inlet filter" may be interchanged and generally referred to as "inlet filter" and "inlet filter assembly." The term "air inlet filter housing" may also be interchanged and generally referred to as "filter housing" and "air filter assembly housing" throughout this disclosure. Furthermore, the term "exhaust stack" may also be interchanged and generally referred to as "turbine exhaust stack" throughout this disclosure.

[0036] Various example embodiments are disclosed herein that provide mobile electric fracturing operations for one or more well sites. To provide fracturing operations, a mobile source of electricity may be configured to provide electric power to a variety of fracturing equipment located at the well sites. The mobile source of electricity may be implemented using at least two transports to reduce its "footprint" at a site. One transport, the power generation transport, may comprise a gas

turbine and generator along with ancillary equipment that supplies electric power to the well sites. For example, the power generation transport may produce electric power in the ranges of about 15-35 megawatt (MW) when providing electric power to a single well site. A second transport, the inlet and exhaust transport, may comprise one or more gas turbine inlet air filters and a gas turbine exhaust stack. The power generation transport and the inlet and exhaust transport may be arranged such that the inlet and exhaust are connected at the side of the gas turbine enclosure rather than through the top of the gas turbine enclosure. In one embodiment, the mobile source of electricity may comprise a third supplemental transport, an auxiliary gas turbine generator transport, that provides power to ignite, start, or power on the power generation transport and/or provide ancillary power where peak electric power demand exceeds the electric power output of the gas turbine generator transport. The auxiliary gas turbine generator transport may comprise a smaller gas turbine generator than the one used in the power generation transport (e.g., provides about 1-8 MW of electric power).

[0037] Also disclosed herein are various example embodiments of implementing mobile fracturing operations using a fracturing pump transport that comprises a dual shaft electric motor configured to drive at least two pumps. The dual shaft electric motor may be an electric motor configured to operate within a desired mechanical power range, such as about 1,500 horsepower (HP) to about 10,000 HP. Each of the pumps may be configured to operate within a desired mechanical power range, such as about 1,500 HP to about 5,000 HP, to discharge fracturing fluid at relatively high pressures (e.g., about 10,000 pounds per square inch (PSI)). In one embodiment, the pumps may be plunger-style pumps that comprise one or more plungers to generate the high-pressure fracturing fluid. The fracturing pump transport may mount and couple the dual shaft electric motor to the pumps using sub-assemblies that isolate and allow operators to remove the pumps and/or the dual shaft electric motor individually and without disconnecting the fracturing pump transport from the mobile fracturing system.

[0038] The disclosure also includes various example embodiments of a control network system that monitors and controls one or more hydraulic fracturing equipment remotely. The different fracturing equipment, which include, but are not limited to, a blender, hydration unit, sand handling equipment, chemical additive system, and the mobile source of electricity, may be configured to operate remotely using a network topology, such as an Ethernet ring topology network. The control network system may remove implementing control stations located on and/or in close proximity to the fracturing equipment. Instead, a designated location, such as a data van and/or a remote location

away from the vicinity of the fracturing equipment may remotely control the hydraulic fracturing equipment.

[0039] FIG. 1 is a schematic diagram of an embodiment of a well site 100 that comprises a wellhead 101 and a mobile fracturing system 103. Generally, a mobile fracturing system 103 may perform fracturing operations to complete a well and/or transform a drilled well into a production well. For example, the well site 100 may be a site where operators are in the process of drilling and completing a well. Operators may start the well completion process with vertical drilling, running production casing, and cementing within the wellbore. The operators may also insert a variety of downhole tools into the wellbore and/or as part of a tool string used to drill the wellbore. After the operators drill the well to a certain depth, a horizontal portion of the well may also be drilled and subsequently encased in cement. The operators may be subsequently pack the rig, and a mobile fracturing system 103 may be moved onto the well site 100 to perform fracturing operations that force relatively high pressure fracturing fluid through wellhead 101 into subsurface geological formations to create fissures and cracks within the rock. The fracturing system 103 may be moved off the well site 100 once the operators complete fracturing operations. Typically, fracturing operations for well site 100 may last several days.

[0040] To provide an environmentally cleaner and more transportable fracturing fleet, the mobile fracturing system 103 may comprise a mobile source of electricity 102 configured to generate electricity by converting hydrocarbon fuel, such as natural gas, obtained from one or more other sources (e.g., a producing wellhead) at well site 100, from a remote offsite location, and/or another relatively convenient location near the mobile source of electricity 102. Improving mobility of the mobile fracturing system 103 may be beneficial because fracturing operations at a well site typically last for several days and the fracturing equipment is subsequently removed from the well site after completing the fracturing operation. Rather than using fuel that significantly impacts air quality (e.g., diesel fuel) as a source of power and/or receiving electric power from a grid or other type of stationary power generation facility (e.g., located at the well site or offsite), the mobile fracturing system 103 utilizes a mobile source of electricity 102 as a power source that burns cleaner while being transportable along with other fracturing equipment. The generated electricity from the mobile source of electricity 102 may be supplied to fracturing equipment to power fracturing operations at one or more well sites. As shown in FIG. 1, the mobile source of electricity 102 may be implemented using two transports in order to reduce the well site footprint and the ability for operators to move

the mobile source of electricity 102 to different well sites and/or different fracturing jobs. Details regarding implementing the mobile source of electricity 102 are discussed in more detail in FIGS. 4A-6.

[0041] The mobile source of electricity 102 may supply electric power to fracturing equipment within the mobile fracturing system 103 that may include, but is not limited to, at least one switch gear transport 112, a plurality of drive power transports 104, at least one auxiliary power transport 106, at least one blender transport 110, at least one data van 114 and a plurality of fracturing pump transports 108 that deliver fracturing fluid through wellhead 101 to subsurface geological formations. The switch gear transport 112 may receive the electricity generated from the mobile source of electric power 102 via one or more electrical connections. In one embodiment, the switch gear transport 112 may use 13.8 kilovolts (KV) electrical connections to receive power from the mobile source of electric power 102. The switch gear transport 112 may comprise a plurality of electrical disconnect switches, fuses, transformers, and/or circuit protectors to protect the fracturing equipment. The switch gear transport 112 may transfer the electricity received from the mobile source of electricity 102 to the drive power transports 104 and auxiliary power transports 106.

[0042] The auxiliary power transport 106 may comprise a transformer and a control system to control, monitor, and provide power to the electrically connected fracturing equipment. In one embodiment, the auxiliary power transport 106 may receive the 13.8 KV electrical connection and step down the voltage to 4.8 KV, which is provided to other fracturing equipment, such as the fracturing pump transport 108, the blender transport 110, sand storage and conveyor, hydration equipment, chemical equipment, data van 114, lighting equipment, and any additional auxiliary equipment used for the fracturing operations. The auxiliary power transport 106 may step down the voltage to 4.8 KV rather than other voltage levels, such as 600 V, in order to reduce cable size for the electrical connections and the amount of cabling used to connect the mobile fracturing system 103. The control system may be configured to connect to a control network system such that the auxiliary power transport 106 may be monitored and/or controlled from a distant location, such as the data van 114 or some other type of control center.

[0043] The drive power transports 104 may be configured to monitor and control one or more electrical motors located on the fracturing pump transports 108 via a plurality of connections, such as electrical connections (e.g., copper wires), fiber optics, wireless, and/or combinations thereof. The connections are omitted from FIG. 1 for clarity of the drawing. The drive power transports 104 may

be part of the control network system, where each of the drive power transports 104 comprise one or more variable frequency drives (VFDs) used to monitor and control the prime movers on the fracturing pump transports 108. The control network system may communicate with each of the drive power transports 104 to monitor and/or control each of the VFDs. The VFDs may be configured to control the speed and torque of the prime movers by varying the input frequency and voltage to the prime movers. Using FIG. 1 as an example, each of the drive power transports 104 may be configured to drive a plurality of the fracturing pump transports 108. Other drive power transport to fracturing pump transport ratios may be used as desired. In one embodiment, the drive power transports 104 may comprise air filters and blowers that intake ambient air to cool the VFDs. Other embodiments of the drive power transports 104 may use an air conditioning units and/or water cooling to regulate the temperature of the VFDs.

[0044] The fracturing pump transport 108 may receive the electric power received from the drive power transport 104 to power a prime mover. The prime mover converts electric power to mechanical power for driving one or more pumps. In one embodiment, the prime mover may be a dual shaft electric motor that drives two different pumps. The fracturing pump transport 108 may be arranged such that one pump is coupled to opposite ends of the dual shaft electric motor and avoids coupling the pumps in series. By avoiding coupling the pump in series, the fracturing pump transport 108 may continue to operate when either one of the pumps fails or have been removed from the fracturing pump transport 108. Additionally, repairs to the pumps may be performed without disconnecting the system manifolds that connect the fracturing pump transport 108 to other fracturing equipment within the mobile fracturing system 103 and wellhead 101. Details regarding implementing the fracturing pump transport 108 are discussed in more detail in FIGS. 7A-7B.

[0045] The blender transport 110 may receive the electric power fed through the auxiliary power transport 106 to power a plurality of electric blenders. A plurality of prime movers may drive one or more pumps that pump source fluid and blender additives (e.g., sand) into a blending tub, mix the source fluid and blender additives together to form fracturing fluid, and discharge the fracturing fluid to the fracturing pump transport 108. In one embodiment, the electric blender may be a dual configuration blender that comprises electric motors for the rotating machinery that are located on a single transport, which is described in more detail in U.S. Patent Application Publication No. 2012/0255734, filed April 6, 2012 by Todd Coli et al. and entitled "Mobile, Modular, Electrically Powered System for use in Fracturing Underground Formations," which is herein incorporated by

reference in its entirety. In another embodiment, a plurality of enclosed mixer hoppers may be used to supply the proppants and additives into a plurality of blending tubs. The electric blender that comprises the enclosed mixer hoppers are discussed in more detail in FIGS. 9A and 9B.

[0046] The data van 114 may be part of a control network system, where the data van 114 acts as a control center configured to monitor and provide operating instructions in order remotely operate the blender transport 110, the mobile source of electricity 102, and fracturing pump transport 108 and/or other fracturing equipment within the mobile fracturing system 103. For example, the data van 114 may communicate via the control network system with the VFDs located within the drive power transports 104 that operate and monitor the health of the electric motors used to drive the pumps on the fracturing pump transports 108. In one embodiment, the data van 114 may communicate with the variety of fracturing equipment using a control network system that has a ring topology. A ring topology may reduce the amount of control cabling used for fracturing operations and increase the capacity and speed of data transfers and communication. Details regarding implementing the control network system are discussed in more detail in FIG 10.

[0047] Other fracturing equipment shown in FIG. 1, such as gas conditioning transport, water tanks, chemical storage of chemical additives, hydration unit, sand conveyor, and sandbox storage are known by persons of ordinary skill in the art, and therefore are not discussed in further detail. In one or more embodiments of the mobile fracturing system 103, one or more of the other fracturing equipment shown in FIG. 1 may be configured to receive power generated from the mobile source of electricity 102. Additionally, as shown in FIG. 1, one or more embodiments of the mobile fracturing system 103 may not include the use of a missile that receives low-pressure fluid and releases high-pressure fluid towards the wellhead 101. The control network system for the mobile fracturing system 103 may remotely synchronizes and/or slaves the electric blender of the blender transport 110 with the electric motors of the fracturing pump transports 108. Unlike a conventional diesel powered blender, the electric blenders may perform rate changes to the pump rate change mounted on the fracturing pump transports 108. In other words, if the pumps within the fracturing pump transports 108 perform a rate change increase, the electric blender within a blender transport 110 may also automatically compensate its rate and ancillary equipment, such as the sand conveyor, to accommodate the rate change. Manual commands from an operator may not be used to perform the rate change.

[0048] FIG. 2 is a schematic diagram an embodiment of a well site 200 that includes a mobile source of electricity 204 that comprises three transports for the mobile fracturing system 202. The mobile fracturing system 202 may be substantially similar to mobile fracturing system 103, except that mobile fracturing system comprises an auxiliary gas turbine generator transport 206. The auxiliary gas turbine generator transport 206 may be configured to provide power to ignite, start, or power on the mobile source of electricity 204 and/or provide ancillary power where peak electric power demand exceeds the electric power output of a gas turbine generator transport. The auxiliary gas turbine generator transport may comprise a smaller, gas turbine or diesel generator that generates less power (e.g., provides about 1-8 MW of electric power) than the one used in the gas turbine generator transport. Additionally or alternatively, the auxiliary gas turbine generator transport 206 may provide testing, standby, peaking, and/or other emergency backup power functionality for the mobile fracturing system 202.

[0049] FIG. 2 illustrates that the mobile fracturing system 202 arranges and positions the drive power transport 104 and the auxiliary power transport 106 in an orientation that is about parallel to the switch gear transport 112 and the fracturing pump transports 108. Positioning the drive power transport 104 and the auxiliary power transport 106 in a parallel orientation rather than about a perpendicular orientation as shown in FIG. 1 may be beneficial, for example reducing the foot print of the mobile fracturing system 202. Moreover, FIG. 2 also illustrates that a fuel source 208, such as natural gas from a producing wellhead, may be located at the well site and be used by the mobile source of electricity 204 to generate electricity.

[0050] Although FIGS. 1 and 2 illustrate a specific configuration for a mobile fracturing system 103 at a well site 100, the disclosure is not limited to that application and/or the specific embodiment illustrated in FIGS. 1 and 2. For instance, embodiments of the present disclosure may include a plurality of wellheads 101, a plurality of blender transports 110, and a plurality of auxiliary power transports 106. Additionally, the mobile source of electricity 102 is not limited for use in a fracturing operation and may be applicable to power other types of equipment and devices not typically used in a fracturing operation. The use and discussion of FIGS. 1 and 2 is only an example to facilitate ease of description and explanation.

[0051] FIG. 3 is a schematic diagram an embodiment of a well site 300 that includes two wellheads 101 and two data vans 114. The two data vans 114 may be part of the control network system that simultaneously monitors and provides operating instructions to the two different

wellheads 101. An additional blender transport 110 may be added to provide fracturing fluid to fracturing pump transports 108 used to fracture the subsurface geological structure underneath the second wellhead 101. Although FIG. 3 illustrates that both wellheads 101 are located on the same well site 300, other embodiments may have the wellheads 101 located at different well sites.

[0052] Mobile Source of Electricity

[0053] The mobile source of electricity may be part of the mobile fracturing system used at a well site as described in FIGS. 1-3. In other words, the mobile source of electricity may be configured to be transportable to different locations (e.g., different well sites) along with other fracturing equipment (e.g., fracturing pump transports) that are part of the mobile fracturing system and may not be left behind after completing fracturing operations. The mobile source of electricity may include at least two different transports that improve mobility of the dedicated electric power by simplifying and minimizing the operations for the mobilization and de-mobilization process. For example, the mobile source of electricity may improve mobility by enabling a mobilization and de-mobilization time period of about 24 hours. The mobile source of electricity also incorporates a two transport footprint, where the same two transport system may be used for transportation and operation modes. Although FIGS. 4A-6 illustrate embodiments of implementing a mobile source of electricity using two different transports, other embodiments of the mobile source of electricity may mount the gas turbine generator, air inlet filter housing, gas turbine exhaust stack, and other components shown in FIGS. 4A-6 on a different number of transports (e.g., all on one transport or more than two transports). To provide electric power for fracturing operations at one or more locations (e.g., well sites), the mobile source of electricity be designed to unitize and mobilize a gas-turbine and generator adapted to convert hydrocarbon fuel, such as natural gas, into electricity.

[0054] FIGS. 4A and 4B are schematic diagrams of an embodiment of the gas turbine generator transport 400. FIG. 4A illustrates a side-profile view of the gas turbine generator transport 400 with a turbine enclosure 402 that surrounds components within the gas turbine generator transport 400 and includes cavities for the inlet plenum 404, exhaust collector 406, and an enclosure ventilation inlet 418. FIG. 4B illustrates a side-profile view of the gas turbine generator transport 400 that depicts the components within the turbine enclosure 402. As shown in FIG. 4B, the gas turbine generator transport 400 may comprise the following equipment: (1) an inlet plenum 404; (2) a gas turbine 407 (e.g., General Electric (GE) 2500); (3) an exhaust collector 406; (4) a generator 408; (5) a generator breaker 410; and (6) a control system 412. Other components not shown in FIG. 4B, but which may

also be located on the gas turbine generator transport 400 include a turbine lube oil system, a fire suppression system, and a generator lube oil system.

[0055] The gas turbine generator transport 400 includes the gas turbine 407 to generate mechanical energy (i.e., rotation of a shaft) from a hydrocarbon fuel source, such as natural gas, liquefied natural gas, condensate, and/or other liquid fuels. As shown in FIG. 4B, the gas turbine shaft is connected to the generator 408 such that the generator 408 converts the supplied mechanical energy from the rotation of the shaft to produce electric power. The gas turbine 407 may be a gas turbine, such as the GE LM2500 family of gas turbines, the Pratt and Whitney FT8 gas turbines, or any other gas turbine that generates enough mechanical power for a generator 408 to power fracturing operations at one or more well sites. The generator 408 may be a Brush BDAX 62-170ER generator or any other generator configured to generate electric power for fracturing operations at one or more well sites. For example, the gas turbine 407 and generator 408 combination within a gas turbine generator transport 400 may generate electric power from a range of at least about 15 megawatt (MW) to about 35 MW. Other types of gas-turbine generators with power ranges greater than about 35 MW or less than about 15 MW may also be used depending on the amount of power needed at the well sites. In one embodiment, to increase mobility of the gas turbine generator transport 400, the gas turbine 407 may be configured to fit within a dimension of about 14.5 feet long and about four feet in diameter and/or the generator 408 may be configured to fit within a dimension of about 18 feet long and about 7 feet wide.

[0056] The generator 408 may be housed within the turbine enclosure 402 that includes air ventilation fans internal to the generator 408 that draws air into the air inlet located on the front and/or back of the generator 408 and discharges air out on the sides via the air outlets 414. Other embodiments may have the air outlets positioned on different locations of the enclosure for the generator 408. In one embodiment, the air inlet may be inlet louvres and the air outlets may be outlet louvres that protect the generator from the weather elements. A separate generator ventilation stack unit may be mounted on the top of the gas turbine generator transport 400.

[0057] The turbine enclosure 402 may also comprise gas turbine inlet filter(s) configured to provide ventilation air and combustion air via one or more inlet plenums 404 to the gas turbine 407. Additionally, enclosure ventilation inlets 418 may be added to increase the amount of ventilation air. The ventilation air may be air used to cool the gas turbine 407 and ventilate the gas turbine enclosure 402. The combustion air may be the air that is supplied to the gas turbine 407 to aid in the production

of the mechanical energy. The inlet plenum 404 may be configured to collect the intake air from the gas turbine inlet filter and supply the intake air to the gas turbine. The exhaust collector 406 may be configured to collect the air exhaust from the gas turbine and supply the exhaust air to the gas turbine exhaust stack.

[0058] To improve mobility of the gas turbine generator transport 400, the air inlet filter housing and the gas turbine exhaust stack are configured to be connected from at least one of the sides of the turbine enclosure 402, as opposed to connecting both the air inlet filter housing and the gas turbine exhaust stack on the top of the turbine enclosure 402 or connecting the air inlet filter housing at one end of the gas turbine generator transport 400 and connecting the exhaust collector from the side of the turbine enclosure 402. The air inlet filter housing and gas turbine exhaust stack from the inlet and exhaust transport may connect with the turbine enclosure 402 using one or more expansion connections that extend from one or both of the transports, located at the sides of the turbine enclosure 402. Any form of connection may be used that provides coupling between the turbine enclosure 402 and the air inlet filter housing and gas turbine exhaust stack without using a crane, forklift, and/or any other external mechanical means to connect the expansion connections in place and/or to connect the air inlet filter housing and gas turbine exhaust stack to the side of the turbine enclosure 402. The expansion connections may comprise a duct and/or an expansion joint to connect the air inlet filter housing and gas turbine exhaust stack to the turbine enclosure 402. Additionally, the routing of the air inlet filter housing and gas turbine exhaust stack via the sides of the turbine enclosure 402 may provide a complete aerodynamic modeling where the inlet air flow and the exhaust air flow are used to achieve the gas turbine nameplate output rating. The inlet and exhaust transport is discussed in more detail later in FIGS. 5A and 5B.

[0059] To improve mobility over a variety of roadways, the gas turbine generator transport 400 in FIGS. 4A and 4B may have a maximum height of about 13 feet and 6 inches, a maximum width of about 8 feet and 6 inches, and a maximum length of about 66 feet. Further, the gas turbine generator transport 400 may comprise at least three axles used to support and distribute the weight on the gas turbine generator transport 400. Other embodiments of the gas turbine generator transport 400 may be transports that exceed three axles depending on the total transport weight. The dimensions and the number of axles may be adjusted to allow for the transport over roadways that typically mandate certain height, length, and weight restrictions.

[0060] In one embodiment, the gas turbine 407 and generator 408 may be mounted to an engineered transport frame 416, a sub-base, sub-skid, or any other sub-structure used to support the mounting of gas turbine 407 and generator 408. The single engineered transport frame may be used to align the connections between the gas turbine 407, the generator 408, the inlet plenum 404 and the exhaust collector 406 and/or lower the gas turbine and generator by configuring for a flush mount to the single engineered transport frame 416. The single engineered transport frame 416 may allow for easier alignment and connection of the gas turbine 407 and generator 408 compared to using separate sub-base for the gas turbine 407 and generator 408. Other embodiments of the gas turbine generator transport 400 may use a plurality of sub-bases, for example, mounting the gas turbine 407 on one sub-base and mounting the generator 408 on another sub-base.

[0061] FIG. 4B illustrates that the generator breaker 410 and control systems 412 may be located on the gas turbine generator transport 400. The generator breaker 410 may comprise one or more circuit breakers that are configured to protect the generator 408 from current and/or voltage fault conditions. The generator breaker 410 may be a medium voltage (MV) circuit breaker switchboard. In one embodiment, the generator breaker may be about three panels, two for the generator and one for a feeder that protect relays on the circuit breaker. In one embodiment, the generator breaker 410 may be vacuum circuit breaker. The control system 412 may be configured to control, monitor, regulate, and adjust the power output of the gas turbine 407 and generator 408. For example, the control system 412 may monitor and balance the load produced by the fracturing operations by generating enough electric power to match the load demands. The control system 412 may also be configured to synchronize and communicate with a control network system that allows a data van or other computing systems located in a remote location (e.g., off the well site) to control, monitor, regulate, and adjust power output of the generator 408. Although FIG. 4B illustrates that the generator breaker 410 and/or control system 412 may be mounted on the gas turbine generator transport 400, other embodiments of the mobile source of electricity may mount the generator breaker 410 and/or control system 412 in other locations (e.g. switch gear transport).

[0062] Other equipment that may also be located on the gas turbine generator transport 400, but are not shown in FIGS. 4A and 4B include the turbine lube oil system, gas fuel valves, generator lube oil system, and fire suppression system. The lube oil systems or consoles, which generally refer to both the turbine lube oil system and generator lube oil system within this disclosure, may be configured to provide a generator and turbine lube oil filtering and cooling systems. In one

embodiment, the turbine lube oil console area of the transport may also contain the fire suppression system, which may comprise sprinklers, water mist, clean agent, foam sprinkler, carbon dioxide, and/or other equipment used to suppress a fire or provide fire protection for the gas turbine 407. The mounting of the turbine lube oil consoles and the fire suppression system onto the gas turbine generator transport 400 reduces this transport's footprint by eliminating the need for an auxiliary transport and connections for the turbine and generator lube oil, filtering, cooling systems and the fire suppression system to the gas turbine generator transport. The turbine and generator lube oil systems may be mounted on a skid that is located underneath the generator 408 or any other location on the gas turbine generator transport 400.

[0063] FIGS. 5A and 5B are schematic diagrams of embodiments of an inlet and exhaust transport 500. Specifically, FIG. 5A depicts the inlet and exhaust transport 500 while in transportation mode and FIG. 5B depicts the inlet and exhaust transport 500 while in operational mode. As shown in FIGS. 5A and 5B, the inlet and exhaust transports 500 include an air inlet filter housing 502 and a gas turbine exhaust stack 504. Although not shown in FIGS. 5A and 5B, one or more gas turbine inlet filters and ventilation fans may be located within or housed in the air inlet filter housing 302.

[0064] FIGS. 5A and 5B illustrate that the air inlet filter housing 502 may be mounted on the inlet and exhaust transport 500 at a fixed location. Other embodiments of the inlet and exhaust transport 500 may mount the air inlet filter housing 502 with a configuration such that the air inlet filter housing 502 may slide in one or more directions when transitioning between operational mode and transportation mode. For example, as shown in FIG. 5C, the air inlet filter housing 502 may slide out for operational mode and slide back for transport mode. Sliding the air inlet filter housing 502 may be used to align the air inlet filter housing 502 with the inlet plenum of the gas turbine enclosure mounted on the gas turbine generator transport. In another embodiment, the air inlet filter housing 502 may be mounted on a turntable with the ability to engage the inlet plenum of the gas turbine enclosure mounted on the gas turbine generator transport. The air inlet filter housing 502 may comprise a plurality of silencers that reduce noise. The different embodiments for mounting the air inlet filter housing 502 may depend on the amount of clean air and the air flow dynamics needed to supply the gas turbine for combustion.

[0065] The gas turbine exhaust stack 504 may comprise the gas turbine exhaust 508, an exhaust extension 506 configured for noise control, and an exhaust end connector 510. The exhaust extension

506 may comprise a plurality of silencers that reduce noise from the inlet and exhaust transport 500. As shown in FIG. 5A, the gas turbine exhaust stack 504 may be mounted to initially lie on its side during transportation mode. In operational mode, the gas turbine exhaust stack 504 may be rotated up without using external mechanical means such that the gas turbine exhaust stack 504 is mounted to the inlet and exhaust transport 500 on its base and in the upright position. In operational mode, the gas turbine exhaust stack 504 may be positioned using hydraulics, pneumatics, and/or electric motors such that it aligns and connects with the exhaust end connector 510 and exhaust collector of the gas turbine enclosure shown in FIGS. 4A and 4B.

[0066] The exhaust end connector 510 may be adjusted to accommodate and align the gas turbine exhaust stack 504 with the exhaust collector of the gas turbine enclosure. In operational mode, the exhaust end connector 510 may move forward in a side direction, which is in the direction toward the gas turbine enclosure. The exhaust end connector 510 may move backward in the side direction, which is in the direction away from the gas turbine enclosure, when transitioning to the transportation mode. Other embodiments of the gas turbine exhaust stack 504 may have the gas turbine exhaust 508 and the exhaust end connector 510 connected as a single component such that the exhaust end connector 510 and the gas turbine exhaust stack 504 are rotated together when transitioning between the transportation and operational modes.

[0067] In another embodiment, during transport, the gas turbine exhaust stack 504 may be sectioned into a first section and a second section. For example, the first section may correspond to the gas turbine exhaust 508 and the second section may correspond to the exhaust extension 506. The first section of the gas turbine exhaust stack 508 may be in the upright position and the second section of the gas turbine exhaust stack 506 may be mounted adjacent to the first section of the gas turbine exhaust for transport. The first section and the second section may be hinged together such that the second section may be rotated up to stack on top of the first section for operation. In another embodiment, the gas turbine exhaust stack 504 may be configured such that the entire gas turbine exhaust stack 504 may be lowered or raised while mounted on the inlet and exhaust transport 500.

[0068] Typically, the air inlet filter housing 502 and gas turbine exhaust stack 504 may be transported on separate transports and subsequently crane lifted onto the top of gas turbine enclosure and mounted on the gas turbine generator transport during operation mode. The separate transports to carry the air inlet filter housing 502 and gas turbine exhaust stack 504 may not be used during operational mode. However, by adapting the air inlet filter housing 502 and gas turbine exhaust stack

504 to be mounted on a single transport and to connect to at least one of the sides of the gas turbine enclosure mounted on the gas turbine generator transport, the inlet and exhaust transport may be positioned alongside the gas turbine generator transport and subsequently connect the air inlet and exhaust plenums for operations. The result is having a relatively quick rig-up and/or rig-down that eliminates the use of heavy lift cranes, forklifts, and/or any other external mechanical means at the operational site.

[0069] FIG. 6 is a schematic diagram of an embodiment of the two transport mobile electric power source 600 when in operational mode. FIG. 6 illustrates a top-down-view of the coupling between the inlet and exhaust transport 500 and the gas turbine transport 400 during operational mode. The exhaust expansion connection 602 may move and connect (e.g., using hydraulics) to the exhaust end connector 510 without using external mechanical means in order to connect the gas turbine exhaust stack of the inlet and exhaust transport with the exhaust collector of the gas turbine generator transport. The inlet expansion connections 604 may move and connect the air inlet filter housing of the inlet and exhaust transport and the inlet plenum of the gas turbine generator transport. The two transports 400 and 500 may be parked at a predetermined orientation and distance such that the exhaust expansion connection 602 and inlet expansion connections 604 are able to connect the two transports 400 and 500.

[0070] In one embodiment, to adjust the positioning, alignment, and distance in order to connect the two transports 400 and 500, each of the transports 400 and 500 may include a hydraulic walking system. For example, the hydraulic walking system may move and align transport 500 into a position without attaching the two transports 400 and 500 to transportation vehicles (e.g., a tractor or other type of motor vehicle). Using FIGS. 4 and 5 as an example, the hydraulic walking system may comprise a plurality of outriggers and/or support feet 412 used to move transport 400 and/or transport 500 back and forth and/or sideways. At each outrigger and/or support feet 412, the hydraulic walking system may comprise a first hydraulic cylinder that lifts the transport and a second hydraulic cylinder that moves the transport in the designated orientation or direction. A hydraulic walking system on the transport increases mobility by reducing the precision needed when parking the two transports next to each other.

[0071] FIG. 11 is a flow chart of an embodiment of a method 1100 to provide a mobile source of electricity for fracturing operations. Method 1100 may start at block 1102 by transporting a mobile source of electricity with other fracturing equipment to a well site that comprises a non-producing

well. Method 1100 may then move to block 1104 and convert the mobile source of electricity from transportation mode to operational mode. The same transports may be used during the conversation from transportation mode to operational mode. In other words, transports are not added and/or removed when setting up the mobile source of electricity for operational mode. Additionally, method 1100 be performed without the use of a forklift, crane, and/or other external mechanical means to transition the mobile source of electricity into operational mode. The conversion process for a two transport trailer is described in more detail in FIGS. 4A-6.

[0072] Method 1100 may then move to block 1106 and generate electricity using the mobile source of electricity to power fracturing operations at one or more well sites. In one embodiment, method 1100 may generate electricity by converting hydrocarbon fuel into electricity using a gas turbine generator. Method 1100 may then move to block 1108 and convert the mobile source of electricity from operational mode to transportation mode. Similar to block 1104, the conversion process for block 1108 may use the same transports without using a forklift, crane, and/or other external mechanical means to transition the mobile source of electricity back to transportation mode. Method 1100 may then move to block 1110 to remove the mobile source of electricity along with other fracturing equipment from the well site once fracturing operations are completed.

[0073] Fracturing Pump Transport

[0074] FIGS. 7A and 7B are schematic diagrams of embodiments of a fracturing pump transport 700 powered by the mobile source of electricity as described in FIGS. 4A-6. The fracturing pump transport 700 may include a prime mover 704 powering two separate pumps 702A and 702B. By combining a single prime mover 704 attached to two separate pumps 702A and 702B on a transport, a fracturing operation may reduce the amount of pump transports, prime movers, variable frequency drives (VFD's), ground iron, suction hoses, and/or manifold transports. Although FIGS. 7A and 7B illustrates that the fracturing pump transport 700 supports a single prime mover 704 power two separate pumps 702A and 702B, other embodiments of the fracturing pump transport 700 may include a plurality of prime movers 704 that each power the pumps 702A and 702B.

[0075] A "lay-down" trailer 710 design may provide mobility, improved safety, and enhanced ergonomics for crew members to perform routine maintenance and operations of the pumps as the "lay-down" arrangement positions the pumps lower to the ground as the main trailer beams are resting on the ground for operational mode. As shown in FIGS. 7A and 7B, the "lay-down" trailer 710 has an upper section above the trailer axles that could hold or have mounted the fracturing pump

trailer power and control systems 708. The fracturing pump trailer power and control system 708 may comprise one or more electric drives, transformers, controls (e.g., a programmable logic controller (PLC) located on the fracturing pump transport 700), and cables for connection to the drive power trailers and/or a separate electric pumper system. The electric drives may provide control, monitoring, and reliability functionality, such as preventing damage to a grounded or shorted prime mover 704 and/or preventing overheating of components (e.g., semiconductor chips) within the electric drives. The lower section, which may be positioned lower than the trailer axles, may hold or have mounted the prime mover 704 and the pumps 702A and 702B attached on opposite sides of each other.

[0076] In one embodiment, the prime mover 704 may be a dual shaft electric motor that has a motor shaft that protrudes on opposite sides of the electric motor. The dual shaft electric motor may be any desired type of alternating current (AC) or direct current (DC) motor. In one embodiment, the dual shaft electric motor may be an induction motor and in another embodiment the dual shaft electric motor may be a permanent magnet motor. Other embodiments of the prime mover 704 may include other electric motors that are configured to provide about 5,000 HP or more. For example, the dual shaft electric motor may deliver motor power in a range from about 1,500 HP to about 10,000 HP. Specific to some embodiments, the dual shaft electric motor may be about a 5,000 HP rated electric motor or about a 10,000 HP electric motor. The prime mover 704 may be driven by at least one variable frequency drive that is rated to a maximum of about 5,000 HP and may receive electric power generated from the mobile source of electric power.

[0077] As shown in FIGS. 7A and 7B, one side of the prime mover 704 drives one pump 702A and the opposite side of the prime mover 704 drives a second pump 702B. The pumps 702A and 702B are not configured in a series configuration in relation to the prime mover 704. In other words, the prime mover 704 independently drives each pump 702A and 702B such that if one pump fails, it can be disconnected and the other pump can continue to operate. The prime mover 704, which could be a dual shaft electric motor, eliminates the use of diesel engines and transmissions. Moreover, using a dual shaft electric motor on a transport may prevent dissonance or feedback when transferring power to the pumps. In one embodiment, the prime mover 704 may be configured to deliver at least about 5,000 HP distributed between the two pumps 702A and 702B. For instance, prime mover 704, which may be a dual shaft electric motor, may provide about 2,500 HP to one of the pumps 702A and about 2,500 HP to the other pump 702B in order to deliver a total of about

5,000 HP. Other embodiments may have the prime mover 704 deliver less than 5,000 HP or more than 5,000 HP. For example, the prime mover 704 may deliver a total of about 3,000 HP by delivering about 1,500 HP to one of the pumps and about 1,500 HP to the other pump. Another example may have the prime mover 704 deliver a total of about 10,000 HP by delivering about 5,000 HP to one of the pumps 702A and about 5,000 HP to another pump 702B. Specifically, in one or more embodiments, the prime mover 704 may operate at HP ratings of about 3,000 HP, 3,500 HP, 4,000 HP, 4,500 HP, 5,000 HP, 5,200 HP, 5,400 HP, 6,000 HP, 7,000 HP, 8,000 HP, 9,000 HP, and/or 10,000 HP.

[0078] The fracturing pump transport 700 may reduce the footprint of fracturing equipment on a well-site by placing two pumps 702A and 702B on a single transport. Larger pumps may be coupled to a dual shaft electric motor that operates with larger horse power to produce additional equipment footprint reductions. In one embodiment, each of the pumps 702A and 702B may be quintiplex pumps located on a single transport. Other embodiments may include other types of plunger style pumps, such as triplex pumps. The pumps 702A and 702B may each operate from a range of about 1,500 HP to about 5,000 HP. Specifically, in one or more embodiments, each of the pumps 702A and 702B may operate at HP ratings of about 1,500 HP, 1,750 HP, 2,000 HP, 2,250 HP, 2,500 HP, 2,600 HP, 2,700 HP, 3,000 HP, 3,500 HP, 4,000 HP, 4,500 HP, and/or 5,000 HP. The pumps 702A and 702B may not be configured in a series configuration where the prime mover 704 drives a first pump 702A and the first pump 702B subsequently drives a second pump 702B.

[0079] FIG. 7A also illustrates that each pump 702A and 702B, which may also be generally referred to in this disclosure as pump 702, is mounted on the fracturing pump transport 700 with the same orientation. In particular, each pump 702 is mounted such that the fluid end assembly 716 for each pump 702 is facing the same side of the fracturing pump transport 700. Additionally, in FIG. 7A, the power end assembly 718 for each pump 702 is facing the same side of the fracturing pump transport 700. In other words, for a given pump 702 (e.g., pump 702A), the fluid end assembly 716 and power end assembly 718 are located on opposite sides of the fracturing pump transport 700. As shown in FIG. 7A, both the fluid end assembly 716 and power end assembly 718 of a pump 702 may face sides of the fracturing pump transport 700 that are about orthogonal or perpendicular to the front end 720 and back end 722 of the fracturing pump transport 700. Having the fluid end side 716 of each pump 702 face the same side of the fracturing pump transport 700 may be beneficial by simplifying and reducing the amount of plumbing used to route both the low pressure fluid line and

high pressure fluid line into and out of the fracturing pump transport 700. For example, if pump 702A's and 702B's fluid end assembly 716 are facing opposite sides of the fracturing pump transport 700, the fracturing pump transport 700 may include plumbing that routes both the low pressure fluid lines and high pressure fluid lines on both sides of the fracturing pump transport 700. Alternatively, if pump 702A's and 702B's fluid end assembly 716 are facing the same side of the fracturing pump transport 700, at least a majority of the plumbing that routes both the low pressure fluid lines and high pressure fluid lines could be located on one side of the fracturing pump transport 700.

[0080] In one embodiment, to mount both pumps 702 where the fluid end assemblies 716 are facing the same side of the fracturing pump transport 700, one of the pumps 702 (e.g., pump 702B) may be configured with a right-side pinion while the other pump 702 (e.g., pump 702A) is configured with a pinion located on the opposite side of the pump 702, which can be referred to as a left-side pinion. In particular, a pump 702 with a right-side pinion may be designated to mount to a specific side of the prime mover 704, such as the side of the prime mover 704 facing the back end 722 (e.g., the end with trailer axles), and the pump 702 with a left-side pinion may be designated to mount on the other side of the prime mover 704, such as the side of the prime mover 704 facing the front end 720 (e.g., trailer hitch). Because the pumps 702 are located on opposite sides of the prime mover 704, placing pinions on different sides of the pumps 702 allows the fluid end assembly 716 for each pump 702 to face the same side of the fracturing pump transport 700.

[0081] In another embodiment, the fracturing pump transport 700 may include one or more pumps 702 configured with a dual pinion 724. A pump 702 with the dual pinion configuration would include both a left-side pinion and a right-side pinion. FIG. 7B illustrates that each pump 702A and 702B has a dual pinion 724, where the two pinion ends are located on opposite sides of each other. Having pumps 702 configured with a dual pinion 724 provides additional flexibility compared to pumps 702 with either a right-side pinion or a left-side pinion. Specifically, a pump 702 with a dual pinion 724 may be able to mount on either side of the prime mover 704 while having the fluid end assembly 716 for each pump 702 face the same side of the fracturing pump transport 700.

[0082] Another advantage of having the fluid end assemblies 716 face the same side of the fracturing pump transport 700 is to avoid damaging the pump 702 at different loads and/or requiring mounting of a custom fracturing pump. In embodiments where the fluid end assemblies 716 are facing opposite directions, the pinions for pumps 702A and 702B may be rotating in opposite directions when driven by the prime mover 704. A pinion, whether a right-pinion, left-pinion, or a

dual pinion 724, may be located within the power end assembly 718 and includes a pinion shaft and one or more pinion gears configured to generate rotational movement of the power end assembly 718. The rotational movement may generate torque that moves the plungers in the fluid end assembly 716 used to pump and pressurize fracturing fluid. To produce torque, typically, a pinion gear may interface with a bull gear that drives a crankshaft, which in turn moves the fluid end plungers. The pinion gear and the bull gear are commonly helical gears configured to engage with each other by rotating in a specified direction. If the pinion shaft, pinion gear, and bull gear are rotated in a direction opposite to the designed direction, the pinion gear may turn the bull gear until the pinion gear generates enough torque to break the bull gear and damage the pump 702. To avoid damaging the pumps 702, one of the pumps 702 would need to be customized to provide torque when the pinion rotates in a direction opposite of conventional fracturing pumps. Including a customized fracturing pump on the fracturing pump transport 700 could not only lead to an increase in manufacturing cost, but also decrease operational and maintenance flexibility by requiring pumps 702A and 702B to be mounted on designated sides of the prime mover 704.

[0083] The prime mover 704 and each of the pumps 702A and 702B may be mounted on sub-assemblies configured to be isolated and allow for individual removal from the fracturing pump transport. In other words, the prime mover 704 and each of the pumps 702A and 702B can be removed from service and replaced without shutting down or compromising other portions of the fracturing system. The prime mover 704 and pumps 702A and 702B may be connected to each other via couplings that are disconnected when removed from the fracturing pump transport 700. If the prime mover 704 needs to be replaced or removed for repair, the prime mover sub-assembly may be detached from the fracturing pump transport 700 without removing the two pumps 702A and 702B from the fracturing pump transport. For example, pump 702A can be isolated from the fracturing pump transport 700, removed and replaced by a new pump 702A. If the prime mover 704 and/or the pumps 702A and 702B requires service, an operator can isolate the different components from the fluid lines, and unplug, un-pin, and remove the prime mover 704 and/or the pumps 702A and 702B from the fracturing pump transport. Furthermore, each pump 702A and 702B sub-assembly may be detached and removed from the fracturing pump transport 700 without removal of the other pump and/or the prime mover 704. As such, the fracturing pump transport 700 may not need to be disconnected from the manifold system and driven out of the location. Instead, replacement prime

mover 704 and/or the pumps 702A and 702B may be placed backed into the line and reconnected to the fracturing pump transport 700.

[0084] To implement the independent removal of the sub-assemblies, the two pumps 702A and 702B may be coupled to the prime mover 704 using a drive line assembly 706 that is adapted to provide remote operation that engages and/or disengages one or both pumps 702A and 702B from the prime mover 704. The drive line assembly 706 may comprise one or more couplings and one or more drive shafts. For example, the drive line assembly 706 may comprise a fixed coupling that connects to one of the pumps 702A or 702B, a keyed shaft 712, and an engagement coupling (e.g., spline-tooth coupling 714). The keyed shaft 712 may interconnect the fixed coupling (e.g., a flex coupling or universal joint-based coupling) to a spline-tooth coupling 714 that attaches to the prime mover 704. The fixed coupling may directly connect the keyed shaft 712 to the pinion of the pump or indirectly connect the keyed shaft 712 to the pinion of the pump using a pump drive shaft. To engage and/or disengage one or both pumps 702A and 702B from the prime mover 704, the spline-tooth coupling 714 may include a splined sliding sleeve coupling and a motor coupling that provides motor shaft alignment with the keyed shaft 712. Hydraulic fluid and/or mechanical power may be used to adjust the splined sliding sleeve coupling to engage and/or disengage the pumps 702A and 702B from the prime mover 704. Other embodiments of couplings that may be used to engage and/or disengage the keyed shaft 712 from the prime mover 704 may include torque tubes, air clutches, electro-magnetic clutches, hydraulic clutches, and/or other clutches and disconnects that have manual and/or remote operated disconnect devices.

[0085] FIG. 13 is a schematic diagram of an embodiment of a fracturing pump transport 1300 configured to remotely engage and/or disengage one or more pumps 702 from the prime mover 704. Although FIG. 13 illustrates that the prime mover 704 is a dual-shaft electric motor, other embodiments of the fracturing pump transport 1300 may use other types of electric motors, such an electric motor that has only one shaft extending outward. As shown in FIG. 13, the fracturing pump transport 1300 may comprise an engagement panel 1302 and a monitoring station 1304, such as a human monitoring interface (HMI) station. The engagement panel 1302 may include a control system that adjusts an engagement coupling to transition between an engaged and a disengaged position. In one embodiment, the engagement panel 1302 may include levers or switches that an operator may manually operate to engage or disengage the keyed shaft 712 from the motor shaft using the engagement coupling. Additionally or alternatively, the engagement

panel 1302 may include electronic controllers that receive instructions from remote locations, such as a monitoring station 1304, another location at the well site (e.g., data van), and/or off-site to engage and/or disengage the pumps 702 from the prime mover 704. In response to receiving a remote command, the engagement panel 1302 may trigger the engagement and/or disengagement of one or more of the pumps from the prime mover 704. For instance, if pump 702A was disengaged and pump 702B was engaged, in response to receiving the remote command, the engagement panel 1302 may trigger the engagement of pump 702A and disengagement of pump 702B. The remote command may also produce a result where both pumps 702 are disengaged or engaged with the prime mover.

[0086] The engagement panel 1302 may vary its mounting location on the fracturing pump transport 1300 and the control mechanism used to engage and/or disengage the pumps 702 from the prime mover 704. Although FIG. 13 illustrates the engagement panel 1302 is located at the front end of the fracturing pump transport 1300, other embodiments could have the engagement panel 1302 located at other locations, such as being part of the trailer power and control systems 708 and/or closer in proximity to the trailer power and control systems 708. The control mechanism implemented by the engagement panel 1302 may be based on the type of engagement coupling used to engage or disengage the pumps 702 and prime mover 704. For example, the engagement panel 1302 may be a hydraulic control bank, which is discussed in more detail in FIGS. 15A and 15B that include hydraulic controllers (e.g., hydraulic and electronic control valves) that manage hydraulic fluid pressure when the engagement coupling is a splined tooth coupling.

[0087] The monitoring station 1304, which may be part of the trailer power and control systems 708, may include hardware and/or software that allow an operator to manage and control (e.g., provide instructions) the engagement panel 1302 to engage and/or disengage the pumps 702 from the prime mover 704. For example, the monitoring station 1304 may be configured with a safety control system that prevents the execution of engagement and/or disengagement instructions when the prime mover and/or pumps are operational. In one embodiment, the monitoring station 1304 may also include network components for receiving remote engagement or disengagement instructions by connecting to a control network system that communicates with other fracturing equipment and/or control systems. The control network system is described in more detail in FIG. 10.

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[0088] The fracturing pump transport 1300 may also include proximity sensors (not shown in FIG. 13) used to determine whether the engagement coupling is in an engagement or disengagement position when performing remote monitoring at the monitoring station 1304, another location at the well site (e.g., data van), and/or off-site. In one embodiment, the proximity sensors may be coupled to the engagement coupling and/or located in close proximity to the engagement coupling to determine whether the pumps 702 are engaged and/or disengaged with the prime mover 704. Information obtained from the proximity sensors may also be useful in allowing the monitoring station 1304 and/or other control systems that are part of the control network system (e.g., data van) to determine the number of operating pumps (e.g., none, one, or two) for fracturing pump transport 1300. An operator and/or control system may use the number of pumps to accurately measure the fluid pumping rate during operations.

[0089] FIGS. 14A and 14B are schematic diagrams of an embodiment of a drive line assembly 1400 used to remotely engage and/or disengage a pump from a prime mover. FIG. 14A illustrates that the engagement coupling 1410 is in an engagement position while FIG. 14B illustrates that the engagement coupling 1410 is in a disengagement position. When manual and/or remote instructions are sent to move the engagement coupling 1410 into an engaged position, the engagement coupling 1410 may translate the rotational movement from the motor shaft 1408 of the prime mover to the keyed shaft (e.g., a driveline shaft or pump pinion). In a disengaged position, the engagement coupling 1410 disengages the keyed shaft from the motor shaft 1408 of the prime mover such that the rotational movement is not translated to the keyed shaft even though the motor shaft 1408 continues to rotate. For FIGS. 14A and 14B, the keyed shaft would be located underneath the shaft cover 1406 used to mount the proximity sensors 1404A and 1404B.

[0090] FIGS. 14A and 14B also illustrate that the engagement coupling 1410 includes a spline-tooth coupling with a sleeve that moves back in forth using hydraulic cylinders 1402 (e.g., hydraulic rams). When the hydraulic cylinders 1402 move the sleeve in a designated direction (e.g., in the direction of the pump) the spline-tooth coupling may engage the keyed shaft and transfer rotational movement from the motor shaft 1408 to the keyed shaft. When the hydraulic cylinders 1402 move the sleeve an opposite direction (e.g., in the direction of the prime mover), the spline-tooth coupling may disengage the keyed shaft and isolate the rotational movement the motor shaft 1408 generates from the keyed shaft. Other embodiments, may use mechanical power instead of hydraulic power to move the sleeves of the spline-tooth coupling. As shown in FIGS 14A and 14B, the motor shaft 1408

may refer to one end of the dual shaft that protrudes out of the prime mover. Other embodiments could have the motor shaft 1408 be a drive line shaft that is coupled to one end of the dual shaft of the prime mover. In other words, the engagement coupling 1410 may directly or indirectly connect the keyed shaft engagement coupling 1410 to a prime mover.

[0091] The drive line assembly 1400 may also include one or more proximity sensors 1404A and 1404B to determine the position of the engagement coupling 1410, and one or more fixed couplings 1412 used to directly or indirectly couple the keyed shaft with a pump pinion. In FIG. 14A, the proximity sensor 1404A may detect when the engagement coupling 1410 is in an engagement position, and in FIG. 14B, the proximity sensor 1404B may detect when the engagement coupling 1410 has moved to a disengagement position. FIGS. 14A and 14B also depict fixed couplings 1412 that couples the keyed shaft to a pump pinion. The drive line assembly 1400 may vary the number of fixed couplings 1412 and intermediate drive shafts based on space availability, misalignment tolerances, and whether vibrations from the pump need to be deflected to avoid affecting the operation of the prime mover. Additionally, in one or more embodiments, the pump's pinion may move or walk slightly axially (e.g., 1/16ths of an inch). Having fixed couplings 1412 and intermediate drive shafts may allow the pump's pinion shaft to move or walk slightly without damaging the motor shaft and/or bearings of the prime mover. Examples of fixed couplings 1412 may include, but are not limited to, flex couplings and/or universal joint-based coupling.

[0092] Although FIGS. 14A and 14B illustrate a specific embodiment of a drive line assembly 1400, the disclosure is not limited to the specific embodiment illustrated in FIGS. 14A and 14B. For instance, engagement coupling 1410 may be implemented using other types of coupling, such as torque tubes, air clutches, electro-magnetic clutches, hydraulic clutches. The type of engagement coupling 1401 may then determine what powers the engagement and/or disengagement operation, such as hydraulic, mechanical, and/or electric power. Additionally, the engagement coupling 1410 may be configured to statically and/or dynamically engage and/or disengage the keyed shaft from the motor shaft 1408. In a static engagement and/or disengagement, the pumps and/or prime mover may not be operational when engagement or disengagement occurs. For instance, the motor shaft 1408 is not rotating when performing static engagement and/or disengagement. In a dynamic engagement and/or disengagement, the pumps, prime mover and/or motor shaft 1408 are rotating when engagement and/or disengagement occurs. For example, rather than using a spline-tooth coupling, the drive line assembly 1400 may use an air clutch to perform

dynamic engagement or disengagement. The use and discussion of FIGS. 14A and 14B is only an example to facilitate ease of description and explanation.

[0093] FIG. 15A is a schematic diagram of an embodiment of an engagement panel 1500 configured to cause remote engagement and/or disengagement of one or more pumps with a prime mover, and FIG. 15B is a schematic diagram of an embodiment of a hydraulic control bank 1502 located within an engagement panel 1500. FIG. 15A illustrates that the engagement panel 1500 includes a hydraulic control bank 1502 with one or more hydraulic levers 1504 that operators may manually operate to trigger engagement and/or disengagement of one or more pumps from a prime mover. As shown in FIG. 15B, adjusting the hydraulic levers 1504 may activate hydraulic control valves 1506 that adjust hydraulic fluid pressures to move an engagement coupling, such as a spline-tooth coupling, to an engagement and/or disengagement position. The hydraulic control bank 1502 may also include electronic control valves 1508 that adjust hydraulic fluid pressures based on instructions received from a remote location, such as a monitoring station, another location at the well site (e.g., data van), and/or off-site. In one embodiment, the electronic control valves 1508 may include one or more electronic solenoids that adjust the hydraulic fluid pressures to engage and/or disengage one or more pumps from the prime mover. Additionally or alternatively, the engagement panel 1500 may also be configured to prevent engagement and/or disengagement while the motor shaft of the prime mover is rotating (e.g., when an operator attempts to adjust the hydraulic levers and/or remote instructions are received) in instances the engagement coupling is configured to only perform static engagement and/or disengagement.

[0094] FIG. 12 is a flow chart of an embodiment of a method 1200 to pump fracturing fluid into a wellhead. Method 1200 starts at block 1202 and receives electric power to power at least one prime mover. The prime mover may be a dual-shaft electric motor located on a fracturing pump transport as shown in FIGS. 7A and 7B. Method 1200 may then move to block 1204 and receive fracturing fluid produced from one or more blenders. In one embodiment, the blenders may be electric blenders that includes enclosed mixer hoppers.

[0095] Method 1200 then moves to block 1206 and drives one or more pumps using the at least one prime mover to pressurize the fracturing fluid. In one embodiment, the pumps may be positioned on opposite sides and may be both driven by a single shaft from the dual-shaft electric motor when the engagement couplings for both pumps are in engagement position. In other words, when two

pumps are operating and engaged, method 1200 may drive the two pumps in a parallel configuration instead of a serial configuration. If one of the pumps are removed and/or disengaged, method 1200 may continue to drive the remaining pump. Method 1200 may receive engagement and/or disengagement instructions manually and/or from a remote location to engage and/or disengaged the pumps prior to or while driving the pumps. Method 1200 may then move to block 1208 and pump the pressurized fracturing fluid into a wellhead.

[0096] Blender Transport

[0097] FIGS. 8A and 8B are schematic diagrams of an embodiment of a blender transport 800 that includes an electric blender 806. FIG. 8A illustrates a top-down view of the blender transport 800 and FIG. 8B illustrates a side-profile view of the blender transport 800. The blender transport 800 may be powered by the mobile source of electricity as described in FIGS. 1-6. The electric blender 806 may be a dual configuration blender, as described in U.S. Patent Application Publication 2012/0255734, with a blending capacity of about 240 bpm. The dual configuration blender may comprise electric motors for all rotating machinery and may be mounted on a single transport. The dual configuration blender may have two separate blending units that are configured to be independent and redundant. For example, any one or both the blending units may receive a source fluid via inlet manifolds of the blending units. The source fluid may originate from the same source or different sources. The source fluid may subsequently be blended by any one or both of the blending tub and subsequently discharged out of any one or both outlet manifolds of the blending units. Other embodiments of the blender transport 800 may be single configuration blender that includes a single blending unit.

[0098] FIGS. 8A and 8B illustrate a "lay-down" trailer 802 design that provides mobility and improves ergonomics for the crew members that perform routine maintenance and operations of the electric blender 806 as the "lay-down" positions the blender tubs, pumps and piping lower to the ground level and the main trailer beams are resting on the ground for operational mode.

[0099] Similar to the "lay-down" trailer 710, the "lay-down" trailer 802 may comprise an upper section above the trailer axles and a lower section below the trailer axles. In one embodiment, the electric blender 806 and associated equipment on the trailer may be controlled and monitored remotely via a control system network. As shown in FIGS. 8A and 8B, a blender control system 804 that comprises a PLC, transformers and one or more variable frequency drives are mounted on upper section of the blender transport 800. To provide remote control and monitoring functions, the

network may interface and communicate with the PLC (e.g., provide operating instructions), and the PLC may subsequently control one or more variable frequency drives mounted on the blender trailer to drive one or more electric motors of the blender. Operating the blender transport 800 remotely may eliminate equipment operators from being exposed to hazardous environment and avoiding potential exposure concentrated chemicals, silica dust, and rotating machinery. For example, a conventional blender transport typically includes a station for an operator to manually operate the blender. By remotely controlling using the control network and blender control system 804, the station may be removed from the blender transport 800. Recall that a data van may act as a hub to provide the remote control and monitoring functions and instructions to the blender control system 804.

[00100] FIGS. 9A and 9B are schematic diagrams of an embodiment of a blender transport 900 that includes an electric blender 902 with enclosed mixer hoppers 904. FIG. 9A illustrates a top-down view of the blender transport 900 and FIG. 9B illustrates a side-profile view of the blender transport 900. The electric blender 902 is substantially similar to the electric blender 806 except that the electric blender 902 uses enclosed mixer hoppers 904 to add proppants and additives to the blending tub. FIGS. 9A and 9B illustrate that the electric blender 902 is a dual configuration blender that includes two enclosed mixer hoppers 904 powered by two electric motors, where each of the electric motors may operate an enclosed mixer hopper 904.

[00101] Blenders that comprises open hoppers and augers typically have the proppants (e.g., sand) and/or additives exposed to the weather elements. In situations where precipitation occurs at the well site, operators may cover the open hoppers and augers with drapes, tarps, and/or other coverings to prevent the precipitation from contaminating the proppants and/or additives. The enclosed mixer hopper 904 replaces the open hopper and augers typically included in a blender (e.g., electric blender 806 in FIGS. 8A and 8B) with enclosed mixer hoppers 904 (FIGS. 9A and 9B). By replacing the open hopper and augers with enclosed mixer hoppers 904 the blender transport 900 may have the advantages of dust free volumetric proppant measurement, dust free mixing of proppant and additives, moderate the transport of proppants, perform accurate volumetric measurements, increase proppant transport efficiency with low slip, prevent proppant packing from vibration, produce a consistent volume independent of angle of repose, and meter and blend wet sand. Other advantages include the removal of gearboxes and increasing safety for operators with the enclosed drum.

[00102] Control Network System

[00103] FIG. 10 is a schematic diagram of an embodiment of a control network system 1000 used to monitor, control, and communicate with a variety of control systems located at one or more well sites. FIG. 10 illustrates that the control network system 1000 may be in a ring-topology that interconnects the control center 1002, blender transports 1004, chemical additive unit 1006, hydration unit 1008, and fracturing pump transports 1012. A ring topology network may reduce the amount of control cabling used for fracturing operations and increase the capacity and speed of data transfers and communication. Additionally, the ring topology may allow for two way communication and control by the control center 1002 for equipment connected to the control network system 1000. For example, the control center may be able to monitor and control the other fracturing equipment 1010 and third party equipment 1014 when added to the control network system 1000, and for multiple pieces of equipment to communicate with each other. In other network topologies, such as a star or mesh topology, the other fracturing equipment 1010 and third party equipment 1014 may be limited to one way communication where data is transmitted from the fracturing equipment 1010 and/or third party equipment 1014 to the control center 1002, but not vice versa or between different pieces of equipment.

[00104] In one embodiment, the control network system 1000 may be a network, such as an Ethernet network that connects and communications with the individual control systems for each of the fracturing equipment. The control center 1002 may be configured to monitor, control, and provide operating instructions to the different fracturing equipment. For example, the control center 1002 may communicate with the VFDs located within the drive power transports 104 that operate and monitor the health of the electric motors used to drive the pumps on the fracturing pump transports 108. In one embodiment, the control center 1002 may be one or more data vans. More data vans may be used when the fracturing operations include fracturing more than two wellheads simultaneously.

[00105] At least one embodiment is disclosed and variations, combinations, and/or modifications of the embodiment(s) and/or features of the embodiment(s) made by a person having ordinary skill in the art are within the scope of the disclosure. Alternative embodiments that result from combining, integrating, and/or omitting features of the embodiment(s) are also within the scope of the disclosure. Where numerical ranges or limitations are expressly stated, such express ranges or limitations may be understood to include iterative ranges or limitations of like magnitude

falling within the expressly stated ranges or limitations (e.g., from about 1 to about 10 includes, 2, 3, 4, etc.; greater than 0.10 includes 0.11, 0.12, 0.13, etc.). The use of the term "about" means ±10% of the subsequent number, unless otherwise stated.

[00106] Use of the term "optionally" with respect to any element of a claim means that the element is required, or alternatively, the element is not required, both alternatives being within the scope of the claim. Use of broader terms such as comprises, includes, and having may be understood to provide support for narrower terms such as consisting of, consisting essentially of, and comprised substantially of. Accordingly, the scope of protection is not limited by the description set out above but is defined by the claims that follow, that scope including all equivalents of the subject matter of the claims. Each and every claim is incorporated as further disclosure into the specification and the claims are embodiment(s) of the present disclosure.

[00107] While several embodiments have been provided in the present disclosure, it should be understood that the disclosed systems and methods might be embodied in many other specific forms without departing from the spirit or scope of the present disclosure. The present examples are to be considered as illustrative and not restrictive, and the intention is not to be limited to the details given herein. For example, the various elements or components may be combined or integrated in another system or certain features may be omitted, or not implemented.

[00108] In addition, techniques, systems, subsystems, and methods described and illustrated in the various embodiments as discrete or separate may be combined or integrated with other systems, modules, techniques, or methods without departing from the scope of the present disclosure. Other items shown or discussed as coupled or directly coupled or communicating with each other may be indirectly coupled or communicating through some interface, device, or intermediate component whether electrically, mechanically, or otherwise.

CLAIMS

What is claimed is:

1. A system for pumping and pressurizing fracturing fluid, comprising:

a mobile transport;

an electric prime mover mounted on the mobile transport;

a fracturing pump mounted on the mobile transport;

an engagement panel configured to receive a remote command to disengage the fracturing pump from the electric prime mover; and

a drive line assembly comprising an engagement coupling configured to disengage the fracturing pump and a shaft of the electric prime mover triggered by the engagement panel in response to receiving the remote command.

2. The system of claim 1, wherein the electric prime mover is a dual shaft electric prime mover that extends the shaft out on opposites sides of the dual shaft electric prime mover.

3. The system of claim 2, further comprising a second fracturing pump mounted on the mobile transport and a second drive line assembly that comprises a second engagement coupling configured to selectively disengage the second fracturing pump and the dual shaft electric prime mover.

4. The system of claim 1, wherein the drive line assembly comprises a keyed shaft, and wherein the engagement coupling is configured to selectively disengage the keyed shaft with the shaft.

5. The system of claim 4, wherein the drive line assembly comprises a fixed coupling that couples a pinion shaft of the fracturing pump to the keyed shaft.

6. The system of claim 1, further comprising a monitoring station mounted on the mobile transport and configured to transmit the remote command to the engagement panel.

7. The system of claim 1, wherein the engagement coupling is configured to selectively disengage when the shaft is rotating.

8. The system of claim 1, wherein the engagement coupling is configured to selectively disengage after the shaft stops rotating.

9. The system of claim 1, wherein the fracturing pump includes a dual-pinion shaft.

10. The system of claim 1, further comprising a second fracturing pump mounted on the mobile transport, wherein the fracturing pump and the second fracturing pump each comprise a fluid end assembly that are mounted on a same side of the mobile transport.

11. A fracturing pump transport comprising:

a first fracturing pump;

a second fracturing pump;

a dual shaft electric motor that comprises a shaft having a first end and a second end;

a first drive line assembly that comprises a first engagement coupling that allows for selective engagement, disengagement, or both of the first fracturing pump with the first end of the shaft;

a second drive line assembly that comprises a second engagement coupling that allows for selective engagement, disengagement, or both of the second fracturing pump with the second end of the shaft; and

an engagement panel that allows for selective engagement or disengagement at the first engagement coupling based on receiving a remote command.

12. The fracturing pump transport of claim 11, wherein the first drive line assembly comprises a keyed shaft, and wherein the engagement coupling allows for selective engagement, disengagement, or both of the keyed shaft with the first end of the shaft.

13. The fracturing pump transport of claim 12, wherein the first drive line assembly comprises a fixed coupling that couples the first fracturing pump to the keyed shaft.

14. The fracturing pump transport of claim 11, wherein the engagement coupling allows for selective engagement, disengagement, or both after the shaft stops rotating.

15. The fracturing pump transport of claim 11, wherein the first fracturing pump includes a dual pinion shaft.

16. The fracturing pump transport of claim 11, wherein the first fracturing pump and the second fracturing pump each comprise a fluid end assembly that face a same side of the fracturing pump transport.

17. A method for pumping and pressurizing fracturing fluid, the method comprising:

receiving a disengagement command from a location remote to a fracturing pump transport;

disengaging, in response to receiving the disengagement command, a first fracturing pump mounted on the fracturing pump transport with a dual shaft electric prime mover mounted on the fracturing pump transport using a first drive line assembly, wherein the first drive line assembly comprises an engagement coupling that allows for selective engagement between the first fracturing pump and the dual shaft electric prime mover; and

driving a second fracturing pump mounted on the fracturing pump transport with the dual shaft electric prime mover after disengaging the first fracturing pump from the dual shaft electric prime mover using the first drive line assembly.

18. The method of claim 17, further comprising:

receiving a second disengagement command from the location remote to the fracturing pump transport; and

disengaging, in response to receiving the second disengagement command, the second fracturing pump with the dual shaft electric prime mover using a second drive line assembly, wherein the second drive line assembly comprises a second engagement coupling that allows for selective engagement between the second fracturing pump and the dual shaft electric prime mover.

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19. The method of claim 18, wherein the dis-engaging of the second fracturing pump with the dual shaft electric prime mover occurs after the dual shaft electric prime mover stops driving the second fracturing pump.

20. The method of claim 17, wherein the first fracturing pump and the second fracturing pump each comprise a fluid end assembly mounted on a same side of the fracturing pump transport.

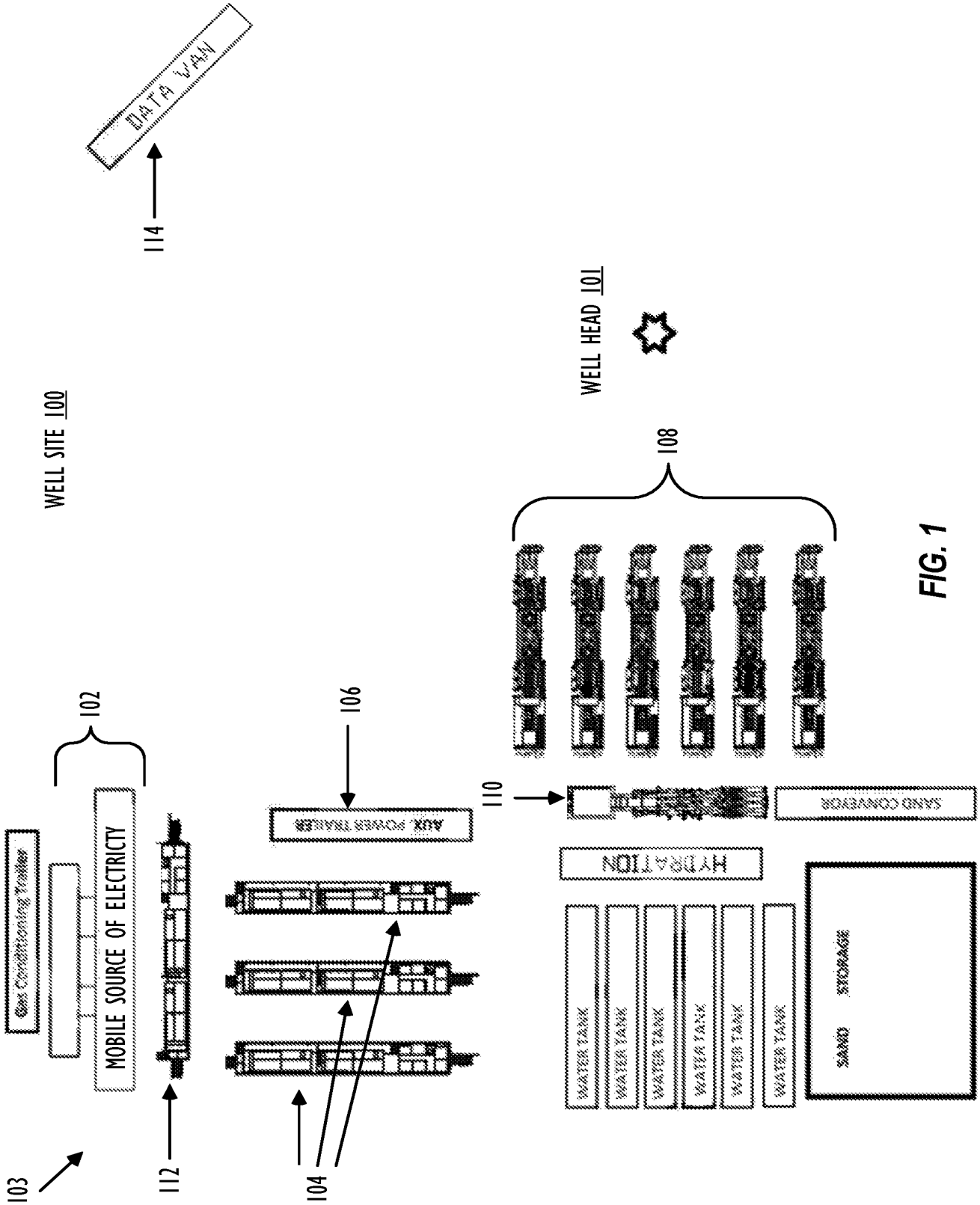

DATA VAN
114
WELL HEAD 101
WELL SITE 100
108
102
106
110
Gas Conditioning Trailer
MOBILE SOURCE OF ELECTRICITY
AUX POWER TRAILER
SAND CONVEYOR
HYDRATION
WATER TANK
WATER TANK
WATER TANK
WATER TANK
WATER TANK
WATER TANK
SAND STORAGE
103
112
104

FIG. 1

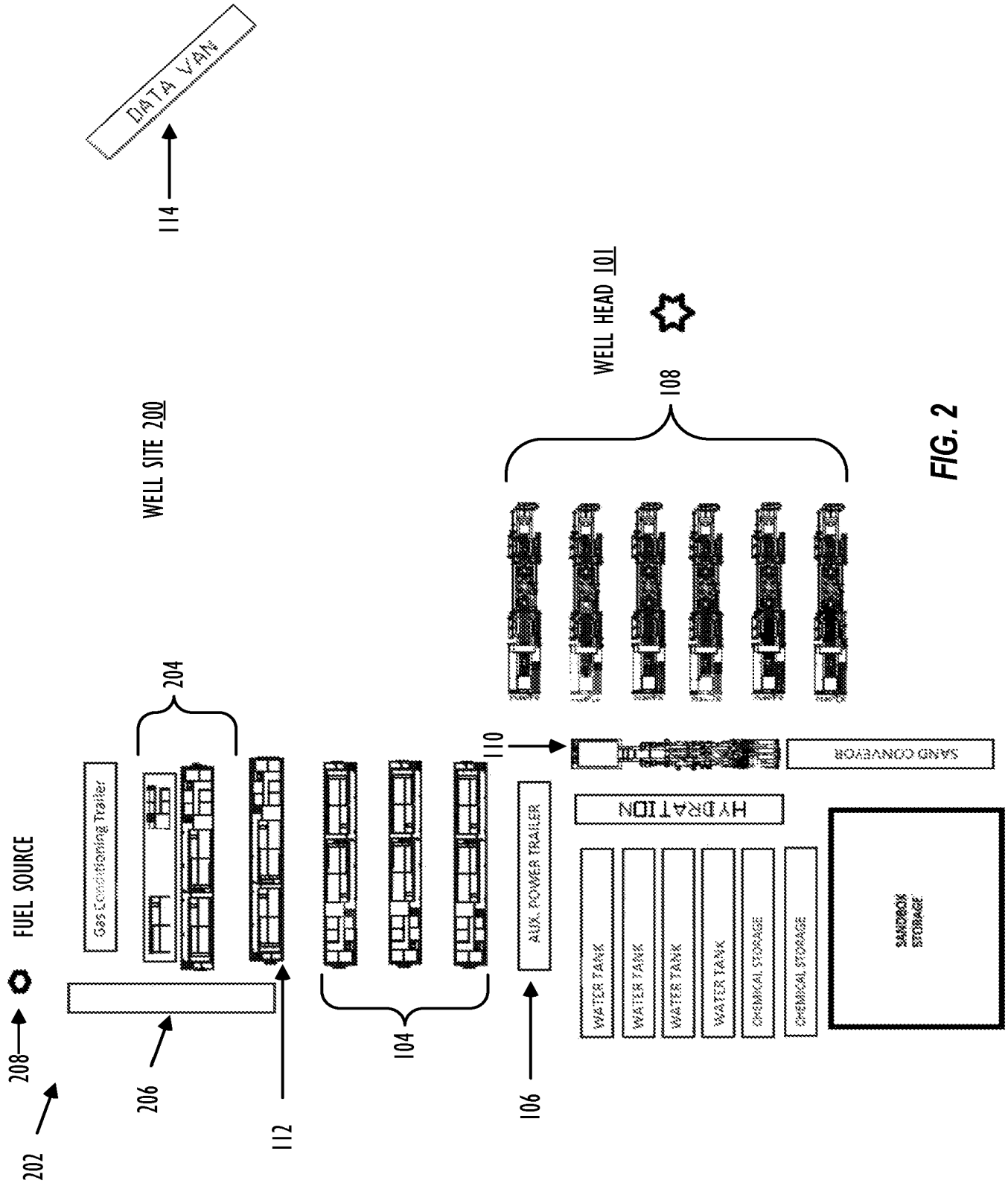

DATA VAN
114
WELL HEAD 101
108
WELL SITE 200
204
110
SAND CONVEYOR
HYDRATION
WATER TANK
WATER TANK
WATER TANK
WATER TANK
CHEMICAL STORAGE
CHEMICAL STORAGE
SANDBOX STORAGE
AUX. POWER TRAILER
Gas Conditioning Trailer
FUEL SOURCE
208
202
206
112
104
106

FIG. 2

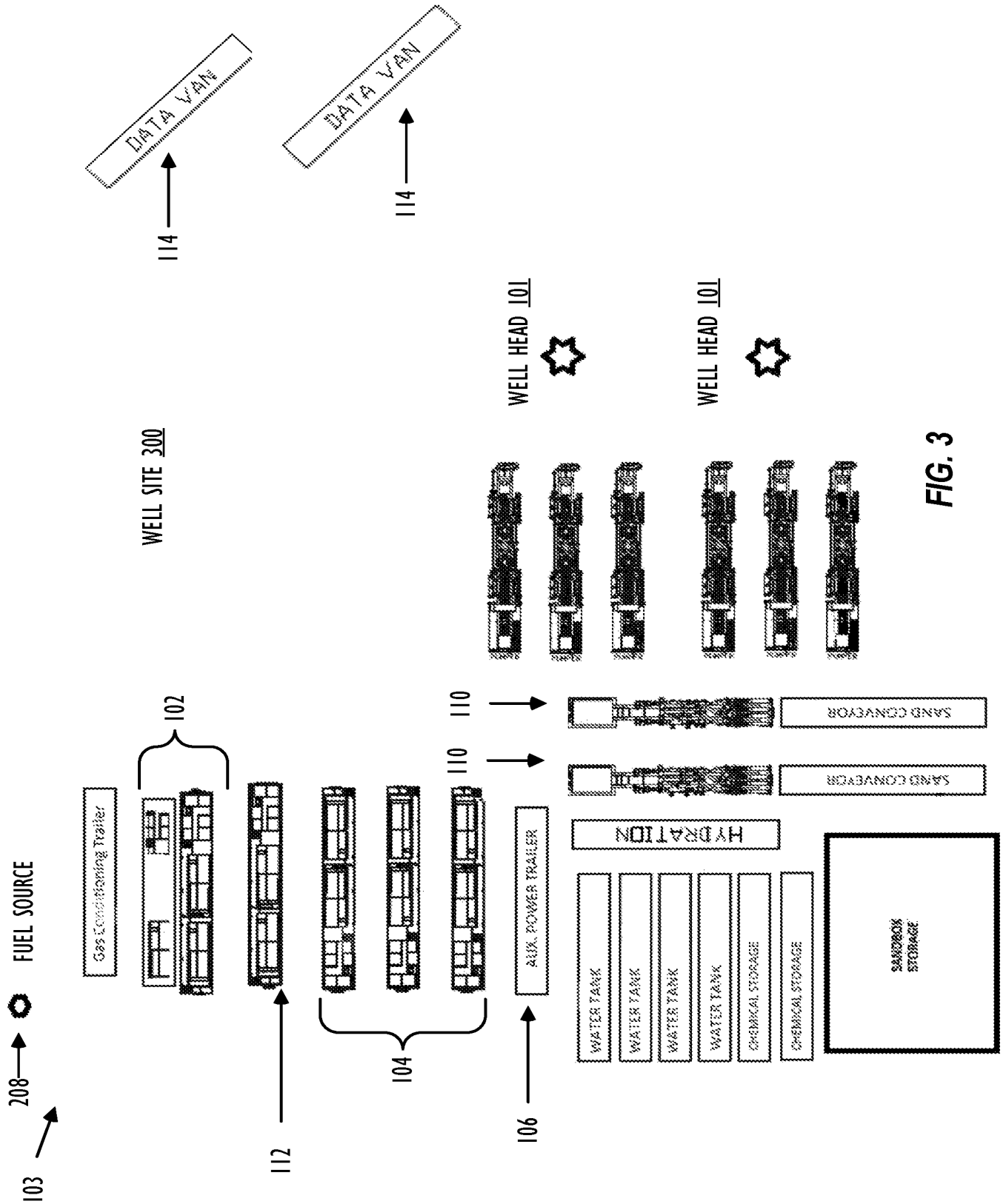

DATA VAN
DATA VAN
114
114
WELL HEAD 101
WELL HEAD 101
WELL SITE 300
102
110
110
SAND CONVEYOR
SAND CONVEYOR
HYDRATION
WATER TANK
WATER TANK
WATER TANK
WATER TANK
CHEMICAL STORAGE
CHEMICAL STORAGE
SANDBOX STORAGE
AUX. POWER TRAILER
Gas Conditioning Trailer
104
106
112
208
FUEL SOURCE
103

FIG. 3

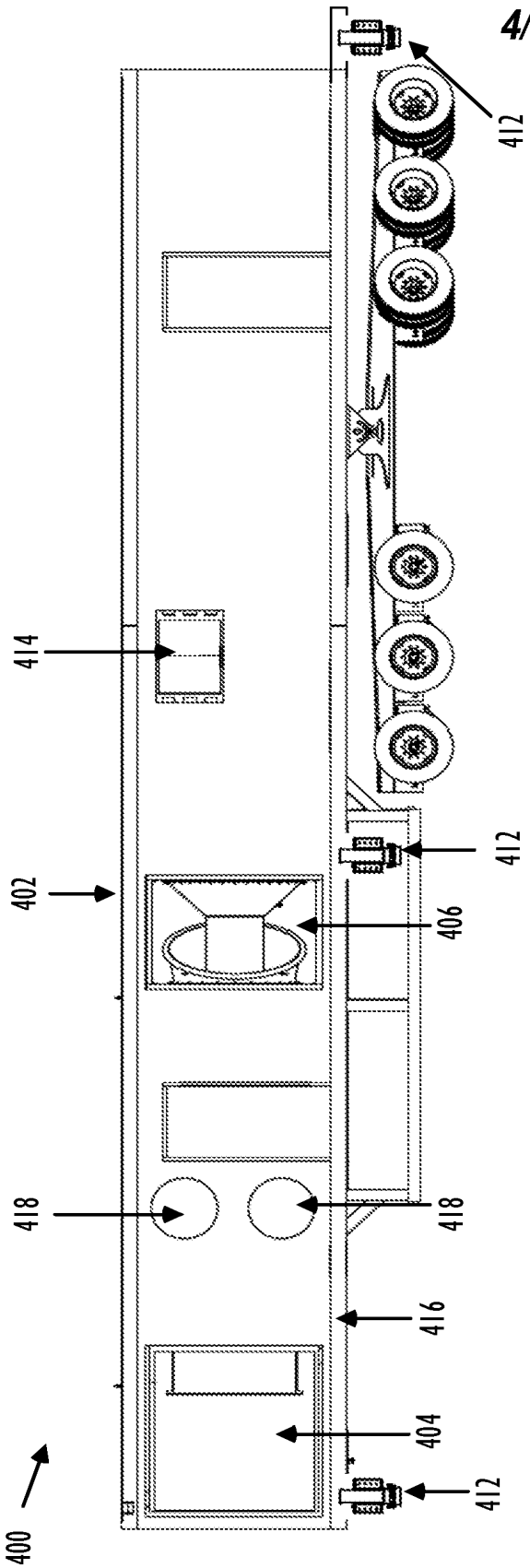


FIG. 4A

FIG. 4B

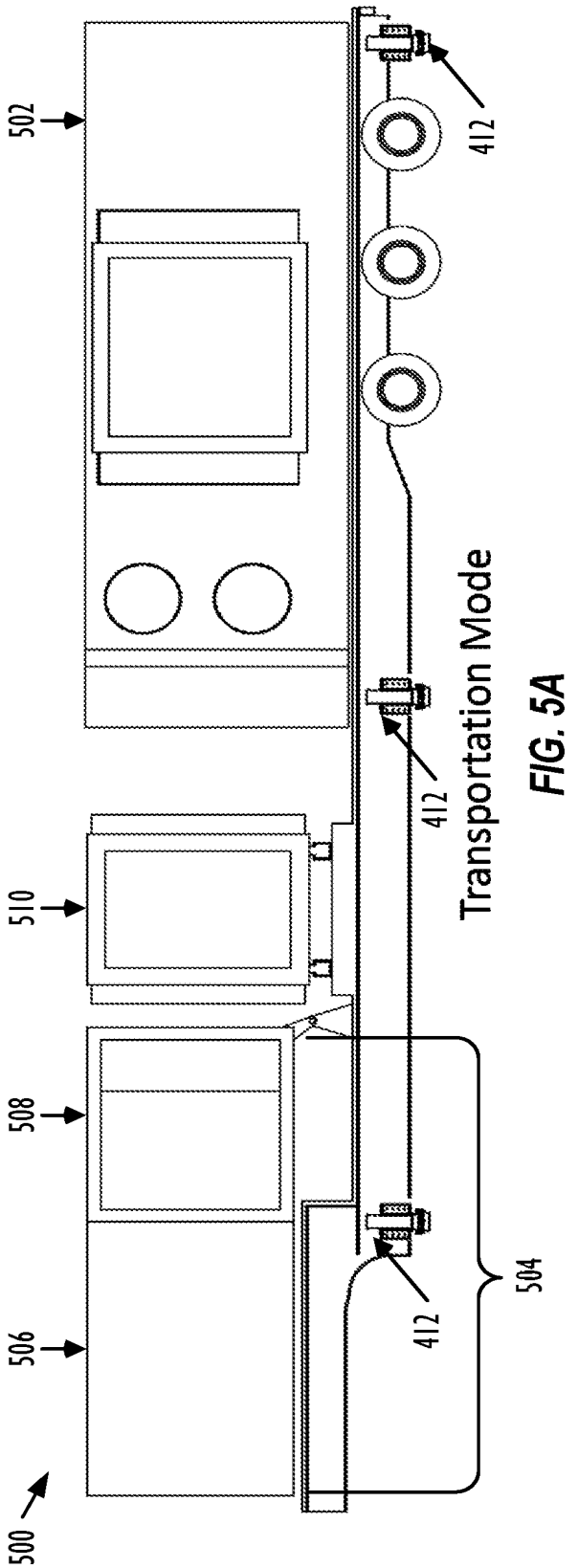

502
412
510
508
506
504
500
Transportation Mode

FIG. 5A

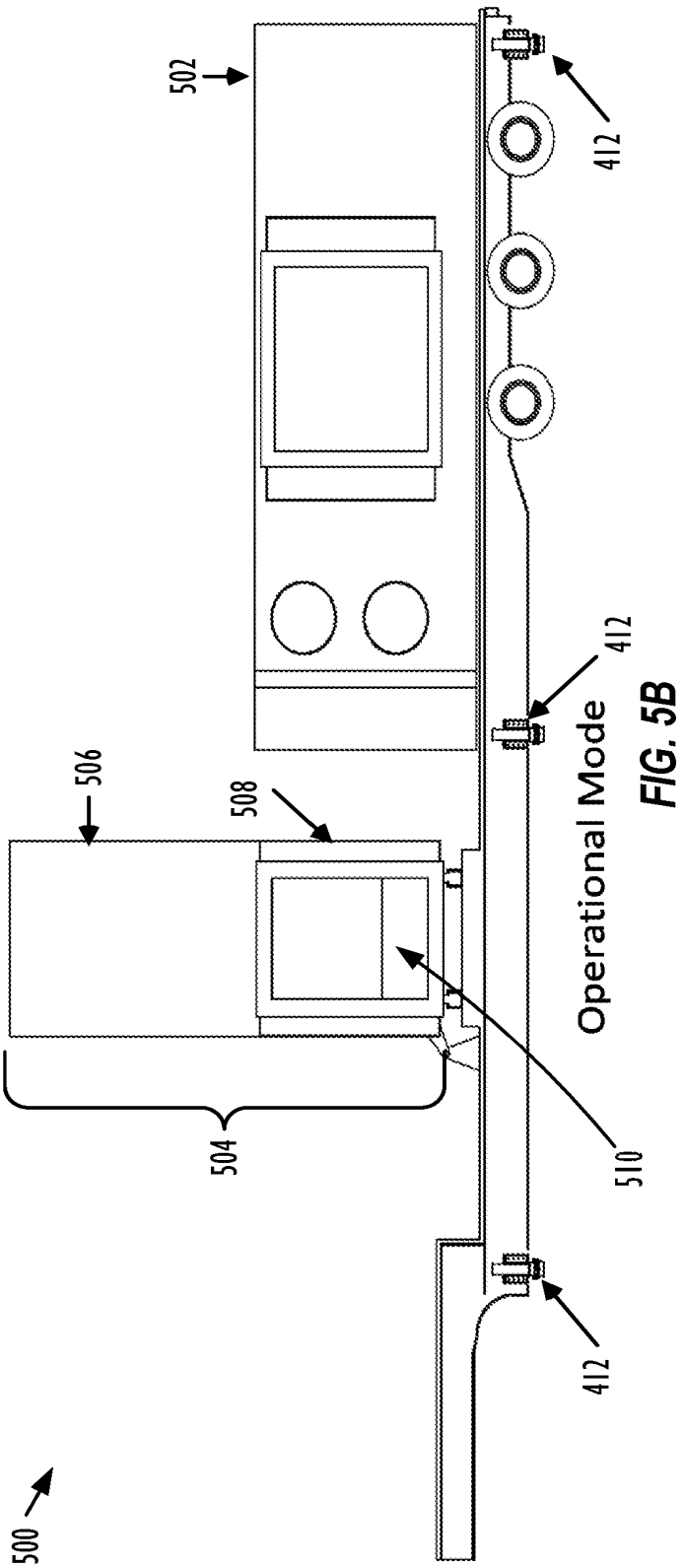

502
412
506
508
504
510
500
Operational Mode

FIG. 5B

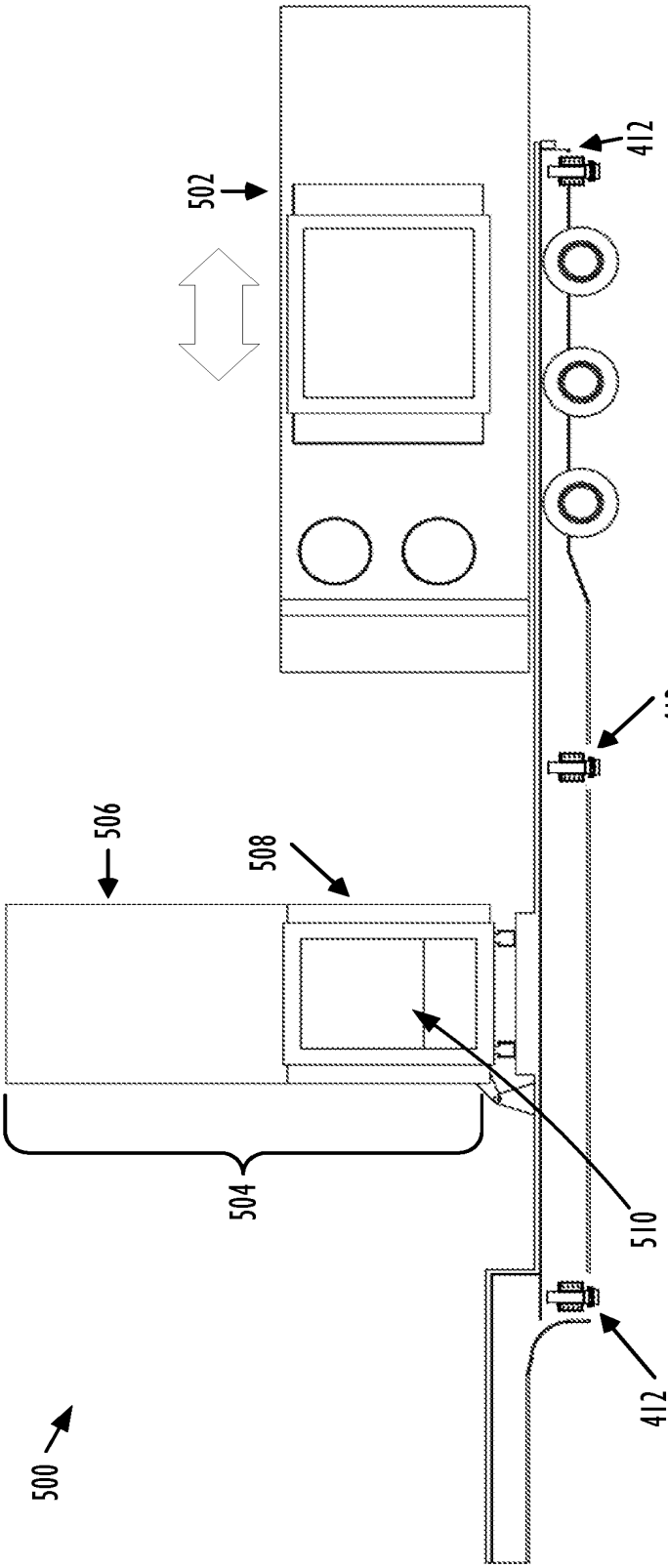


FIG. 5C

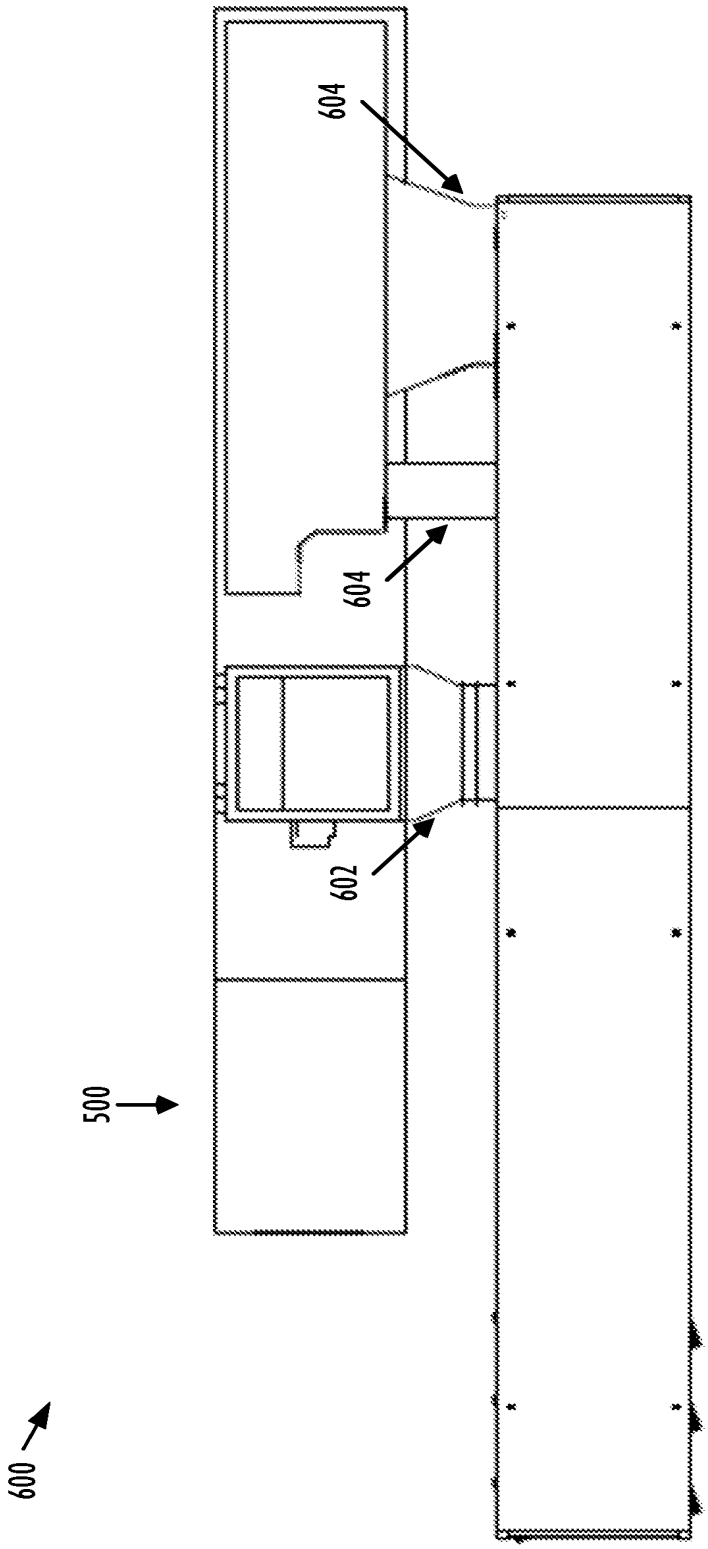


FIG. 6

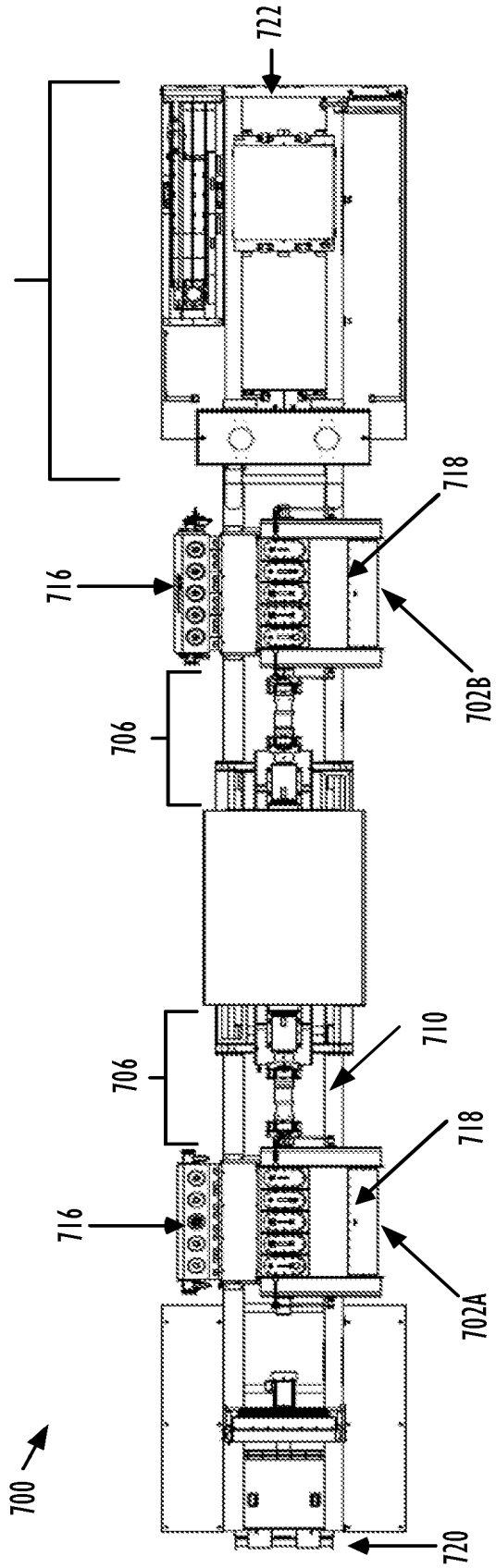

722
708
718
716
706
702B
710
718
716
702A
700
720

FIG. 7A

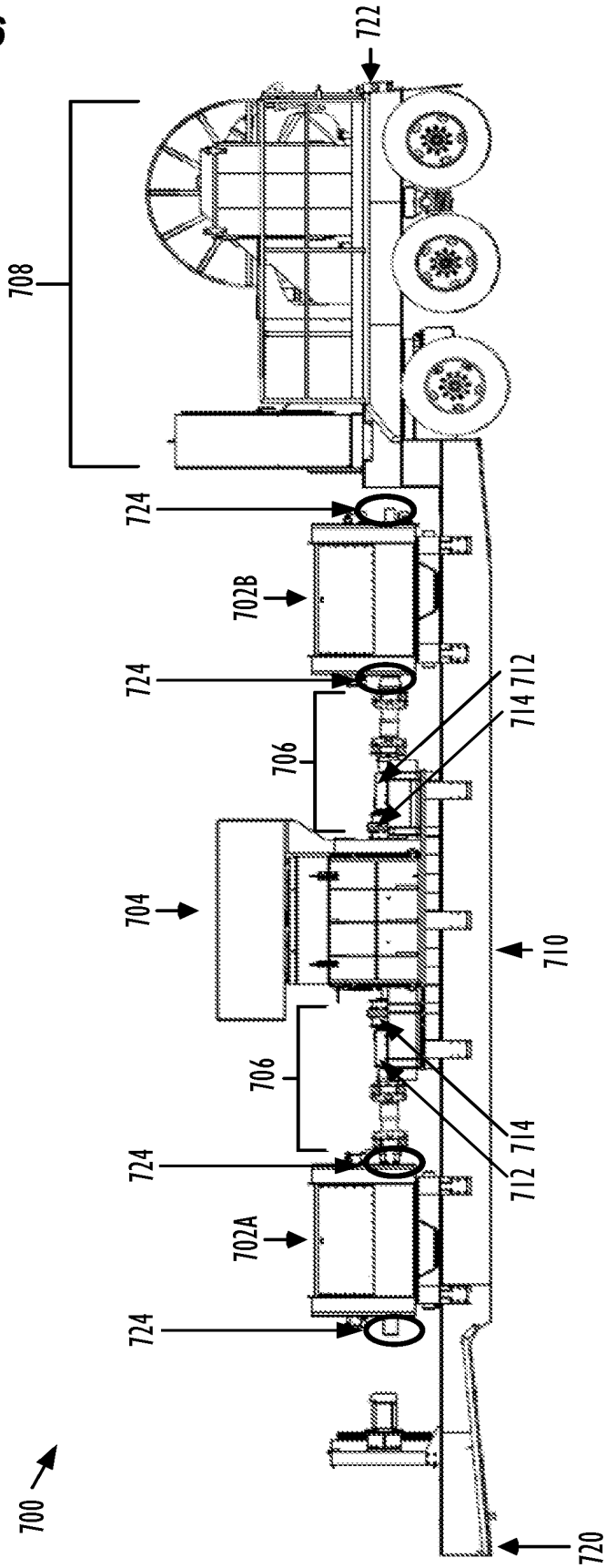

722
708
724
702B
724
706
714 712
704
710
706
712 714
724
702A
724
700
720

FIG. 7B

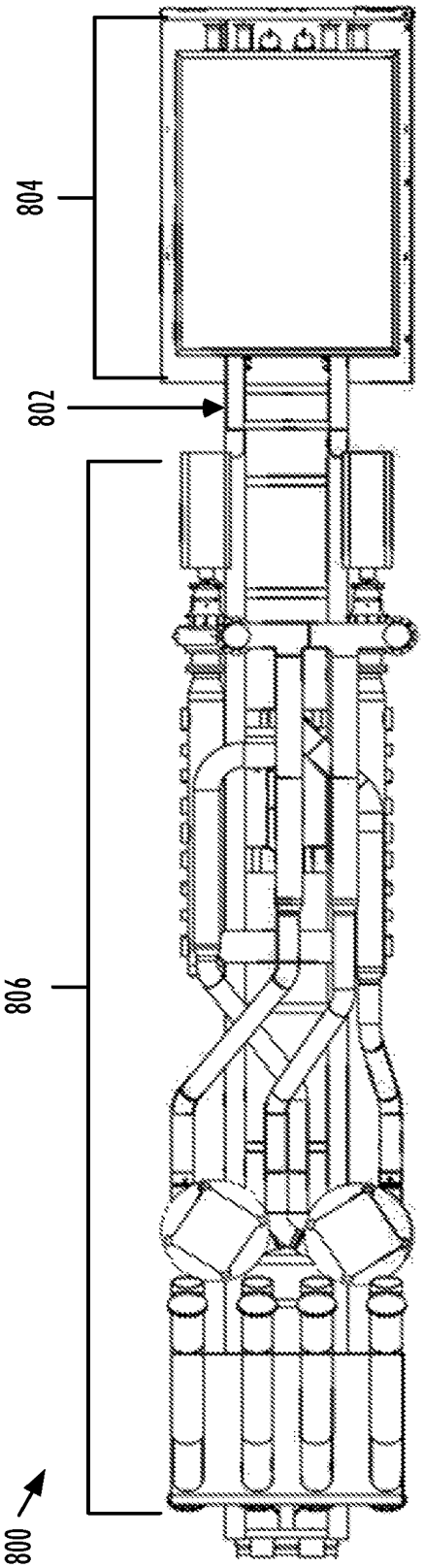


FIG. 8A

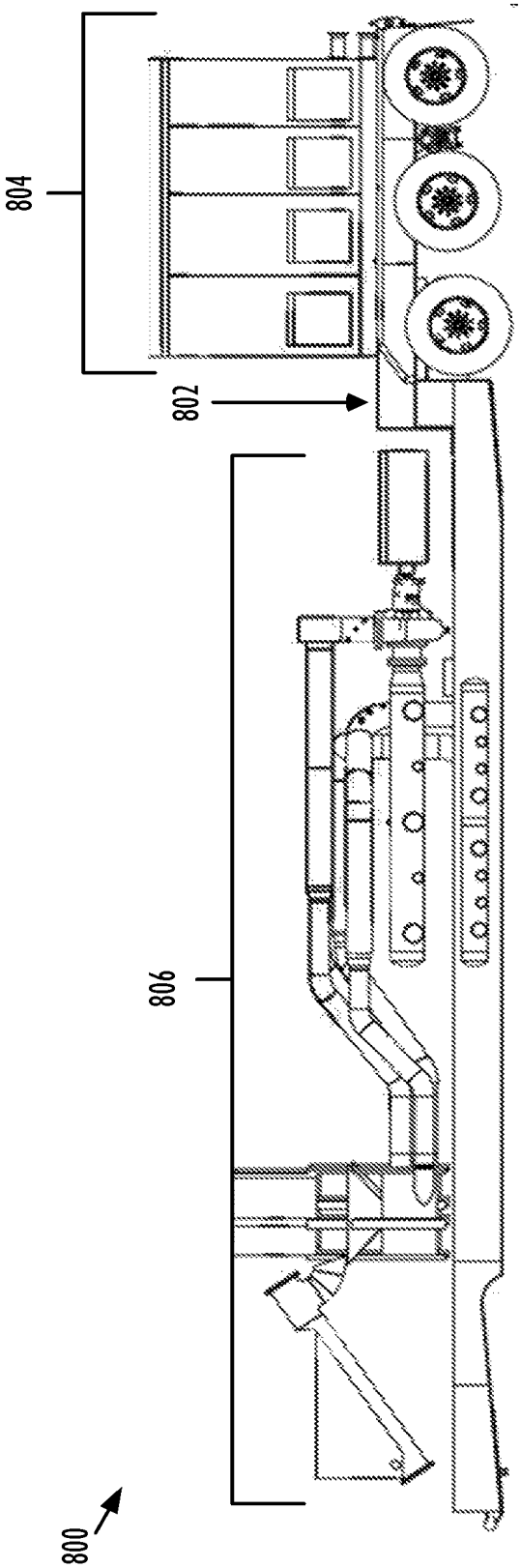


FIG. 8B

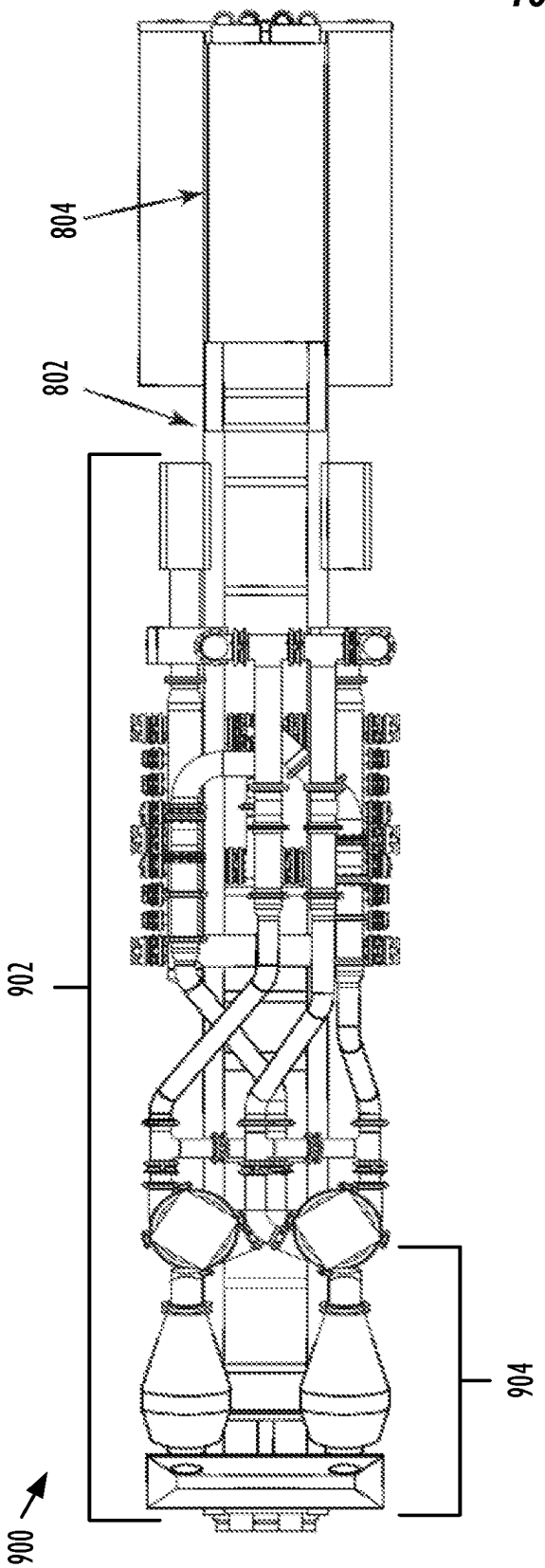


FIG. 9A

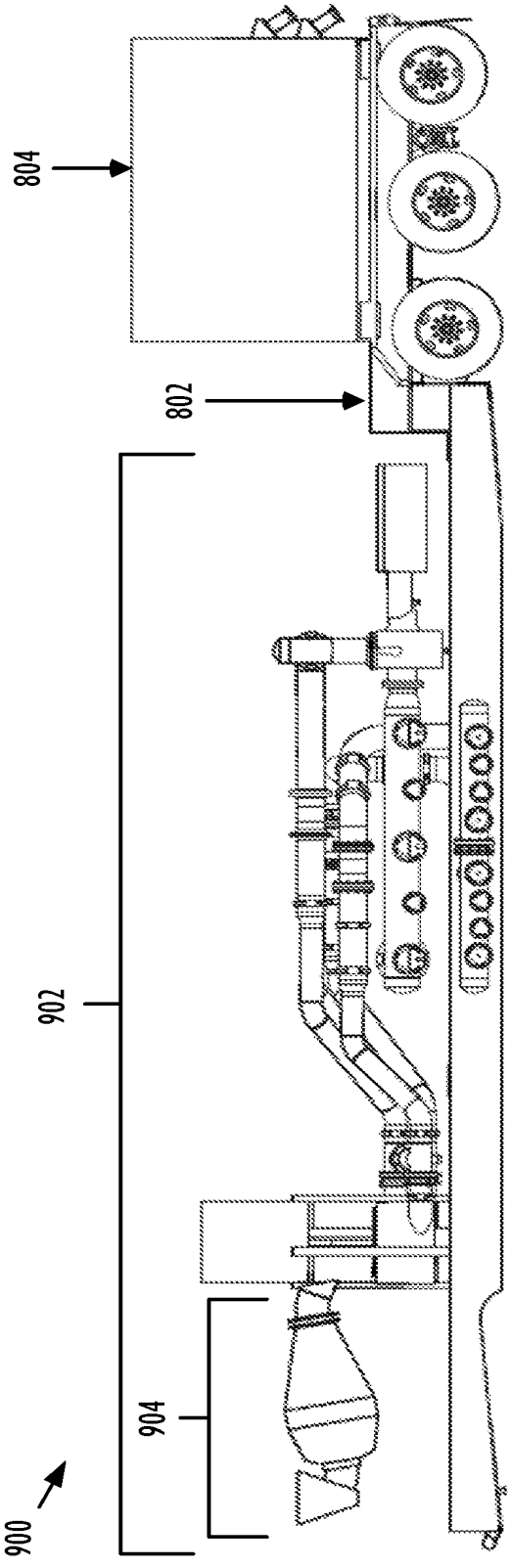


FIG. 9B

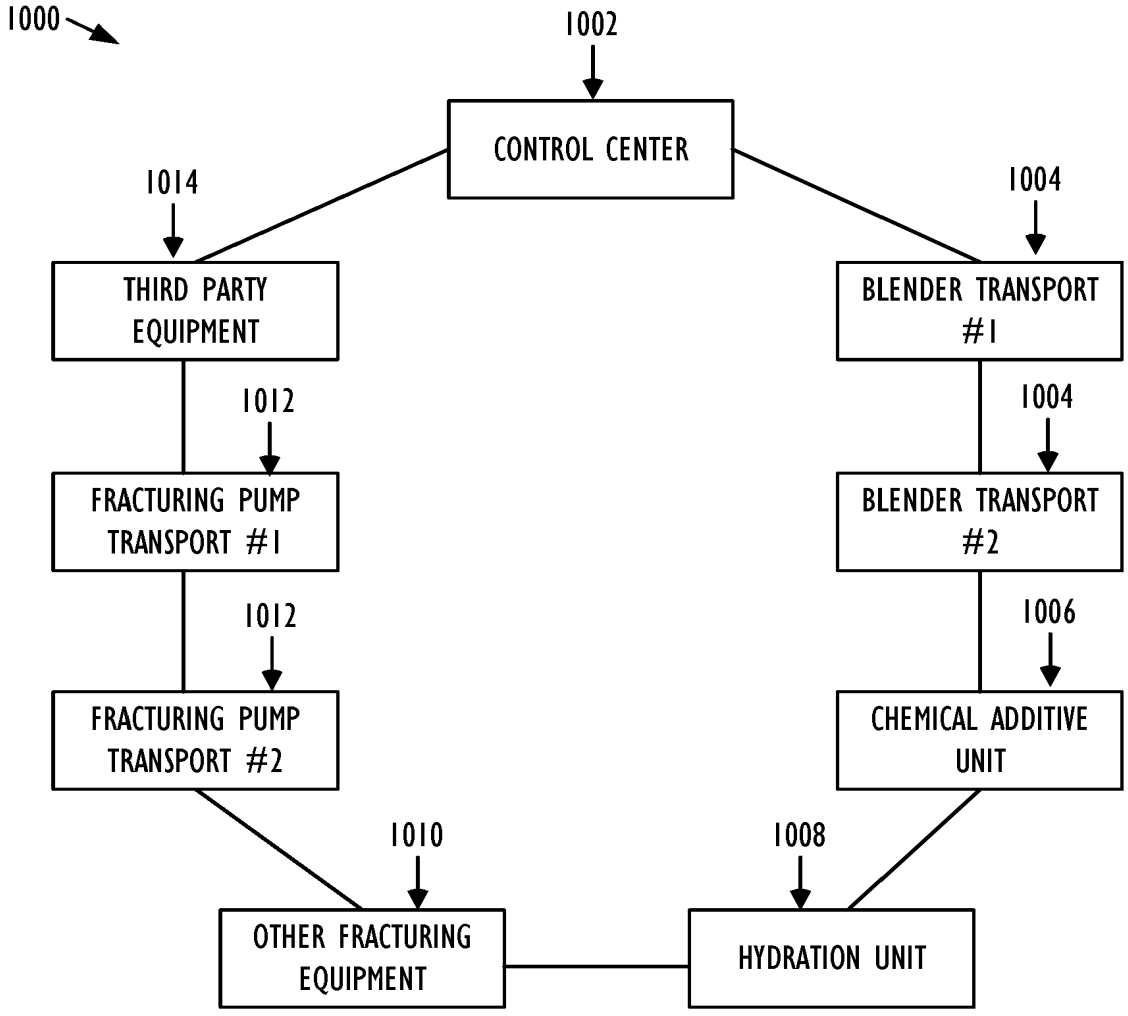

1000
1002
CONTROL CENTER
1014
1004
THIRD PARTY EQUIPMENT
BLENDER TRANSPORT #1
1012
1004
FRACTURING PUMP TRANSPORT #1
BLENDER TRANSPORT #2
1012
1006
FRACTURING PUMP TRANSPORT #2
CHEMICAL ADDITIVE UNIT
1010
1008
OTHER FRACTURING EQUIPMENT
HYDRATION UNIT

FIG. 10

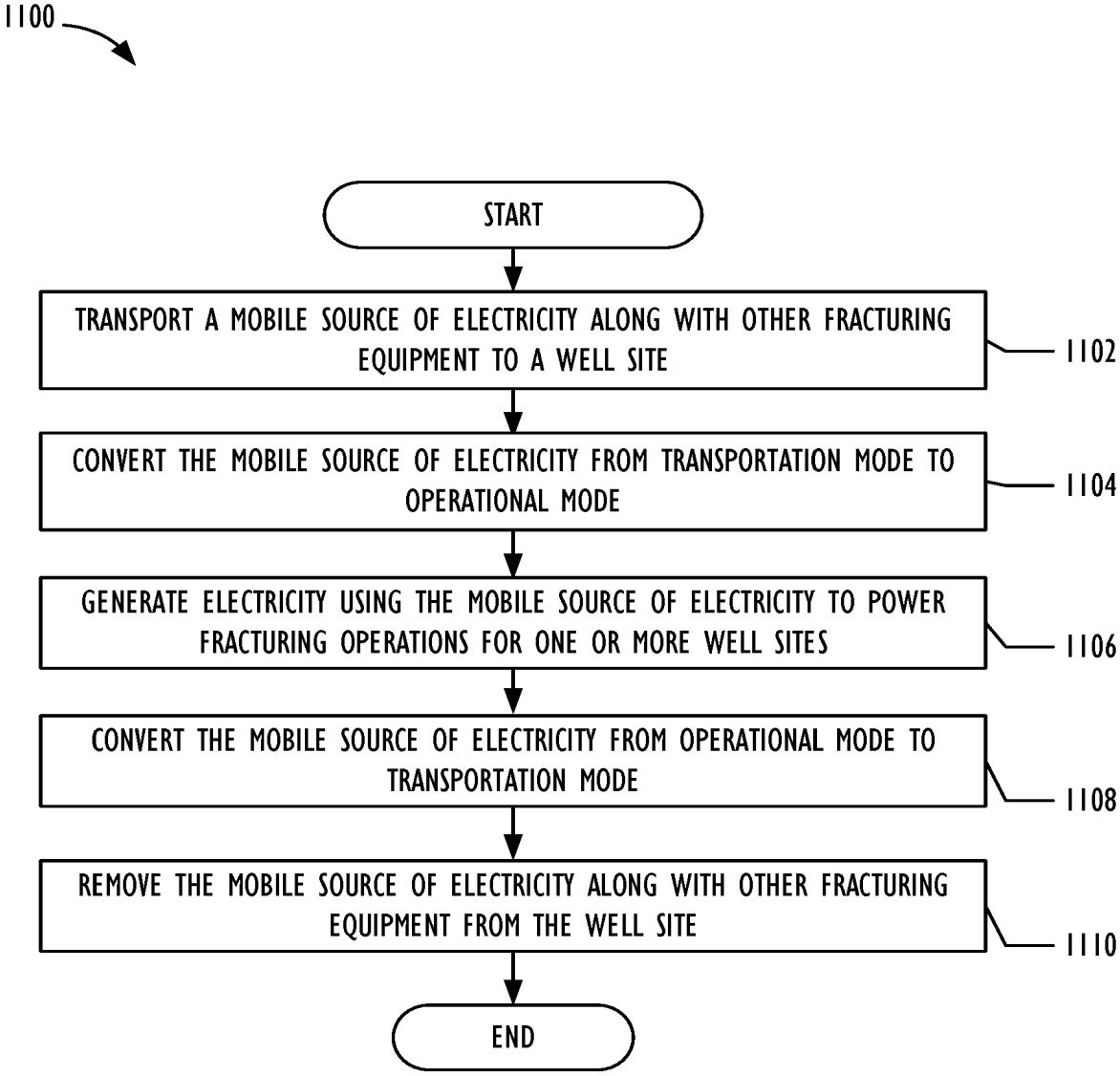

1100
START
TRANSPORT A MOBILE SOURCE OF ELECTRICITY ALONG WITH OTHER FRACTURING EQUIPMENT TO A WELL SITE
1102
CONVERT THE MOBILE SOURCE OF ELECTRICITY FROM TRANSPORTATION MODE TO OPERATIONAL MODE
1104
GENERATE ELECTRICITY USING THE MOBILE SOURCE OF ELECTRICITY TO POWER FRACTURING OPERATIONS FOR ONE OR MORE WELL SITES
1106
CONVERT THE MOBILE SOURCE OF ELECTRICITY FROM OPERATIONAL MODE TO TRANSPORTATION MODE
1108
REMOVE THE MOBILE SOURCE OF ELECTRICITY ALONG WITH OTHER FRACTURING EQUIPMENT FROM THE WELL SITE
1110
END

FIG. 11

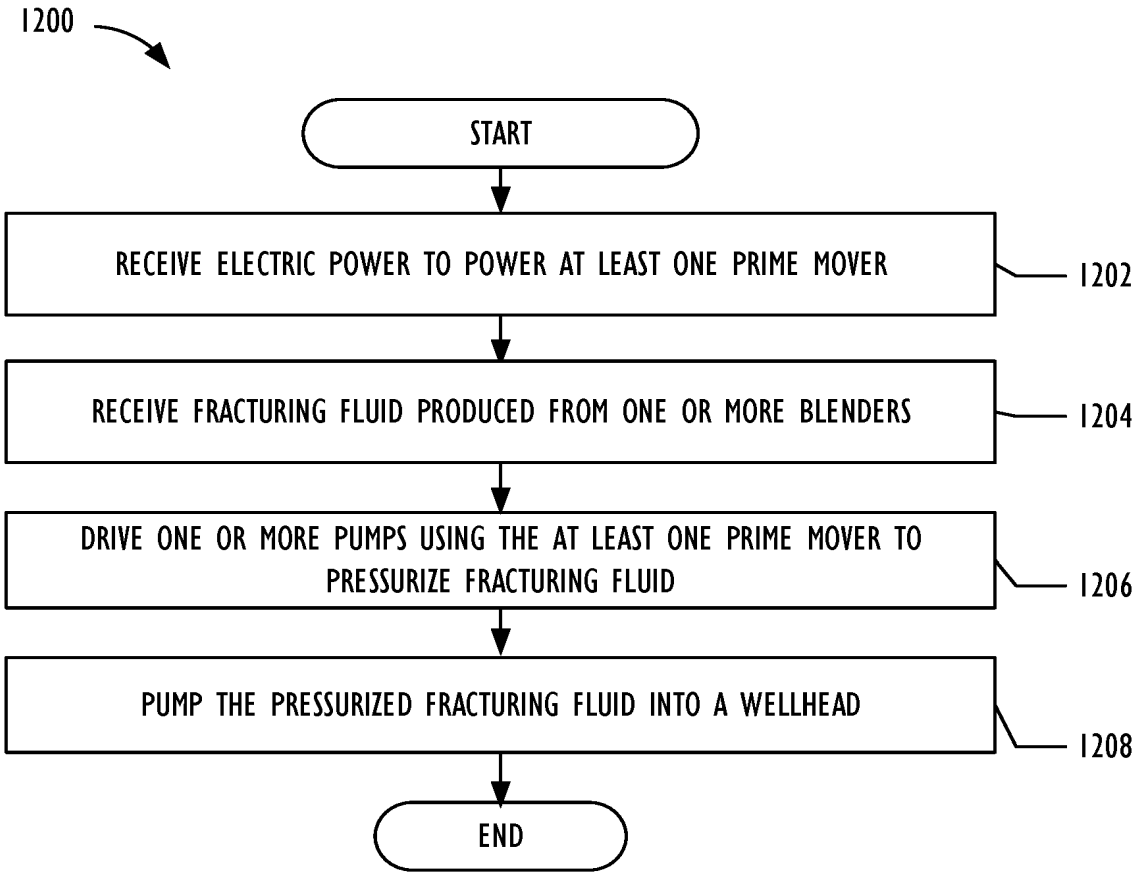

1200
START
RECEIVE ELECTRIC POWER TO POWER AT LEAST ONE PRIME MOVER
1202
RECEIVE FRACTURING FLUID PRODUCED FROM ONE OR MORE BLENDERS
1204
DRIVE ONE OR MORE PUMPS USING THE AT LEAST ONE PRIME MOVER TO PRESSURIZE FRACTURING FLUID
1206
PUMP THE PRESSURIZED FRACTURING FLUID INTO A WELLHEAD
1208
END

FIG. 12

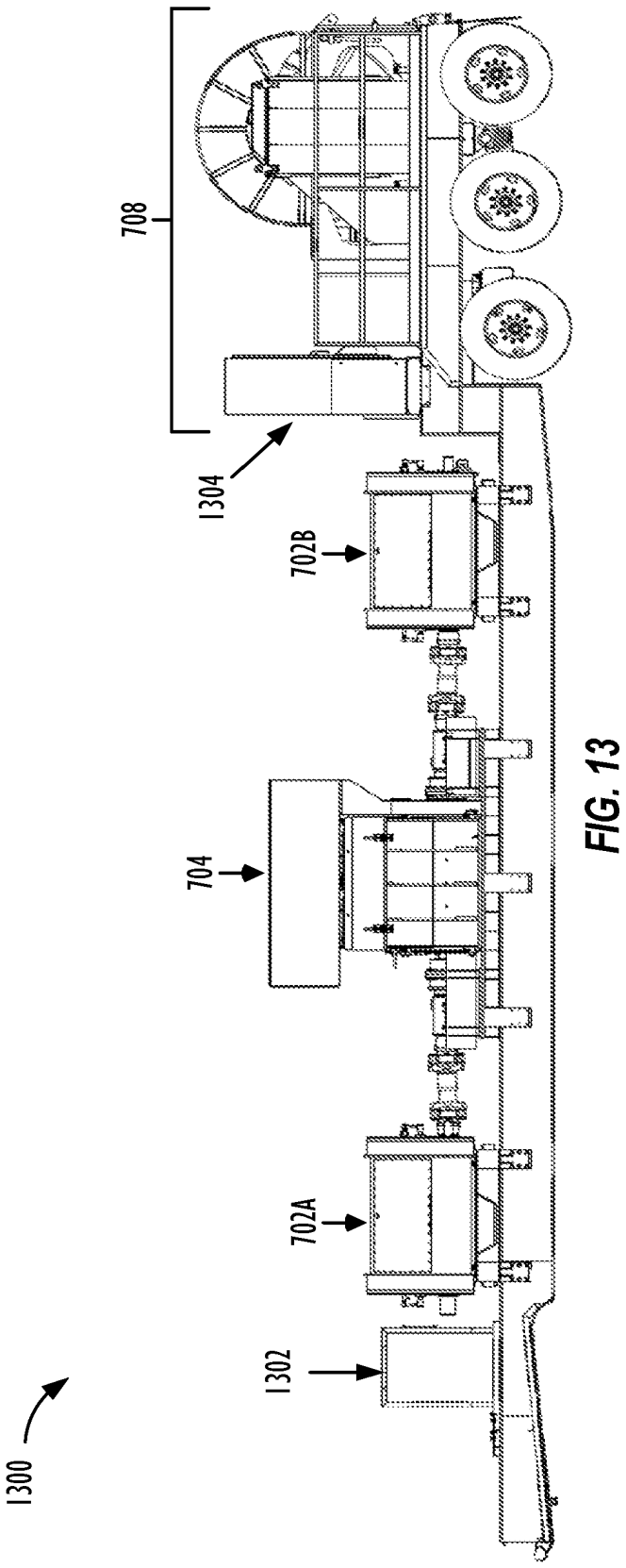


FIG. 13

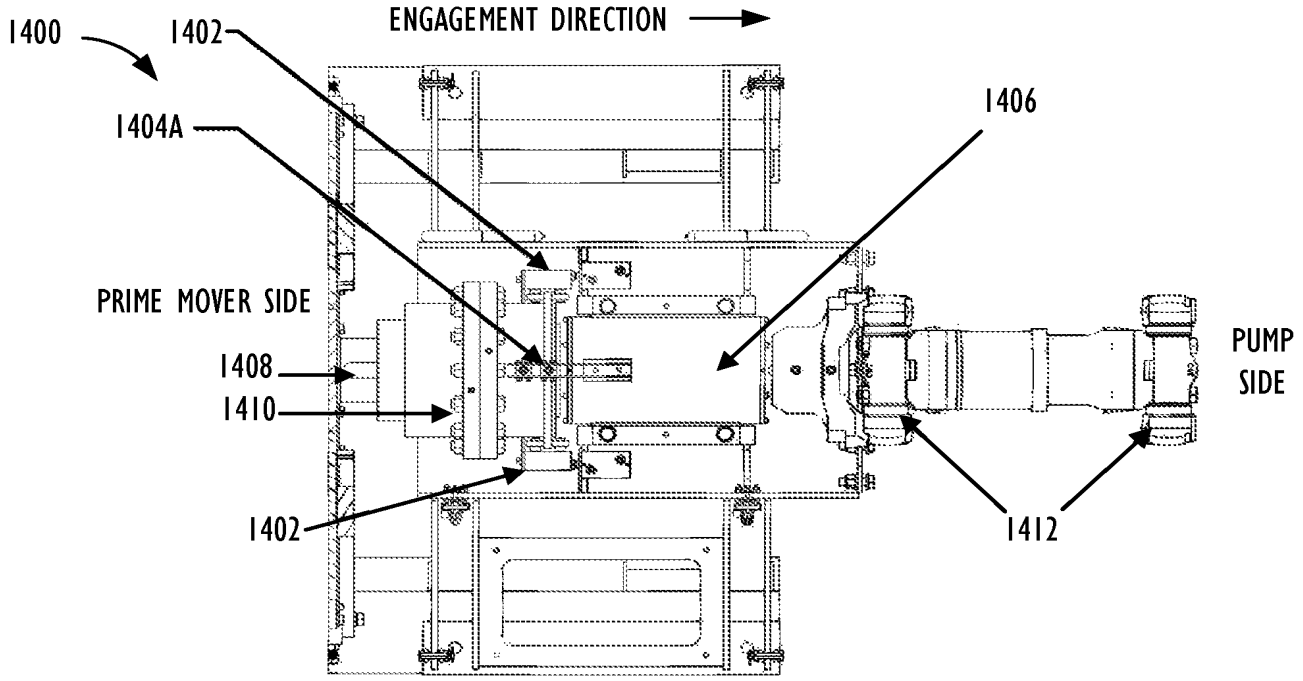


FIG. 14A

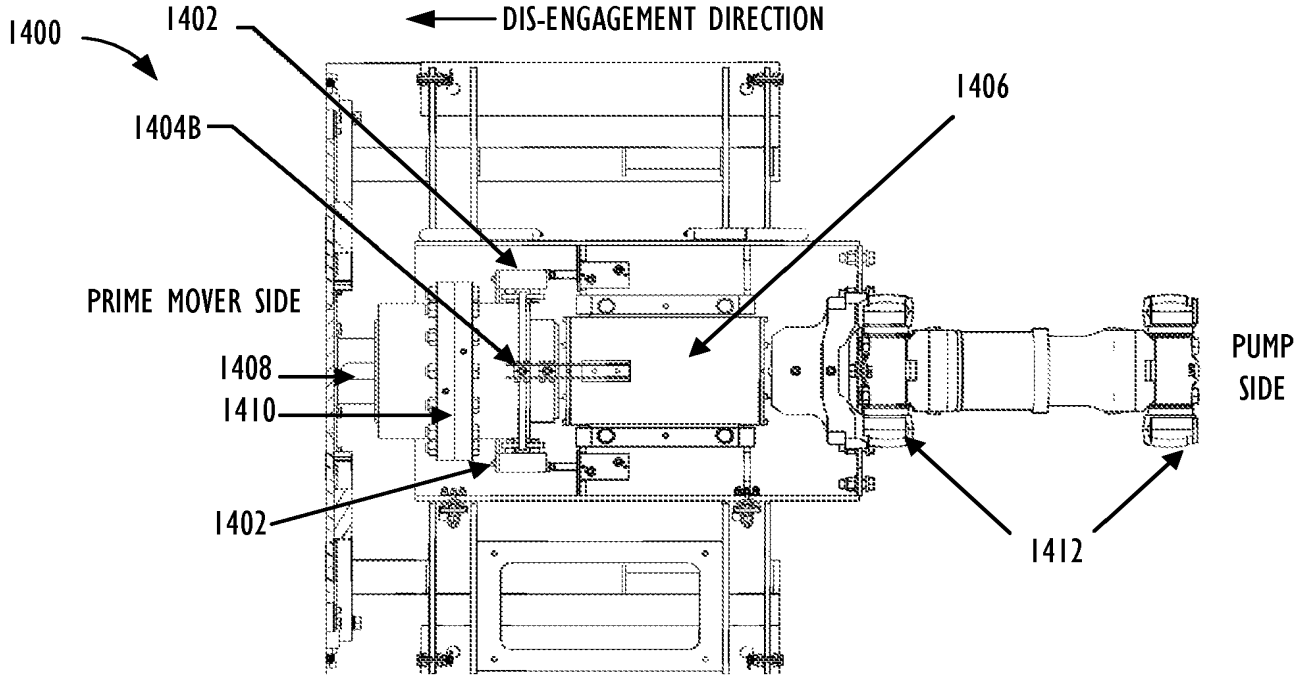


FIG. 14B

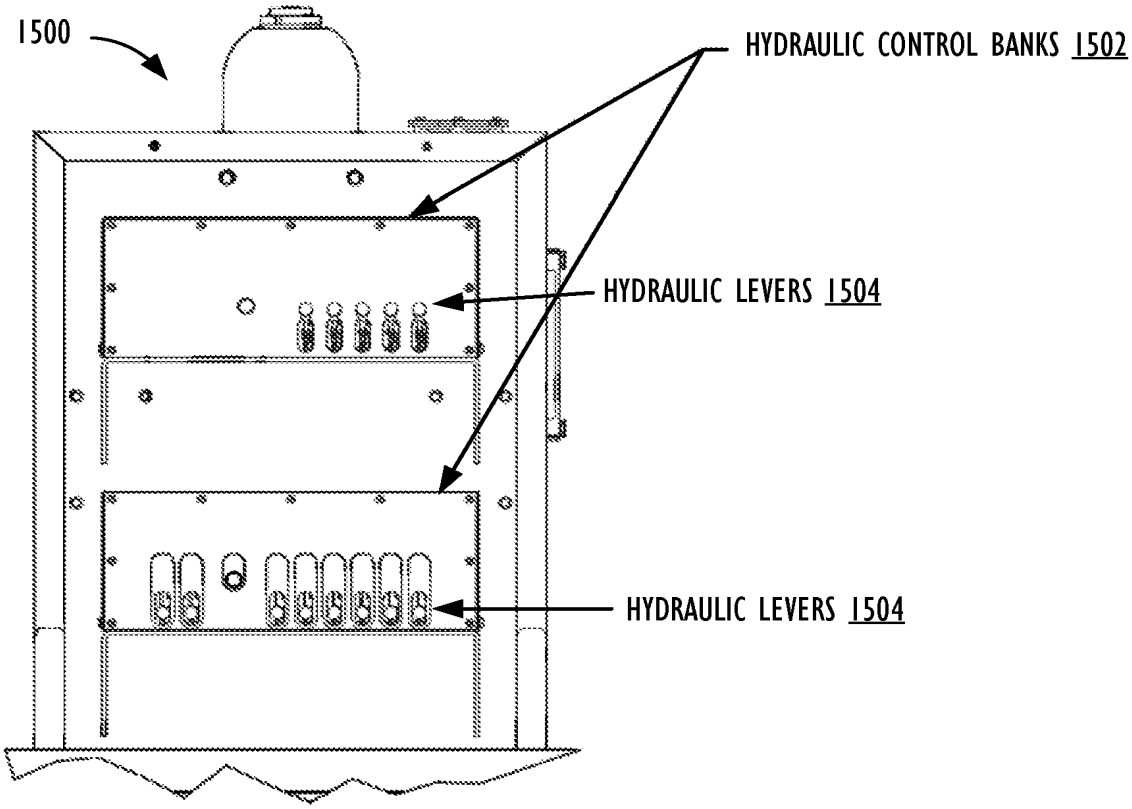


FIG. 15A

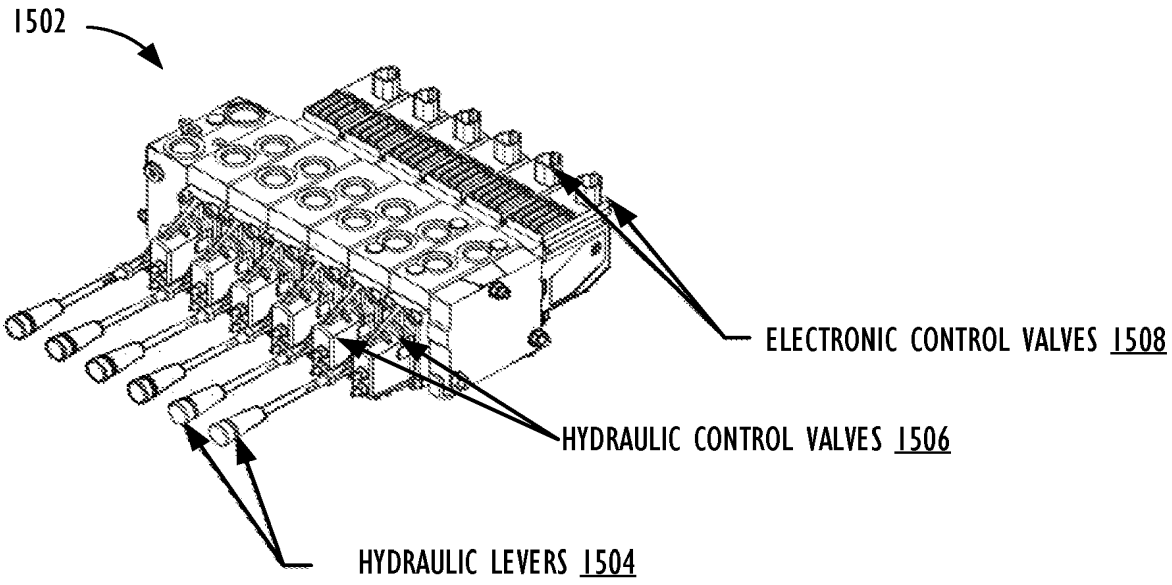


FIG. 15B

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - F04B17/03, F04B17/06, F04B23/04, F16D1/06, F16D1/08, F16D1/10, F16D3/06, F04D29/043, F04D29/044, F04D29/053

CPC - F04B17/03, F04B17/06, F04B23/04, F16D1/06, F16D1/0876, F16D2001/103, F16D3/06, F04D29/043, F04D29/044

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F04B 17/03, 17/06, 23/04; F16D 1/06, 1/08, 1/10, 3/06; F04D 29/043, 29/044, 20/053, 29/054; E21B 41/00, 43/26 (2016.01)
CPC: F04B 17/03, 17/06, 23/04; F16D 1/06, 1/0876, 2001/103; F04D 29/043, 29/044, 29/053, 29/054; E21B 41/0085, 43/26; B62D 63/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

USPC: 417/338, 360, 410.1, 429; 403/359.1; 74/15.63; 166/308.1; 137/351

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, INPADOC Data); Google; Google Scholar; EBSCO; Search Terms: mobile, portable, transportable, pump, fracturing, hydraulic, fluid, liquid, motor, mover, electric, remote, command, control, operate, instruct, disengage, disconnect, detach, separate, uncouple, release, shaft, dual, two, second, pinion, spline, flute, key, coupling, sleeve

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US 2016/177675 A1 (Evolution Well Services, Llc) 23 June 2016 (23.06.2016) figures 1, 7A, 7B; paragraphs [0008], [0040], [0046], [0048], [0076]-[0079], [0081]-[0083], [0086], [0087]	1-4, 7, 8, 11-14, 17-19 ---------- 5, 6, 9, 10, 15, 16, 20
Y	US 2009/0068031 A1 (Gambier, P. et al) 12 March 2009 (12.03.2009) figures 3, 5, 6; paragraph [0026], [0031]	5, 10, 16, 20
Y	US 6,398,521 B1 (Yorulmazoglu, I.) 04 June 2002 (04.06.2002) figures 1, 3-5; column 2, lines 40-45; column 5, lines 20-25, 50-55	9, 15
Y	US 2003/0057704 A1 (Baten, R. et al) 27 March 2003 (27.03.2003) figure 3; paragraph [0016]	6
A	US 2015/0275891 A1 (Schlumberger Technology Corp) 01 October 2015 (01.10.2015) entire document	1-20
A	US 8,997,904 B2 (General Electric Co) 07 April 2015 (07.04.2015) entire document	1-20
A	US20130306322 A1 (General Electric Co) 21 November 2013 (21.11.2013) entire document	1-20
A	WO 2015/162427 A2 (S. A. Armstrong Limited) 29 October 2015 (29.10.2015) entire document	1-20

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 October 2016 (31.10.2016)	21 NOV 2016

Name and mailing address of the ISA/US	Authorized officer
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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(54) Title: DRILLING RIG POWER SUPPLY BUS MANAGEMENT

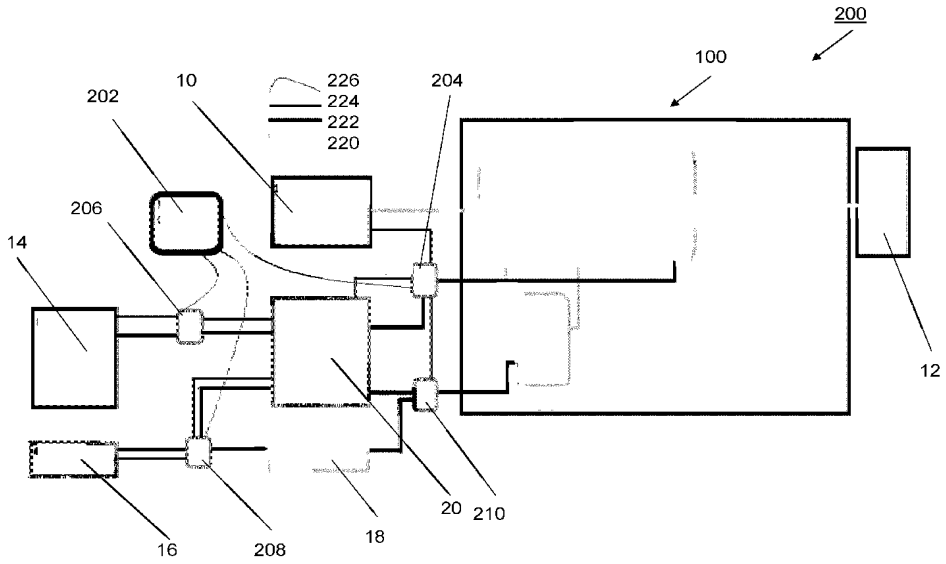


Figure 2

(57) Abstract: A power system and method for the adaptive power control of a drilling rig. While operating the internal combustion engine in its efficient operating range, unrequired mechanical power is converted to electrical power for storage, or use via the electrical bus on the rig. When the internal combustion engine is not required to provide mechanical or electrical power it is deactivated, and then reactivated – electrical storage on the system in the meantime providing electrical power to the bus as required. The power supply and management system could be retroactively fitted to an existing drilling rig by the incorporation of a generator and electrical storage device thereon. The system and method of the present invention allow for the optimized use of combustion-based power on a drilling rig while minimizing environmental emissions from the idle running of the at least one internal combustion engine.

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[Continued on next page]

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DRILLING RIG POWER SUPPLY BUS MANAGEMENT

FIELD OF THE INVENTION

The present invention relates to power supply systems for drilling rigs, and more particularly to a rig mud pump drive and a power management system and method associated therewith.

BACKGROUND OF THE INVENTION

System inefficiencies in the power supply of a drilling rig, for example, for use in oil and gas exploration, result in increased fuel consumption and therefore increased emissions output, either due to power losses in the electrical power distribution of sizeable electrical power over a considerable distance of the rig or due to use of oversized and underutilized mechanical drive systems – in particular the mud pump drive system - that are designed for peak power requirements but are utilized most of the time substantially below peak power, yet have to be in a state of readiness (running) at all times for good control.

Internal Combustion Engine (ICE) systems in compliance with new environmental regulations require higher levels of maintenance load and heat to ensure proper operation of after-treatment systems employed to reduce emissions. Failure to provide adequate load and or temperature will result in a deteriorated after-treatment system no longer capable of meeting the new

environmental regulations, thus requiring, for example, a 'Force Regen' process in which the ICE system raises its speed and creates artificial load in order to develop high levels of heat in order to clean the after-treatment system by burning the contamination therein.

While fully electric powered rigs using batteries charged by generator sets and power management systems address some of the problems arising from peak or cyclical loads, they have inherent efficiency losses due to the electrical power distribution such as, for example, losses from the generator creating the power, transmission losses between the generator and the battery or load sensing system and between the battery or load sensing system and the drives, and losses in the electric drives. Consequently, there have been developments where the draw-works (hoisting and rotary functions) are electrically driven, while the mud pump(s) – having the most significant power consumption - are mechanically actuated to take advantage of the efficiencies of the mechanical power train.

Unfortunately, the ICE system driving the mud pump(s) are still underutilized for most of their operating time resulting in the aforementioned problems. It is desirable to provide a rig mud pump drive that enables operation of an ICE driving the mud pump within its efficient operating range.

It is also desirable to provide a power management system and method associated with the mud pump drive that enables operation of an ICE driving the mud pump within its efficient operating range.

It is also desirable to provide a power management system and method associated with the mud pump drive that keeps the mud pump drive in a state of readiness while the ICE driving the mud pump is shut off.

SUMMARY OF THE INVENTION

Accordingly, one object of the present invention is to provide a rig mud pump drive that enables operation of an ICE driving the mud pump within its efficient operating range.

Another object of the present invention is to provide a power management system and method associated with the mud pump drive that enables operation of an ICE driving the mud pump within its efficient operating range.

Another object of the present invention is to provide a power management system and method associated with the mud pump drive that keeps the mud pump drive in a state of readiness while the ICE driving the mud pump is shut off.

According to one aspect of the present invention, there is provided with a rig mud pump drive. The rig mud pump drive comprises an input power drive shaft adapted for being connected to an internal combustion engine for receiving mechanical input power therefrom. An output power

drive shaft is adapted for being connected to the rig mud pump for providing mechanical output power thereto. A mechanical drive train is interposed between the input power drive shaft and the output power drive shaft and mechanically connected thereto. One or more electric generators/motors is mechanically connected to the mechanical drive train. The electric generators or motors can be located anywhere in the mechanical drive train in relation to other components therein, so long as the necessary rotary power for mechanical power of the generator can be provided – as such the generator could be connected right in proximity to the internal combustion engine, or elsewhere along the drive shaft etc. All such approaches are contemplated within the scope of the present invention, either in newly built or retrofitted rigs .

According to the aspect of the present invention, there is provided with a power management system. The power management system comprises a processor and a control communications network connected to the processor. The control communications network includes a mud pump drive control node connected to an internal combustion engine for driving a mud pump of the rig, an electric motor or generator interposed between the internal combustion engine and the mud pump, and an electric power storage device. A draw-works control node is connected to the electric power storage device and draw-works of the rig. A generator set control node is connected to the electric power storage device, an electric generator set of the rig, and main rig power. The processor controls operation of the internal combustion engine, the electric generator set and the electric motor or generator in dependence upon power consumption of the mud pump, the draw-works, and the main rig power such that the internal combustion engine for driving the mud pump is operated within its efficient operating range.

According to the aspect of the present invention, there is provided with a method for managing power supply of a drilling rig. A processor is connected via a control communications network to an internal combustion engine for driving a mud pump of the rig, an electric motor or generator interposed between the internal combustion engine and the mud pump, an electric power storage device, draw-works of the rig, an electric generator set of the rig, and main rig power. Operation of the internal combustion engine, the electric generator set and the electric motor or generator is controlled in dependence upon power consumption of the mud pump, the draw-works, and the main rig power such that the internal combustion engine for driving the mud pump is operated within its efficient operating range.

The advantage of the present invention is that it provides a rig mud pump drive that enables operation of an ICE driving the mud pump within its efficient operating range.

A further advantage of the present invention is that it provides a power management system and method associated with the mud pump drive that enables operation of an ICE driving the mud pump within its efficient operating range.

A further advantage of the present invention is to provide a power management system and method associated with the mud pump drive that keeps the mud pump drive in a state of readiness while the ICE driving the mud pump is shut off.

The adaptive power management method of the present invention could be implemented in a pre-existing rig or rig drivetrain, by merely installing a single generator into an existing drivetrain of a rig and executing the remainder of the control system and methodology outlined herein. Provision of a retrofit ability for the use of pre-existing rigs and rig drivetrains is explicitly contemplated within the scope of the present invention – any method which would allow for the adaptable control of internal combustion power and related other components and the electrical power bus on a rig, as outlined in further detail elsewhere herein, is contemplated within the scope of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the present invention is described below with reference to the accompanying drawings, in which:

Figure 1a is a simplified block diagram illustrating a drilling rig mud pump drive according to a preferred embodiment of the invention;

Figures 1b and 1c are simplified block diagrams illustrating in a front view and a cross-sectional view, respectively, an electric generator with modulating electric motor or generators of the rig mud pump drive according to the preferred embodiment of the invention;

Figure 2 is a simplified block diagram illustrating a power management system according to a preferred embodiment of the invention; and

Figure 3 is a simplified block diagram illustrating five different modes of power provided to the mud pump using the power management system according to the preferred embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which the invention belongs. Although any methods and materials similar or equivalent to those described herein can be used in the practice or testing of the present invention, the preferred methods and materials are now described.

Referring to Figures 1a to 1c, a rig mud pump drive 100 according to a preferred embodiment of the invention is provided. Input power drive shaft 102 connected to an ICE such as, for example, a high-powered diesel engine (not shown) for receiving mechanical input power therefrom. Output power drive shaft 104 is connected via, for example, a shave and belt drive to a rig mud pump for providing mechanical output power thereto. The input power drive shaft 102 and the

output power drive shaft 104 is connected via a mechanical drive train 103. Any number of different types of connections or transmission arrangements can be understood by those skilled in the art for the link of the generator 106 to the drivetrain 103 – this could include a transmission, gearbox, clutch, belt drive or any number of other types of connections or transmission arrangements which will be understood to those skilled in the art and are all contemplated within the scope of the present invention.

The number of modulating electric motor or generators 112 is not limited to 5 as illustrated, but may be varied between 1 and any number with a more substantial number of modulating electric motor or generators 112 providing more flexibility in operating the rig mud pump drive 100 at the expense of higher complexity and cost. The modulating electric motor or generators 112 are of conventional technology. For example, regular AC asynchronous electric motors can usually be employed as electric generators without any internal modifications. The electric generator 106 and the modulating electric motor or generators 112 are electrically connected to the electrical power system of the rig via electric connections 108 and 114, respectively.

The rig mud pump drive 100 also comprises a mechanism 116 for separating the ICE from the drive train 110. For example, the rig mud pump drive 100 for driving a mud pump using an ICE comprises an electric generator 106 and five modulating electric motor or generators 112 as shown. Preferably, the modulating electric motor or generators 112 are designed to provide sufficient mechanical power for driving the mud pump in order to keep the rig mud pump drive 100 in a state of readiness while the ICE driving the mud pump is shut off.

Referring to Figure 2, a power management system 200 according to a preferred embodiment of the invention is provided. The mud pump (not shown) is mechanically 220 driven by ICE 10 via sheave 12 connected to the mud pump drive 100. The power management system 200 comprises a processor 202 such as, for example, a conventional off-the-shelf Field-Programmable Gate Array (FPGA), connected to a control communications network 224, 226. For example, the processor 202 and the control communications network 224, 226 are implemented as a conventional Controller Area Network (CAN) bus with the processor 202 forming 'Master Control' communicating with, for example, control nodes 204, 206, 208, and 210.

Mud pump drive control node 204 is connected to ICE 10 for driving a mud pump of the drilling rig via shave 12; modulating electric motor or generators 112; an electric power storage device 20 of the rig. Generator control node 18 is connected to the electric generator 106, the electric power storage device 20; rig power bus 18 (the rig power bus 18 being any electric power consumption of the rig other than draw-works 14 and the modulating electric motor or generators 112 connected to the electric supply network of the rig); and the mud pump drive control node 204. Draw-works control node 206 is connected to the electric power storage device 20; and draw-works 14 of the rig. Generator set control node 208 is connected to the electric power storage device 20; electric generator set 16 of the rig, and the rig power bus 18.

Electric power transmission lines 222 connect the electric generator 106 and the modulating electric motor or generators 112 via control nodes 204 and 210 to the electric power storage

device 20 and the rig power bus 18, as well as the draw-works 14 and the electric generator set 16 via control nodes 206 and 208 to the electric power storage device 20 and the rig power bus 18. The electric power is converted where necessary from AC to DC, for example, for battery or load sensing system storage, using conventional rectifiers and from DC to AC using conventional inverters.

The processor 202 controls operation of the ICE 10, the electric generator set 16, the electric generator 106, and the modulating electric motor or generators 112 in dependence upon the power consumption of the mud pump (sheave 12), the draw-works 14, and the rig power bus 18 such that the ICE 10 is operated within its efficient operating range.

Figure 3 illustrates five modes of operation of the power management system 200. In mode, I, the electric generator 106, and the modulating electric motor or generators 112 produce electric power 234 for storage or use when there is no mechanical power requirement from the pump. In mode II, the electric generator 106, and the modulating electric motor or generators 112 produce electric power 234 for storage in the electric power storage device 20 or use in other loads on site when the mechanical power consumption 232 of the mud pump is less than the power 230 produced by the ICE 10 when operated in its efficient range P1. In mode III, the system uses the ICE to produce only mechanical power to the pump, and the electric generator and modulating motor are used just for speed variation. In mode IV, the modulating electric motor or generators 112 produce mechanical power 236 to assist the ICE when the mechanical power consumption 232 of the mud pump (for example, peak power) is higher than the energy 230 produced by the

ICE 10 when operated in its efficient range P1. In mode V, the modulating electric motor or generators 112 produce mechanical power 238 for driving the mud pump while the ICE 10 is shut off.

The five modes of operation of the power management system 200 provide substantial efficiency increase and emissions reduction by:

Mode I: operating the ICE 10 in its efficient range and providing electric power to the electric supply network of the rig (which also substantially prevents the use of 'Force Regen' processes) and reduces the need for running additionally dedicated Genset engines onsite;

Mode II: operating the ICE 10 in its efficient range and providing excess as electric power to the electric supply network of the rig (which also substantially prevents the use of 'Force Regen' processes) and reduces the need for running additionally dedicated Genset engines onsite;

Mode III: enabling maximum power transfer efficiency by utilizing mechanic power transfer from ICE to Pump directly;

Mode IV: enabling employment of a smaller ICE 10 than needed to provide peak power to the mud pump by importing electrical power as required to add power to the drivetrain;

and,

Mode IV: shutting the ICE 10 off, reducing run-time of the ICE which has the additional advantages of increasing the overall lifetime and decreasing the maintenance of the ICE 10, also leaving the unit in the state of readiness as dictated by the application.

It will be apparent to those of skill in the art that by routine modification the present invention can be optimized for use in a wide range of conditions and application. It will also be evident to those of skill in the art that there are various ways and designs with which to produce the apparatus and methods of the present invention. The illustrated embodiments are therefore not intended to limit the scope of the invention, but to provide examples of the device and method to enable those of skill in the art to appreciate the inventive concept.

Those skilled in the art will recognize that many more modifications besides those already described are possible without departing from the inventive concepts herein. The inventive subject matter, therefore, is not to be restricted except in the scope of the appended claims. Moreover, in interpreting both the specification and the claims, all terms should be understood in the broadest possible manner consistent with the context. In particular, the words "comprises" and "comprising" should be construed as referring to elements, components, or steps in a non-exclusive manner, indicating that the referenced elements, components, or steps may be present, or utilized, or combined with other features, components, or actions that are not expressly referenced.

We claim:

1. A power management system for use on a drilling rig or frac rig comprising at least one power-consuming component, at least one electric power storage device, at least one internal combustion engine and an electric generator set providing power to a rig power bus, said system comprising:

    a. a processor; and

    b. a control communications network connected to the processor, the control communications network comprising:

        i. a generator set control node operatively connected to control the at least one electric power storage device, the electric generator set and the at least one internal combustion engine; and

        ii. at least one component control node operatively connected to control power supply to a power-consuming component of the rig from at least one power generating or storage component of the rig;

wherein the processor controls operation of the internal combustion engine, the electric generator set and the electric power storage device in dependence upon power consumption of the at least one power-consuming component and the rig power bus, such that the internal combustion engine is operated within its efficient operating range while

providing necessary power to the components of the rig requiring same.

2. The power management system of Claim 1 wherein the rig is a pre-existing rig with a conventional power system, and the electric generator set and the electric power storage device are components added to the rig along with the power management system to enable adaptive power management of a pre-existing rig and drive train.

3. The power management system of claim 1 wherein the at least one component control node comprises a mud pump drive control node operatively connected to a mud pump of the rig driven by the internal combustion engine, an electric motor or generator interposed between the internal combustion engine and the mud pump, and an electric power storage device.

4. The power management system of claim 3 wherein the electric motor or generator comprises an electric generator and at least one modulating electric motor or generator, wherein the mud pump drive control node is connected to the at least one modulating electric motor or generator and a generator control node connected to the electric generator, the electric power storage device, and the rig power bus.

5. The power management system of claim 1 wherein the at least component control node comprises a draw-works control node connected to the electric power storage device and draw-works of the rig.

6. An adaptively powered drilling rig or frac rig, comprising:

a. at least one power-consuming component;

b. at least one electric power storage device;

c. at least one internal combustion engine connected to an electric generator set providing power to a rig power bus; and

d. a power management system comprising:

i. a processor; and

ii. a control communications network connected to the processor, the control communications network comprising:

1. a generator set control node operatively connected to control the at least one electric power storage device, the electric generator set

and the at least one internal combustion engine; and

2. at least one component control node operatively connected to control power supply to a power-consuming component of the rig from at least one power generating or storage component of the rig;

wherein during operation of the rig the processor controls operation of the internal combustion engine, the electric generator set and the electric power storage device in dependence upon power consumption of the at least one power-consuming component and the rig power bus, such that the internal combustion engine is operated within its efficient operating range while providing necessary power to the components of the rig requiring same.

7. The adaptively powered rig of Claim 6 further comprising a mud pump driven by the internal combustion engine, wherein the at least one component control node comprises a mud pump drive control node operatively connected to the mud pump, an electric motor or generator interposed between the internal combustion engine and the mud pump, and an electric power storage device.

8. The adaptively powered rig of Claim 7 wherein the electric motor or generator comprises

an electric generator and at least one modulating electric motor or generator, wherein the mud pump drive control node is connected to the at least one modulating electric motor or generator and a generator control node connected to the electric generator, the electric power storage device, and the rig power bus.

9. The adaptively powered rig of Claim 6 wherein at least one power-consuming component of the rig is draw-works, and wherein the at least component control node comprises a draw-works control node connected to the electric power storage device and the draw-works.

10. A mud pump drive for use on a drilling rig or a frac rig comprising:

a. an input power drive shaft adapted for being connected to an internal combustion engine for receiving mechanical input power therefrom;

b. an output power drive shaft adapted for being connected to amud pump on the rig for providing mechanical output power thereto;

c. a mechanical drive train interposed between the input power drive shaft and the output power drive shaft and mechanically connected thereto;

d. an electric generator mechanically connected to the mechanical drive train; and

e. at least one modulating electric motor or generator mechanically connected to the mechanical drive train.

11. The mud pump drive of claim 10 wherein the at least one modulating electric motor or generator is capable of providing sufficient mechanical power for driving the mud pump.

12. A method for managing power supply on a drilling rig or frac rig, said method comprising:

a. providing a processor connected via a control communications network to an internal combustion engine for driving a mud pump of the rig, an electric motor or generator interposed between the internal combustion engine and the mud pump, an electric generator set of the drilling rig, rig power bus and at least one power-consuming component of the rig; and

b. during operation of the rig, controlling operation of the internal combustion engine, the electric generator set and the electric motor or generator in

dependence upon power consumption of the power-consuming components of the rig and the rig power bus such that the internal combustion engine for driving the mud pump is operated within its efficient operating range.

13. The method of Claim 12 wherein the equipment further comprises an electric power storage device connected to the network.

14. The method of claim 13 wherein the electric motor or generator produces electric power for storage in the electric power storage device when the mechanical power consumption of the mud pump is less than the power produced by the internal combustion engine when operated in its efficient range.

15. The method of claim 12 wherein the electric motor or generator produces mechanical power when the mechanical power consumption of the mud pump is greater than the power produced by the internal combustion engine when operated in its efficient range.

16. The method of claim 12 wherein the electric motor or generator produces mechanical power for driving the mud pump and wherein the internal combustion engine is shut off.

17. The method of claim 15 wherein the internal combustion engine is shut off when the power consumption of the mud pump is less than the power produced by the internal combustion engine when operated in its efficient range.

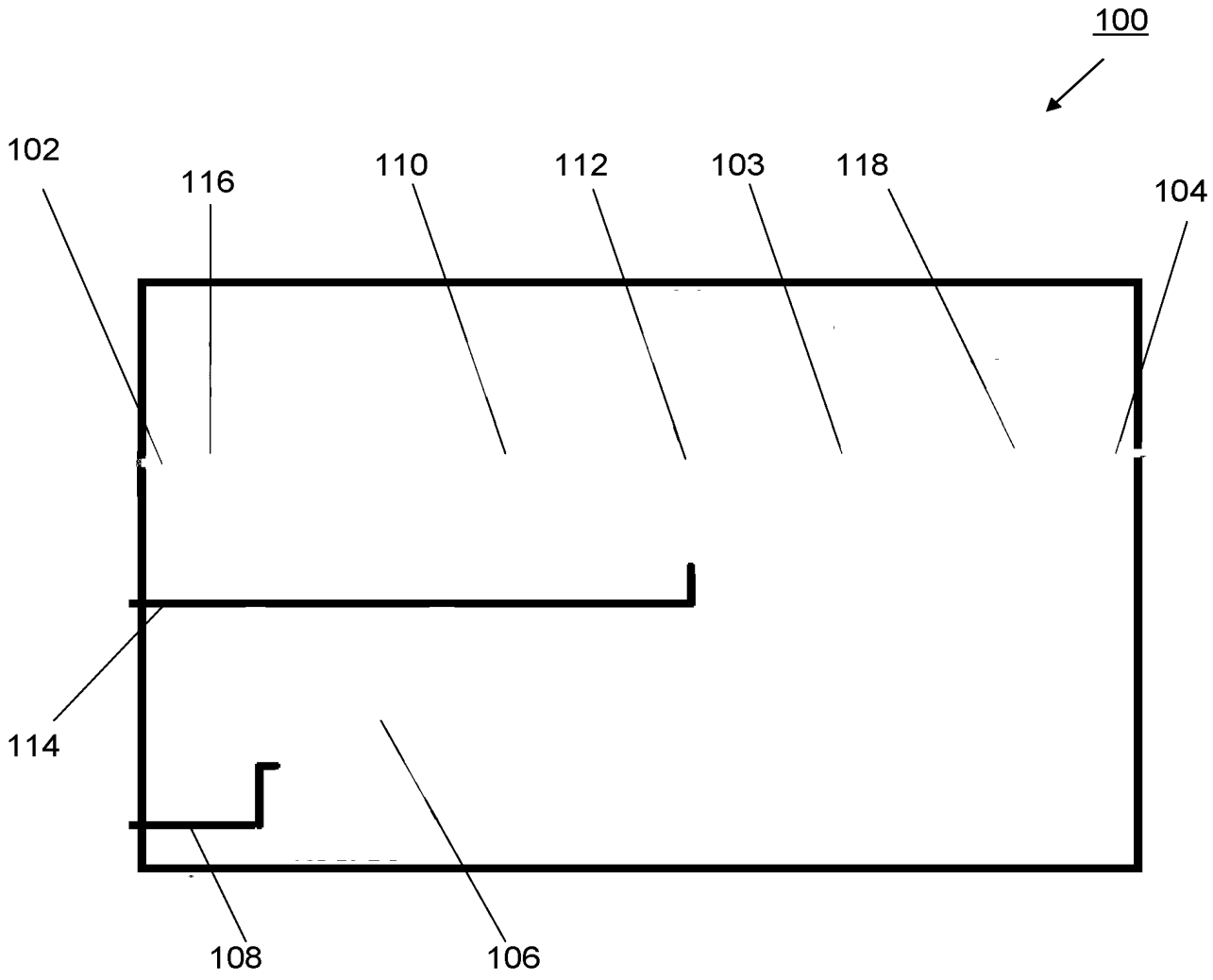


Figure 1a

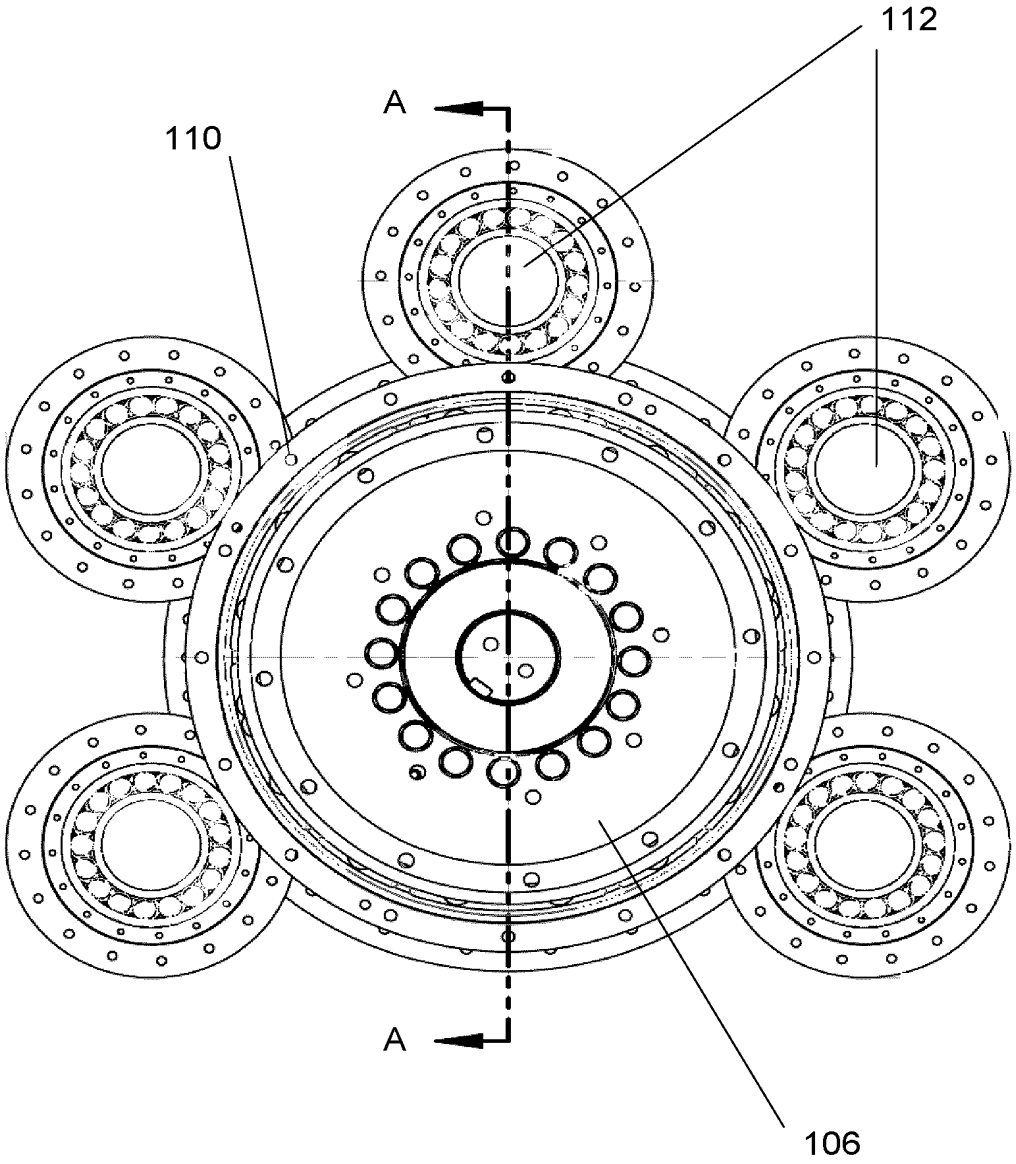


Figure 1b

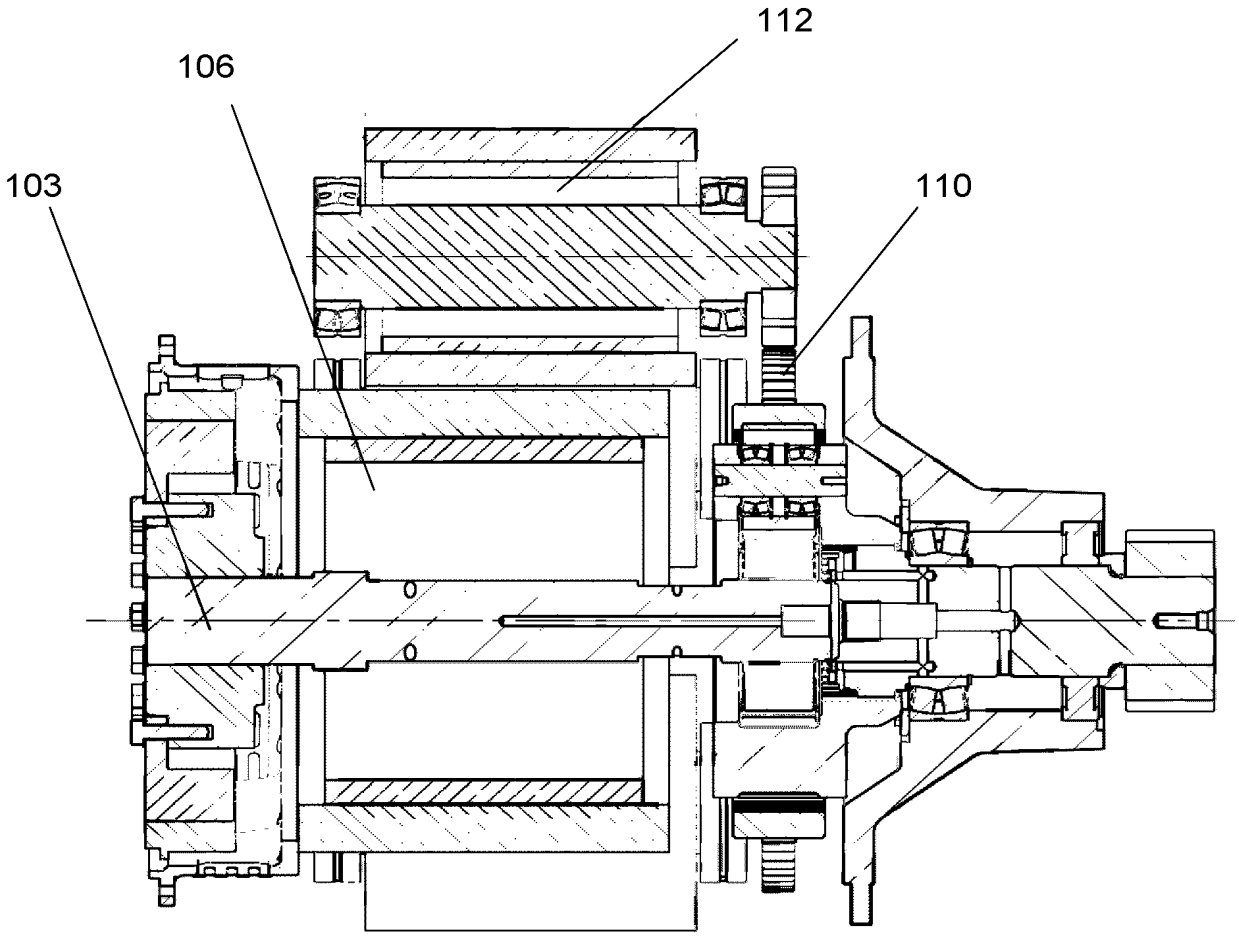


Figure 1c (Section A – A)

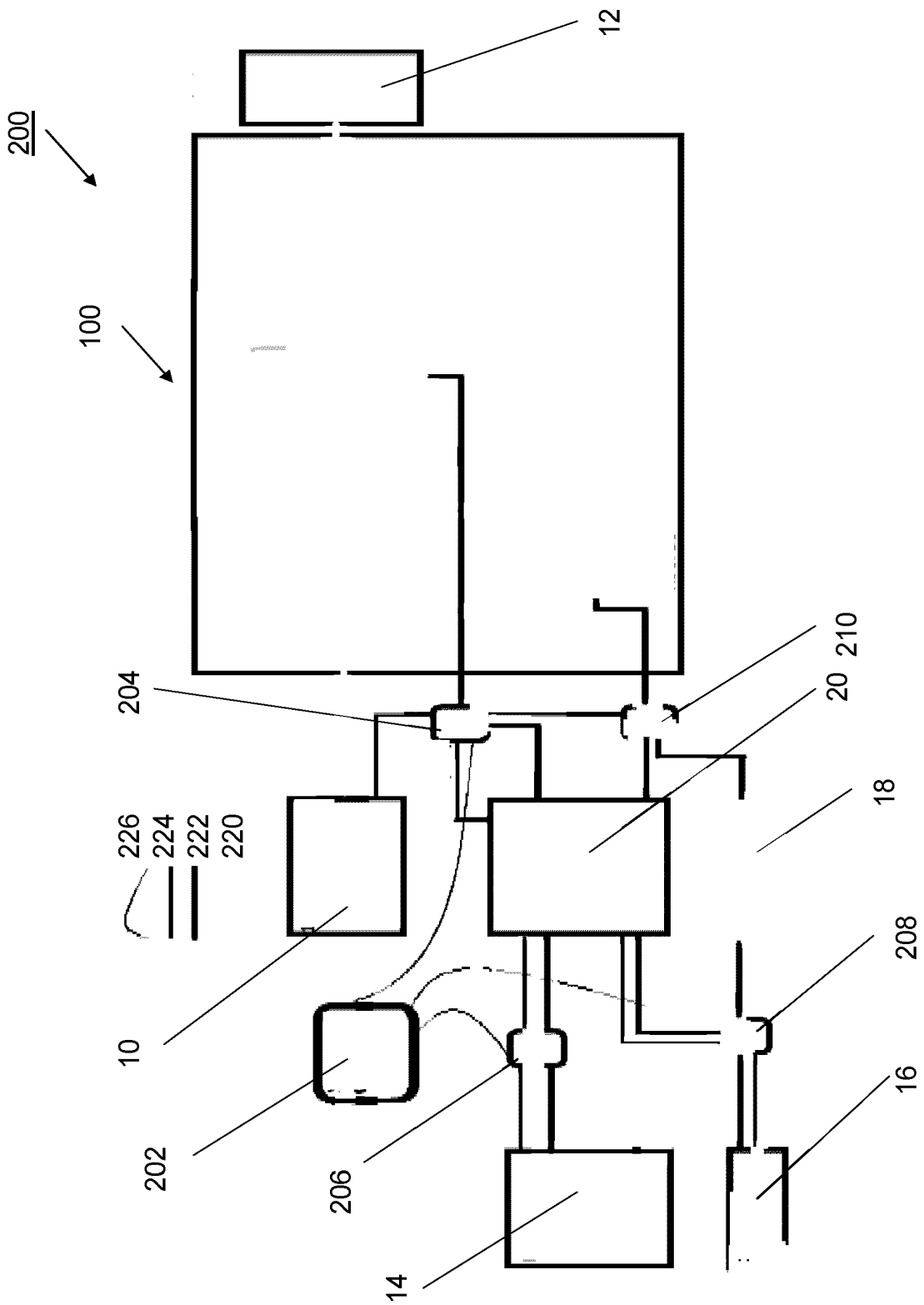


Figure 2

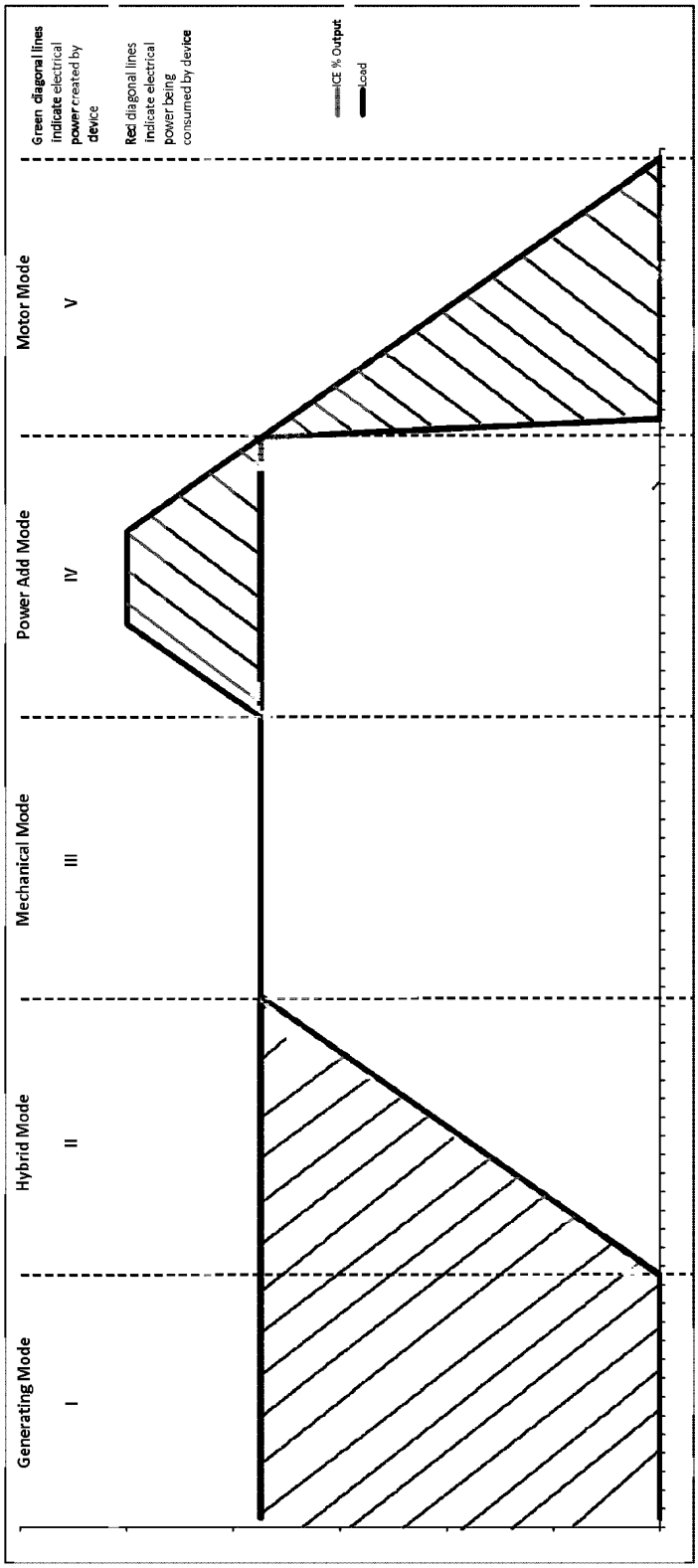

Green diagonal lines indicate electrical power created by device
Red diagonal lines indicate electrical power being consumed by device
ICE % Output
Load
Generating Mode
I
Hybrid Mode
II
Mechanical Mode
III
Power Add Mode
IV
Motor Mode
V

Figure 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2018/050601

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***E21B 41/00*** (2006.01) , ***E21B 21/00*** (2006.01) , ***E21B 43/26*** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: ***E21B 41/00*** (2006.01) , ***E21B 21/00*** (2006.01) , ***E21B 43/26*** (2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Questel Orbit, CPD; keywords: motor, engine, ice, combustion, generator, electric, mud, pump, drive, transmission, gearbox, manage, efficient.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO2015011223 A2 (URIONA, S.L.) 29 January 2015 (29-01-2015) {fig.3}	10 – 11
A		1 – 9, 12 – 17
A	CN204458030 U (XU JINGGUO, et al.) 8 July 2015 (08-07-2015)	1 – 17
A	US20110074165 A1 (GRIMES, M.F., et al.) 31 March 2011 (31-03-2011) {fig.1}	1 – 17
A	WO2009070876 A1 (LESKO, G.) 11 June 2009 (11-06-2009)	1 – 17
A	CA2607466 A1 (EGILSSON, T., et al.) 23 April 2009 (23-04-2009) {fig.1b}	1 – 17
A	CN2546617 Y (HU DEXIANG, et al.) 23 April 2003 (23-04-2003)	1 – 17

☐ Further documents are listed in the continuation of Box C.

☑ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier application or patent but published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 4 July 2018 (04-07-2018)	Date of mailing of the international search report 17 July 2018 (17-07-2018)
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 819-953-2476	Authorized officer Edward Dabrowski (819) 639-7842

LIBERTY EXHIBIT 1056, Page 176

Box No. II **Observations where certain claims were found unsearchable (Continuation of item 2 of the first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III **Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

Group A: claims 1-9, 12-17; power management of interacting oil rig components.

Group B: claims 10-11; a rig mud pump drive.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☑ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claim Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2018/050601

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
WO2015011223A2	29 January 2015 (29-01-2015)	WO2015011223A2	29 January 2015 (29-01-2015)
		WO2015011223A3	28 May 2015 (28-05-2015)
		DE102013214635A1	19 February 2015 (19-02-2015)
CN204458030U	08 July 2015 (08-07-2015)	None	
US2011074165A1	31 March 2011 (31-03-2011)	US2011074165A1	31 March 2011 (31-03-2011)
		AT546611T	15 March 2012 (15-03-2012)
		CA2678668A1	28 August 2008 (28-08-2008)
		CA2678668C	08 May 2012 (08-05-2012)
		CN101675206A	17 March 2010 (17-03-2010)
		EP2126268A1	02 December 2009 (02-12-2009)
		EP2126268B1	22 February 2012 (22-02-2012)
		US2008203734A1	28 August 2008 (28-08-2008)
		WO2008102166A1	28 August 2008 (28-08-2008)
WO2009070876A1	11 June 2009 (11-06-2009)	None	
CA2607466A1	23 April 2009 (23-04-2009)	CA2607466A1	23 April 2009 (23-04-2009)
		CA2607466C	11 December 2012 (11-12-2012)
CN2546617Y	23 April 2003 (23-04-2003)	None	

Electronic Patent Application Fee Transmittal

Application Number:	16728359
Filing Date:	27-Dec-2019
Title of Invention:	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
First Named Inventor/Applicant Name:	Jared Oehring
Filer:	Taylor P. Evans/Tina Fluharty
Attorney Docket Number:	047158.100066

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	1806	1	260	260
		Total in USD ($)		**260**

Electronic Acknowledgement Receipt

EFS ID:	42138589
Application Number:	16728359
International Application Number:	
Confirmation Number:	6981
Title of Invention:	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Taylor P. Evans/Tina Fluharty
Filer Authorized By:	Taylor P. Evans
Attorney Docket Number:	047158.100066
Receipt Date:	10-MAR-2021
Filing Date:	27-DEC-2019
Time Stamp:	10:59:01
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$260
RAM confirmation Number	E202130B16114602
Deposit Account	501349
Authorized User	Tina Fluharty

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	047158-100066-IDS.pdf	1035847 b148208d0c65ba00e12133e087377b09ea65b526	no	7
Warnings:					
Information:					
2	Foreign Reference	047158-CN104196613A.pdf	602165 640d7c784711f7b9e6dfbf72a3aeb1df5136d9a3	no	10
Warnings:					
Information:					
3	Foreign Reference	047158-CN104196613A-abstract1.pdf	69377 bb4adb4e13a78bdbe9dd9e4f27f41d4e4117fd10	no	1
Warnings:					
Information:					
4	Non Patent Literature	047158-FOA-100048.pdf	1870514 1c2bc074a5b87b3cb70af7afb8408c72e41b5c7c	no	20
Warnings:					
Information:					
5	Non Patent Literature	047158-FOA-100054.pdf	719596 5e7347f833aa8a4816966894e6b26d5d23c372f5	no	8
Warnings:					
Information:					
6	Non Patent Literature	047158-FOA-100058.pdf	1483347 0d7a4a73f3d8edde25a7652ff8c34d1a61a550ad	no	14
Warnings:					
Information:					

7	Non Patent Literature	047158-ISR-WO-50069.pdf	1443141 98ca53c5b4dcc05b5aa9baa734e4d00f2e94200e	no	8
Warnings:					
Information:					
8	Non Patent Literature	047158-ISR-WO-500065.pdf	720293 78127bd1a5534edfc36bbeafeff316ed456dcd20	no	10
Warnings:					
Information:					
9	Non Patent Literature	047158-ISR-WO-500067.pdf	1324294 440598ae1e25dd1bf8e36d91ff310041d1324a46	no	8
Warnings:					
Information:					
10	Non Patent Literature	047158-ISR-WO-500068.pdf	506844 03abdbbfb19f9f16d6d919f01c00776b87a398a5	no	8
Warnings:					
Information:					
11	Non Patent Literature	047158-Morris.pdf	1066638 57894cc17802012c9ed66f63a5dd012e7b23cf9a	no	18
Warnings:					
Information:					
12	Non Patent Literature	047158-NFOA-100061.pdf	650017 893907dbd49e68ab8f956dd863d17f3be8346ad2	no	7
Warnings:					
Information:					
13	Non Patent Literature	047158-NFOA-100062.pdf	577049 50dcf34b7a3467d53f7dc3deb395e8f5dbec8334	no	6
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14	Foreign Reference	047158-WO2018044307A1.pdf	2913956 98ae95d003b5c43bedd7b5bd50e596652f7c597a	no	55
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16	Fee Worksheet (SB06)	fee-info.pdf	30687 abbff6b4b03aab98b9f32f835957649b0f6cf7bf	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	16046545	

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/728,359	12/27/2019	Jared Oehring	047158.100066	6981

132858 7590 03/09/2021

Hogan Lovells US LLP
609 Main Street
Suite 4200
Houston, TX 77002

EXAMINER	
LEMBO, AARON LLOYD	

ART UNIT	PAPER NUMBER
3679	

NOTIFICATION DATE	DELIVERY MODE
03/09/2021	ELECTRONIC

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):

hlusdocketing@hoganlovells.com
stephanie.mcdonough@hoganlovells.com

Supplemental ***Notice of Allowability***	**Application No.** 16/728,359	**Applicant(s)** Oehring et al.	
	Examiner AARON L LEMBO	**Art Unit** 3679	**AIA (FITF) Status** Yes

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

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to Claims filed 09/29/2020.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ 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.

3. ☑ The allowed claim(s) is/are 1-8 and 21-26 . As a result of the allowed claim(s), 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** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ 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)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/AARON L LEMBO/
Primary Examiner, Art Unit 3679

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16728359
Filing Date	2019-12-27
First Named Inventor	Jared Oehring
Art Unit	3679
Examiner Name	Aaron Lloyd Lembo
Attorney Docket Number	047158.100066

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6560131		2003-05-06	VonBrethorst	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20170302218		2017-10-19	Janik	
	2	20140174691		2014-06-26	Kamps	
	3	20030000759		2003-01-02	Schmitz	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	734988	AU		1997-09-22	Wilhelm		X

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.L.L./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16728359
Filing Date	2019-12-27
First Named Inventor	Jared Oehring
Art Unit	3679
Examiner Name	Aaron Lloyd Lembo
Attorney Docket Number	047158.100066

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	International Search Report and Written Opinion mailed November 24, 2020 in corresponding PCT Application No. PCT/US20/44274	X

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/AARON L LEMBO/	Date Considered	03/04/2021

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.L.L./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16728359
Filing Date	2019-12-27
First Named Inventor	Jared Oehring
Art Unit	3679
Examiner Name	Aaron Lloyd Lembo
Attorney Docket Number	047158.100066

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

X That each item of information contained in the 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 the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

X See attached certification statement.

X The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Taylor P. Evans/	Date (YYYY-MM-DD)	2021-02-24
Name/Print	Taylor P. Evans	Registration Number	60506

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.L.L./

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16728359
Filing Date	2019-12-27
First Named Inventor	Jared Oehring
Art Unit	3679
Examiner Name	Aaron Lloyd Lembo
Attorney Docket Number	047158.100066

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6560131		2003-05-06	VonBrethorst	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20170302218		2017-10-19	Janik	
	2	20140174691		2014-06-26	Kamps	
	3	20030000759		2003-01-02	Schmitz	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	734988	AU		1997-09-22	Wilhelm		X

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16728359
	Filing Date	2019-12-27
	First Named Inventor	Jared Oehring
	Art Unit	3679
	Examiner Name	Aaron Lloyd Lembo
	Attorney Docket Number	047158.100066

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	International Search Report and Written Opinion mailed November 24, 2020 in corresponding PCT Application No. PCT/US20/44274	X

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16728359
	Filing Date	2019-12-27
	First Named Inventor	Jared Oehring
	Art Unit	3679
	Examiner Name	Aaron Lloyd Lembo
	Attorney Docket Number	047158.100066

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☒ That each item of information contained in the 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 the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☒ See attached certification statement.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Taylor P. Evans/	Date (YYYY-MM-DD)	2021-02-24
Name/Print	Taylor P. Evans	Registration Number	60506

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To: TAYLOR EVANS
HOGAN LOVELLS US LLP
609 MAIN STREET, SUITE 4200
HOUSTON, TX 77002

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Applicant's or agent's file reference 047158.500064	Date of mailing *(day/month/year)* 24-NOV 2020 FOR FURTHER ACTION See paragraphs 1 and 4 below
International application No. PCT/US 20/44274	International filing date *(day/month/year)* 30 July 2020 (30.07.2020)
Applicant U.S. WELL SERVICES, LLC	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46).

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   How? Directly to the International Bureau preferably through ePCT, or on paper to:
   The International Bureau of WIPO, 34, chemin des Colombettes, 1211 Geneva 20, Switzerland

   For more detailed instructions, see the *PCT Applicant's Guide*, International Phase, paragraphs 9.004 – 9.011.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ With regard to any protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:
   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with any request to forward the texts of both the protest and the decision thereon to the designated Offices.
   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

   Shortly after the expiration of 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

   Within 19 months from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later); otherwise, the applicant must, within 20 months from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices. In respect of other designated Offices, the time limit of 30 months (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

   Within 22 months from the priority date, the applicant may request that a supplementary international search be carried out by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Lee Young Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/220 (revised January 2020)

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To: TAYLOR EVANS
HOGAN LOVELLS US LLP
609 MAIN STREET, SUITE 4200
HOUSTON, TX 77002

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Applicant's or agent's file reference 047158.500064	Date of mailing *(day/month/year)* 24-NOV-2020 FOR FURTHER ACTION See paragraphs 1 and 4 below
International application No. PCT/US 20/44274	International filing date *(day/month/year)* 30 July 2020 (30.07.2020)
Applicant U.S. WELL SERVICES, LLC	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   How? Directly to the International Bureau preferably through ePCT, or on paper to:
   The International Bureau of WIPO, 34, chemin des Colombettes, 1211 Geneva 20, Switzerland

   For more detailed instructions, see the *PCT Applicant's Guide*, International Phase, paragraphs 9.004 – 9.011.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ With regard to any protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:
   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with any request to forward the texts of both the protest and the decision thereon to the designated Offices.
   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   The applicant may **submit comments on an informal basis on the written opinion of the International Searching Authority** to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

   Shortly after the expiration of **18 months from the priority date, the international application will be published** by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for **entry into the national phase** before those designated Offices. In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

   Within **22 months from the priority date, the applicant may request that a supplementary international search be carried out** by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Lee Young Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/220 (revised January 2020)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION
047158.500064	see Form PCT/ISA/220 as well as, where applicable, item 5 below.

International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/US 20/44274	30 July 2020 (30.07.2020)	01 August 2019 (01.08.2019)

Applicant
U.S. WELL SERVICES, LLC

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report
   a. With regard to the language, the international search was carried out on the basis of:
      ☒ the international application in the language in which it was filed.
      ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).
   b. ☐ This international search report has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).
   c. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, see Box No. I.

2. ☐ Certain claims were found unsearchable (see Box No. II).

3. ☐ Unity of invention is lacking (see Box No. III).

4. With regard to the title,
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the drawings,
   a. the figure of the drawings to be published with the abstract is Figure No. 1A
      ☐ as suggested by the applicant.
      ☐ as selected by this Authority, because the applicant failed to suggest a figure.
      ☒ as selected by this Authority, because this figure better characterizes the invention.
   b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 20/44274

A. CLASSIFICATION OF SUBJECT MATTER

IPC - F04B 49/06; F01D 15/10; F01D 15/08 (2020.01)

CPC - F04B 49/06; F01D 15/08; F01D 15/10; F04B 15/02; F04B 23/00;

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2018/0183219 A1 (U.S. Well Services, LLC) 28 June 2018 (28.06.2018) entire document, especially: fig. 1-3, 6, 12; para [0016], [0021], [0039], [0043], [0044], [0049], [0056], [0057], [0065], [0079], [0080], [0087]	1, 8, 10 --- 2-7, 9, 11-20
Y	US 2017 / 0302218 A1 (ELECTRONIC POWER DESIGN) 19 October 2017 (19.10.2017) para [0020]	2-4, 12-13, 16
Y	US 6,560,131 B1 (William F. vonBrethorst) 06 May 2003 (06.05.2003) entire document, especially: fig.1; col 1 in 35-56, col 3 in 11-25	5, 6, 14, 18
Y	AU 734988 B2 (Nextek Power Systems, Inc.) 22 September 1997 (22.09.1997) pp 6b in 9-14	7, 15
Y	US 2014/0174691 A1 (MULTITEK NORTH AMERICA, LLC) 26 June 2014 (26.06.2014) para [0030], [0035]	9, 19
Y	US 2003/0000759 A1 (Schmitz et al.) 02 January 2003 (02.01.2003) para [0023].	11-20

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 September 2020	24 NOV 2020
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Lee Young Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/210 (second sheet) (July 2019)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 20/44274

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2018/0306159 A1 (WESTPORT POWER INC.) 25 October 2018 (25.10.2018) para [0149]	20

LIBERTY EXHIBIT 1056, Page 199

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: TAYLOR EVANS
HOGAN LOVELLS US LLP
609 MAIN STREET, SUITE 4200
HOUSTON, TX 77002

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)* 24 NOV 2020

Applicant's or agent's file reference
047158.500064

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 20/44274	30 July 2020 (30.07.2020)	01 August 2019 (01.08.2019)

International Patent Classification (IPC) or both national classification and IPC
IPC - F04B 49/06; F01D 15/10; F01D 15/08 (2020.01)
CPC - F04B 49/06; F01D 15/08; F01D 15/10; F04B 15/02; F04B 23/00;

Applicant U.S. WELL SERVICES, LLC

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box **No. IV** Lack of unity of invention
- ☒ Box **No. V** Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	24 September 2020	Lee Young PCT Help Desk Telephone No. 571-272-4300

Form PCT/ISA/237 (cover sheet) (revised January 2019)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/44274

Box No. I Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of:

☒ the international application in the language in which it was filed.

☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(b)).

3. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this opinion has been established on the basis of a sequence listing:

a. ☐ forming part of the international application as filed:

☐ in the form of an Annex C/ST.25 text file

☐ on paper or in the form of an image file.

b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4 ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/44274

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	2-7, 9, 11-20	YES
	Claims	1, 8, 10	NO
Inventive step (IS)	Claims	None	YES
	Claims	1-20	NO
Industrial applicability (IA)	Claims	1-20	YES
	Claims	None	NO

2. Citations and explanations:
Claims 1, 8 and 10 lack novelty under PCT Article 33(2) as being anticipated by US 2018/0183219 A1 to U.S. Well Services, LLC (hereinafter "U.S. Well").

Regarding Claim 1:
U.S. Well discloses a hydraulic fracturing power system (para [0044] "FIG. 1 is a block diagram showing the basic components of a hydraulic fracturing well site power generation system 100 for providing electrical load sharing according to an embodiment.").

comprising:
a power source (para [0044] "A turbine generator 105 can include a natural gas turbine engine coupled to a three-phase, 60 hertz (Hz) electric generator to produce power as the turbine engine rotates. ");

a power storage system (battery bank, para [0044] "In the illustrated embodiment, the turbine generator 105 is shown being electrically connected to an electronic equipment room (EER) 115, which can house wiring, breakers, controls, monitoring systems, fire suppression support, and a battery bank for secondary power when the turbine is not operating and there is no other power source.");

electric powered hydraulic fracturing equipment (para [0043] "The systems described herein are not limited to use in processes involving hydraulic fracturing. For example, the system includes electric fracturing equipment and power generation equipment. The power generation equipment can be used to supply any oilfield equipment including compressor stations, pumping stations, nitrogen plants, CO2 plants, drilling rigs, work-over rigs, barracks, coiled tubing units, refineries, or other systems or applications that do not have access to a utility provided power grid or that have a dynamic power load or low power factor."; para [0021] "In an embodiment, the one or more auxiliaries can include any of a blender, electric wireline equipment, a water transfer pump, an electric crane, a data van, a work trailer, living quarters, an emergency shower, sand equipment, a turbine inlet chiller, a compressor station, a pumping station, a second fracturing site, a drill rig, or a nitrogen plant, or a combination thereof.")

in selective electrical communication with the power source, the power storage system, or both (with power source, para [0056]-[0057] "FIG. 6 is a block diagram showing an embodiment 600 illustrating a plurality of generator sets 605-a, 605-b, 605-c for use with a system for fracturing a subterranean formation. Similarly to the example 500 illustrated in FIG. 5, switchgear "A" 625-a is an electrical hub combining the power output of three 5.7 MW natural gas turbine generators from generator sets 605-a, 605-b, 605-c, where switchgear "A" 625-a can supply electrical power to two other switchgear "B" units 625-b-1, 625-b-2. While described as being a 5.7 MW generator, other generator configurations capable of operating at other power outputs are also envisioned. For example, in an embodiment, a 6.5 MW turbine generator can be used. In contrast to the example provided in FIG. 5, in this example switchgear "C" 525-c is replaced with a second switchgear "B" 625-b-2. Both switchgear "B" units 625-b-1, 625-b-2 couple to and provide power for a secondary auxiliary, which can include any one or more of a secondary blender, electric wireline, water transfer, crane, a second data van, turbine inlet chillers, and the like.");

and at least one circuit breaker between the power source, the power storage system, or both, and the electric powered hydraulic fracturing equipment (power source, para [0039] "A feature of the switchgear configurations described herein is the capability to selectively choose between either load sharing, to provide efficiency and flexibility; or having isolated banks of equipment, to provide protection and redundancy. In an embodiment, the switchgear optionally includes a tie breaker."; para [0049] "The switchgear trailer 325 can house large breakers and fault protection equipment required for safe operations and for "lock-out", "tag-out" of power going to selected equipment.").

---Claim 1 Continued---
---Continued in Supplemental Boxes---

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/44274

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Regarding Claim 18:
Claim 18 is written as dependent on Claim 11.
However, this is considered to be in error because the claim element "the power source" lacks antecedence .
Therefore, for the purpose of this search and opinion, Claim 18 will be considered to depend on Claim 14.

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
Box V.2 Citations and explanations:
---Claim 1 Continued---

the circuit breaker having an open position that opens an electric circuit between the electric powered hydraulic fracturing equipment and the power source, the power storage system, or both (power source, para [0039] "In an embodiment, the switchgear optionally includes a tie breaker. The tie breaker will isolate one or more of the plurality of electric pumps, the turbine generator, and the switchgear units when the tie breaker is in an open position."; para [0065] "In one example procedure for starting the turbine generators, all breakers (not shown) in each switchgear and EER can be set to an open position such that no electricity passes across the breakers, and generator set 905-b can be started from a black start generator (not shown).").

and a closed position that closes the electric circuit (para [0039] "The tie breaker can synchronize three-phase power of a similar voltage and frequency from different sources to act as a common bus, and can evenly distribute the electrical load between a plurality of electric pumps and turbine generators when the tie breaker is in a closed position."; para [0065] "Once generator set 905-b is running and operating steadily, generator set 905-b can be connected to the bus on switchgear .B+. 925-b-1 by closing the breakers in each switchgear and EER.").

Regarding Claim 8:
U.S. Well discloses the hydraulic fracturing power system of claim 1,
and U.S. Well further discloses:
wherein at least one of the power source and the power storage system are electrically connected to the at least one circuit breaker via a power line (power source, para [0016] "In an embodiment, the system can further include at least two switchgear units electrically coupled to the at least one generator, and a tie breaker electrically coupled between each of the at least two switchgear units."; para [0079]-[0080] "FIG. 12 is a block diagram depicting an example 1200 of a switchgear load sharing option for providing power to equipment which is on a different site than the power generation equipment, according to an embodiment. Although illustrated in example 1200 in one configuration, many other switchgear configurations can provide power to equipment located remotely from the power generation equipment. As shown, a series of four generator sets 1205-a, 1205-b, 1205-c, 1205-d can provide power to switchgear "A" 1225-a-1 at a first location. Power received at switchgear "A" 1225-a-1 can be communicated to switchgear "A" 1225-a-2 at a second location. In the illustrated embodiment, load sharing is handled by switchgear units A. 1225-a-1, 1225-a-2, such that a tie breaker between two switchgear "B" units 1225-b-1, 1225-b-2 may not be necessary. In one example, the long distance transmission line can be several miles long and can be in the form of overhead or buried power lines. Any distance up to approximately 30 miles is feasible; at further distances, step-up transformers may be used to prevent transmission losses from becoming prohibitive. This approximation can depend on the power generated, the power required, and the power conductors used.").

Regarding Claim 10:
U.S. Well discloses the hydraulic fracturing power system of claim 1,
and U.S. Well further discloses:
wherein the at least one circuit breaker is substantially enclosed in a switchgear housing (para [0049] "The switchgear trailer 325 can house large breakers and fault protection equipment required for safe operations and for lock-out, tag-out of power going to selected equipment.").

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
Box V.2 Citations and explanations:

Claims 2-4 lack an inventive step under PCT Article 33(3) as being obvious over U.S. Well in view of US 2017/0302216 A1 to ELECTRONIC POWER DESIGN (hereinafter 'ELECTRONIC').

Regarding Claim 2:
U.S. Well discloses the hydraulic fracturing power system of claim 1.

Furthermore, U.S. Well discloses: wherein the power storage system is at least one battery (para [0044] ". In the illustrated embodiment, the turbine generator 105 is shown being electrically connected to an electronic equipment room (EER) 115, which can house wiring, breakers, controls, monitoring systems, fire suppression support, and a battery bank for secondary power when the turbine is not operating and there is no other power source.").

U.S. Well does not disclose: at least one solid state battery selected from the group consisting of electrochemical capacitors, lithium ion batteries, nickel-cadmium batteries, and sodium sulfur batteries.

ELECTRONIC discloses:
at least one solid state battery selected from the group consisting of electrochemical capacitors, lithium ion batteries, nickel-cadmium batteries, and sodium sulfur batteries (lithium ion, para [0020] "In particular illustrative embodiment, the battery types include but are not limited to Aluminium-ion battery, Flow battery, Vanadium redox battery, Zinc-bromine battery, Zinc-cerium battery, Lead-acid battery, Deep cycle battery, VRLA battery, AGM battery, Gel battery, Lithium air battery, Lithium-ion battery, Lithium ion lithium cobalt oxide battery (ICR), Lithium ion manganese oxide battery (IMR), Lithium ion polymer battery, Lithium iron phosphate battery, Lithium-sulfur battery, Lithium-titanate battery, Thin film lithium-ion battery, Magnesium-ion battery, Molten salt battery, Nickel-cadmium battery, Nickel-cadmium battery vented cell type, Nickel hydrogen battery, Nickel-iron battery, Nickel metal hydride battery, Low self-discharge NiMH battery, Nickel -zinc battery, Organic radical battery, Polymer-based battery, Polysulfide bromide battery, Potassium-ion battery, Rechargeable alkaline battery, Rechargeable fuel battery, Silicon air battery, Silver-zinc battery, Silver calcium battery, Sodium-ion battery, Sodium-sulfur battery, Sugar battery, Super iron battery, UltraBattery and Zinc ion battery.")

It would have been obvious to a person with ordinary skill in the art to use a solid state battery selected from the group consisting of electrochemical capacitors, lithium ion batteries, nickel-cadmium batteries, and sodium sulfur batteries for the power storage system of U.S. Well as per ELECTRONIC since they are popular, low cost power storage devices.

Regarding Claim 3:
U.S. Well as modified by ELECTRONIC discloses the hydraulic fracturing power system of claim 2,
and ELECTRONIC further discloses:
wherein the power storage system is at least one flow battery selected from the group consisting of redox batteries, iron-chromium batteries, vanadium redox batteries, and zinc-bromine batteries (vanadium redox battery, para [0020] "In particular illustrative embodiment, the battery types include but are not limited to Aluminium-ion battery, Flow battery, Vanadium redox battery, Zinc-bromine battery, Zinc-cerium battery, Lead-acid battery, Deep cycle battery, VRLA battery, AGM battery, Gel battery, Lithium air battery, Lithium-ion battery, Lithium ion lithium cobalt oxide battery (ICR), Lithium ion manganese oxide battery (IMR), Lithium ion polymer battery, Lithium iron phosphate battery, Lithium-sulfur battery, Lithium-titanate battery, Thin film lithium-ion battery, Magnesium-ion battery, Molten salt battery, Nickel-cadmium battery, Nickel-cadmium battery vented cell type, Nickel hydrogen battery, Nickel-iron battery, Nickel metal hydride battery, Low self-discharge NiMH battery, Nickel-zinc battery, Organic radical battery, Polymer-based battery, Polysulfide bromide battery, Potassium-ion battery, Rechargeable alkaline battery, Rechargeable fuel battery, Silicon air battery, Silver-zinc battery, Silver calcium battery, Sodium-ion battery, Sodium-sulfur battery, Sugar battery, Super iron battery, UltraBattery and Zinc ion battery.").

Regarding Claim 4:
U.S. Well as modified by ELECTRONIC discloses the hydraulic fracturing power system of claim 3,
and ELECTRONIC further discloses:
wherein the at least one battery is rechargeable (para [0020] "Any type of rechargeable or non-rechargeable battery can be used as a DC power source in a particular embodiment of the invention.").

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
Box V.2 Citations and explanations:

Claims 5-6 lack an inventive step under PCT Article 33(3) as being obvious over U.S. Well in view of US 6,560,131 B1 to William F. vonBrethorst (hereinafter 'vonBrethorst').

Regarding Claim 5:
U.S. Well discloses the hydraulic fracturing power system of claim 1,
but it does not disclose:
wherein the at least one circuit breaker comprises a first circuit breaker and a second circuit breaker,
the first circuit breaker electrically connected to the power source, and the second circuit breaker electrically connected to the power storage system.

vonBrethorst discloses:
a first circuit breaker and a second circuit breaker (col 1 ln 35-49 "A stored energy system is provided for delivering AC electrical power to a load. This system includes a single housing in which is housed a battery bank for storing DC power, and an inverter for converting DC electrical power to AC electrical power. The inverter includes an input terminal connected to, a source of DC electrical power and an output terminal for delivery of AC electrical power. The inverter further includes internal circuitry which accepts an AC electrical power input and provides this AC electrical power to the output AC electrical power terminal of the inverter. The stored electrical system includes five circuit breakers mounted on the outside surface of the housing. Twist lock plugs are connected to each of the circuit breakers for removably connecting electrical input power sources and electrical output loads to the circuit breakers.").

the first circuit breaker electrically connected to the power source (col 1 ln 52-56, third or fourth breaker, "A third circuit breaker is connected to a generator for generating AC electrical power. A fourth circuit breaker is connected to utility supplying AC electrical power. A fifth circuit breaker is connected to the outside AC electrical power load.").

and the second circuit breaker electrically connected to the power storage system (col 1 ln 49-52, first or second breaker "A first circuit breaker is connected to an outside solar panel DC electrical power source. A second circuit breaker is connected to a DC electrical power wind generator.").

It would have been obvious to a person with ordinary skill in the art to connect the equipment of the system of U.S. Well to the power source and the power storage by different circuit breakers as per vonBrethorst since it will allow to independently control the power supply from either the power source or the power storage unit.

Regarding Claim 6:
U.S. Well as modified by vonBrethorst discloses the hydraulic fracturing power system of claim 5,
and vonBrethorst further discloses:
wherein each of the first circuit breaker and the second circuit breaker is electrically connected via a common bus (col 3 ln 11-25 "The internal circuit breaker 100 is connected to a main power bus 104 with cable 106. The circuit breaker 58 is connected to the main power bus 104 via cable 108. The DC service panel 102 includes an internal ground terminal 110 connected to an external DC ground, as shown. The ground terminal 110 is in line with an internal shunt 112, which in turn is connected via cable 44 to a system meter 114. In a preferred embodiment, the system meter 114 is a Model TM-500 obtained from Xantrax, Technologies. This meter has a toggle switch allowing the meter to display the charge level of the battery bank 132, the DC voltage across battery bank 132, real time amperage in and out of the system 10 and the am hours into or out of the system 10.").

Neither of them specifically disclose:
connected to the electric powered hydraulic fracturing equipment.

It would have been obvious to a person with ordinary skill in the art to connect the breakers to the electric powered hydraulic fracturing equipment of the system of U.S. Well as modified by vonBrethorst via the common bus of the same system since as per vonBrethorst the breakers are connected between the power supply and load of the system (vonBrethorst, col 1 ln 35-36).

---Continued on next page---

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
Box V.2 Citations and explanations:

Claim 7 lacks an inventive step under PCT Article 33(3) as being obvious over U.S. Well in view of AU 734988 B2 to Nextek Power Systems, Inc. (hereinafter 'Nextek').

Regarding Claim 7:
U.S. Well discloses the hydraulic fracturing power system of claim 1,
and U.S. Well further discloses:
wherein the at least one circuit breaker is a first circuit breaker (para [0016] "in an embodiment, the system can further include at least two switchgear units electrically coupled to the at least one generator, and a tie breaker electrically coupled between each of the at least two switchgear units.").

U.S. Well does not disclose:
wherein both the power source and the power storage system are electrically connected to the first circuit breaker.

Nextek discloses:
a first circuit breaker, and wherein both the power source and the power storage system are electrically connected to the first circuit breaker (pp 6b in 9-14 "In another form of the invention there is provided a method of managing power at a site which includes providing both an AC and a DC power capability at said site, providing storage battery means for storing DC energy, supplying said storage battery means with DC power for maintaining the voltage level of said storage battery means not greater than fully charged, and providing circuit breaker means in the AC and DC power paths and ganging said circuit breaker means for simultaneous tripping.").

It would have been obvious to a person with ordinary skill in the art to electrically connect both the power source and the power storage system to the same circuit breaker since it would allow to open/close both power supply simultaneously.

Claim 9 lacks an inventive step under PCT Article 33(3) as being obvious over U.S. Well in view of US 2014/0174691 A1 to MULTITEK NORTH AMERICA, LLC (hereinafter 'Multitek').

Regarding Claim 9:
U.S. Well discloses the hydraulic fracturing power system of claim 1,
and U.S. Well further discloses:
mounted to a trailer (para [0067] "Switchgear trailers can be positioned on mobile trailers in some embodiments, or can be body-load or skid mounted units in other embodiments.").

U.S. Well does not disclose:
wherein the power storage system is mounted to a trailer.

Multitek discloses:
wherein the power storage system is mounted to a trailer (para [0030] "In an exemplary application, the heating system 10 is particularly useful in heating a supply fluid and transferring that heated supply fluid at high flow rates to enable a homogeneous temperature distribution through tanks and reservoirs, such as may be used in connection with a hydraulic fracturing job at a remote well site."; para [0035] "An electrical source for actuating the engine 12 and providing auxiliary power is provided by a set of batteries (not shown) mounted on the trailer 32.").

It would have been obvious to a person with ordinary skill in the art to mount the power storage system of U.S. Well to the trailer of the said system as per Multitek since the switchgear is already mounted to the trailer in the said method and mounting the power storage as well will make it convenient and portable as the trailer is mobile (fig. 1, para [0030], Multitek).

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
Box V.2 Citations and explanations:

Claims 11, 16 and 17 lack an inventive step under PCT Article 33(3) as being obvious over U.S. Well in view of US 2003/0000759 A1 to Schmitz et al. (hereinafter 'Schmitz').

Regarding Claim 11:
U.S. Well discloses a system for powering electric hydraulic fracturing equipment (para [0044] "FIG. 1 is a block diagram showing the basic components of a hydraulic fracturing well site power generation system 100 for providing electrical load sharing according to an embodiment."), comprising:

a power storage system (battery bank, para [0044] "In the illustrated embodiment, the turbine generator 105 is shown being electrically connected to an electronic equipment room (EER) 115, which can house wiring, breakers, controls, monitoring systems, fire suppression support, and a battery bank for secondary power when the turbine is not operating and there is no other power source.");

electric powered hydraulic fracturing equipment (para [0043] "The systems described herein are not limited to use in processes involving hydraulic fracturing. For example, the system includes electric fracturing equipment and power generation equipment. The power generation equipment can be used to supply any oilfield equipment including compressor stations, pumping stations, nitrogen plants, CO2 plants, drilling rigs, work-over rigs, barracks, coiled tubing units, refineries, or other systems or applications that do not have access to a utility provided power grid or that have a dynamic power load or low power factor."; para [0021] "In an embodiment, the one or more auxiliaries can include any of a blender, electric wireline equipment, a water transfer pump, an electric crane, a data van, a work trailer, living quarters, an emergency shower, sand equipment, a turbine inlet chiller, a compressor station, a pumping station, a second fracturing site, a drill rig, or a nitrogen plant, or a combination thereof.").

in selective electrical communication (para [0056]-[0057] "FIG. 6 is a block diagram showing an embodiment 600 illustrating a plurality of generator sets 605-a, 605-b, 605-c for use with a system for fracturing a subterranean formation. Similarly to the example 500 illustrated in FIG. 5, switchgear LAL 625-a is an electrical hub combining the power output of three 5.7 MW natural gas turbine generators from generator sets 605-a, 605-b, 605-c, where switchgear LAL 625-a can supply electrical power to two other switchgear LBL units 625-b-1, 625-b-2. While described as being a 5.7 MW generator, other generator configurations capable of operating at other power outputs are also envisioned. For example, in an embodiment, a 6.5 MW turbine generator can be used. In contrast to the example provided in FIG. 5, in this example switchgear LCL 525-c is replaced with a second switchgear LBL 625-b-2. Both switchgear LBL units 625-b-1, 625-b-2 couple to and provide power for a secondary auxiliary, which can include any one or more of a secondary blender, electric wireline, water transfer, crane, a second data van, turbine inlet chillers, and the like.");

and at least one circuit breaker (para [0039] "A feature of the switchgear configurations described herein is the capability to selectively choose between either load sharing, to provide efficiency and flexibility; or having isolated banks of equipment, to provide protection and redundancy. In an embodiment, the switchgear optionally includes a tie breaker."; para [0049] "The switchgear trailer 325 can house large breakers and fault protection equipment required for safe operations and for Llock-out, tag-outL of power going to selected equipment."),

the circuit breaker configured to facilitate or prevent electrical communication (para [0039] "The tie breaker can synchronize three-phase power of a similar voltage and frequency from different sources to act as a common bus, and can evenly distribute the electrical load between a plurality of electric pumps and turbine generators when the tie breaker is in a closed position. The tie breaker will isolate one or more of the plurality of electric pumps, the turbine generator, and the switchgear units when the tie breaker is in an open position. The use of a tie breaker can provide an advantage over previous load sharing systems because use of a tie breaker provides more options for the equipment operators and allows the fleet to be more versatile as to which mode of operationL protection and redundancy, or efficiency and flexibility is more desirable at any given moment.").

---Claim 11 Continued---
---Continued on next page---

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
Box V.2 Citations and explanations:

---Claim 11 Continued---

U.S. Well does not disclose:
in selective electrical communication with the power storage system;
the circuit breaker between the power storage system and the electric powered hydraulic fracturing equipment.

It would have been obvious to a person with ordinary skill in the art to selectively electrically communicate the electric powered hydraulic fracturing equipment of the system of U.S. Well with the power storage of the said system since the equipment is coupled to the power source in the said system and the power storage is supposed to replace the power source in case of power source failure.

U.S. Well still does not disclose:
the circuit breaker between the power storage system and the electric powered hydraulic fracturing equipment.

Schmitz discloses:
the circuit breaker between the power storage system and the electric powered hydraulic fracturing equipment (para [0023] "The individual batteries must be disconnected from the vehicle when it is switched off (ignition key withdrawn) or if an exceptional situation such as for example an accident occurs. In order to ensure this, high-power circuit breakers are inserted into the connecting lines at the locations illustrated in FIG. 1 between the batteries and the external terminals. In particular, a circuit breaker 6a is located between a first external terminal 4a and the first battery 5a, a circuit breaker 7a is located in the vicinity of the first battery 5a in the connecting line between the first battery 5a and the third battery 5c, a further circuit breaker 7c is located in the vicinity of the third battery 5c in the connecting line which has already been mentioned between the first battery 5a and the third battery 5c and a third circuit breaker 6b is located in the vicinity of the second battery 5b in the line between this second battery 5b and the second external terminal 4b.").

It would have been obvious to a person with ordinary skill in the art to use a circuit breaker between the power storage and the electric powered hydraulic fracturing equipment in the system of U.S. Well as per Schmitz since it will allow to control (switch on/off) the power supply from the said power storage in case of an emergency or when the equipment is non-functional (para [0009], Schmitz).

Regarding Claim 16:
U.S. Well as modified by Schmitz discloses the system for powering electric hydraulic fracturing equipment of claim 11,
and U.S. Well discloses further comprising:

a power source (para [0044] "A turbine generator 105 can include a natural gas turbine engine coupled to a three-phase, 60 hertz (Hz) electric generator to produce power as the turbine engine rotates. In an alternative, the generator can generate electricity at 50 Hz or at any other power level useful for hydraulic fracturing fleets"),

wherein at least one of the power source and the power storage system are electrically connected to the at least one circuit breaker via a power line (power source, para [0016] "In an embodiment, the system can further include at least two switchgear units electrically coupled to the at least one generator, and a tie breaker electrically coupled between each of the at least two switchgear units."; para [0079]-[0080] "FIG. 12 is a block diagram depicting an example 1200 of a switchgear load sharing option for providing power to equipment which is on a different site than the power generation equipment, according to an embodiment. Although illustrated in example 1200 in one configuration, many other switchgear configurations can provide power to equipment located remotely from the power generation equipment. As shown, a series of four generator sets 1205-a, 1205-b, 1205-c, 1205-d can provide power to switchgear "A" 1225-a-1 at a first location. Power received at switchgear "A" 1225-a-1 can be communicated to switchgear "A" 1225-a-2 at a second location. In the illustrated embodiment, load sharing is handled by switchgear units "A" 1225-a-1, 1225-a-2, such that a tie breaker between two switchgear "B" units 1225-b-1, 1225-b-2 may not be necessary. In one example, the long distance transmission line can be several miles long and can be in the form of overhead or buried power lines. Any distance up to approximately 30 miles is feasible; at further distances, step-up transformers may be used to prevent transmission losses from becoming prohibitive. This approximation can depend on the power generated, the power required, and the power conductors used.").

Regarding Claim 17:
U.S. Well as modified by Schmitz discloses the system for powering electric hydraulic fracturing equipment of claim 11,
and U.S. Well further discloses:

wherein the at least one circuit breaker is substantially enclosed in a switchgear housing (para [0049] "The switchgear trailer 325 can house large breakers and fault protection equipment required for safe operations and for lock-out, tag-out, of power going to selected equipment.").

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
Box V.2 Citations and explanations:

Claims 12-13 lack an inventive step under PCT Article 33(3) as being obvious over U.S. Well in view of Schmitz, and in further view of ELECTRONIC.

Regarding Claim 12:
U.S. Well as modified by Schmitz discloses the system for powering electric hydraulic fracturing equipment of claim 11.

Furthermore, U.S. Well discloses: wherein the power storage system is at least one battery (para [0044] ". In the illustrated embodiment, the turbine generator 105 is shown being electrically connected to an electronic equipment room (EER) 115, which can house wiring, breakers, controls, monitoring systems, fire suppression support, and a battery bank for secondary power when the turbine is not operating and there is no other power source.").

U.S. Well does not disclose: at least one solid state battery selected from the group consisting of electrochemical capacitors, lithium ion batteries, nickel-cadmium batteries, and sodium sulfur batteries.

ELECTRONIC discloses:
at least one solid state battery selected from the group consisting of electrochemical capacitors, lithium ion batteries, nickel-cadmium batteries, and sodium sulfur batteries (lithium ion, para [0020] "In particular illustrative embodiment, the battery types include but are not limited to Aluminium-ion battery, Flow battery, Vanadium redox battery, Zinc-bromine battery. Zinc-cerium battery, Lead-acid battery, Deep cycle battery, VRLA battery, AGM battery, Gel battery, Lithium air battery, Lithium-ion battery, Lithium ion lithium cobalt oxide battery (ICR), Lithium ion manganese oxide battery (IMR), Lithium ion polymer battery, Lithium iron phosphate battery, Lithium-sulfur battery, Lithium-titanate battery, Thin film lithium-ion battery, Magnesium-ion battery, Molten salt battery, Nickel-cadmium battery, Nickel-cadmium battery vented cell type, Nickel hydrogen battery, Nickel-iron battery, Nickel metal hydride battery, Low self-discharge NiMH battery, Nickel -zinc battery, Organic radical battery, Polymer-based battery, Polysulfide bromide battery, Potassium-ion battery, Rechargeable alkaline battery, Rechargeable fuel battery, Silicon air battery, Silver-zinc battery, Silver calcium battery, Sodium-ion battery, Sodium-sulfur battery, Sugar battery, Super iron battery, UltraBattery and Zinc ion battery.")

It would have been obvious to a person with ordinary skill in the art to use a solid state battery selected from the group consisting of electrochemical capacitors, lithium ion batteries, nickel-cadmium batteries, and sodium sulfur batteries for the power storage system of U.S. Well as per ELECTRONIC since they are popular, low cost power storage devices.

Regarding Claim 13:
U.S. Well as modified by Schmitz and ELECTRONIC discloses the system for powering electric hydraulic fracturing equipment of claim 12, and ELECTRONIC further discloses:
wherein the power storage system is at least one flow battery selected from the group consisting of redox batteries, iron-chromium batteries, vanadium redox batteries, and zinc-bromine batteries (vanadium redox battery, para [0020] "In particular illustrative embodiment, the battery types include but are not limited to Aluminium-ion battery, Flow battery, Vanadium redox battery, Zinc-bromine battery. Zinc-cerium battery, Lead-acid battery, Deep cycle battery, VRLA battery, AGM battery, Gel battery, Lithium air battery, Lithium-ion battery, Lithium ion lithium cobalt oxide battery (ICR), Lithium ion manganese oxide battery (IMR), Lithium ion polymer battery, Lithium iron phosphate battery, Lithium-sulfur battery, Lithium-titanate battery, Thin film lithium-ion battery, Magnesium-ion battery, Molten salt battery, Nickel-cadmium battery, Nickel-cadmium battery vented cell type, Nickel hydrogen battery, Nickel-iron battery, Nickel metal hydride battery, Low self-discharge NiMH battery, Nickel-zinc battery, Organic radical battery, Polymer-based battery, Polysulfide bromide battery, Potassium-ion battery, Rechargeable alkaline battery, Rechargeable fuel battery, Silicon air battery, Silver-zinc battery, Silver calcium battery, Sodium-ion battery, Sodium-sulfur battery, Sugar battery, Super iron battery, UltraBattery and Zinc ion battery.")

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
Box V.2 Citations and explanations:

Claim 14 lacks an inventive step under PCT Article 33(3) as being obvious over U.S. Well in view of Schmitz, and in further view of vonBrethorst.

Regarding Claim 14:
U.S. Well as modified by Schmitz discloses the system for powering electric hydraulic fracturing equipment of claim 11,
and U.S. Well further discloses:
a power source (para [0044] "A turbine generator 105 can include a natural gas turbine engine coupled to a three-phase, 60 hertz (Hz) electric generator to produce power as the turbine engine rotates. In an alternative, the generator can generate electricity at 50 Hz, or at any other power level useful for hydraulic fracturing fleets").

However neither of them disclose further comprising:
wherein the at least one circuit breaker comprises a first circuit breaker and a second circuit breaker, the first circuit breaker electrically connected to the power source, and the second circuit breaker electrically connected to the power storage system.

vonBrethorst discloses:
a first circuit breaker and a second circuit breaker (col 1 in 35-49 "A stored energy system is provided for delivering AC electrical power to a load. This system includes a single housing in which is housed a battery bank for storing DC power, and an inverter for converting DC electrical power to AC electrical power. The inverter includes an input terminal connected to, a source of DC electrical power and an output terminal for delivery of AC electrical power. The inverter further includes internal circuitry which accepts an AC electrical power input and provides this AC electrical power to the output AC electrical power terminal of the inverter. The stored electrical system includes five circuit breakers mounted on the outside surface of the housing. Twist lock plugs are connected to each of the circuit breakers for removably connecting electrical input power sources and electrical output loads to the circuit breakers."),

the first circuit breaker electrically connected to the power source (col 1 in 52-56, third or fourth breaker, "A third circuit breaker is connected to a generator for generating AC electrical power. A fourth circuit breaker is connected to utility supplying AC electrical power. A fifth circuit breaker is connected to the outside AC electrical power load."),

and the second circuit breaker electrically connected to the power storage system (col 1 in 49-52, first or second breaker "A first circuit breaker is connected to an outside solar panel DC electrical power source. A second circuit breaker is connected to a DC electrical power wind generator.").

It would have been obvious to a person with ordinary skill in the art to connect the equipment of the system of U.S. Well to the power source and the power storage by different circuit breakers as per vonBrethorst since it will allow to independently control the power supply from either the power source or the power storage unit.

Claim 15 lacks an inventive step under PCT Article 33(3) as being obvious over U.S. Well in view of Schmitz, and in further view of Nextek.

Regarding Claim 15:
U.S. Well as modified by Schmitz discloses the system for powering electric hydraulic fracturing equipment of claim 11,
and U.S. Well discloses further comprising:

a power source (para [0044] "A turbine generator 105 can include a natural gas turbine engine coupled to a three-phase, 60 hertz (Hz) electric generator to produce power as the turbine engine rotates. In an alternative, the generator can generate electricity at 50 Hz, or at any other power level useful for hydraulic fracturing fleets"),

wherein the at least one circuit breaker is a first circuit breaker (para [0016] "In an embodiment, the system can further include at least two switchgear units electrically coupled to the at least one generator, and a tie breaker electrically coupled between each of the at least two switchgear units.").

Neither of them disclose:
wherein both the power source and the power storage system are electrically connected to the first circuit breaker.

Nextek discloses:
a first circuit breaker, and wherein both the power source and the power storage system are electrically connected to the first circuit breaker (pp 6b in 9-14 "In another form of the invention there is provided a method of managing power at a site which includes providing both an AC and a DC power capability at said site, providing storage battery means for storing DC energy, supplying said storage battery means with DC power for maintaining the voltage level of said storage battery means not greater than fully charged, and providing circuit breaker means in the AC and DC power paths and ganging said circuit breaker means for simultaneous tripping.").

It would have been obvious to a person with ordinary skill in the art to electrically connect both the power source and the power storage system of the system of U.S. Well as modified by Schmitz to the same circuit breaker as per Nextek since it would allow to open/close both power supply simultaneously.

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
Box V.2 Citations and explanations:
Claim 19 lacks an inventive step under PCT Article 33(3) as being obvious over U.S. Well in view of Schmitz, and in further view of Multitek.

Regarding Claim 19:
U.S. Well as modified by Schmitz discloses the system for powering electric hydraulic fracturing equipment of claim 17,

and U.S Well discloses further comprising:
a power source (para [0044] "A turbine generator 105 can include a natural gas turbine engine coupled to a three-phase, 60 hertz (Hz) electric generator to produce power as the turbine engine rotates. In an alternative, the generator can generate electricity at 50 Hz. or at any other power level useful for hydraulic fracturing fleets").

wherein the power source is electrically connected to the at least one circuit breaker via a power line (para [0016] "In an embodiment, the system can further include at least two switchgear units electrically coupled to the at least one generator, and a tie breaker electrically coupled between each of the at least two switchgear units."; para [0079]-[0080] "FIG. 12 is a block diagram depicting an example 1200 of a switchgear load sharing option for providing power to equipment which is on a different site than the power generation equipment, according to an embodiment. Although illustrated in example 1200 in one configuration, many other switchgear configurations can provide power to equipment located remotely from the power generation equipment. As shown, a series of four generator sets 1205-a, 1205-b, 1205-c, 1205-d can provide power to switchgear "A" 1225-a-1 at a first location. Power received at switchgear "A" 1225-a-1 can be communicated to switchgear "A" 1225-a-2 at a second location. In the illustrated embodiment, load sharing is handled by switchgear units "A" 1225-a-1, 1225-a-2, such that a tie breaker between two switchgear "B" units 1225-b-1, 1225-b-2 may not be necessary. In one example, the long distance transmission line can be several miles long and can be in the form of overhead or buried power lines. Any distance up to approximately 30 miles is feasible; at further distances, step-up transformers may be used to prevent transmission losses from becoming prohibitive. This approximation can depend on the power generated, the power required, and the power conductors used."),

and Schmitz further discloses:
where the power storage system is electrically coupled (para [0023] "The individual batteries must be disconnected from the vehicle when it is switched off (ignition key withdrawn) or if an exceptional situation such as for example an accident occurs. In order to ensure this, high-power circuit breakers are inserted into the connecting lines at the locations illustrated in FIG. 1 between the batteries and the external terminals. In particular, a circuit breaker 6a is located between a first external terminal 4a and the first battery 5a, a circuit breaker 7a is located in the vicinity of the first battery 5a in the connecting line between the first battery 5a and the third battery 5c, a further circuit breaker 7c is located in the vicinity of the third battery 5cin the connecting line which has already been mentioned between the first battery 5a and the third battery 5c and a third circuit breaker 6b is located in the vicinity of the second battery 5b in the line between this second battery 5b and the second external terminal 4b.")

Neither of them disclose:
where the power storage system is located adjacent the switchgear housing and electrically coupled directly to the switchgear without a power line.

it would have been obvious to a person with ordinary skill in the art to electrically couple the power storage to the switchgear in the system of U.S. Well as modified by Schmitz since the said power storage system is coupled to the breaker and the breaker is housed inside the switch gear.

U.S. Well as modified by Schmitz still does not disclose:
where the power storage system is located adjacent the switchgear housing
and electrically coupled directly without a power line.

Multitek discloses:
the power storage system is located adjacent the switchgear housing and coupled directly without a power line coupled directly to the switchgear without a power line (mounted, para [0030] "In an exemplary application, the heating system 10 is particularly useful in heating a supply fluid and transferring that heated supply fluid at high flow rates to enable a homogeneous temperature distribution through tanks and reservoirs, such as may be used in connection with a hydraulic fracturing job at a remote well site."; para [0035] "An electrical source for actuating the engine 12 and providing auxiliary power is provided by a set of batteries (not shown) mounted on the trailer 32.").

it would have been obvious to a person with ordinary skill in the art to locate the power storage system adjacent to the switchgear housing and electrically connect the power storage system to the switch gear without a power line in the system of U.S. Well as modified by Schmitz by mounting it to the switch gear housing trailer as per Multitek since it will allow to prevent any losses and interference caused by wired connections as well as convenience of attaching or removing the power storage system from the said housing.

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
Box V 2 Citations and explanations:

Claim 20 lacks an inventive step under PCT Article 33(3) as being obvious over U.S. Well in view of Schmitz, and in further view of US 2018/0306159 A1 to WESTPORT POWER INC. (hereinafter 'Westport').

Regarding Claim 20:
U.S. Well as modified by Schmitz discloses the system for powering electric hydraulic fracturing equipment of claim 17,
and Schmitz discloses further comprising:

software in communication with the power storage system to integrate control of the power storage system with other features of the system (para [0031] "The aforesaid sequence of the disconnection of the power supply from the vehicle is preferably ensured by a switch-off unit 20 in a redundant fashion in order to ensure the greatest possible degree of protection against failures. In particular, the switch-off sequence can be achieved, on the one hand, by software control and, on the other hand, by means of a hardware switching operation. In a possible switch-off unit 20 according to FIG. 2, the input end of a first relay 23 is connected, on the one hand, to a supply voltage 22 (12 volts) via an inertia switch 24 and on the other hand to ground via a transistor 21. In the normal, closed state of the inertia switch 24, there is thus a flow of current through the primary side of the relay 23, as a result of which this relay brings about, at the output end, a current connection between the supply voltage 22 and the coils of the main circuit breaker 6a, which leads to the main circuit breaker 6a closing.").
Neither of them disclose:
the software configured to monitor the state of the power storage system
and to integrate control of the power storage system for powering electric hydraulic fracturing equipment.

It would have been obvious to a person with ordinary skill in the art to use the software of the system of U.S. Well as modified by Schmitz to integrate control of the power storage system with other features of the system for powering electric hydraulic fracturing equipment since the said equipment is the load of the said system.

However, neither of them still disclose:
the software configured to monitor the state of the power storage system.

Westport discloses:
the software configured to monitor the state of the power storage system (para [0149] "The control system may include software and sensors to monitor system voltage and start the APU to run for battery charging. The control system may include software to shut down the APU after battery charging has occurred for a preset time. The control system may include software and sensors to monitor the APU's battery voltage and to start the APU engine in order to charge the APU's battery via the APU's belt driven alternator. The control system may include software to determine if a low system voltage is due to low batteries, a steady low voltage or due to high loads such as starter motors for the main engine. In the case of temporary low voltage, the software will not attempt to start the APU to avoid nuisance starts.").

It would have been obvious to a person with ordinary skill in the art to monitor the state of the power storage system by the software in the system of U.S. Well as modified by Schmitz as per Westport since it will allow to detect issues with the battery such low voltage, high temperature, overload conditions, etc.

Claim 18 lacks an inventive step under PCT Article 33(3) as being obvious over U.S. Well in view of Schmitz, in further view of vonBrethorst, and in further view of ELECTRONIC.

Regarding Claim 18:
Based on the assumption of Box VIII, U.S. Well as modified by Schmitz and vonBrethorst discloses the system for powering electric hydraulic fracturing equipment of claim 14,
but none of them disclose:
wherein the power source is rechargeable.

ELECTRONIC further discloses:
wherein the power source is rechargeable (para [0020] "Any type of rechargeable or non-rechargeable battery can be used as a DC power source in a particular embodiment of the invention.").

It would have been obvious to a person with ordinary skill in the art to use the rechargeable cell of ELECTRONIC as the power source of U.S. Well as modified by Schmitz and vonBrethorst since it will allow to reuse the cell, which is convenient and cost effective.

Claims 1-20 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used in industry.

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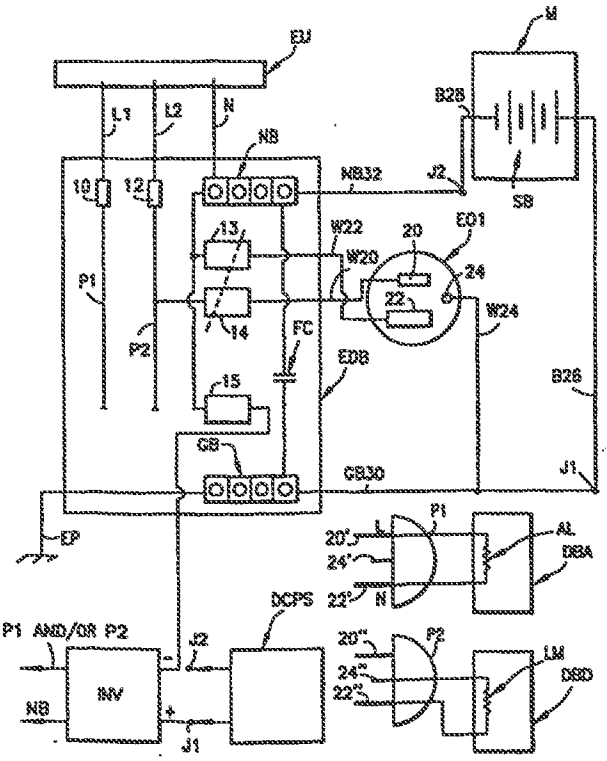
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(54) Title: MODULAR POWER MANAGEMENT SYSTEM AND METHOD

(57) Abstract

An electrical distribution system and method has storage battery mechanism (M) of very large equivalent capacitance providing excellent ripple filtering and an ideal path to ground, a filter capacitor mechanism (FC) of microfarad size providing DC blocking and limited AC path to ground. The storage battery entity (SB) is maintained as to its charge by DC supply which provides regulated DC power in which switching regulation may be involved. The system and method provides dual voltage capability, both DC and AC in which circuit breakers (10, 12, 14 and 15) may be ganged for simultaneous tripping, and in which intrinsic DC circuit(s) (DBD) may be looped to increase current-carrying capability.



MODULAR POWER MANAGEMENT SYSTEM AND METHOD

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of my copending application Serial No. 08/328,574 filed 10/24/94 and which will issue as Patent 5,500,561 on 03/19/96; which was a file-wrapper continuing application of application Serial No. 08/129,575 filed 9/29/93, now abandoned; which in turn was a file-wrapper continuing application of application Serial No. 07/944,786 filed 9/14/92, now abandoned; which in turn was a file-wrapper continuing application of my original application Serial No. 07/638,637 filed 1/18/91 and now abandoned.

The disclosures of Patent 5,500,561 and my prior applications are incorporated herein by reference thereto.

BACKGROUND AND BRIEF SUMMARY OF THE INVENTION

In view of the confusion and oft-times misleading and even incorrect usage of some electrical terms in the patent as well as the technical literature, and to distinguish even from terms which may have been loosely employed in my Patent 5,500,561, the terms "inverter" or inverter means, "converter" or converter means, and "intrinsic DC load" or intrinsic DC load means shall now be defined insofar as usage in this CIP disclosure is concerned. That is to say, inverter or inverter means shall mean a device, circuit or system that delivers AC power when energized from a source of DC power i.e., it is the opposite of rectification; converter or converter means shall mean a device, circuit or system that both receives and provides DC power in which AC is generated as an intermediate process in the flow of energy; and the term intrinsic DC load or intrinsic DC load means shall mean a DC device, circuit or system which functions as a DC load in response to DC power

input thereto.

My aforesaid patent 5,500,561 is directed to A CUSTOMER SIDE POWER MANAGEMENT SYSTEM AND METHOD and discloses several embodiments wherein substantial relaxation is achieved in the requirement that an electric or public utility maintain a generating capacity far exceeding the anticipated maximum demand for electricity. Generally speaking, my patent and prior applications are directed to systems wherein a direct current power supply means in the form of storage battery means is included in the power management system and operates to alleviate excessive power demands on the electric utility.

Briefly stated, the problem addressed in my copending applications is, at its heart, based upon the fact that power demands placed upon the electric utilities by consumers fluctuate enormously dependent upon the time of day, the day of the week, the season of the year and/or any other factor which may affect demand, including the type of consumer. So-called uninterruptible power supplies have been proposed but are generally inadequate to alleviate the problem in a proper and efficient manner. Such a system is exemplified by the Lavin et al patent 5,289,045 of Feb. 22, 1994 and attention is called to the references cited as prior art against my aforesaid prior applications.

This CIP application relates to electrical distribution generally and in particular to electrical distribution as it applies particularly to dwellings for example, wherein it is well known that electrical energy is distributed from a public or electric utility in AC form, normally in split-phase having the meaning that two 120 V AC phases of the utility are brought into a building so as to be available as two 120 V AC circuits and a 240

V AC circuit. Such a three-wire system involves the use of two line power conductors and a neutral wire conductor supplied by the utility. These conductors, according to usual practice, are brought into the customer's distribution box and connected therein to two line power busses through suitable circuit breaker means and directly to a neutral buss housed within the box. The box also houses a ground buss which, according to normal practice, is provided with a wire connection extending externally of the box and into electrical connection with an earthing pole which establishes earth potential at the ground buss.

This CIP application is directed to the problem of efficiently using and/or utilizing electrical power and to the method thereof, more specifically, of efficiently utilizing DC power at the site of interest by establishing a dual voltage capability at such site.

An object of this invention is to permit two different power supply systems, one DC and the other AC, to reside on common building wiring as found in the United States and elsewhere in the world.

Another object of this invention is to provide a compatible power wiring system that allows both DC power operation and AC power operation to coexist, without modification to the power wiring system, from common building wiring power outlets. This compatibility allows, for example, appliances which operate on low voltage 24 V DC, especially those which now do or in the future will function as intrinsic DC loads or intrinsic DC load means, and those which operate as conventional 120 V AC appliances, to be used within the same building space and with existing cabling or wiring.

Another object of this invention is to introduce the concept of ganged circuit breaker means in power wiring systems.

Still another object of this invention is the provision of dual voltage capability with ganged circuit breaker means functioning to interrupt not only both the "high" and "low" sides of AC voltage circuitry but DC circuitry as well.

Stated otherwise, the preceding object may utilize one circuit breaker means in an AC path and a second circuit breaker means in a DC current path as well.

Still another object of this invention is to provide an intrinsic DC load means that embodies looping of the wiring through one circuit breaker means connecting to one side of the DC power source and through a second circuit breaker means to the other side of the DC power source.

A further object of this invention is to provide apparatus that requires only a simple input connection after the electric distribution box of living quarters or of a dwelling (either mobile or not) such that it will function in a variety of different ways which permit stand alone function with DC energy input from a plurality of DC power source means i.e., from generator means, photo-voltaic means, wind turbine means, and etc.

A further object of the invention is to provide the combination of filter capacitor means and storage battery means disposed in electrical parallel, the filter capacitor means functioning as a limited AC path to ground, sized, in capacitance to assure a low impedance path to ground at 60 Hz, the storage battery means functioning to conduct current in opposite directions, consistent with the requirements for AC conduction to ground. That is, the storage battery means and its associated DC power supply provide both a DC isolation path to ground and an AC continuity path to ground whereas the filter capacitor means

supplies a limited AC path to ground.

A further object of this invention is to provide a system in conformity with the preceding object wherein the filter capacitor means is hard wired within the electrical distribution box and the storage battery means is housed within the module unit of this invention.

Another object of the invention is to provide the combination of an electrical distribution box housing neutral buss means, power buss means, ground buss means and filter capacitor means, the latter being of limited capacitance and little bulk so as to provide a limited AC path to ground, and a modular power system module unit which houses storage battery means of substantial capacitance and large bulk compared with said filter capacitor means so as to conduct current in opposite directions to provide for AC conduction to ground.

Another object of the invention is to provide a practical approach to the application of building-side DC power for intrinsic DC devices or loads.

It is a further object of this invention to minimize a customer's peak power demands by using a storage battery means for peak clipping and valley filling purposes.

Another important object of this invention is to provide a modular unit in which the modular unit comprises storage battery means for providing a battery equivalent capacitance which is very large in capacitance and bulk in combination with voltage regulator means or with converter means for controlling the charge level of the storage battery means.

Another object of this invention is to provide a system in accord with the preceding object in combination with intrinsic DC

load means for utilizing the storage capacity of the storage battery means.

Another object of this invention is to provide a modular system using a rechargeable storage battery means as part of a critical conversion circuit for filtering and voltage regulation (which may involve a converter) to protect the storage battery means from damage by overcharging or undercharging and in which the storage battery means supplies power to an intrinsic DC load means.

Still another object of the invention is to provide the combination of an electrical distribution box housing neutral buss means, power buss means, ground buss means and filter capacitor means, the latter being of limited capacitance and little bulk so as to provide a limited AC path to ground and be DC blocking, and a modular power system module unit which houses storage battery means of substantial capacitance and large bulk compared with said filter capacitor means, and intrinsic DC load means for drawing upon the storage capacity of said storage battery means.

A further object of this invention involves the battery equivalent capacitance of said storage battery means being very large consistent with an ideal AC path to ground and the capacitance of said filter capacitor means being very small consistent with a limited AC path to ground but large enough to pass sufficient current to keep the worse case fault currents well below any shock hazards and to allow sufficient current flow to trip relevant circuit breakers in the event of a short circuit.

It is an object of this invention to provide an arrangement in accord with the preceding object in combination with converter means in which high frequency AC is generated as an intermediate process in the flow of energy and in which special capacitor means

is provided for absorbing voltage spikes of said high frequency AC.

In accordance with the invention there is provided a modular power management system including:

an electrical distribution panel;

a system of busses housed within the panel and including electrical power buss means, neutral buss means and ground buss means;

a module unit including storage battery means external to the panel and having connections to said neutral buss means and said ground buss means;

external circuit means for power delivery by said distribution panel; and

circuit breaker means protecting said external circuit means and including at least one pair of circuit breakers which are ganged for simultaneous tripping.

The invention also provides a modular power management system having common wiring for allowing both AC and DC power therethrough including:

an electrical distribution panel capable of receiving both AC and DC power simultaneously;

a system of busses housed within the panel including electrical power buss means, neutral buss means and ground buss means;

a module unit including DC power supply means external to the panel connected across said neutral buss means and said ground buss means within said panel;

means for delivering AC power to said power, neutral, and ground buss means within said panel;

means for delivering AC and DC power from said panel comprising an electric outlet having one receptacle connected to said AC power buss means, a second receptacle

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connected to said neutral buss means, and a third receptacle connected to said ground buss means;

means for selectively withdrawing AC or DC power for an external load from said electric outlet connecting said load to selected receptacles within said electric outlet; and

circuit breaker means protecting said external load including circuit breakers ganged for simultaneous tripping of both AC power and DC power to receptacles connected to said neutral and AC power busses.

In another form of the invention there is provided a method of managing power at a site which includes providing both an AC and a DC power capability at said site, providing storage battery means for storing DC energy, supplying said storage battery means with DC power for maintaining the voltage level of said storage battery means not greater than fully charged, and providing circuit breaker means in the AC and DC power paths and ganging said circuit breaker means for simultaneous tripping.

The invention includes a method of electrical distribution at a site which includes the steps of:

providing both an AC and a DC power capability at said site,

providing a common wiring system within said site having electrical lines sharing AC power and DC power passing therethrough,

providing storage battery means for storing DC energy, supplying said storage battery means with DC power for maintaining the voltage level of said storage battery means not greater than fully charged as defined by the float potential of the storage battery used,

providing circuit breaker means in said site ganged for simultaneous tripping of both AC power and DC power, and

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delivering AC power and/or DC power simultaneously through said common wiring at said site, and,

selectively withdrawing AC and/or DC power for at least one external load at said site.

Still further the invention provides a power management system including the combination of an electrical distribution box and a modular unit, said box housing power buss means, neutral buss means, ground buss means and an AC bypass filter capacitor means of relatively small capacitance and bulk connected between said neutral buss means and said ground buss means; said modular unit housing storage battery means for providing a battery equivalent capacitance and bulk which

is very much greater than the capacitance and bulk of said AC bypass filter capacitor means and said storage battery means being housed within said modular unit and connected across said neutral buss means and said ground buss means.

Also the invention provides a power management system having the combination of storage battery means and filter capacitor means for providing both an AC conduction path to ground and a DC isolation path from ground, and means for controlling the charge level of said storage battery means, said filter capacitor means providing a capacitance sized to insure a low impedance path to ground at 60 Hz and said storage battery means providing a capacitance sized to insure conduction to ground in either direction of current flow therethrough, said means for controlling the charge level of said storage battery means being effective to maintain said AC conduction path to ground in the event that said storage battery means is removed from the system.

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BRIEF DESCRIPTION OF THE DRAWING FIGURES

Fig. 1 illustrates the dual voltage concept of the invention, the ganged circuit breaker means concept and the modular concept thereof;

Fig. 2 illustrates the invention with regard to incorporation of the linear voltage regulator and control interface of my copending application as one means for controlling the charge level of the storage battery means;

Fig. 3 illustrates the use of circuit breaker means and the looping of a DC lighting circuit as well as auxiliary DC equipment and an inverter associated with a simplified illustration of the electric distribution box; and

Fig. 4 illustrates a converter fed by the DC supply from a rectifier and providing an output to storage battery means illustrated as having a filter capacitor in electrical parallel therewith.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1

Reference is had at this time to Fig. 1 which shows a partial circuit diagram of this invention, illustrating a conventional three-wire or split-phase system comprised of the electric utility power line wires L1 and L2 and the neutral wire N as may be supplied from an electric utility EU and extending into the electrical distribution box EDB of an abode, dwelling or the like (which may be mobile or not), which box is shown in rather simplified form. Suffice it to say that the box EDB is provided with conventional knock-out openings through which the cables or wires from the utility or to and from other entities are passed,

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the wires L1 and L2 being connected to the power company or electric utility circuit breakers 10 and 12 whereby the internal power busses P1 and P2 and the dwelling circuits AL in the AC distribution box DBA and the dwelling circuit intrinsic load means LM in the DC distribution box DBD to which they are connected are protected from excessive voltages or surges emanating from the utility EU. The neutral wire N is connected internally to the neutral buss NB which is isolated from direct connection to the internal ground buss GB of the distribution box EDB.

A conventional electrical outlet EO1 is shown whose electrical plug openings 20, 22 and 24 are shown to be connected by wires W20, W22 and W24 passing through suitable knock-out openings in the box EDB and into connection with the circuit breaker 14, the neutral buss NB and the ground buss GB, respectively. It will be appreciated that the circuit breakers 10 and 12 referenced above are of conventional type in that they snap into place when the conventional hinged front panel of the box EDB is swung aside to expose any circuit breakers housed within the box. This is much preferred to the older screw-threaded fuse receptacles. At any rate, the modular feature of this invention involves the use of the storage battery means SB having its positive terminal connected by the wiring B26 having a junction J1 with the ground buss wiring GB30 which passes into the box EDB into connection with the ground buss GB as illustrated. The negative terminal of the storage battery means SB is connected by the wiring B28 whose junction J2 with the neutral buss wiring NB32 connects internally of the box EDB to the neutral buss NB as shown.

Since the wire connections W20, W22 and W24 are as shown, the prongs 20', 22' and 24' of the electric plug PL1 may be used to

feed the AC loads AL powered by the box DBA. Similarly, the electric plug PL2 may be used to feed the intrinsic DC load means LM powered by the box DBD.

Fig. 1 illustrates a basic modular unit M which is external to the box EDB and therefore attains some surprising advantages which will now be explained. The basic modular unit M comprises the rechargeable storage battery means SB which represents the battery storage capacity to be drawn upon when DC power is not otherwise available to the consuming load. The storage battery means SB is chargeable in deep cycle fashion to a charge value at which an incipient electrolyte boiling point is reached and the battery charging means employed must be capable of effecting such charge value as will ensure this level of charge without either overcharging or undercharging.

An important aspect of this invention resides in the compound use of the "battery equivalent capacitance", inherent with the storage battery means SB, in conjunction with the filter capacitor FC. The magnitude of the "battery equivalent capacitance" gain per unit volume exhibited by the storage battery means SB is outstanding. To illustrate this point, a standard filter capacitor FC might have a capacitance measured in microfarads (say 50 microfarads) and be of a bulk or volume to fit easily within the box DB. The storage battery means will have a battery equivalent capacitance of at least 10,000 Farads. The high battery equivalent capacitance of the storage battery means is highly effective for AC ripple filtering but the bulk is too high for incorporation within the box EDB and, more importantly, it provides an ideal AC path to ground. If the storage battery means SB were to be removed, even temporarily, the limited AC path to ground supplied by the filter

capacitor FC would be inadequate to provide an adequate AC path to ground, however, the presence of the DC power source DCPS, or its equivalent, provides the adequate path. By substituting a 12 volt deep cycle lead-acid battery means SB of say, 1 cubic foot volume, the relative "battery equivalent capacitance" would be at least 10,000 Farads. Stated otherwise, such storage battery means SB would provide a very large and adequate AC path to ground commensurate with the load current being drawn and the limited AC path to ground afforded by the filter capacitor FC would still be essential to comply with local electrical codes. The two capacitors operate in conjunction with one another and both are essential for complying with local codes, the means SB conducting current in opposite directions consistent with the requirements for AC conduction to ground and its associated DC power supply additionally providing a DC isolation path from ground, and the means FC providing a second, but limited, AC path to ground in the event that the means SB becomes disabled. In regard to the latter, the means FC is sized in capacitance wherein the capacitive reactance Xc is low enough to pass sufficient current to keep both the worst case fault currents well below any shock hazards and to allow sufficient current flow to trip the relevant circuit breaker(s) in the event of an appliance short circuit.

It will be appreciated that although the filter capacitor FC normally would be hard wired within the box EDB, it could be incorporated within the module M in parallel with the storage battery means.

As will be seen, AC potential is available at the wirings W20 and W22 because the power buss P2 is supplied with AC power and DC potential is available at the wirings W22 and W24 because of the

presence of the storage battery means SB. Therefore, the plug openings 20 and 22 may be connected to the AC load means AL of the distribution box DBA through the prongs 20' and 22' of the electric plug PL1 and the plug openings 22 and 24 may be connected to the intrinsic DC load means LM of the electric distribution box DBD through the prongs 22" and 24" of the electric plug PL2.

As noted before, the illustration of Fig. 1 is somewhat simplified because only one AC power buss P2 is connected although other and different connections could be illustrated and only one DC power availability is illustrated between the wirings W22 and W24 although the electrical outlet E01 could be much more complex and offer a great deal more in the way of AC and DC power capabilities. Such will be illustrated in greater detail hereinafter.

FIG. 2

With reference to Fig. 2, note that the circuit shown largely parallels Fig. 3 of my copending application wherein rectification is effected by the diodes 82 and 84. They feed the TEE circuit 94, 90, 92 of the voltage regulator section (so labelled) operating in conjunction with the control interface (so labelled) to output DC at the junction A. Thus, an important objective of this invention is realized, namely, that the charge level of the storage battery means SB to service an intrinsic DC load means such as 46 in Fig. 2 or the electronically (DC) ballasted fluorescent lighting circuit FL in Fig. 3, is maintained at the desired level. Note that the three modes of operation as disclosed in Patent 5,500,501 obtain.

When AC input is present, the voltage regulator function illustrated in Fig. 2 is one means for maintaining the charge level

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of the storage battery means SB, contained within the module M and which is connected to the junctions J1 and J2 (see Fig. 1). The lighting load 46 is, of course, an intrinsic DC load means such as the looped LIGHTS circuits FL looped between the ground buss GB and the circuit breakers B5 and B6 which are connected to the neutral buss NB as in Fig. 3. The DC power source DCPS of Fig. 1 is the photo-voltaic panel means PV of Fig. 2 and the inverter means INV is shown in both Figs. 1 & 2. It will also be understood that although the electric distribution box EDB is not illustrated fully in Fig. 2, this is done for simplicity to avoid overcrowding of the Figure.

FIG. 3

Fig. 3 shows the electric distribution box EDB in simplified and uncluttered form and is principally directed to illustrating the concept of ganged circuit breakers and of looping of an intrinsic DC load means as well the use of a load source means. The box EDB is outlined and the ground buss GB, the neutral buss NB and the power buss P2 are all designated. The DC ballasted fluorescent lighting intrinsic DC load means FL comprises an example of a distributor box DBD emanating from the box EDB. Each looping WDBD54 and WDBD56 is between the neutral buss NB (-DC) through the circuit breaker means B5 and B6 to the ground buss GB (+DC). Four electrical outlet means EO1, EO2, EO3 and EO4 are illustrated, all identical, with the two wirings W20 connected with the power buss P2 through the respective circuit breaker means B1 and B3. Similarly, the two wirings W22 are connected with the neutral buss NB through the respective circuit breaker means B2 and B4. The two circuit breakers B1 and B3 each correspond to the circuit breaker 14 in Fig. 1 whereas the two circuit breakers B2

and B4 each correspond to the circuit breaker 13 in Fig. 1. The circuit breakers B1 and B2 "belong" to an AC path and a DC path, respectively, and the circuit breakers B3 and B4 similarly "belong".

Electric plugs PL1 and/or PL2 may be plugged in to the electric outlets with their prongs 20', 22', 24' and/or 20", 22", 24" as previously described.

The DC power sources DCPS are illustrated as the DC generator and the photo-voltaic panel means PV which, after regulation at the regulator 40, passes through the isolating diode D2 to the junction A to which the positive side of the DC generator DCPS is connected through the isolating diode D1. The junction A is connected to the ground buss GB through the circuit breaker B8 whereas the AC input from the inverter 50 is connected to the neutral buss NB by means of the wiring W50 and to the circuit breaker B7 through the wiring W52. The looping of the intrinsic DC load means effectively doubles the current carrying capacities of the associated wirings whereas the ganging of the AC and DC paths as to circuit breaker means allows the dual voltage aspect to be carried out with increased safety.

To reiterate some of the above, the modular concept of this invention is very important in that it involves the provision of separate entities which are the storage battery means SB and the filter capacitor means FC. The storage battery means SB has a very large battery equivalent capacitance consistent with an excellent AC path to ground and the filter capacitor means FC has a very small capacitance consistent with a limited AC path to ground and being sized in capacitance wherein the capacitive reactance Xc is low enough to pass sufficient current to keep both the worst case

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fault currents well below any shock hazards and to allow sufficient current flow to trip the relevant circuit breaker(s) in the event of an appliance short circuit. As noted, the capacitance of the filter capacitor FC should be in the order of 50 microfarads.

FIG. 4

Fig. 4 is directed to a circuit which embodies a switching type converter of very high efficiency and is a preferred form of converter because this type of DC-to-DC power supply represents high efficiency contemporaneously possible. Fig. 4 illustrates input mechanisms, some of which are not designated by reference characters but which are designated as to function, and also illustrates output mechanisms, none of which are designated by reference characters but which are designated as to function. In all such cases, the meanings should be clear and the additional descriptive material detailing the mechanisms and reference characters are believed to be unnecessary.

The block enclosed in dashed lines and designated by the reference character 501 is a typical full wave rectifier bridge circuit (i.e., the opposite of an inverter) feeding the capacitor 505 at the junction 501' and whose purpose is to reduce the rectified ripple component of the circuit 501 and provide filtered DC input voltage, present between the junction 501' and the conductor 501v, to the converter means.

The converter circuit shown, downstream of and as fed by filtered DC from the rectifier circuit 501, has junctions 521' and 521'' within the section 521 between which the resistor/capacitor pair 521r and 521c are connected and which pair provide the further junction 521'''. The junction 521''' is connected to the conductor 521v which supplies the pulse width modulator 503 with positive

voltage Vcc, and this junction feeds the diode 521d1 having junctions with the parallel resistor/capacitor pair which are connected between the diode 521d2 and the junction 521''.

The converter employs a pulse width modulator PWM, indicated at 503, controlling the switching transistor circuit 508 to impress transient voltage spikes present on the conductor 508v through the primary of the transformer 506 to cycle current to the primary windings L1 and L2 of the transformer 506 whereby "ac is generated as an intermediate process in the flow of energy" as is defined in the above definition of "converter". The secondary side of the transformer 506 is represented by the windings L3 and L4.

The circuit 509 is an optical isolation link between the pulse width modulator 503 and the control means 522 on the secondary side of the transformer 506 which allows control voltage on the conductor 509v emanating from the pulse width modulator 503 on the primary side of the transformer 506 to provide an input to the control means 522 on the secondary side to influence the pulse width modulator PWM 503 without current leakage back from the secondary circuit. Typically, the frequency of conversion effected by the transformer 506 will be 20,000-100,000 Hz which dictates the need for the special capacitor 517 to absorb these transients, the capacitance of the capacitor 517 being typically about 1 microfarad when used.

A secondary winding L4 drives the circuit 514 which, similarly to the rectifier 501 plus the filtering of the capacitor 505, provides a DC output, in this case the proper DC input to the control means 522 at the conductor 514v. The control means 522 has an output conductor 522o connected to the optical link 510 for controlling the three modes of operation of voltage control in

accord with the principles of my prior applications. That is to say, when the optical isolator 510 link is "on", modes which permit DC current to flow from the photovoltaic means 520 are operative, i.e., either or both DC power input from the means 520 alone and partial or shared DC power input from the means 520. When the optical isolator 510 link is "off", the remaining mode, DC power input solely from another source, (i.e., no photovoltaic input) is effected.

The modes are controlled by the DC voltage prevailing across the junctions J1 and J2 (or the presence of a rechargeable DC mechanism such as a storage battery means connected to these junctions) in which case, mode 1, DC power input to the rechargeable DC mechanism alone, mode 2, shared DC power input, and mode 3 no DC power input to the rechargeable DC mechanism are the order of the day. That is to say, when the conductors 523 and 524 are connected to one of the DC sources illustrated in Fig. 4, or to a DC power source such as DCPS in Fig. 1 or in Fig. 3, the system will be fully operative for the purposes intended.

Stated another way, the DC voltage applied to the storage means will depend upon the feed back influenced by the resistors 36, 42, 43, 44, 45, 68, 70, 74 and 76 in Fig. 2 or by the resistors including 511, 512, 513 and 515 in Fig 4.

This is true even if the system according to this invention is operated on the barest of input. For example, in locations where either AC or DC power is available only part of the time, or is available on site only from mechanism thereat, some configuration disclosed in the drawing Figures herein will be effective to provide DC power supply to the storage battery means.

The claims defining the invention are as follows:

1. A modular power management system including:

an electrical distribution panel;

a system of busses housed within the panel and including electrical power buss means, neutral buss means and ground buss means;

a module unit including storage battery means external to the panel and having connections to said neutral buss means and said ground buss means;

external circuit means for power delivery by said distribution panel; and

circuit breaker means protecting said external circuit means and including at least one pair of circuit breakers which are ganged for simultaneous tripping.

2. A modular power management system as defined in claim 1 wherein one of said pair of circuit breakers is connected with a DC external circuit means and the other is connected with an AC external circuit means.

3. A modular power management system as defined in claim 2 including DC power supply means connected to said module unit for supplying said storage battery means with DC power.

4. A modular power management system as defined in claim 3 wherein said DC power supply means is voltage regulator means for maintaining said storage battery means within a desired voltage range.

5. A modular power management system as defined in claim 3 wherein said DC power supply means is converter means.

6. A modular power management system as defined in claim 3 wherein one of said external circuits is an intrinsic DC load.

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7. A modular power management system as defined in any one of the preceding claims wherein one of said pair of circuit breakers is connected with a DC external circuit and the other is connected with an AC external circuit.

8. A modular power management system having common wiring for allowing both AC and DC power therethrough including:

an electrical distribution panel capable of receiving both AC and DC power simultaneously;

a system of busses housed within the panel including electrical power buss means, neutral buss means and ground buss means;

a module unit including DC power supply means external to the panel connected across said neutral buss means and said ground buss means within said panel;

means for delivering AC power to said power, neutral, and ground buss means within said panel;

means for delivering AC and DC power from said panel comprising an electric outlet having one receptacle connected to said AC power buss means, a second receptacle connected to said neutral buss means, and a third receptacle connected to said ground buss means;

means for selectively withdrawing AC or DC power for an external load from said electric outlet connecting said load to selected receptacles within said electric outlet; and

circuit breaker means protecting said external load including circuit breakers ganged for simultaneous tripping of both AC power and DC power to receptacles connected to said neutral and AC power busses.

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9. A method of managing power at a site which includes providing both an AC and a DC power capability at said site, providing storage battery means for storing DC energy, supplying said storage battery means with DC power for maintaining the voltage level of said storage battery means not greater than fully charged, and providing circuit breaker means in the AC and DC power paths and ganging said circuit breaker means for simultaneous tripping.

10. The method of managing power at a site as defined in claim 9 including the step of providing filter capacitor means in electrical parallel with said storage battery means, the battery equivalent capacitance of said storage battery means being very large consistent with an ideal AC path to ground and the capacitance of said filter capacitor means being very small consistent with a limited AC path to ground but large enough to pass sufficient current to keep the worst case fault currents well below any shock hazards and to allow sufficient current flow to trip relevant circuit breakers in the event of a short circuit.

11. A method of managing power at a site which includes providing storage battery means for storing DC energy, supplying said storage battery means with DC power, providing filter capacitor means in electrical parallel with said storage battery means, the battery equivalent capacitance of said storage battery means being very large consistent with an ideal AC path to ground and the capacitance of said filter capacitor means being very small consistent with a limited AC path to ground but large enough to pass sufficient current to keep the worst case fault currents well below any shock hazards and to allow sufficient current flow to trip relevant circuit breakers in the event of a short circuit.

12. A method of electrical distribution at a site which includes the steps of:

providing both an AC and a DC power capability at said site,

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providing a common wiring system within said site having electrical lines sharing AC power and DC power passing therethrough,

providing storage battery means for storing DC energy, supplying said storage battery means with DC power for maintaining the voltage level of said storage battery means not greater than fully charged as defined by the float potential of the storage battery used,

providing circuit breaker means in said site ganged for simultaneous tripping of both AC power and DC power, and

delivering AC power and/or DC power simultaneously through said common wiring at said site, and,

selectively withdrawing AC and/or DC power for at least one external load at said site.

13. The method of electrical distribution at a site as defined in claim 12 further including the step of providing filter capacitor means in electrical parallel with said storage battery means, measuring the battery equivalent capacitance of said storage battery means so that the battery equivalent capacitance of said storage battery means is very large consistent with an ideal AC path to ground and the capacitance of said filter capacitor means is very small consistent with a limited AC path to ground but large enough to pass sufficient current to keep fault currents as determined by the ratings of the circuit breakers from constituting a shock hazard and to allow sufficient current flow to trip relevant circuit breakers during a short circuit, and passing current therethrough.

14. A power management system having the combination of storage battery means and filter capacitor means for providing both an AC conduction path to ground and a DC isolation path from ground, and means for controlling the charge level o said storage battery

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means, said filter capacitor means providing a capacitance sized to insure a low impedance path to ground at 60 Hz and said storage battery means providing a capacitance sized to insure conduction to ground in either direction of current flow therethrough.

15. A power management system as defined in claim 14 wherein said means for controlling the charge level of said storage battery means is a voltage regulator means with rectifier means providing DC input to said voltage regulator means.

16. A power management system as defined in claim 14 wherein said means for controlling the charge level of said storage battery means is a converter means with rectifier means providing DC input to said converter means.

17. A power management system including the combination of an electrical distribution box and a modular unit, said box housing power buss means, neutral buss means, ground buss means and an AC bypass filter capacitor means of relatively small capacitance and bulk connected between said neutral buss means and said ground buss means; said modular unit housing storage battery means for providing a battery equivalent capacitance and bulk which is very much greater than the capacitance and bulk of said AC bypass filter capacitor means and said storage battery means being housed within said modular unit and connected across said neutral buss means and said ground buss means.

18. The combination as defined in claim 17 including DC power supply means for supplying said storage battery means with DC energy, and intrinsic DC load means connected between said ground buss means and said neutral buss means for supply by said storage battery means.

19. The combination as defined in claim 17 or 18 including ganged circuit breaker means ganged for simultaneous tripping.

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20. the combination as defined in claim 17, 18 or 19 wherein said DC power supply means includes a device selected from the group consisting of electrical power generating means, photo-voltaic means, and alternate DC sources.

21. The combination as defined in claim 17 or 18 including voltage regulator means for maintaining a charge level on said storage battery means and rectifier means for providing DC input to said regulator means.

22. The combination as defined in claim 17 or 18 including converter means for maintaining a charge level on said storage battery means and rectifier means for providing DC input to said converter means.

23. A power management system having the combination of storage battery means and filter capacitor means for providing both an AC conduction path to ground and a DC isolation path from ground, and means for controlling the charge level of said storage battery means, said filter capacitor means providing a capacitance sized to insure a low impedance path to ground at 60 Hz and said storage battery means providing a capacitance sized to insure conduction to ground in either direction of current flow therethrough, said means for controlling the charge level of said storage battery means being effective to maintain said AC conduction path to ground in the event that said storage battery means is removed from the system.

24. In a power management system as defined in claim 23 wherein said means for controlling the charge level comprising DC power source means.

25. In a power management system as defined in claim 23 wherein said means for controlling the charge level includes voltage regulator means.

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26. In a power management system as defined in claim 23 wherein said means for controlling the charge level includes converter means in which high frequency AC is generated as an intermediate process in the flow of energy.

27. In a power management system as defined in claim 23, 24, 25 or 26 including special filter capacitor means for absorbing voltage spikes of said high frequency AC.

28. A modular power management system substantially as hereinbefore described with reference to the figures.

29. A method of managing power at a site substantially as hereinbefore described with reference to the figures.

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30. A universal power system utilizing a power controller capable of inputting multiple power sources, including at least one primary source of AC or DC electrical power of singular or variable voltage and at least one secondary power connection for processing external DC electrical power in service to at least one DC compatible load at its output, such as a lighting fixture requiring DC electrical power, said system including:
said power controller including a converter converting said primary AC or DC electrical power into a defined DC-regulated voltage used to provide and manage end-use service power;
said power controller having said at least one secondary power connection for processing at least one external alternative DC power source in readiness for service to said at least one DC compatible load; and,
said power controller having circuitry at said secondary power connection for combining said alternative DC power source with said voltage regulated DC voltage converted from said primary power source in service to said at least one DC compatible load.

31. The universal power system of Claim 30 wherein said at least one secondary power connection includes at least one firsttwo secondary power connections and at least one second secondary power connection.

32. The universal power system of Claim 30 wherein said alternative DC power source is at least one external electrical storage medium such as a rechargeable storage battery.

33. The universal power system of Claim 30 wherein said alternative DC power source is at least one supplemental source of power capable of providing DC electricity.

34. The universal power system of Claim 31 wherein said at least one alternative DC power source is an external electrical storage medium, such as a rechargeable storage battery.

35. The universal power system of Claim 31 wherein said second secondary alternative DC power source is at least one supplemental source of power capable of providing DC electricity.

36. The universal power system of Claim 31 wherein said first secondary alternative DC power source is at least one external electrical storage medium such as a rechargeable storage battery and said second secondary alternative DC power source is at least one supplemental source capable of providing DC electricity.

37. The universal power system as in Claim 31 further including said power controller having, in the absence of said primary AC or DC electrical power source, circuitry for combining power from said at least one first secondary power connection and said at least one second secondary power connection in service to said at least one DC compatible load,in the absence of said primary electrical power source.

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38. The universal power system as in Claim 37 wherein said power system is a stand-alone power system capable of supporting end-use electrical loads in the absence of a central AC grid power source or any source at its primary input.

39. The universal power system as in Claim 37 wherein said power system is a stand-alone power system capable of supporting end-use electrical loads in the absence of a central AC grid power source at it primary input but with a local source of AC or DC power at its primary input.

40. The universal power system as in Claim 31 wherein said power system is a solar-assisted power system wherein further including a source of AC or DC power is connected to said primary input and a external photovoltaic source of DC electrical power is connected to said secondary input of said power controller in service to at least one DC load.

41. The universal power system of Claim 31 wherein said universal power system is an un-interruptible power system, wherein constructed so that if the primary source of AC or DC power connected to said primary input should fails, then at least one DC source of rechargeable electric storage is available and connected to the second secondary connection of said power controller in service to said DC load.

42. The universal power system of Claim 31 wherein said power system is a solar electric power system of a first type, wherein further at least one rechargeable source of DC power is being connected to said first secondary connection and a photovoltaic source of nominal DC voltage is being connected to said second secondary connection of said power controller in service to said at least one DC load.

43. The universal power system of Claim 31 wherein said power system is a solar electric power system of a second type, wherein further a photovoltaic source of variable DC voltage is being connected to said primary input of said power controller with and at least one supplemental source of rechargeable DC power being connected to said first secondary connection with optional use of said second secondary connection.

44. The universal power system of Claim 31 wherein said power system is a solar electric power system of a third type, wherein further a least one rechargeable source of DC power is being connected to said first secondary connection and a photovoltaic source of nominal DC voltage is being connected to said second secondary connection of said power controller in service to a DC-to-AC line compatible inverter in order to support at least one conventional AC load.

45. The power system of claim 43 wherein said power controller supports at its output a DC-to-AC line compatible inverter and at least one other DC load.

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46. The universal power system of Claim 31 wherein said power system is a solar electric power system of a fourth type, wherein further a photovoltaic source of variable DC voltage is being connected to said primary input of said power controller with and at least one source of rechargeable DC power being connected to said first secondary connection, with optional use of said second secondary connection in service to a DC-to-AC line compatible inverter in order to support at least one conventional AC load.

47. The power system of claim 46 wherein said power controller supports at its output a DC-to-AC line compatible inverter and at least one other DC load.

48. The universal power system as in Claim 31 wherein said power system includes a further source of AC or DC power at said primary input and a fuel cell source of DC electrical power is connected to said second secondary connection.

49. The universal power system of Claim 31 wherein said power system is a fuel cell power system of a first type, wherein further at least one rechargeable source of DC power is being connected to said first secondary connection and a fuel cell source of nominal DC voltage is being connected to said second secondary connection of said power controller in service to said at least one DC load.

50. The universal power system of Claim 31 wherein said power system is a fuel cell power system of a second type, wherein further a fuel cell source of variable DC voltage is being connected to said primary input of said power controller with and at least one supplemental source of rechargeable DC power being connected to said first secondary connection with optional use of said second secondary connection.

51. The universal power system of Claim 31 wherein said power system is a fuel cell power system of a third type, wherein further a least one rechargeable source of DC power is being connected to said first secondary connection and a fuel cell source of nominal DC voltage is being connected to said second secondary connection of said power controller in service to a DC-to-AC line compatible inverter in order to support at least one conventional AC load.

52. The power system of claim 51 wherein said power controller supports at its output a DC-to-AC line compatible inverter and at least one other DC load.

53. The universal power system of Claim 31 wherein said power system is a fuel cell power system of a fourth type, wherein further a fuel cell source of variable DC voltage is being connected to said primary input of said power controller with and at least one source of rechargeable DC power being connected to said first secondary connection with optional use of said second secondary connection in service to a DC-to-AC line compatible inverter in order to support at least one conventional AC load.

54. The power system of claim 53 wherein said power controller supports at its output a DC-to-AC line compatible inverter and at least one other DC load.

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55. The universal power system as in Claim 31 wherein alternative power source is a cogenerator connected to said second secondary input of said power controller in service to said at least one DC load.

56. The universal power system of Claim 31wherein said power system is a cogenerator power system of a first type, wherein further at least one rechargeable source of DC power is being connected to said first secondary connection and a cogenerator source of nominal DC voltage is being connected to said second secondary connection of said power controller in service to said at least one DC load.

57. The universal power system of Claim 31 wherein said power system is a cogenerator power system of a second type, wherein further a cogenerator source of variable DC voltage isbeing connected to said primary input of said power controller with and at least one supplemental source of rechargeable DC power being connected to said first secondary connection with optional use of said second secondary connection.

58. The universal power system of Claim 31 wherein said power system is a cogenerator power system of a third type, wherein further a least one rechargeable source of DC power is being connected to said first secondary connection and a cogenerator source of nominal DC voltage is being connected to said second secondary connection of said power controller in service to a DC-to-AC line compatible inverter in order to support at least one conventional AC load.

59. The power system of claim 55 wherein said power controller supports at its output a DC-to-AC line compatible inverter and at least one other DC load.

60. The universal power system of Claim 31 wherein said power system is a cogenerator power system of a fourth type. wherein further a cogenerator source of variable DC voltage is being connected to said primary input of said power controller with and at least one source of rechargeable DC power being connected to said first secondary connection with optional use of said second secondary connection in service to a DC-to-AC line compatible inverter in order to support at least one conventional AC load.

61. The power system of claim 60 wherein said power controller supports at its output a DC-to-AC line compatible inverter and at least one other DC load.

62. The universal power system as in Claim 31 wherein alternative power source is an alternative DC power producing source device connected to said second secondary input of said power controller in service to said at least one DC load.

63. The universal power system of Claim 31 wherein said power system is an alternative DC power producing source device of a first type, wherein further at least one rechargeable source of DC power is being connected to said first secondary connection

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and an alternative DC power producing source device of nominal DC voltage is being connected to said second secondary connection of said power controller in service to said at least one DC load.

64. The universal power system of Claim 31 wherein said power system is an alternative DC power producing source device of a second type, wherein further an alternative DC power producing source device of variable DC voltage is being connected to said primary input of said power controller with and at least one supplemental source of rechargeable DC power being connected to said first secondary connection with optional use of said second secondary connection.

65. The universal power system of Claim 31 wherein said power system is an alternative DC power producing source device of a third type, wherein further a least one rechargeable source of DC power is being connected to said first secondary connection and an alternative DC power producing source device of nominal DC voltage is being connected to said second secondary connection of said power controller in service to a DC-to-AC line compatible inverter in order to support at least one conventional AC load.

66. The universal power system of Claim 31 wherein said power system is a cogenerator power system of a fourth type, wherein further a cogenerator source of variable DC voltage is being connected to said primary input of said power controller with and at least one source of rechargeable DC power being connected to said first secondary connection with optional use of said second secondary connection in service to a DC-to-AC line compatible inverter in order to support at least one conventional AC load.

67. The universal power system of Claim 30 wherein said power system is a voltage regulated power system of higher quality, wherein further said primary source of power is being any variable voltage AC source of power with optional use of at least one supplemental source of secondary power.

68. The universal power system of Claim 31 wherein said power system is a voltage regulated power system of higher quality, wherein further said primary source of power is being any variable voltage AC source of power with optional use of at least one supplemental source of secondary power.

69. The universal power system of Claim 68 wherein said power system is a brown-out and over-voltage free power system, wherein further said system supplements power and is being applied to avoid electrical conditions where there is of a precipitous

AUSTRALIAN PATENT OFFICE

drop in line or source voltage, known as a brown-outs, and/or an unstable upper and lower excursion of line voltage or source power at the primary input.

70. The universal power system of Claim 30 wherein said primary source of power is an AC generatora source of AC with optional use of at least one of said first and/or second secondary DC connection source of DC power.

71. The universal power system of Claim 70 wherein said AC generator is a gas-fueled generator.

72. The universal power system of Claim 71 wherein said AC generator is a cogenerator.

73. The universal power system of Claim 30 wherein said primary source of power is one of an AC gas-fueled generator or and a AC cogenerator or other conceivable source of AC with optional use of said first and/or second secondary DC input source of DC power.

74. The universal power system of Claim 31 wherein said primary source of power is one of an AC gas-fueled generator or and a AC cogenerator or other conceivable source of AC with optional use of said first and/or second secondary DC input source of DC power.

75. The universal power system of Claim 30 wherein said at least one DC load is any DC compatible load or loads such as one of lighting, office equipment, electronic devices, motor drive apparatus, DC-to-AC line inverter or and any end-use device capable operating at the DC output voltage of said power controller.

76. The universal power system of Claim 31 wherein said at least one DC load is any DC compatible load or loads such asone of lighting, office equipment, electronic devices, motor drive apparatus, DC-to-AC line inverter or and any end-use device capable operating at the DC output voltage of said power controller.

77. The universal power system of Claim 30wherein said at least one DC load is an 60hz 60Hz inverter, wherein said power system is being acceptable to devices that operate on standard AC line voltages at the output of said inverter.

78. The universal power system of Claim 31 wherein said at least one DC load is an 60hz 60Hz inverter, wherein said power system is being acceptable to devices that operate on standard AC line voltages at the output of the inverter.

79. The universal power system of Claim 30 wherein said power system is a unitary and modular package, said package forming a building block which may be installed in incremental units for greater service capacity.

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80. The universal power system of Claim 31, wherein said power system is a unitary and modular package, said package forming a building block which may be installed in incremental units for greater service capacity.

81. The universal power system of Claim 79 wherein said power system is applied with outputs connected in series for greater voltage and power capacity.

82. The universal power system of Claim 80 wherein said power system is applied with outputs connected in parallel for greater current capacity and power capacity thus for flexible building blocks.

83. The universal power system of Claim 79 , wherein said unitary and modular package is connected in close physical proximity with individual output circuit legs to said loads, such as individual or grouped lighting fixtures, and remote from said primary AC or DC input power source connection, thus minimizing load-side voltage drops when said power controller's DC output voltage is operating with relativea low voltage; said at least one DC load leg comprising a plurality of DC load legs clustered around said modular universal power system.

84. The universal power system of Claim 80 , wherein said unitary and modular package is connected in close physical proximity with individual output circuit legs to said loads, such as individual or grouped lighting fixtures, and remote from said primary AC or DC input power source connection, thus minimizing load-side voltage drops when said power controller's DC output voltage is operating with a relative low voltage; said at least one DC load leg comprising a plurality of DC load legs clustered around said modular universal power system.

85. The universal power system of Claim30 , wherein said power system is an emergency lighting system in service to a lighting load with a source of primary power connected at the input and with a storable power source at the first secondary input to insure operation during primary power interruptions.

86. The universal power system of Claim 31, wherein said power system is an emergency lighting system in service to a lighting load with a source of primary power connected at the input and with a storable power source at the first secondary input to insure operation during primary power interruptions.

87. The universal power system of Claim 79, wherein said power system is an emergency lighting system in service to a lighting load with a source of primary power connected at the input and with a storable power source at the first secondary input to insure operation during primary power interruptions.

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88. The universal power system of Claim 80, wherein said power system is an emergency lighting system in service to a lighting load with a source of primary power connected at the input and with a storable power source at the first secondary input to insure operation during primary power interruptions.

89. The universal power system of Claim 30 wherein said power system is an emergency power system in service to any electrical load at its output, with or without an optional intermediate DC-to-AC line compatible inverter at said output, with a source of primary power being connected at the input and a with a storable power source provided at the first secondary input to insure operation during primary power interruptions.

90. The universal power system of Claim 31 wherein said power system is an emergency power system in service to any electrical load at its output, with or without an optional intermediate DC-to-AC line compatible inverter at said output, with a source of primary power being connected at the input and a with a storable power source being provided at the first secondary input to insure operation during primary power interruptions.

91. The universal power system of Claim 79 wherein said power system is an emergency power system in service to any electrical load at its output, with or without an optional intermediate DC-to-AC line compatible inverter at said output, with a source of primary power being connected at the input and a with a storable power source being provided at the first secondary input to insure operation during primary power interruptions.

92. The universal power system of Claim 80 wherein said power system is an emergency power system in service to any electrical load at its output, with or without an optional intermediate DC-to-AC line compatible inverter at said output, with a source of primary power being connected at the input and a with a storable power source being provided at the first secondary input to insure operation during primary power interruptions.

Dated this 23rd day of April 2001

PATENT ATTORNEY SERVICES

Attorneys for

NEXTEK POWER SYSTEMS INC

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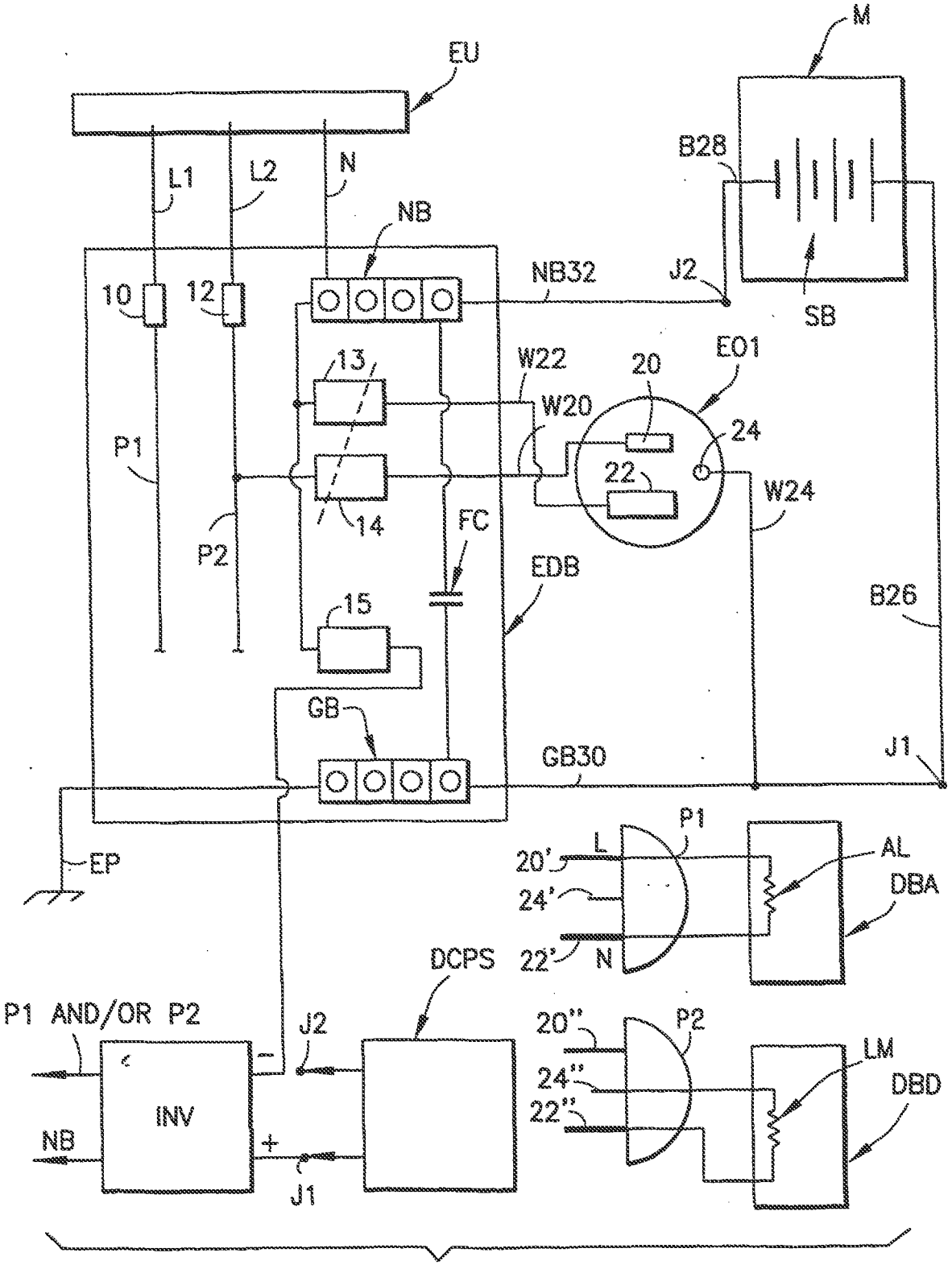

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EO1
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W24
14
FC
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EDB
B26
15
GB
GB30
J1
P1
EP
20'
L
AL
24'
DBA
22'
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DCPS
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J2
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P2
LM
24''
DBD
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INV
NB
J1

FIG. 1

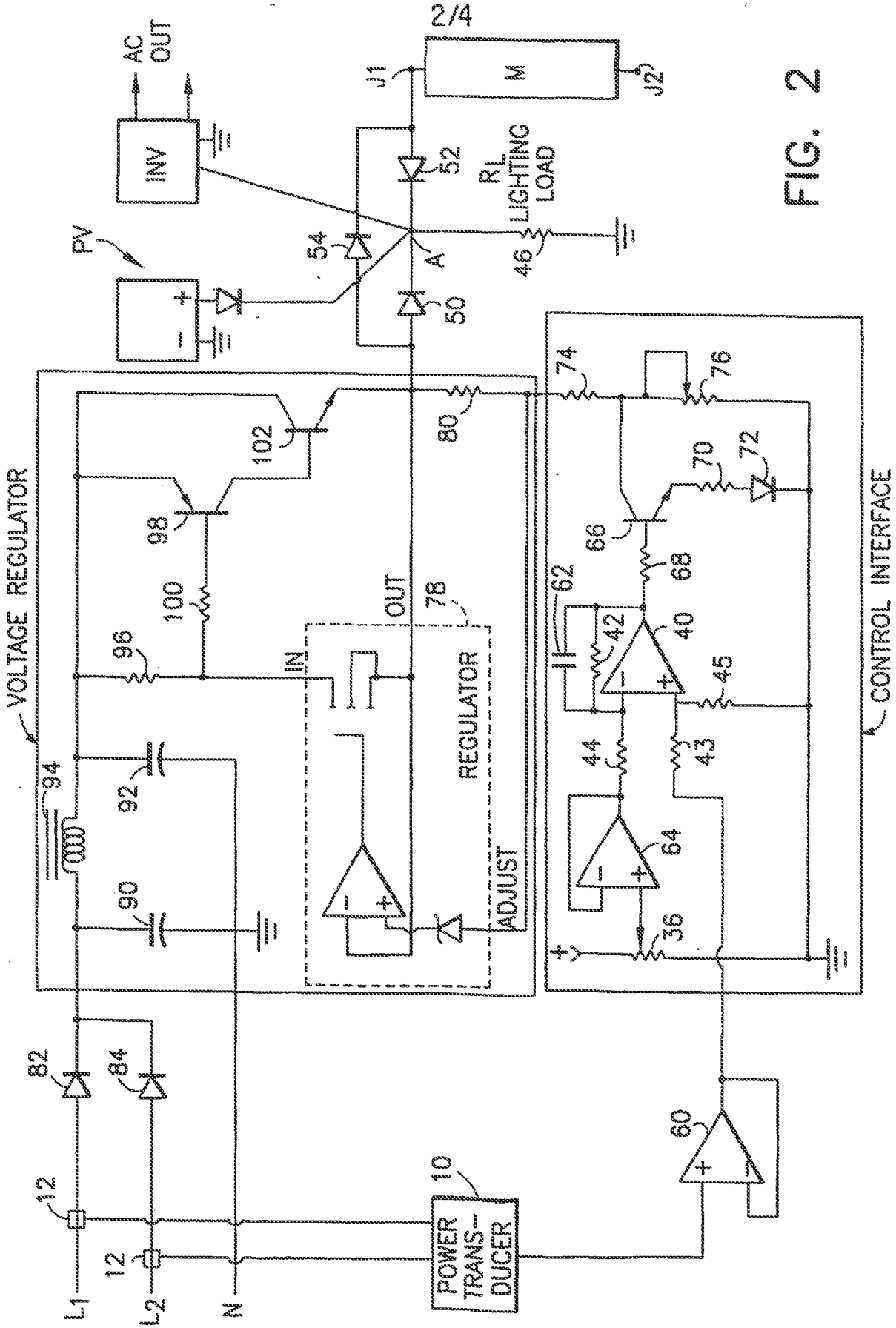

AC OUT
INV
PV
J1
J2
M
52
54
50
A
R_L LIGHTING LOAD
46
74
76
80
102
98
100
96
70
72
66
68
62
42
40
45
44
43
64
36
94
92
90
OUT
IN
78
REGULATOR
ADJUST
VOLTAGE REGULATOR
CONTROL INTERFACE
82
84
12
12
L1
L2
N
10
POWER TRANS-DUCER
60

FIG. 2

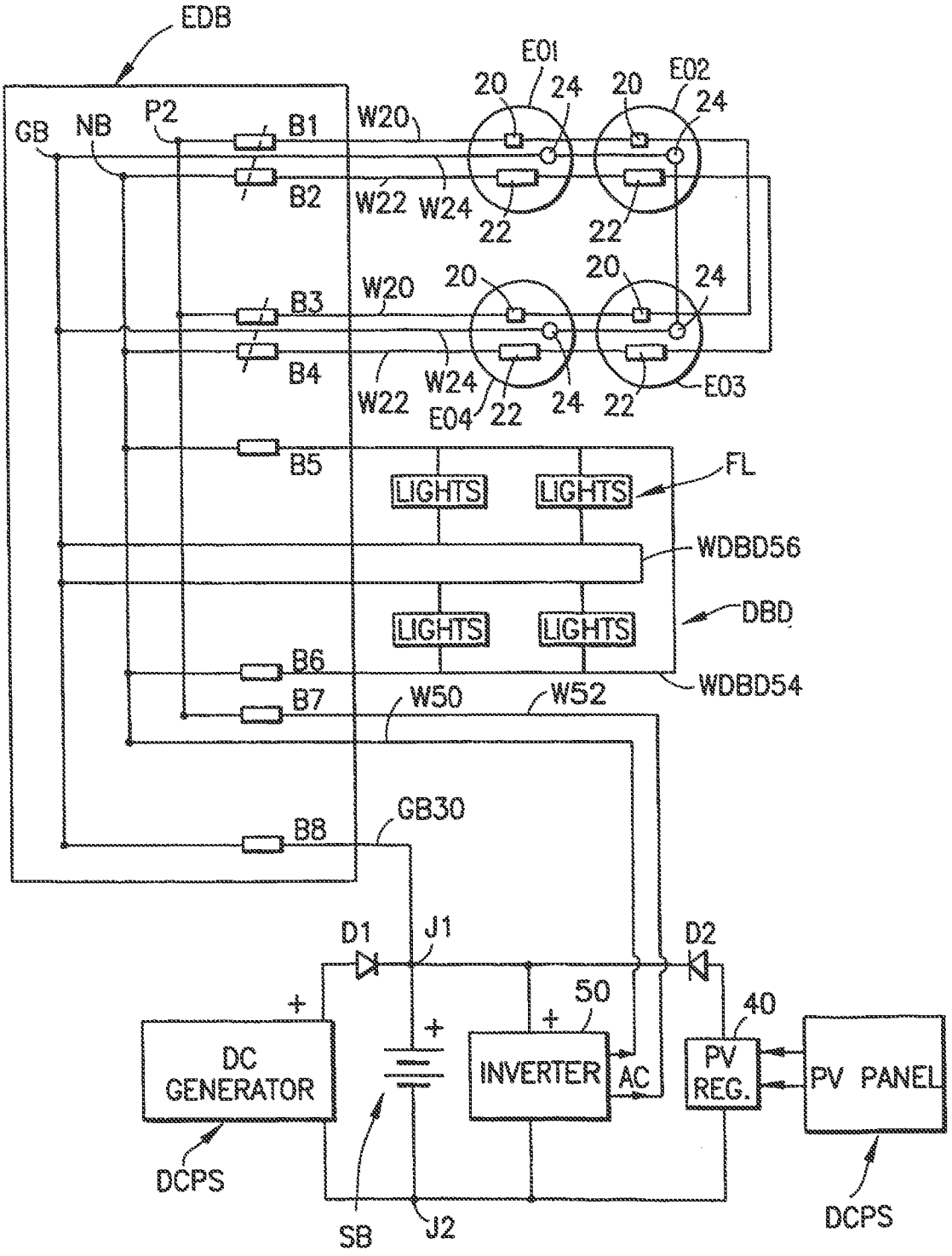

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W52
LIGHTS
FL
WDBD56
DBD
WDBD54
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D2
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DC GENERATOR
INVERTER
AC
PV REG.
PV PANEL
DCPS
SB

FIG. 3

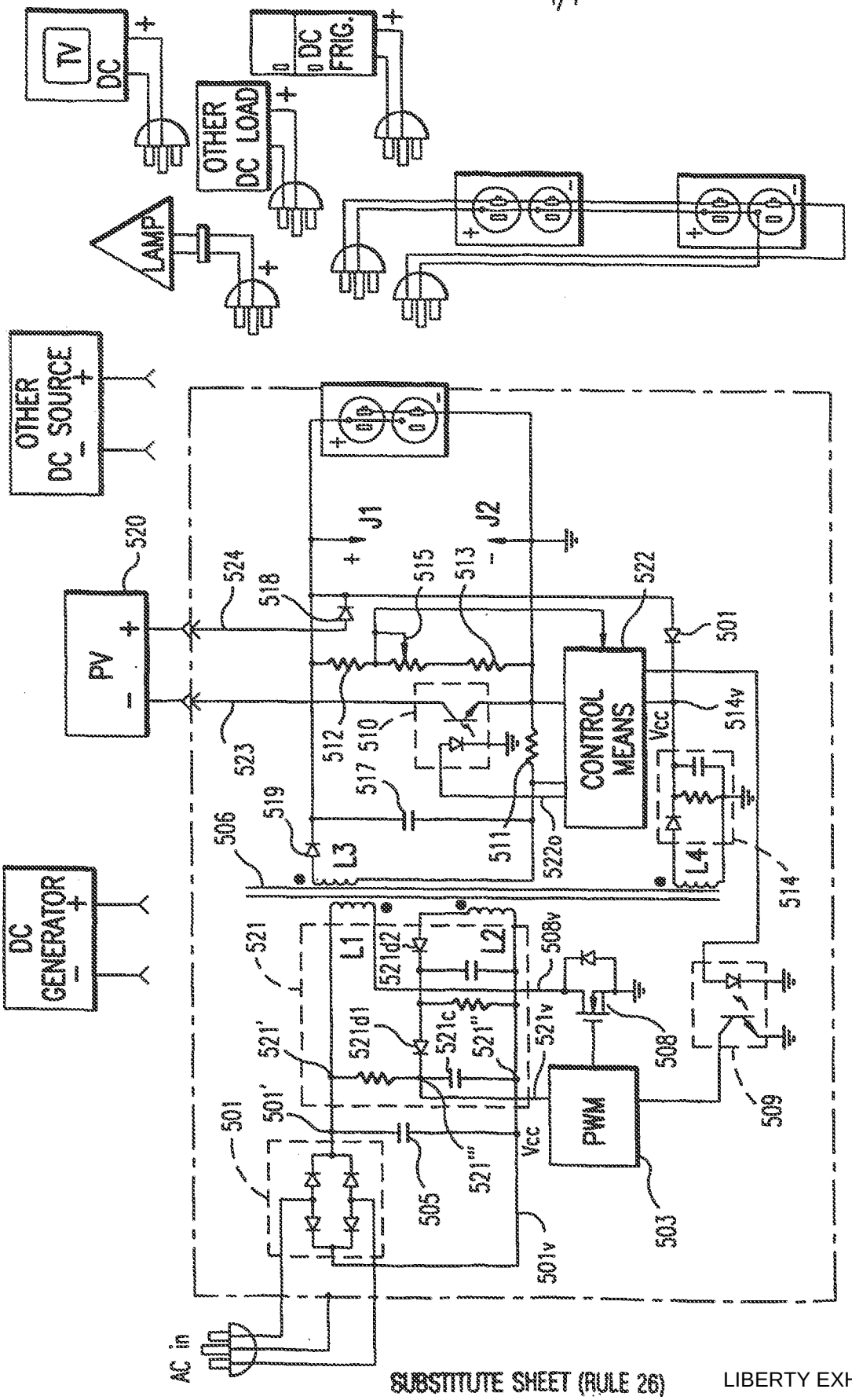

TV DC
OTHER DC LOAD
DC FRIG.
LAMP
OTHER DC SOURCE
PV
DC GENERATOR
AC in
CONTROL MEANS
PWM
L1
L2
L3
L4
J1
J2
Vcc
501
501'
501v
503
505
506
508
508v
509
510
511
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517
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521'
521''
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521c
521d1
521d2
521v
522
522o
523
524

FIG. 4

Electronic Patent Application Fee Transmittal

Application Number:	16728359
Filing Date:	27-Dec-2019
Title of Invention:	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
First Named Inventor/Applicant Name:	Jared Oehring
Filer:	Taylor P. Evans/Stephanie McDonough
Attorney Docket Number:	047158.100066

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	1806	1	260	260
		Total in USD ($)		**260**

Electronic Acknowledgement Receipt

EFS ID:	42011752
Application Number:	16728359
International Application Number:	
Confirmation Number:	6981
Title of Invention:	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Taylor P. Evans/Stephanie McDonough
Filer Authorized By:	Taylor P. Evans
Attorney Docket Number:	047158.100066
Receipt Date:	24-FEB-2021
Filing Date:	27-DEC-2019
Time Stamp:	15:37:11
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$260
RAM confirmation Number	E20212NF37310979
Deposit Account	501349
Authorized User	Stephanie McDonough

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37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	100066_IDS.pdf	1034451 503aedb5772e83d1881c14ef7497b918c04f08a8	no	4
Warnings:					
Information:					
2	Other Reference-Patent/App/Search documents	500064_ISR.pdf	1034101 ca0b06d3011c13546580b7fcbb58d29fef623511	no	19
Warnings:					
Information:					
3	Foreign Reference	AU734988.pdf	1661957 5df3e645d2c5d2360997621ca99040b712142c6e	no	40
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	30795 a27de7ecd70de78c7887491c5f16c0a5d7c26cb5	no	2
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New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/728,359	12/27/2019	Jared Oehring	047158.100066	6981

132858 7590 02/19/2021

Hogan Lovells US LLP
609 Main Street
Suite 4200
Houston, TX 77002

EXAMINER	
LEMBO, AARON LLOYD	

ART UNIT	PAPER NUMBER
3679	

NOTIFICATION DATE	DELIVERY MODE
02/19/2021	ELECTRONIC

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):

hlusdocketing@hoganlovells.com
stephanie.mcdonough@hoganlovells.com

Supplemental ***Notice of Allowability***	**Application No.** 16/728,359	**Applicant(s)** Oehring et al.	
	Examiner AARON L LEMBO	**Art Unit** 3679	**AIA (FITF) Status** Yes

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

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to Claims filed 09/29/2020.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ 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.

3. ☑ The allowed claim(s) is/are 1-8 and 21-26 . As a result of the allowed claim(s), 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** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ 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)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/AARON L LEMBO/
Primary Examiner, Art Unit 3679

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
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(Not for submission under 37 CFR 1.99)

Application Number	16728359
Filing Date	2019-12-27
First Named Inventor	Jared OEHRING
Art Unit	3679
Examiner Name	Aaron Lloyd LEMBO
Attorney Docket Number	047158-100066

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	10302079	B2	2019-05-28	Kendrick	

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	1	20170159654	A1	2017-06-08	Kendrick	
	2	20130180722	A1	2013-07-18	Olarte Caro et al.	
	3	20130299167	A1	2013-11-14	Fordyce et al.	
	4	20110052423	A1	2011-03-03	Gambier et al.	
	5	20030079875	A1	2003-01-05	Weng	

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	Application Number	16728359
	Filing Date	2019-12-27
	First Named Inventor	Jared OEHRING
	Art Unit	3679
	Examiner Name	Aaron Lloyd LEMBO
	Attorney Docket Number	047158-100066

	6	20170226838	A1	2017-08-10	Ceizobka et al.	

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	1	Non-Final Office Action issued in US Patent Application No. 14/881,535 mailed May 20, 2020	
	2	Non-Final Office Action issued in US Patent Application No. 15/145,443 mailed May 8, 2020	
	3	Non-Final Office Action issued in US Patent Application No. 16/458,696 mailed May 22, 2020	
	4	International Search Report and Written Opinion issued in PCT/US2020/023809 mailed June 2, 2020	
	5	KARIN, "Duel Fuel Diesel Engines," (2015), Taylor & Francis, pp 62-63, Retrieved from https://app.knovel.com/hotlink/toc/id:kpDFDE0001/dual-fueal-diesel-engines/duel-fuel-diesel-engines (Year 2015)	

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	Application Number	16728359
	Filing Date	2019-12-27
	First Named Inventor	Jared OEHRING
	Art Unit	3679
	Examiner Name	Aaron Lloyd LEMBO
	Attorney Docket Number	047158-100066

	6	GOODWIN, "High-voltage auxilliary switchgear for power stations," Power Engineering Journal, 1989, 10 pg. (Year 1989)

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EXAMINER SIGNATURE

Examiner Signature	/AARON L LEMBO/	Date Considered	10/19/2020

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16728359
Filing Date	2019-12-27
First Named Inventor	Jared OEHRING
Art Unit	3679
Examiner Name	Aaron Lloyd LEMBO
Attorney Docket Number	047158-100066

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the 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 the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☒ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Taylor P. Evans/	Date (YYYY-MM-DD)	2020-06-23
Name/Print	Taylor P. Evans	Registration Number	60506

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.L.L./

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16728359
Filing Date	2019-12-27
First Named Inventor	Jared Oehring
Art Unit	3679
Examiner Name	Aaron Lloyd Lembo
Attorney Docket Number	047158.100066

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	9324049		2016-04-26	Thomeer	
	2	10415332		2019-09-17	Morris	
	3	10669804		2020-06-02	Kotrla	
	4	3055682		1962-09-25	Bacher	
	5	9513055		2016-12-06	Seal	
	6	9061223		2015-06-23	Winborn	
	7	8091928		2012-01-10	Carrier	
	8	6719900		2004-04-13	Hawkins	

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Art Unit	3679
Examiner Name	Aaron Lloyd Lembo
Attorney Docket Number	047158.100066

	9	5433243		1995-07-18	Griswold	
	10	5230366		1993-07-27	Marandi	
	11	2610741		1952-09-16	Schmid	
	12	10337308		2019-07-02	Broussard	
	13	5004400		1991-04-02	Handke	
	14	9260253		2016-02-16	Naizer	
	15	9340353		2016-05-17	Oren	
	16	9499335		2016-11-22	McIver	
	17	9909398		2018-03-06	Pham	
	18	8997904		2015-04-07	Cryer	
	19	8774972		2014-07-08	Rusnak	

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	First Named Inventor	Jared Oehring
	Art Unit	3679
	Examiner Name	Aaron Lloyd Lembo
	Attorney Docket Number	047158.100066

	20	9051822		2015-06-09	Ayan	
	21	7170262		2007-01-30	Pettigrew	
	22	5025861		1991-06-25	Huber	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20160258267		2016-09-08	Payne	
	2	20130180722		2013-07-18	Olarte Caro	
	3	20130299167		2013-11-14	Fordyce	
	4	20110052423		2011-03-03	Gambier	
	5	20030079875		2003-05-01	Weng	
	6	20170226838		2017-08-10	Ciezobka	

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	Application Number	16728359
	Filing Date	2019-12-27
	First Named Inventor	Jared Oehring
	Art Unit	3679
	Examiner Name	Aaron Lloyd Lembo
	Attorney Docket Number	047158.100066

	7	20170096885		2017-04-06	Oehring	
	8	20170175516		2017-06-22	Eslinger	
	9	20190010793		2019-01-10	Hinderliter	
	10	20130317750		2013-11-28	Hunter	
	11	20190112910		2019-04-18	Oehring	
	12	20160326854		2016-11-10	Broussard	
	13	20170130743		2017-05-11	Anderson	
	14	20140138079		2014-05-22	Broussard	
	15	20180045331		2018-02-15	Lopez	
	16	20180266412		2018-09-20	Stokkevag	
	17	20180343125		2018-11-29	Clish	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16728359
	Filing Date	2019-12-27
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	Art Unit	3679
	Examiner Name	Aaron Lloyd Lembo
	Attorney Docket Number	047158.100066

	18	20180291713		2018-10-11	Jeanson	
	19	20200232454		2020-07-23	Chretien	
	20	20190119096		2019-04-25	Haile	
	21	20180238147		2018-08-23	Shahri	
	22	20140238683		2014-08-28	Korach	
	23	20130284278		2013-10-31	Winborn	
	24	20060065319		2006-03-30	Csitari	
	25	20130306322		2013-11-21	Sanborn	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							

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Art Unit	3679
Examiner Name	Aaron Lloyd Lembo
Attorney Docket Number	047158.100066

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T5
	1	International Search Report and Written Opinion mailed June 2, 2020 in corresponding PCT Application No. PCT/US20/23809	☒
	2	International Search Report and Written Opinion mailed June 23, 2020 in corresponding PCT Application No. PCT/US20/23912	☒
	3	International Search Report and Written Opinion mailed July 22, 2020 in corresponding PCT Application No. PCT/US20/00017	☒
	4	Office Action mailed August 4, 2020 in related U.S. Patent Application No. 16/385,070	☒
	5	Office Action mailed June 29, 2020 in related U.S. Patent Application No. 16/404,283	☒
	6	Canadian Office Action mailed August 17, 2020 in related CA Patent Application No. 2,944,968	☒
	7	Office Action mailed June 22, 2020 in related U.S. Patent Application No. 16/377,861	☒
	8	Canadian Office Action mailed August 18, 2020 in related CA Patent Application No. 2,933,444	☒

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EXAMINER SIGNATURE

Examiner Signature	/AARON L LEMBO/	Date Considered	10/19/2020

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.L.L./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16728359
	Filing Date	2019-12-27
	First Named Inventor	Jared Oehring
	Art Unit	3679
	Examiner Name	Aaron Lloyd Lembo
	Attorney Docket Number	047158.100066

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.L.L./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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First Named Inventor	Jared Oehring
Art Unit	3679
Examiner Name	Aaron Lloyd Lembo
Attorney Docket Number	047158.100066

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☒ That each item of information contained in the 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 the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☒ See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Taylor P. Evans/	Date (YYYY-MM-DD)	2020-09-02
Name/Print	Taylor P. Evans	Registration Number	60506

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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PTO/AIA/01 (06-12)
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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE

As the below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 16/728,359

filed on 12-27-2019.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Alexander James Christinzio Date (Optional): 02.08.2021

Signature: Alexander Christinzio

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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filed on 12-27-2019.

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I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

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LEGAL NAME OF INVENTOR

Inventor: Lon Robinson Date (Optional): _____

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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Electronic Acknowledgement Receipt

EFS ID:	41864098
Application Number:	16728359
International Application Number:	
Confirmation Number:	6981
Title of Invention:	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Taylor P. Evans/Stephanie McDonough
Filer Authorized By:	Taylor P. Evans
Attorney Docket Number:	047158.100066
Receipt Date:	08-FEB-2021
Filing Date:	27-DEC-2019
Time Stamp:	14:36:42
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Oath or Declaration filed	047158-100066_Inventor_Declaration_Alex.pdf	186245 b8673e31963cd860367624fd49e450718ba8006f	no	1

Warnings:

Information:					
2	Oath or Declaration filed	047158-100066_Inventor_Declaration_Lon.pdf	79155 c853d004ab467c2510720902 3ae34122b8ad61b0	no	1

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/728,359	12/27/2019	Jared Oehring	047158.100066	6981

7590 02/03/2021

Hogan Lovells US LLP
609 Main Street
Suite 4200
Houston, TX 77002

EXAMINER	
LEMBO, AARON LLOYD	
ART UNIT	**PAPER NUMBER**
3679	
NOTIFICATION DATE	**DELIVERY MODE**
02/03/2021	ELECTRONIC

NOTICE REQUIRING INVENTOR'S OATH OR DECLARATION

☐ An inventor's oath or declaration in compliance with 37 CFR 1.63 or substitute statement in compliance with 37 CFR 1.64 executed by or with respect to each inventor has not yet been submitted.

The inventor's oath or declaration or substitute statement dated 06/09/2020 is defective. The inventor's oath or declaration does not comply with 37 CFR 1.63 or the substitute statement does not comply with 37 CFR 1.64 because it:

☐ does not include a statement that the person executing the oath or declaration or substitute statement believes the named inventor or joint inventor to be the original inventor or an original joint inventor of a claimed invention in the application for which the oath or declaration is being submitted.

☐ does not state that the application was made or was authorized to be made by the person executing the oath or declaration or substitute statement.

☐ does not acknowledge that any willful false statement made in such oath or declaration or substitute statement is punishable under section 1001 of title 18 by fine or imprisonment of not more than 5 years, or both.

☐ does not identify the person executing the oath or declaration or substitute statement by his or her legal name.

☐ does not identify the application to which the oath or declaration or substitute statement is directed.

☒ Other: --- None received: Lon ROBINSON and Alexander James CHRISTINZIO

The substitute statement dated ____ does not comply with 37 CFR 1.64 because it:

☐ does not identify the inventor with respect to whom the statement applies.

☐ does not identify the relationship to the non-signing inventor.

☐ does not identify the circumstances permitting execution of the statement.

☐ was signed by someone other than the applicant.

☐ Other: _____

An oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each inventor MUST be filed **no later than the date on which the issue fee is paid.** See 35 U.S.C. 115(f). Failure to timely comply will result in ABANDONMENT of this application. This period for reply is not extendable under 37 CFR 1.136(a).

Questions relating to this Notice should be directed to the Application Assistance Unit at 571-272-4200.

(571)-272-4200 or 1(888)-786-0101
Patent Publication Branch
Office of Data Management

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

132858 7590 01/21/2021

Hogan Lovells US LLP
609 Main Street
Suite 4200
Houston, TX 77002

EXAMINER
LEMBO, AARON LLOYD

ART UNIT	PAPER NUMBER
3679	

DATE MAILED: 01/21/2021

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/728,359	12/27/2019	Jared Oehring	047158.100066	6981

TITLE OF INVENTION: SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	04/21/2021

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

132858 7590 01/21/2021

Hogan Lovells US LLP
609 Main Street
Suite 4200
Houston, TX 77002

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/728,359	12/27/2019	Jared Oehring	047158.100066	6981

TITLE OF INVENTION: SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	04/21/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
LEMBO, AARON LLOYD	3679	166-090100

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/728,359	12/27/2019	Jared Oehring	047158.100066	6981

132858 7590 01/21/2021

Hogan Lovells US LLP
609 Main Street
Suite 4200
Houston, TX 77002

EXAMINER	
LEMBO, AARON LLOYD	
ART UNIT	**PAPER NUMBER**
3679	

DATE MAILED: 01/21/2021

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

LIBERTY EXHIBIT 1056, Page 282

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 16/728,359	Applicant(s) Oehring et al.	
	Examiner AARON L LEMBO	Art Unit 3679	AIA (FITF) Status Yes

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

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to Claims filed 09/29/2020.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ 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.

3. ☑ The allowed claim(s) is/are 1-8 and 21-26 . As a result of the allowed claim(s), 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** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ 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)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☑ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/AARON L LEMBO/
Primary Examiner, Art Unit 3679

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.

Allowable Subject Matter

Claims 1-8 and 21-26 are allowed.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to AARON L LEMBO whose telephone number is (571)270-3065. The examiner can normally be reached on Monday-Friday, 7am-4pm.

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, Matthew Troutman can be reached on 5712703654. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/AARON L LEMBO/
Primary Examiner
Art Unit 3679

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/728,359	Oehring et al.
	Examiner	**Art Unit**
	AARON L LEMBO	3679

CPC								
Symbol							**Type**	**Version**
F16L	/	33	/	02			F	2013-01-01
E21B	/	43	/	26			I	2013-01-01
F04B	/	17	/	03			I	2013-01-01
F04B	/	15	/	02			I	2013-01-01
F04B	/	1	/	00			I	2013-01-01

CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	14	
/AARON L LEMBO/ Primary Examiner, Art Unit 3679	08 January 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1, 2

U.S. Patent and Trademark Office — Part of Paper No.: 20210108

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/728,359	Oehring et al.
	Examiner	**Art Unit**
	AARON L LEMBO	3679

INTERNATIONAL CLASSIFICATION				
CLAIMED				
F16L	/	33	/	02
E21B	/	43	/	26
F04B	/	17	/	03
F04B	/	15	/	02
F04B	/	1	/	00

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	14	
/AARON L LEMBO/ Primary Examiner, Art Unit 3679	08 January 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1, 2

U.S. Patent and Trademark Office

Part of Paper No.: 20210108

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/728,359	Oehring et al.
	Examiner	**Art Unit**
	AARON L LEMBO	3679

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	-	10	-	19										
2	2	-	11	-	20										
3	3	-	12	9	21										
4	4	-	13	10	22										
5	5	-	14	11	23										
6	6	-	15	12	24										
7	7	-	16	13	25										
8	8	-	17	14	26										
-	9	-	18												

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	14	
/AARON L LEMBO/ Primary Examiner, Art Unit 3679	08 January 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1, 2

U.S. Patent and Trademark Office

Part of Paper No.: 20210108

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/728,359	Oehring et al.
	Examiner	Art Unit
	AARON L LEMBO	3679

CPC - Searched*		
Symbol	**Date**	**Examiner**
F16L33/02	06/17/2020	/all/
E21B43/26	06/17/2020	/all/
F04B1/00	06/17/2020	/all/
F04B15/02	06/17/2020	/all/
F04B17/03	06/17/2020	/all/

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**
EAST Text Search	06/17/2020	/all/
IP.com Search	06/17/2020	/all/
IDS Considered	06/17/2020	/all/
Inventor Search	06/17/2020	/all/
Assignee Search	06/17/2020	/all/
Updated Search	01/08/2021	/all/

/AARON L LEMBO/ Examiner, Art Unit 3679	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/728,359	Oehring et al.
	Examiner	Art Unit
	AARON L LEMBO	3679

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
F16L33	02	01/08/2021	/all/
E21B43	26	01/08/2021	/all/
F04B1	15	01/08/2021	/all/
F04B15	02	01/08/2021	/all/
F04B17	03	01/08/2021	/all/

/AARON L LEMBO/ Examiner, Art Unit 3679	

LIBERTY EXHIBIT 1056, Page 298

Bibliographic Data

Application No: 16/728,359

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /AARON L LEMBO/ Examiner's Signature | Initials

Title: SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/27/2019	166	3679	047158.100066
RULE			

APPLICANTS

U.S. Well Services, LLC, Houston, TX,

INVENTORS

Jared Oehring, Houston, TX, UNITED STATES

Brandon Hinderliter, Houston, TX, UNITED STATES

Lon Robinson, Houston, TX, UNITED STATES

Alexander James Christinzio, Houston, TX, UNITED STATES

CONTINUING DATA

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

02/26/2020

STATE OR COUNTRY

UNITED STATES

ADDRESS

Hogan Lovells US LLP
609 Main Street
Suite 4200
Houston, TX 77002
UNITED STATES

FILING FEE RECEIVED

$5,860

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16728359
Filing Date	2019-12-27
First Named Inventor	Jared Oehring
Art Unit	3679
Examiner Name	Aaron Lloyd Lembo
Attorney Docket Number	047158.100066

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	10695950	B2	2020-06-30	Igo et al.	
	2	9706185	B2	2017-07-11	Ellis	
	3	9482086	B2	2016-11-01	Richardson et al.	
	4	5517822	A	1996-05-21	Haws et al.	
	5	6626646	B2	2003-09-30	Rajewski	
	6	6765304	B2	2004-07-20	Baten et al.	
	7	10627003	B2	2020-04-21	Dale et al.	
	8	8763387	B2	2014-07-01	Schmidt	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.L.L./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16728359
	Filing Date	2019-12-27
	First Named Inventor	Jared Oehring
	Art Unit	3679
	Examiner Name	Aaron Lloyd Lembo
	Attorney Docket Number	047158.100066

	9	9051923	B2	2015-06-09	Kuo	
	10	10711576	B2	2020-07-14	Bishop	
	11	10669471	B2	2020-06-02	Schmidt et al.	
	12	10184465	B2	2019-01-22	Enis et al.	
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U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20200047141	A1	2020-02-13	Oehring et al.	
	2	20170138171	A1	2017-05-18	Richards et al.	

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	3	20120152716	A1	2012-06-12	Kikukawa et al.	
	4	20080095644	A1	2008-04-24	Mantei et al.	
	5	20130255271	A1	2013-10-03	Yu et al.	
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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	3067854	CA	A1	2019-01-03	Morris et al.		

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	Attorney Docket Number	047158.100066

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NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	Non-Final Office Mailed October 26, 2020 in US Patent Application 15/356,436	
	2	Non-Final Office Mailed October 5, 2020 in US Patent Application No.16/443,273	
	3	Non-Final Office Action Mailed September 29, 2020 in US Patent Application No. 16/943,727	
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	Art Unit	3679
	Examiner Name	Aaron Lloyd Lembo
	Attorney Docket Number	047158.100066

	8	International Search Report and Written Opinion Mailed September 3, 2020 in PCT/US2020/36932
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	10	"Water and Glycol Heating Systems• (https://www.heat-inc.com/wg-series-water-glycol-systems/) 18 June 2018 (18.06.2018), entire document, especlally WG Series Water Glycol Systems
	11	"Heat Exchanger" (https://en.wiklpedia.org/w/index.php?title=Heat_exchanger&oldid=89300146) 12-18-19 April 2019 (18.04.2019), entire document, especially para (0001]
	12	Canadian Office Action issued September 8, 2020 in Canadian Patent Application No. 2,928,707
	13	Canadian Office Action issued August 31, 2020 in Canadian Patent Application No. 2,944,980
	14	International Search Report and Written Opinion Mailed August 28, 2020 in PCT/US20/23821

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EXAMINER SIGNATURE

Examiner Signature	/AARON L LEMBO/	Date Considered	01/07/2021

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Filing Date	2019-12-27
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Art Unit	3679
Examiner Name	Aaron Lloyd Lembo
Attorney Docket Number	047158.100066

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☒ That each item of information contained in the 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 the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☒ See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Taylor P. Evans/	Date (YYYY-MM-DD)	2020-11-20
Name/Print	Taylor P. Evans	Registration Number	60506

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1	(pump and reducer and union and shank) same fitting	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:05
L2	0	(pump with fitting) and (reducer and union and shank) same fitting	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:05
L3	272	(pump with fitting) and (reducer with fitting)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:05
L4	5,221	electric$4 with hydraulic$4 with pump and plunger	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:08
L5	10	electric$4 with hydraulic$4 with pump and multi-plunger	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:08
L6	6	electric$4 with hydraulic$4 with pump and (multi-plunger duplex triplex) with pump and pump with fitting and hose with fitting	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:12

L7	12	electric$4 with pump and (multi-plunger duplex triplex) with pump and pump with fitting and hose with fitting and pump with (hydraulic$4 fractur$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:30
L8	11	electric$4 with pump and (multi-plunger duplex triplex) with pump and pump with fitting and pump with hose and hose with fitting and pump with (hydraulic$4 fractur$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:45
L9	42,111	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:54
L10	8	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump and hose and fitting and reduc$4 with fitting and hose with fitting and hose with pump	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:55
L11	5	(US-10563490-$ or US-10760557-$ or US-9316216-$ or US-8469108-$ or US-3652188-$).did.	USPAT	OR	ON	2021/01/08 21:55
L12	8	l10 and reduc$4 with fitting and hose with fitting and hose with pump	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:56
L13	5	l11 and reduc$4 with fitting and hose with fitting and hose with pump	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/08 21:56
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S5	383	S2 or S3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/20 10:01
S6	320	(US-20190316447-$ or US-20190292866-$ or US-20190245348-$ or US-20190211661-$ or US-20190203567-$ or US-20190178235-$ or US-20190169971-$ or US-20190162061-$ or US-20190128080-$ or US-20190120024-$ or US-20190112910-$ or US-20190100989-$ or US-20190063309-$ or US-20190003329-$ or US-20180320483-$ or US-20180245428-$ or US-20180216455-$ or US-20180156210-$ or US-20180038216-$ or US-20180028992-$ or US-20130025706-$ or US-20170328179-$ or US-20170314979-$ or US-20170021318-$ or US-20170292513-$ or US-20170259227-$).did. or (US-20170241221-$ or US-20170234250-$ or US-20170226842-$ or US-20170159570-$ or US-20170146189-$ or US-20170145918-$ or US-20170114625-$ or US-20170051732-$ or US-20170036872-$ or US-20170022807-$ or US-20160348479-$ or US-20160341281-$ or US-20160319650-$ or US-20160312108-$ or US-20160290563-$ or US-20160290114-$ or US-20160281484-$ or US-20160265457-$ or US-20160230525-$ or US-20160230524-$ or US-20160221220-$ or US-20160208595-$ or US-20160186531-$	US-PGPUB; USPAT	OR	ON	2020/06/20 10:49

or US-20160160889-$ or US-20160105022-$ or US-20160102537-$ or US-20150330172-$).did. or (US-20150314225-$ or US-20150300336-$ or US-20150225113-$ or US-20150217672-$ or US-20150211512-$ or US-20150176386-$ or US-20150159911-$ or US-20150136043-$ or US-20150114652-$ or US-20150097504-$ or US-20150083426-$ or US-20150075778-$ or US-20150053426-$ or US-20150027712-$ or US-20140379300-$ or US-20140290768-$ or US-20140277772-$ or US-20140255214-$ or US-20140251623-$ or US-20140246211-$ or US-20140219824-$ or US-20140124162-$ or US-20140095114-$ or US-20140060658-$ or US-20140054965-$ or US-20140000899-$ or US-20130343858-$).did. or (US-20130341029-$ or US-20130306322-$ or US-20130233542-$ or US-20130175039-$ or US-20130175038-$ or US-20130009469-$ or US-20120247783-$ or US-20120232728-$ or US-20120222865-$ or US-20120205400-$ or US-20120205301-$ or US-20120127635-$ or US-20120085541-$ or US-20120049625-$ or US-20120018016-$ or US-20110272158-$ or US-20110247878-$ or US-20110166046-$ or US-20110085924-$ or US-20110061855-$ or US-20110017468-$ or US-20110005757-$ or US-20100322802-$ or US-20100303655-$ or US-20100293973-$ or US-20100250139-$ or US-20100172202-$).did. or (US-20100146981-$ or US-20100132949-$ or US-20100051272-$ or US-20100045109-$ or US-20100038907-$ or US-20100019574-$ or US-20090308602-$ or US-20090260826-$ or US-20090200035-$ or US-20090188181-$ or US-20090145611-$ or US-20090095482-$ or US-20090093317-$ or US-20090078410-$ or US-20090065299-$ or US-20090045782-$ or US-20080264649-$ or US-20080264625-$ or US-20080217024-$ or US-20080208478-$ or US-20080137266-$ or US-

20080112802-$ or US-20080041596-$ or US-20080017369-$ or US-20070278140-$ or US-20070226089-$ or US-20070201305-$).did. or (US-20070187163-$ or US-20070131410-$ or US-20060052903-$ or US-20050274508-$ or US-20050116541-$ or US-20050061548-$ or US-20040167738-$ or US-20040102109-$ or US-20040040746-$ or US-20040000077-$ or US-20020169523-$ or US-20030056514-$ or US-20030138327-$).did. or (US-10260327-$ or US-10246984-$ or US-10378326-$ or US-9915128-$ or US-10280724-$ or US-9103193-$ or US-9995218-$ or US-9970278-$ or US-9893500-$ or US-9745840-$ or US-9650879-$ or US-10020711-$ or US-9534473-$ or US-9840901-$ or US-9140110-$ or US-10119381-$ or US-10407990-$ or US-10232332-$ or US-9650871-$ or US-10393108-$ or US-10254732-$ or US-9410410-$ or US-10036238-$ or US-9587649-$ or US-10008880-$ or US-10227854-$).did. or (US-8997904-$ or US-9963961-$ or US-8789601-$ or US-9738461-$ or US-8534235-$ or US-8154419-$ or US-7845413-$ or US-1656861-$ or US-1671436-$ or US-2183364-$ or US-2220622-$ or US-2248051-$ or US-2407796-$ or US-2416848-$ or US-2753940-$ or US-3061039-$ or US-3066503-$ or US-3302069-$ or US-3334495-$ or US-3722595-$ or US-3764233-$ or US-3773140-$ or US-3837179-$ or US-3849662-$ or US-3881551-$ or US-4037431-$ or US-4100822-$).did. or (US-4151575-$ or US-4226299-$ or US-4265266-$ or US-4432064-$ or US-4442665-$ or US-4456092-$ or US-4506982-$ or US-4512387-$ or US-4529887-$ or US-4538916-$ or US-4676063-$ or US-4759674-$ or US-4793386-$ or US-4845981-$ or US-4922463-$ or US-5006044-$ or US-5025861-$ or US-5050673-$ or US-5130628-$ or US-5131472-$ or US-5172009-$ or US-5189388-$ or US-5366324-$ or US-5422550-$ or US-5548093-$ or US-5590976-$ or US-5655361-$).did. or (US-5736838-$ or

		US-5755096-$ or US-5790972-$ or US-5865247-$ or US-5879137-$ or US-5894888-$ or US-5907970-$ or US-6138764-$ or US-6142878-$ or US-6164910-$ or US-6202702-$ or US-6208098-$ or US-6254462-$ or US-6271637-$ or US-6273193-$ or US-6315523-$ or US-6477852-$ or US-6484490-$ or US-6491098-$ or US-6529135-$ or US-6776227-$ or US-6802690-$ or US-6808303-$ or US-6931310-$ or US-6936947-$ or US-7082993-$ or US-7104233-$).did. or (US-7170262-$ or US-7173399-$ or US-7308933-$ or US-7312593-$ or US-7336514-$ or US-7445041-$ or US-7494263-$ or US-7500642-$ or US-7525264-$ or US-7563076-$ or US-7581379-$ or US-7675189-$ or US-7683499-$ or US-7717193-$ or US-7755310-$ or US-7807048-$ or US-7835140-$ or US-7894757-$ or US-7977824-$ or US-7984757-$ or US-8037936-$ or US-8054084-$ or US-8083504-$ or US-7926562-$ or US-8096891-$ or US-8139383-$ or US-8146665-$).did. or (US-8232892-$ or US-8261528-$ or US-8272439-$ or US-8310272-$ or US-8354817-$ or US-8474521-$ or US-8573303-$ or US-8596056-$ or US-8616005-$ or US-8616274-$ or US-8646521-$ or US-8692408-$ or US-8727068-$ or US-8760657-$ or US-8774972-$ or US-8800652-$ or US-8807960-$ or US-8838341-$ or US-8851860-$ or US-8857506-$ or US-8899940-$ or US-8905056-$ or US-8905138-$ or US-9018881-$ or US-9051822-$ or US-9067182-$ or US-9119326-$).did. or (US-9160168-$ or US-9322239-$ or US-9450385-$ or US-9611728-$ or US-9728354-$ or US-9863228-$ or US-9932799-$ or US-9976351-$ or US-10287873-$ or US-10309205-$ or US-10371012-$ or US-10436026-$).did.				
S7	320	(US-20190316447-$ or US-20190292866-$ or US-20190245348-$ or US-20190211661-$ or US-20190203567-$ or US-20190178235-$ or US-20190169971-$ or US-20190162061-$ or US-20190128080-$	US-PGPUB; USPAT	OR	ON	2020/06/20 10:50

or US-20190120024-$ or US-20190112910-$ or US-20190100989-$ or US-20190063309-$ or US-20190003329-$ or US-20180320483-$ or US-20180245428-$ or US-20180216455-$ or US-20180156210-$ or US-20180038216-$ or US-20180028992-$ or US-20130025706-$ or US-20170328179-$ or US-20170314979-$ or US-20170021318-$ or US-20170292513-$ or US-20170259227-$).did. or (US-20170241221-$ or US-20170234250-$ or US-20170226842-$ or US-20170159570-$ or US-20170146189-$ or US-20170145918-$ or US-20170114625-$ or US-20170051732-$ or US-20170036872-$ or US-20170022807-$ or US-20160348479-$ or US-20160341281-$ or US-20160319650-$ or US-20160312108-$ or US-20160290563-$ or US-20160290114-$ or US-20160281484-$ or US-20160265457-$ or US-20160230525-$ or US-20160230524-$ or US-20160221220-$ or US-20160208595-$ or US-20160186531-$ or US-20160160889-$ or US-20160105022-$ or US-20160102537-$ or US-20150330172-$).did. or (US-20150314225-$ or US-20150300336-$ or US-20150225113-$ or US-20150217672-$ or US-20150211512-$ or US-20150176386-$ or US-20150159911-$ or US-20150136043-$ or US-20150114652-$ or US-20150097504-$ or US-20150083426-$ or US-20150075778-$ or US-20150053426-$ or US-20150027712-$ or US-20140379300-$ or US-20140290768-$ or US-20140277772-$ or US-20140255214-$ or US-20140251623-$ or US-20140246211-$ or US-20140219824-$ or US-20140124162-$ or US-20140095114-$ or US-20140060658-$ or US-20140054965-$ or US-20140000899-$ or US-20130343858-$).did. or (US-20130341029-$ or US-20130306322-$ or US-20130233542-$ or US-20130175039-$ or US-20130175038-$ or US-20130009469-$ or US-20120247783-$ or US-20120232728-$

or US-20120222865-$ or US-20120205400-$ or US-20120205301-$ or US-20120127635-$ or US-20120085541-$ or US-20120049625-$ or US-20120018016-$ or US-20110272158-$ or US-20110247878-$ or US-20110166046-$ or US-20110085924-$ or US-20110061855-$ or US-20110017468-$ or US-20110005757-$ or US-20100322802-$ or US-20100303655-$ or US-20100293973-$ or US-20100250139-$ or US-20100172202-$).did. or (US-20100146981-$ or US-20100132949-$ or US-20100051272-$ or US-20100045109-$ or US-20100038907-$ or US-20100019574-$ or US-20090308602-$ or US-20090260826-$ or US-20090200035-$ or US-20090188181-$ or US-20090145611-$ or US-20090095482-$ or US-20090093317-$ or US-20090078410-$ or US-20090065299-$ or US-20090045782-$ or US-20080264649-$ or US-20080264625-$ or US-20080217024-$ or US-20080208478-$ or US-20080137266-$ or US-20080112802-$ or US-20080041596-$ or US-20080017369-$ or US-20070278140-$ or US-20070226089-$ or US-20070201305-$).did. or (US-20070187163-$ or US-20070131410-$ or US-20060052903-$ or US-20050274508-$ or US-20050116541-$ or US-20050061548-$ or US-20040167738-$ or US-20040102109-$ or US-20040040746-$ or US-20040000077-$ or US-20020169523-$ or US-20030056514-$ or US-20030138327-$).did. or (US-10260327-$ or US-10246984-$ or US-10378326-$ or US-9915128-$ or US-10280724-$ or US-9103193-$ or US-9995218-$ or US-9970278-$ or US-9893500-$ or US-9745840-$ or US-9650879-$ or US-10020711-$ or US-9534473-$ or US-9840901-$ or US-9140110-$ or US-10119381-$ or US-10407990-$ or US-10232332-$ or US-9650871-$ or US-10393108-$ or US-10254732-$ or US-9410410-$ or US-10036238-$ or US-9587649-$ or US-10008880-$ or US-10227854-$).did. or (US-8997904-$ or

US-9963961-$ or US-8789601-$ or US-9738461-$ or US-8534235-$ or US-8154419-$ or US-7845413-$ or US-1656861-$ or US-1671436-$ or US-2183364-$ or US-2220622-$ or US-2248051-$ or US-2407796-$ or US-2416848-$ or US-2753940-$ or US-3061039-$ or US-3066503-$ or US-3302069-$ or US-3334495-$ or US-3722595-$ or US-3764233-$ or US-3773140-$ or US-3837179-$ or US-3849662-$ or US-3881551-$ or US-4037431-$ or US-4100822-$).did. or (US-4151575-$ or US-4226299-$ or US-4265266-$ or US-4432064-$ or US-4442665-$ or US-4456092-$ or US-4506982-$ or US-4512387-$ or US-4529887-$ or US-4538916-$ or US-4676063-$ or US-4759674-$ or US-4793386-$ or US-4845981-$ or US-4922463-$ or US-5006044-$ or US-5025861-$ or US-5050673-$ or US-5130628-$ or US-5131472-$ or US-5172009-$ or US-5189388-$ or US-5366324-$ or US-5422550-$ or US-5548093-$ or US-5590976-$ or US-5655361-$).did. or (US-5736838-$ or US-5755096-$ or US-5790972-$ or US-5865247-$ or US-5879137-$ or US-5894888-$ or US-5907970-$ or US-6138764-$ or US-6142878-$ or US-6164910-$ or US-6202702-$ or US-6208098-$ or US-6254462-$ or US-6271637-$ or US-6273193-$ or US-6315523-$ or US-6477852-$ or US-6484490-$ or US-6491098-$ or US-6529135-$ or US-6776227-$ or US-6802690-$ or US-6808303-$ or US-6931310-$ or US-6936947-$ or US-7082993-$ or US-7104233-$).did. or (US-7170262-$ or US-7173399-$ or US-7308933-$ or US-7312593-$ or US-7336514-$ or US-7445041-$ or US-7494263-$ or US-7500642-$ or US-7525264-$ or US-7563076-$ or US-7581379-$ or US-7675189-$ or US-7683499-$ or US-7717193-$ or US-7755310-$ or US-7807048-$ or US-7835140-$ or US-7894757-$ or US-7977824-$ or US-7984757-$ or US-8037936-$ or US-8054084-$ or US-8083504-$ or US-7926562-$ or US-8096891-$ or US-8139383-$ or US-

		8146665-$).did. or (US-8232892-$ or US-8261528-$ or US-8272439-$ or US-8310272-$ or US-8354817-$ or US-8474521-$ or US-8573303-$ or US-8596056-$ or US-8616005-$ or US-8616274-$ or US-8646521-$ or US-8692408-$ or US-8727068-$ or US-8760657-$ or US-8774972-$ or US-8800652-$ or US-8807960-$ or US-8838341-$ or US-8851860-$ or US-8857506-$ or US-8899940-$ or US-8905056-$ or US-8905138-$ or US-9018881-$ or US-9051822-$ or US-9067182-$ or US-9119326-$).did. or (US-9160168-$ or US-9322239-$ or US-9450385-$ or US-9611728-$ or US-9728354-$ or US-9863228-$ or US-9932799-$ or US-9976351-$ or US-10287873-$ or US-10309205-$ or US-10371012-$ or US-10436026-$).did.				
S8	93	fitting and lembo.xa.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/20 10:50
S9	22	("20020070014" | "20060159376" | "20090057026" | "20090315276" | "20110308815" | "20190056024" | "2937598" | "3055682" | "3224817" | "3254908" | "4281726" | "4715526" | "5617879" | "6263982" | "6505649" | "6923476" | "8215645" | "9157293").PN. OR ("10669804").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/20 10:50
S10	5	S6 and fitting and electri$4 with pump$4 and union	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/20 10:51
S11	221	("5" "5" adj inch) with (hose diameter) and fractur$4 and pump$4 same (electric$4 and plunger)	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/20 10:55
S12	476	(frac$4 frack$4 fractur$4) and (pump$4 with hose with fitting)	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:38
S13	44	(frac$4 frack$4 fractur$4) and (pump$4 with hose with fitting) and fitting with diameter and hose with diameter	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:41

S14	59	(hydraulic$4 with fractur$4) and (pump$4 with hose with fitting)	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:43
S15	23	(US-20190323337-$ or US-20190248938-$ or US-20190137012-$ or US-20130284278-$ or US-20110272158-$ or US-20080264649-$).did. or (US-9052037-$ or US-9903192-$ or US-9513055-$ or US-10102471-$ or US-9400065-$ or US-10227430-$ or US-9284819-$ or US-9061223-$ or US-9050545-$ or US-8985202-$ or US-9341056-$ or US-9341055-$ or US-8162063-$ or US-10280724-$ or US-9840901-$ or US-8146665-$).did. or (US-2831551-$).did.	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:45
S16	23	S15 and (pump$4 with hose with fitting)	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:45
S17	14	("20060065319" | "20100018911" | "20130240042" | "2610741" | "2661096" | "3748837" | "4051042" | "4836238" | "5230366" | "5433243" | "6390446" | "6719900").PN. OR ("9061223").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:55
S18	3	((US adj well adj services.as.) (oehring.in. hinderliter.in. robinson.in. christinzio.in.)) and fitting with hose with diameter$4 same pump$4	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:57
S19	5	((US adj well adj services.as.) (oehring.in. hinderliter.in. robinson.in. christinzio.in.)) and fitting with hose with diameter$4	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:58
S20	18	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and fitting with hose with diameter$4	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 22:05
S21	8	fitting with hose with diameter$4 and (hose fitting) with pump$4 and union with pump$4	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 22:06
S22	1	union same shank same reducer same fitting same hose	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 22:18
S23	1	union same shank same reducer same fitting and fitting same hose	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 22:18

S24	0	union with shank with reducer and fitting same hose	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 22:18
S25	0	union with shank with reducer	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 22:18
S26	1	union with shank with reducer	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 22:19
S27	0	union same shank same reducer and fitting with hose	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 22:19
S28	326	(US-20190316447-$ or US-20190292866-$ or US-20190245348-$ or US-20190211661-$ or US-20190203567-$ or US-20190178235-$ or US-20190169971-$ or US-20190162061-$ or US-20190128080-$ or US-20190120024-$ or US-20190112910-$ or US-20190100989-$ or US-20190063309-$ or US-20190003329-$ or US-20180320483-$ or US-20180245428-$ or US-20180216455-$ or US-20180156210-$ or US-20180038216-$ or US-20180028992-$ or US-20130025706-$ or US-20170328179-$ or US-20170314979-$ or US-20170021318-$ or US-20170292513-$ or US-20170259227-$).did. or (US-20170241221-$ or US-20170234250-$ or US-20170226842-$ or US-20170159570-$ or US-20170146189-$ or US-20170145918-$ or US-20170114625-$ or US-20170051732-$ or US-20170036872-$ or US-20170022807-$ or US-20160348479-$ or US-20160341281-$ or US-20160319650-$ or US-20160312108-$ or US-20160290563-$ or US-20160290114-$ or US-20160281484-$ or US-20160265457-$ or US-20160230525-$ or US-20160230524-$	US-PGPUB; USPAT	OR	ON	2020/06/21 22:20

or US-20160221220-$ or US-20160208595-$ or US-20160186531-$ or US-20160160889-$ or US-20160105022-$ or US-20160102537-$ or US-20150330172-$).did. or (US-20150314225-$ or US-20150300336-$ or US-20150225113-$ or US-20150217672-$ or US-20150211512-$ or US-20150176386-$ or US-20150159911-$ or US-20150136043-$ or US-20150114652-$ or US-20150097504-$ or US-20150083426-$ or US-20150075778-$ or US-20150053426-$ or US-20150027712-$ or US-20140379300-$ or US-20140290768-$ or US-20140277772-$ or US-20140255214-$ or US-20140251623-$ or US-20140246211-$ or US-20140219824-$ or US-20140124162-$ or US-20140095114-$ or US-20140060658-$ or US-20140054965-$ or US-20140000899-$ or US-20130343858-$).did. or (US-20130341029-$ or US-20130306322-$ or US-20130233542-$ or US-20130175039-$ or US-20130175038-$ or US-20130009469-$ or US-20120247783-$ or US-20120232728-$ or US-20120222865-$ or US-20120205400-$ or US-20120205301-$ or US-20120127635-$ or US-20120085541-$ or US-20120049625-$ or US-20120018016-$ or US-20110272158-$ or US-20110247878-$ or US-20110166046-$ or US-20110085924-$ or US-20110061855-$ or US-20110017468-$ or US-20110005757-$ or US-20100322802-$ or US-20100303655-$ or US-20100293973-$ or US-20100250139-$ or US-20100172202-$).did. or (US-20100146981-$ or US-20100132949-$ or US-20100051272-$ or US-20100045109-$ or US-20100038907-$ or US-20100019574-$ or US-20090308602-$ or US-20090260826-$ or US-20090200035-$ or US-20090188181-$ or US-20090145611-$ or US-20090095482-$ or US-20090093317-$ or US-20090078410-$ or US-20090065299-$ or US-20090045782-$ or US-20080264649-$ or US-20080264625-$ or US-

20080217024-$ or US-20080208478-$ or US-20080137266-$ or US-20080112802-$ or US-20080041596-$ or US-20080017369-$ or US-20070278140-$ or US-20070226089-$ or US-20070201305-$).did. or (US-20070187163-$ or US-20070131410-$ or US-20060052903-$ or US-20050274508-$ or US-20050116541-$ or US-20050061548-$ or US-20040167738-$ or US-20040102109-$ or US-20040040746-$ or US-20040000077-$ or US-20020169523-$ or US-20030056514-$ or US-20030138327-$ or US-20130284278-$).did. or (US-10260327-$ or US-10246984-$ or US-10378326-$ or US-9915128-$ or US-10280724-$ or US-9103193-$ or US-9995218-$ or US-9970278-$ or US-9893500-$ or US-9745840-$ or US-9650879-$ or US-10020711-$ or US-9534473-$ or US-9840901-$ or US-9140110-$ or US-10119381-$ or US-10407990-$ or US-10232332-$ or US-9650871-$ or US-10393108-$ or US-10254732-$ or US-9410410-$ or US-10036238-$ or US-9587649-$ or US-10008880-$ or US-10227854-$).did. or (US-8997904-$ or US-9963961-$ or US-8789601-$ or US-9738461-$ or US-8534235-$ or US-8154419-$ or US-7845413-$ or US-1656861-$ or US-1671436-$ or US-2183364-$ or US-2220622-$ or US-2248051-$ or US-2407796-$ or US-2416848-$ or US-2753940-$ or US-3061039-$ or US-3066503-$ or US-3302069-$ or US-3334495-$ or US-3722595-$ or US-3764233-$ or US-3773140-$ or US-3837179-$ or US-3849662-$ or US-3881551-$ or US-4037431-$ or US-4100822-$).did. or (US-4151575-$ or US-4226299-$ or US-4265266-$ or US-4432064-$ or US-4442665-$ or US-4456092-$ or US-4506982-$ or US-4512387-$ or US-4529887-$ or US-4538916-$ or US-4676063-$ or US-4759674-$ or US-4793386-$ or US-4845981-$ or US-4922463-$ or US-5006044-$ or US-5025861-$ or US-5050673-$ or US-5130628-$ or US-5131472-$ or US-5172009-$ or US-5189388-$ or US-

5366324-$ or US-5422550-$ or US-5548093-$ or US-5590976-$ or US-5655361-$).did. or (US-5736838-$ or US-5755096-$ or US-5790972-$ or US-5865247-$ or US-5879137-$ or US-5894888-$ or US-5907970-$ or US-6138764-$ or US-6142878-$ or US-6164910-$ or US-6202702-$ or US-6208098-$ or US-6254462-$ or US-6271637-$ or US-6273193-$ or US-6315523-$ or US-6477852-$ or US-6484490-$ or US-6491098-$ or US-6529135-$ or US-6776227-$ or US-6802690-$ or US-6808303-$ or US-6931310-$ or US-6936947-$ or US-7082993-$ or US-7104233-$).did. or (US-7170262-$ or US-7173399-$ or US-7308933-$ or US-7312593-$ or US-7336514-$ or US-7445041-$ or US-7494263-$ or US-7500642-$ or US-7525264-$ or US-7563076-$ or US-7581379-$ or US-7675189-$ or US-7683499-$ or US-7717193-$ or US-7755310-$ or US-7807048-$ or US-7835140-$ or US-7894757-$ or US-7977824-$ or US-7984757-$ or US-8037936-$ or US-8054084-$ or US-8083504-$ or US-7926562-$ or US-8096891-$ or US-8139383-$ or US-8146665-$).did. or (US-8232892-$ or US-8261528-$ or US-8272439-$ or US-8310272-$ or US-8354817-$ or US-8474521-$ or US-8573303-$ or US-8596056-$ or US-8616005-$ or US-8616274-$ or US-8646521-$ or US-8692408-$ or US-8727068-$ or US-8760657-$ or US-8774972-$ or US-8800652-$ or US-8807960-$ or US-8838341-$ or US-8851860-$ or US-8857506-$ or US-8899940-$ or US-8905056-$ or US-8905138-$ or US-9018881-$ or US-9051822-$ or US-9067182-$ or US-9119326-$).did. or (US-9160168-$ or US-9322239-$ or US-9450385-$ or US-9611728-$ or US-9728354-$ or US-9863228-$ or US-9932799-$ or US-9976351-$ or US-10287873-$ or US-10309205-$ or US-10371012-$ or US-10436026-$ or US-10669804-$ or US-3055682-$ or US-9513055-$ or US-9061223-$ or US-8091928-$).did.

S29	14	S28 and fitting with hose	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 22:20
S30	2	hose with fracturing with inches	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 23:16
S31	0	fracturing with pump with S17 adj inches	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 23:18
S32	0	fracturing with pump with S17	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 23:18
S33	322	fracturing with pump with "6"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 23:18
S34	0	fracturing with pump with "6" near2 (inch$4 diameter)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 23:19
S35	2,134	pump with "6" near2 (inch$4 diameter)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 23:19

S36	21	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump with "6" near2 (inch$4 diameter)	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 23:19
S37	0	hose with drop adj out adj rate and fracturing	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/23 08:29
S38	0	hose with drop adj out and fracturing	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/23 08:29
S39	6	hose with dropout and fracturing	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/23 08:29
S40	0	hose with pump with slurry with diameter and fracturing	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/23 08:30
S41	109	(hose pump) with slurry with diameter and fracturing	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/23 08:30
S42	0	(hose and pump) with slurry with diameter and fracturing	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/23 08:30
S43	108	(pump) with slurry with diameter and fracturing	US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	ON	2020/06/23 08:31

			JPO; DERWENT; IBM_TDB			
S44	1	(hose) with slurry with diameter and fracturing	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/23 08:31
S45	47	("10337308" | "10415332" | "10669804" | "20030079875" | "20060065319" | "20110052423" | "20130180722" | "20130284278" | "20130299167" | "20130306322" | "20130317750" | "20140138079" | "20140238683" | "20160258267" | "20160326854" | "20170096885" | "20170130743" | "20170175516" | "20170226838" | "20180045331" | "20180238147" | "20180266412" | "20180291713" | "20180343125" | "20190010793" | "20190112910" | "20190119096" | "20200232454" | "2610741" | "3055682" | "5004400" | "5025861" | "5230366" | "5433243" | "6719900" | "7170262" | "8091928" | "8774972" | "8997904" | "9051822" | "9061223" | "9260253" | "9324049" | "9340353" | "9499335" | "9513055" | "9909398").PN.	US-PGPUB; USPAT	OR	ON	2020/10/19 13:01
S46	7	("10302079" | "20030079875" | "20110052423" | "20130180722" | "20130299167" | "20170159654" | "20170226838").PN.	US-PGPUB; USPAT	OR	ON	2020/10/19 15:42
S47	47	("10337308" | "10415332" | "10669804" | "20030079875" | "20060065319" | "20110052423" | "20130180722" | "20130284278" | "20130299167" | "20130306322" | "20130317750" | "20140138079" | "20140238683" | "20160258267" | "20160326854" | "20170096885" | "20170130743" | "20170175516" | "20170226838" | "20180045331" | "20180238147" | "20180266412" | "20180291713" | "20180343125" | "20190010793" | "20190112910" | "20190119096" | "20200232454" | "2610741" | "3055682" | "5004400" | "5025861" | "5230366" | "5433243" |	US-PGPUB; USPAT	OR	ON	2020/10/19 15:42

		"6719900" | "7170262" | "8091928" | "8774972" | "8997904" | "9051822" | "9061223" | "9260253" | "9324049" | "9340353" | "9499335" | "9513055" | "9909398").PN.				
S48	25	("10184465" | "10627003" | "10669471" | "10695950" | "10711576" | "20080095644" | "20120152716" | "20130189629" | "20130255271" | "20160273456" | "20170043280" | "20170074076" | "20170138171" | "20200047141" | "20200088152" | "5517822" | "6626646" | "6765304" | "8506267" | "8763387" | "8795525" | "9051923" | "9482086" | "9706185" | "9739546").PN.	US-PGPUB; USPAT	OR	ON	2021/01/07 14:15
S49	3	"20170218727"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/07 14:29
S50	1	(S48 S49) and pump$4 same fitting	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/07 14:32
S51	0	(S48 S49) and pump$4 with plung$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/07 14:33
S52	22	(S48 S49) and pump$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/01/07 14:33

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp

L14	7	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump and hose and fitting and reduc$4 with fitting and hose with fitting and hose with pump	USPAT	OR	ON	2021/01/08 21:58

1/8/2021 9:58:58 PM
C:\Users\alembo\Documents\EAST\Workspaces\16 728359 - SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE.wsp

PTO/SB/08a (02-18)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	16728359
Filing Date	2019-12-27
First Named Inventor	Jared Oehring
Art Unit	3679
Examiner Name	Aaron Lloyd Lembo
Attorney Docket Number	047158.100066

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	10695950	B2	2020-06-30	Igo et al.	
	2	9706185	B2	2017-07-11	Ellis	
	3	9482086	B2	2016-11-01	Richardson et al.	
	4	5517822	A	1996-05-21	Haws et al.	
	5	6626646	B2	2003-09-30	Rajewski	
	6	6765304	B2	2004-07-20	Baten et al.	
	7	10627003	B2	2020-04-21	Dale et al.	
	8	8763387	B2	2014-07-01	Schmidt	

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	9	9051923	B2	2015-06-09	Kuo	
	10	10711576	B2	2020-07-14	Bishop	
	11	10669471	B2	2020-06-02	Schmidt et al.	
	12	10184465	B2	2019-01-22	Enis et al.	
	13	8795525	B2	2014-08-05	McGinnis et al.	
	14	9739546	B2	2017-08-22	Bertilsson et al.	
	15	8506267	B2	2013-08-13	Gambier et al.	

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	1	20200047141	A1	2020-02-13	Oehring et al.	
	2	20170138171	A1	2017-05-18	Richards et al.	

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	3	20120152716	A1	2012-06-12	Kikukawa et al.	
	4	20080095644	A1	2008-04-24	Mantei et al.	
	5	20130255271	A1	2013-10-03	Yu et al.	
	6	20160273456	A1	2016-09-22	Zhang et al.	
	7	20170043280	A1	2017-02-16	Vankouwenberg	
	8	20170074076	A1	2017-03-16	Joseph et al.	
	9	20200088152	A1	2020-03-19	Allion et al.	
	10	20130189629	A1	2013-07-25	Chandler	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	3067854	CA	A1	2019-01-03	Morris et al.		

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	Filing Date	2019-12-27
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	Art Unit	3679
	Examiner Name	Aaron Lloyd Lembo
	Attorney Docket Number	047158.100066

	2	108049999	CN	A	2018-05-18	Kailong High Tech Co. Ltd.	English-Language Translation	
	3	205986303	CN	U	2017-02-22	Zhenjiang Daqo Secheron Traction Power Co. Ltd.	English-Language Abstract	

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	Non-Final Office Mailed October 26, 2020 in US Patent Application 15/356,436	
	2	Non-Final Office Mailed October 5, 2020 in US Patent Application No.16/443,273	
	3	Non-Final Office Action Mailed September 29, 2020 in US Patent Application No. 16/943,727	
	4	Non-Final Office Action Mailed September 2, 2020 in US Patent Application No. 16/356,263	
	5	Non-Final Office Action Mailed August 31, 2020 in US Patent Application No. 16/167,083	
	6	ALBONE, "Mobile Compressor Stations for Natural Gas Transmission Service," ASME 67-GT-33, Turbo Expo, Power for Land, Sea and Air, Vol. 79887, p. 1-10, 1967	
	7	Canadian Office Action issued September 22, 2020 in Canadian Application No. 2,982,974	

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	Attorney Docket Number	047158.100066

	8	International Search Report and Written Opinion Mailed September 3, 2020 in PCT/US2020/36932
	9	"Process Burner" (https://www.cebasrt.com/productsloii-gaslprocess-bumer) 06 September 6, 2018 (06.09.2018), entire document, especially para (Burners for refinery Heaters]
	10	"Water and Glycol Heating Systems• (https://www.heat-inc.com/wg-series-water-glycol-systems/) 18 June 2018 (18.06.2018), entire document, especlally WG Series Water Glycol Systems
	11	"Heat Exchanger" (https://en.wiklpedia.org/w/index.php?title=Heat_exchanger&oldid=89300146) 12-18-19 April 2019 (18.04.2019), entire document, especially para (0001]
	12	Canadian Office Action issued September 8, 2020 in Canadian Patent Application No. 2,928,707
	13	Canadian Office Action issued August 31, 2020 in Canadian Patent Application No. 2,944,980
	14	International Search Report and Written Opinion Mailed August 28, 2020 in PCT/US20/23821

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Examiner Signature		Date Considered	

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	First Named Inventor	Jared Oehring
	Art Unit	3679
	Examiner Name	Aaron Lloyd Lembo
	Attorney Docket Number	047158.100066

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☒ That each item of information contained in the 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 the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☒ See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Taylor P. Evans/	Date (YYYY-MM-DD)	2020-11-20
Name/Print	Taylor P. Evans	Registration Number	60506

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To: TAYLOR P. EVANS
HOGAN LOVELLS US LLP
609 MAIN STREET, SUITE 4200
HOUSTON, TX 77002

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Applicant's or agent's file reference 047158.500057	Date of mailing (day/month/year) 03 SEP 2020 FOR FURTHER ACTION See paragraphs 1 and 4 below
International application No. PCT/US 20/36832	International filing date (day/month/year) 10 June 2020 (10.06.2020)

Applicant U.S. WELL SERVICES, LLC

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   How? Directly to the International Bureau preferably through ePCT, or on paper to:
   The International Bureau of WIPO, 34, chemin des Colombettes, 1211 Geneva 20, Switzerland

   For more detailed instructions, see the *PCT Applicant's Guide*, International Phase, paragraphs 9.004 – 9.011.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ With regard to any protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:
   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with any request to forward the texts of both the protest and the decision thereon to the designated Offices.
   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

   Shortly after the expiration of 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis* 3).

   Within 19 months from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later); otherwise, the applicant must, within 20 months from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices. In respect of other designated Offices, the time limit of 30 months (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

   Within 22 months from the priority date, the applicant may request that a supplementary international search be carried out by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Lee Young Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/220 (revised January 2020)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference		FOR FURTHER ACTION
047168.500057		see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/US 20/36932	10 June 2020 (10.06.2020)	10 June 2019 (10.06.2019)
Applicant U.S. WELL SERVICES, LLC		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the international Bureau.

This international search report consists of a total of 3 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the language, the international search was carried out on the basis of:

☒ the international application in the language in which it was filed.

☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

b. ☐ This international search report has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43.6bis(a)).

c. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, see Box No. I.

2. ☐ Certain claims were found unsearchable (see Box No. II).

3. ☐ Unity of invention is lacking (see Box No. III).

4. With regard to the title,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the drawings,

a. the figure of the drawings to be published with the abstract is Figure No. 1

☒ as suggested by the applicant.

☐ as selected by this Authority, because the applicant failed to suggest a figure.

☐ as selected by this Authority, because this figure better characterizes the invention.

b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 20/36932

A. CLASSIFICATION OF SUBJECT MATTER

IPC - E21B 43/26, F02C 7/236, E21B 43/16, B01D 1/00, C10G 7/00,F01D 15/10 (2020.01)

CPC - E21B 43/26, B60H 1/2209, B60H 1/2203, F23D 14/66, F02D 19/0628, F02D 41/00, B60H 2001/2271, C10J 3/723, C10K 1/101, C10J 2300/1223

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X - Y	US 2017/0218727 A1 (US WELL SERVICES LLC) 3 August 2017 (03.08.2017), entire document, especially, abstract, Fig 5, para [0023], [0038], [0045], [0049], [0070], [0072]-[0075].	1-4, 6, 9-14 --- 5, 7-8, 15
Y	CN 108049999 A (KAILONG HIGH TECH CO LTD) 18 May 2018 (18.05.2018), entire document, especially, para [0002], [0023].	5, 15
Y	"Process Burner" (https://www.cabeart.com/products/oil-gas/process-burner) 06 September 2018 (06.09.2018), entire document, especially para [Burners for refinery Heaters]	7, 15
Y	US 9,739,546 B2 (BERTILSSON et al.) 22 August 2017 (22.08.2017), entire document, especially, abstract, col. 2 in 4-6.	8
Y	US 10,254,732 B2 (US WELL SERVICES LLC) 9 April 2019 (09.04.2019), entire document, especially, abstract, Fig. 1.	8
A	"Water and Glycol Heating Systems" (https://www.heat-inc.com/wg-series-water-glycol-systems/) 18 June 2018 (18.06.2018), entire document, especially WG Series Water Glycol Systems	3
A	"Heat Exchanger" (https://en.wikipedia.org/w/index.php?title=Heat_exchanger&oldid=893001461) 18 April 2019 (18.04.2019), entire document, especially para [0001]	12

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 August 2020	03 SEP 2020
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Lee Young Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/210 (second sheet) (July 2019)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 20/36932

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2019/0010793 A1 10 January 2019 (10.01.2019), entire document	1-15
A	US 2013/0189929 A1 (CHANDLER) 12 March 2013 (12.03.2013), entire document	1-15

Form PCT/ISA/210 (continuation of second sheet) (July 2019)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: TAYLOR P. EVANS
HOGAN LOVELLS US LLP
609 MAIN STREET, SUITE 4200
HOUSTON, TX 77002

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	03 SEP 2020
Applicant's or agent's file reference 047158.500057	FOR FURTHER ACTION See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 20/36932	10 June 2020 (10.06.2020)	10 June 2019 (10.06.2019)

International Patent Classification (IPC) or both national classification and IPC

IPC - E21B 43/26, F02C 7/236, E21B 43/16, B01D 1/00,C10G 7/00, F01D 15/10 (2020.01)

CPC - E21B 43/26, B60H 1/2209, B60H 1/2203, F23D 14/66, F02D 19/0628, F02D 41/00, B60H 2001/2271, C10J 3/723, C10K 1/101, C10J 2300/1223

Applicant U.S. WELL SERVICES, LLC

1. This opinion contains indications relating to the following items:

- [X] Box No. I Basis of the opinion
- [ ] Box No. II Priority
- [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [ ] Box No. IV Lack of unity of invention
- [X] Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI Certain documents cited
- [ ] Box No. VII Certain defects in the international application
- [X] Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	17 August 2020	Lee Young PCT Help Desk Telephone No. 571-272-4300

Form PCT/ISA/237 (cover sheet) (revised January 2019)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/36932

Box No. I Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of:

☒ the international application in the language in which it was filed.

☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(b)).

3. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this opinion has been established on the basis of a sequence listing:

a. ☐ forming part of the international application as filed:

☐ in the form of an Annex C/ST.25 text file.

☐ on paper or in the form of an image file.

b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/36932

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	4-5, 7-8 and 10-15	YES
	Claims	1-3, 6 and 9	NO
Inventive step (IS)	Claims	NONE	YES
	Claims	1-15	NO
Industrial applicability (IA)	Claims	1-15	YES
	Claims	NONE	NO

2. Citations and explanations:

Claims 1-3, 6 and 9 lack novelty under PCT article 33(2) as being anticipated by US 2017/0218727 A1 to US Well Services LLC (hereinafter "US Well").

As per claim 1, US Well teaches, a system (abstract - "hydraulic fracturing system", Fig 6 shows the system) mounted on a skid (para [0075] - "skid similar in placement to the vaporization equipment", which implies that the vaporization equipment or line heaters are mounted on the skid) for use in fracturing operations (abstract, "for fracturing a subterranean formation"), the system characterized by:

a line heater on the skid (vaporizers 636 and filtration units 640 in Fig. 6, para[0070] - "a vaporizer 636-a, 636-b, 636-c, 636-d", vaporizers heat liquids in order to create vapor, therefore, a vaporizer is a line heater, para[0074] - "Filtration units can also provide heating to the gaseous fuels") to enable heating of fuel to be used with a turbine generator (302, 304) (para [0023] "a gas compression system fluidly coupled to the at least one turbine generator so as to provide fuel for use by the at least one turbine generator", para[0075] - "skid similar in placement to the vaporization equipment", which implies that the vaporization equipment or line heaters are mounted on the skid); and

one or more pressure regulators coupled to the line heater (para [0073] - "Regulators can be in the form of a specialized unit containing multiple regulators and bypass or isolation valves, such as the pressure regulator skid 220 of FIG. 2 can be individual regulators 614 spread throughout the compression system", para [0073] - "Each piece of equipment can contain dedicated internal pressure regulators", implying that the line heater can have dedicated pressure regulators coupled to it) to enable adjustment of a pressure associated with the fuel (Note: "to enable adjustment of a pressure associated with the fuel" is considered intended use and carries no patentable weight. US Well's pressure regulators are considered capable of " to enable adjustment of a pressure associated with the fuel " since it is known in the art that pressure regulators enable the adjustment of a pressure associated with the fluid in the system, in this case, fuel).

As per claim 2, US Well teaches, the system of claim 1, further characterized by: a bypassable indirect heating bath functioning as the line heater (para [0072] "vaporization system 632" can be an indirect heating bath - an indirect heating bath can be used to vaporize the fuel by providing heat, para [0074] - "Valves 610 are optionally provided at the fuel inlets and outlets to each piece of equipment", where each piece of equipment includes the indirect heating bath, it is known in the art that valves can be used for either isolation, shut off or bypassing, which will allow bypassing the heating bath) through which a fuel pipe comprising the fuel passes (para [0072] "The vaporization system 632 can optionally handle liquid fuels") to enable the heating of the fuel (para [0072] - "The vaporization system 632 can also separate the liquids from the gas, vaporize the liquid, then recombine the gaseous fuel with the vaporized fuel and lean-out the mixture with nitrogen rich air to create the correct lower heating value (LHV) and energy density of the new SNG mixture").

As per claim 3, US Well teaches, the system of claim 1, further characterized by: a glycol bath or glycol-based heat exchanger provided as the line heater (vaporization system 632 in Fig 6 is a heat exchanger, as it exchanges heat from surroundings to vaporize the fuel, para [0072] - " to create the correct lower heating value (LHV) and energy density of the new SNG mixture", a heat exchanger can be a glycol based heat exchanger as evidenced by https://www.heat-inc.com/water-glycol-systems/ See WB Series Water Glycol Systems) through which a fuel pipe characterized by the fuel passes to enable the heating of the fuel (para [0072] "The vaporization system 632 can optionally handle liquid fuels").

As per claim 6, US Well teaches, the system of claim 1, further characterized by: a redundant heating sub-system characterized by an electric heater (para [0048] - "Heaters on the pipes can also be utilized to keep the gas route warm enough so the vapor does not condense. In an embodiment, electric heaters can be powered by the turbines when the turbines are running, and by a standby generator (black start generator) if the turbines have not yet been started") to support the heating of the fuel upon failure of a feature of the line heater (Note: "to support the heating of the fuel upon failure of a feature of the line heater " is considered intended use and carries no patentable weight. US Well's electric heater is considered capable of supporting "the heating of the fuel upon failure of a feature of the line heater").

-*-Continued in Supplemental Box-*-

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 2020/66932

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made.

Claim 5: Regarding Claim 5, the recitation "methanol injector" fails to set forth and clearly/distinctly point out any further structural limitations. Further, the specification fails to properly enable the structure. For purposes of this opinion, the term "methanol injector" has been interpreted to be any structure that can inject methanol in a heater.

Claim 8: Regarding Claim 8, the recitation "methanol extractor" fails to set forth and clearly/distinctly point out any further structural limitations. Further, the specification fails to properly enable the structure. For purposes of this opinion, the term "methanol extractor" has been interpreted to be any structure that can remove or vent methanol in a heater system.

Claim 15: Regarding Claim 15, the recitation "methanol injector" fails to set forth and clearly/distinctly point out any further structural limitations. Further, the specification fails to properly enable the structure. For purposes of this opinion, the term "methanol injector" has been interpreted to be any structure that can inject methanol in a heater.

Claim 18: Regarding Claim 18, the recitation "methanol extractor" fails to set forth and clearly/distinctly point out any further structural limitations. Further, the specification fails to properly enable the structure. For purposes of this opinion, the term "methanol extractor" has been interpreted to be any structure that can remove or vent methanol in a heater system.

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/38832

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
-*-Box V.2 - Citations and Explanations-*-

As per claim 9, US Well teaches, the system of claim 1, further characterized by: one or more first valves associated with an inlet of the line heater (para [0074] - "Valves 610 are optionally provided at the fuel inlets and outlets to each piece of equipment", where each piece of equipment includes the line heater) to enable bypassing of the line heater (See Fig 6 - vaporization system 632 comprises multiple line heater units in parallel - 636-a, 636-b, 636-c, 636-d. Valves 610 when coupled to each of these units as described, enable bypass of each line heater when operated in combination); or
one or more second valves associated with an inlet to the one or more pressure regulators (para [0074] - "Valves 610 are optionally provided at the fuel inlets and outlets to each piece of equipment", where each piece of equipment includes the pressure regulator) to enable bypassing of the one or more pressure regulators (para [0073] - "Regulators can be in the form of a specialized unit containing multiple regulators and bypass or isolation valves, such as the pressure regulator skid 220 of FIG. 2, or can be individual regulators 614 spread throughout the compression system." - bypass valves enable bypassing of the pressure regulators. See 220 in Fig 2, multiple valves can be operated in combination, enabling bypassing the pressure regulators).

Claims 4 and 10-14 lack an inventive step under PCT Article 33(3) as being obvious over US Well.

As per claim 4, US Well teaches, the system of claim 1, further characterized by:
a bypassable pressure regulator functioning as the one or more pressure regulators (para [0073] - "Regulators can be in the form of a specialized unit containing multiple regulators and bypass or isolation valves, such as the pressure regulator skid 220 of FIG. 2, can be individual regulators 614 spread throughout the compression system. Each piece of equipment can contain dedicated internal pressure regulators") to enable the adjustment of the pressure associated with the fuel (para [0073] - "extra pressure regulation or fuel filtering can be applied to any embodiment.", individual regulators or pressure regulation skid as described above enable the adjustment of the pressure associated with the fuel).
In a further embodiment, US Well teaches a bypassable high pressure regulator or a bypassable low pressure regulator in a different embodiment (para [0049] - "In an embodiment, the pressure regulation skid 220 can regulate the pressure of incoming fuel at a low pressure"). Accordingly, it would have been obvious to one of ordinary skill in the art to arrive at a bypassable high pressure regulator or a bypassable low pressure regulator in order to regulate the fuel pressure at high or low values to maintain the necessary fuel pressure to facilitate optimal combustion parameters and/or prevent failures due to higher or lower than specification fuel pressure values.

As per claim 10, US Well teaches, the system of claim 9, further characterized by:
one or more remote receivers associated with the one or more first valves or the one or more second valves (para [0074] - "Valves 610 are optionally provided at the fuel inlets and outlets to each piece of equipment", para [0074] - "Some of these valves can be manual, while others can be actuated and controlled either digitally or by an automatic control system", where the automatic control system can include a receiver associated with the valve) and a datavan (436) (para [0036] "Additional components (not shown) of a hydraulic fracturing system can include flowback tanks, pressure relief tanks, well heads, control units, sand silos, a datavan") to enable the bypassing of the line heater or the one or more pressure regulators (See Fig 6 - vaporization system 632 comprises multiple line heater units in parallel - 636-a, 636-b, 636-c, **636-d. Valves** 610 when coupled to each of these units as described, enable bypass of each line heater when operated in combination) from an input of a datavan (**436**) or from one or more sensors associated with the line heater or the one or more pressure regulators, the one or more sensors to **detect temperature** information or pressure information during operation of the system (A data van is used to provide input to the system to **control system** characteristics such as flow, which includes operation and enabling of bypass or shut off valves associated with either the line **heater or the** flow regulators as evidenced by Oeiving - abstract "allow operators to wirelessly monitor and control proppant storage units from inside a datavan through sensors and control mechanisms that interface with fracturing software to schedule the flow of the proppant", "A user at the datavan controls the proppant usage").

As per claim 11, US Well teaches, a method for supporting fracturing operations, the method characterized by:
positioning a line heater on a skid (vaporizers 636 and filtration units in Fig 6 show line heater, Fig 6 - para [0075] - "skid similar in placement to the vaporization equipment", which implies that the vaporization equipment or line heaters are mounted on the skid) to enable heating of fuel to be used with a
turbine generator (para [0023] "a gas compression system fluidly coupled to the at least one turbine generator so as to provide fuel for use by the at least one turbine generator");
coupling one or more pressure regulators to the line heater (para [0073] - "Regulators can be in the form of a specialized unit containing multiple regulators and bypass or isolation valves, such as the pressure regulator skid 220 of FIG. 2, or can be individual regulators 614 spread throughout the compression system. Each piece of equipment can contain dedicated internal pressure regulators."); and
enabling the one or more pressure regulators to adjust a pressure associated
with the fuel (para [0073] - "Extra pressure regulation or fuel filtering can be applied to any embodiment.", "Regulators can be in the form of a specialized unit containing multiple regulators and bypass or isolation valves, such as the pressure regulator skid 220 of FIG. 2, or can be individual regulators 614", pressure regulatorsinherently enable the adjustment of pressure of the fluid line they are coupled to).
While US Well does not disclose a positive recitation of a method, US Well's device is inherently used to perform the claimed method - US Well teaches how the gas compression system for fracturing operations functions and how to operate it, including the line heaters and pressure regulators. Accordingly it would have been obvious to a person having ordinary skill in the art to have utilized the system and teachings of US Well as a whole, effectively providing a method of use through enabling a user to assemble and operate the system so as to properly utilize it for heating and regulate pressure of the fuel to the required specification.

-*-Continued in next Supplemental Box-*-

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
-*-Supplemental Box - Box V.2 - Citations and Explanations-*-

As per claim 12, US Well teaches, the method of claim 11, further characterized by:
providing a bypassable indirect heating bath to function as the line heater (para[0070] - "a vaporizer 636-a, 636-b, 636-c, 636-d", See vaporization system 632 in Fig 6 can be an indirect heating bath - an indirect heating bath can be used to vaporize the fuel by providing heat, para [0074] - "Valves 610 are optionally provided at the fuel inlets and outlets to each piece of equipment". Vaporization system 632 in Fig 6 comprises multiple line heater units in parallel - 636-a, 636-b, 636-c, 636-d. Valves 610 when coupled to each of these units as described, enable bypass of each line heater when operated in combination);
and
enabling the fuel to pass through a fuel pipe within the bypassable indirect heating bath characterized by a chemical warmer to perform the heating of the fuel (para [0072] - "The vaporization system 632 can optionally handle liquid fuels, gaseous fuels, and any combination of liquids mixed with gaseous fuels. The vaporization system 632 can also separate the liquids from the gas, vaporize the liquid." In order to vaporize liquid fuels, the fuel inherently has to pass through a fuel pipe through the bypassable indirect heating bath. A heat exchanger by definition exchanges heat between two fluid media, where the second media provides or removes heat from the primary medium, as evidenced by para [0001] "A heat exchanger is a device used to transfer heat between two or more fluids. Heat exchangers are used in both cooling and heating processes. The fluids may be separated by a solid wall to prevent mixing or they may be in direct contact" https://en.wikipedia.org/w/index.php?title=Heat_exchanger&oldid=983001469) where the second fluid is defined as a chemical warmer). While US Well does not explicitly disclose the positive recitation of a method, US Well's line heater is inherently used to perform claimed method - US Well teaches how the line heater functions and how to operate it. Accordingly, it would have been obvious to one of ordinary skill in the art to have utilized the system and teachings of US Well as a whole, effectively providing a method of use through enabling a user to enable the fuel to pass through the line heater as defined in order to utilize the line heater to heat the fuel in the system.

As per claim 13, US Well teaches, the method of claim 11, further characterized by:
providing a glycol bath or glycol-based heat exchanger as the line heater (vaporization system 632 in Fig 6 is a heat exchanger, as it exchanges heat from surroundings to vaporize the fuel , para [0072] - "to create the correct lower heating value (LHV) and energy density of the new SNG mixture", a heat exchanger can be a glycol based heat exchanger as evidenced by para [WG Series Water Glycol Systems] https://www.heat-inc.com/water-glycol-systems/).
enabling the fuel to pass through a fuel pipe within the glycol bath or the glycol-based heat exchanger to perform the heating of the fuel (para [0072] - "The vaporization system 632 can optionally handle liquid fuels. The vaporization system 632 can also separate the liquids from the gas, vaporize the liquid " In order to vaporize liquid fuels, the fuel inherently has to pass through a fuel pipe within the glycol bath. US Well's vaporizer functioning as the line heater inherently enables the fuel to pass through the fuel pipe in order to exchange heat, where the vaporizer is a glycol-based heat exchanger).
While US Well does not disclose a positive recitation of a method, US Well's device is inherently used to perform the claimed method - US Well teaches how the vaporization system functions and how to operate it. Accordingly it would have been obvious to a person having ordinary skill in the art to have utilized the system and teachings of US Well as a whole, effectively providing a method of use through enabling a user to provide a glycol based heat exchanger as line heater and enable fuel to pass through it.

As per claim 14, US Well teaches, the method of claim 11, further characterized by:
providing a bypassable pressure regulator to function as the one or more pressure regulators (para [0073] - "Regulators can be in the form of a specialized unit containing multiple regulators and bypass or isolation valves, such as the pressure regulator skid 220 of FIG. 2, can be individual regulators 614 spread throughout the compression system. Each piece of equipment can contain dedicated internal pressure regulators", the bypass valves in the pressure regulators allow the pressure regulators to be bypassable).
enabling the adjustment of the pressure associated with the fuel using the bypassable high pressure regulator or the bypassable low pressure regulator (para **[0073]** - "Extra pressure regulation or fuel filtering can be applied to any embodiment."; "Regulators can be in the form of a specialized unit containing multiple regulators and bypass or isolation valves, such as the pressure regulator skid 220 of FIG. 2, can be individual regulators 614 spread throughout the compression system. Each piece of equipment can contain dedicated internal pressure regulators", pressure regulators enable the adjustment of the pressure of the fluid in the system, in this case, fuel).
While US Well Services does not specifically teach a bypassable high pressure regulator or a bypassable low pressure regulator in this embodiment, US Well Services teaches a bypassable high pressure regulator or a bypassable low pressure regulator in a different embodiment (para [0049] - "In an embodiment, the pressure regulation **skid 220 can** regulate the pressure of incoming fuel at a low pressure"). Accordingly, it would have been obvious to one of ordinary skill in the art to arrive at a bypassable high pressure regulator or a bypassable low pressure regulator in order to regulate the fuel pressure at high or low values to maintain the necessary fuel pressure to facilitate optimal combustion parameters and/or prevent failures due to higher or lower than specification fuel pressure values.
While US Well does not disclose the positive recitation of a method, US Well teaches function of the pressure regulators in the system and how to operate it. Accordingly, it would have been obvious to a person having ordinary skill in the art to have utilized the system and teachings of US Well as a whole, effectively providing a method of use through enabling a user to install and operate the pressure regulators so as to adjust the fuel pressure in order to maintain optimum fuel combustion parameters and/or mitigate failures arising from out-of-specification high or low fuel pressure values.

-*-Continued in next Supplemental Box-*-

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
-*-Supplemental Box - Box V.3 - Citations and Explanations:*-

Claim 5 lacks an inventive step under PCT Article 33(3) as being obvious over US Well in view of CN 108049999 A to KAILONG HIGH TECH CO LTD (hereinafter 'Kailong').

As per claim 5, US Well teaches, the system of claim 1 further characterized by:
a redundant heating sub-system (para [0045] - "Heaters on the pipes can also be utilized to keep the gas route warm enough so the vapor does not condense") but does not specifically teach the redundant heating sub-system characterized by a methanol injector and a methanol extractor to support the heating of the fuel upon failure of a feature of the line heater.
However, Kailong teaches a redundant heating sub-system (para [0002] - "a methanol heater" characterized by a methanol injector (para [0024] - "fuel pump 16 for supplying methanol is disposed between the air inlet 2 and pre-combustion chamber 4", where the fuel pump is the methanol injector) (Note: See Box VIII) and a methanol extractor (para [0023] - "The heat exchange medium outlet 15") (Note: See Box VIII) to support the heating of the fuel upon failure of a feature of the line heater (Note: "to support the heating of the fuel upon failure of a feature of the line heater" is considered intended use and carries no patentable weight. Kailong's methanol heater is considered capable of supporting heating of the fuel upon the failure of a feature of the line heater.
Accordingly, it would have been obvious to employ Kailong's methanol heater comprising a methanol injector and extractor to utilize a redundant heating system with an alternatively available fuel to keep the system running upon failure of the main line heater, and additionally utilize methanol's anti-freeze properties to run the system in cold weather.

Claim 7 lacks an inventive step under PCT Article 33(3) as being obvious over US Well in view of "Process Burner" (https://www.cebaair.com/products/oil-gas/process-burner) (hereinafter 'CEBA')

As per claim 7, US Well teaches, the system of claim 1, further characterized by a burner associated with the line heater to promote the heating of the fuel (para [0074] - "allow the gas to remain mixed and uncondensed, and to combust properly in the combustion chamber", where the combustion chamber is a burner) but does not specifically teach the system of claim 1, further characterized by:
a forced draft burner associated with the line heater to promote the heating of the fuel. However, CEBA teaches, a forced draft burner associated with the line heater to promote the heating of the fuel (para [Burners for Refinery Heaters] - "SAMIA COMBUSTION burners' design allows the use of a wide range of fuel gases , such as natural gas, waste gas and light, medium or heavy oils - to be fired either on their own or in combination. The combustion air can be supplied to the burner in natural draft or forced draft modes"). Accordingly, it would have been obvious to one of ordinary skill in the art to use CEBA's forced draft burner in order to allow the use of a wide range of fuel gases in the system and to support the heating of the fuel for combustion.

Claim 8 lacks an inventive step under PCT Article 33(3) as being obvious over US Well in view of US 9,739,546 B2 to Bertilsson et al. (hereinafter Bertilsson) in further view of US 10,254,732 B2 to US Well Services LLC (hereinafter Oehring)

As per claim 8, US Well teaches, the system of claim 1, further characterized by a datavan (para [0036] - "Additional components (not shown) of a hydraulic fracturing system can include flowback tanks, pressure relief tanks, well heads, control units, sand silos, a data van") but does not specifically teach the system of claim 1 further characterized by: one or more sensors associated with the line heater and the one or more pressure regulators, the one or more sensors to: detect temperature or pressure information at one or more of an input and an output of the line heater and the one or more pressure regulators; and transmit the temperature or pressure information to a remote receiver of a datavan (436).
However, Bertilsson teaches one or more sensors associated with the line heater (abstract - "A sensor configured to sense at least one parameter and to produce a signal depending on the parameter includes a sensor probe that is provided between the adjoining plates", col. 2, ln 4-6 - "Such a sensor may comprise or consist of a leak detection sensor , a temperature sensor , a pressure sensor , a fouling sensor or any other possible sensor"; the one or more sensors to detect temperature or pressure information at one or more of an input and an output of the line heater (col. 2, ln 4-6 - "Such a sensor may comprise or consist of a leak detection sensor , a temperature sensor , a pressure sensor , a fouling sensor or any other possible sensor").
Bertilsson teaches sensors associated with detecting pressure. (col. 2, ln 4-6 - "Such a sensor may comprise or consist of a leak detection sensor , a temperature sensor , a pressure sensor , a fouling sensor or any other possible sensor") Accordingly, it would have been obvious to one of ordinary skill in the art to have arrived at installing one or more sensors associated with the pressure regulators, the one or more sensors to detect temperature or pressure information at one or more of an input and an output of the line heater and the one or more pressure regulators.
The further reference to Oehring teaches the sensors transmit the temperature or pressure information to a remote receiver of a datavan. (See Fig 1 - sensor 116 transmits the signal to a serial receiver 128 on a datavan 102). Accordingly, it would have been obvious to one of ordinary skill in the art to have employed the sensors from Bertilsson on the line heater of US Well to measure the inlet and outlet flow and monitor the signals received from the system and further to transmit as taught by Oehring to a datavan in order to maximize the prevention of failures due to pressure and temperature.

-*-Continued in Supplemental Box-*-

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/36932

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
-*-Supplemental Box - Box V.4 - Citations and Explanations-*-

Claim 15 lacks an inventive step under PCT Article 33(3) as being obvious over US Well in view of Kallong in further view of "Process Burner" (https://www.cebasrl.com/products/oil-gas/process-burner) (hereinafter 'CEBA')

As per claim 15, US Well teaches, the method of claim 11, further characterized by:
supporting the heating of the fuel either in operation or upon failure of a feature of the line heater using one or more of:
redundant heating characterized by an electric heater, and (para [0048] - "Heaters on the pipes can also be utilized to keep the gas route warm enough so the vapor does not condense. In an embodiment, electric heaters can be powered by the turbines when the turbines are running, and by a standby generator (black start generator) if the turbines have not yet been started") and a
burner associated with the line heater (para [0074] - "allow the gas to remain mixed and uncondensed, and to combust properly in the combustion chamber", where the combustion chamber is a burner) but does not specifically teach: redundant heating characterized by a methanol injector and a methanol extractor, where a burner is a forced draft burner.
However, Kallong teaches a redundant heating sub-system (para [0002] - "a methanol heater" characterized by a methanol injector para [0024] - "fuel pump 10 for supplying methanol is disposed between the air inlet 2 and pre-combustion chamber 4", where the fuel pump is the methanol injector) (Note: see Box VIII) and a methanol extractor (para [0023] - "The heat exchange medium outlet 15") (Note: see Box VIII).
The further reference to CEBA teaches, a forced draft burner associated with the line heater to promote the heating of the fuel (para [Burners for Refinery Heaters] - "SAMIA COMBUSTION burners' design allows the use of a wide range of fuel gases such as natural gas, waste gas and light, medium or heavy oils - to be fired either on their own or in combination. The combustion air can be supplied to the burner in natural draft or forced draft modes"). Accordingly, it would have been obvious to one of ordinary skill in the art to use Accordingly, it would have been obvious to one of ordinary skill in the art to have employed Kallong's methanol heater as a secondary redundant heating sub-system in order to provide a back up heat source in case of failure of the primary heating system and utilize it for methanol's anti-freeze properties in cold weather conditions and further applied CEBA's forced draft burner in the system of US Well in order to support the heating of the fuel for combustion and utilize it for a wide variety of fuels when the primary fuel source is not available.
Furthermore, while US Well in view of Kallong in further view of CEBA do not explicitly teach the positive recitation of a method, US Well in view of Kallong in further view of CEBA teach the individual components of the system and how to operate it. Accordingly, it would have been obvious to one of ordinary skill in the art to use the teachings of US Well in view of Kallong in further view of CEBA's device to employ redundant heating systems in order to support the heating of fuel upon the failure of a feature of the line heater system.

Claims 1-15 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used by industry.

SEARCH HISTORY

Application Number	PCT/US 20/36932
Search Conducted By	RES
Search Approved By	SCL

CPC/IPC Classifications Searched	CPC - E21B 43/26, B60H 1/2209, B60H 1/2203, F23D14/66, F02D 19/0628, F02D41/00, B60H 2001/2271, C10J 3/723, C10K 1/101, C10J 2300/1223, C10J 2300/1671, C10J 2300/1884, C10J 3/00, F24H 1/06,F24H 1/08, F24H 1/40, F24H 1/43, F24H 9/2035, F28D 7/00 66, F28D 7/0066, F28D 7/08, F28 F9/26, F24H 1/009, C10G 7/00, F02C 3/22, F04B 49/20, C10G 7/00, F02B 3/06, C10G 7/00, F02B 3/00, F05D 2220/32, B60P 3/00, E21B7/026 IPC(8) - E21B 43/26, F02C 7/236, E21B 43/16, B01D 1/00, C10G 7/00, F01D 15/10, E21B 41/00, E21B 43/00, E21B 44/00 (2020.01)
Date Conducted	17 August 2020 (17.08.2020)

Documentation Searched	CPC - E21B 43/26, B60H 1/2209, B60H 1/2203, F23D14/66, F02D 19/0628, F02D41/00, B60H 2001/2271, C10J 3/723, C10K 1/101, C10J 2300/1223, C10J 2300/1671, C10J 2300/1884, C10J 3/00, F24H 1/06,F24H 1/08, F24H 1/40, F24H 1/43, F24H 9/2035, F28D 7/00 66, F28D 7/0066, F28D 7/08, F28 F9/26, F24H 1/009, C10G 7/00, F02C 3/22, F04B 49/20, C10G 7/00, F02B 3/06, C10G 7/00, F02B 3/00, F05D 2220/32, B60P 3/00, E21B7/026 IPC(8) - E21B 43/26, F02C 7/236, E21B 43/16, B01D 1/00, C10G 7/00, F01D 15/10, E21B 41/00, E21B 43/00, E21B 44/00 (2020.01) USPC - 196/133, 208/347, 208/370, 307/29, 700/293
Search Terms Used	fuel, combustible, heat*, device, equipment, skid turbine, generator, heat*, warm, bath, heat*, sensor%, temperature, methanol, glycol, hinderliter brandon, US WELL SERVICES LLC, oehring jared, skid, combustibl*, regulat*, valve%, pressure%, draft, air, convection, sensor%, force%, pipe%, duct%, passage*, path* inflamm*, propellant, charge, indirect cool* exchanger%, bath%,

	sink%, transfer*, pass*, bypass*, circumvent*, divert*, avoid*, pump, inject*, infus*, dispenser%, , control*, gate*, detect*, measur*, actuator%, probe%, inlet%, outlet% data, feedback, information, vehicle%, truck%, van%, port%, room
Date Conducted	17 August 2020 (17.08.2020)

Electronic Database Searched	PatBase
Files Searched	Full-text: AU BE BR CA CH CN DE DK EP ES FI FR GB IN JP KR SE TH TW US WO Bibliographic: (Europe) AT BA BE BG CH CS CY CZ DD DK EE ES FI GE GR HR HU IE IS IT LT LU LV MC MD MT NL NO PL PT RO RS SE SI SK SM TR UA YU (Asia) EA GC HK ID IL IN KZ MN MY PH RU SG SU TH TJ TW UZ VN (North America) CA CR CU DO GT HN MX NI PA SV TT (South America) AR BR CL CO EC PE UY (Australasia) AU NZ (Africa) AP DZ EG KE MA MW OA ZA ZM ZW
Date Conducted	17 August 2020 (17.08.2020)

Search Logic:

Search 1: ft=(fuel or combustible) w2 (heat*) (Results 54429)
Search 2: 1 and ft=(device or equipment) (Results 34780)
Search 3: 2 and ft=(skid) (Results 517)
Search 4: 3 and ft=(turbine or generator) (Results 400)
Search 5: 4 and ft=(heat* or warm or temperature) near (bath) (Results 5)
Search 6: 4 and ft=(heat*) (Results 400)
Search 7: 6 and ft=(sensor%) (Results 341)
Search 8: 7 and ft=(temperature) (Results 341)
Search 9: 8 and ft=(methanol) (Results 13)
Search 10: 9 not 5 (Results 10)
Search 11: 8 and ft=(glycol) (Results 100)
Search 12: inv=(hinderliter brandon) (Results 15)
Search 13: PPA=(US WELL SERVICES LLC) (Results 12)
Search 14: inv = (oehring jared) (Results 16)
Search 15: 12 or 13 or 14 (Results 18)
Search 16: 15 and ft=(skid) (Results 12)
Search 17: PN=(US8951019 OR US8404013 OR US8070863 OR US20130189629) (Results 4)
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F24H1/009 OR C10G7/00 OR F02C3/22 OR F04B49/20 OR C10G7/00 OR F02B3/06 OR C10G7/00 OR F02B3/00 OR E21B43/26 OR F05D2220/32 OR B60P3/00 OR E21B7/026) (Results 60752)
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Search 21: 18 or 19 or 20 (Results 151556)
Search 22: 21 and ft=(skid) (Results 1444)
Search 23: 22 and ft=(heat*) (Results 692)
Search 24: 23 and ft=(fuel or combustibl*) (Results 414)
Search 25: 24 and ft=(turbine) (Results 259)
Search 26: 25 and ft=(generat*) (Results 252)
Search 27: 26 and ft=(regulat* or valve%) (Results 235)
Search 28: 27 and ft=(regulat* or valve%) w2 (pressure%) (Results 157)
Search 29: 28 and ft=(glycol) (Results 87)
Search 30: 29 not (15 or 9) (Results 84)
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Search 36: 35 and ft = (draft or air or convection) (Results 17)
Search 37: 35 and ft=(draft) (Results 10)
Search 38: 37 and ft=(force% or convection) w2 (draft) (Results 0)
Search 39: 21 and ft=(fuel or gas or combustibl*) w2 (heat*) (Results 9781)
Search 40: 39 and ft=(turbine) w2 (generat*) (Results 1021)
Search 41: 40 and ft=(glycol) (Results 101)
Search 42: 41 and ft=(methanol) (Results 45)
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Search 44: 21 and ft=(heat*) (Results 61782)
Search 45: 44 and ft=(regulat* or control* or gate* or valve* or bypass*) (Results 39978)
Search 46: 45 and ft=(pipe% or duct% or passage* or path*) (Results 29153)
Search 47: 46 and ft=(fuel% or gas* or combustible* or inflamm* or propellant or charge) (Results 25413)
Search 48: 47 and ft=(indirect) near (heat*) (Results 1389)
Search 49: 47 and ft=(heat*) near (exchanger% or bath% or sink% or transfer*) (Results 12468)
Search 50: 47 and ft=(heat* or cool* or temperature*) near (exchanger% or bath% or sink% or transfer*) (Results 12765)
Search 51: 50 and ft=(pass* or bypass* or circumvent* or divert* or avoid*) (Results 11903)
Search 52: 51 and ft=(forced or convection or enforced) (Results 3509)
Search 53: 52 and ft=(draft or air or current or blast or blow) (Results 3084)
Search 54: 53 and ft=(methanol) (Results 401)
Search 55: 54 and ft=(pump or inject* or infus* or dispenser%) (Results 379)
Search 56: 55 not (15 or 42 or 35) (Results 365)
Search 57: 56 and ft=(pressure) (Results 360)

Search 58: 57 and ft=(pressure) near (regulat* or control* or gate* or valve* or bypass*) (Results 280)
Search 59: 58 and ft=(sensor% or detect* or measur* or actuator% or probe%) (Results 271)
Search 60: 59 and ft=((sensor% or detect* or measur* or actuator% or probe%) w10 (temperature or pressure)) (Results 243)
Search 61: 59 and ft=((sensor% or detect* or measur* or actuator% or probe%) near (inlet% or outlet%)) (Results 30)
Search 62: 60 and ft = (data or feedback or information) near (vehicle% or truck% or van% or port% or room) (Results 3)

Electronic Database Searched	Google
Files Searched	Web (Articles excluding patents)
Date Conducted	17 August 2020 (17.08.2020)

Search Logic:

fracking skids
About 972,000 results (0.53 seconds)
skid fuel system oil and gas
About 24,200,000 results (0.41 seconds)
fuel forwarding skid
About 659,000 results (0.37 seconds)
fuel forwarding skid with heating
About 995,000 results (0.47 seconds)
glycol based heat exchanger for fuel or gas
About 3,920,000 results (0.54 seconds)
methanol injector back up heater
About 892,000 results (0.46 seconds)
heat exchanger with pressure regulator and valves
About 41,800,000 results (0.71 seconds)
heat exchanger with bypass valve and pressure regulators
About 16,800,000 results (0.46 seconds)
bypassable heating system with redundant back up heaters
About 8 results (1.00 seconds)
fuel heater with back up electric heater
About 173,000,000 results (0.77 seconds)

Electronic Database Searched	Google
Files Searched	Patents (US Patents, Published Applications, EPO publications, International, China, Germany, Canada)
Date Conducted	17 August 2020 (17.08.2020)

Search Logic:

Fuel gas conditioning equipment
About 35,752 results
mobile fuel gas conditioning
About 32,194 results
fuel gas heater mobile fuel conditioning
About 30,890 results
fuel gas conditioning skid
Page 2 of about 6,469 results
Fuel gas heater for turbine generator
About 58,428 results
fracking skids fuel gas heat turbine generator
About 189 results
secondary electric heating
57,883 results
heat exchanger for heating fuel
About 66,427 results
(heat exchanger heating fuel) language:ENGLISH
About 58,677 results
(methanol heater) language:ENGLISH
About 48,218 results

Innovation, Sciences et Développement économique Canada
Office de la Propriété Intellectuelle du Canada

Innovation, Science and Economic Development Canada
Canadian Intellectual Property Office

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(54) Titre : DISTRIBUTION D'ENERGIE ELECTRIQUE POUR OPERATION DE FRACTURATION
(54) Title: ELECTRIC POWER DISTRIBUTION FOR FRACTURING OPERATION

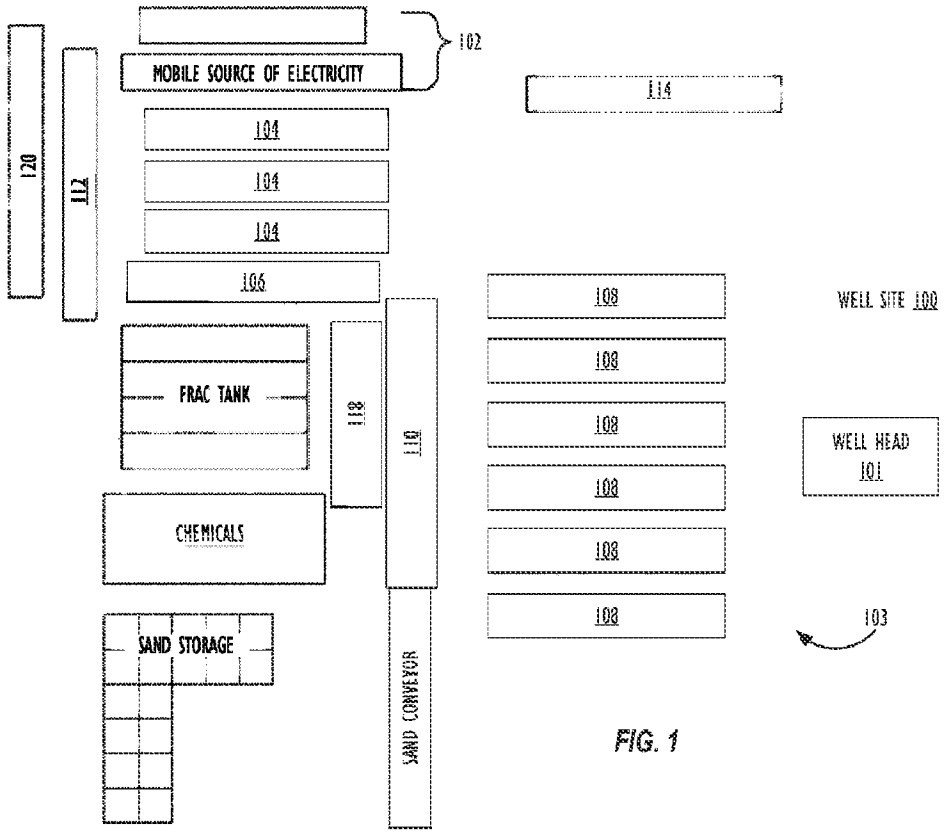


FIG. 1

(57) Abrégé/Abstract:
Providing electric power distribution for fracturing operations comprising receiving, at a transport, electric power from a mobile source of electricity at a first voltage level and supplying, from the transport, the electric power to a fracturing pump transport at the

(21) 3 067 854

(13) A1

(57) Abrégé(suite)/Abstract(continued):
first voltage level using only a first, single cable connection. The first voltage level falls within a range of 1,000 V to 35 kilovolts. The transport also supplies electric power to a second transport at the first voltage level using only a second, single cable connection.

LIBERTY EXHIBIT 1056, Page 347

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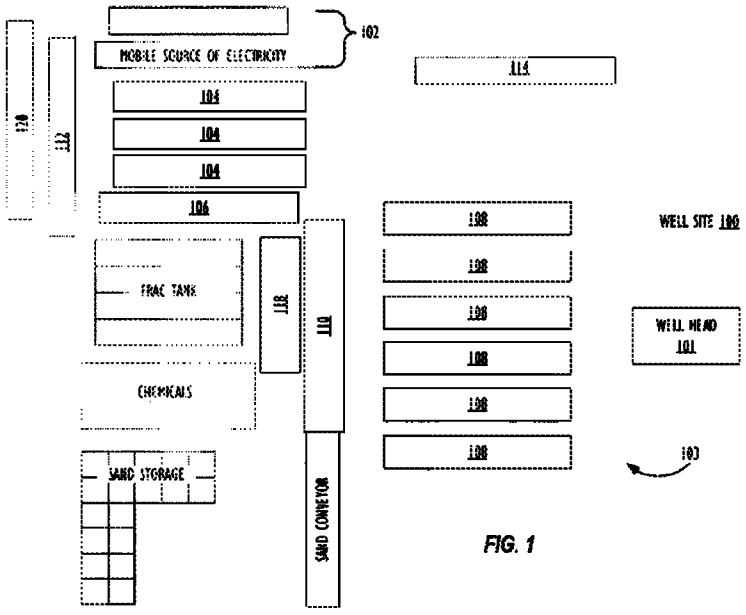


FIG. 1

(57) Abstract: Providing electric power distribution for fracturing operations comprising receiving, at a transport, electric power from a mobile source of electricity at a first voltage level and supplying, from the transport, the electric power to a fracturing pump transport at the first voltage level using only a first, single cable connection. The first voltage level falls within a range of 1,000 V to 35 kilovolts. The transport also supplies electric power to a second transport at the first voltage level using only a second, single cable connection.

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ELECTRIC POWER DISTRIBUTION FOR FRACTURING OPERATION

BACKGROUND

[0001] Hydraulic fracturing has been commonly used by the oil and gas industry to stimulate production of hydrocarbon producing wells, such as oil and/or gas wells. Hydraulic fracturing, sometimes called "fracing" or "fracking" is the process of injecting fracturing fluid into a wellbore to fracture the subsurface geological formations and release hydrocarbons. The fracturing fluid is pumped into a wellbore at a pressure sufficient to cause fissures within the underground geological formations. Once inside the wellbore, the fracturing fluid fractures the underground formation. The fracturing fluid may include water, various chemical additives, and proppants that promote the extraction of the hydrocarbon reserves, such as oil and/or gas. Proppants, such as fracturing sand, prevent fissures and fractures in the underground formation from closing; thereby, allowing the formation to remain open so that hydrocarbons flow through the hydrocarbon wells.

[0002] Implementing fracturing operations at well sites requires extensive investment in equipment, labor, and fuel. A typical fracturing operation uses fracturing equipment, personnel to operate and maintain the fracturing equipment, large amounts of fuel to power the fracturing operations, and relatively large volumes of fracturing fluids. As such, planning for fracturing operations is complex and encompasses a variety of logistical challenges that include minimizing the on-site area or "footprint" of the fracturing operations, providing adequate power and/or fuel to continuously power the fracturing operations, increasing the efficiency of the hydraulic fracturing equipment, and reducing the environmental impact resulting from fracturing operations. Thus, numerous innovations and improvements of existing fracturing technology are needed to address the variety of complex and logistical challenges faced in today's fracturing operations.

SUMMARY

[0003] The following presents a simplified summary of the disclosed subject matter in order to provide a basic understanding of some aspects of the subject matter disclosed herein. This summary is not an exhaustive overview of the technology disclosed herein, and it is not intended to identify key or critical elements of the

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invention or to delineate the scope of the invention. Its sole purpose is to present concepts in a simplified form as a prelude to the more detailed description that is discussed later.

[0004] In one embodiment, an apparatus comprising a hydration tank, a fracturing blender, and an internal manifold system. The internal manifold system couples the hydration tank and the fracturing blender to route fluid between the hydration tank and the fracturing blender. The apparatus also comprises a single transport frame that couples the hydration tank, the fracturing blender, and the internal manifold system to form a single transport.

[0005] In another embodiment, a method for producing fracturing fluid, comprising receiving source fluid from one or more inlet manifolds of a single transport and driving a first pump mounted on the single transport to route the source fluid from the inlet manifolds into a hydration tank mounted on the single transport. The method also drives second pump mounted on the single transport to route hydrated fluid produced by the hydration tank to a blending tub mounted on the single transport and discharges fracturing fluid produced by the blending tub to one or more outlet manifolds of the single transport.

[0006] In yet another embodiment, a transport comprising a transport frame, an internal manifold system coupled to the transport frame, and a hydration tank coupled to the transport frame. The hydration tank is configured to receive a source fluid from the internal manifold system, produce a hydrated fluid with a target viscosity based on the source fluid, and output the hydrated fluid to the internal manifold system. The transport also comprises a blender coupled to the transport frame, where the blender is configured to receive the hydrated fluid from the internal manifold system, produce a fracturing fluid based on the hydrated fluid, and discharge the hydrated fluid to the internal manifold system. The delivery rate of the hydrated fluid for the hydration tank corresponds to an amount of fracturing fluid the blender provides to one or more fracturing pump transports.

[0007] In another embodiment, an electric fracturing system comprises a switch gear transport electrically connected to a power generation source to provide electric power at a first voltage level. The electric fracturing system also comprises an electrical cable that supplies electric power at the first voltage level and a fracturing

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pump transport electrically connected to the switch gear transport via only the electrical cable. The fracturing pump transport comprises a transformer that steps down the electric power received at the first voltage level to a lower voltage level. The fracturing pump transport is not electrically connected to the switch gear transport via another electrical cable at a voltage level that differs from the first voltage level.

[0008] In another embodiment, a transport that comprises a single transport frame and an electric prime mover mounted on the single transport frame. The pump is coupled to the electric prime mover and mounted on the single transport frame and a transformer coupled to the electric prime mover and mounted on the single transport frame. The transformer is configured to receive electric power at a first voltage level from a power source via a single cable assembly and step down the electric power at the first voltage level to a lower voltage level. The transformer is also configured to supply the electric power at the lower voltage level to the electric prime mover, where the transport is not connected to any other cable assemblies that supply electric power at the first voltage level and other voltage levels.

[0009] In yet another embodiment, a method for electric power distribution used for fracturing operations. The method comprises receiving, at a transport, electric power from a mobile source of electricity at a first voltage level, where the first voltage level falls within a range of 1,000 V to 35 kilovolts and supplying, from the transport, the electric power to a fracturing pump transport at the first voltage level using only a first, single cable connection The method also includes supplying, from the transport, the electric power to a second transport at the first voltage level using only a second, single cable connection.

[0010] In yet another embodiment, each of the above described embodiments and variations thereof, may be implemented as a method, apparatus, and/or system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] For a more complete understanding of this disclosure, reference is now made to the following brief description, taken in connection with the accompanying drawings and detailed description, wherein like reference numerals represent like parts.

[0012] FIG. 1 is a schematic diagram of an embodiment of a well site that comprises a wellhead and a mobile fracturing system.

[0013] FIG. 2 is a schematic diagram of an embodiment of a medium-low voltage power distribution system for the mobile fracturing system.

[0014] FIG. 3 is a schematic diagram of another embodiment of a medium voltage power distribution system for the mobile fracturing system.

[0015] FIG. 4A illustrates a side view of an embodiment of a hydration-blender transport.

[0016] FIG. 4B illustrates an under tank cross sectional view of the hydration-blender transport.

[0017] FIG. 4C illustrates a cross sectional view of the hydration-blender transport that depicts the inside of the hydration tank.

[0018] FIG. 4D illustrates a top view the hydration-blender transport that depicts the top of the hydration tank.

[0019] FIG. 4E illustrates a cross sectional view of the hydration-blender transport that corresponds to section cut A-A shown in FIG. 4D.

[0020] FIG. 4F illustrates an under tank cross sectional view of another embodiment of a hydration-blender transport.

[0021] FIG. 5 illustrate an embodiment of a hydration-blender transport that includes a single blending tub.

[0022] FIG. 6 is a flow chart of an embodiment of a method to provide fracturing fluid using a single hydration-blender transport.

[0023] FIG. 7 is a flow chart of an embodiment of a method to provide electric power to fracturing equipment.

[0024] While certain embodiments will be described in connection with the illustrative embodiments shown herein, the invention is not limited to those embodiments. On the contrary, all alternatives, modifications, and equivalents are included within the spirit and scope of the invention as defined by the claims. In the drawing figures, which are not to scale, the same reference numerals are used throughout the description and in the drawing figures for components and elements having the same structure, and primed reference numerals are used for components

and elements having a similar function and construction to those components and elements having the same unprimed reference numerals.

DETAILED DESCRIPTION

[0025] The term "fracturing sand" is used in this disclosure to serve as a non-limiting example of a proppant used as a component of fracturing fluid. "Fracturing sand" is also used herein to collectively refer to both wet and dry fracturing sand. Embodiments in this disclosure are not limited to fracturing sand and any other type of proppant, such as man-made ceramics, aluminum beads and sintered bauxite, can be used with the various embodiments presented in the disclosure. Unless otherwise specified within the disclosure, the term "fracturing sand" can be interchanged throughout this disclosure with the term "proppants."

[0026] As used herein, the term "wet fracturing sand" refers to a quantity of fracturing sand that contains a moisture content of about one percent or more, which is typically determined based on weight. "Dry fracturing sand" refers to quantities of fracturing sand that contain a moisture content of less than about one percent. As used herein, the term "liquefying wet fracturing sand" refers to enhancing and transforming the flow properties of wet fracturing sand to be substantially similar to dry fracturing sand in order to accurately control the amount of metered fracturing sand. Wet fracturing sand can liquefy and flow when shaken with force.

[0027] As used herein, the term "transport" refers to any transportation assembly, including, but not limited to, a trailer, truck, skid, rail car, and/or barge used to transport relatively heavy structures and/or other types of articles, such as fracturing equipment and fracturing sand. A transport could be independently movable from another transport. For example, a first transport can be mounted or connected to a motorized vehicle that independently moves the first transport while an unconnected second transport remains stationary.

[0028] As used herein, the term "trailer" refers to a transportation assembly used to transport relatively heavy structures and/or other types of articles (such as fracturing equipment and fracturing sand) that can be attached and/or detached from a transportation vehicle used to pull or tow the trailer. As an example, the transportation vehicle is able to independently move and tow a first trailer while an unconnected second trailer remains stationary. In one or more embodiments, the

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trailer includes mounts and manifold systems to connect the trailer to other fracturing equipment within a fracturing system or fleet. The term "lay-down trailer" refers to a specific embodiment of a trailer that includes two sections with different vertical heights. One of the sections or the upper section is positioned at or above the trailer axles and another section or the lower section is positioned at or below the trailer axles. In one embodiment, the main trailer beams of the lay-down trailer may be resting on the ground when in operational mode and/or when uncoupled from a transportation vehicle, such as a tractor.

[0029] As used herein, the term "low voltage" refers to a voltage range from about 50 volts (V) to 1,000 V for alternating current (AC) electric power. The term "medium voltage" refers to a voltage range from about 1,000 V to about 35 kilovolts (kV) for AC electric power, and the term "high voltage" refers to a voltage range greater than 35 kV for AC electric power. Although the terms "low voltage," "medium voltage," and "high voltage" generally refer to voltage ranges in AC electric power, the disclosure is not limited to AC electric power and could also utilize current (DC) voltage.

[0030] Unless otherwise specified within the disclosure, the term "electrical connection" refers to connecting one transport to another transport using one or more electrical cables. The term "electrical cable" can be interchanged throughout this disclosure with the term "power cable" "power cable connection," "cable connection," or "electrical cable connection." The terms "electrical cable," "power cable" "power cable connection," "cable connection," and "electrical cable connection" refer to a single cable assembly that bundles together one or more wires (e.g., copper wires) that carry AC or DC electric current to provide electric power. In one or more embodiments, the single cable assembly also includes other wire types, such as fiber optic wires that perform other functions besides providing electric power. For example, the fiber optic wires are able to carry light for the purposes of transferring communication signals.

[0031] Various example embodiments are disclosed herein for performing mobile fracturing operations using a hydration-blender transport. Rather than having a hydration transport that is separate and independent from a blender transport, a fracturing fleet may replace two or more different transports with a single hydration-

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blender transport. The hydration-blender transport includes a hydration tank and a blender unit (e.g., a single configuration blender or a dual configuration blender) interconnected with each other using the hydration-blender transport's internal manifold system. The internal manifold system directly couples the hydration tank and blender unit such that the hydration tank is able to provide fracturing fluid to the blender unit without requiring manifolds or other fluid connections (e.g., piping or hoses) that are external to the hydration-blender transport. To draw in source fluid, such as water or a fluid mixture (e.g., water with chemical additives), via one or more inlet manifolds, the hydration-blender transport comprises a plurality of electric prime movers that drive a plurality of pumps. Based on how an operator configures the inlet valves of the internal manifold system, the hydration-blender transport can transfer the source fluid to the hydration tank and blender unit, or completely by-pass the hydration tank and blender unit and transport the source fluid directly to one or more outlet manifolds. By doing so, the hydration-blender transport is able to perform a variety of operations that include, but are not limited to straight through operations, hydration-blender operations, and split stream operations.

[0032] Also disclosed are various example embodiments that distribute electric power from a mobile source of electricity. In one embodiment for fracturing operations, a power distribution system positions the voltage step down operation downstream and in close proximity to the fracturing equipment within a mobile fracturing system. As an example, a fracturing pump transport and a hydration-blender transport both include transformers that step down a supplied voltage level to one or more lower voltage levels that the fracturing equipment (e.g., electric prime movers) utilizes. The transports could also include drives (e.g., variable frequency drives (VFDs)) to control and monitor the electric prime movers. By doing so, the mobile fracturing system is able to reduce the number of transports by eliminating the use of an auxiliary unit transport (e.g., auxiliary unit transport 106 in FIG. 2) and/or drive power transports (e.g., drive power transports 104 in FIG. 2). A switch gear transport within the mobile fracturing system is then able to directly provide to the other transports, such as a hydration-blender transport and the fracturing pump transport, electric power at a relatively high medium voltage level (e.g., 13.8 kV);thereby, reducing the number of electrical cables to power fracturing equipment.

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For example, the switch gear transport may connect to each fracturing pump transport using a single electrical cable that supplies electric power at 13.8 kV. Each transformer mounted on the fracturing pump transport is then able to step down the supplied electric power to different voltage levels (e.g., 4.2 kV and 480 V) and provide enough electric current to power fracturing equipment.

[0033] FIG. 1 is a schematic diagram of an embodiment of a well site 100 that comprises a wellhead 101 and a mobile fracturing system 103. Generally, a mobile fracturing system 103 may perform fracturing operations to complete a well and/or transform a drilled well into a production well. For example, the well site 100 may be a site where operators are in the process of drilling and completing a well. Operators may start the well completion process with vertical drilling, running production casing, and cementing within the wellbore. The operators may also insert a variety of downhole tools into the wellbore and/or as part of a tool string used to drill the wellbore. After the operators drill the well to a certain depth, a horizontal portion of the well may also be drilled and subsequently encased in cement. The operators may subsequently pack the rig and move a mobile fracturing system 103 onto the well site 100 to perform fracturing operations that force relatively high pressure fracturing fluid through wellhead 101 into subsurface geological formations to create fissures and cracks within the rock. The mobile fracturing system 103 may then be moved off the well site 100 once the operators complete fracturing operations. Typically, fracturing operations for well site 100 may last several days or weeks.

[0034] As shown in FIG. 1, the mobile fracturing system 103 includes a mobile source of electricity 102 configured to generate electricity by converting hydrocarbon fuel, such as natural gas, obtained from one or more other sources (e.g., a producing wellhead, gathering pipe systems and/or pipelines) at well site 100, from a remote offsite location, and/or another relatively convenient location near the mobile source of electricity 102. The mobile source of electricity 102 supplies the generated electricity to fracturing equipment to power fracturing operations at one or more well sites. In particular, the mobile source of electricity 102 may supply electric power to fracturing equipment within the mobile fracturing system 103 that includes, but is not limited to, the switch gear transport 112, drive power transports 104, auxiliary unit transport 106, blender transport 110, data van 114, hydration transport 118, auxiliary

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power transport 120, and fracturing pump transports 108 in order to deliver fracturing fluid through wellhead 101 to subsurface geological formations.

[0035] The switch gear transport 112 may receive the electricity generated from the mobile source of electricity 102 via one or more electrical connections. In one embodiment, the switch gear transport 112 uses 13.8 kilovolts (kV) electrical connections to receive power from the mobile source of electricity 102. The switch gear transport 112 may comprise a plurality of electrical disconnect switches, fuses, transformers, and/or circuit protectors to protect other fracturing equipment within the mobile fracturing system 103. The switch gear transport 112 may then transfer the electricity received from the mobile source of electricity 102 to the drive power transports 104 and auxiliary unit transports 106. The power distribution system to supply power from the mobile source of electricity 102 to the mobile fracturing system 103 is discussed in more detail in FIG. 2.

[0036] The auxiliary unit transport 106 may comprise a transformer and a control system to control, monitor, and provide power to the electrically connected fracturing equipment. In one embodiment, the auxiliary unit transport 106 receives a relatively higher medium voltage (e.g., 13.8 kV) electrical connection and steps down the electric power to a lower voltage. For example, the auxiliary unit transport 106 steps down the voltage level from 13.8 kV to 480 V. The auxiliary unit transport 106 may then provide the stepped down voltage to other fracturing equipment, such as the blender transport 110, sand storage and conveyor, data van 114, and lighting equipment.

[0037] The drive power transports 104 may be configured to monitor and control one or more electric prime movers located on the fracturing pump transports 108 via a plurality of connections, such as electrical connections (e.g., copper wires), fiber optics, wireless, and/or combinations thereof. The drive power transports 104 may also receive power from the switch gear transport 112 and step down the 13.8 kV electrical connection to lower voltages. In one embodiment, the drive power transports 104 may step down the voltage to 4.2 kV rather than other lower voltage levels, such as 600 V, in order to reduce cable size of the electrical cable and the number of electrical cables used to connect the mobile fracturing system 103. In FIG. 1, the fracturing pump transport 108 utilizes the electric power received from the

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drive power transport 104 to power one or more electric prime movers that convert electric power to mechanical power in order to drive one or more pumps.

[0038] To form fracturing fluid, the hydration transport 118 combines a fluid, such as water from a frac tank, with a polymer-based slurry to produce a hydrated fluid with a target viscosity. The polymer-based slurry may be a viscous slurry concentrate that contains hydratable polymers that include, but are not limited to guar gum, hydroxypropyl guar (HPG), carboxymethyl HPG, carboxymethyl hydroxyethyl cellulose, and combinations thereof. Because the polymer-based slurry has a specified hydration rate, the viscosity level of the hydrated fluid after initially combining the polymer-based slurry with the fluid may not equal the target viscosity. Typically, the hydrated fluid requires a certain amount of mixing time (also known as residence time) to hydrate the polymer-based slurry so that the hydrated fluid reaches the target viscosity. For example, after combining the source fluid with the polymer-based slurry, the viscosity of the hydrated fluid increases as the degree of hydration of the polymer-based slurry increases.

[0039] In one embodiment, the blender transport 110 receives electric power from the auxiliary unit transport 106 to power a plurality of electric prime movers to perform a variety of blending operations. For instance, some of the electric prime movers may drive one or more pumps to route source fluid to the blender transport 110 to produce fracturing fluid. Non-limiting examples include directing source fluid (e.g., hydrated fluid from the hydration transport 118) received at one or more inlet manifolds into one or more blending tubs and/or discharging fracturing fluid via one or more outlet manifolds to supply fracturing fluid to the fracturing pump transports 108. Other electric prime movers may power other blending operations, such as metering the fracturing sand into the blending tubs and mixing hydrated fluid with fracturing sand to form the fracturing fluid.

[0040] The data van 114 may be part of a control network system, where the data van 114 acts as a control center configured to monitor and provide operating instructions in order to remotely operate the hydration transport 118, the blender transport 110, the mobile source of electricity 102, fracturing pump transport 108 and/or other fracturing equipment within the mobile fracturing system 103. For example, the data van 114 may communicate via the control network system with the

VFDs located within the drive power transports 104 that operate and monitor the health of the electric motors used to drive the pumps on the fracturing pump transports 108. Other fracturing equipment shown in FIG. 1, such as gas conditioning transport, frac tanks, chemical storage of chemical additives, sand conveyor, and sand container storage are known by persons of ordinary skill in the art, and therefore are not discussed in further detail.

[0041] In one embodiment, rather than having a separate hydration transport 118 and blender transport 110, the mobile fracturing system 103 could include a single hydration-blender transport (not shown in FIG. 1). Using FIG. 1 as an example, the hydration-blender transport receives electric power from the auxiliary unit transport 106 to power a plurality of electric prime movers to perform a variety of hydration and blending operation. As an example, the hydration tank of the hydration-blender transport could be configured to perform a continuous hydration process to hydrate a polymer-based slurry with the source fluid to reach the target viscosity. Implementing a continuous hydration process rather than a batch process allows the hydration tank to produce hydrated fluid as needed or in real-time, where the rate of hydrated fluid production corresponds to the amount of fracturing fluid the blender unit provides to the fracturing pump transport 108. To provide an adequate amount of residence time to hydrate the polymer-based slurry, the hydration tank may direct the hydrated fluid to travel a torturous flow path that delays supplying the hydrated fluid to the blender unit.

[0042] The torturous flow path may be configured to provide a minimal amount of residence time for a given flow rate to produce hydrated fluid with the target viscosity. Moreover, the torturous flow path is configured to hold a targeted volume of hydrated fluid to sustain a delivery rate of the hydrated fluid to the blender unit. For example, to provide a targeted flow rate of about 80 to 100 barrels per minute (bpm) and a residence time of about three minutes, the torturous flow path or volume of the hydration tank would need to hold at least about 240 barrels. As the hydrated fluid travels through the torturous flow path, the torturous flow path may also be configured to further mix, agitate, and apply shear forces that enhance hydration of the polymer-based slurry. The torturous flow path for the hydration tank may be

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implemented using a variety of methods known by persons of ordinary skill in the art.

[0043] One or more pumps on the hydration-blender transport may then direct the hydrated fluid with the target viscosity to the blender unit to mix fracturing sand with the hydrated fluid. In one embodiment, the hydration-blender transport may include a dual configuration blender that comprises electric prime movers (e.g., electric motors) for the rotating machinery. The dual configuration blender may have two separate blending tubs configured to be independent and redundant, where any one or both of the blending tubs may receive hydrated fluid that originated from any of the inlet manifolds. In other words, source fluid received from any of the inlet manifolds may subsequently be hydrated and then blended by any one or both of the blending tubs. Afterwards, the blended fracturing fluid is discharged out of any of the outlet manifolds. In one embodiment, when both blending tubs are operational, the dual configuration blender may have a blending capacity of up to about 240 bpm. Other embodiments of the hydration-blender transport may utilize a single configuration blender that only has a single blending tub.

[0044] Combining the hydration tank and blender into a single hydration-blender transport also allows the hydration-blender transport to support a variety of operation modes, such as straight through operation mode, hydration operation mode, and/or split stream operation mode. In a straight through operation mode, the hydration-blender transport receives the source fluid from one or more inlet manifolds and directly discharges the source fluid to one or more outlet manifolds by having the source fluid bypass both the hydration tank and blending tubs of the blender unit. By doing so, the hydration-blender transport supplies source fluid, which can also be referred to as clean fluid, to one or more fracturing pump transports 108. In hydration operation mode, the hydration-blender transport directs the source fluid into the hydration tank, pumps the hydrated fluid into the blending tubs to form fracturing fluid and discharges the fracturing fluid, which can also be referred to as dirty fluid, to one or more outlet manifolds. In a split stream operation mode, the hydration-blender transport is able to discharge both clean fluid and dirty fluid to different outlet manifolds. To supply a split stream to the fracturing pump transports, a portion of the source fluid bypasses both the hydration tank and blending tubs and directly flows

out to the outlet manifolds, and a remaining portion of the source fluid is directed into the hydration tank to generate the dirty fluid.

[0045] Having a hydration-blender transport with different operation modes provides operators flexibility in utilizing a variety of fracturing fluids. Specifically, the hydration-blender transport is flexible enough to provide clean fluid, dirty fluid, or both based on an operator's desired fracturing operation. Using FIG. 1 as an example, the mobile fracturing system 103 may have some of the fracturing pump transports 108 pump clean fluid and other fracturing pump transports 108 pump dirty fluid as fracturing fluid. An operator may desire to utilize clean fluid as fracturing fluid because of the potential benefits of increasing and enhancing the life of fracturing pumps. Because of additional wear fracturing sand and the polymer-based slurry may cause, pumps and manifold equipment exposed to dirty fluid are often susceptible to higher maintenance costs and/or decreases in useful life when compared to pumps and manifold equipment operating with clean fluid. As such, by having some of the fracturing pump transports 108 pump clean fluid, an operator may reduce fracturing operating costs.

[0046] Power Distribution from a Mobile Source of Electricity

[0047] FIG. 2 is a schematic diagram of an embodiment of a medium-low voltage power distribution system for the mobile fracturing system 103. Although the voltage and current levels referenced in FIG. 2 generally refer to AC electric power, other embodiments could have the mobile fracturing system 103 configured to be powered using DC electric power. As shown in FIG. 2, the mobile source of electricity 102 provides power by connecting to the switch gear transport 112 using three medium voltage (e.g., 13.8 kV) cable connections. In one or more embodiments, the mobile source of electricity 102 includes a turbine-electric generator transport that compresses and mixes combustion air with hydrocarbon gas to spin and generate mechanical energy and then converts the mechanical energy to electricity. The mobile source of electricity 102 could also include an inlet and exhaust transport that provides ventilation and combustion air to the turbine-electric generator transport when generating electricity. Configuring and utilizing a turbine-electric generator transport and an inlet and exhaust transport are discussed and shown in more detail in U.S. Patent 9,534,473, filed December 16, 2015 by Jeffrey G. Morris et al. and

entitled "Mobile Electric Power Generation for Hydration Fracturing of Subsurface Geological Formations," which is hereby incorporated by reference as if reproduced in its entirety. In other embodiments, the mobile source of electricity 102 could include other transport configurations to employ a centralized source of electricity that powers fracturing equipment.

[0048] The switch gear transport 112 contains a transformer that steps down the medium voltage (e.g., 13.8 kV) electric power to a low voltage level (e.g., 480 V) and provides a low voltage (e.g., 480 V) electrical connection to other transports. Using FIG. 2 as an example, the switch gear transport 112 connects to the drive power transports 104 and the auxiliary unit transport 106 using the 480 V electrical connection. FIG. 2 also illustrates that the switch gear transport 112 utilizes four 480 V cable connections from an auxiliary power transport 120 that provides electric power to ignite, start, or power on the mobile source of electricity 102 and/or provide ancillary power where peak electric power demand exceeds the electric power output of mobile source of electricity 102. Although not shown in FIG. 2, in other embodiments, the switch gear transport 112 may also include a transformer to step down the electric power from a medium voltage level (e.g., 13.8 kV) to a relatively lower medium voltage level (e.g., 4.2 kV) and provide the relatively lower medium voltage level (e.g., 4.2 kV) directly to the drive power transports 104.

[0049] As shown in FIG. 2, both the hydration transport 118, blender transport 110, and fracturing pump transports 108 do not contain transformers to step down the voltage for the switch gear transport's 112 electric power. Instead, the voltages supplied to power the fracturing equipment (e.g., the electric prime movers) are stepped down upstream at different transports within the mobile fracturing system 103. As an example, the drive power transports 104 may be operable to step down a medium voltage level (e.g., 13.8 kV) that the switch gear transport 112 supplies to a relatively lower medium voltage level (e.g., 4.2 kV), and the auxiliary unit transport 106 may be able to step down a medium voltage level (e.g., 13.8 kV) that the switch gear transport 112 supplies to a low voltage level (e.g., 480 V). In other examples, switch gear transport 112 may include other transformers that step down the voltage to other voltages. The drive power transports 104 and auxiliary unit transport 106 then supply the stepped down voltages to power electric prime movers mounted on

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transports (e.g., blender transport 110 and fracturing pump transports 108) and other fracturing equipment. In one or more embodiments, the transformers and/or drives (e.g., VFDs) for controlling the electric prime movers may be placed on drive power transports 104 and/or auxiliary unit transport 106 because the fracturing pump transports 108 and/or blender transports 110 may not have enough space or may exceed a specific weight limit.

[0050] In FIG. 2, the switch gear transport 112 provides a medium voltage (e.g., 13.8 kV) electrical connection and a low voltage (e.g., 480 V) electrical connection to the drive power transports 104. Specifically, each drive power transport 104 receives a single medium voltage (e.g., 13.8 kV) cable connection from the switch gear transport 112 and utilizes transformers to step down the voltage level of the received electric power from the medium voltage level (e.g., 13.8 kV) to a relatively lower medium voltage level (e.g., 4.2 kV). Each drive power transport 104 also receives a single low voltage (e.g., 480 V) cable connection from the switch gear transport 112. After the drive power transports 104 receives electric power from the switch gear transport 112, each drive power transport 104 provides electric power to two different fracturing pump transports 108. In other words, the mobile fracturing system 103 implements a 2:1 ratio regarding the number of fracturing pump transports 108 that receive electric power from a drive power transport 104. Other embodiments could have different ratios where the drive power transport 104 supply power to a single fracturing pump transport 108 (e.g., 1:1 ratio) or more than two fracturing pump transport 108 (e.g., 3:1 or 4:1 ratio).

[0051] As shown in FIG. 2, each drive power transport 104 supplies a low voltage (e.g., 480 V) cable connection and two relatively lower medium voltage (e.g., 4.2 kV) cable connections to power each fracturing pump transport 108. The low voltage cable connection may supply electric power to drives (e.g., VFDs) and/or other electrical equipment (e.g., sensors) mounted on the fracturing pump transport 108. The two medium voltage (e.g., 4.2 kV) cable connections supply electric power to one or more electric prime movers that drive one or more pumps that pump fracturing fluid into a wellbore. As an example, the fracturing pump transport 108 contains a 5,000 horsepower (HP) dual-shaft electric motor that utilizes about 600 amperes (A) of electric current to operate. The dual-shaft electric motor could be a dual-shaft

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electric motor that is discussed and shown in more detail in U.S. Patent 9,534,473, filed December 16, 2015 by Jeffrey G. Morris et al. and entitled "Mobile Electric Power Generation for Hydration Fracturing of Subsurface Geological Formations." To supply enough electric power, each of the medium voltage (e.g., 4.2 kV) cable connections could provide about 300 A of electric current. Having a single medium voltage (e.g., 4.2 kV) electrical cable that provides 600 A of electric current to the dual-shaft electric motor may not be desirable because of safety concerns with the relatively high current flow. Besides safety concerns regarding the relatively high current (e.g., 600 A) flow, having a single electrical cable could also cause connection and/or disconnections issues because of the thicker cable size used to support relatively high current flow.

[0052] FIG. 2 also illustrates that the switch gear transport 112 supplies a single medium voltage (e.g., 13.8 kV) cable connection and a single low voltage (e.g., 480 V) cable connection to an auxiliary unit transport 106. The auxiliary unit transport 106 includes at least one transformer to step down the voltage from the medium voltage level (13.8 kV) to the low voltage level (e.g., 480 V). The auxiliary unit transport 106 supplies a low voltage level (e.g., 480 V) electrical connection to both the hydration transport 118 and blender transport 110. In FIG. 2, the hydration transport 118 and blender transport 110 are separate and independent from each other, where the hydration transport 118 receives two low voltage (e.g., 480 V) cable connections and the blender transport 110 receives eight low voltage (e.g., 480 V) cable connections from the auxiliary unit transport 106. Other embodiments of the power distribution system may have the auxiliary unit transport 106 provide a low voltage (e.g., 480 V) electrical connection (e.g., ten cable connections) to a single hydration-blender unit transport for embodiments when the blender transport 110 and hydration transport 118 are integrated into a single transport.

[0053] FIG. 3 is a schematic diagram of another embodiment of a medium voltage power distribution system for the mobile fracturing system 302. In contrast to FIG. 2, the power distribution system moves the voltage step down further downstream by placing transformers 310 and/or 312 on the fracturing pump transports 304 and hydration-blender transport 306. As shown in FIG. 3, the mobile fracturing system 302 reduces the number of transports by eliminating the need for

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an auxiliary unit transport (e.g., auxiliary unit transport 106 in FIG. 2) and/or drive power transports (e.g., drive power transports 104 in FIG. 2). Instead, the drives (e.g., VFDs) to control and monitor the electric prime movers of the fracturing pump transports 304 and transformers 310 and/or 312 for stepping down the voltage for the electric power are mounted on the fracturing pump transport 304 and the hydration-blender transport 306.

[0054] FIG. 3 illustrates that switch gear transport 308 connects to a mobile source of electricity 102 with six medium voltage (e.g., 13.8 kV) cable connections. The switch gear transport also connects to an auxiliary power transport 120 with one medium voltage (e.g., 13.8 kV) cable connection. The switch gear transport 308 also includes a transformer 312 that steps down electric power received at a medium voltage level (e.g., 13.8 kV) from the auxiliary power transport 120 to a low voltage level (e.g., 480 V). The low voltage level (e.g., 480 V) connection may provide electric power to ignite, start, or power on the mobile source of electricity 102. In contrast to FIG. 2, the switch gear transport 308 does not output or provide low voltage (e.g., 480 V) electrical connections to other transports. Specifically, the switch gear transport 308 outputs and supplies medium voltage (e.g., 13.8 kV) cable connections directly to the hydration-blender transport 306 and the fracturing pump transport 304 without connecting to any intermediate transports (e.g., drive power transport 104 and auxiliary unit transport 106 in FIG. 2). FIG. 3 depicts that the switch gear transport 308 generates a total seven medium voltage (e.g., 13.8 kV) cable connection, where each fracturing pump transports 304 is directly connected to the switch gear transport 308 with a single medium voltage (e.g., 13.8 kV) cable connection. The switch gear transport 308 also directly connects to the hydration-blender transport 306 using a single medium voltage (e.g., 13.8 kV) cable connection.

[0055] The medium voltage power distribution system shown in FIG. 3 is able to reduce the number of electrical cables used to supply electric power to the fracturing pump transport 304 and hydration-blender transport 306 when compared to the medium-low power distribution system shown in FIG. 2. Specifically, when compared to the medium-low power distribution system shown in FIG. 2, the medium voltage power distribution system in FIG. 3 is able to reduce the number of electrical cables that provide power to each fracturing pump transport 304. As shown in FIG.

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3, the mobile fracturing system 302 reduces the number of electrical cables from three electrical cables to one electrical cable for each fracturing pump transport 304. A further reduction of electrical cables is shown by supplying one electrical cable to the hydration-blender transport 306 instead of the ten electrical cables used to power both the blender transport 110 and hydration transport 118. One reason the medium voltage power distribution system is able to utilize less electrical cables is that each electrical cable does not need to supply a relatively high current (e.g., 600 A) to each of the fracturing pump transports 304 and hydration-blender transport 306. Supplying electric power at relatively lower current levels avoids the safety concerns and/or connection/disconnection issues associated with using a single electrical cable that supplies relatively high current (e.g., 600 A).

[0056] Each fracturing pump transport 304 may include one or more transformers to step down the voltage received from the switch gear transport 308 to different voltage levels. Using FIG. 3 as an example, each fracturing pump transport 304 may include two separate and independent transformers, a first transformer 310 to step down to a voltage level of 4.2 kV and a second transformer 312 to step down to a voltage level of 480 V. In other examples, each fracturing pump transport 304 could include a single transformer that produces multiple voltages levels. For example, the fracturing pump transport 304 may mount a three phase or three winding transformer to step down the voltage to two different voltage levels. Recall that the 4.2 kV voltage level supplies electric power to one or more electric prime movers that drive one or more pumps and the 480 V supplies electric power to the drives and/or other control instrumentation mounted on the fracturing pump transport 304. Transformers 310 and 312 are configured to supply enough electric current to power the prime movers, drivers, and/or other control instrumentation.

[0057] FIG. 3 also illustrates that the hydration-blender transport 306 may include a transformer that steps down the voltage level to 480 V. The hydration-blender transport 306 can use the stepped down voltages levels to provide electric power to the electric prime movers for the hydration-blender transport 306, drives, and/or other control instrumentation mounted on the hydration-blender transport 306. The hydration-blender transport 306 may also be configured to provide electric power at the 480 V voltage level to other downstream fracturing equipment, such as the sand

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conveyor. In FIG. 3, the medium voltage power distribution system may utilize two electrical connections to provide electric power to the sand conveyor. Although FIG. 3 illustrates that switch gear transport 308 provides electric power to a hydration-blender transport 306, other embodiments could have the switch gear transport 308 separately connect to a hydration transport and a blender transport. In such an embodiment, the switch gear transport 308 may connect to the hydration transport using a single medium voltage (e.g., 13.8 kV) cable connection and another single medium voltage (e.g., 13.8 kV) cable connection to connect to the blender transport.

[0058] By mounting the drives and transformers 310 and/or 312 onto the fracturing pump transport 304 and hydration-blender transport 306, the transports become individually autonomous by removing the need for other separate support-based trailers, such as the auxiliary unit transport and drive power transports that provide power conversion and/or drive control. Having autonomous trailers allows the mobile fracturing system 302 to become scalable and flexible, where each fracturing pump transport may be interchangeable with each other. For example, if the well is relatively small, the mobile fracturing system 302 may have a reduced number of fracturing pump transports 304 (e.g., four transports instead of six transports). Conversely, if the well is large and/or the well site is located at high elevations and/or high temperatures, more fracturing pump transports 304 can be stacked to increase pumping capacity without utilizing additional support-based transports (e.g., drive power transports 104 shown in FIGS. 1 and 2).

[0059] Although FIGS. 2 and 3 illustrates specific embodiments of mobile fracturing system 103 and 302 that utilize electric power for operations, the disclosure is not limited to these particular embodiments. For instance, with reference to FIG. 3, the disclosure describes a switch gear transport 308 receiving electric power from a mobile source of electric. However, other embodiments could have the switch gear transport 308 receive electric power from other types of power sources, such as a power grid or a stationary power source. Additionally or alternatively, the mobile fracturing system 302 shown in FIG. 3 may utilize a separate hydration transport and blender transport instead of the hydration-blender transport 306. The use and discussion of FIGS. 2 and 3 are only examples to facilitate ease of description and explanation.

[0060] Hydration-Blender Transport

[0061] FIG. 4A illustrates a side view of an embodiment of a hydration-blender transport 400 that comprises a hydration tank 402, a blender unit 404, an electric prime mover 406, a pump 408, and multiple manifold groups 410, 412, and 414. FIG. 4A also depicts that the hydration-blender transport 400 as a trailer that includes four axles. Other embodiments of the hydration-blender transport 400 may vary the number of axles depending on the weight of the fracturing equipment and/or the size of the hydration tank 402. For example, the hydration-blender transport 400 may include three axles to allow for mounting of a hydration tank 402 with larger volume. By removing the axle 401 from the trailer, the hydration-blender transport 400 has more available space to mount a larger hydration tank 402.

[0062] Depending on the operation modes, the manifold groups 410, 412, and 414 may be configured as inlet manifolds that receive source fluid and/or outlet manifolds that supply fracturing fluid to one or more fracturing pump transports. The manifold groups 410, 412, and 414 are coupled to the hydration-blender transport's 400 internal manifold system to route fluid within the hydration-blender transport 400. The electric prime movers 406 (e.g., electric motors) may drive the pumps 408 to draw in and deliver source fluid to the hydration tank 402, blender unit 404, and/or directly to another manifold group based on the configuration of the internal manifold system. To implement a variety of operation modes, the internal manifold system includes a plurality of valves (not shown in FIG. 4A) configured to isolate different sections of the internal manifold system.

[0063] The internal manifold system may comprise a hydration tank manifold system 416, a hydration-blender manifold system 418, a blender output manifold system 420, an interconnector manifold system 424, and an under tank manifold system 430. The interconnector manifold system 424 may connect the manifold groups 410, 412, and 414, the pumps 408, the hydration tank manifold system 416, the hydration-blender manifold system 418, and the under tank manifold system 430 to each other. To connect the interconnector manifold system 424 to the manifold groups 410 and 412, connection points 426 and 432, respectively, may be used to connect the interconnector manifold system 424 to the under tank manifold system 430. The hydration tank manifold system 416 may be configured to receive source

fluid from one or more of the manifold groups 410, 412, and 414 via the interconnector manifold system 424 to transport the source fluid within the hydration tank 402.

[0064] After the hydration tank 402 hydrates the polymer-based slurry with the source fluid, the hydration-blender manifold system 418 transports the hydrated fluid from the hydration tank 402 to blending tubs 454. Once the blending tubs 454 mix fracturing sand with the hydrated fluid to form fracturing fluid, the blender output manifold system 420 may then transport the fracturing fluid from the blender unit 404 to one or more manifold groups 410, 412, and 414. A feedback manifold system 428 may be configured to feedback liquid within the hydration tank 402 to maintain a desired level of hydrated fluid. The under tank manifold system 430 may be configured to connect the manifold groups 410, 412, and 414 to each other. Although not illustrated, the internal manifold system shown in FIG. 4 may include other components known by persons of ordinary skill in the art to monitor fluid properties and/or direct fluids within the hydration-blender transport 400, such as flow meters, densitometers, and valves.

[0065] As shown in FIG. 4A, the hydration-blender transport 400 may include a power and control system 436. In one embodiment, the power and control system 436 may include a drive (e.g., a VFD) to control the electric prime movers 406 and a transformer to step down incoming voltage. For example, the transformer is configured to receive a relative higher voltage (e.g., 13.8 kV) and step down the voltage level to 480 V. The power and control system 436 may also be configured to provide electric power at the 480 V voltage level to other downstream fracturing equipment, such as the sand conveyor. In another embodiment, the power and control system 436 may include the drive to control the electric prime movers 406, but may not include the transformer and instead receives power at the stepped down voltage (e.g., 480 V) from another transport.

[0066] FIG. 4A illustrates that the blender unit 404 is a dual configuration blender that includes two separate blending modules to produce fracturing fluid. Each blending module includes a blending tub 454, a hopper 450 (also known as surge tanks), and a metering component 452 (e.g., an auger). To power the blending operations, the blender unit 404 may also include prime movers 456 and 458. As

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shown in FIG. 4A, each of the blending modules includes an electric prime mover 456 to power the metering component 452 that meters fracturing sand into the blending tub 454, and an electric prime mover 458 to drive pumps to power the blending tub. The blending tub 454 mixes the fracturing sand and hydrated fluid received from the hydration-blender manifold system 418 to produce the fracturing fluid that discharges via the blender output manifold system 420. The blending tub 454 may discharge the fracturing fluid using a pump (not shown in FIG. 4A) driven by a prime mover.

[0067] In FIG. 4A, the metering component 452 is an auger positioned at an incline to meter the fracturing sand into a blending tub 454. Other embodiments of the blender unit 404 may have the metering component 452 positioned in a straight or horizontal orientation. Correctly controlling and metering fracturing sand into the blending tub 454 affects the overall proppant concentration of the fracturing fluid (e.g., weight of the slurry). Controlling the overall proppant concentration is advantageous because the overall proppant concentration could affect the proppant transport and the propped fracture dimensions of the subsurface geological formations and the realization of the hydraulic fracturing treatment.

[0068] The blender unit 404 unit may be configured to produce fracturing fluid using dry fracturing sand and/or wet fracturing sand. In one embodiment, to be able to produce fracturing fluid using wet fracturing sand, the blender unit 404 may include one or more vibrator components (e.g., mechanical vibrators, vibration screens, and acoustic generators), which are not shown in FIG. 4A, to liquefy sand and enhance the flow properties of the wet fracturing sand. The vibrator components may be powered by a variety of power sources that include, but are not limited to, air pressure, hydraulics, and/or electricity. When powering the vibrator components by electricity, the blender unit 404 includes electric motors to drive hydraulic pumps that operate the vibrator components. By controlling the electric motors, an operator is able to indirectly control one or more vibrator components via the hydraulic pressure. In another example, operators are able to control the one or more vibrator components directly by connecting one or more electric motors to one or more vibrator components. Adjusting the electric motors' attributes, such as frequency, voltage, and/or amperage could vary operation of the vibrator components. To reduce

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vibration and disturbances to other components of the hydration-blender transport 400, the blender unit 404 may include a vibration isolation system that include springs, air bags, rubber-based dampeners (e.g., rubber bushings), and/or other vibration isolation components. In embodiments where a vibration screen and/or acoustic waves are used to directly liquefy sand without vibrating the blending tub, the vibration isolation system may dampen and reduce the amount of vibration experienced by the blending tub. Processing and liquefying wet fracturing sand is discussed in more detail in U.S. Patent Application No. 15/452,415, filed March 7, 2017 by Jeffrey G. Morris et al. and entitled "Utilizing Wet Fracturing Sand for Hydraulic Fracturing Operations," which is hereby incorporated by reference as if reproduced in its entirety.

[0069] FIG. 4B illustrates an under tank cross sectional view of the hydration-blender transport 400. Specifically, FIG. 4B represents the C-C cross sectional view illustrated in FIG. 4A that highlights the under tank manifold system 430. As shown in FIG. 4B, the under tank manifold system 430 includes two redundant sides that are coupled together using crossing manifolds 440 and 442. The blender output manifold system 420 discussed in FIG. 4A, connects to both sides of the under tank manifold system 430 at connection points 444 such that the output of one of the blending tubs connects to one side of the under tank manifold system 430. The crossing manifolds 440 and 442 allow fracturing fluid to be discharged to either side or both sides of the hydration-blender transport 400 and also allows the hydration tank to receive source fluid from either side of the hydration-blender transport 400. Each side of the under tank manifold system 430 also includes the manifold groups 410, 412, and 414, where each manifold group can be isolated using values (not shown in FIG. 4B). The crossing manifolds 440 and 442 may include valves to allow or prevent fluid from flowing to both sides of the under tank manifold system 430.

[0070] FIG. 4B also illustrates that the under tank manifold system 430 includes three pump connection points 446, connection points 426, and a connection point 432. The three pump connection points 446 interconnect the under tank manifold system 430 to the pumps 408 shown in FIG. 4A. FIG. 4A illustrates that the electric prime movers 406 are positioned above the pumps 408 such that one or more of the electric prime movers 406 may drive one or more pumps 408. The pumps 408 are

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then able to direct source fluid and/or fracturing fluid into and out of the under tank manifold system 430. For instance, the pumps 408 may be able to pump source fluid received from one or more manifold groups 410, 412, and 414 to the interconnector manifold system 424 via connection points 426. One or more valves can be set according to the operation mode for the hydration-blender transport 400. For example, to implement split streaming operation, a valve associated with the connection point 432 may be set to an open position such that source fluid received from the manifold groups 410, 412, and 414 is sent directly to another manifold groups 410, 412, and 414 (e.g., manifold group 412) and bypasses the hydration tank 402. In other words, the connection point 432 may be used to bypass the hydration tanks 402 and blending tubs 454 and directly pump source fluid received from one or more manifold groups 410, 412, and 414 back out to other manifold groups 410, 412, and 414.

[0071] FIG. 4C illustrates a cross sectional view of the hydration-blender transport 400 that depicts the inside of the hydration tank 402. As shown in FIG. 4C, the inside of the hydration tank 402 includes the interconnector manifold system 424 that allows the pumps, driven by electric prime movers 406, to direct fluid to different sections of the internal manifold system. In particular, the interconnector manifold system 424 connects to the hydration tank manifold system 416 via connection points 462 and 438 and connects to the hydration-blender manifold system 418 via connection point 464. Using the interconnector manifold system 424, the pumps are able to direct source fluid received at one or more manifold groups 410, 412, and 414 to the hydration tank via the hydration tank manifold system 416 and/or pump hydrated fluid to the blending tubs 454 via the hydration-blender manifold system 418.

[0072] FIG. 4D illustrates a top view of the hydration-blender transport 400 that depicts the top of the hydration tank 402. In FIG. 4D, the hydration tank manifold system 416 receives source fluid and directs that source fluid to a diffuser located at the top of the hydration tank 402. The diffuser combines the source fluid with the polymer-based slurry and feeds the hydrated fluid to a tortuous flow path within the hydration tank 402. Once the hydrated fluid travels through the tortuous flow path, the hydration-blender manifold system 418 obtains the hydrated fluid via the

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interconnector manifold system 424 and supplies the hydrated fluid to the blending tubs 454. In one embodiment, the hydration-blender manifold system 418 includes two different manifold connections, where each manifold connection supplies hydrated fluid to one of the blending tubs 454. Afterwards, the blending tub discharges the fracturing fluid via the blender output manifold system 420.

[0073] FIG. 4E illustrates a cross sectional view of the hydration-blender transport 400 that corresponds to section cut A-A shown in FIG. 4D. In FIG. 4E, the electric prime mover 406 and pump 408 combination is mounted in an upright position such that the electric prime mover 406 is mounted on top of the pump 408. The pumps 408 are also connected to the under tank manifold system 430. Three different electric prime mover 406 and pump 408 combinations may be used to provide enough power to simultaneously pump source fluid into the hydration-blender transport 400, pump hydrated fluid into the blending tubs 454, and/or pump fluid out of the hydration-blender transport 400. In one embodiment, the pumps 408 may be centrifugal pumps.

[0074] FIG. 4F illustrates an under tank cross sectional view of another embodiment of a hydration-blender transport 400. Specifically, FIG. 4F represents the C-C cross sectional view illustration of an under tank manifold system 480 that is substantially similar to the under tank manifold system 430 shown in FIG. 4B. The under tank manifold system 480 is similar to the under tank manifold system 430 except that the under tank manifold system 480 includes a sump 482 for collecting and remove fluid from the hydration tank 402. As an example, when an operator completes a fracturing job, the operator may empty fluid stored within the hydration tank 402 before transportation. An operator is able to divert stored fluid within the hydration tank 402 to the sump 482 when discharging fluid out of the hydration tank 402.

[0075] FIG. 5 illustrates an embodiment of a hydration-blender transport 500 that includes a single blending tub. FIG. 5 illustrates a top view of the hydration-blender transport 500 that depicts the top of the hydration tank. FIG. 5 is similar to FIG. 4D except that manifolds within the hydration-blender manifold system 418 and blender output manifold system 420 that correspond to the missing blending tub have been removed. For example, in FIG. 4D, once the hydrated fluid travels through the

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tortuous flow path, the hydration-blender manifold system 418 supplies the hydrated fluid to only one blending tub 454. The hydration-blender manifold system 418 includes only one manifold connection to supply hydrated fluid to the one blending tubs 454. Afterwards, the blending tub 454 discharges the fracturing fluid via the blender output manifold system 420(e.g., using a pump not shown in FIG. 5), which only has one outlet manifold connection to the blending tub 454. Although FIG. 5 illustrates that three electric prime movers 406 may be used to drive three pumps 408, other embodiments of the hydration-blender transport 500 could include two electric prime movers 406 that drive two pumps 408.

[0076] FIG. 6 is a flow chart of an embodiment of a method 600 to provide fracturing fluid using a single hydration-blender transport. Method 600 may correspond to the hydration-blender operation mode and the split-stream operation mode. The use and discussion of FIG. 6 is only an example to facilitate explanation and is not intended to limit the disclosure to this specific example. For example, although FIG. 6 illustrates that the blocks within method 600 are implemented in a sequential order, method 600 is not limited to this sequential order. For instance, one or more of the blocks, such as blocks 604 and 606, could be implemented in parallel.

[0077] Method 600 may start at block 602 by receiving source fluid from one or more inlet/outlet manifolds. To implement block 602, method 600 may configure one or more values within the hydration-blender transport such that some of the inlet/outlet manifolds are configured to receive source fluid and some of the of inlet/outlet manifolds discharge fracturing fluid. Method 600 may then move to block 604 and drive one or more pumps to route the source fluid from the inlet/outlet manifolds into a hydration tank. In one embodiment, method 600 may use electric prime movers to drive pumps to route the source fluid.

[0078] Method 600 continues to block 606 and hydrates a polymer-based slurry with the source fluid to produce hydrated fluid with a target viscosity. In one embodiment, method 600 may utilize a tortuous flow path that provides enough residence time and a flow rate to supply fracturing fluid to a blender unit. Afterwards, method 600 moves to block 608 and drives one or more pumps to route the hydrated fluid into one or more blending tubs. Method 600 then moves to block 610 and mixes the hydrated fluid with metered fracturing sand to produce fracturing fluid.

Afterwards, method 600 continues to block 612 and drives one or more pumps to discharge the fracturing fluid from the blending tubs. Prior to discharging the fracturing fluid, method 600 may configure one or more valves to direct which inlet/outlet manifolds receive the fracturing fluid.

[0079] FIG. 7 is a flow chart of an embodiment of a method 700 to supply electric power to fracturing equipment using a medium voltage power distribution system. For example the medium voltage power distribution system that includes the switch gear transport 308 and transformers 310 and 312 shown in FIG. 3 can implement method 700. The use and discussion of FIG. 7 is only an example to facilitate explanation and is not intended to limit the disclosure to this specific example. For example, although FIG. 7 illustrates that the blocks within method 700 are implemented in a sequential order, method 700 is not limited to this sequential order. For instance, one or more of the blocks, such as blocks 704 and 706, could be implemented in parallel.

[0080] Method 700 may start at block 702 by receiving electric power from a mobile source of electricity at a medium voltage level. As an example, method 700 receives electric power at 13.8 kV or at some other relatively higher medium voltage level from the mobile source of electricity. In one or more other embodiments, method 700 may receive electric power from other power sources, such as a power grid or a power plant. Method 700 may then move to block 704 and supply electric power to one or more fracturing pump transports at the medium voltage level (e.g., 13.8 kV). At block 704, method 700 does not step down the electric power received from the mobile source of electricity to a lower voltage level using transformers. Instead, method 700 at block 706 supplies electric power to one or more transports at the medium voltage level. As discussed with reference to FIG. 3, method 700 is able to reduce the number of electrical cables used to supply electric power to transports, such as fracturing pump transport 304 and hydration-blender transport 306, when compared to the medium-low power distribution system shown in FIG. 2.

[0081] Method 700 continues to block 708 and steps down the medium voltage level received at the fracturing pump transports to one or more lower voltage levels. In one embodiment, method 700 may step down the voltage level to a lower medium voltage level (e.g., 4.2 kV) or a low voltage level (e.g., 600 V or 480 V). By stepping

the voltage down at the fracturing pump transport, method 700 is able to reduce the number of transports by eliminating the drive power transports (e.g., drive power transports 104 in FIG. 2). Afterwards, method 700 moves to block 710 and steps down the medium voltage level received at other transports to one or more lower voltage levels. For example, method 700 can step down the voltage at a hydration transport, a blender transport, a hydration-blender transport, or combinations thereof. Stepping down the voltage at the different transports also reduces the number of transports by eliminating the auxiliary unit transport. Subsequently, method 700 may move to block 712 and supply electric power to one or more electric prime movers mounted on the fracturing pump transports and other transports with the lower voltage levels.

[0082] At least one embodiment is disclosed and variations, combinations, and/or modifications of the embodiment(s) and/or features of the embodiment(s) made by a person having ordinary skill in the art are within the scope of the disclosure. Alternative embodiments that result from combining, integrating, and/or omitting features of the embodiment(s) are also within the scope of the disclosure. Where numerical ranges or limitations are expressly stated, such express ranges or limitations may be understood to include iterative ranges or limitations of like magnitude falling within the expressly stated ranges or limitations (e.g., from about 1 to about 10 includes, 2, 3, 4, etc.; greater than 0.10 includes 0.11, 0.12, 0.13, etc.). The use of the term "about" means ±10% of the subsequent number, unless otherwise stated.

[0083] Use of the term "optionally" with respect to any element of a claim means that the element is required, or alternatively, the element is not required, both alternatives being within the scope of the claim. Use of broader terms such as comprises, includes, and having may be understood to provide support for narrower terms such as consisting of, consisting essentially of, and comprised substantially of. Accordingly, the scope of protection is not limited by the description set out above but is defined by the claims that follow, that scope including all equivalents of the subject matter of the claims. Each and every claim is incorporated as further disclosure into the specification and the claims are embodiment(s) of the present disclosure.

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[0084] While several embodiments have been provided in the present disclosure, it should be understood that the disclosed systems and methods might be embodied in many other specific forms without departing from the spirit or scope of the present disclosure. The present examples are to be considered as illustrative and not restrictive, and the intention is not to be limited to the details given herein. For example, the various elements or components may be combined or integrated in another system or certain features may be omitted, or not implemented.

[0085] In addition, techniques, systems, subsystems, and methods described and illustrated in the various embodiments as discrete or separate may be combined or integrated with other systems, modules, techniques, or methods without departing from the scope of the present disclosure. Other items shown or discussed as coupled or directly coupled or communicating with each other may be indirectly coupled or communicating through some interface, device, or intermediate component whether electrically, mechanically, or otherwise.

CLAIMS

What is claimed is:

1. An electric fracturing system comprising:

a switch gear transport electrically connected to a power generation source to provide electric power at a first voltage level;

an electrical cable that supplies electric power at the first voltage level; and

a fracturing pump transport electrically connected to the switch gear transport via only the electrical cable,

wherein the fracturing pump transport comprises a transformer that steps down the electric power received at the first voltage level to at least one lower voltage level.

2. The system of claim 1, wherein the first voltage level is a medium voltage level.

3. The system of claim 1, wherein the at least one lower voltage level is a medium voltage level.

4. The system of claim 1, wherein the switch gear transport is able to provide electric power at a second voltage level.

5. The system of claim 1, wherein the electrical cable connection comprises fiber optic wires that allows for communication between the switch gear transport and the fracturing pump transport.

6. The system of claim 1, further comprising:

a second electrical cable that supplies electric power at the first voltage level only; and

a blender-hydration transport electrically connected to the switch gear transport via the second electrical cable.

7. The system of claim 6, wherein the blender-hydration transport comprises a transformer that steps down the electric power from the first voltage level to one or more other lower voltage levels.

8. The system of claim 1, further comprising:

a second electrical cable that supplies electric power at the first voltage level only; and

a blender transport electrically connected to the switch gear transport via the second electrical cable.

9. The system of claim 1, further comprising:

a second electrical cable that supplies electric power at the first voltage level only; and

a hydration transport electrically connected to the switch gear transport via the second electrical cable.

10. A transport for fracturing operations comprising:

a single transport frame;

an electric prime mover mounted on the single transport frame;

a pump coupled to the electric prime mover and mounted on the single transport frame; and

a transformer coupled to the electric prime mover and mounted on the single transport frame, wherein the transformer is configured to:

receive electric power at a first voltage level from a power source via a single cable assembly;

step down the electric power at the first voltage level to at least one lower voltage level; and

supply the electric power at the at least one lower voltage level to the electric prime mover,

wherein the transport is not connected to any other cable assemblies that supply electric power at the first voltage level and other voltage levels.

11. The transport of claim 10, wherein the transport is a fracturing pump transport.

12. The transport of claim 10, wherein the transport is a hydration-blender transport.

13. The transport of claim 10, wherein the electric prime mover is a dual-shaft electric motor.

14. The transport of claim 10, wherein the transformer is further configured to step down the electric power at the first voltage level to one or more other lower voltage levels.

15. The transport of claim 14, wherein the second lower voltage level is a medium voltage level and the lower voltage level is a low voltage level.

16. The transport of claim 10, wherein the power source is a switch gear transport.

17. A method for electric power distribution for fracturing operations, comprising:

receiving, at a transport, electric power from a mobile source of electricity at a first voltage level, wherein the first voltage level falls within a range of 1,000 V to 35 kilovolts;

supplying, from the transport, the electric power to a fracturing pump transport at the first voltage level using only a first, single cable connection; and

supplying, from the transport, the electric power to a second transport at the first voltage level using only a second, single cable connection.

18. The method of claim 17, further comprising receiving, at the transport, electric power from an auxiliary power transport at the first voltage level.

19. The method of claim 18, further comprising stepping down, at the transport, the electric power from the auxiliary power transport from the first voltage level to at least one lower voltage level.

20. The method of claim 19, further comprising supplying, from the transport, the electric power at the lower voltage level to the mobile source of electricity.

21. An electric fracturing system for use with at least one power generation source providing source electric power, the system comprising:

a switch gear transport electrically connected to the at least one power generation source, and configured to receive the source electric power at a first medium voltage level;

a first electrical cable connected to the switch gear transport that supplies first electric power at the first medium voltage level from the switch gear transport; and

a first fracturing pump transport comprising: at least one first transformer, at least one drive, at least one electric prime mover, and at least one pump, each being disposed on the first fracturing pump transport,

wherein the at least one first transformer is electrically connected to the switch gear transport via only the first electrical cable, wherein the at least one first

transformer is further electrically connected to the at least one electric prime mover and to the at least one drive,

wherein the at least one first transformer is configured to step down the first electric power received at the first medium voltage level to a first lower medium voltage level that powers the at least one electric prime mover,

wherein each of the at least one drive and the at least one pump is coupled to the at least one electric prime mover, and

wherein the at least one first transformer is further configured to step down the first electric power received at the first medium voltage level to a first low voltage level that is lower than the first lower medium voltage level and that powers the at least one drive.

22. The system of claim 21, wherein the first medium voltage level is set to be at 13.8 kilovolts.

23. The system of claim 21, wherein the first low voltage level falls within a range of 50 volts to 1000 volts.

24. The system of claim 21, wherein the switch gear transport comprises a second transformer electrically connected to an auxiliary source of power providing second electric power of the first medium voltage level, wherein the second transformer is configured to step down the first medium voltage level to a second low voltage level that falls within a range of 50 volts to 1000 volts.

25. The system of claim 24, further comprising a second electrical cable disposed in electrical communication with the second transformer and configured to supply the second electric power at the second low voltage level from the switch gear transport,

wherein the second low voltage level is at a voltage for igniting and starting the at least one power generation source.

26. The system of claim 21, further comprising:

a second electrical cable connected to the switch gear transport that supplies second electric power at the first medium voltage level from the switch gear transport; and

a blender-hydration transport electrically connected to the switch gear transport via the second electrical cable and without having a trailer connected in between the switch gear transport and the blender-hydration transport,

wherein the blender-hydration transport comprises a hydration tank and at least one blending tub mounted on a single transport frame.

27. The system of claim 26, wherein the blender-hydration transport further comprises a second transformer that steps down the second electric power from the first medium voltage level to a second lower medium voltage level that is at a voltage less than the first medium voltage level.

28. The system of claim 21, further comprising:

a second electrical cable connected to the switch gear transport that supplies second electric power at the first medium voltage level from the switch gear transport; and

a blender transport electrically connected to the switch gear transport via the second electrical cable.

29. The system of claim 21, further comprising:

a second electrical cable connected to the switch gear transport that supplies second electric power at the first medium voltage level from the switch gear transport; and

a hydration transport electrically connected to the switch gear transport via the second electrical cable.

30. A fracturing transport for fracturing operations, the fracturing transport used with a switch gear transport providing electric power and comprising:

a single transport frame;

at least one electric prime mover mounted on the single transport frame;

a drive mounted on the single transport frame and coupled to the at least one electric prime mover;

a plurality of pumps coupled to the electric prime mover and mounted on the single transport frame; and

at least one transformer coupled through the drive to the electric prime mover and mounted on the single transport frame, wherein the transformer is configured to:

receive electric power at a first medium voltage level from the switch gear transport via a single cable assembly;

step down the electric power at the first medium voltage level to a lower medium voltage level, and supply the electric power at the lower medium

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voltage level through the drive to the electric prime mover to drive the pumps; and

step down the electric power at the first medium voltage level to a low voltage level, and supply the electric power at the low voltage level to the drive,

wherein the fracturing transport is not connected to any other cable assemblies that supply electric power at the first medium voltage level and other voltage levels.

31. The fracturing transport of claim 30, wherein the first medium voltage level is at a 13.8 kilovolt level.

32. The fracturing transport of claim 30, wherein the lower medium voltage level is at a voltage less than 13.8 kilovolts.

33. The fracturing transport of claim 30, wherein the electric prime mover is a dual-shaft electric motor.

34. The fracturing transport of claim 30, wherein the low voltage level falls within a range of 50 volts to 1000 volts.

35. The fracturing transport of claim 30, wherein the at least one transformer comprises a single transformer having a first transformer winding configured to step down the electric power at the first medium voltage level to the lower medium voltage level that falls within a first range of 1000 volts to 35 kilovolts, and having a second transformer winding configured to step down the electric power at the first medium voltage level to the low voltage level that falls within a second range of 50 volts to 1000 volts.

36. The fracturing transport of claim 30, wherein the switch gear transport receives electric power at the first medium voltage level from at least one power source.

37. The system of claim 21, wherein the first medium voltage level and the first lower medium voltage level fall within a range of 1000 volts to 35 kilovolts.

38. The system of claim 21, wherein the at least one first transformer comprises one of:

a single transformer configured to step down the first medium voltage level to the first lower medium voltage level and the first low voltage level; and

one transformer configured to step down the first medium voltage level to the first lower medium voltage level and another transformer configured to step down the first medium voltage level to the first low voltage level.

39. A method for electric power distribution for fracturing operations, the method comprising:

receiving, at a switch gear transport, source electric power from at least one mobile source of electricity at a first medium voltage level;

supplying, from the switch gear transport, first electric power at the first medium voltage level using only a first cable connection;

receiving, at a fracturing pump transport, the first electric power at the first medium voltage level supplied directly using the first cable connection;

stepping down, with at least one first transformer disposed on the fracturing pump transport, the first medium voltage level to both a lower medium voltage level and a low voltage level;

powering an electric prime mover disposed on the fracturing pump transport with the lower medium voltage level;

powering a drive disposed on the fracturing pump transport with the low voltage level; and

controlling output of the powered electric prime mover with the powered drive.

40. The method of claim 39, further comprising:

supplying, from the switch gear transport, second electric power at the first medium voltage level using only a second cable connection; and

receiving, at one of a blender transport, a hydration blender, and a blender-hydration transport, the second electric power at the first medium voltage level supplied directly using the second cable connection.

41. The method of claim 39, wherein the first medium voltage level and the lower medium voltage level fall within a range of 1000 volts to 35 kilovolts.

42. The method of claim 39, wherein the low voltage level falls within a range of 50 volts to 1000 volts.

43. The method of claim 39, further comprising:

stepping down, with a second transformer disposed on the switch gear transport, the first medium voltage level to a second low voltage level; and

supplying, from the switch gear transport, the electric power at the second

low voltage level to the mobile source of electricity to ignite and start the at least one mobile source of electricity.

44. An electric fracturing system for use with at least one power generation source providing source electric power, the system comprising:

a switch gear transport electrically connected to the at least one power generation source and configured to receive the source electric power at a first voltage level;

a first electrical cable connected to the switch gear transport and configured to supply first electric power at the first voltage level from the switch gear transport; and

a first transport comprising: at least one first transformer, at least one first drive, and at least one first electric prime mover, each being disposed on the first transport,

wherein the at least one first transformer is electrically connected to the switch gear transport via only the first electrical cable, wherein the at least one first transformer is further electrically connected to the at least one first drive and to the at least one first electric prime mover,

wherein the at least one first transformer is configured to step down the first electric power received at the first voltage level to a second voltage level that powers the at least one first drive, the second voltage level being less than the first voltage level, and

wherein the at least one first drive is coupled to the at least one first electric prime mover.

45. The system of claim 44, wherein the first voltage level falls within a range of 1000 volts to 35 kilovolts.

46. The system of claim 45, wherein the first voltage level is set to be at 13.8 kilovolts.

47. The system of claim 44, wherein the second voltage level falls within a range of 50 volts to 1000 volts.

48. The system of claim 44, wherein the first transport is a blender-hydration transport that is electrically connected to the switch gear transport via the first electrical cable and without having a trailer connected in between the switch gear

transport and the blender-hydration transport,

wherein the blender-hydration transport comprises a hydration tank and at least one blending tub mounted on a single transport frame, and

wherein the second voltage level further powers the at least one first electric prime mover.

49. The system of claim 44, wherein the first transport is a blender transport that is electrically connected to the switch gear transport via the first electrical cable and without having a trailer connected in between the switch gear transport and the blender transport,

wherein the blender transport comprises at least one blending tub mounted on a blender transport frame, and

wherein the second voltage level further powers the at least one first electric prime mover.

50. The system of claim 49, further comprising:

a second electrical cable connected to the switch gear transport and configured to supply second electric power at the first voltage level from the switch gear transport; and

a hydration transport electrically connected to the switch gear transport via the second electrical cable and without having a transport connected in between the switch gear transport and the hydration transport,

wherein the hydration transport comprises a hydration tank mounted on a hydration transport frame.

51. The system of claim 50, wherein the hydration transport further comprises: a second transformer, at least one second drive, and at least one second electric prime mover, each being disposed on the hydration transport,

wherein the second transformer is electrically connected to the switch gear transport via only the second electrical cable, wherein the second transformer is further electrically connected to the at least one second drive and to the at least one second electric prime mover disposed on the hydration transport,

wherein the second transformer is configured to step down the second electric power received at the first voltage level to a third voltage level that powers the at least one second drive disposed on the hydration transport, the third voltage level being

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less than the first voltage level, and

wherein the at least one second drive is coupled to the at least one second electric prime mover disposed on the hydration transport.

52. The system of claim 44, wherein the first transport is a first fracturing pump transport that is electrically connected to the switch gear transport via the first electrical cable and without having a trailer connected in between the switch gear transport and the first fracturing pump transport,

wherein the first fracturing pump transport further comprises at least one pump which is disposed on the first fracturing pump transport,

wherein the at least one first transformer is further configured to step down the first electric power received at the first voltage level to an intermediate voltage level that powers the at least one first electric prime mover, wherein the intermediate voltage level is lower than the first voltage level and is higher than the second voltage level, and

wherein each of the at least one first drive and the at least one pump is coupled to the at least one first electric prime mover.

53. The system of claim 44, wherein the switch gear transport comprises a third transformer electrically connected to an auxiliary source of power providing third electric power at the first voltage level, wherein the third transformer is configured to step down the first voltage level to a third voltage level that falls within a range of 50 volts to 1000 volts.

54. The system of claim 53, further comprising a third electrical cable disposed in electrical communication with the third transformer and configured to supply electric power at the third voltage level from the switch gear transport,

wherein the third voltage level is at a voltage for igniting and starting the at least one power generation source.

55. The system of claim 44, wherein the first electrical cable comprises fiber optic wires configured to communicate between the switch gear transport and the first transport.

56. A blender transport for fracturing operations, the blender transport used with a switch gear transport providing electric power and comprising:

a single transport frame;

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at least one blending tub mounted on the single transport frame;

at least one electric prime mover mounted on the single transport frame;

a drive mounted on the single transport frame and coupled to the at least one electric prime mover; and

a transformer coupled through the drive to the electric prime mover and mounted on the single transport frame, wherein the transformer is configured to:

receive the electric power at a first voltage level from the switch gear transport via the single cable assembly,

step down the electric power at the first voltage level to a second voltage level less than the first voltage level, and

supply the electric power at the second voltage level to the drive and to the electric prime mover.

57. The blender transport of claim 56, wherein the first voltage level is at a 13.8 kilovolt level.

58. The blender transport of claim 56, wherein the second voltage level falls within a range of 50 volts to 1000 volts.

59. The blender transport of claim 56, wherein the single cable assembly comprises fiber optic wires that allow for communication between the switch gear transport and the blender transport.

60. A hydration-blender transport for fracturing operations, the hydration-blender transport used with a switch gear transport providing electric power and comprising:

a single transport frame;

a hydration tank mounted on the single transport frame;

at least one blending tub mounted on the single transport frame;

at least one electric prime mover mounted on the single transport frame;

a drive mounted on the single transport frame and coupled to the at least one electric prime mover; and

a transformer coupled through the drive to the electric prime mover and mounted on the single transport frame, wherein the transformer is configured to:

receive the electric power at a first voltage level from the switch gear transport via a single cable assembly,

step down the electric power at the first voltage level to a second

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voltage level less than the first voltage level, and

supply the electric power at the second voltage level to the drive and to the electric prime mover.

61. The hydration-blender transport of claim 60, wherein the first voltage level is at a 13.8 kilovolt level.

62. The hydration-blender transport of claim 60, wherein the second voltage level falls within a range of 50 volts to 1000 volts.

63. The hydration-blender transport of claim 60, wherein the single cable assembly comprises fiber optic wires that allow for communication between the switch gear transport and the hydration-blender transport.

64. A transport used with a switch gear for fracturing operations, the switch gear being remote from the transport and providing electric power to the transport via a cable, the transport comprising:

a transport frame;

an electric prime mover mounted on the transport frame;

a drive mounted on the transport frame and coupled to the electric prime mover;

an electrical connection disposed on the transport frame and configured to connect to the cable of the switch gear; and

at least one transformer coupled through the drive to the electric prime mover and mounted on the transport frame, the at least one transformer being in electrical communication with the electrical connection and being configured to: receive the electric power at a first voltage level from the switch gear via the cable, step down the electric power at the first voltage level to at least one second voltage level less than the first voltage level, and supply the electric power at the at least one second voltage level to the drive and to the electric prime mover.

65. The transport of claim 64, further comprising a blending tub mounted on the transport frame and being operable with the electric prime mover.

66. The transport of claim 65, further comprising a hydration tank mounted on the transport frame and disposed in fluid communication with the blending tub.

67. The transport of claim 64, further comprising a pump mounted on the transport frame and coupled to the electric prime mover, the at least one transformer

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being configured to step down the electric power received at the first voltage level to an intermediate one and to a low one of the at least one second voltage level, the at least one transformer configured to supply the electric power at the low voltage level to the drive, the at least one transformer configured to supply the electric power at the intermediate voltage level through the drive to the electric prime mover to drive the pump.

68. The transport of claim 67, wherein the first voltage level is at a 13.8 kilovolt level, the low voltage level falls within a range of 50 volts to 1000 volts, the intermediate voltage level is at a voltage in a range from the low voltage level to less than the first voltage level.

69. The transport of claim 67, wherein the at least one transformer comprises one of:

a single transformer configured to step down the first voltage level to the intermediate voltage level and the low voltage level; and

a first transformer configured to step down to the intermediate voltage level and a second transformer configured to step down to the low voltage level.

FIG. 1

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CA 03067854 2019-12-18

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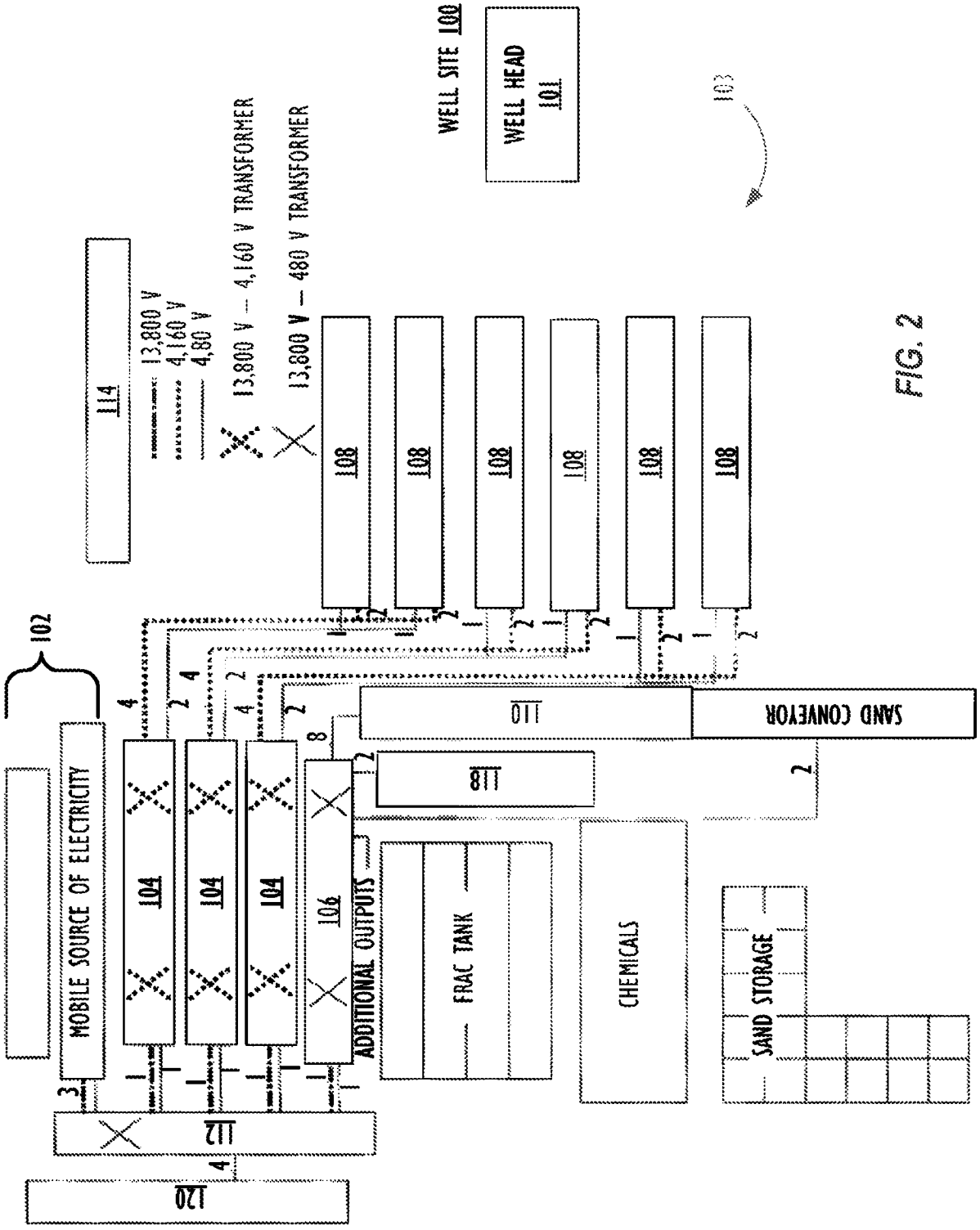

WELL SITE 100
WELL HEAD 101
103
114
13,800 V
4,160 V
480 V
13,800 V — 4,160 V TRANSFORMER
13,800 V — 480 V TRANSFORMER
108
102
MOBILE SOURCE OF ELECTRICITY
104
106
ADDITIONAL OUTPUTS
FRAC TANK
CHEMICALS
SAND STORAGE
110
SAND CONVEYOR
118
112
120

FIG. 2

3/10

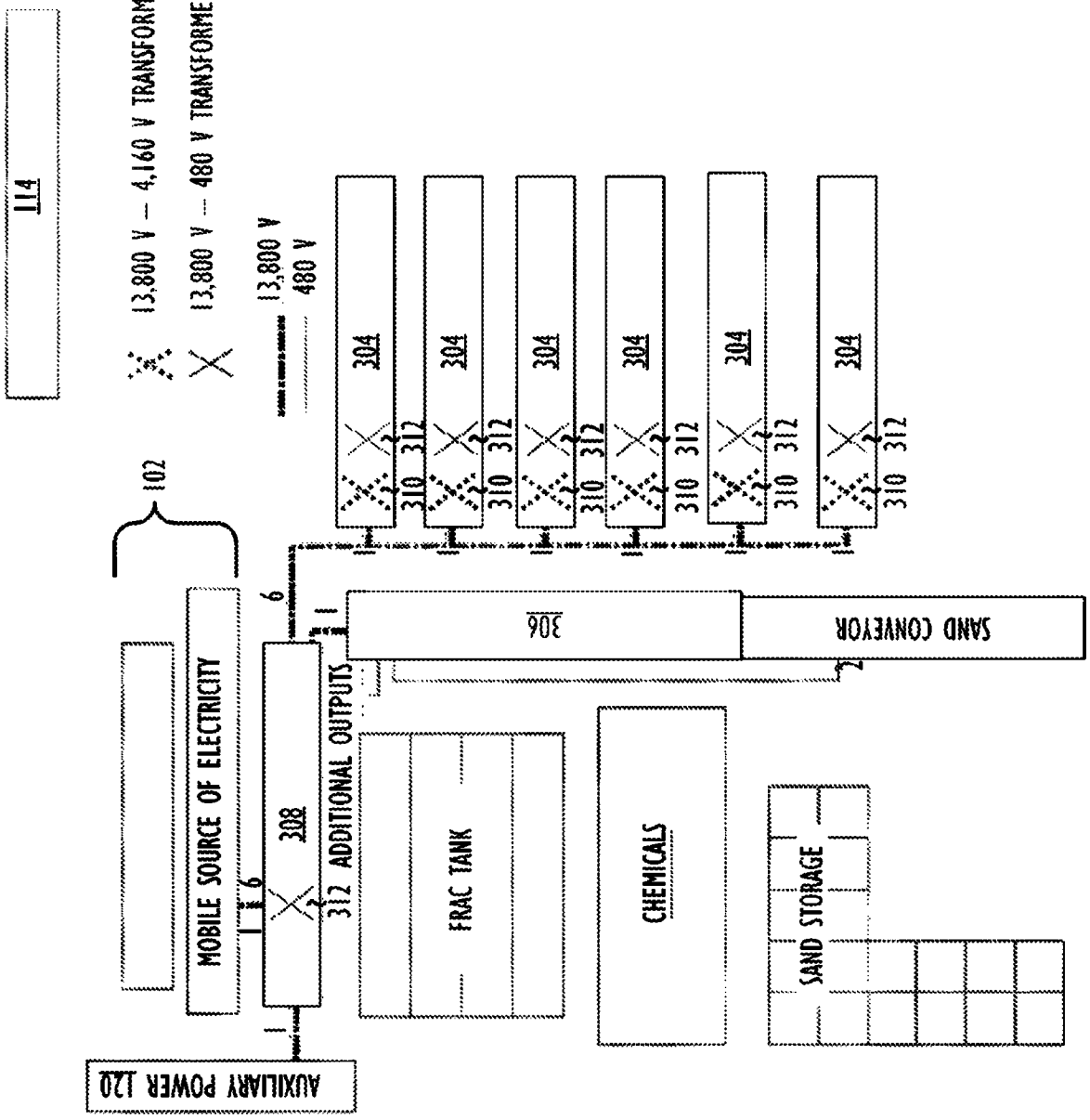

WELL SITE 100
WELL HEAD 101
302
114
13,800 V – 4,160 V TRANSFORMER
13,800 V – 480 V TRANSFORMER
13,800 V
480 V
304
310
312
102
MOBILE SOURCE OF ELECTRICITY
208
312 ADDITIONAL OUTPUTS
306
SAND CONVEYOR
FRAC TANK
CHEMICALS
SAND STORAGE
AUXILIARY POWER 120

FIG. 3

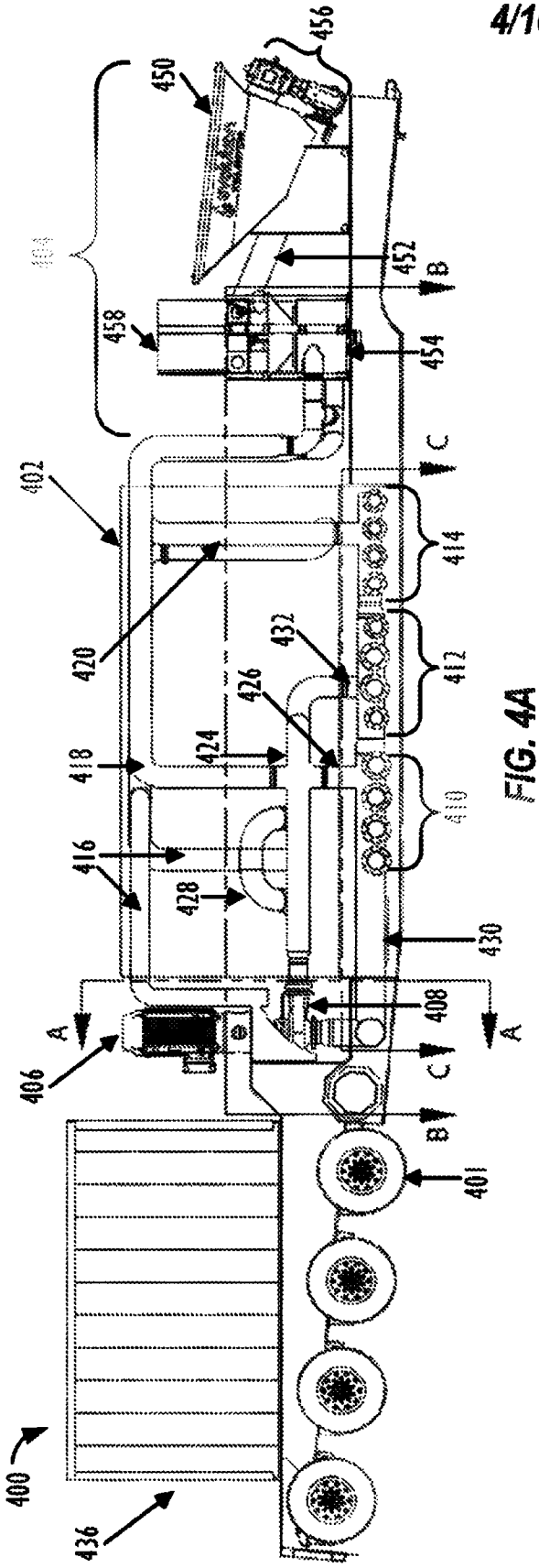

456
450
452
B
458
454
C
402
414
420
432
426
412
424
418
410
416
428
430
408
A
406
C
B
401
400
436

FIG. 4A

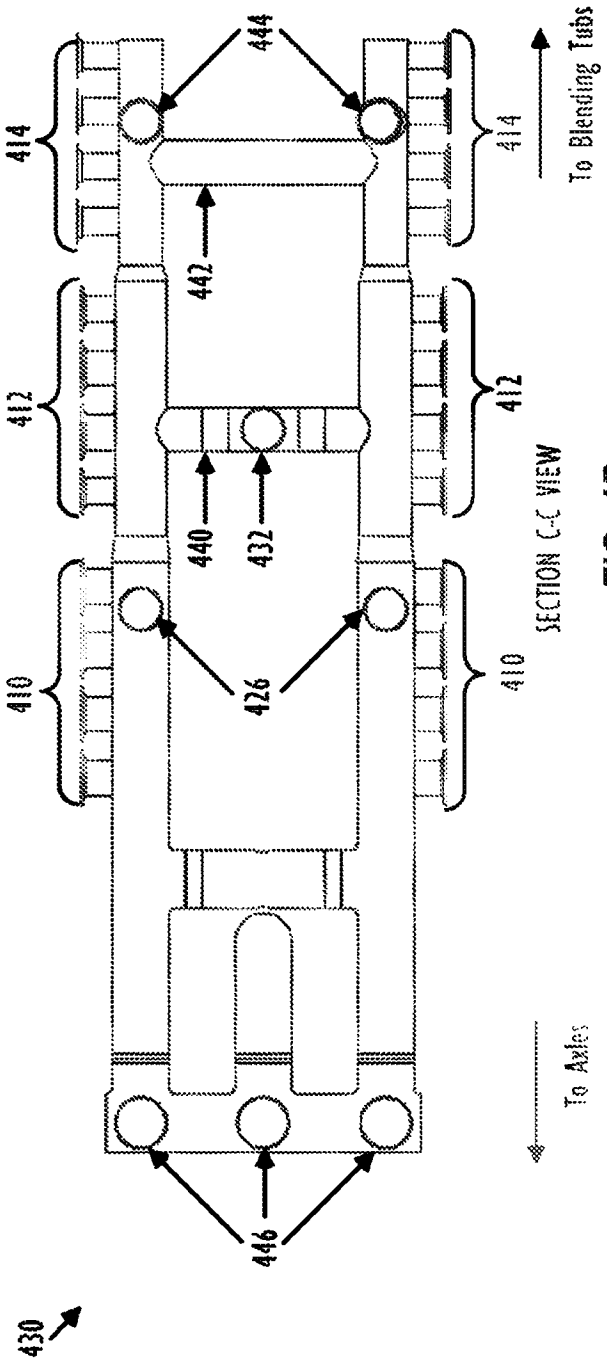
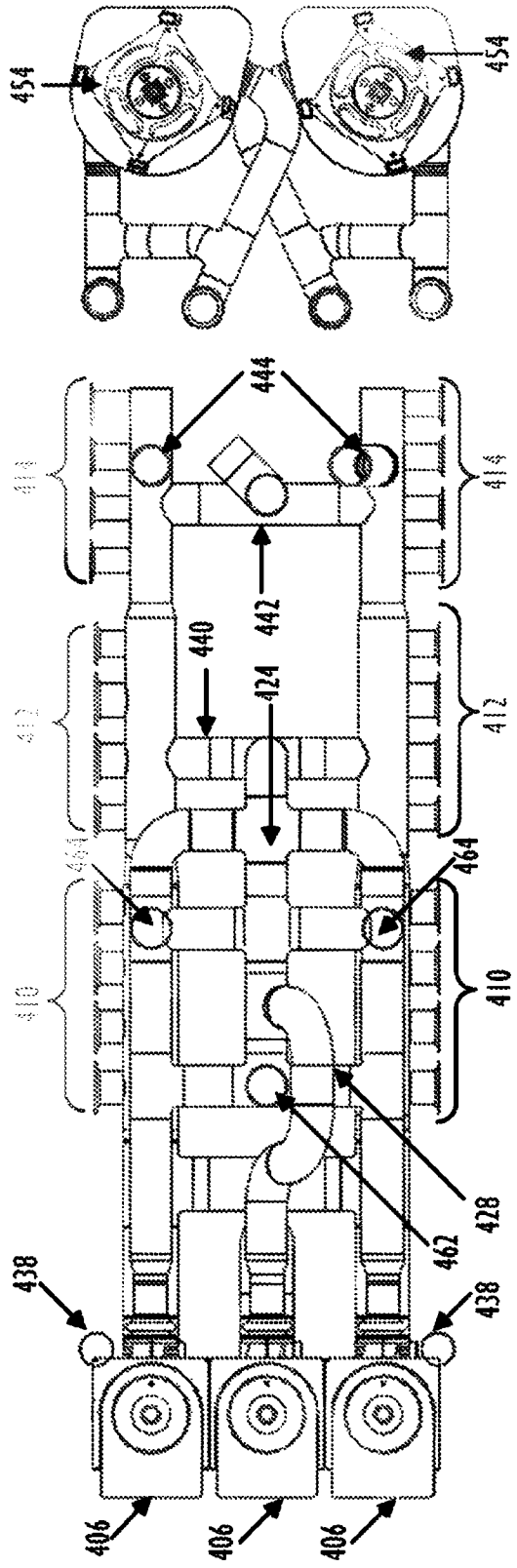

444
414
To Blending Tubs
442
412
440
432
SECTION C-C VIEW
410
426
446
To Axles
430

FIG. 4B



SECTION B-B VIEW

FIG. 4C

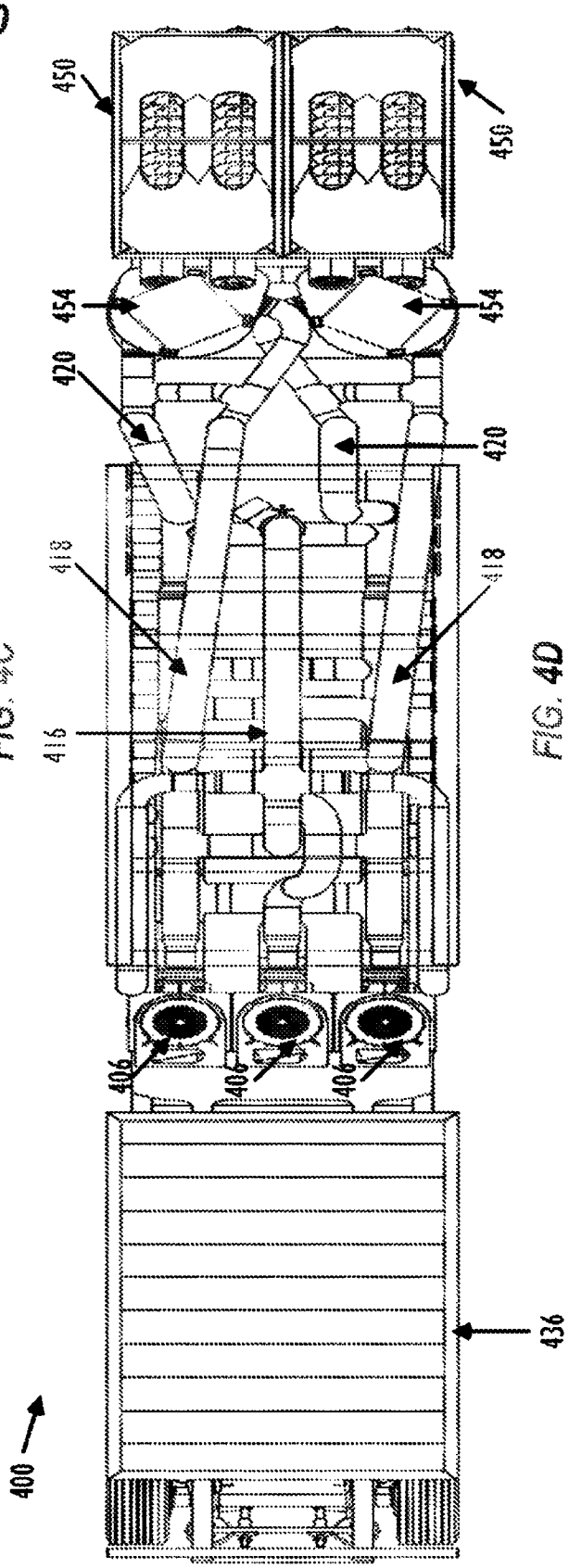


FIG. 4D

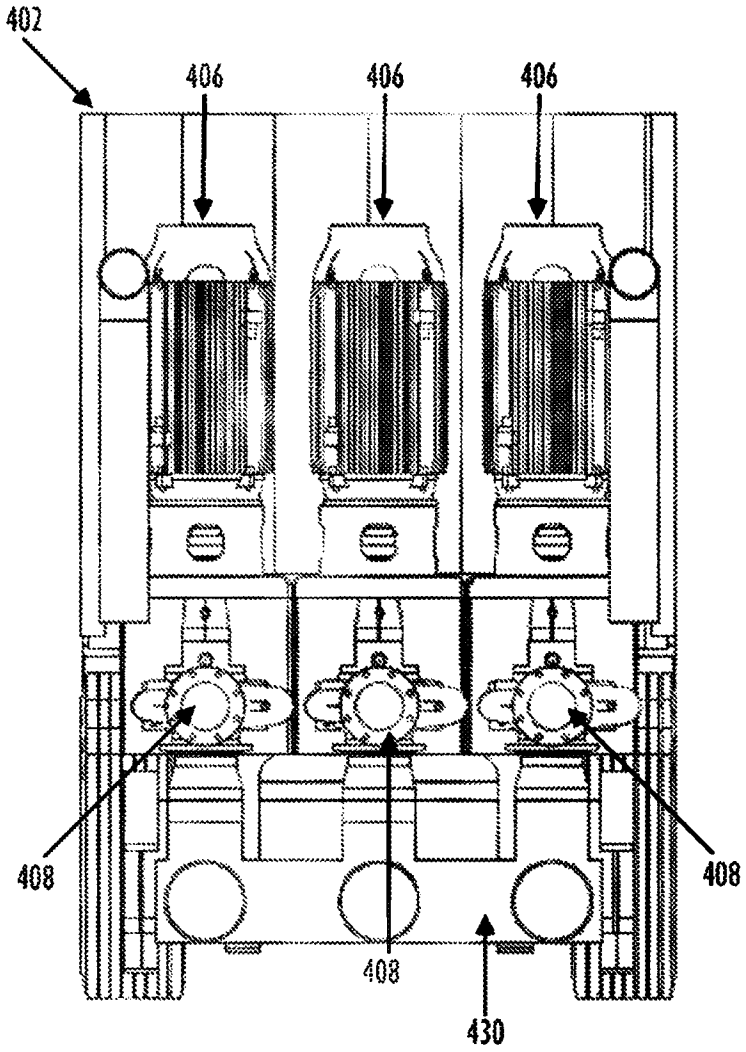


FIG. 4E

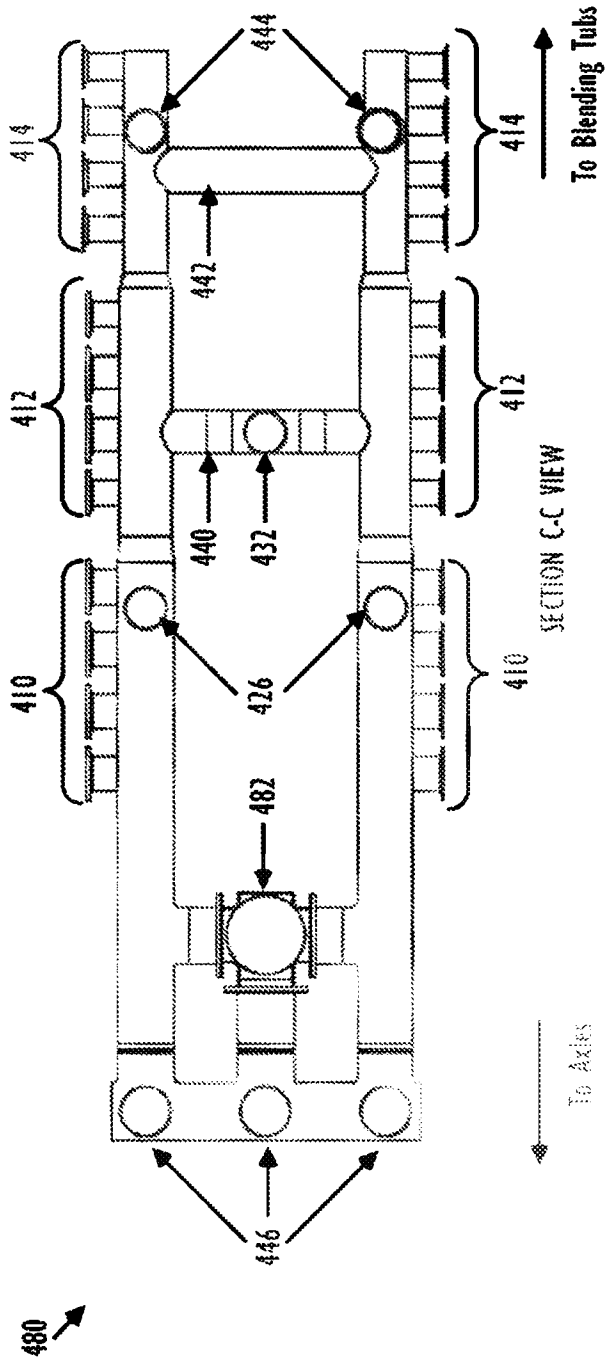

444
414
414
To Blending Tubs
442
412
412
440
432
410
426
410
SECTION C-C VIEW
482
To Axles
446
480

FIG. 4F

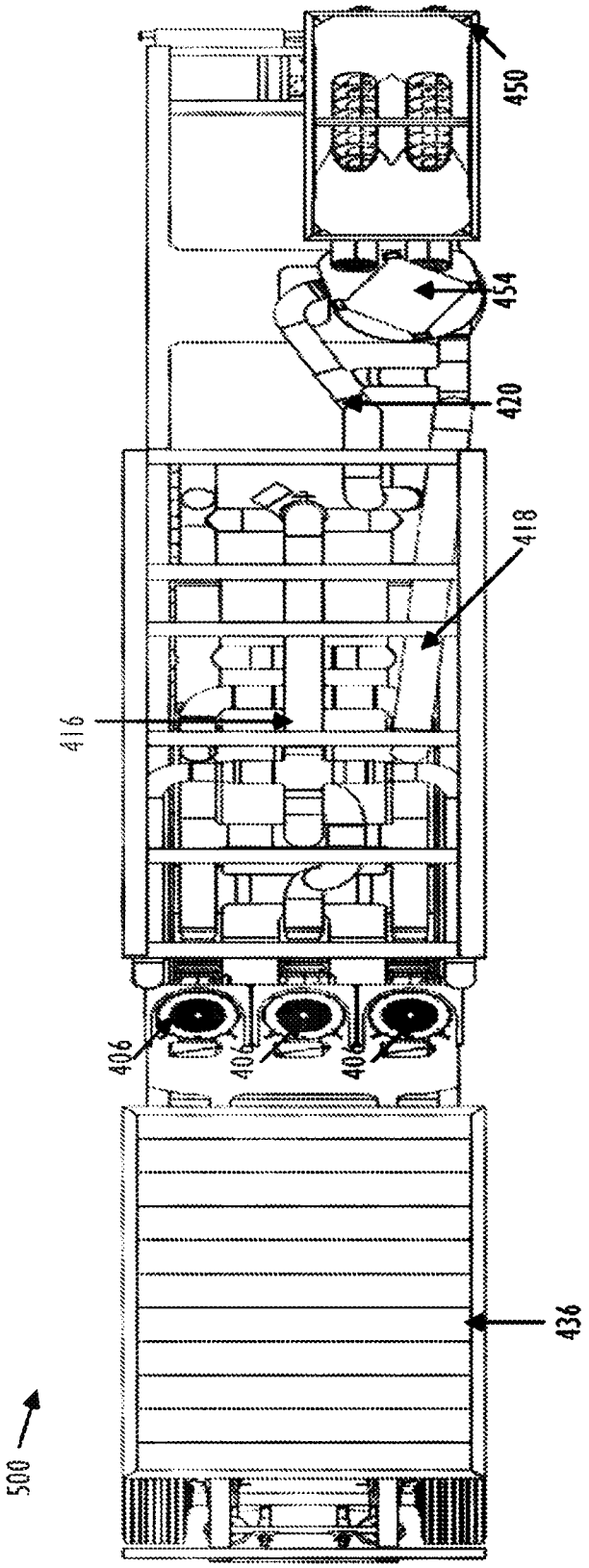


FIG. 5

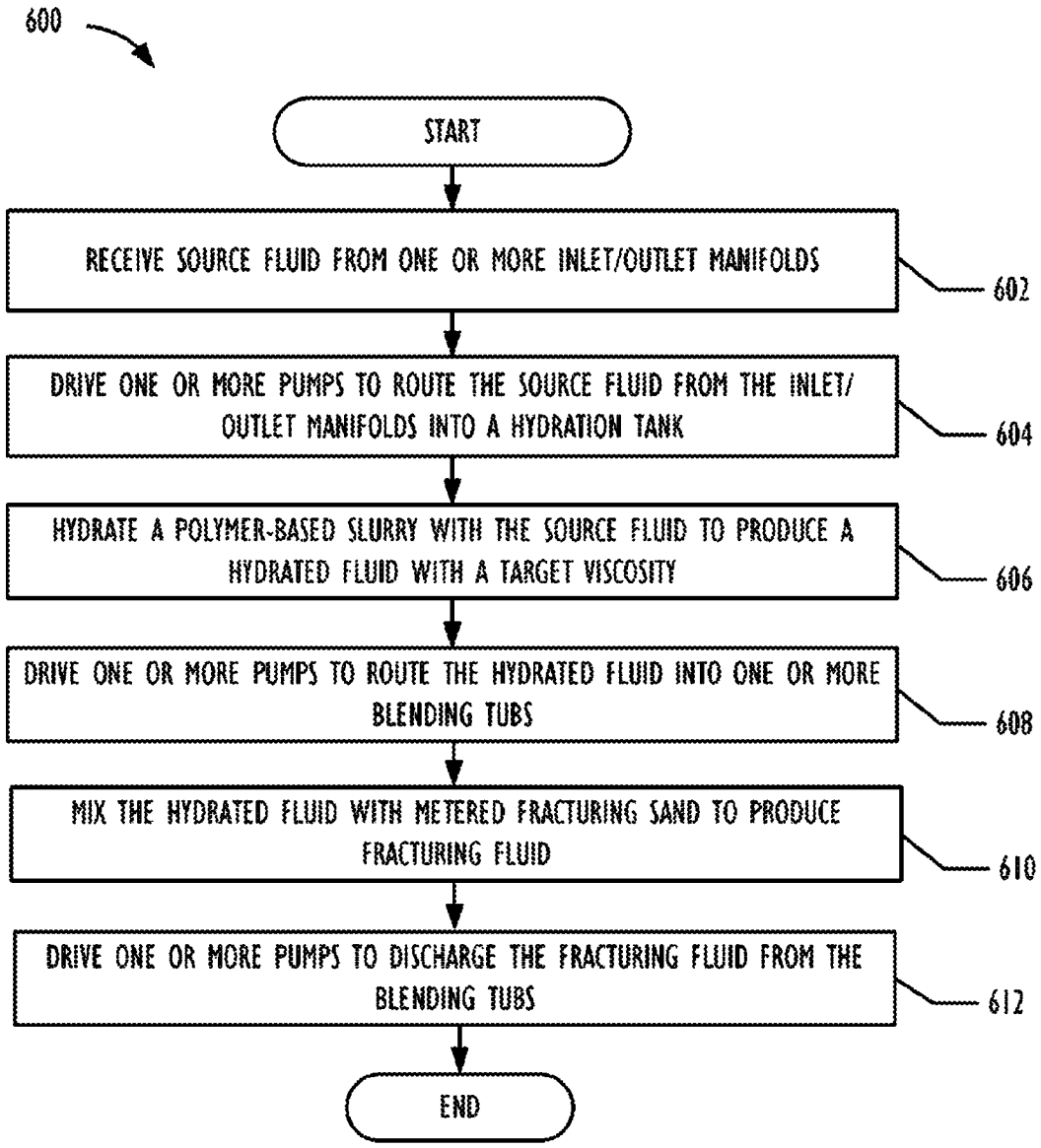

600
START
RECEIVE SOURCE FLUID FROM ONE OR MORE INLET/OUTLET MANIFOLDS
602
DRIVE ONE OR MORE PUMPS TO ROUTE THE SOURCE FLUID FROM THE INLET/ OUTLET MANIFOLDS INTO A HYDRATION TANK
604
HYDRATE A POLYMER-BASED SLURRY WITH THE SOURCE FLUID TO PRODUCE A HYDRATED FLUID WITH A TARGET VISCOSITY
606
DRIVE ONE OR MORE PUMPS TO ROUTE THE HYDRATED FLUID INTO ONE OR MORE BLENDING TUBS
608
MIX THE HYDRATED FLUID WITH METERED FRACTURING SAND TO PRODUCE FRACTURING FLUID
610
DRIVE ONE OR MORE PUMPS TO DISCHARGE THE FRACTURING FLUID FROM THE BLENDING TUBS
612
END

FIG. 6

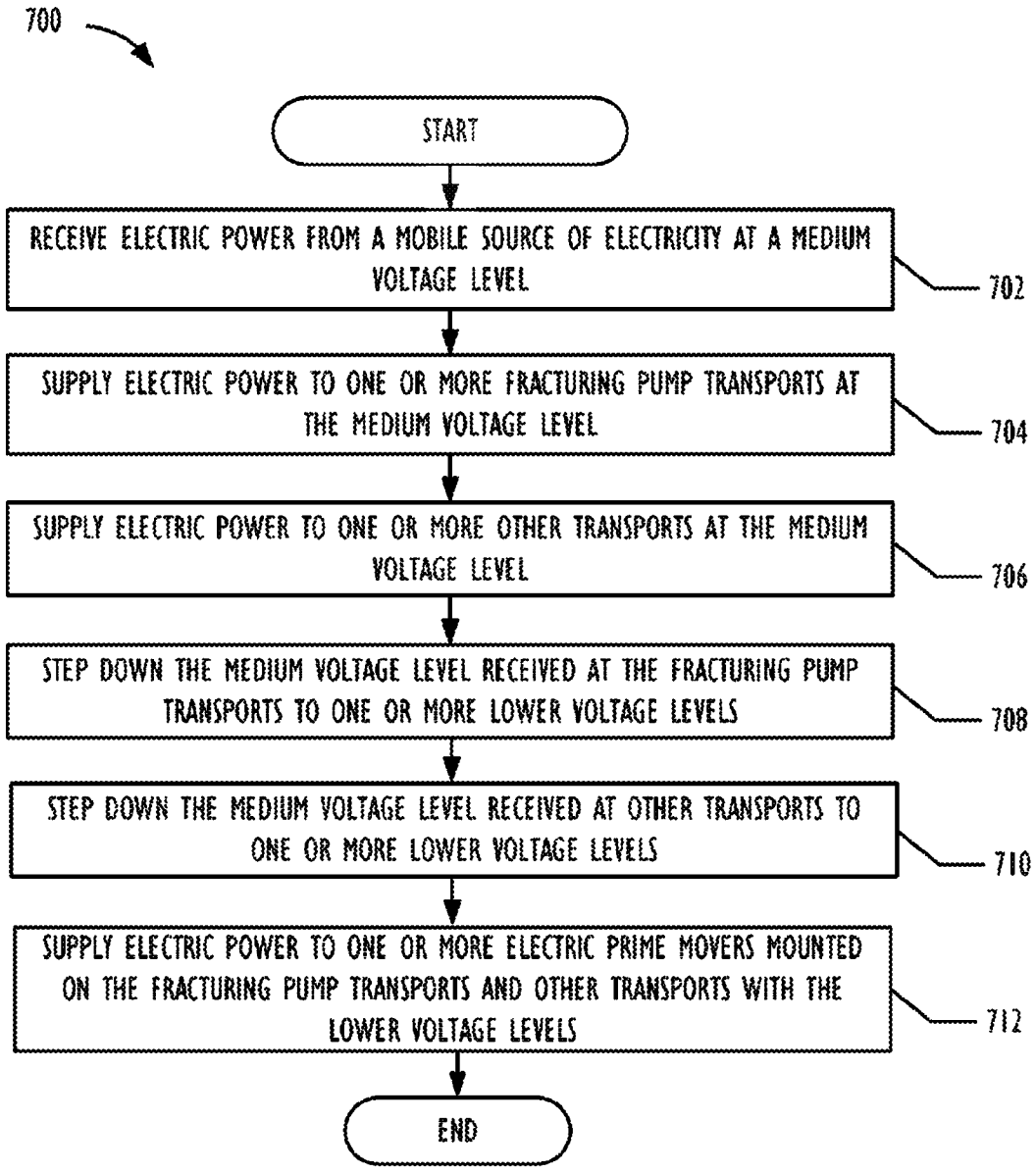

700
START
RECEIVE ELECTRIC POWER FROM A MOBILE SOURCE OF ELECTRICITY AT A MEDIUM VOLTAGE LEVEL
702
SUPPLY ELECTRIC POWER TO ONE OR MORE FRACTURING PUMP TRANSPORTS AT THE MEDIUM VOLTAGE LEVEL
704
SUPPLY ELECTRIC POWER TO ONE OR MORE OTHER TRANSPORTS AT THE MEDIUM VOLTAGE LEVEL
706
STEP DOWN THE MEDIUM VOLTAGE LEVEL RECEIVED AT THE FRACTURING PUMP TRANSPORTS TO ONE OR MORE LOWER VOLTAGE LEVELS
708
STEP DOWN THE MEDIUM VOLTAGE LEVEL RECEIVED AT OTHER TRANSPORTS TO ONE OR MORE LOWER VOLTAGE LEVELS
710
SUPPLY ELECTRIC POWER TO ONE OR MORE ELECTRIC PRIME MOVERS MOUNTED ON THE FRACTURING PUMP TRANSPORTS AND OTHER TRANSPORTS WITH THE LOWER VOLTAGE LEVELS
712
END

FIG. 7

120
112
MOBILE SOURCE OF ELECTRICITY
102
104
104
104
106
FRAC TANK
CHEMICALS
SAND STORAGE
118
SAND CONVEYOR
110
114
108
108
108
108
108
108
WELL HEAD
101
WELL SITE 100
103

FIG. 1

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(12)发明专利申请

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(21)申请号 201810072047.7

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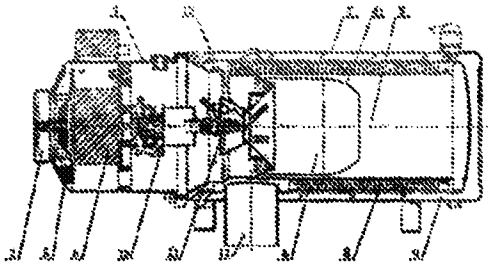
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(54)发明名称

一种甲醇加热器

(57)摘要

本发明公开一种甲醇加热器，包括机体，机体的一端开有进风口，其另一端设置有预燃燃室，预燃燃室设置于热交换器内，并与热交换器中的主燃燃室相连通，热交换器上开有排气口，热交换器的换热介质出口与汽车内散热器的加热介质进口相连，且热交换器的换热介质进口与循环泵的一端相连，循环泵的另一端与汽车内散热器的加热介质出口相连，机体内位于进风口与预燃燃室之间设置有用于提供甲醇的燃料泵，燃料泵的出液端连接有喷嘴，机体内邻近喷嘴处设置有点火电极。本发明不会影响车辆续航里程，且其结构简单、紧凑，并具有燃烧充分、环保性好的特点，经测试，其排放污染物的含量仅为燃油加热器的1/3~1/2，启动、停止时不会产生烟雾。



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1.一种甲醇加热器，其特征在于：包括机体，所述机体的一端开有进风口，其另一端设置有预燃烧室，所述预燃烧室设置于热交换器内，并与热交换器中的主燃烧室相连通，所述热交换器上开有排气口，所述热交换器的换热介质出口与汽车内散热器的加热介质进口相连，且热交换器的换热介质进口与循环泵的一端相连，所述循环泵的另一端与汽车内散热器的加热介质出口相连，所述机体内位于进风口与预燃烧室之间设置有用于提供甲醇的燃料泵，所述燃料泵的出液端连接有喷嘴，所述机体内邻近喷嘴处设置有点火电极。

2.根据权利要求1所述的一种甲醇加热器，其特征在于：所述机体内邻近进风口处设置有由电机驱动的助燃风扇。

3.根据权利要求2所述的一种甲醇加热器，其特征在于：所述电机为变频电机。

4.根据权利要求1所述的一种甲醇加热器，其特征在于：所述燃料泵为脉冲柱塞泵。

5.根据权利要求1所述的一种甲醇加热器，其特征在于：所述热交换器包括换热壳体，所述换热壳体的内壁上设置有换热片，且换热壳体为中空结构，换热壳体的中空部分形成换热介质通道。

6.根据权利要求5所述的一种甲醇加热器，其特征在于：所述换热介质通道为螺旋形。

7.根据权利要求1所述的一种甲醇加热器，其特征在于：所述预燃烧室远离点火电极的一端设置有缩口部，所述缩口部的口径由邻近点火电极的一端至远离点火电极的一端依次减小。

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一种甲醇加热器

技术领域

[0001] 本发明涉及汽车领域，尤其涉及一种甲醇加热器。

背景技术

[0002] 汽车是指以车载电源为动力，用电机驱动车轮行驶，符合道路交通、安全法规各项要求的车辆。由于对环境影响相对传统汽车较小，其前景被广泛看好。

[0003] 目前，大型的汽车如电动公交车、电动客车，其车厢取暖的热源主要采用燃油加热器或电加热器，然而，燃油加热器存在污染物排放偏高的问题，尤其是启动或停止时，其污染物排放较大，肉眼可明显看到烟雾变化，特别不方便的是，在气温变化时，需要更换不同牌号的柴油；电加热器虽然解决了燃油加热器存在的污染物排放偏高的问题，但其增加了用电负荷，一定程度上会影响续航里程；此外，现有甲醇燃料汽车是以甲醇作为燃料的汽车，现阶段甲醇燃料汽车存在冬季冷启动困难的问题，如何在冬季给甲醇发动机预热，提高甲醇燃料汽车的适应性，急需解决。

发明内容

[0004] 本发明的目的在于针对上述问题，提供一种甲醇加热器，其能在不影响车辆续航里程的条件下，给车厢采暖、除霜或预热发动机，并极大的降低污染物排放。

[0005] 本发明的目的是通过以下技术方案来实现：

[0006] 一种甲醇加热器，包括机体，所述机体的一端开有进风口，其另一端设置有预燃烧室，所述预燃烧室设置于热交换器内，并与热交换器中的主燃烧室相连通，所述热交换器上开有排气口，所述热交换器的换热介质出口与汽车内散热器的加热介质进口相连，且热交换器的换热介质进口与循环泵的一端相连，所述循环泵的另一端与汽车内散热器的加热介质出口相连，所述机体内位于进风口与预燃烧室之间设置有用于提供甲醇的燃料泵，所述燃料泵的出液端连接有喷嘴，所述机体内邻近喷嘴处设置有点火电极。

[0007] 作为本发明的一种优选方案，所述机体内邻近进风口处设置有由电机驱动的助燃风扇。

[0008] 作为本发明的一种优选方案，所述电机为变频电机。

[0009] 作为本发明的一种优选方案，所述燃料泵为脉冲柱塞泵。

[0010] 作为本发明的一种优选方案，所述热交换器包括换热壳体，所述换热壳体的内壁上设置有换热片，且换热壳体为中空结构，换热壳体的中空部分形成换热介质通道。

[0011] 作为本发明的一种优选方案，所述换热介质通道为螺旋形。

[0012] 作为本发明的一种优选方案，所述预燃烧室远离点火电极的一端设置有缩口部，所述缩口部的口径由邻近点火电极的一端至远离点火电极的一端依次减小；通过采用上述结构，使得甲醇燃料能够燃烧充分。

[0013] 本发明的有益效果为，所述一种甲醇加热器不会影响车辆续航里程，且其结构简单、紧凑，并具有燃烧充分、环保性好的特点，经测试，其排放污染物的含量仅为燃油加热器

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的1/3～1/2，启动、停止时不会产生烟雾。

附图说明

[0014] 图1为本发明一种甲醇加热器的主视图；

[0015] 图2为本发明一种甲醇加热器的侧视图；

[0016] 图3为本发明一种甲醇加热器的俯视图。

具体实施方式

[0017] 下面结合附图并通过具体实施方式来进一步说明本发明的技术方案，可以理解的是，此处所描述的实施例仅仅用于解释本发明，而非对本发明的限定。

[0018] 请参照图1至图3所示，于本实施例中，一种甲醇加热器，包括机体1，所述机体1的左端开有进风口2，其右端设置有预燃烧室4，所述机体1内邻近进风口2处设置有由电机6驱动的助燃风扇5，所述电机6为变频电机，所述预燃烧室4设置于热交换器内，并与热交换器中的主燃烧室3相连通，所述预燃烧室4的右端设置有缩口部41，所述缩口部41的口径由左端至右端依次减小，所述热交换器上开有排气口13，所述热交换器包括换热壳体7，所述换热壳体7的内壁上设置有换热片8，且换热壳体7为中空结构，换热壳体7的中空部分形成换热介质通道9，所述换热介质通道9为螺旋形，所述换热介质通道9的换热介质出口15与汽车内散热器的加热介质进口相连，且换器介质通道9的换热介质进口与循环泵14的一端相连，所述循环泵14的另一端与汽车内散热器的加热介质出口相连，所述机体1内位于进风口2与预燃烧室4之间设置有用于提供甲醇的燃料泵10，所述燃料泵10为脉冲柱塞泵，且燃料泵10的出液端连接有喷嘴11，所述机体1内邻近喷嘴11处设置有点火电极12。

[0019] 所述换热片8的截面为门字形结构，且其开口的宽度由靠近火焰的一端至排气口13的一端依次递增，即由图1中的右端至左端依次递增，进而可改善气体流动性，提高换热效率。

[0020] 工作时，助燃风扇5由电机6带动吹出高速旋转的助燃风，甲醇燃料由燃料泵10加压后经喷嘴11喷出，喷出的雾化甲醇燃料迅速与助燃空气混合后，被点火电极12高压放电点燃后在预燃烧室4内部分燃烧，并将混合气体加热到一定温度，经过预燃烧室4右端缩口部41缩口后，混合气体再次膨胀，并于主燃烧室3内充分燃烧，其燃烧热量通过换热片8传给换热介质通道9内的换热介质，换热介质在循环泵14的作用下被送至汽车内的散热器，供汽车内取暖、除霜或给发动机预热。

[0021] 一种甲醇加热器不会影响车辆续航里程，且具有环保性好的特点，经测试，其尾气排放污染物的含量仅为燃油加热器的1/3～1/2，启动、停止时不会产生烟雾。

[0022] 以上实施例只是阐述了本发明的基本原理和特性，本发明不受上述实施例限制，在不脱离本发明精神和范围的前提下，本发明还有各种变化和改变，这些变化和改变都落入要求保护的本发明范围内，本发明要求保护范围由所附的权利要求书界定。

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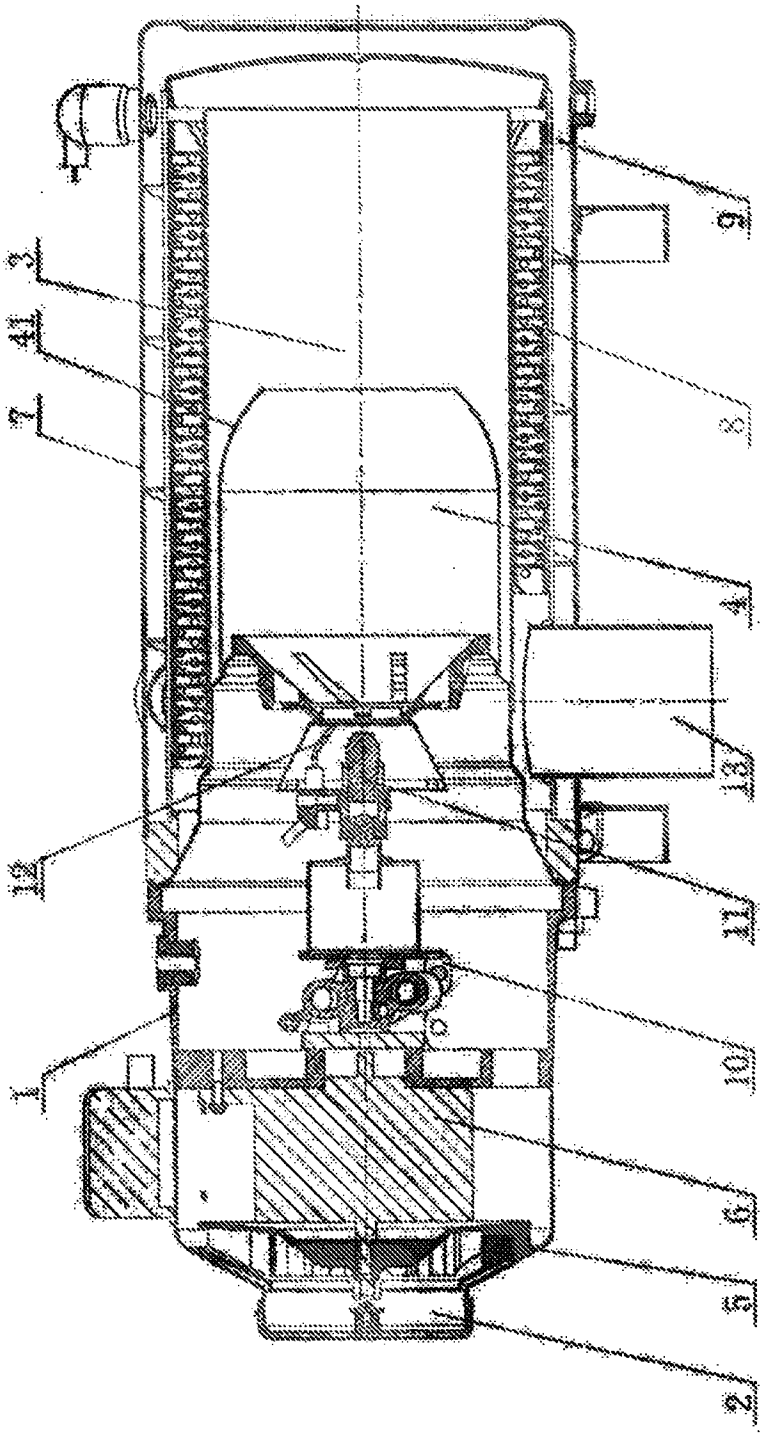


图1

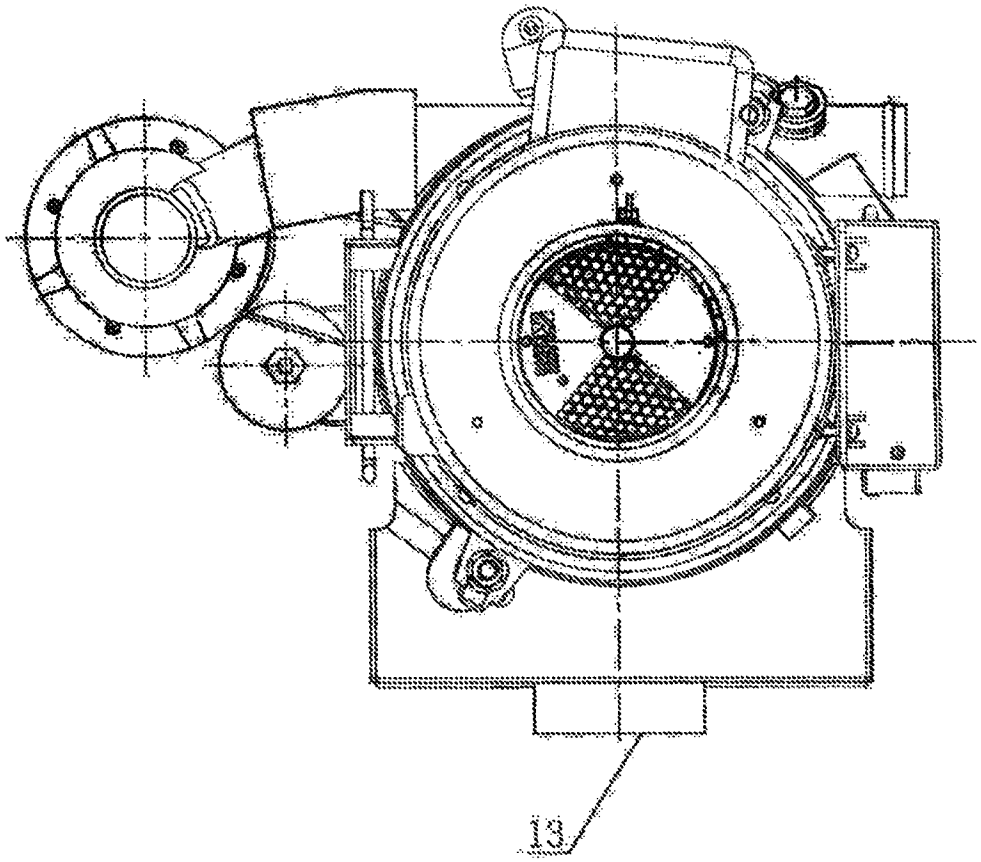


图2

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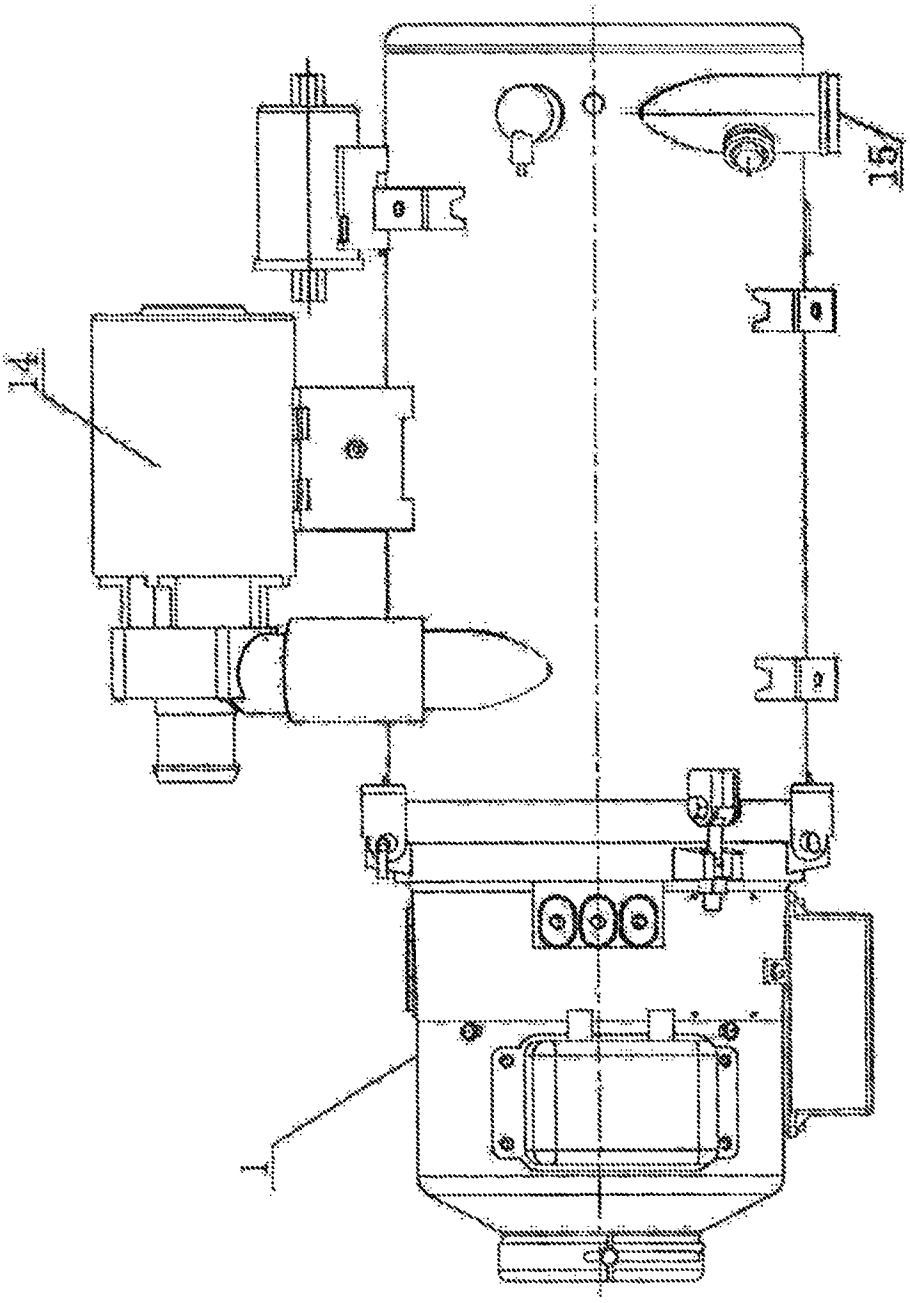


图3

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CN108049999A Methyl alcohol heater

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The wording below is an initial machine translation of the original publication. To apply more advanced translation technology, use Patent Translate.

[0001] Technical field

[0002] The invention relates to the field of automobiles, in particular to a methanol heater.

[0003] Background technique

[0004] Automobile is a vehicle that is driven by a vehicle-mounted power supply and driven by a motor-driven wheel to meet the requirements of road traffic and safety regulations. As the impact on the environment is relatively small compared to traditional cars, its prospects are widely optimistic.

[0005] At present, large-sized automobiles, such as electric buses and electric buses, mainly use fuel heaters or electric heaters for heat sources in their compartments. However, fuel heaters have a problem of high pollutant emissions, especially when starting or stopping. The emission of pollutants is relatively large, and the change of smoke can be clearly seen with the naked eye. Particularly inconvenient is that when the temperature changes, different grades of diesel oil need to be replaced; the electric heater solves the problem of high emission of pollutants in the fuel heater. However, it has increased the power load, which will affect the cruising range to a certain extent. In addition, the existing methanol fuel vehicle is a car with methanol as the fuel. At this stage, the methanol fuel vehicle has the problem of cold start in winter. How to give methanol in the winter? Preheating the engine and improving the adaptability of the methanol fuel vehicle are urgently needed.

[0006] Summary of the Invention

[0007] An object of the present invention is to provide a methanol heater that can provide heating, defrosting, or warm-up of the vehicle without affecting the cruising range of the vehicle, and greatly reduces the emission of pollutants.

[0008] The purpose of the present invention is to achieve through the following technical solutions:

[0009] A methanol heater includes a body having an air inlet at one end and a pre-combustion chamber at the other end. The pre-combustion chamber is disposed in a heat exchanger and is connected to a main combustion chamber in a heat exchanger. In communication, an exhaust port is opened in the heat exchanger, a heat exchange medium outlet of the heat exchanger is connected to a heating medium inlet of a radiator in the automobile, and a heat exchange medium inlet and a circulation pump end of the heat exchanger are connected Connected, the other end of the circulating pump is connected with the heating medium outlet of the radiator in the automobile, and a fuel pump for supplying methanol is arranged in the body between the air inlet and the pre-combustion chamber, and the liquid outlet of the fuel pump is provided in the body. A nozzle is connected and an ignition electrode is provided in the body adjacent to the nozzle.

[0010] As a preferred solution of the present invention, a booster fan driven by a motor is disposed in the body near the air inlet.

[0011] As a preferred solution of the present invention, the motor is a variable frequency motor.

[0012] As a preferred solution of the present invention, the fuel pump is a pulse plunger pump.

[0013] As a preferred solution of the present invention, the heat exchanger includes a heat exchange shell, a heat exchange sheet is arranged on the inner wall of the heat exchange shell, and the heat exchange shell is a hollow structure, and the heat exchange shell is hollow. Part of the formation of heat exchange media channels.

[0014] As a preferred solution of the present invention, the heat exchange medium passage is spiral.

[0015] As a preferred solution of the present invention, the end of the pre-combustion chamber remote from the ignition electrode is provided with a necking portion, and the mouth diameter of the necking portion is reduced from one end adjacent to the ignition electrode to the end remote from the ignition electrode; The above structure enables sufficient combustion of the methanol fuel.

[0016] The beneficial effect of the present invention is that the methanol heater does not affect the cruising range of the vehicle, and its structure is simple and compact, and has the characteristics of full combustion and good environmental protection. After testing, the content of discharged pollutants is only 1/3 to 1/2 of the fuel heater does not generate smoke when starting or stopping.

[0017] Description of the drawings

[0018] Figure 1 is a front view of a methanol heater according to the present invention;

[0019] Figure 2 is a side view of a methanol heater of the present invention;

[0020] FIG. 3 is a top view of a methanol heater of the present invention.

[0021] detailed description

[0022] The technical solutions of the present invention will be further described below with reference to the accompanying drawings and specific implementation manners. It can be understood that the embodiments described herein are only used to explain the present invention and do not limit the present invention.

[0023] Referring to FIGS. 1 to 3, in the present embodiment, a methanol heater includes a body 1, an air inlet 2 is opened at a left end of the body 1, and a pre-combustion chamber 4 is disposed at a right end of the body 1. A combustion-supporting fan 5 driven by a motor 6 is disposed adjacent to the air inlet 2 in the interior 1. The motor 6 is an inverter motor. The pre-combustion chamber 4 is disposed in the heat exchanger and is in contact with the main combustion chamber in the heat exchanger 3. In communication, the front end of the pre-combustion chamber 4 is provided with a necking portion 41. The mouth diameter of the necking portion 41 is sequentially reduced from the left end to the right end, and an exhaust port 13 is opened on the heat exchanger. The exchanger comprises a heat exchange shell 7, a heat exchange sheet 8 is arranged on the inner wall of the heat exchange shell 7, and the heat exchange shell 7 is a hollow structure, and the hollow part of the heat exchange shell 7 forms a heat exchange medium channel 9. The heat exchange medium channel 9 is in a spiral shape. The heat exchange medium outlet 15 of the heat exchange medium channel 9 is connected to the heating medium inlet of the radiator in the automobile, and the heat exchange medium inlet and the circulating pump of the medium channel 9 of the changer are connected. One end of the 14 is connected, and the other end of the circulation pump 14 is connected to the heating medium outlet of the radiator in the automobile. A fuel pump 10 for supplying methanol is disposed between the air inlet 2 and the pre-combustion chamber 4 in the body 1 and the fuel pump 10 is a pulse plunger pump, and the nozzle 11 is connected to the liquid outlet of the fuel pump 10 . The ignition electrode 12 is provided in the body 1 adjacent to the nozzle 11 .

[0024] The cross-section of the heat exchange sheet 8 is a gate-shaped structure, and the width of the opening thereof is gradually increased from the end near the flame to the end of the exhaust port 13, that is, from the right end to the left end in FIG. 1, thereby improving the gas flow. Sex, improve heat transfer efficiency.

[0025] During operation, the combustion-supporting fan 5 is driven by the motor 6 to blow out high-speed rotating combustion air. The methanol fuel is pressurized by the fuel pump 10 and then is ejected through the nozzle 11. The sprayed atomized methanol fuel quickly mixes with the combustion air, and the ignited electrode 12 is mixed. After the ignition of the high pressure discharge, partial combustion occurs in the pre-combustion chamber 4 and the mixed gas is heated to a certain temperature. After passing through the shrinking portion 41 at the right end of the pre-combustion chamber 4, the mixed gas expands again and is fully burned in the main combustion chamber 3. The combustion heat is transferred to the heat exchange medium in the heat exchange medium passage 9 through the heat exchange sheet 8, and the heat exchange medium is sent to the radiator in the automobile under the action of the circulation pump 14 to provide heating, defrosting, or heating in the automobile. Engine warm up.

[0026] A methanol heater does not affect the cruising range of the vehicle, and it is environmentally friendly. After testing, the amount of pollutants emitted by the exhaust gas is only 1/3 to 1/2 of the fuel heater, and it will not start or stop. Produce smoke.

[0027] The above embodiments merely illustrate the basic principle and characteristics of the present invention, and the present invention is not limited by the above embodiments. Without departing from the spirit and scope of the present invention, the present invention has various changes and changes, and these changes and changes are It falls within the scope of the claimed invention. The scope of the invention is defined by the appended claims.

Espacenet

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Portable direct current emergency power source car

Inventor(s): HAN WEI; ZHU XIANGLIAN; QIAN XIAOSEN; XU RONGJUN; ZHU XIAOYONG ± (韩伟, ; 朱祥连, ; 钱小森, ; 许荣军, ; 朱晓勇)

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Classification: **- international:** *B62D63/06; H02J9/00*
- cooperative:

Application number: CN201620888198U 20160816

Priority number (s): CN201620888198U 20160816

Abstract of CN205986303 (U)

The utility model relates to a portable direct current emergency power source car, including highly integrated's medium voltage switchgear or constitutions such as low -voltage switchgear, rectifier transformer, rectifier, direct current switch cabinet, control panel, cable transfer case, cable wire reel and portable flat -bed trailer, all equipment highly integrated all install on the flat -bed trailer that has the automatic rising location, and the flat -bed trailer is furnished with a trailing link that pulls of buying car in installments, has characteristics such as traction movement input fast, also can shift up down independent installation from the flat -bed trailer according to the user demand, the distribution part adopts prepackage type box -type substation scheme, and compact structure is non -maintaining, long service life.

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H02J 9/00(2006.01)
B62D 63/06(2006.01)

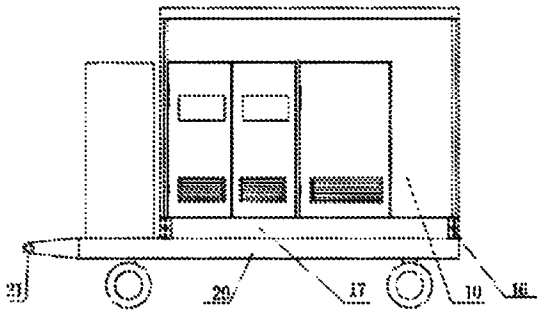
权利要求书1页 说明书2页 附图1页

(54)实用新型名称

一种移动式直流应急电源车

(57)摘要

本实用新型涉及一种移动式直流应急电源车，包括高度集成化的中压开关柜或/和低压开关柜、整流变压器、整流器、直流开关柜、控制屏、电缆转接箱、电缆绕线盘以及移动式平板挂车等组成，所有设备高度集成化，全部安装到具有自动升降定位的平板挂车上；且平板挂车配有供车辆牵引的牵引挂环，具有可快速牵引移动投放等特点，也可根据使用需求从平板挂车上移下，独立安装；配电部分采用预装式箱式变电站方案，结构紧凑，免维护，使用寿命长。



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1.一种移动式直流应急电源车，其特征在于，所述移动式直流应急电源车包括移动式平板挂车，所述移动式平板挂车安装有预装式箱式变电站，所述预装式箱式变电站上设有固定支件将所述预装式箱式变电站固定在移动式平板挂车上；所述预装式箱式变电站内设有相互连通的中压开关柜或/和低压开关柜、整流变压器、整流器和直流开关柜；所述预装式箱式变电站底部设有电缆走线通道；所述移动式平板挂车设有供车辆牵引的牵引挂环。

2.根据权利要求1所述的一种移动式直流应急电源车，其特征在于，所述预装式箱式变电站内还设有控制屏；所述移动式直流应急电源车上还设有电缆转接箱和电缆绕线盘。

3.根据权利要求1所述的一种移动式直流应急电源车，其特征在于，所述预装式箱式变电站上设有固定支件并通过活动连接方式将所述预装式箱式变电站固定在移动式平板挂车上。

4.根据权利要求3所述的一种移动式直流应急电源车，其特征在于，所述预装式箱式变电站上设有固定支件并通过螺栓固定方式将所述预装式箱式变电站固定在移动式平板挂车上。

5.根据权利要求1所述的一种移动式直流应急电源车，其特征在于，所述移动式平板挂车为自动升降定位的移动式平板挂车。

6.根据权利要求5所述的一种移动式直流应急电源车，其特征在于，所述自动升降定位的移动式平板挂车通过液压支腿升降装置实现自动升降。

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一种移动式直流应急电源车

技术领域

[0001] 本实用新型涉及城市轨道交通系统中的供电设备，具体涉及一种移动式直流应急电源车。

背景技术

[0002] 在城市轨道交通项目建设初期临时车辆用电、变电站故障退出运行而临时供电、灾害应急供电、变电所供电设备大修无法及时恢复供电等情况下，没有临时电源供使用使其恢复正常工作，因此需要提供移动式直流应急电源。

实用新型内容

[0003] 本实用新型的目的在于为了克服现有技术中的不足而提供一种移动式直流应急电源车，满足城市轨道交通项目建设初期临时车辆用电、变电站故障退出运行而临时供电、灾害应急供电、变电所供电设备大修无法及时恢复供电等供电需求而专门设计。

[0004] 为实现上述技术目的采用的技术方案为：

[0005] 一种移动式直流应急电源车，包括移动式平板挂车，所述移动式平板挂车安装有预装式箱式变电站，所述预装式箱式变电站上设有固定支件将所述预装式箱式变电站固定在移动式平板挂车上；所述预装式箱式变电站内设有相互连通的中压开关柜或/和低压开关柜、整流变压器、整流器和直流开关柜；所述预装式箱式变电站底部设有电缆走线通道；所述移动式平板挂车设有供车辆牵引的牵引挂环。

[0006] 本实用新型提出的一种移动式直流应急电源车的进一步优选方案为：

[0007] 其中，所述预装式箱式变电站内还设有控制屏；所述移动式直流应急电源车上还设有电缆转接箱和电缆绕线盘。

[0008] 其中，预装式箱式变电站通过活动连接方式将预装式箱式变电站固定在移动式平板挂车上；优选为螺栓固定方式预装式箱式变电站固定在移动式平板挂车上。

[0009] 其中，移动式平板挂车为可自动升降定位的移动式平板挂车；其中可自动升降定位的移动式平板挂车通过液压支腿升降装置实现自动升降。

[0010] 本实用新型提出的一种移动式直流应急电源车，与现有技术相比，有益效果为：本实用新型的移动式直流应急电源车由高度集成化的中压开关柜或/和低压开关柜、整流变压器、整流器、直流开关柜、控制屏、电缆转接箱、电缆绕线盘以及移动式平板挂车等组成，所有设备高度集成化，全部安装到具有自动升降定位的平板挂车上；且平板挂车配有供车辆牵引的牵引挂环，具有可快速牵引移动投放等特点，也可根据使用需求从平板挂车上移下，独立安装；配电部分采用预装式箱式变电站方案，结构紧凑，免维护，使用寿命长。

附图说明

[0011] 图1：移动式直流应急电源车的结构示意图。

[0012] 图2：移动式直流应急电源车的俯视图。

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[0013] 说明书附图中的附图标记说明如下：

[0014] 10预装式箱式变电站，11中压开关柜或/和低压开关柜，12整流变压器，13整流器，14直流开关柜，15控制屏，16固定安装支件，17电缆走线通道，20平板挂车，21牵引挂环，31电缆转接箱，32电缆绕线盘。

具体实施方式

[0015] 下面结合具体实施方式和附图对本实用新型作进一步说明。

[0016] 图1-2所示为本实用新型提出的一种移动式直流应急电源车的一个实施例的结构示意图。图中显示，所述移动式直流应急电源车包括移动式平板挂车20，移动式平板挂车上安装有预装式箱式变电站10，预装式箱式变电站上设有固定支件16将预装式箱式变电站固定在移动式平板挂车上；其中，预装式箱式变电站通过螺栓固定的方式固定在移动式平板挂车上，使得预装式箱式变电站可根据需要从移动式平板挂车上移下，独立安装。预装式箱式变电站内设有相互连通的中压开关柜或/和低压开关柜11、整流变压器12、整流器13和直流开关柜14；预装式箱式变电站底部设有电缆走线通道17，使得预装式箱式变电站内部的电缆可很容易从电缆走线通道连接至外部配套的设备上，方便电缆接线。移动式平板挂车设有供车辆牵引的牵引挂环21。其中，预装式箱式变电站内还设有控制屏15；其中，移动式直流应急电源车上还设有电缆转接箱31和电缆绕线盘32，用于快速收放电缆。

[0017] 本申请中所述的“和/或”的含义指的是各自单独存在或两者同时存在的情况均包括在内。

[0018] 本申请中所述的“连接”的含义可以是部件之间的直接连接也可以是部件间通过其它部件的间接连接。

[0019] 本实用新型的具体实施方式中凡未涉及到的说明属于本领域的公知技术，可参考公知技术加以实施。

[0020] 上述具体实施方式是对本实用新型提出的一种移动式直流应急电源车技术思想的具体支持，不能以此限定本实用新型的保护范围，凡是按照本实用新型提出的技术思想，在本技术方案的基础上所做的任何等同变化或等效改动，均属于本实用新型技术方案保护范围。

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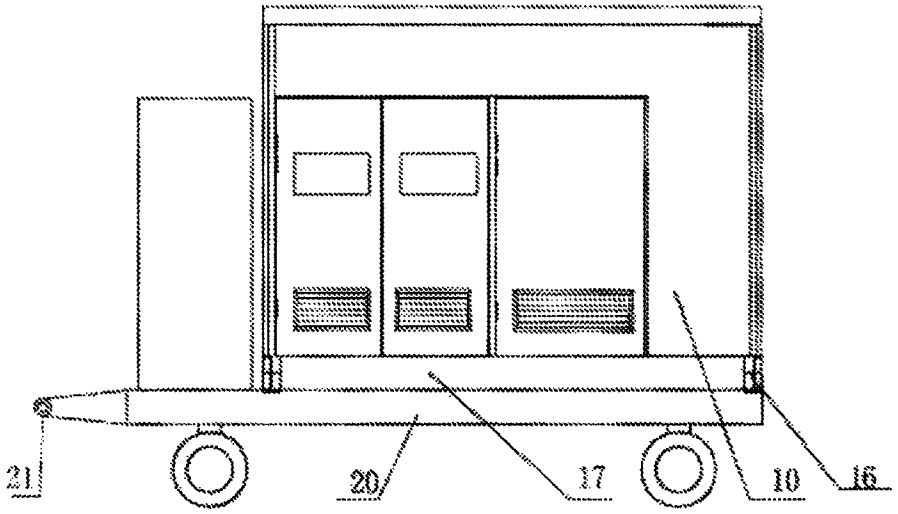


图1

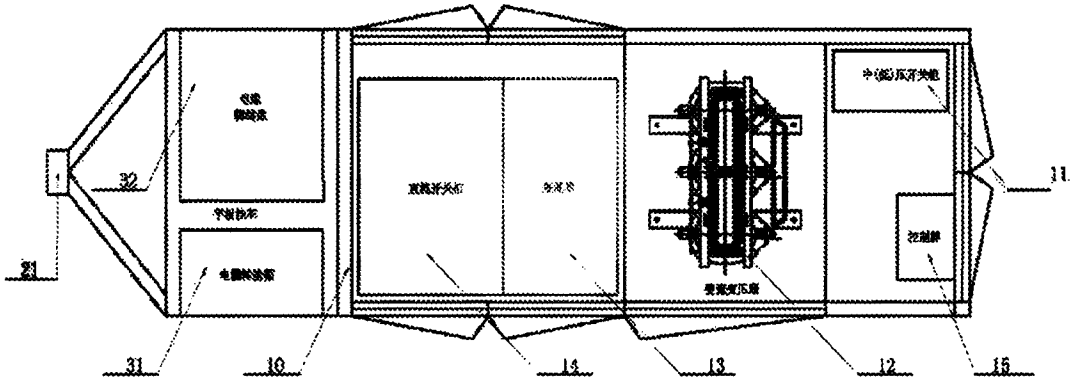


图2

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Electronic Acknowledgement Receipt

EFS ID:	41179207
Application Number:	16728359
International Application Number:	
Confirmation Number:	6981
Title of Invention:	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Taylor P. Evans/Stephanie McDonough
Filer Authorized By:	Taylor P. Evans
Attorney Docket Number:	047158.100066
Receipt Date:	20-NOV-2020
Filing Date:	27-DEC-2019
Time Stamp:	10:11:19
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	047158-100066_IDS.pdf	1036253 2a991fadab7984d0ae96239953bc72fbfe2dbb1f	no	7

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2	Non Patent Literature	047158-Albone.pdf	1396726 bbd859d44be87e93222b2b583fe22a836e27bbac	no	10
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6	Other Reference-Patent/App/Search documents	100049-NFOA_9-2.pdf	1511401 ad5ba89045499f89890195bd43029c8bc38e3d55	no	16
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14	Foreign Reference	CN205986303-abstract.pdf	95862 059dff68770d26488cf683bc7d457b0d6ab88590	no	1
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Information:					
15	Foreign Reference	CN205986303U.pdf	611846 d9f5d439e4e0ab642a6eeff9104efcfce9b1c12b	no	5
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Information:					

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Warnings:					
Information:					
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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/728,359	Filing Date 12/27/2019	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	09/29/2020	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 14	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $460 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/VENICE M WILLIAMS/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Acknowledgement Receipt

EFS ID:	40698507
Application Number:	16728359
International Application Number:	
Confirmation Number:	6981
Title of Invention:	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Joe Grdinovac/Tina Fluharty
Filer Authorized By:	Joe Grdinovac
Attorney Docket Number:	047158.100066
Receipt Date:	29-SEP-2020
Filing Date:	27-DEC-2019
Time Stamp:	13:30:35
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment/Req. Reconsideration-After Non-Final Reject	047158-100066-response.pdf	71146 694a5154ad3a3b4eba9c7ec14c91c3e445a155ea	no	11

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I hereby certify that this correspondence is being filed via EFS-Web with the United States Patent and Trademark Office on September 29, 2020.

Hogan Lovells US LLP

By: /Tina M. Fluharty /

PATENT
Attorney Docket No.: 047158.100066

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Confirmation No.: 6981
Oehring	Examiner: Lembo, Aaron Lloyd
Application No.: 16/728,359	Technology Center/Art Unit: 3679
Filed: December 27, 2019	
For: SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE	AMENDMENT

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

In response to the Non-Final Office Action mailed June 29, 2020, please enter the following amendments and remarks:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 6 of this paper.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

1. (Currently Amended) A hydraulic fracturing system for fracturing a subterranean formation, comprising:

an electric powered, multi-plunger hydraulic fracturing pump having an inlet and an outlet, the outlet coupled to a well associated with the subterranean formation and powered by at least one electric motor~~, the electric powered pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation~~;

a fluid source, coupled to the inlet of the electric powered pump, the fluid source providing a slurry for injection into the subterranean formation;

a hose extending between the fluid source and the electric powered pump, the hose being flexible and having a first diameter;

a fitting between the hose and the electric powered pump, the fitting having a first end for receiving the hose at the first diameter and a second end for coupling to the electric powered pump at a second diameter, the second diameter being larger than the first diameter; and

a distribution system, positioned between the wellbore and the electric powered pump, the distribution system collecting the slurry from electric powered pumps for injection into the subterranean formation.

2. (Original) The system of claim 1, wherein the first diameter is approximately 5 inches and the second diameter is approximately 6 inches.

3. (Currently Amended) The system of claim 1, wherein the fitting further comprises:

a union at the second end, the union configured to couple to a mating fitting;

a shank end at the first end, the shank end receiving at least a portion of the hose, the shank end being crimped over at least the portion of the hose; and

a reducer between the union and the shank end, at least a portion of the reducer extending into a groove formed in the union, the union extending farther laterally than the reducer.

4. (Original) The system of claim 3, wherein the fitting is formed as an integral piece with at least one rigid coupling between at least one of the union, the shank end, and the reducer.

5. (Original) The system of claim 1, wherein the first diameter is particularly selected based at least in part on a threshold, the threshold corresponding to a drop out rate for the slurry.

6. (Original) The system of claim 1, wherein the first diameter is particularly selected based at least in part on a pressure drop rate, a damage accumulation rate, or a suggested flow rate.

7. (Original) The system of claim 1, wherein the first diameter is associated with a second threshold, corresponding to a maximum suggested flow rate, an operating window for the electric powered pump exceeding the maximum suggested flow rate.

8. (Original) The system of claim 1, further comprising:

a plurality of electric powered, multi-plunger pumps, each pump receiving fluid from the fluid source;

a plurality of hoses having the first diameter; and

a plurality of fittings between respective hoses of the plurality of the hoses and respective pumps of the plurality of pumps, each of the pumps having a connection having the second diameter.

9-20. (Cancelled)

21. (New) A hydraulic fracturing system for fracturing a subterranean formation, comprising:

an electric powered, multi-plunger hydraulic fracturing pump having an inlet and an outlet, the outlet coupled to a well associated with the subterranean formation and powered by at least one electric motor;

a fluid source, coupled to the inlet of the electric powered pump, the fluid source providing a slurry for injection into the subterranean formation;

a hose extending between the fluid source and the electric powered pump, the hose being flexible and having a first diameter;

a fitting between the hose and the electric powered pump, the fitting comprising:

a union arranged at a first end, the union having a second diameter, larger than the first diameter, and being configured to couple to the pump;

a shank end configured to receive at least a portion of the hose, the shank end being securable to at least the portion of the hose, the shank end including an opening to receive the shank end; and

a reducer positioned between the union and the shank end, the reducer being welded to the respective union and shank end at each end, the reduce having an increasing diameter along its axial length, the reducer extending at least partially into the union; and

a distribution system, positioned between the wellbore and the electric powered pump, the distribution system collecting the slurry from electric powered pumps for injection into the subterranean formation.

22. (New) The system of claim 21, wherein the first diameter is approximately 5 inches and the second diameter is approximately 6 inches.

23. (New) The system of claim 21, wherein the first diameter is particularly selected based at least in part on a threshold, the threshold corresponding to a drop out rate for the slurry.

24. (New) The system of claim 21, wherein the first diameter is particularly selected based at least in part on a pressure drop rate, a damage accumulation rate, or a suggested flow rate.

25. (New) The system of claim 21, wherein the first diameter is associated with a second threshold, corresponding to a maximum suggested flow rate, an operating window for the electric powered pump exceeding the maximum suggested flow rate.

26. (New) The system of claim 21, further comprising:

a plurality of electric powered, multi-plunger pumps, each pump receiving fluid from the fluid source;

a plurality of hoses having the first diameter; and

a plurality of fittings between respective hoses of the plurality of the hoses and respective pumps of the plurality of pumps, each of the pumps having a connection having the second diameter.

REMARKS

This paper is responsive to the Non-Final Office Action mailed May 11, 2020. Claims 1-8 were pending before submission of this paper. Claim 1 is in independent form. Claims 1-8 stand rejected. Specifically, claims 1-7 are rejected under 35 U.S.C. § 103 as allegedly unpatentable over Winborn (U.S. Patent Publication No. 2013/0284278; hereinafter "Winborn") and Kotrla et al. (U.S. Patent No. 10,669,804; hereinafter "Kotrla"). Claim 8 is rejected under 35 U.S.C. § 103 as allegedly unpatentable over Winborn, Kotrla, and Kajaria et al. (U.S. Patent No. 8,474,521; hereinafter "Kajaria"). Applicant respectfully disagrees and traverses these rejections.

Claims 1 and 3 are amended. Support for all amended claims can be found in the specification and no new matter has been added by these amendments. Claims 21-26 are new. Upon entry of the amendments, claims 1-8 and 21-26 will remain pending. Reconsideration of the claims in view of the amendments and the following remarks is respectfully requested.

I. Claims 1-7 are allowable over Winborn and Kotrla

Claims 1-7 stand rejected under 35 U.S.C. § 103 as allegedly unpatentable over Winborn and Kotrla. Applicant respectfully disagrees and traverses this rejection.

With regard to rejections under 35 U.S.C. § 103, the Examiner must provide evidence which as a whole shows that the legal determination sought to be proved (*i.e.*, the reference teachings establish a *prima facie* case of obviousness) is more probable than not. M.P.E.P. § 2142. Accordingly, "the key to supporting any rejection under 35 U.S.C. § 103 is the clear articulation of the reason(s) why the claimed invention would have been obvious." M.P.E.P. § 2142; *see KSR International Co. v. Teleflex, Inc.*, 550 U.S.398, 82 USPQ 2d 1385, 1395-97 (2007).

When considering whether to reject a claim as obvious, an Examiner must consider the totality of the evidence. *See, e.g., In re Chu*, 66 F.3d 292 (Fed. Cir. 1995). Furthermore, this evidence must be considered in view of a *Graham* analysis, which considers factors include the scope and content of the prior art, the difference between the prior art and the claims at issue, the

level or ordinary skill in the pertinent art, and an evaluation of any relevant secondary considerations. *See Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 17 (1966).

Furthermore, obviousness rejections are improper when a proposed modification would render the prior art inoperable or where the prior art has failed to recognize an unsolved problem or solution. *See In re Fritch*, 972 F. 2d 1260, 1265 (Fed. Cir. 1992) and *Cardiac Pacemakers, Inc. v. St. Jude Medical, Inc.*, 381 F.3d 1371 (Fed. Cir. 2004). Additionally, proposed combinations require a reasonable expectation of success. *See In re Dow Chem. Co.*, 837 F.2d 469 (Fed. Cir. 1988).

A. Independent Claim 1

Claim 1, as amended, recites:

> A hydraulic fracturing system for fracturing a subterranean formation, comprising:
> an electric powered, multi-plunger hydraulic fracturing pump having an inlet and an outlet, the outlet coupled to a well associated with the subterranean formation and powered by at least one electric motor;
> a fluid source, coupled to the inlet of the electric powered pump, the fluid source providing a slurry for injection into the subterranean formation;
> a hose extending between the fluid source and the electric powered pump, the hose being flexible and having a first diameter;
> a fitting between the hose and the electric powered pump, the fitting having a first end for receiving the hose at the first diameter and a second end for coupling to the electric powered pump at a second diameter, the second diameter being larger than the first diameter; and
> a distribution system, positioned between the wellbore and the electric powered pump, the distribution system collecting the slurry from electric powered pumps for injection into the subterranean formation.

Applicant respectfully asserts that the cited references, taken alone or in hypothetical combination, fail to obviate independent claim 1. Accordingly, Applicant respectfully requests withdrawal of the rejection of claim 1 and the claims depending therefrom.

1. The cited references do not teach an electric hydraulic fracturing pump.

The Office Action contends Winborn teaches the claimed "electric powered, multi-plunger hydraulic fracturing pump," yet also acknowledges it is not shown in Winborn. *See* Office Action, 2. Applicant respectfully submits that the contention that any pump utilized with Winborn is an electric hydraulic fracturing pump is, at least, conclusory and

therefore does not rise to the level of supporting a *prima facie* case of obviousness. Indeed, typical hydraulic fracturing systems utilize diesel-powered pumps. The inclusion of Kotrla fails to overcome this deficiency, as Kotrla is directed toward subsea wellbore operations. Accordingly, Applicant respectfully requests withdrawal of the rejection of claim 1.

2. The cited references do not teach a fitting for use with a slurry.

The Office Action contends that Wilborn teaches the claimed slurry line and cites to a chemical tank 20 as allegedly corresponding to the claimed "fluid source" for providing a slurry. *See id.* Applicant respectfully disagrees at least because Wilborn is directed toward a chemical injection system and provides no indication that the chemicals are provided in the form of a slurry. Indeed, Wilborn notes that particulates are undesirable with respect to chemical injection by providing a filter 12 "to remove particulates that could clog or damage the chemical injection pump when the chemicals flow through the chemical injection pump." Wilborn, ¶ [0036]. Accordingly, the cited reference has failed to identify a slurry flow system. Additionally, the combination of Kotrla does not overcome the deficiencies of Wilborn, which also fails to mention a slurry flow system. Accordingly, Applicant respectfully requests withdrawal of the rejection of claim 1.

3. Wilborn and Kotrla fail to recognize the unsolved problem or the solution

Neither Wilborn nor Kotrla identify the problem associated with efficient fluid flow rates for fracturing operations. Traditional fracturing systems typically use 6" connections for equipment and 4" hoses for fluid flow. *See* Specification, ¶¶ [0017] and [0018]. While this configuration may enable desirable flow characteristics, insufficient flow volume is provided with the 4" hoses, which may lead an increased number of units on a well site, which may increase costs. *See id.* The present application has identified that it is insufficient to merely provide larger hoses because of other competing factors, such as flow rates, pump capabilities, and drop out rates for proppant suspended in the fluid. Furthermore, providing additional equipment at a well site is rarely desirable, due to the congestion and a small footprint.

Embodiments of Applicant's disclosure have identified a potential substitution for a 5" hose along with a fitting that enables quick coupling to the existing 6" standard connections. This 5" selection, however, is more than merely an attempt to make an

efficiently function design. Instead, Applicant has identified how factors such a pump's operational thresholds along with drop out rates should be combined in order to determine that the traditional hoses may be replaced for larger hoses without sacrificing other characteristics of the fracturing operation. The cited references fail to identify this problem all together. For example, Wilborn is directed toward chemical injection and not to the overall fracturing operation. Furthermore, Kotrla is directed toward subsea operations and not to fracturing. Without recognizing the problems or the source of the problems, neither Wilborn nor Kotrla, alone or in combination, discloses, teaches or suggests the solution provided by the instant application. The Supreme Court in *Eible Process* and its progeny long have held that recognizing the source of the problem is inventive. Accordingly, Applicant respectfully requests withdrawal of the rejection of claim 1.

B. Dependent Claims 2-7

Claims 2-7 depend from claim 1. Accordingly, Applicant respectfully submits that claims 2-7 are allowable at least for depending from an allowable independent claim. Withdrawal of the pending rejection is, therefore, respectfully requested.

1. A crimped shank end is not identified in the Office Action.

With respect to claim 3, the Office Action contends that crimping the shank end is illustrated with reference to Kotrla. However, there are no sections cited that illustrate a crimping connection. Indeed, cited FIG. 6 appears to show a solid component, such as a tubular, slipped into another solid component with no indication of a crimp to form a coupling between the components. Accordingly, Applicant respectfully requests withdrawal of the rejection of claim 3.

2. Official Notice is improper.

The Office Action takes Official Notice with respect to claims 5 and 6 directed toward fluid flow path design. *See* Office Action at 4. Applicant respectfully submits that official notice is improper in this instance, as "assertions of technical facts in the areas of esoteric technology or specific knowledge of the prior art must always be supported by citation to some reference work recognized as standard in the pertinent art." *In re Ahlert*, 424 F.2d 1088,

1091 (CCPA 1970). This is not the case. The Office Action cites to 5:51-67 of Chaffee, which includes a generic recitation of providing a hose with sufficient capacity to supply fracturing operations. There is no indication regarding the consideration of drop out rates or other features of the claims. Moreover, "while 'official notice' may be relied on, these circumstances should be rare when an application is under final rejection or action under 37 CFR 1.113." MPEP 2144.03(A). Applicant respectfully submits that Official Notice is improper and requests withdrawal of the rejection of claims 5 and 6.

II. Claim 8 is are allowable over Winborn, Kotrla, and Kajaria

Claim 8 stands rejected under 35 U.S.C. § 103 as allegedly unpatentable over Winborn, Kotrla, and Kajaria. Applicant respectfully disagrees and traverses this rejection.

Claim 8 depends from claim 1. Accordingly, Applicant respectfully submits that claim 8 is allowable at least for depending from an allowable independent claim. Withdrawal of the pending rejection is, therefore, respectfully requested.

III. Amendment To The Claims

Unless otherwise specified or addressed in the remarks section, amendments to the claims are made for purposes of clarity, and are not intended to alter the scope of the claims or limit any equivalents thereof. The amendments are supported by the specification and do not add new matter. In addition, by focusing on specific claims and claim elements in the discussion above, Applicant does not imply that other claim elements are disclosed or suggested by the references. In addition, any characterizations of claims and/or cited art are being made to facilitate expeditious prosecution of this application. Applicant reserves the right to pursue at a later date any other broader or narrower claims that capture any subject matter supported by the present disclosure, including subject matter found to be specifically disclaimed herein or by another prosecution. Accordingly, reviewers of this or any child or related prosecution history shall not reasonably infer that Applicant has made any disclaimers or disavowals of any subject matter supported by the present disclosure.

IV. CONCLUSION

In view of the foregoing, Applicant believes all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

Further, the Commissioner is hereby authorized to charge any additional fees or credit any overpayment in connection with this paper to Deposit Account No. 50-1349.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 713-632-1413.

September 29, 2020

Respectfully submitted,

/Joe Grdinovac/
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PTO/SB/08a (02-18)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16728359
Filing Date	2019-12-27
First Named Inventor	Jared Oehring
Art Unit	3679
Examiner Name	Aaron Lloyd Lembo
Attorney Docket Number	047158.100066

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	9324049		2016-04-26	Thomeer	
	2	10415332		2019-09-17	Morris	
	3	10669804		2020-06-02	Kotrla	
	4	3055682		1962-09-25	Bacher	
	5	9513055		2016-12-06	Seal	
	6	9061223		2015-06-23	Winborn	
	7	8091928		2012-01-10	Carrier	
	8	6719900		2004-04-13	Hawkins	

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	9	5433243		1995-07-18	Griswold	
	10	5230366		1993-07-27	Marandi	
	11	2610741		1952-09-16	Schmid	
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	16	9499335		2016-11-22	McIver	
	17	9909398		2018-03-06	Pham	
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	20	9051822		2015-06-09	Ayan	
	21	7170262		2007-01-30	Pettigrew	
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	1	20160258267		2016-09-08	Payne	
	2	20130180722		2013-07-18	Olarte Caro	
	3	20130299167		2013-11-14	Fordyce	
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	8	20170175516		2017-06-22	Eslinger	
	9	20190010793		2019-01-10	Hinderliter	
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	Attorney Docket Number	047158.100066

	18	20180291713		2018-10-11	Jeanson	
	19	20200232454		2020-07-23	Chretien	
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	24	20060065319		2006-03-30	Csitari	
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	1	International Search Report and Written Opinion mailed June 2, 2020 in corresponding PCT Application No. PCT/US20/23809	☒
	2	International Search Report and Written Opinion mailed June 23, 2020 in corresponding PCT Application No. PCT/US20/23912	☒
	3	International Search Report and Written Opinion mailed July 22, 2020 in corresponding PCT Application No. PCT/US20/00017	☒
	4	Office Action mailed August 4, 2020 in related U.S. Patent Application No. 16/385,070	☒
	5	Office Action mailed June 29, 2020 in related U.S. Patent Application No. 16/404,283	☒
	6	Canadian Office Action mailed August 17, 2020 in related CA Patent Application No. 2,944,968	☒
	7	Office Action mailed June 22, 2020 in related U.S. Patent Application No. 16/377,861	☒
	8	Canadian Office Action mailed August 18, 2020 in related CA Patent Application No. 2,933,444	☒

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	Attorney Docket Number	047158.100066

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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(Not for submission under 37 CFR 1.99)

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Art Unit	3679
Examiner Name	Aaron Lloyd Lembo
Attorney Docket Number	047158.100066

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☒ That each item of information contained in the 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 the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☒ See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Taylor P. Evans/	Date (YYYY-MM-DD)	2020-09-02
Name/Print	Taylor P. Evans	Registration Number	60506

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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From the INTERNATIONAL SEARCHING AUTHORITY

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HOGAN LOVELLS US LLP
609 MAIN STREET, SUITE 4200
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PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

	Date of mailing *(day/month/year)* 23 JUN 2020
Applicant's or agent's file reference 047156.500052	FOR FURTHER ACTION See paragraphs 1 and 4 below
International application No. PCT/US2020/023912	International filing date *(day/month/year)* 20 March 2020
Applicant U.S. WELL SERVICES, LLC	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

Filing of amendments and statement under Article 19:
The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

How? Directly to the International Bureau preferably through ePCT, or on paper to:
The International Bureau of WIPO, 34, chemin des Colombettes, 1211 Geneva 20, Switzerland
(Facsimile No.: +41 22 338 82 70)

For more detailed instructions, see the *PCT Applicant's Guide*, International Phase, paragraphs 9.004 – 9.011.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ With regard to any protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:
   - ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with any request to forward the texts of both the protest and the decision thereon to the designated Offices.
   - ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

Shortly after the expiration of 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

Within 19 months from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later); otherwise, the applicant must, within 20 months from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices. In respect of other designated Offices, the time limit of 30 months (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

Within 22 months from the priority date, the applicant may request that a supplementary international search be carried out by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine R. Copenheaver Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/220 (revised January 2019)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION
047156.500052	see Form PCT/ISA/220 as well as, where applicable, item 5 below.

International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/US2020/023912	20 March 2020	20 March 2019

Applicant

U.S. WELL SERVICES, LLC

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 9 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the language, the international search was carried out on the basis of:

   ☒ the international application in the language in which it was filed

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

   b. ☐ This international search report has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

   c. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, see Box No. I.

2. ☐ Certain claims were found unsearchable (see Box No. II).

3. ☐ Unity of invention is lacking (see Box No. III).

4. With regard to the title,

   ☒ the text is approved as submitted by the applicant.

   ☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

   ☒ the text is approved as submitted by the applicant.

   ☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the drawings,

   a. the figure of the drawings to be published with the abstract is Figure No. 1

   ☒ as suggested by the applicant.

   ☐ as selected by this Authority, because the applicant failed to suggest a figure.

   ☐ as selected by this Authority, because this figure better characterizes the invention.

   b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2020/023912

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - E21B 43/26; E21B 41/00; E21B 43/16; E21B 43/267; E21B 47/00; F04B 49/20 (2020.01)
CPC - E21B 43/26; E21B 21/062; E21B 41/00; E21B 43/128; E21B 43/267; E21B 47/00; F04B 51/00 (2020.05)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
see Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
see Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
see Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2017/0096885 A1 (US WELL SERVICES LLC) 06 April 2017 (06.04.2017) entire document	1-6, 9-13, 15
Y	US 2017/0175516 A1 (SCHLUMBERGER TECHNOLOGY CORPORATION) 22 June 2017 (22.06.2017) entire document	1-6, 9-13, 15
A	US 2019/0010793 A1 (US WELL SERVICES LLC) 10 January 2019 (10.01.2019) entire document	1-15
A	US 2013/0317750 A1 (S.P.M. FLOW CONTROL, INC.) 28 November 2013 (28.11.2013) entire document	1-15
A	US 2016/0258267 A1 (STEWART & STEVENSON, LLC) 08 September 2016 (08.09.2016) entire document	1-15

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 May 2020	23 JUN 2020
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine R. Copenheaver Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/210 (second sheet) (July 2019)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: TAYLOR P. EVANS
HOGAN LOVELLS US LLP
609 MAIN STREET, SUITE 4200
HOUSTON, TX 77002

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)* 23 JUN 2020

Applicant's or agent's file reference
047156.500052

FOR **FURTHER** ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2020/023912	20 March 2020	20 March 2019

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - E21B 43/26; E21B 41/00; E21B 43/16; E21B 43/267; E21B 47/00; F04B 49/20 (2020.01)
CPC - E21B 43/26; E21B 21/062; E21B 41/00; E21B 43/128; E21B 43/267; E21B 47/00; F04B 51/00 (2020.05)

Applicant U.S. WELL SERVICES, LLC

1. This opinion contains indications relating to the following items:

- [X] Box No. I Basis of the opinion
- [ ] Box No. II Priority
- [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [ ] Box No. IV Lack of unity of invention
- [X] Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI Certain documents cited
- [ ] Box No. VII Certain defects in the international application
- [ ] Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	19 May 2020	Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 Telephone No. 571-272-4300

Form PCT/ISA/237 (cover sheet) (revised January 2019)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2020/023912

Box No. I Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of:

☒ the international application in the language in which it was filed.

☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(b)).

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

a. ☐ forming part of the international application as filed:

☐ in the form of an Annex C/ST.25 text file.

☐ on paper or in the form of an image file.

b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2020/023912

Box No. V Reasoned **statement** under Rule **43*bis*.1(a)**(i) with regard to **novelty, inventive step and industrial applicability; citations and explanations supporting** such statement

1 Statement

Novelty (N)	Claims	1-15	YES
	Claims	None	NO
Inventive step (IS)	Claims	7, 8, 14	YES
	Claims	1-6, 9-13, 15	NO
Industrial applicability (IA)	Claims	1-15	YES
	Claims	None	NO

2. Citations and explanations:

Claims 1-6, 9-13, and 15 lack an inventive step under PCT Article 33(3) as being obvious over US 2017/0096885 A1 to US Well Services LLC (hereinafter US Well '885) in view of Schlumberger Technology Corporation (hereinafter Schlumberger).

Regarding Claim 1, US Well '885 discloses a hydraulic fracturing system ("A hydraulic fracturing system", abstract), comprising: a pump system (pump system 36, fig. 1) fluidly coupled to a wellhead at a well site (fig.1 shows pump system 36 fluidly coupled to a wellhead 41 at a well site next to well bore 12) to pump a fracturing fluid into the wellhead ("After being discharged from pump system 36, slurry is pumped into a wellhead assembly 41", para. [0030]); a blender (blender unit 28, fig. 1) configured to mix together proppant and a fluid mixture to form the fracturing fluid ("A proppant source 32 contains proppant, which is delivered to the blender unit 28 as represented by line 34, where line 34 can be a conveyer. Inside the blender unit 28, the proppant and fluid/additive mixture are combined to form a fracturing slurry", para. [0028]); a proppant storage and delivery system configured to provide the proppant for the blender ("A proppant source 32 contains proppant, which is delivered to the blender unit 28 as represented by line 34", para. [0028]); a hydration unit (hydration unit 18, fig. 1) configured to mix an additive into a fluid to form the fluid mixture ("The fluid, which in one example is water, is mixed inside of the hydration unit 18 with the additives. In an embodiment, the fluid and additives are mixed over a period of time, to allow for uniform distribution of the additives within the fluid", para. [0028]) and provide the fluid mixture to the blender ("In the example of FIG. 1, the fluid and additive mixture is transferred to a blender unit 28 via line 30", para. [0028]); a fluid storage and delivery system configured to provide the fluid for the hydration unit (fig. 1 shows fluid source 20 and line 22 configured to provide fluid for the hydration unit 18); an additive storage and delivery system configured to provide the additive to the hydration unit (fig. 1 shows additive source 24 and line 26 configured to provide the additive to the hydration unit 18).
US Well '885 fails to explicitly disclose damage accumulation monitoring, a damage accumulation monitoring system comprising a plurality of sensing devices and integrated into one or more components of the pump system, the blender system, the proppant storage and delivery system, the fluid storage and delivery system, and the additive storage and delivery system, the damage accumulation sensor system configured to monitor a plurality of parameters of the hydraulic fracturing system via the plurality of sensing devices to determine respective accumulated damage measurements of the one or more components.
Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches a damage accumulation monitoring system ("Additionally, virtual torque shaft data may be used to predict torsional fatigue life damage and remaining fatigue life of various shafts in submersible pumping system 22", para. [0039]), a damage accumulation monitoring system comprising a plurality of sensing devices ("Another illustrated component is a sensor unit 52 utilized in sensing a variety of wellbore parameters. It should be noted, however, that sensor unit 52 may comprise a variety of sensors", para. [0019]) and integrated into one or more components of the pump system, the blender system, the proppant storage and delivery system, the fluid storage and delivery system, and the additive storage and delivery system ("sensor systems deployed along electric submersible pumping system 22, along casing 36, or along other regions of the wellbore 24 to obtain data for determining one or more desired parameters, as described more fully below", para. [0019]), the damage accumulation sensor system configured to monitor a plurality of parameters of the pumping system via the plurality of sensing devices ("a variety of sensor systems 52 may comprise sensors located at surface 30 to obtain desired data helpful in the process of determining measured parameters related to prediction of failures/run life of electric submersible pumping system 22 or specific components of pumping system 22", para. [0019]) to determine respective accumulated damage measurements of the one or more components ("sensor systems 52 may comprise sensors located at surface 30 to obtain desired data helpful in the process of determining measured parameters related to prediction of failures/run life of electric submersible pumping system 22 or specific components of pumping system 22", para. [0019]; "the processing system 54 also may be used to control operation of the pumping system,...,a control system for adjusting operation of the electric submersible pumping system 22 in response to predictions of run life or component failure", para. [0023]).
It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Well '885 with the teaching of Schlumberger for the purpose of monitoring the pumping system and its components and thereby predicting the run life of a pumping system (abstract of Schlumberger).

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:

Regarding Claim 2, modified US Well '885 discloses the hydraulic fracturing system of claim 1.
US Well '885 fails to explicitly disclose wherein the accumulated damage measurement of a component is indicative of an amount of actual usage incurred by the component during a period of time.
Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches wherein the accumulated damage measurement of a component is indicative of an amount of actual usage incurred by the component during a period of time ("sensor systems deployed along electric submersible pumping system 22, along casing 36, or along other regions of the wellbore 24 to obtain data for determining one or more desired parameters, as described more fully below,...sensor systems 52 may comprise sensors located at surface 30 to obtain desired data helpful in the process of determining measured parameters related to prediction of failures/run life of electric submersible pumping system 22 or specific components of pumping system 22", para. [0019]; "The measured data 80 is obtained from sensors, such as sensors 74, which monitor at least one component of electric submersible pumping system 22 during operation. This data is provided to the component/system degradation model 70 so that the data may be appropriately processed via processing system 54 to predict a remaining useful life of the component (or overall pumping system 22) during operation of the electric submersible pumping system 22", para. [0028]).
It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Well '885 with the teaching of Schlumberger for the purpose of monitoring the pumping system and its components and thereby predicting the run life of a pumping system (abstract of Schlumberger).

Regarding Claim 3, US Well '885 discloses a hydraulic fracturing system ("A hydraulic fracturing system", abstract), comprising: a plurality of hydraulic fracturing equipment positioned at a well site ("The system further includes hydraulic fracturing system components for making the fracturing fluid slurry", abstract), comprising: one or more pumps configured to pressurize a fracturing fluid (fig.1 shows pump system 36 fluidly coupled to a wellhead 41 at a well site next to well bore 12; "After being discharged from pump system 36, slurry is pumped into a wellhead assembly 41", para. [0030]); and a distribution system fluidly coupled to receive and consolidate fracturing fluid from the plurality of pumps for injection into a wellhead (blender unit 28, fig. 1; "A proppant source 32 contains proppant, which is delivered to the blender unit 28 as represented by line 34, where line 34 can be a conveyer. Inside the blender unit 28, the proppant and fluid/additive mixture are combined to form a fracturing slurry", para. [0028]; "A proppant source 32 contains proppant, which is delivered to the blender unit 28 as represented by line 34", para. [0028]; "The fluid, which in one example is water, is mixed inside of the hydration unit 16 with the additives. In an embodiment, the fluid and additives are mixed over a period of time, to allow for uniform distribution of the additives within the fluid", para. [0028]; "After being discharged from pump system 36, slurry is pumped into a wellhead assembly 41. Discharge piping 42 connects discharge of pump system 36 with wellhead assembly 41 and provides a conduit for the slurry between the pump system 36 and the wellhead assembly 41", para. [0030]).
US Well '885 fails to explicitly disclose damage accumulation monitoring, a damage accumulation monitoring system, comprising: a plurality of sensing devices integrated into respective components of the plurality of hydraulic fracturing equipment, the plurality of sensing devices configured to measure a plurality of usage parameters of the respective components; and a processing device configured to receive the plurality of usage parameters and determine respective damage accumulation measurements of the respective components based at least in part on the usage parameters.
Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches a damage accumulation monitoring system ("Additionally, virtual torque shaft data may be used to predict torsional fatigue life damage and remaining fatigue life of various shafts in submersible pumping system 22", para. [0039]), a damage accumulation monitoring system, comprising: a plurality of sensing devices ("Another illustrated component is a sensor unit 52 utilized in sensing a variety of wellbore parameters. It should be noted, however, that sensor unit 52 may comprise a variety of sensors", para. [0019]) integrated into respective components of the plurality of hydraulic fracturing equipment ("sensor systems deployed along electric submersible pumping system 22, along casing 36, or along other regions of the wellbore 24 to obtain data for determining one or more desired parameters, as described more fully below", para. [0019]), the plurality of sensing devices configured to measure a plurality of usage parameters of the respective components ("a variety of sensor systems 52 may comprise sensors located at surface 30 to obtain desired data helpful in the process of determining measured parameters related to prediction of failures/run life of electric submersible pumping system 22 or specific components of pumping system 22", para. [0019]); and a processing device configured to receive the plurality of usage parameters (fig. 2 shows processor control system 54 configured to receive parameters from the sensor unit 52 and sensors 74) and determine respective damage accumulation measurements of the respective components based at least in part on the usage parameters ("sensor systems 52 may comprise sensors located at surface 30 to obtain desired data helpful in the process of determining measured parameters related to prediction of failures/run life of electric submersible pumping system 22 or specific components of pumping system 22", para. [0019]; "the processing system 54 also may be used to control operation of the pumping system,...,a control system for adjusting operation of the electric submersible pumping system 22 in response to predictions of run life or component failure", para. [0023]; "The measured data 80 is obtained from sensors, such as sensors 74, which monitor at least one component of electric submersible pumping system 22 during operation. This data is provided to the component/system degradation model 70 so that the data may be appropriately processed via processing system 54 to predict a remaining useful life of the component (or overall pumping system 22) during operation of the electric submersible pumping system 22", para. [0028]).
It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Well '885 with the teaching of Schlumberger for the purpose of monitoring the pumping system and its components and thereby predicting the run life of a pumping system (abstract of Schlumberger).

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US2020/023912

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:

Regarding Claim 4, modified US Wall '885 discloses the hydraulic fracturing system of claim 3.
US Wall '885 fails to explicitly disclose wherein the accumulated damage measurement of a component is indicative of an amount of actual usage incurred by the component during a period of time.
Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches wherein the accumulated damage measurement of a component is indicative of an amount of actual usage incurred by the component during a period of time ("the control aspects of processing system 54 may be automated so that automatic adjustments to the operation of pumping system 22 may be implemented in response to run life/component failure predictions resulting from data processed according to algorithm 66", para. [0023]; "Referring generally to FIG. 3, an example of overall algorithm 66 is illustrated as one technique for evaluating data related to electric submersible pumping system 22 in a manner facilitating run life prediction", para. [0024]; this shows the amount of usage for the pumping system 22 components over a period of time).
It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Wall '885 with the teaching of Schlumberger for the purpose of avoiding the pumping system from a failure and thereby automatically adjust the operation of pumping system in response to the life/failure time for a components (para. [0023] of Schlumberger).

Regarding Claim 5, modified US Wall '885 discloses the hydraulic fracturing system of claim 4.
US Wall '885 fails to explicitly disclose wherein the damage accumulation monitoring system further determines an estimated remaining life of the component based on the accumulated damage measurement, wherein the estimated remaining life is expressed as a percentage.
Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches wherein the damage accumulation monitoring system further determines an estimated remaining life of the component based on the accumulated damage measurement ("This data is provided to the component/system degradation model 70 so that the data may be appropriately processed via processing system 54 to predict a remaining useful life of the component (or overall pumping system 22) during operation of the electric submersible pumping system 22", para. [0028]; "the degradation model 70 may be programmed or otherwise configured to predict the remaining useful life of the motor magnet wire based on the motor winding temperatures according to predetermined relationships between useful life and temperatures", para. [0029]).
It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Wall '885 with the teaching of Schlumberger for the purpose of monitoring the pumping system and its components and thereby predicting the run life of a pumping system (abstract of Schlumberger)
It would have been obvious to one of ordinary skill in the art at the time of the invention to provide any type of displayed/indicated information on the estimated remaining life is expressed as a percentage since such a modification depends only on the intended use of the apparatus/system and the desired information to be displayed. The motivation for doing so would have been to providing a better scale for the life time of the parts and thereby alarming the operator on the optimum time to replace the pumping parts.

Regarding Claim 6, modified US Wall '885 discloses the hydraulic fracturing system of claim 4.
US Wall '885 fails to explicitly disclose wherein the damage accumulation monitoring system further determines a damage accumulation rate based on the accumulated damage measurement with respect to the duration of the period of time.
Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches wherein the damage accumulation monitoring system further determines a damage accumulation rate based on the accumulated damage measurement with respect to the duration of the period of time ("the control aspects of processing system 54 may be automated so that automatic adjustments to the operation of pumping system 22 may be implemented in response to run life/component failure predictions resulting from data processed according to algorithm 66", para. [0023]; "Referring generally to FIG. 3, an example of overall algorithm 66 is illustrated as one technique for evaluating data related to electric submersible pumping system 22 in a manner facilitating run life prediction", para. [0024]; this shows the amount of usage for the pumping system 22 components over a period of time).
It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Wall '885 with the teaching of Schlumberger for the purpose of avoiding the pumping system from a failure and thereby automatically adjust the operation of pumping system in response to the life/failure time for a components (para. [0023] of Schlumberger).

Regarding Claim 9, modified US Wall '885 discloses the hydraulic fracturing system of claim 3.
US Wall '885 fails to explicitly disclose wherein the use parameters include one or more of a set of parameters including operation time, observed cycles, amount pumped, fuel consumed, power consumed, number of start/stops, or amount of flow.
Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches wherein the use parameters include one or more of a set of parameters including operation time, observed cycles, amount pumped, fuel consumed, power consumed, number of start/stops, or amount of flow ("an electric submersible pumping system 22 having a submersible pump 40, a pump intake 42, and a submersible electric motor 44 that powers submersible pump 40", para. [0018]; "The processing system 54 may be used to process data from the sensors and/or other data according to a desired overall algorithm which facilitates prediction of system run life. In some applications, the processing system 54 is in the form of a computer based control system which may be used to control, for example, a surface power system 56 which is operated to supply electrical power to pumping system 22 via power cable 46", para. [0020]; "This allows the processing system 54 to be used as a control system for adjusting operation of the electric submersible pumping system 22 in response to predictions of run life or component failure. In some applications, the control aspects of processing system 54 may be automated so that automatic adjustments to the operation of pumping system 22 may be implemented in response to run life/component failure predictions resulting from data processed according to algorithm 66", para. [0023]).
It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Wall '885 with the teaching of Schlumberger for the purpose of avoiding the pumping system from a failure and thereby automatically adjust the operation of pumping system in response to the life/failure time for a components (para. [0023] of Schlumberger).

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:

Regarding Claim 10, US Well '885 discloses a hydraulic fracturing method ("A hydraulic fracturing system", abstract), comprising: a pump system (pump system 36, fig. 1), comprising: providing a fracturing fluid to a plurality of pumps (Arranged in rows and transverse to acid tanker 100 are pump trucks 1021-12, which make up the pump system 36 for pressurizing the slurry so that it can be injected into wellhead 41, para. [0038]); pumping the fracturing fluid into a distribution system (fig. 2 shows the slurry being pumped into pump trucks 1021-12); injecting the fracturing fluid into a wellhead ("After being discharged from pump system 36, slurry is pumped into a wellhead assembly 41", para. [0030]).
US Well '885 fails to explicitly disclose detecting respective usage parameters associated with of a plurality of components of the plurality of pumps, the distribution system, or the wellhead via a plurality of sensing devices instrumented thereon; and determining a damage accumulation parameter associated with of a plurality of components of the plurality of pumps, the distribution system, or the wellhead based at least in part on the respective usage parameters.
Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches detecting respective usage parameters associated with of a plurality of components of the plurality of pumps ("Additionally, virtual torque shaft data may be used to predict torsional fatigue life damage and remaining fatigue life of various shafts in submersible pumping system 22", para. [0039]), the distribution system, or the wellhead via a plurality of sensing devices instrumented thereon ("Another illustrated component is a sensor unit 52 utilized in sensing a variety of wellbore parameters. It should be noted, however, that sensor unit 52 may comprise a variety of sensors", para. [0019]); and determining a damage accumulation parameter associated with of a plurality of components of the plurality of pumps, the distribution system, or the wellhead based at least in part on the respective usage parameters ("sensor systems deployed along electric submersible pumping system 22, along casing 36, or along other regions of the wellbore 24 to obtain data for determining one or more desired parameters, as described more fully below", para. [0019]; "a variety of sensor systems 52 may comprise sensors located at surface 30 to obtain desired data helpful in the process of determining measured parameters related to prediction of failures/run life of electric submersible pumping system 22 or specific components of pumping system 22", para. [0019]; "sensor systems 52 may comprise sensors located at surface 30 to obtain desired data helpful in the process of determining measured parameters related to prediction of failures/run life of electric submersible pumping system 22 or specific components of pumping system 22", para. [0019]; "the processing system 54 also may be used to control operation of the pumping system,...,a control system for adjusting operation of the electric submersible pumping system 22 in response to predictions of run life or component failure", para. [0023]).
It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Well '885 with the teaching of Schlumberger for the purpose of monitoring the pumping system and its components and thereby predicting the run life of a pumping system (abstract of Schlumberger).

Regarding Claim 11, modified US Well '885 discloses the hydraulic fracturing method of claim 10.
US Well '885 fails to explicitly disclose wherein the accumulated damage parameter of a component is indicative of an amount of actual usage incurred by the component during a period of time.
Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches wherein the accumulated damage parameter of a component is indicative of an amount of actual usage incurred by the component during a period of time ("the control aspects of processing system 54 may be automated so that automatic adjustments to the operation of pumping system 22 may be implemented in response to run life/component failure predictions resulting from data processed according to algorithm 66", para. [0023]; "Referring generally to FIG. 3, an example of overall algorithm 66 is illustrated as one technique for evaluating data related to electric submersible pumping system 22 in a manner facilitating run life prediction", para. [0024]; this shows the amount of usage for the pumping system 22 components over a period of time).
It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Well '885 with the teaching of Schlumberger for the purpose of avoiding the pumping system from a failure and thereby automatically adjust the operation of pumping system in response to the life/failure time for a components (para. [0023] of Schlumberger).

Regarding Claim 12, modified US Well '885 discloses the hydraulic fracturing method of claim 10.
US Well '885 fails to explicitly disclose determining an estimated remaining life of the component based on the accumulated damage parameter, wherein the estimated remaining life is expressed as a percentage.
Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches wherein the damage accumulation monitoring system further determines an estimated remaining life of the component based on the accumulated damage measurement ("This data is provided to the component/system degradation model 70 so that the data may be appropriately processed via processing system 54 to predict a remaining useful life of the component (or overall pumping system 22) during operation of the electric submersible pumping system 22", para. [0028]; "the degradation model 70 may be programmed or otherwise configured to predict the remaining useful life of the motor magnet wire based on the motor winding temperatures according to predetermined relationships between useful life and temperatures", para. [0029]).
It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Well '885 with the teaching of Schlumberger for the purpose of monitoring the pumping system and its components and thereby predicting the run life of a pumping system (abstract of Schlumberger).
It would have been obvious to one of ordinary skill in the art at the time of the invention to provide any type of displayed/indicated information on the estimated remaining life is expressed as a percentage since such a modification depends only on the intended use of the apparatus/system and the desired information to be displayed. The motivation for doing so would have been to providing a better scale for the life time of the parts and thereby alarming the operator on the optimum time to replace the pumping parts.

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:

Regarding Claim 13, modified US Well '885 discloses the hydraulic fracturing method of claim 11.
US Well '885 fails to explicitly disclose determining a damage accumulation rate based on the accumulated damage parameter with respect to the duration of the period of time.
Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches determining a damage accumulation rate based on the accumulated damage parameter with respect to the duration of the period of time ("the control aspects of processing system 54 may be automated so that automatic adjustments to the operation of pumping system 22 may be implemented in response to run life/component failure predictions resulting from data processed according to algorithm 66", para. [0023]; "Referring generally to FIG. 3, an example of overall algorithm 68 is illustrated as one technique for evaluating data related to electric submersible pumping system 22 in a manner facilitating run life prediction", para. [0024]; this shows the amount of usage for the pumping system 22 components over a period of time).
It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Well '885 with the teaching of Schlumberger for the purpose of avoiding the pumping system from a failure and thereby automatically adjust the operation of pumping system in response to the life/failure time for a components (para. [0023] of Schlumberger).

Regarding Claim 15, modified US Well '885 discloses the hydraulic fracturing method of claim 13.
US Well '885 fails to explicitly disclose further comprising: updating the damage accumulation rate over time.
Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches updating the damage accumulation rate over time ("The measured motor winding temperatures are then used in the corresponding degradation model 70 to predict in real-time the remaining useful life of the pumping string component, e.g. submersible motor 44. In this specific example, the degradation model 70 may be programmed or otherwise configured to predict the remaining useful life of the motor magnet wire based on the motor winding temperatures according to predetermined relationships between useful life and temperatures", para. [0029]).
It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Well '885 with the teaching of Schlumberger for the purpose of avoiding the pumping system from a failure and thereby automatically adjust the operation of pumping system in response to the life/failure time for a components (para. [0023] of Schlumberger).

Claims 7, 8, and 14 meet the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest:

Regarding claim 7, the prior art of record, individually or in combination, does not teach or fairly suggest the hydraulic fracturing system of claim 6, wherein the damage accumulation monitoring system further determines an estimated maintenance time based on the damage accumulation rate and the accumulated damage measurement.

The following prior art is made of record to support and further define the reasons that claim 7 meets the criteria set out in PCT Article 33 (2)-(3):
Schlumberger discloses the damage accumulation rate and the accumulated damage measurement ("Additionally, virtual torque shaft data may be used to predict torsional fatigue life damage and remaining fatigue life of various shafts in submersible pumping system 22", para. [0039]; "sensor systems 52 may comprise sensors located at surface 30 to obtain desired data helpful in the process of determining measured parameters related to prediction of failures/run life of electric submersible pumping system 22 or specific components of pumping system 22", para. [0019]; "the processing system 54 also may be used to control operation of the pumping system,...,a control system for adjusting operation of the electric submersible pumping system 22 in response to predictions of run life or component failure", para. [0023]).
However Schlumberger fails to disclose wherein the damage accumulation monitoring system further determines an estimated maintenance time based on the damage accumulation rate and the accumulated damage measurement.

Claim 8 depends from claim 7, and therefore meets the criteria set out in PCT Article 33(2)-(3) for at least the same reasons as claim 7.

Regarding claim 14, the prior art of record, individually or in combination, does not teach or fairly suggest the hydraulic fracturing method of claim 13, further comprising: determining an estimated maintenance time based on the damage accumulation rate and the accumulated damage parameter.

The following prior art is made of record to support and further define the reasons that claim 14 meets the criteria set out in PCT Article 33 (2)-(3):
Schlumberger discloses the damage accumulation rate and the accumulated damage parameter ("Additionally, virtual torque shaft data may be used to predict torsional fatigue life damage and remaining fatigue life of various shafts in submersible pumping system 22", para. [0039]; "sensor systems 52 may comprise sensors located at surface 30 to obtain desired data helpful in the process of determining measured parameters related to prediction of failures/run life of electric submersible pumping system 22 or specific components of pumping system 22", para. [0019]; "the processing system 54 also may be used to control operation of the pumping system,...,a control system for adjusting operation of the electric submersible pumping system 22 in response to predictions of run life or component failure", para. [0023]).
However Schlumberger fails to disclose determining an estimated maintenance time based on the damage accumulation rate and the accumulated damage parameter.

Claims 1-15 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.

Search History:

Limited Classification Search

The Patent Analyst performed a limited classification search within the following US, IPC, CPC, ECLA, or F-Term classification areas:

CPC Class/Subclass(es): E21B 43/26; E21B 21/062; E21B 41/00; E21B 43/128; E21B 43/267; E21B 47/00; F04B 51/00 (2020.05)

IPC (8) Class/Subclass(es): E21B 43/26; E21B 41/00; E21B 43/16; E21B 43/267; E21B 47/00; F04B 49/20; F04B 51/00; G01N 27/90 (2020.01)

U.S. Class/Subclass(es): 73/152.18; 166/75.15; 166/250.01; 166/305.1; 166/308.1; 166/308.2

See Global Search Results.

Global Patent Literature Text Search

The Patent Analyst performed the following global text search, which was not limited by classification but may or may not have been limited by other criteria:

Questel Orbit: https://www.orbit.com

#	Search query	Results
1	((US D WELL)/PA/OPA OR ("US WELL SERVICES")/NPAN OR ("MATLIN & ACQUISITION")/NPAN OR ("USWS FLEET 10")/NPAN OR ("USWS FLEET II")/NPAN)	47
2	1 AND ((DAMAG+) 3D (ACCUM+))	1
3	(WO2019113147)/PN	1
4	..CITBF NOSOURCE SS 3 1 RANKED	323
5	4 AND ((DAMAG+) 3D (ACCUM+))	0
6	4 AND (FRACTUR+)	109
7	6 AND (BLENDER?)	26
8	6 AND (PROPPANT?)	21
9	7 AND 8	9
10	1 AND (USAG+)	3
11	(US20200073353 OR CA2944980)/PN	2
12	..CITBF NOSOURCE SS 11 SET	5
13	(US9194207)/PN	1
14	..CITBF NOSOURCE SS 13 1 RANKED	162
15	14 AND (FRACTUR+)	36
16	(US20160258267 OR US20130299167 OR US20130180722)/PN	3

17	..CITBF NOSOURCE SS 16 SET	129
18	17 AND ((USAG+) 5D (INCUR+))	0
19	17 AND (USAG+)	1
20	..CITBF NOSOURCE SS 16 2 RANKED	60
21	20 AND (PROPPANT?)	29
22	21 AND (BLENDER?)	5
23	(US10227854 OR US10487261)/PN	2
24	..CITBF NOSOURCE SS 23 1 RANKED	16
25	..CITBF NOSOURCE SS 23 2 RANKED	36
26	(US20130233560)/PN	1
27	..CITBF NOSOURCE SS 26 1 RANKED	19
28	(WO2017213886)/PN	1
29	..CITBF NOSOURCE SS 28 1 RANKED	20
30	(US20140277772 OR US20130233560 OR US200901206 35 OR US2004007392 OR US20040007392 OR US4510800 OR WO2010101668)/PN	6
31	..CITBF NOSOURCE SS 30 3 RANKED	19
32	(WO201910158)/PN	1
33	..CITBF NOSOURCE SS 32 1 RANKED	223
34	33 AND (PROPPANT?)	17
35	33 AND (BLENDER?)	21
36	33 AND (USAG+)	11
37	(((HYDRAULIC+) 8D (FRACTUR+)) AND (PUMP+))/TI/AB/CLMS/TX	18851
38	37 AND ((BLENDER?) 8D (PROPPANT?))	50
39	(US20140290768 OR US20140277772 OR US20170096885 OR US20070277982)/PN	4
40	..CITBF NOSOURCE SS 39 4 RANKED	132
41	40 AND ((BLENDER?) 8D (PROPPANT?))	7
42	37 AND ((USAG+) 5D (INCUR+))	0
43	37 AND (USAG+)	283
44	43 AND (PROPPANT?)	35
45	37 AND ((USAG+) 5D (SENSOR?))	2
46	37 AND (DAMAG+)	2960

47	46 AND (PROPPANT?)	556
48	47 AND (BLENDER?)	33
49	37 AND ((DAMAG+) 5D (ACCUMULAT+))	17
50	(US4839571)/PN	1
51	..CITBF NOSOURCE SS 50 1 RANKED	49
52	51 AND ((DAMAG+) 5D (ACCUMULAT+))	1
53	37 AND ((USAG+) 5D (SENSOR?))	2
54	37 AND ((US+) 5D (SENSOR?))	359
55	54 AND (PROPPANT?)	24
56	37 AND (INCURRED+)	21
57	37 AND (SENSOR?)	1938
58	57 AND ((BLENDER?) 8D (PROPPANT?))	10
59	57 AND (PROPPANT?)	134
60	59 AND (BLENDER?)	15
61	37 AND ((REMAIN+) 5D (LIFE?))	12
62	(WO2017100387)/PN	1
63	..CITBF NOSOURCE SS 62 1 RANKED	5
64	37 AND ((RUN+) 5D (LIFE?))	4
65	37 AND ((FATIG+) 5D (ACCUMULAT+))	2
66	37 AND ((FATIG+) 5D (PUMP+))	18
67	((FRACTUR+) 5D (PUMP+)) AND ((FATIG+) 5D (PUMP+))	38
68	(WO201910158)/PN	1
69	..CITBF NOSOURCE SS 68 1 RANKED	223
70	69 AND ((FATIG+) 5D (PUMP+))	1
71	69 AND ((LIF+) 5D (PUMP+))	8
72	(166305100)/PCL	1954
73	(166308100)/PCL	1259
74	(166250010)/PCL	1306
75	(166308200)/PCL	443
76	(073152180)/PCL	297
77	(166075150)/PCL	158

78	72 OR 73 OR 74 OR 75 OR 76 OR 77	4919
79	78 AND (((HYDRAULIC+) 8D (FRACTUR+)) AND (PUMP+))	349
80	79 AND ((BLENDER?) 8D (PROPPANT?))	4
81	79 AND (BLENDER?)	18
82	79 AND (PROPPANT?)	138
83	82 AND (SENSOR?)	9
84	78 AND ((FATIG+) 5D (ACCUMULAT+))	0
85	78 AND ((FATIG+) 5D (PUMP+))	2
86	78 AND ((RUN+) 5D (LIFE?))	1
87	78 AND ((FRACTUR+) 5D (PUMP+)) AND ((FATIG+) 5D (PUMP+))	1
88	78 AND ((REMAIN+) 5D (LIFE?))	5
89	78 AND ((USAG+) 5D (INCUR+))	0
90	78 AND ((US+) 5D (INCUR+))	1
91	37 AND ((LIFE+) 5D (PUMP+))	89
92	91 AND (SENSOR?)	7
93	79 AND (HYDRAT+)	27
94	79 AND (ADDITIV+)	58
95	78 AND ((DAMAG+) 5D (ACCUMULAT+))	4
96	79 AND (DAMAG+)	85
97	78 AND ((DAMAG+) 5D (RATE?))	3
98	(E21B-043/26)/IPC	11336
99	(E21B-043/267)/IPC	3985
100	(E21B-043/16)/IPC	7492
101	(E21B-047/00)/IPC	20898
102	(E21B-041/00)/IPC	9203
103	(G01N-027/90)/IPC	9287
104	(F04B-049/20)/IPC	1272
105	(F04B-051/00)/IPC	6145
106	98 OR 99 OR 100 OR 101 OR 102 OR 103 OR 104 OR 105	63853
107	106 AND (((HYDRAULIC+) 8D (FRACTUR+)) AND (PUMP+))	2075
108	107 AND ((BLENDER?) 8D (PROPPANT?))	25

109	107 AND ((USAG+) 5D (INCUR+))	0
110	107 AND ((DAMAG+) 5D (ACCUMULAT+))	2
111	107 AND ((REMAIN+) 5D (LIFE?))	3
112	(US20130317750)/PN	1
113	..CITBF NOSOURCE SS 112 1 RANKED	191
114	113 AND ((REMAIN+) 5D (LIFE?))	20
115	106 AND ((FRACTUR+) 5D (PUMP+)) AND ((FATIG+) 5D (PUMP+))	7
116	106 AND ((REMAIN+) 5D (LIFE?))	80
117	116 AND (FRACTUR+)	6
118	107 AND ((LIFE+) 5D (PUMP+))	20
119	107 AND (BLENDER?)	125
120	107 AND (PROPPANT?)	657
121	119 AND 120	54
122	107 AND ((FATIG+) 5D (PUMP+))	3
123	106 AND ((DAMAG+) 5D (RATE?))	78
124	123 AND (PUMP+)	29
125	106 AND ((RUN+) 5D (LIFE?))	33
126	(US20170175516)/PN	1
127	..CITBF NOSOURCE SS 126 1 RANKED	14
128	(US10113549 OR US20080236821 OR US20130080117 OR US20130151156 OR US20140034390 OR US20180066503)/PN	6
129	..CITBF NOSOURCE SS 128 6 RANKED	56
130	(US8874383)/PN	1
131	..CITBF NOSOURCE SS 130 1 RANKED	35
132	(E21B-043/26)/CPC	6418
133	(E21B-043/267)/CPC	2650
134	(E21B-047/00)/CPC	7033
135	(E21B-043/128)/CPC	1474
136	(E21B-041/00)/CPC	6830
137	(E21B-021/062)/CPC	526
138	(F04B-051/00)/CPC	1879
139	132 OR 133 OR 134 OR 135 OR 136 OR 137 OR 138	23971

140	139 AND (((HYDRAULIC+) 8D (FRACTUR+)) AND (PUMP+))	1382
141	140 AND ((BLENDER?) 8D (PROPPANT?))	23
142	139 AND ((USAG+) 5D (INCUR+))	0
143	140 AND ((REMAIN+) 5D (LIFE?))	3
144	140 AND ((FATIG+) 5D (PUMP+))	1
145	139 AND ((FATIG+) 5D (PUMP+))	12
146	139 AND ((FRACTUR+) 5D (LIFE?))	26
147	139 AND ((SENSOR?) 8D (LIFE?))	47
148	139 AND (((LIFE?) 8D (BLENDER+)) AND (BLENDENR?))	0
149	139 AND (((LIFE?) 8D (PROPPANT+)) AND (BLENDENR?))	0
150	139 AND (((LIFE?) 8D (ADDITIV+)) AND (BLENDENR?))	0
151	139 AND ((DAMAG+) 5D (ACCUMULAT+))	20
152	(WO201762074)/PN	1
153	..CITBF NOSOURCE SS 152 1 RANKED	17
154	140 AND ((BLENDER?) 8D (PROPPANT?))	23
155	139 AND ((USAG+) 5D (INCUR+))	0
156	140 AND ((REMAIN+) 5D (LIFE?))	3
157	139 AND ((FRACTUR+) 5D (PUMP+)) AND ((FATIG+) 5D (PUMP+))	6
158	139 AND ((RUN+) 5D (LIFE?))	22
159	139 AND ((REMAIN+) 5D (LIFE?))	46
160	139 AND ((PROPPANT+) 5D (LIFE?))	2
161	139 AND ((DAMAG+) 5D (SENSOR?))	53
162	(US20180209415)/PN	1
163	..CITBF NOSOURCE SS 162 1 RANKED	6
164	(US20120157356 OR US8905056)/PN	2
165	..CITBF NOSOURCE SS 164 2 RANKED	63
166	139 AND ((DAMAG+) 5D (MAINTENANC+))	9
167	106 AND ((DAMAG+) 5D (MAINTENANC+))	49
168	78 AND ((DAMAG+) 5D (MAINTENANC+))	1
169	37 AND ((DAMAG+) 5D (MAINTENANC+))	4
170	139 AND ((LIF+) 5D (MAINTENANC+))	31

171	78 AND ((LIF+) 5D (MAINTENANC+))	1
172	37 AND ((LIF+) 5D (MAINTENANC+))	18
173	*MEM "home/QPTLD337/ACCUM" /XPN /APID	196

Google Patents: https://patents.google.com

#	Search query	Results
1	**(hydraulic fracturing system)(pump system)(blender)(proppant)(hydration unit)(additive storage)(monitoring usage incurred)**	**38**
2	(fracturing pump)(incurred usage)(sensor)	1,850
3	(fracturing pump)(hydraulic)(monitoring)(damage)(sensing devices)(usage parameters)	12,400
4	(damage accumulation monitoring)(hydraulic fracturing system)(sensors)(proppant storage)(additive storage)	127
5	(frac pump)(pump system)(blender)(proppant)(hydration unit)(maintenance)(storage)	1,120

Computer Accessed Text Databases Searched

The Patent Analyst searched the following computer accessed text databases:

Google: https://www.google.com/

#	Search query	Results
1	(US well services LLC)(hydraulic fracturing system)(pump)(blender)(proppant)	23,200
2	(hydraulic fracturing system)(accumulated damage)(incurred)(pumps)(sensing devices)	258,000
3	(hydrauiic fracturing system)(damage accumulation)(remaining lifetime)(pump)(maintenance time)	1,780,000
4	(accumulation)(fracturing pump)(estimated maintenance)(damage parameter)(proppant)(hydration)(fluid storage)	45,400
5	(frac pump)(accumulation damage)(measurement)(sensor)(usage)(incurred)	216,000

Google Scholar: https://scholar.google.com/

#	Search query	Results
1	**(hydraulic fracturing system)(pump system)(blender)(proppant storage)(hydration unit)(fluid storage)(additive storage)(amount of actual usage incurred)**	**44**
2	(hydraulic fracturing system)(monitoring)(pump)(blender)(proppant)(hydration unit)(measuring proppant usage)(sensors)	306
3	(hydraulic fracturing system)(damage accumulation)(pump system)(life time)(hydration unit)(fluid storage)(proppant)(additive storage)	326
4	(frac pump)(maintenance)(additive storage)(proppant)(damage accumulation)(maintenance)(blender)(sensor)	176

5	**(fracturing pump)(hydraulic)(accumulated damage)(measurement)(sensors)(actual usage incurred)(hydration unit)(proppant)**	**43**

YouTube: https://youtube.com

#	Search query	Results
1	(US WELL SERVICES, LLC)(damage accumulation)(monitoring)	N/A
2	(frac pump)(maintenance)(damage accumulation)(proppant)	N/A
3	(frac pump)(proppant storage)(hydration unit)(maintenance)(accumulation measurement)	N/A
4	(frac pump)(accumulated damage measurement)	N/A
5	(frac pump)(accumulated damage parameter)(time period)(duration)	N/A

Date search was completed: 19 May 2020

SR/DD

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To: TAYLOR P. EVANS
HOGAN LOVELLS US LLP
609 MAIN STREET, SUITE 4200
HOUSTON, TX 77002

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

	Date of mailing *(day/month/year)* 22 JUL 2020
Applicant's or agent's file reference 047158.500056	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/US 20/00017	International filing date *(day/month/year)* 12 May 2020 (12.05.2020)
Applicant U.S. WELL SERVICES, LLC	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   How? Directly to the International Bureau preferably through ePCT, or on paper to:
   The International Bureau of WIPO, 34, chemin des Colombettes, 1211 Geneva 20, Switzerland

   For more detailed instructions, see the *PCT Applicant's Guide*, International Phase, paragraphs 9.004 – 9.011.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ With regard to any protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:
   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with any request to forward the texts of both the protest and the decision thereon to the designated Offices.
   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

   Shortly after the expiration of 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

   Within 19 months from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later); otherwise, the applicant must, within 20 months from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices. In respect of other designated Offices, the time limit of 30 months (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

   Within 22 months from the priority date, the applicant may request that a supplementary international search be carried out by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Lee Young Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/220 (revised January 2020)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION
047158.500056	see Form PCT/ISA/220 as well as, where applicable, item 5 below.

International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/US 20/00017	12 May 2020 (12.05.2020)	13 May 2019 (13.05.2019)

Applicant
U.S. WELL SERVICES, LLC

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the language, the international search was carried out on the basis of:

☒ the international application in the language in which it was filed.

☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

b. ☐ This international search report has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

c. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, see Box No. I.

2. ☐ Certain claims were found unsearchable (see Box No. II).

3. ☐ Unity of invention is lacking (see Box No. III).

4. With regard to the title,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the drawings,

a. the figure of the drawings to be published with the abstract is Figure No. 1

☒ as suggested by the applicant.

☐ as selected by this Authority, because the applicant failed to suggest a figure.

☐ as selected by this Authority, because this figure better characterizes the invention.

b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 20/00017

A. CLASSIFICATION OF SUBJECT MATTER
IPC - E21B 43/26, E21B 43/267, E21B 44/00 (2020.01)
CPC - E21B 43/26, E21B 43/267, E21B 44/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y --- A	US 2016/0258267 A1 (Stewart & Stevenson, LLC) 8 September 2016 (08.09.2016) Entire document especially para [0014], [0017], [0037]-[0042], [0052]-[0053], [0105] and figs. 1-6	1, 4-5, 8-10, 13-14, 17-18 ------ 2-3 ------ 6-7, 11-12, 15-16
Y --- A	US 2019/0112910 A1 (U.S. Well Services, LLC) 18 April 2019 (18.04.2019) Entire document especially para [0018], [0023]-[0024] and [0040] and figs. 1-7	2-3 ------ 6-7, 11-12, 15-16
A	US 2016/0326854 A1 (US Well Services LLC) 10 November 2016 (10.11.2016) Entire document	1-18
A	US 2017/0130743 A1 (Energy Recovery, Inc.) 11 May 2017 (11.05.2017) Entire document	1-18
A	US 2014/0138079 A1 (US Well Services LLC) 22 May 2014 (22.05.2014) Entire document	1-18
A	US 2018/0045331 A1 (Schlumberger Technology Corporation) 15 February 2018 (15.02.2018) Entire document	1-18
A	US 2018/0266412 A1 (Impact Solutions AS) 20 September 2018 (20.09.2018) Entire document	1-18
A	US 2018/0343125 A1 (Bedrock Automation Platforms Inc.) 29 November 2018 (29.11.2018) Entire document	1-18

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 June 2020	22 JUL 2020
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Lee Young Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/210 (second sheet) (July 2019)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: TAYLOR P. EVANS
HOGAN LOVELLS US LLP
609 MAIN STREET, SUITE 4200
HOUSTON, TX 77002

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)* 22 JUL 2020

Applicant's or agent's file reference
047158.500056

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 20/00017	12 May 2020 (12.05.2020)	13 May 2019 (13.05.2019)

International Patent Classification (IPC) or both national classification and IPC
IPC - E21B 43/26, E21B 43/267, E21B 44/00 (2020.01)
CPC - E21B 43/26, E21B 43/267, E21B 44/00

Applicant U.S. WELL SERVICES, LLC

1. This opinion contains indications relating to the following items:

- [x] Box No. I Basis of the opinion
- [ ] Box No. II Priority
- [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [ ] Box No. IV Lack of unity of invention
- [x] Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI Certain documents cited
- [ ] Box No. VII Certain defects in the international application
- [x] Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	30 June 2020	Lee Young PCT Help Desk Telephone No. 571-272-4300

Form PCT/ISA/237 (cover sheet) (revised January 2019)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/00017

Box No. I Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(b)).

3. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/00017

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-16	YES
	Claims	None	NO
Inventive step (IS)	Claims	2-3, 6-7, 11-12, 15-16	YES
	Claims	1, 4-5, 8-10, 13-14, 17-18	NO
Industrial applicability (IA)	Claims	1-16	YES
	Claims	None	NO

2. Citations and explanations:
Claims 1, 4-5, 8-10, 13-14 and 17-18 lack an inventive step under PCT Article 33(3) as being obvious over US 2016/0258267 A1 to Stewart & Stevenson, LLC (hereinafter "Stewart")

Regarding Claim 1, Stewart teaches a system (See figs. 1-6; para [0041]-[0042]) for use in fracturing operations (para [0042]), the system characterized by:
an electric motor (411 - "frac motors", fig. 3; para [0047]);
a turbine generator (100a-d - "turbine generators", figs. 2A-B) to generate electric power (See figs. 2A-B; para [0021], [0044]);
a vector control subsystem (410 - "frac motor variable frequency drive", fig. 3; para [0047]) to receive the electric power from the turbine generator (See figs. 2A-B; turbine generators 100a-d supply power for the rest of the system including fracturing unit control system 400 of fig. 3) and to control the electric motor using determined parameters provided to the vector control subsystem (para [0014], [0017], [0037]-[0039], [0105]); and
at least one pump (710 - "fracturing pumps", fig. 6; para [0052]) to receive torque input from the electric motor (para [0052]-[0053]) but does not specifically teach wherein the vector control subsystem is encoderless. However, Stewart does teach that the vector control subsystem is capable of being an encoderless subsystem (para [0041] - an open loop control mode is an encoderless mode). The decision of whether to have the vector control subsystem be encoderless or to comprise an encoder is a binary decision. Accordingly, it would have been obvious to one of ordinary skill in the art using routine experimentation and design principles to have the vector control subsystem be encoderless in order to reduce the complexity of the system as encoderless control subsystems require less components and are easier to construct and include with a system.

Regarding Claim 4, Stewart teaches the system of claim 1, further characterized by: an encoderless variable frequency drive (VFD) (410 - "frac motor variable frequency drive", fig. 3; VFD 410 is encoderless as laid out in treatment of claim 1) functioning as the encoderless vector control subsystem (410 - "frac motor variable frequency drive", fig. 3).

Regarding Claim 5, Stewart teaches the system of claim 1, further characterized by:
a machine interface (para [0038]-[0039] - "human machine interface") to receive the determined parameters for the encoderless vector control subsystem (para [0038]-[0039]); and
at least one processor (para [0039] - "programmable automation controller") to apply the determined parameters to the electric motor prior to engagement of a load with the electric motor (para [0039]).

Regarding Claim 6, Stewart teaches the system of claim 1, wherein the determined parameters for the encoderless vector control subsystem (para [0014], [0017], [0037]-[0039], [0105]) is selected from at least speed values, motor values (para [0038] - "AC motors' speed set points to be entered and transmitted; para [0041]), and proportional-integral-derivative (PID) control values.

Regarding Claim 9, Stewart teaches the system of claim 1, further characterized by: one or more plunger pumps (710a-b - "fracturing pumps", fig. 6; para [0120]-[0121]) adapted to receive the torque input from the electric motor (para [0052]-[0053]) but does not specifically teach wherein the one or more plunger pumps are triplex quintuplex, novemplex, or septuplex plunger pumps. However, Stewart does teach that each of the one or more plunger pumps can comprise a plurality of plungers (para [0120]-[0121] - "n is the number of pump plungers"). Accordingly, it would have been obvious to one of ordinary skill in the art to design the plunger pumps to have enough plungers to at least be a triplex pump (3 plungers) in order to ensure the pumps have the volumetric flow capacity necessary for the fracturing operations.

-*-Continued in Supplemental Box-*-

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/00017

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claim 3: The term "the vibration sensor" is confusing and lacks proper antecedent basis. The term is properly introduced in claim 2. As written, claim 3 depends from claim 1. Accordingly, for purposes of this opinion, claim 3 has been interpreted to depend from claim 2.

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
-*-Supplemental Box - Box V.2 - Citations and Explanations-*-

Regarding Claim 10, Stewart teaches a method (See figs. 1-8; para [0041]-[0042]) for using electric pumps (710 - "fracturing pumps", fig. 6) in fracturing operations (para [0042]) characterized by:
engaging an electric motor (411 - "frac motors", fig. 3) with a turbine generator (100a-d - "turbine generators", figs. 2A-B);
enabling a vector control subsystem (410 - "frac motor variable frequency drive", fig. 3) to receive electric power from the turbine generator (See figs. 2A-B; para [0044]);
controlling the electric motor using determined parameters input to the vector control subsystem (para [0014], [0017], [0037]-[0039], [0105]); and
engaging at least one pump (710 - "fracturing pumps", fig. 6) with the torque input from the electric motor (para [0052]-[0053]) but does not specifically teach wherein the vector control subsystem is encoderless. However, Stewart does teach that the vector control subsystem is capable of being an encoderless subsystem (para [0041] - an open loop control mode is an encoderless mode). The decision of whether to have the vector control subsystem be encoderless or to comprise an encoder is a binary decision. Accordingly, it would have been obvious to one of ordinary skill in the art using routine experimentation and design principles to have the vector control subsystem be encoderless in order to reduce the complexity of the system as encoderless control subsystems require less components and are easier to construct and include with a system.

Regarding Claim 13, Stewart teaches the method of claim 10, further characterized by: using an encoderless variable frequency drive (VFD) (410 - "frac motor variable frequency drive", fig. 3; VFD 410 is encoderless as laid out in treatment of claim 1) as the encoderless vector control subsystem (410 - "frac motor variable frequency drive", fig. 3).

Regarding Claim 14, Stewart teaches the method of claim 10, further characterized by:
enabling a machine interface (para [0038]-[0039] - "human machine interface") to receive the determined parameters for the encoderless vector control subsystem (para [0038]-[0039]); and
applying, using at least one processor (para [0039] - "programmable automation controller"), the determined parameters to the electric motor prior to engagement of a load with the electric motor (para [0039]).

Regarding Claim 17, Stewart teaches the method of claim 10, wherein the determined parameters for the encoderless vector control subsystem (para [0014], [0017], [0037]-[0039], [0105]) is selected from at least speed values, motor values (para [0038] - "AC motors' speed set points to be entered and transmitted; para [0041]), and proportional-integral-derivative (PID) control values.

Regarding Claim 18, Stewart teaches the method of claim 10, further characterized by: engaging one or more plunger pumps (710a-b - "fracturing pumps", fig. 6; para [0120]-[0121]) with the electric motor to receive the torque out from the electric motor (para [0052]-[0053]) but does not specifically teach wherein the one or more plunger pumps are triplex quintuplex, novemplex, or septuplex plunger pumps. However, Stewart does teach that each of the one or more plunger pumps can comprise a plurality of plungers (para [0120]-[0121] - "n is the number of pump plungers"). Accordingly, it would have been obvious to one of ordinary skill in the art to design the plunger pumps to have enough plungers to at least be a triplex pump (3 plungers) in order to ensure the pumps have the volumetric flow capacity necessary for the fracturing operations.

Claims 2-3 lacks novelty under PCT Article 33(2) as being anticipated by Stewart in view of US 2019/0112910 A1 to U.S. Well Services, LLC (hereinafter 'Well')

Regarding Claim 2, Stewart teaches the system of claim 1, but does not specifically teach the system further characterized by: a vibration sensor for monitoring vibration induced in a feature associated with a turbine of the turbine generator and providing input for the determined parameters based in part on the vibration. Further, Well teaches a system for use in fracturing operations (See figs. 1-7; para [0018]) comprising a turbine generator (74 - "turbine", fig. 2) to generate electric power (para [0023]-[0024]), the system further comprising a vibration sensor (178 - "sensor", fig. 7; para [0040]) for monitoring vibration induced in a feature (para [0040]) associated with a turbine (74 - "turbine", fig. 2) of the turbine generator (74 - "turbine", fig. 2; intended use: the vibration sensor is capable of monitoring vibration in a feature associated with the turbine generator) and providing input for the determined parameters based in part on the vibration (para [0040]). Accordingly, it would have been obvious to one of ordinary skill in the art to use the vibration sensor taught by Well on a feature associated with the turbine of the system taught by Stewart in order to allow an operator to determine if the turbine of the system is operating a too high or too low of a rate.

Regarding Claim 3, the modified Stewart teaches the system of claim 2 (Note: See Box VIII), further characterized by: the vibration sensor (Well: 178 - "sensor", fig. 7; para [0040]) associated with a body of the turbine generator (Stewart: 100a-d - "turbine generators", figs. 2A-B) for monitoring the vibration induced in the body of the turbine of the turbine generator, in part, due to a feedback resonance received to the turbine (intended use: the vibration sensor of well is capable of monitoring vibration in a body of the turbine generator due to a feedback resonance).

-*-Continued in next Supplemental Box-*-

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
-*-Supplemental Box - Box V.2 - Citations and Explanations-*-

Claims 6-7, 11-12 and 15-16 meet the criteria of PCT Article 33(2) & 33(3) because, as will be shown, the prior art does not teach, nor does it fairly suggest, the claimed limitations.

The prior art is exemplified by (1) Stewart and (2) Well

(1) Stewart teaches a system (See figs. 1-6; para [0041]-[0042]) for use in fracturing operations (para [0042]), the system characterized by:
an electric motor (411 - "frac motors", fig. 3);
a turbine generator (100a-d - "turbine generators", figs. 2A-B) to generate electric power (See figs. 2A-B; para [0021], [0044]);
a vector control subsystem (410 - "frac motor variable frequency drive", fig. 3) to receive the electric power from the turbine generator (See figs. 2A-B; turbine generators 100a-d supply power for the rest of the system including fracturing unit control system 400 of fig. 3) and to control the electric motor using determined parameters provided to the vector control subsystem (para [0014], [0017], [0037]-[0039], [0105]); and
at least one pump (710 - "fracturing pumps", fig. 6) to receive torque input from the electric motor (para [0052]-[0053]).

(2) Well teaches a system for use in fracturing operations (See figs. 1-7; para [0018]) comprising a turbine generator (74 - "turbine", fig. 2) to generate electric power (para [0023]-[0024]), and a vector control subsystem (102 - "VFD", fig. 2), the system further comprising a vibration sensor (178 - "sensor", fig. 7; para [0040]) for monitoring vibration induced in a feature (para [0040]).

Regarding Claim 6, Stewart teaches the system of claim 1, wherein the determined parameters for the encoderless vector control subsystem is determined based in part on oscillation alarm values (para [0055]-[0056]) but does not specifically teach wherein the oscillation alarm values represent vibration in at least a portion of a body associated with the turbine generator, for a period of time, being within a range of about 15 to about 45 upon engagement of the motor with a load. Further, Well teaches a system for use in fracturing operations (See figs. 1-7; para [0018]) comprising a turbine generator (74 - "turbine", fig. 2) to generate electric power (para [0023]-[0024]), and a vector control subsystem (102 - "VFD", fig. 2), the system further comprising a vibration sensor (178 - "sensor", fig. 7; para [0040]) for monitoring vibration induced in a feature (para [0040]). However, any combination of the above references fails to teach wherein the oscillation alarm values represent vibration in at least a portion of a body associated with the turbine generator. Accordingly, the prior art does not specifically teach or fairly suggest individually or in combination the system as claimed.

Regarding Claim 7, Stewart teaches the system of claim 1, wherein the determined parameters for the encoderless vector control subsystem is determined based in part on oscillation alarm values (para [0055]-[0056]) but does not specifically teach wherein the oscillation alarm values represent vibration in at least a portion of a body associated with the turbine generator, for a period of time, being less than about 70 upon engagement of the motor with a load. Further, Well teaches a system for use in fracturing operations (See figs. 1-7; para [0018]) comprising a turbine generator (74 - "turbine", fig. 2) to generate electric power (para [0023]-[0024]), and a vector control subsystem (102 - "VFD", fig. 2), the system further comprising a vibration sensor (178 - "sensor", fig. 7; para [0040]) for monitoring vibration induced in a feature (para [0040]). However, any combination of the above references fails to teach wherein the oscillation alarm values represent vibration in at least a portion of a body associated with the turbine generator. Accordingly, the prior art does not specifically teach or fairly suggest individually or in combination the system as claimed.

Regarding Claim 11, Stewart teaches the method of claim 10, but does not specifically teach wherein the determined parameters are based in part on vibration induced in a feature associated with the turbine generator. Further, Well teaches a system for use in fracturing operations (See figs. 1-7; para [0018]) comprising a turbine generator (74 - "turbine", fig. 2) to generate electric power (para [0023]-[0024]), the system further comprising a vibration sensor (178 - "sensor", fig. 7; para [0040]) for monitoring vibration induced in a feature (para [0040]). However, any combination of the above references fails to teach wherein the determined parameters are based in part on vibration induced in a feature associated with the turbine generator. Accordingly, the prior art does not specifically teach or fairly suggest individually or in combination the method as claimed.

Regarding Claim 12, the prior art does not specifically teach or fairly suggest individually or in combination the method as claimed since it is dependent on claim 11.

Regarding Claim 15, Stewart teaches the method of claim 10, wherein the determined parameters for the encoderless vector control subsystem is determined based in part on oscillation alarm values (para [0055]-[0056]), but does not specifically teach wherein the oscillation alarm values represent vibration in at least a body of a turbine associated with the turbine generator, having values from a range of about 15 to about 45 upon engagement of the motor with a load. Further, Well teaches a system for use in fracturing operations (See figs. 1-7; para [0018]) comprising a turbine generator (74 - "turbine", fig. 2) to generate electric power (para [0023]-[0024]), and a vector control subsystem (102 - "VFD", fig. 2), the system further comprising a vibration sensor (178 - "sensor", fig. 7; para [0040]) for monitoring vibration induced in a feature (para [0040]). However, any combination of the above references fails to teach wherein the oscillation alarm values represent vibration in at least a portion of a body associated with the turbine generator. Accordingly, the prior art does not specifically teach or fairly suggest individually or in combination the method as claimed.

-*-Continued in next Supplemental Box-*-

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
-*-Supplemental Box - Box V.2 - Citations and Explanations-*-

Regarding Claim 16, Stewart teaches the method of claim 10, wherein the determined parameters for the encoderless vector control subsystem is determined based in part on oscillation alarm values (para [0055]-[0056]), but does not specifically teach wherein the oscillation alarm values represent vibration in at least a body of a turbine associated with the turbine generator, having decreased values less than a range of about 70 to about 80 upon engagement of the motor with a load. Further, Weil teaches a system for use in fracturing operations (See figs. 1-7; para [0018]) comprising a turbine generator (74 - "turbine", fig. 2) to generate electric power (para [0023]-[0024]), and a vector control subsystem (102 - "VFD", fig. 2), the system further comprising a vibration sensor (178 - "sensor", fig. 7; para [0040]) for monitoring vibration induced in a feature (para [0040]). However, any combination of the above references fails to teach wherein the oscillation alarm values represent vibration in at least a portion of a body associated with the turbine generator. Accordingly, the prior art does not specifically teach or fairly suggest individually or in combination the method as claimed.

Claims 1-18 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used by industry.

SEARCH HISTORY

Application Number	PCT/US 20/00017
Search Conducted By	MFG
Search Approved By	SCL

CPC/IPC Classifications Searched	IPC(8): E21B 43/26, E21B 43/267, E21B 44/00 (2020.01) CPC: E21B 43/26, E21B 43/267, E21B 44/00
Date Conducted	30 June 2020 (30.06.2020)

Documentation Searched	IPC(8): E21B 43/26, E21B 43/267, E21B 44/00 (2020.01) CPC: (keyword limited; see below)
Search Terms Used	U.S. Well Services, Inc jared oehring encoder hydraulic fracturing open loop turbine electric motor sensor vibration alarm value
Date Conducted	30 June 2020 (30.06.2020)

Electronic Database Searched	PatBase
Files Searched	Full-text: AU BE BR CA CH CN DE DK EP ES FI FR GB IN JP KR SE TH TW US WO Bibliographic: (European) AT BA BE BG CH CS CY CZ DD DK EE ES FI GE GR HR HU IE IS IT LT LU LV MC MD MT NL NO PL PT RO RS SE SI SK SM TR UA YU (Asia) EA GC HK ID IL IN KZ MN MY PH RU SG SU TH TJ TW UZ VN (North America) CA CR CU DO GT HN MX NI PA SV TT (South America) AR BR CL CO EC PE UY (Australasia) AU NZ (Africa) AP DZ EG KE MA MW OA ZA ZM ZW
Date Conducted	30 June 2020 (30.06.2020)
Search Logic:	

#	Search query	Results

#	Search query	Results
1	IC=(E21B43/26) OR CPC=(E21B43/26)	11810
2	1 AND FT=(encoderless*)	0
3	FT=(encoderless*)	139
4	3 AND FT=(frac*)	27
5	4 AND FT=(pump* OR turbin*)	7
6	IC=(E21B*) OR CPC=(E21B*)	380349
7	6 AND FT=(encoderless*)	2
8	1 AND FT=(open loop* OR openloop* OR open-loop*)	24
9	8 AND FT=(turbin*)	8
10	6 AND FT=(open loop* OR openloop* OR open-loop*)	466
11	10 AND FT=(turbin*)	110
12	11 AND FT=(pump* AND motor*)	83
13	12 AND FT=(sens* NEAR (turbin* OR vibrat*))	11
14	IC=(E21B43/267) OR CPC=(E21B43/267)	3939
15	(1 OR 14) AND FT=(turbin*)	394
16	15 AND FT=(sens* NEAR vibrat*)	43
17	16 AND FT=(sens* NEAR turbin*)	4
18	pn=(US20160326854 OR US2016258267)	2
19	CTB 18 OR CTF 18	369
20	19 AND TAC=(frac*)	140
21	20 AND FT=(motor*)	87
22	21 AND FT=(turbin*)	47
23	22 NOT (5 OR 7 OR 9 OR 13 OR 17 OR 18)	42
24	IC=(E21B44/00) OR CPC=(E21B44/00)	7341
25	24 AND FT=(turbin*)	618
26	25 AND FT=(frac*)	265
27	26 AND FT=(open loop* OR openloop* OR open-loop* OR (open* NEAR loop*))	36
28	27 NOT (5 OR 7 OR 9 OR 13 OR 17 OR 18)	30
29	15 AND FT=(sens* NEAR turbin*)	8
30	15 AND FT=(vibrat* NEAR turbin*)	3

Electronic Database Searched	Google
Files Searched	Patents
Date Conducted	30 June 2020 (30.06.2020)

Search Logic:

assignee:(U.S. Well Services, Inc.) - About 12 results
assignee:(jared oehring) - About 25 results
(encoder) assignee:(jared oehring) - About 1 results
(hydraulic fracturing) (open loop) - About 40,014 results
(hydraulic fracturing) (open loop) (turbine) - About 1,803 results
(hydraulic fracturing) (open loop) (turbine) (electric motor) - About 929 results
(hydraulic fracturing) (open loop) (turbine) (sensor) - About 1,162 results
(hydraulic fracturing) (turbine) (vibration sensor) - About 1,604 results
(hydraulic fracturing) (turbine sensor) - About 6,714 results
(hydraulic fracturing) (turbine sensor) (alarm value) - About 808 results

Electronic Database Searched	Google
Files Searched	Web
Date Conducted	30 June 2020 (30.06.2020)

Search Logic:

(U.S. Well Services, Inc.) - About 3,060,000,000 results
(jared oehring) - About 46,900 results
(encoder) (jared oehring) - About 581 results
(hydraulic fracturing) (open loop) - About 1,270,000 results
(hydraulic fracturing) (open loop) (turbine) - About 2,370,000 results
(hydraulic fracturing) (open loop) (turbine) (electric motor) - About 144,000 results
(hydraulic fracturing) (open loop) (turbine) (sensor) - About 1,720,000 results
(hydraulic fracturing) (turbine) (vibration sensor) - About 1,700,000 results
(hydraulic fracturing) (turbine sensor) - About 897,000 results
(hydraulic fracturing) (turbine sensor) (alarm value) - About 1,520,000 results

Electronic Acknowledgement Receipt

EFS ID:	40452456
Application Number:	16728359
International Application Number:	
Confirmation Number:	6981
Title of Invention:	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Taylor P. Evans/Stephanie McDonough
Filer Authorized By:	Taylor P. Evans
Attorney Docket Number:	047158.100066
Receipt Date:	02-SEP-2020
Filing Date:	27-DEC-2019
Time Stamp:	12:54:10
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	047158-100066_IDS.pdf	1036021 59811**71b17698f58bee3ade9fecdfc8**ee3aa**33ac**	no	9

Warnings:

Information:					
2	Other Reference-Patent/App/Search documents	047158-100040.pdf	272909 6713dd00a0bd08ed1c63ffb36150d1101b2d0c83	no	8
Warnings:					
Information:					
3	Other Reference-Patent/App/Search documents	047158-100050.pdf	264400 1e64f5a5ba4882df1663f08d022315f88b9064ea	no	8
Warnings:					
Information:					
4	Other Reference-Patent/App/Search documents	047158-100054.pdf	294356 8b4e935944e693768eda4a2c8ce9c54bbc4b6169	no	9
Warnings:					
Information:					
5	Other Reference-Patent/App/Search documents	047158-500051_ISR.pdf	819292 ce7cb211944228f4d5d3218d796a2cfcf9fd2c72	no	17
Warnings:					
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Information:					
6	Other Reference-Patent/App/Search documents	047158-500052_ISR.pdf	896242 c2425428ea5877d276d1990bb2fbc90d9fb1c6c2	no	18
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7	Other Reference-Patent/App/Search documents	047158-500056_ISR.pdf	575726 80028a0ff8f35f021afe090c0ace9c33b13b1333	no	13
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8	Other Reference-Patent/App/Search documents	CIPO_Office-Action-2020-08-17-P52029CA00.pdf	190566 defc90838ca55844161a039faaa41793e96a25d6	no	4
Warnings:					
Information:					
9	Other Reference-Patent/App/Search documents	CIPO_Office-Action-2020-08-18-P52026CA00.pdf	178892 410c4d70ab14fc85319f39b44e6a8b410a933e7d	no	4
Warnings:					
Information:					
		Total Files Size (in bytes):	4528404		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/728,359	12/27/2019	Jared Oehring	047158.100066	6981

132858 7590 06/29/2020

Hogan Lovells US LLP
609 Main Street
Suite 4200
Houston, TX 77002

EXAMINER	
LEMBO, AARON LLOYD	

ART UNIT	PAPER NUMBER
3679	

NOTIFICATION DATE	DELIVERY MODE
06/29/2020	ELECTRONIC

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):

hlusdocketing@hoganlovells.com

Office Action Summary	Application No. 16/728,359	Applicant(s) Oehring et al.	
	Examiner AARON L LEMBO	Art Unit 3679	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 06/09/2020.

☐ 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) 1-8 is/are pending in the application.

5a) Of the above claim(s) _____ 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 or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ 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)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

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.

DETAILED ACTION

Election/Restrictions

Claims 9-20 are 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.

Election was made **without** traverse in the reply filed on 06/09/2020.

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 of this title, 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.

Claims 1-7 are rejected under 35 U.S.C. 103 as being unpatentable over Winborn (US 2013/0284278) in view of Kotrla et al (US 10,669,804).

1. (Original) WInborn discloses a hydraulic fracturing system for fracturing a subterranean formation, comprising:

an electric powered, multi-plunger pump (not shown, connected to the end of 19) having an inlet and an outlet, the outlet coupled to a well associated with the subterranean formation and powered by at least one electric motor, the electric powered pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation;

a fluid source (20), coupled to the inlet of the electric powered pump, the fluid source providing a slurry for injection into the subterranean formation;

a hose (19) extending between the fluid source and the electric powered pump, the hose being flexible and having a first diameter;

a fitting (shown but not explained) between the hose and the electric powered pump, the fitting having a first end for receiving the hose and a second end for coupling to the electric powered pump; and
a distribution system, positioned between the wellbore and the electric powered pump, the distribution system collecting the slurry from electric powered pumps for injection into the subterranean formation. (Implied by paragraph [0005] wherein fluid is transferred from pumps to a well. The concept of a distribution system is further found to be obvious to one of ordinary skill in the art due to its essential nature in the hydraulic fracturing system.)

Winborn fails to specify the fitting having the first end for receiving the hose at a first diameter and the second end for coupling to the electric powered pump at a second diameter, the second diameter being larger than the first diameter.

Kotrla et al (US 10,669,804) however teaches a hose and fitting arrangement (Figure 6) comprising the fitting (60) having a first end for receiving the hose at the first diameter and a second end for coupling to the electric powered pump at a second diameter, the second diameter being larger than the first diameter.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was filed to include the use of differing diameters, as taught by Kotrla, to the invention of Winborn for the expected benefit of providing desired flow characteristics across connections.

2. (Original) The combination discloses the system of claim 1, however fails to specify wherein the first diameter is approximately 5 inches and the second diameter is approximately 6 inches.

Such a determination is merely considered an arbitrary measurement based on design choice and is understood to be within the capabilities of one of ordinary skill in the art. This is due to the commercial availability and use of 5 inch diameter hoses and 6 inch diameter pump inlets in the frac art.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was filed to include wherein the first diameter is approximately 5 inches and the second diameter is approximately 6 inches to comply with the commonly-found fitting requirements of hoses and fracturing pumps.

3. (Original) The combination discloses the system of claim 1, wherein the fitting further comprises:
a union (Kotrla - 64) at the second end, the union configured to couple to a mating fitting (Kotrla - 50);
a shank end (Kotrla - toward 121) at the first end, the shank end receiving at least a portion of the hose (Kotrla - 120), the shank end being crimped over at least the portion of the hose; and
a reducer (change in diameter from wide end of 64 to narrower end) between the union and the shank end. (Figure 6 of Kotrla illustrates such a system)

4. (Original) The combination discloses the system of claim 3, wherein the fitting is formed as an integral piece with at least one rigid coupling between at least one of the union, the shank end, and the reducer. (Figure 6 of Kotrla)

5/6. (Original) The combination discloses the system of claim 1, however fails to specify wherein the first diameter is particularly selected based at least in part on a threshold, the threshold corresponding to a drop out rate for the slurry. OR at least in part on a pressure drop rate, a damage accumulation rate, or a suggested flow rate.

The Examiner takes Official Notice, however that a fluid flow path designed to function as a slurry flow path would also be designed to function efficiently as such. Additionally, the diameter would depend on various slurry properties and flow variables. (As evidenced by Chaffee et al US 5,472,049, Column 5, Lines 51-67)

In summary, as the combination of Winborn in view of Kotrla provides a fluid flow path having the claimed features, it is found to anticipate the broadly claimed “threshold”, “pressure drop rate”, “damage accumulation rate” and “suggested flow rate” limitations as well.

7. (Original) The system of claim 1, wherein the first diameter is associated with a second threshold, corresponding to a maximum suggested flow rate, an operating window for the electric powered pump exceeding the maximum suggested flow rate. (The diameter claimed to be “associated with” various threshold figures is found to be exceedingly broad. Since any fluid communication through a flow line requires factoring of the diameter of the flow passage, this limitation is found to be anticipated by the existence of a flow path in WInborn.)

Claim 8 is rejected under 35 U.S.C. 103 as being unpatentable over Winborn (US 2013/0284278) in view of Kotrla et al (US 10,669,804) and further in view of Kajaria et al (US 8,474,521).

8. (Original) The combination discloses the system of claim 1, with a pump having a connection having the second diameter.

The combination however fails to specify multiples of the various systems.

Kajaria et al (US 8,474,521) however teaches a system further comprising:
a plurality of electric powered, multi-plunger pumps, each pump receiving fluid from the fluid source;
a plurality of hoses having the first diameter; and
a plurality of fittings between respective hoses of the plurality of the hoses and respective pumps of the plurality of pumps (Figure 4A)

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was filed to include the use of multiple pumps, hoses and fittings, as taught by Kajaria to the combination of Winborn and Kotrla for the expected benefit of producing the required fracturing fluid more quickly and efficiently.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to AARON L LEMBO whose telephone number is (571)270-3065. The examiner can normally be reached on Monday-Friday, 7am-4pm.

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, Matthew Troutman can be reached on 5712703654. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/AARON L LEMBO/

Patent Examiner
Art Unit 3679

Notice of References Cited	Application/Control No. 16/728,359	Applicant(s)/Patent Under Reexamination Oehring et al.	
	Examiner AARON L LEMBO	Art Unit 3679	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-10669804-B2	06-2020	Kotrla; Johnnie	E21B33/06	1/1
*	B	US-3055682-A	09-1962	BACHER HANS E	F16L33/18	285/222.1
*	C	US-20130284278-A1	10-2013	Winborn; Craig V.	F16L15/00	137/15.01
*	D	US-9513055-B1	12-2016	Seal; Thomas Joseph	F26B19/00	1/1
*	E	US-9061223-B2	06-2015	Winborn; Craig V.	B01D35/02	1/1
*	F	US-8091928-B2	01-2012	Carrier; Michael Owen	F16L33/02	285/242
*	G	US-20060065319-A1	03-2006	Csitari; Mikulas	F01P3/205	137/887
*	H	US-6719900-B2	04-2004	Hawkins; Stanley E.	B01D29/118	210/248
*	I	US-5433243-A	07-1995	Griswold; David E.	B01D35/157	137/498
*	J	US-5230366-A	07-1993	Marandi; Ali	G05D7/01	137/613
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	N					
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NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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	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.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/728,359	Oehring et al.
	Examiner	Art Unit
	AARON L LEMBO	3679

CPC - Searched*		
Symbol	**Date**	**Examiner**
F16L33/02	06/17/2020	/all/
E21B43/26	06/17/2020	/all/
F04B1/00	06/17/2020	/all/
F04B15/02	06/17/2020	/all/
F04B17/03	06/17/2020	/all/

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**
EAST Text Search	06/17/2020	/all/
IP.com Search	06/17/2020	/all/
IDS Considered	06/17/2020	/all/
Inventor Search	06/17/2020	/all/
Assignee Search	06/17/2020	/all/

/AARON L LEMBO/ Examiner, Art Unit 3679	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/728,359	Oehring et al.
	Examiner	Art Unit
	AARON L LEMBO	3679

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

/AARON L LEMBO/ Examiner, Art Unit 3679	

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	1	"16728359"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/20 09:33
S2	204	("10008880" | "10020711" | "10036238" | "10107086" | "10119381" | "10196878" | "10227854" | "10232332" | "10246984" | "10254732" | "10260327" | "10280724" | "10287873" | "10309205" | "10371012" | "10378326" | "10393108" | "10407990" | "10436026" | "1656861" | "1671436" | "20020169523" | "20030056514" | "20030138327" | "20040000077" | "20040040746" | "20040102109" | "20040167738" | "20050061548" | "20050116541" | "20050274508" | "20060052903" | "20070131410" | "20070187163" | "20070201305" | "20070226089" | "20070277982" | "20070278140" | "20080017369" | "20080041596" | "20080112802" | "20080137266" | "20080208478" | "20080217024" | "20080264625" | "20080264649" | "20090045782" | "20090065299" | "20090078410" | "20090093317" | "20090095482" | "20090145611" | "20090153354" | "20090188181" | "20090200035" | "20090260826" | "20090308602" | "20100000508" | "20100019574" | "20100038907" | "20100045109" | "20100051272" | "20100132949" | "20100146981" | "20100172202" | "20100250139" | "20100293973" | "20100303655" | "20100322802" | "20110005757" | "20110017468" | "20110061855" | "20110085924" | "20110166046" | "20110247878" | "20110272158" | "20120018016" | "20120049625" | "20120085541" | "20120127635" | "20120205301" | "20120205400" | "20120222865" | "20120232728" | "20120247783" |	US-PGPUB; USPAT	OR	ON	2020/06/20 09:51

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		"20170314979" | "20170328179" | "20170369258" | "20180028992" | "20180038216" | "20180156210" | "20180183219" | "20180216455" | "20180245428" | "20180258746" | "20180274446" | "20180320483" | "20180363437").PN.				
S3	179	("20190003329" | "20190010793" | "20190063309" | "20190100989" | "20190112910" | "20190120024" | "20190128080" | "20190162061" | "20190169971" | "20190178057" | "20190178235" | "20190203567" | "20190203572" | "20190211661" | "20190226317" | "20190245348" | "20190292866" | "20190292891" | "20190316447" | "2183364" | "2220622" | "2248051" | "2407796" | "2416848" | "2753940" | "3061039" | "3066503" | "3302069" | "3334495" | "3722595" | "3764233" | "3773140" | "3837179" | "3849662" | "3881551" | "4037431" | "4100822" | "4151575" | "4226299" | "4265266" | "4432064" | "4442665" | "4456092" | "4506982" | "4512387" | "4529887" | "4538916" | "4676063" | "4759674" | "4793386" | "4845981" | "4922463" | "5006044" | "5025861" | "5050673" | "5130628" | "5131472" | "5172009" | "5189388" | "5366324" | "5422550" | "5548093" | "5590976" | "5655361" | "5736838" | "5755096" | "5790972" | "5865247" | "5879137" | "5894888" | "5907970" | "6138764" | "6142878" | "6164910" | "6202702" | "6208098" | "6254462" | "6271637" | "6273193" | "6315523" | "6477852" | "6484490" | "6491098" | "6529135" | "6776227" | "6802690" | "6808303" | "6931310" | "6936947" | "7082993" | "7104233" | "7170262" | "7173399" | "7308933" | "7312593" | "7336514" | "7445041" | "7494263" | "7500642" | "7525264" | "7563076" | "7581379" | "7675189" | "7683499" | "7717193" | "7755310" | "7807048" | "7835140" | "7845413" | "7894757" | "7926562" | "7977824" | "7984757" | "8037936" | "8054084" | "8083504" | "8096354" | "8096891" | "8139383" | "8146665" | "8154419" | "8232892" | "8261528" | "8272439" | "8310272" | "8354817" |	US-PGPUB; USPAT	OR	ON	2020/06/20 09:51

		"8474521" | "8534235" | "8573303" | "8596056" | "8616005" | "8616274" | "8646521" | "8692408" | "8727068" | "8760657" | "8774972" | "8789601" | "8800652" | "8807960" | "8838341" | "8851860" | "8857506" | "8899940" | "8905056" | "8905138" | "8997904" | "9018881" | "9051822" | "9067182" | "9103193" | "9119326" | "9121257" | "9140110" | "9160168" | "9322239" | "9366114" | "9410410" | "9450385" | "9475020" | "9475021" | "9534473" | "9562420" | "9587649" | "9611728" | "9650871" | "9650879" | "9728354" | "9738461" | "9745840" | "9840901" | "9863228" | "9893500" | "9915128" | "9932799" | "9963961" | "9970278" | "9976351" | "9995218").PN.				
S4	383	S2 or S3	US-PGPUB; USPAT	OR	ON	2020/06/20 10:01
S5	383	S2 or S3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/20 10:01
S6	320	(US-20190316447-$ or US-20190292866-$ or US-20190245348-$ or US-20190211661-$ or US-20190203567-$ or US-20190178235-$ or US-20190169971-$ or US-20190162061-$ or US-20190128080-$ or US-20190120024-$ or US-20190112910-$ or US-20190100989-$ or US-20190063309-$ or US-20190003329-$ or US-20180320483-$ or US-20180245428-$ or US-20180216455-$ or US-20180156210-$ or US-20180038216-$ or US-20180028992-$ or US-20130025706-$ or US-20170328179-$ or US-20170314979-$ or US-20170021318-$ or US-20170292513-$ or US-20170259227-$).did. or (US-20170241221-$ or US-20170234250-$ or US-20170226842-$ or US-20170159570-$ or US-20170146189-$ or US-20170145918-$ or US-20170114625-$ or US-20170051732-$ or US-20170036872-$ or US-20170022807-$ or US-20160348479-$ or US-20160341281-$ or US-20160319650-$ or US-20160312108-$ or US-20160290563-$ or US-	US-PGPUB; USPAT	OR	ON	2020/06/20 10:49

		20160290114-$ or US-20160281484-$ or US-20160265457-$ or US-20160230525-$ or US-20160230524-$ or US-20160221220-$ or US-20160208595-$ or US-20160186531-$ or US-20160160889-$ or US-20160105022-$ or US-20160102537-$ or US-20150330172-$).did. or (US-20150314225-$ or US-20150300336-$ or US-20150225113-$ or US-20150217672-$ or US-20150211512-$ or US-20150176386-$ or US-20150159911-$ or US-20150136043-$ or US-20150114652-$ or US-20150097504-$ or US-20150083426-$ or US-20150075778-$ or US-20150053426-$ or US-20150027712-$ or US-20140379300-$ or US-20140290768-$ or US-20140277772-$ or US-20140255214-$ or US-20140251623-$ or US-20140246211-$ or US-20140219824-$ or US-20140124162-$ or US-20140095114-$ or US-20140060658-$ or US-20140054965-$ or US-20140000899-$ or US-20130343858-$).did. or (US-20130341029-$ or US-20130306322-$ or US-20130233542-$ or US-20130175039-$ or US-20130175038-$ or US-20130009469-$ or US-20120247783-$ or US-20120232728-$ or US-20120222865-$ or US-20120205400-$ or US-20120205301-$ or US-20120127635-$ or US-20120085541-$ or US-20120049625-$ or US-20120018016-$ or US-20110272158-$ or US-20110247878-$ or US-20110166046-$ or US-20110085924-$ or US-20110061855-$ or US-20110017468-$ or US-20110005757-$ or US-20100322802-$ or US-20100303655-$ or US-20100293973-$ or US-20100250139-$ or US-20100172202-$).did. or (US-20100146981-$ or US-20100132949-$ or US-20100051272-$ or US-20100045109-$ or US-20100038907-$ or US-20100019574-$ or US-20090308602-$ or US-20090260826-$ or US-20090200035-$ or US-20090188181-$ or US-20090145611-$ or US-20090095482-$ or US-20090093317-$ or US-20090078410-$ or US-20090065299-$ or US-20090045782-$ or US-20080264649-$ or US-20080264625-$ or US-20080217024-$ or US-20080208478-$ or US-20080137266-$ or US-				

		20080112802-$ or US-20080041596-$ or US-20080017369-$ or US-20070278140-$ or US-20070226089-$ or US-20070201305-$).did. or (US-20070187163-$ or US-20070131410-$ or US-20060052903-$ or US-20050274508-$ or US-20050116541-$ or US-20050061548-$ or US-20040167738-$ or US-20040102109-$ or US-20040040746-$ or US-20040000077-$ or US-20020169523-$ or US-20030056514-$ or US-20030138327-$).did. or (US-10260327-$ or US-10246984-$ or US-10378326-$ or US-9915128-$ or US-10280724-$ or US-9103193-$ or US-9995218-$ or US-9970278-$ or US-9893500-$ or US-9745840-$ or US-9650879-$ or US-10020711-$ or US-9534473-$ or US-9840901-$ or US-9140110-$ or US-10119381-$ or US-10407990-$ or US-10232332-$ or US-9650871-$ or US-10393108-$ or US-10254732-$ or US-9410410-$ or US-10036238-$ or US-9587649-$ or US-10008880-$ or US-10227854-$).did. or (US-8997904-$ or US-9963961-$ or US-8789601-$ or US-9738461-$ or US-8534235-$ or US-8154419-$ or US-7845413-$ or US-1656861-$ or US-1671436-$ or US-2183364-$ or US-2220622-$ or US-2248051-$ or US-2407796-$ or US-2416848-$ or US-2753940-$ or US-3061039-$ or US-3066503-$ or US-3302069-$ or US-3334495-$ or US-3722595-$ or US-3764233-$ or US-3773140-$ or US-3837179-$ or US-3849662-$ or US-3881551-$ or US-4037431-$ or US-4100822-$).did. or (US-4151575-$ or US-4226299-$ or US-4265266-$ or US-4432064-$ or US-4442665-$ or US-4456092-$ or US-4506982-$ or US-4512387-$ or US-4529887-$ or US-4538916-$ or US-4676063-$ or US-4759674-$ or US-4793386-$ or US-4845981-$ or US-4922463-$ or US-5006044-$ or US-5025861-$ or US-5050673-$ or US-5130628-$ or US-5131472-$ or US-5172009-$ or US-5189388-$ or US-5366324-$ or US-5422550-$ or US-5548093-$ or US-5590976-$ or US-5655361-$).did. or (US-5736838-$ or US-5755096-$ or US-			

		5790972-$ or US-5865247-$ or US-5879137-$ or US-5894888-$ or US-5907970-$ or US-6138764-$ or US-6142878-$ or US-6164910-$ or US-6202702-$ or US-6208098-$ or US-6254462-$ or US-6271637-$ or US-6273193-$ or US-6315523-$ or US-6477852-$ or US-6484490-$ or US-6491098-$ or US-6529135-$ or US-6776227-$ or US-6802690-$ or US-6808303-$ or US-6931310-$ or US-6936947-$ or US-7082993-$ or US-7104233-$).did. or (US-7170262-$ or US-7173399-$ or US-7308933-$ or US-7312593-$ or US-7336514-$ or US-7445041-$ or US-7494263-$ or US-7500642-$ or US-7525264-$ or US-7563076-$ or US-7581379-$ or US-7675189-$ or US-7683499-$ or US-7717193-$ or US-7755310-$ or US-7807048-$ or US-7835140-$ or US-7894757-$ or US-7977824-$ or US-7984757-$ or US-8037936-$ or US-8054084-$ or US-8083504-$ or US-7926562-$ or US-8096891-$ or US-8139383-$ or US-8146665-$).did. or (US-8232892-$ or US-8261528-$ or US-8272439-$ or US-8310272-$ or US-8354817-$ or US-8474521-$ or US-8573303-$ or US-8596056-$ or US-8616005-$ or US-8616274-$ or US-8646521-$ or US-8692408-$ or US-8727068-$ or US-8760657-$ or US-8774972-$ or US-8800652-$ or US-8807960-$ or US-8838341-$ or US-8851860-$ or US-8857506-$ or US-8899940-$ or US-8905056-$ or US-8905138-$ or US-9018881-$ or US-9051822-$ or US-9067182-$ or US-9119326-$).did. or (US-9160168-$ or US-9322239-$ or US-9450385-$ or US-9611728-$ or US-9728354-$ or US-9863228-$ or US-9932799-$ or US-9976351-$ or US-10287873-$ or US-10309205-$ or US-10371012-$ or US-10436026-$).did.				
S7	320	(US-20190316447-$ or US-20190292866-$ or US-20190245348-$ or US-20190211661-$ or US-20190203567-$ or US-20190178235-$ or US-20190169971-$ or US-20190162061-$ or US-20190128080-$ or US-20190120024-	US-PGPUB; USPAT	OR	ON	2020/06/20 10:50

	$ or US-20190112910-$ or US-20190100989-$ or US-20190063309-$ or US-20190003329-$ or US-20180320483-$ or US-20180245428-$ or US-20180216455-$ or US-20180156210-$ or US-20180038216-$ or US-20180028992-$ or US-20130025706-$ or US-20170328179-$ or US-20170314979-$ or US-20170021318-$ or US-20170292513-$ or US-20170259227-$).did. or (US-20170241221-$ or US-20170234250-$ or US-20170226842-$ or US-20170159570-$ or US-20170146189-$ or US-20170145918-$ or US-20170114625-$ or US-20170051732-$ or US-20170036872-$ or US-20170022807-$ or US-20160348479-$ or US-20160341281-$ or US-20160319650-$ or US-20160312108-$ or US-20160290563-$ or US-20160290114-$ or US-20160281484-$ or US-20160265457-$ or US-20160230525-$ or US-20160230524-$ or US-20160221220-$ or US-20160208595-$ or US-20160186531-$ or US-20160160889-$ or US-20160105022-$ or US-20160102537-$ or US-20150330172-$).did. or (US-20150314225-$ or US-20150300336-$ or US-20150225113-$ or US-20150217672-$ or US-20150211512-$ or US-20150176386-$ or US-20150159911-$ or US-20150136043-$ or US-20150114652-$ or US-20150097504-$ or US-20150083426-$ or US-20150075778-$ or US-20150053426-$ or US-20150027712-$ or US-20140379300-$ or US-20140290768-$ or US-20140277772-$ or US-20140255214-$ or US-20140251623-$ or US-20140246211-$ or US-20140219824-$ or US-20140124162-$ or US-20140095114-$ or US-20140060658-$ or US-20140054965-$ or US-20140000899-$ or US-20130343858-$).did. or (US-20130341029-$ or US-20130306322-$ or US-20130233542-$ or US-20130175039-$ or US-20130175038-$ or US-20130009469-$ or US-20120247783-$ or US-20120232728-$ or US-20120222865-$ or US-20120205400-$ or US-20120205301-$ or US-20120127635-$ or US-20120085541-$ or US-20120049625-$ or US-20120018016-$ or US-20110272158-$ or US-20110247878-$ or				

	US-20110166046-$ or US-20110085924-$ or US-20110061855-$ or US-20110017468-$ or US-20110005757-$ or US-20100322802-$ or US-20100303655-$ or US-20100293973-$ or US-20100250139-$ or US-20100172202-$).did. or (US-20100146981-$ or US-20100132949-$ or US-20100051272-$ or US-20100045109-$ or US-20100038907-$ or US-20100019574-$ or US-20090308602-$ or US-20090260826-$ or US-20090200035-$ or US-20090188181-$ or US-20090145611-$ or US-20090095482-$ or US-20090093317-$ or US-20090078410-$ or US-20090065299-$ or US-20090045782-$ or US-20080264649-$ or US-20080264625-$ or US-20080217024-$ or US-20080208478-$ or US-20080137266-$ or US-20080112802-$ or US-20080041596-$ or US-20080017369-$ or US-20070278140-$ or US-20070226089-$ or US-20070201305-$).did. or (US-20070187163-$ or US-20070131410-$ or US-20060052903-$ or US-20050274508-$ or US-20050116541-$ or US-20050061548-$ or US-20040167738-$ or US-20040102109-$ or US-20040040746-$ or US-20040000077-$ or US-20020169523-$ or US-20030056514-$ or US-20030138327-$).did. or (US-10260327-$ or US-10246984-$ or US-10378326-$ or US-9915128-$ or US-10280724-$ or US-9103193-$ or US-9995218-$ or US-9970278-$ or US-9893500-$ or US-9745840-$ or US-9650879-$ or US-10020711-$ or US-9534473-$ or US-9840901-$ or US-9140110-$ or US-10119381-$ or US-10407990-$ or US-10232332-$ or US-9650871-$ or US-10393108-$ or US-10254732-$ or US-9410410-$ or US-10036238-$ or US-9587649-$ or US-10008880-$ or US-10227854-$).did. or (US-8997904-$ or US-9963961-$ or US-8789601-$ or US-9738461-$ or US-8534235-$ or US-8154419-$ or US-7845413-$ or US-1656861-$ or US-1671436-$ or US-2183364-$ or US-2220622-$ or US-2248051-$ or US-2407796-$ or US-2416848-$ or US-2753940-$ or US-3061039-$ or US-3066503-$ or US-3302069-$ or US-				

	3334495-$ or US-3722595-$ or US-3764233-$ or US-3773140-$ or US-3837179-$ or US-3849662-$ or US-3881551-$ or US-4037431-$ or US-4100822-$).did. or (US-4151575-$ or US-4226299-$ or US-4265266-$ or US-4432064-$ or US-4442665-$ or US-4456092-$ or US-4506982-$ or US-4512387-$ or US-4529887-$ or US-4538916-$ or US-4676063-$ or US-4759674-$ or US-4793386-$ or US-4845981-$ or US-4922463-$ or US-5006044-$ or US-5025861-$ or US-5050673-$ or US-5130628-$ or US-5131472-$ or US-5172009-$ or US-5189388-$ or US-5366324-$ or US-5422550-$ or US-5548093-$ or US-5590976-$ or US-5655361-$).did. or (US-5736838-$ or US-5755096-$ or US-5790972-$ or US-5865247-$ or US-5879137-$ or US-5894888-$ or US-5907970-$ or US-6138764-$ or US-6142878-$ or US-6164910-$ or US-6202702-$ or US-6208098-$ or US-6254462-$ or US-6271637-$ or US-6273193-$ or US-6315523-$ or US-6477852-$ or US-6484490-$ or US-6491098-$ or US-6529135-$ or US-6776227-$ or US-6802690-$ or US-6808303-$ or US-6931310-$ or US-6936947-$ or US-7082993-$ or US-7104233-$).did. or (US-7170262-$ or US-7173399-$ or US-7308933-$ or US-7312593-$ or US-7336514-$ or US-7445041-$ or US-7494263-$ or US-7500642-$ or US-7525264-$ or US-7563076-$ or US-7581379-$ or US-7675189-$ or US-7683499-$ or US-7717193-$ or US-7755310-$ or US-7807048-$ or US-7835140-$ or US-7894757-$ or US-7977824-$ or US-7984757-$ or US-8037936-$ or US-8054084-$ or US-8083504-$ or US-7926562-$ or US-8096891-$ or US-8139383-$ or US-8146665-$).did. or (US-8232892-$ or US-8261528-$ or US-8272439-$ or US-8310272-$ or US-8354817-$ or US-8474521-$ or US-8573303-$ or US-8596056-$ or US-8616005-$ or US-8616274-$ or US-8646521-$ or US-8692408-$ or US-8727068-$ or US-8760657-$ or US-8774972-$ or US-8800652-$ or US-				

		8807960-$ or US-8838341-$ or US-8851860-$ or US-8857506-$ or US-8899940-$ or US-8905056-$ or US-8905138-$ or US-9018881-$ or US-9051822-$ or US-9067182-$ or US-9119326-$).did. or (US-9160168-$ or US-9322239-$ or US-9450385-$ or US-9611728-$ or US-9728354-$ or US-9863228-$ or US-9932799-$ or US-9976351-$ or US-10287873-$ or US-10309205-$ or US-10371012-$ or US-10436026-$).did.				
S8	93	fitting and lembo.xa.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/20 10:50
S9	22	("20020070014" | "20060159376" | "20090057026" | "20090315276" | "20110308815" | "20190056024" | "2937598" | "3055682" | "3224817" | "3254908" | "4281726" | "4715526" | "5617879" | "6263982" | "6505649" | "6923476" | "8215645" | "9157293").PN. OR ("10669804").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/20 10:50
S10	5	S6 and fitting and electri$4 with pump$4 and union	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/20 10:51
S11	221	("5" "5" adj inch) with (hose diameter) and fractur$4 and pump$4 same (electric$4 and plunger)	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/20 10:55
S12	476	(frac$4 frack$4 fractur$4) and (pump$4 with hose with fitting)	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:38
S13	44	(frac$4 frack$4 fractur$4) and (pump$4 with hose with fitting) and fitting with diameter and hose with diameter	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:41
S14	59	(hydraulic$4 with fractur$4) and (pump$4 with hose with fitting)	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:43
S15	23	(US-20190323337-$ or US-20190248938-$ or US-20190137012-$ or US-20130284278-$ or US-20110272158-$ or US-20080264649-$).did. or (US-9052037-$ or US-9903192-$ or US-9513055-$ or US-10102471-$ or US-9400065-$ or US-10227430-$ or US-9284819-$ or US-9061223-$ or US-	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:45

		9050545-$ or US-8985202-$ or US-9341056-$ or US-9341055-$ or US-8162063-$ or US-10280724-$ or US-9840901-$ or US-8146665-$).did. or (US-2831551-$).did.				
S16	23	S15 and (pump$4 with hose with fitting)	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:45
S17	14	("20060065319" | "20100018911" | "20130240042" | "2610741" | "2661096" | "3748837" | "4051042" | "4836238" | "5230366" | "5433243" | "6390446" | "6719900").PN. OR ("9061223").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:55
S18	3	((US adj well adj services.as.) (oehring.in. hinderliter.in. robinson.in. christinzio.in.)) and fitting with hose with diameter$4 same pump$4	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:57
S19	5	((US adj well adj services.as.) (oehring.in. hinderliter.in. robinson.in. christinzio.in.)) and fitting with hose with diameter$4	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 21:58
S20	18	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and fitting with hose with diameter$4	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 22:05
S21	8	fitting with hose with diameter$4 and (hose fitting) with pump$4 and union with pump$4	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 22:06
S22	1	union same shank same reducer same fitting same hose	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 22:18
S23	1	union same shank same reducer same fitting and fitting same hose	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 22:18
S24	0	union with shank with reducer and fitting same hose	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 22:18
S25	0	union with shank with reducer	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 22:18
S26	1	union with shank with reducer	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 22:19

S27	0	union same shank same reducer and fitting with hose	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 22:19
S28	326	(US-20190316447-$ or US-20190292866-$ or US-20190245348-$ or US-20190211661-$ or US-20190203567-$ or US-20190178235-$ or US-20190169971-$ or US-20190162061-$ or US-20190128080-$ or US-20190120024-$ or US-20190112910-$ or US-20190100989-$ or US-20190063309-$ or US-20190003329-$ or US-20180320483-$ or US-20180245428-$ or US-20180216455-$ or US-20180156210-$ or US-20180038216-$ or US-20180028992-$ or US-20130025706-$ or US-20170328179-$ or US-20170314979-$ or US-20170021318-$ or US-20170292513-$ or US-20170259227-$).did. or (US-20170241221-$ or US-20170234250-$ or US-20170226842-$ or US-20170159570-$ or US-20170146189-$ or US-20170145918-$ or US-20170114625-$ or US-20170051732-$ or US-20170036872-$ or US-20170022807-$ or US-20160348479-$ or US-20160341281-$ or US-20160319650-$ or US-20160312108-$ or US-20160290563-$ or US-20160290114-$ or US-20160281484-$ or US-20160265457-$ or US-20160230525-$ or US-20160230524-$ or US-20160221220-$ or US-20160208595-$ or US-20160186531-$ or US-20160160889-$ or US-20160105022-$ or US-20160102537-$ or US-20150330172-$).did. or (US-20150314225-$ or US-20150300336-$ or US-20150225113-$ or US-20150217672-$ or US-20150211512-$ or US-20150176386-$ or US-20150159911-$ or US-20150136043-$ or US-20150114652-$ or US-20150097504-$ or US-20150083426-$ or US-20150075778-$ or US-20150053426-$ or US-20150027712-$ or US-20140379300-$ or US-20140290768-$ or US-20140277772-$ or US-20140255214-$ or US-20140251623-$ or US-20140246211-$ or US-20140219824-$ or US-20140124162-$ or US-20140095114-$ or	US-PGPUB; USPAT	OR	ON	2020/06/21 22:20

US-20140060658-$ or US-20140054965-$ or US-20140000899-$ or US-20130343858-$).did. or (US-20130341029-$ or US-20130306322-$ or US-20130233542-$ or US-20130175039-$ or US-20130175038-$ or US-20130009469-$ or US-20120247783-$ or US-20120232728-$ or US-20120222865-$ or US-20120205400-$ or US-20120205301-$ or US-20120127635-$ or US-20120085541-$ or US-20120049625-$ or US-20120018016-$ or US-20110272158-$ or US-20110247878-$ or US-20110166046-$ or US-20110085924-$ or US-20110061855-$ or US-20110017468-$ or US-20110005757-$ or US-20100322802-$ or US-20100303655-$ or US-20100293973-$ or US-20100250139-$ or US-20100172202-$).did. or (US-20100146981-$ or US-20100132949-$ or US-20100051272-$ or US-20100045109-$ or US-20100038907-$ or US-20100019574-$ or US-20090308602-$ or US-20090260826-$ or US-20090200035-$ or US-20090188181-$ or US-20090145611-$ or US-20090095482-$ or US-20090093317-$ or US-20090078410-$ or US-20090065299-$ or US-20090045782-$ or US-20080264649-$ or US-20080264625-$ or US-20080217024-$ or US-20080208478-$ or US-20080137266-$ or US-20080112802-$ or US-20080041596-$ or US-20080017369-$ or US-20070278140-$ or US-20070226089-$ or US-20070201305-$).did. or (US-20070187163-$ or US-20070131410-$ or US-20060052903-$ or US-20050274508-$ or US-20050116541-$ or US-20050061548-$ or US-20040167738-$ or US-20040102109-$ or US-20040040746-$ or US-20040000077-$ or US-20020169523-$ or US-20030056514-$ or US-20030138327-$ or US-20130284278-$).did. or (US-10260327-$ or US-10246984-$ or US-10378326-$ or US-9915128-$ or US-10280724-$ or US-9103193-$ or US-9995218-$ or US-9970278-$ or US-9893500-$ or US-9745840-$ or US-9650879-$ or US-10020711-$ or US-9534473-$ or US-9840901-$ or US-9140110-$ or US-10119381-$ or US-10407990-$ or US-

10232332-$ or US-9650871-$ or US-10393108-$ or US-10254732-$ or US-9410410-$ or US-10036238-$ or US-9587649-$ or US-10008880-$ or US-10227854-$).did. or (US-8997904-$ or US-9963961-$ or US-8789601-$ or US-9738461-$ or US-8534235-$ or US-8154419-$ or US-7845413-$ or US-1656861-$ or US-1671436-$ or US-2183364-$ or US-2220622-$ or US-2248051-$ or US-2407796-$ or US-2416848-$ or US-2753940-$ or US-3061039-$ or US-3066503-$ or US-3302069-$ or US-3334495-$ or US-3722595-$ or US-3764233-$ or US-3773140-$ or US-3837179-$ or US-3849662-$ or US-3881551-$ or US-4037431-$ or US-4100822-$).did. or (US-4151575-$ or US-4226299-$ or US-4265266-$ or US-4432064-$ or US-4442665-$ or US-4456092-$ or US-4506982-$ or US-4512387-$ or US-4529887-$ or US-4538916-$ or US-4676063-$ or US-4759674-$ or US-4793386-$ or US-4845981-$ or US-4922463-$ or US-5006044-$ or US-5025861-$ or US-5050673-$ or US-5130628-$ or US-5131472-$ or US-5172009-$ or US-5189388-$ or US-5366324-$ or US-5422550-$ or US-5548093-$ or US-5590976-$ or US-5655361-$).did. or (US-5736838-$ or US-5755096-$ or US-5790972-$ or US-5865247-$ or US-5879137-$ or US-5894888-$ or US-5907970-$ or US-6138764-$ or US-6142878-$ or US-6164910-$ or US-6202702-$ or US-6208098-$ or US-6254462-$ or US-6271637-$ or US-6273193-$ or US-6315523-$ or US-6477852-$ or US-6484490-$ or US-6491098-$ or US-6529135-$ or US-6776227-$ or US-6802690-$ or US-6808303-$ or US-6931310-$ or US-6936947-$ or US-7082993-$ or US-7104233-$).did. or (US-7170262-$ or US-7173399-$ or US-7308933-$ or US-7312593-$ or US-7336514-$ or US-7445041-$ or US-7494263-$ or US-7500642-$ or US-7525264-$ or US-7563076-$ or US-7581379-$ or US-7675189-$ or US-7683499-$ or US-7717193-$ or US-7755310-$ or US-7807048-$ or US-

		7835140-$ or US-7894757-$ or US-7977824-$ or US-7984757-$ or US-8037936-$ or US-8054084-$ or US-8083504-$ or US-7926562-$ or US-8096891-$ or US-8139383-$ or US-8146665-$).did. or (US-8232892-$ or US-8261528-$ or US-8272439-$ or US-8310272-$ or US-8354817-$ or US-8474521-$ or US-8573303-$ or US-8596056-$ or US-8616005-$ or US-8616274-$ or US-8646521-$ or US-8692408-$ or US-8727068-$ or US-8760657-$ or US-8774972-$ or US-8800652-$ or US-8807960-$ or US-8838341-$ or US-8851860-$ or US-8857506-$ or US-8899940-$ or US-8905056-$ or US-8905138-$ or US-9018881-$ or US-9051822-$ or US-9067182-$ or US-9119326-$).did. or (US-9160168-$ or US-9322239-$ or US-9450385-$ or US-9611728-$ or US-9728354-$ or US-9863228-$ or US-9932799-$ or US-9976351-$ or US-10287873-$ or US-10309205-$ or US-10371012-$ or US-10436026-$ or US-10669804-$ or US-3055682-$ or US-9513055-$ or US-9061223-$ or US-8091928-$).did.				
S29	14	S28 and fitting with hose	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 22:20
S30	2	hose with fracturing with inches	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 23:16
S31	0	fracturing with pump with S17 adj inches	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 23:18
S32	0	fracturing with pump with S17	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2020/06/21 23:18

			DERWENT; IBM_TDB			
S33	322	fracturing with pump with "6"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 23:18
S34	0	fracturing with pump with "6" near2 (inch$4 diameter)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 23:19
S35	2,134	pump with "6" near2 (inch$4 diameter)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/21 23:19
S36	21	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump with "6" near2 (inch$4 diameter)	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/21 23:19

EAST Search History (Interference)

<This search history is empty>

6/23/2020 8:15:04 AM
C:\Users\alembo\Documents\EAST\Workspaces\16 728359 - SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE.wsp

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	16728359
Filing Date	2019-12-27
First Named Inventor	Jared Oehring
Art Unit	3679
Examiner Name	Aaron Lloyd Lembo
Attorney Docket Number	047158.100066

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	9119326		2015-08-25	McDonnell	
	2	5050673		1991-09-24	Baldridge	
	3	7308933		2007-12-18	Mayfield	
	4	6273193		2001-08-14	Hermann	
	5	5366324		1994-11-22	Arlt	
	6	8646521		2014-02-11	Bowen	
	7	4759674		1988-07-26	Schroder	
	8	1656861		1928-01-17	Leonard	

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	9	10227854		2019-03-12	Glass	
	10	9932799		2018-04-03	Symchuk	
	11	6936947		2005-08-30	Leijon	
	12	7835140		2010-11-16	Mori	
	13	10393108		2019-08-27	Chong	
	14	10378326		2019-08-13	Morris	
	15	10371012		2019-08-06	Davis	
	16	3302069		1967-01-31	Webster	
	17	9728354		2017-08-08	Skolozdra	
	18	10436026		2019-10-08	Ounadjela	
	19	10246984		2019-04-02	Payne	

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	20	10287873		2019-05-14	Filas	
	21	8800652		2014-08-12	Bartko	
	22	9915128		2018-03-13	Hunter	
	23	10196878		2019-02-05	Hunter	
	24	9963961		2018-05-08	Hardin	
	25	10260327		2019-04-16	Kajaria	
	26	7926562		2011-04-19	Poitzsch	
	27	7082993		2006-08-01	Ayoub	
	28	8096354		2012-01-17	Poitzsch	
	29	9976351		2018-05-22	Randall	
	30	10309205		2019-06-04	Randall	

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	31	10407990		2019-09-10	Oehring	
	32	2407796		1946-09-17	Page	
	33	2416848		1947-03-04	Rothery	
	34	7894757		2011-07-26	Keast	
	35	1656861		1928-01-17	Leonard	

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	1	20150354322		2015-12-10	Vicknair	
	2	20170016433		2017-01-19	Chong	
	3	20050061548		2005-03-24	Hooper	
	4	20150053426		2015-02-26	Smith	

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	5	20120247783		2012-10-04	Berner, Jr.	
	6	20120222865		2012-09-06	Larson	
	7	20090145611		2009-06-11	Pallini Jr.	
	8	20080041596		2008-02-21	Blount	
	9	20170036872		2017-02-09	Wallace	
	10	20180363437		2018-12-20	Coli	
	11	20080017369		2008-01-24	Sarada	
	12	20190203572		2019-07-04	Morris	
	13	20180245428		2018-08-30	Richards	
	14	20190316447		2019-10-17	Oehring	
	15	20190226317		2019-07-25	Payne	

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	16	20190100989		2019-04-04	Stewart	
	17	20190178057		2019-06-13	Hunter	
	18	20180216455		2018-08-02	Andreychuk	
	19	20190203567		2019-07-04	Ross	
	20	20170146189		2017-05-25	Herman	
	21	20190292891		2019-09-26	Kajaria	
	22	20190292866		2019-09-26	Ross	
	23	20190128080		2019-05-02	Ross	
	24	20180363437		2019-12-20	Coli	
	25	20170030177		2017-02-02	Oehring	
	26	20080017369		2008-01-24	Sarada	

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	27	20170036872		2017-02-09	Wallace	
	28	20150300336		2015-10-22	Hernandez	
	29	20170314979		2017-11-02	Ye	
	30	20140379300		2014-12-25	Devine	
	31	20170226842		2017-08-10	Omont	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2787814	CA		2014-02-21	Pawlick		☓
	2	2978706	CA		2016-09-09	Payne		☒
	3	2945579	CA		2019-10-08	Oehring		☒
	4	2944980	CA		2017-02-12	Oehring		☒

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Attorney Docket Number	047158.100066

	5	2849825	CA		2018-07-17	Bartko		☒
	6	3000322	CA		2013-04-18	Bartko		☒
	7	2797081	CA		2019-09-10	Hunter		☒
	8	3050131	CA		2011-11-03	Hunter		☒
	9	3018485	CA		2017-08-10	Herman		☒
	10	2482943	CA		2011-05-24	Ayoub		☒
	11	2919649	CA		2019-02-26	Randall		☒
	12	2919666	CA		2019-07-16	Randall		☒
	13	3006422	CA		2017-06-01	Green		☒
	14	2406801	CA		2001-11-01	Demetrius		☒

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	Examiner Name	Aaron Lloyd Lembo
	Attorney Docket Number	047158.100066

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	1	International Search Report and Written Opinion mailed January 2, 2020 in related PCT Application No. PCT/US19/55325	☒
	2	Notice of Allowance mailed January 9, 2020 in related U.S. Patent Application No. 16/570,331	☒
	3	Non-Final Office Action mailed December 23, 2019 in related U.S. Patent Application No. 16/597,008	☒
	4	Non-Final Office Action mailed January 10, 2020 in related U.S. Patent Application No. 16/597,014	☒
	5	Non-Final Office Action mailed December 6, 2019 in related U.S. Patent Application No. 16/564,186	☒
	6	International Search Report and Written Opinion mailed November 26, 2019 in related PCT Application No. PCT/US19/51018	☒
	7	International Search Report and Written Opinion mailed February 11, 2020 in related PCT Application No. PCT/US2019/055323	☒
	8	Final Office Action mailed March 31, 2020 in related U.S. Patent Application No. 15/356,436	☒
	9	Non-Final Office Action mailed March 3, 2020 in related U.S. Patent Application No. 16/152,695	☒

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	Art Unit	3679
	Examiner Name	Aaron Lloyd Lembo
	Attorney Docket Number	047158.100066

EXAMINER SIGNATURE			
Examiner Signature	/AARON L LEMBO/	Date Considered	06/20/2020

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Art Unit	3679
Examiner Name	Aaron Lloyd Lembo
Attorney Docket Number	047158.100066

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Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the 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 the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Taylor P. Evans/	Date (YYYY-MM-DD)	2020-06-17
Name/Print	Taylor P. Evans	Registration Number	60506

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Examiner Name	Aaron Lloyd Lembo
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

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Art Unit	3679
Examiner Name	Aaron Lloyd Lembo
Attorney Docket Number	047158.100066

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
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	Attorney Docket Number	047158.100066

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	Attorney Docket Number	047158.100066

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EXAMINER SIGNATURE

Examiner Signature	/AARON L LEMBO/	Date Considered	06/20/2020

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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Examiner Name	Aaron Lloyd Lembo
Attorney Docket Number	047158.100066

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the 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 the information disclosure statement. See 37 CFR 1.97(e)(1).

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☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Taylor P. Evans/	Date (YYYY-MM-DD)	2020-06-17
Name/Print	Taylor P. Evans	Registration Number	60506

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Bibliographic Data

Application No: 16/728,359

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /AARON L LEMBO/ Examiner's Signature | Initials

Title: SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/27/2019	166	3679	047158.100066
RULE			

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Houston, TX 77002
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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20170218727		2017-08-03	Oehring	
	2	20150136043		2015-05-21	Shaaban	
	3	20160105022		2016-04-14	Oehring	
	4	20160265457		2016-09-15	Stephenson	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.L.L./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16728359
	Filing Date	2019-12-27
	First Named Inventor	Jared Oehring
	Art Unit	3679
	Examiner Name	Aaron Lloyd Lembo
	Attorney Docket Number	047158.100066

	5	20140219824		2014-08-07	Burnette	
	6	20160281484		2016-09-29	Lestz	
	7	20190010793		2019-01-10	Hinderliter	
	8	20150211512		2015-07-30	Wiegman	
	9	20170234250		2017-08-17	Janik	
	10	20120049625		2012-03-01	Hopwood	
	11	20190120024		2019-04-25	Oehring	
	12	20190010793		2019-01-10	Hinderliter	
	13	20180028992		2018-02-01	Stegemoeller	
	14	20170218727		2017-08-03	Oehring	
	15	20150136043		2015-05-21	Shaaban	

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	16	20190112910		2019-04-18	Oehring	
	17	20170096885		2017-04-06	Oehring	
	18	20100045109		2010-02-25	Arnold	
	19	20030056514		2003-03-27	Lohn	
	20	20080264625		2008-10-30	Ochoa	
	21	20140060658		2014-03-06	Hains	
	22	20150027712		2015-01-29	Vicknair	
	23	20160290563		2016-10-06	Diggins	
	24	20170159570		2017-06-08	Bickert	
	25	20140255214		2014-09-11	Burnette	
	26	20190245348		2019-08-08	Hinderliter	

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	27	20190211661		2019-07-11	Reckels	
	28	20190169971		2019-06-06	Oehring	
	29	20100038907		2010-02-18	Hunt	
	30	20190162061		2019-05-30	Stepheson	
	31	20190178235		2019-06-13	Coskrey	
	32	20190063309		2019-02-28	Davis	
	33	20040167738		2004-08-26	Miller	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2707269	CA		2010-12-09	Kidd		X

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Examiner Name	Aaron Lloyd Lembo
Attorney Docket Number	047158.100066

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	Non-Final Office Action issued in corresponding Application No. 16/170,695 dated June 7, 2019	☒
	2	Non-Final Office Action issued in corresponding Application No. 16/268,030 dated May 10, 2019	☒
	3	Final Office Action issued in corresponding Application No. 16/210,749 dated June 11, 2019	☒
	4	Canadian Office Action mailed May 30, 2019 in corresponding CA Application No. 2,833,711	☒
	5	Canadian Office Action mailed June 20, 2019 in corresponding CA Application No. 2,964,597	☒
	6	International Search Report and Written Opinion mailed July 9, 2019 in related PCT Application No. PCT/US2019/027584	☒
	7	Office Action mailed June 7, 2019 in related U.S. Application No. 16/268,030	☒
	8	International Search Report and Written Opinion mailed September 11, 2019 in related PCT Application No. PCT/US2019/037493	☒
	9	Office Action mailed August 19, 2019 in related U.S. Patent Application No. 15/356,436	☒
	10	Office Action mailed October 2, 2019 in related U.S. Patent Application No. 16/152,732	☒

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	Examiner Name	Aaron Lloyd Lembo
	Attorney Docket Number	047158.100066

	11	Office Action mailed September 11, 2019 in related U.S. Patent Application No. 16/268,030	☒
	12	Office Action mailed October 11, 2019 in related U.S. Patent Application No. 16/385,070	☒
	13	Office Action mailed September 3, 2019 in related U.S. Patent Application No. 15/994,772	☒
	14	Office Action mailed September 20, 2019 in related U.S. Patent Application No. 16/443,273	☒
	15	Canadian Office Action mailed October 1, 2019 in related Canadian Patent Application No. 2,936,997	☒
	16	International Search Report and Written Opinion mailed November 26, 2019 in related PCT Application No. PCT/US19/51018	☒
	17	Office Action mailed December 6, 2019 in related U.S. Patent Application No. 16/564,186	☒

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/AARON L LEMBO/	Date Considered	06/20/2020

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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Art Unit	3679
Examiner Name	Aaron Lloyd Lembo
Attorney Docket Number	047158.100066

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the 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 the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Taylor P. Evans/	Date (YYYY-MM-DD)	2020-06-17
Name/Print	Taylor P. Evans	Registration Number	60506

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.L.L./

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Filing Date	2019-12-27
First Named Inventor	Jared OEHRING
Art Unit	3679
Examiner Name	Aaron Lloyd LEMBO
Attorney Docket Number	047158-100066

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	10302079	B2	2019-05-28	Kendrick	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20170159654	A1	2017-06-08	Kendrick	
	2	20130180722	A1	2013-07-18	Olarte Caro et al.	
	3	20130299167	A1	2013-11-14	Fordyce et al.	
	4	20110052423	A1	2011-03-03	Gambier et al.	
	5	20030079875	A1	2003-01-05	Weng	

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	Examiner Name	Aaron Lloyd LEMBO
	Attorney Docket Number	047158-100066

	6	20170226838	A1	2017-08-10	Ceizobka et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							

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	1	Non-Final Office Action issued in US Patent Application No. 14/881,535 mailed May 20, 2020	
	2	Non-Final Office Action issued in US Patent Application No. 15/145,443 mailed May 8, 2020	
	3	Non-Final Office Action issued in US Patent Application No. 16/458,696 mailed May 22, 2020	
	4	International Search Report and Written Opinion issued in PCT/US2020/023809 mailed June 2, 2020	
	5	KARIN, "Duel Fuel Diesel Engines," (2015), Taylor & Francis, pp 62-63, Retrieved from https://app.knovel.com/hotlink/toc/id:kpDFDE0001/dual-fueal-diesel-engines/duel-fuel-diesel-engines (Year 2015)	

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	Attorney Docket Number	047158-100066

	6	GOODWIN, "High-voltage auxilliary switchgear for power stations," Power Engineering Journal, 1989, 10 pg. (Year 1989)

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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Signature	/Taylor P. Evans/	Date (YYYY-MM-DD)	2020-06-23
Name/Print	Taylor P. Evans	Registration Number	60506

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PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To: TAYLOR P. EVANS
HOGAN LOVELLS US LLP
609 MAIN STREET, SUITE 4200
HOUSTON, TX 77002

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

	Date of mailing *(day/month/year)* 02 JUN 2020
Applicant's or agent's file reference 047158.500051	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/US2020/023809	International filing date *(day/month/year)* 20 March 2020
Applicant U.S. WELL SERVICES, LLC	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   How? Directly to the International Bureau of WIPO preferably through ePCT or on paper to, 34 chemin des Colombettes 1211 Geneva 20, Switzerland, Facsimile No.: +41 22 338 82 70

   For more detailed instructions, see *PCT Applicant's Guide*, International Phase, paragraphs 9.004 – 9.011.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ **With regard to any protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:**
   - ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with any request to forward the texts of both the protest and the decision thereon to the designated Offices.
   - ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

   Shortly after the expiration of **18 months from the priority date, the international application will be published** by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for **entry into the national phase** before those designated Offices. In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

   Within **22 months from the priority date, the applicant may request that a supplementary international search be carried** out by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 Telephone No. PCT OSP: 571-272-7774

Form PCT/ISA/220 (July 2017)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 047158.500051	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/US2020/023809	International filing date *(day/month/year)* 20 March 2020	(Earliest) Priority Date *(day/month/year)* 20 March 2019
Applicant U.S. WELL SERVICES, LLC		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the language, the international search was carried out on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

   b. ☐ This international search report has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

   c. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, see Box No. I.

2. ☐ Certain claims were found unsearchable (see Box No. II).

3. ☐ Unity of invention is lacking (see Box No. III).

4. With regard to the title,

   ☒ the text is approved as submitted by the applicant.

   ☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

   ☒ the text is approved as submitted by the applicant.

   ☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the drawings,

   a. the figure of the drawings to be published with the abstract is Figure No. 1

   ☒ as suggested by the applicant.

   ☐ as selected by this Authority, because the applicant failed to suggest a figure.

   ☐ as selected by this Authority, because this figure better characterizes the invention.

   b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2020/023809

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - E21B 44/00; E21B 43/18; E21B 43/25; E21B 43/26; E21B 47/00; E21B 49/00 (2020.01)

CPC - E21B 44/00; E21B 43/16; E21B 43/25; E21B 43/26; E21B 43/267; E21B 47/00; E21B 49/00; E21B 49/008 (2020.05)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

USPC - 73/152.18; 166/250.01; 166/250.1; 166/305.1; 166/308.1; 702/11 (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2016/0258267 A1 (STEWART & STEVENSON, LLC) 06 September 2016 (06.09.2016) entire document	8, 9, 13 --- 1, 4-7, 10, 12
Y	US 2013/0180722 A1 (SCHLUMBERGER TECHNOLOGY CORPORATION) 18 July 2013 (18.07.2013) entire document	1, 4-7, 10
Y	US 2013/0299167 A1 (GASFRAC ENERGY SERVICES INC.) 14 November 2013 (14.11.2013) entire document	4-6, 12
A	US 2011/0052423 A1 (GAMBIER et al) 03 March 2011 (03.03.2011) entire document	1-15
A	US 2003/0079875 A1 (WENG) 01 May 2003 (01.05.2003) entire document	1-15
A	US 2017/0226838 A1 (GAS TECHNOLOGY INSTITUTE) 10 August 2017 (10.08.2017) entire document	1-15

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 May 2020	02 JUN 2020
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: TAYLOR P. EVANS
HOGAN LOVELLS US LLP
609 MAIN STREET, SUITE 4200
HOUSTON, TX 77002

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)* 02 JUN 2020

Applicant's or agent's file reference
047158.500051

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2020/023809	20 March 2020	20 March 2019

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - E21B 44/00; E21B 43/18; E21B 43/25; E21B 43/26; E21B 47/00; E21B 49/00 (2020.01)
CPC - E21B 44/00; E21B 43/16; E21B 43/25; E21B 43/26; E21B 43/267; E21B 47/00; E21B 49/00; E21B 49/008 (2020.05)

Applicant U.S. WELL SERVICES, LLC

1. This opinion contains indications relating to the following items:

- [x] Box No. I Basis of the opinion
- [ ] Box No. II Priority
- [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [ ] Box No. IV Lack of unity of invention
- [x] Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI Certain documents cited
- [ ] Box No. VII Certain defects in the international application
- [ ] Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	11 May 2020	Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/237 (cover sheet) (January 2015)

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2020/023809

Box No. I Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of:

☒ the international application in the language in which it was filed.

☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a)).

3. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this opinion has been established on the basis of a sequence listing:

a. ☐ forming part of the international application as filed:

☐ in the form of an Annex C/ST.25 text file.

☐ on paper or in the form of an image file.

b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2020/023809

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-7, 10-12, 14, 15	YES
	Claims	8, 9, 13	NO
Inventive step (IS)	Claims	2, 3, 11, 14, 15	YES
	Claims	1, 4-10, 12, 13	NO
Industrial applicability (IA)	Claims	1-15	YES
	Claims	None	NO

2. Citations and explanations:

Claims 8, 9, and 13 lack novelty under PCT Article 33(2) as being anticipated by Stewart & Stevenson, LLC (hereinafter Stewart & Stevenson).

Regarding Claim 8, Stewart & Stevenson discloses a method for regulating one or more pumping rates of an electrically powered hydraulic fracturing pump system (title, "an embodiment includes a method for computational control of the speeds of the AC motors such that hydraulic fracturing design parameters, among these being injection rate and pressures, can be automatically achieved. Using this method, an operator can enter a target injection rate and injection pressure limit, or alternatively,...", para. [0105]), comprising: receiving a desired pumping rate for a first pump ("q Target is the target injection rate", para. [0116]); determining a current pumping rate of an adjacent or opposite second pump ("q is the measured injection rate", para. [0116]; q (current pumping rate) can be determined for any of the pumps in the group of pumps); determining a difference between the desired pumping rate and the current pumping rate ("q Error is the injection rate error defined as q Limit - q when in auto pressure control and defined as q Target - q when in auto rate control", para. [0116]) is within a threshold amount ("As illustrated in FIGS. 15B and 15C, a first step 1040a, 1040b of calculating the error values is implemented followed by a next step 1050a, 1050b of determining whether the measured pressure or measured injection rate exceeds a tolerance value in addition to the target injection rate or a target pressure, depending on whether auto rate or auto pressure is selected, for determining whether injection rate should be decreased following the decrease injection rate module of FIG. 15E. If not, the measured pressure or the measured injection rate is compared to the pressure limit or injection rate limit and the limit minus the tolerance value to determine whether the value falls within a "do not exceed" band in a next step 1060a, 1060b. If yes, the current injection rate is maintained. If not, the measured pressure or the measured injection rate is compared with the pressure limit or the injection rate limit,...to determine whether the injection rate should be increased following the increase injection rate module of FIG. 15D", para. [0117]); applying an adjustment to the desired pumping rate ("Referring to FIGS. 15D and 15E, an increase injection rate module or a decrease injection rate module is illustrated, respectively, for determining which pump to increase the injection rate for and the value of the change in revolutions per minute (RPM) for the selected pump,...,in the next operations 1200a, 1200b, the pump for which the injection rate is increased or decreased is selected. In a preferred embodiment, the processing algorithm of the system control unit seeks to maximize the efficiency of the overall system operation,...", para. [0118]).

Regarding Claim 9, Stewart & Stevenson discloses the method of claim 8, and further comprising: determining the difference between the desired pumping rate and the current pumping rate exceeds a threshold amount ("q Error is the injection rate error defined as q Limit - q when in auto pressure control and defined as q Target - q when in auto rate control", para. [0116]); and modifying at least one of the current pumping rate or the desired pumping rate ("As illustrated in FIGS. 15B and 15C, a first step 1040a, 1040b of calculating the error values is implemented followed by a next step 1050a, 1050b of determining whether the measured pressure or measured injection rate exceeds a tolerance value in addition to the target injection rate or a target pressure, depending on whether auto rate or auto pressure is selected, for determining whether injection rate should be decreased following the decrease injection rate module of FIG. 15E. If not, the measured pressure or the measured injection rate is compared to the pressure limit or injection rate limit and the limit minus the tolerance value to determine whether the value falls within a "do not exceed" band in a next step 1060a, 1060b. If yes, the current injection rate is maintained. If not, the measured pressure or the measured injection rate is compared with the pressure limit or the injection rate limit,...to determine whether the injection rate should be increased following the increase injection rate module of FIG. 15D", para. [0117]).

Regarding Claim 13, Stewart & Stevenson discloses the method of claim 8, and further discloses wherein information is transmitted from the one or more pumps from respective sensors ("In this example, a hydraulic fracturing pump 710a may include a pressure transmitter that provides a signal for the pump discharge pressure. The pump discharge pressure is displayed locally and remotely at the system control unit 650", para. [0062]).

LIBERTY EXHIBIT 1056, Page 575

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:

Claims 1, 7, and 10 lack an inventive step under PCT Article 33(3) as being obvious over Stewart & Stevenson, LLC (hereinafter Stewart & Stevenson) in view of Schlumberger Technology Corporation (hereinafter Schlumberger).

Regarding Claim 1, Stewart & Stevenson discloses a method for regulating a pumping rate of an electrically powered hydraulic fracturing pump (title, "an embodiment includes a method for computational control of the speeds of the AC motors such that hydraulic fracturing design parameters, among these being injection rate and pressures, can be automatically achieved. Using this method, an operator can enter a target injection rate and injection pressure limit, or alternatively,...", para. [0105]), comprising: receiving a rate limit for one or more pumps ("q Limit is the injection rate limit", para. [0116]), determining a desired pumping rate for the one or more pumps ("q Target is the target injection rate", para. [0116]); determining a current rate of the one or more pumps ("q is the measured injection rate", para. [0116]); comparing the desired pumping rate to the current rate ("q Error is the injection rate error defined as q Limit - q when in auto pressure control and defined as q Target - q when in auto rate control", para. [0116]); determining, based at least in part on the comparison, an adjustment to the current rate; determining the adjustment does not exceed the rate limit; and applying the adjustment to the current rate of the one or more pumps ("As illustrated in FIGS. 15B and 15C, a first step 1040a, 1040b of calculating the error values is implemented followed by a next step 1050a, 1050b of determining whether the measured pressure or measured injection rate exceeds a tolerance value in addition to the target injection rate or a target pressure, depending on whether auto rate or auto pressure is selected, for determining whether injection rate should be decreased following the decrease injection rate module of FIG. 15E. If not, the measured pressure or the measured injection rate is compared to the pressure limit or injection rate limit and the limit minus the tolerance value to determine whether the value falls within a "do not exceed" band in a next step 1060a, 1060b. If yes, the current injection rate is maintained. If not, the measured pressure or the measured injection rate is compared with the pressure limit or the injection rate limit,..,to determine whether the injection rate should be increased following the increase injection rate module of FIG. 15D", para. [0117]).
Stewart & Stevenson fails to explicitly disclose receiving a step rate limit for one or more pumps, the step rate limit corresponding to at least one of a minimum step rate or a maximum step rate.
Schlumberger, in the field of step rate test procedure in the fracturing process (para. [0025]), teaches measuring a step rate limit for one or more pumps, the step rate limit corresponding to at least one of a minimum step rate or a maximum step rate ("Referring generally to FIG. 2, the fracturing process may involve pumping the injection fluid, e.g. water or another suitable fluid, in a "step rate test" procedure followed by the flow back,...,The step rate test procedure includes a series of successively higher injection rates for which pressure values are read and recorded at each rate and time step 46, as illustrated in FIG. 2. In FIG. 2, a plot of injection rates and the corresponding stabilized pressure values are graphically represented as a constant slope straight line 48 ", para. [0025]; fig. 2 shows the maximum pump rate during the step rate test).
It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Stewart & Stevenson with the teaching of Schlumberger for the purpose of measuring the limits for the pumping rate and thereby finding the formation or breakdown points associated with the injection rates (para. [0025] of Schlumberger).

Regarding Claim 7, modified Stewart & Stevenson discloses the method of claim 1, and further discloses wherein information is transmitted from the one or more pumps from respective sensors ("In this example, a hydraulic fracturing pump 710a may include a pressure transmitter that provides a signal for the pump discharge pressure. The pump discharge pressure is displayed locally and remotely at the system control unit 650", para. [0062]).

Regarding Claim 10, Stewart & Stevenson discloses the method of claim 8.
Stewart & Stevenson fails to explicitly disclose determining a step rate for the first pump.
Schlumberger, in the field of step rate test procedure in the fracturing process (para. [0025]), teaches determining a step rate for the first pump ("Referring generally to FIG. 2, the fracturing process may involve pumping the injection fluid, e.g. water or another suitable fluid, in a "step rate test" procedure followed by the flow back,...,The step rate test procedure includes a series of successively higher injection rates for which pressure values are read and recorded at each rate and time step 46, as illustrated in FIG. 2. In FIG. 2, a plot of injection rates and the corresponding stabilized pressure values are graphically represented as a constant slope straight line 48 ", para. [0025]).
It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Stewart & Stevenson with the teaching of Schlumberger for the purpose of measuring the limits for the pumping rate and thereby finding the formation or breakdown points associated with the injection rates (para. [0025] of Schlumberger).

Claims 4-6 lack an inventive step under PCT Article 33(3) as being obvious over Stewart & Stevenson, LLC (hereinafter Stewart & Stevenson) in view of Schlumberger Technology Corporation (hereinafter Schlumberger) and Gasfrac Energy Services Inc. (hereinafter Gasfrac Energy).

Regarding Claim 4, modified Stewart & Stevenson discloses the method of claim 1.
Stewart & Stevenson fails to explicitly disclose wherein the desired pumping rate corresponds to at least a fraction of a desired overall pumping rate for a group of pumps.
Gasfrac Energy, in the field fracturing method (abstract), teaches wherein the desired pumping rate corresponds to at least a fraction of a desired overall pumping rate for a group of pumps ("A first stream of LPG and gelling agent may be pumped with first frac pressure pump 16. A second stream of lubricated proppant may be pumped with second frac pressure pump 18,...,The first stream and the second stream are combined within wellhead 32 into a combined stream (FIG. 2), In some cases the ratio by volume of the first stream to the second stream is between 9:1 and 1:9, although other ratios may be used....,The method may be controlled using one or more controllers such as command center truck 50 (FIG. 1). Truck 50 may be connected wirelessly or by wired connection to control one or more or all of the operations of the frac components discussed herein", para. [0040]).
It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Stewart & Stevenson with the teaching of Gasfrac Energy for the purpose of providing multiple supplies to the frac pump and thereby increasing the job size performed by the frac pump (para. [0041] of Gasfrac Energy).

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:

Regarding Claim 5, modified Stewart & Stevenson discloses the method of claim 4.
Stewart & Stevenson fails to explicitly disclose wherein at least two pumps of the group of pumps operates at a different pumping rate.
Gasfrac Energy, in the field fracturing method (abstract), teaches wherein at least two pumps of the group of pumps operates at a different pumping rate ("A first stream of LPG and gelling agent may be pumped with first frac pressure pump 16. A second stream of lubricated proppant may be pumped with second frac pressure pump 18,..,The first stream and the second stream are combined within wellhead 32 into a combined stream (FIG. 2), in some cases the ratio by volume of the first stream to the second stream is between 9:1 and 1:9, although other ratios may be used. ...,The method may be controlled using one or more controllers such as command center truck 50 (FIG. 1). Truck 50 may be connected wirelessly or by wired connection to control one or more or all of the operations of the frac components discussed herein", para. [0040]).
It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Stewart & Stevenson with the teaching of Gasfrac Energy for the purpose of providing multiple supplies to the frac pump and thereby increasing the job size performed by the frac pump (para. [0041] of Gasfrac Energy).

Regarding Claim 6, modified Stewart & Stevenson discloses the method of claim 4.
Stewart & Stevenson fails to explicitly disclose wherein at least two pumps of the group of pumps have different adjustments.
Gasfrac Energy, in the field fracturing method (abstract), teaches wherein at least two pumps of the group of pumps have different adjustments ("A first stream of LPG and gelling agent may be pumped with first frac pressure pump 16. A second stream of lubricated proppant may be pumped with second frac pressure pump 18,..,The first stream and the second stream are combined within wellhead 32 into a combined stream (FIG. 2), in some cases the ratio by volume of the first stream to the second stream is between 9:1 and 1:9, although other ratios may be used. ...,The method may be controlled using one or more controllers such as command center truck 50 (FIG. 1). Truck 50 may be connected wirelessly or by wired connection to control one or more or all of the operations of the frac components discussed herein", para. [0040]; this shows that the adjustment rate for first frac pressure pump 16 and second frac pressure pump 18 are different).
It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Stewart & Stevenson with the teaching of Gasfrac Energy for the purpose of providing multiple supplies to the frac pump and thereby increasing the job size performed by the frac pump (para. [0041] of Gasfrac Energy).

Claim 12 lacks an inventive step under PCT Article 33(3) as being obvious over Stewart & Stevenson, LLC (hereinafter Stewart & Stevenson) in view of Gasfrac Energy Services Inc. (hereinafter Gasfrac Energy).

Regarding Claim 12, Stewart & Stevenson discloses the method of claim 8.
Stewart & Stevenson fails to explicitly disclose wherein the desired pumping rate corresponds to at least a fraction of a desired overall pumping rate for a group of pumps.
Gasfrac Energy, in the field fracturing method (abstract), teaches wherein the desired pumping rate corresponds to at least a fraction of a desired overall pumping rate for a group of pumps ("A first stream of LPG and gelling agent may be pumped with first frac pressure pump 16. A second stream of lubricated proppant may be pumped with second frac pressure pump 18,..,The first stream and the second stream are combined within wellhead 32 into a combined stream (FIG. 2), in some cases the ratio by volume of the first stream to the second stream is between 9:1 and 1:9, although other ratios may be used...,The method may be controlled using one or more controllers such as command center truck 50 (FIG. 1). Truck 50 may be connected wirelessly or by wired connection to control one or more or all of the operations of the frac components discussed herein", para. [0040]).
It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Stewart & Stevenson with the teaching of Gasfrac Energy for the purpose of providing multiple supplies to the frac pump and thereby increasing the job size performed by the frac pump (para. [0041] of Gasfrac Energy).

Claims 2, 3, 11, 14, and 15 meet the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest:

Regarding claim 2, the prior art of record, individually or in combination, does not teach or fairly suggest, further comprising: determining a damage accumulation rate for the one or more pumps; and determining the damage accumulation rate is below a threshold.

The following prior art is made of record to support and further define the reasons that claim 2 meets the criteria set out in PCT Article 33 (2)-(3):
Gambier et al. (hereinafter Gambier) discloses determining a damage accumulation rate for the one or more pumps ("In a further embodiment, a method, comprises: attaching a sensor to a pump body comprising a piston bore, an inlet bore and an outlet bore, wherein the sensor comprises one or more for temperature, pressure, acceleration, inclination, humidity, light, density, viscosity, flow rate, chemical composition, strain, deformation, positron decay, acoustic emission, Barkhausen noise, accumulated fatigue damage or a combination thereof", para. [0031]).
However Gambier fails to disclose determining the damage accumulation rate is below a threshold.

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:

Regarding claim 3, the prior art of record, individually or in combination, does not teach or fairly suggest, further comprising: determining a damage accumulation rate for the one or more pumps; determining the damage accumulation rate exceeds a threshold; and transmitting a warning.

The following prior art is made of record to support and further define the reasons that claim 3 meets the criteria set out in PCT Article 33 (2)-(3):
Gambier discloses determining a damage accumulation rate for the one or more pumps ("in a further embodiment, a method, comprises: attaching a sensor to a pump body comprising a piston bore, an inlet bore and an outlet bore, wherein the sensor comprises one or more for temperature, pressure, acceleration, inclination, humidity, light, density, viscosity, flow rate, chemical composition, strain, deformation, positron decay, acoustic emission, Barkhausen noise, accumulated fatigue damage or a combination thereof", para. [0031]).
However Gambier fails to disclose determining the damage accumulation rate exceeds a threshold; and transmitting a warning.

Regarding claim 11, the prior art of record, individually or in combination, does not teach or fairly suggest, wherein the step rate is based, at least in part, on a pump speed, crankshaft rpm, or critical plunger speed.

The following prior art is made of record to support and further define the reasons that claim 11 meets the criteria set out in PCT Article 33(2)-(3):
Schlumberger discloses measuring a step rate limit ("Referring generally to FIG. 2, the fracturing process may involve pumping the injection fluid, e.g. water or another suitable fluid, in a "step rate test" procedure followed by the flow back,...,The step rate test procedure includes a series of successively higher injection rates for which pressure values are read and recorded at each rate and time step 46, as illustrated in FIG. 2. In FIG. 2, a plot of injection rates and the corresponding stabilized pressure values are graphically represented as a constant slope straight line 48 ", para. [0025]; fig. 2 shows the maximum pump rate during the step rate test).
However Schlumberger fails to disclose wherein the step rate is based, at least in part, on a pump speed, crankshaft rpm, or critical plunger speed.

Regarding claim 14, the prior art of record, individually or in combination, does not teach or fairly suggest, further comprising: determining a damage accumulation rate for the first pump; and determining the damage accumulation rate is below a damage threshold.

The following prior art is made of record to support and further define the reasons that claim 14 meets the criteria set out in PCT Article 33(2)-(3):
Gambier discloses determining a damage accumulation rate for the first pump ("in a further embodiment, a method, comprises: attaching a sensor to a pump body comprising a piston bore, an inlet bore and an outlet bore, wherein the sensor comprises one or more for temperature, pressure, acceleration, inclination, humidity, light, density, viscosity, flow rate, chemical composition, strain, deformation, positron decay, acoustic emission, Barkhausen noise, accumulated fatigue damage or a combination thereof", para. [0031]).
However Gambier fails to disclose determining the damage accumulation rate is below a damage threshold.

Regarding claim 15, the prior art of record, individually or in combination, does not teach or fairly suggest, further comprising: determining a damage accumulation rate for the first pump; determining the damage accumulation rate exceeds a damage threshold; transmitting a warning.

The following prior art is made of record to support and further define the reasons that claim 15 meets the criteria set out in PCT Article 33(2)-(3):
Gambier discloses further comprising: determining a damage accumulation rate for the first pump ("in a further embodiment, a method, comprises: attaching a sensor to a pump body comprising a piston bore, an inlet bore and an outlet bore, wherein the sensor comprises one or more for temperature, pressure, acceleration, inclination, humidity, light, density, viscosity, flow rate, chemical composition, strain, deformation, positron decay, acoustic emission, Barkhausen noise, accumulated fatigue damage or a combination thereof", para. [0031]).
However Gambier fails to disclose determining the damage accumulation rate exceeds a damage threshold; transmitting a warning.

Claims 1-15 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.

Search History:

Limited Classification Search

The Patent Analyst performed a limited classification search within the following US, IPC, CPC, ECLA, or F-Term classification areas:

CPC Class/Subclass(es): E21B 44/00; E21B 43/16; E21B 43/25; E21B 43/26; E21B 43/267; E21B 47/00; E21B 49/00; E21B 49/008 (2020.05)

IPC (8) Class/Subclass(es): E21B 44/00; E21B 43/18; E21B 43/25; E21B 43/26; E21B 47/00; E21B 49/00 (2020.01)

U.S. Class/Subclass(es): 73/152.18; 166/250.01; 166/250.1; 166/305.1; 166/308.1; 702/11

See Global Search Results.

Global Patent Literature Text Search

The Patent Analyst performed the following global text search, which was not limited by classification but may or may not have been limited by other criteria:

Questel Orbit: https://www.orbit.com

#	Search query	Results
1	(("US WELL SERVICES")/NPAN OR ("MATLIN & ACQUISITION")/NPAN OR ("USWS FLEET 10")/NPAN OR ("USWS FLEET II")/NPAN)	46
2	1 AND ((FRACTUR+) 5D (PUMP+))	38
3	2 AND ((PUMP+) 3D (RATE?))	4
4	1 AND ((STEP+) 3D (RATE?))	0
5	1 AND ((PUMP+) 5D (RATE?))	5
6	(US9970278)/PN	1
7	..CITBF NOSOURCE SS 6 1 RANKED	312
8	7 AND ((FRACTUR+) 5D (PUMP+))	64
9	7 AND ((STEP+) 3D (RATE?))	1
10	(US5006044)/PN	1
11	..CITBF NOSOURCE SS 10 1 RANKED	197
12	11 AND ((PUMP+) 3D (RATE?))	18
13	(US20130306322)/PN	1
14	..CITBF NOSOURCE SS 13 1 RANKED	37
15	(US10254732)/PN	1
16	(WO2017201526 OR US5813463)/PN	2

17	..CITBF NOSOURCE SS 16 2 RANKED	2
18	..CITBF NOSOURCE SS 16 1 RANKED	30
19	(US20160290114)/PN	1
20	..CITBF NOSOURCE SS 19 1 RANKED	312
21	20 AND ((STEP) 3D (RATE?))	0
22	20 AND (FRACTUR+)	106
23	22 AND ((PUMP+) 5D (RATE?))	17
24	(EP3265218)/PN	1
25	..CITBF NOSOURCE SS 24 1 RANKED	29
26	(US4192182 OR US20130180722 OR WO200314524)/PN	3
27	..CITBF NOSOURCE SS 26 1 RANKED	39
28	(WO200314524)/PN	1
29	..CITBF NOSOURCE SS 28 1 RANKED	37
30	(US9027641 OR US8863833 OR US8490704 OR US8210257 OR US20120150515)/PN	5
31	..CITBF NOSOURCE SS 30 2 RANKED	39
32	(US3058521 OR US4192182 OR US4372380 OR US5165276 OR US6364015)/PN	5
33	..CITBF NOSOURCE SS 32 4 RANKED	19
34	(US20140151043 OR US7569523)/PN	2
35	..CITBF NOSOURCE SS 34 1 RANKED	14
36	(US10563649)/PN	1
37	(WO2017201526 OR US5050674 OR WO200314524)/PN	3
38	..CITBF NOSOURCE SS 37 3 RANKED	37
39	..CITBF NOSOURCE SS 37 2 RANKED	2
40	(US6364015)/PN	1
41	(((PUMP+) 3D (RATE?)) AND ((FRAC+) 3D (PUMP+)))/TI/AB/CLMS/TX	3875
42	41 AND ((STEP) 3D (RATE?))	42
43	(WO2019217480)/PN	1
44	..CITBF NOSOURCE SS 43 1 RANKED	5
45	41 AND ((DESIR+) AND ((PUMP+) 3D (RATE?)))	271
46	41 AND ((CURRENT) AND ((PUMP+) 3D (RATE?)))	109
47	45 AND 46	50

48	(((FRAC+) 5D (PUMP+)) AND ((STEP) 3D (RATE)))/TI/AB/CLMS/TX	669
49	48 AND ((PUMP+) 5D (CONTROL+))	111
50	49 AND (+PROCESS+)	69
51	(WO2018125176)/PN	1
52	..CITBF NOSOURCE SS 51 1 RANKED	8
53	(WO201703501)/PN	1
54	..CITBF NOSOURCE SS 53 1 RANKED	29
55	((((STEP) 3D (RATE?)) AND (TEST?)) AND ((FRACTUR+) 3D (PUMP+)))/TI/AB/CLMS/TX	141
56	55 AND ((FLOW+) 3D (RATE?))	43
57	(WO2017201526)/PN	1
58	..CITBF NOSOURCE SS 57 1 RANKED	2
59	(((FRACTUR+) 5D (PUMP+)) AND ((FLOW+) 3D (RATE?)))/TI/AB/CLMS/TX	4836
60	59 AND ((DESIR+) 3D (RATE?))	47
61	59 AND (((ADJUST+) OR (MODIFY+)) 8D ((FLOW+) 3D (RATE?)))	79
62	61 AND ((CONTROL+) OR (+PROCESS+))	72
63	62 AND (THRESHOLD+)	4
64	61 AND (((MAX+) OR (MIN+)) 5D (LIMIT+))	3
65	(US9879514)/PN	1
66	..CITBF NOSOURCE SS 65 1 RANKED	15
67	(WO201735557 OR US3705532)/PN	2
68	..CITBF NOSOURCE SS 67 SET	17
69	(((REGULAT+) 8D ((PUMP+) 3D (RATE?))) AND ((FRACTUR+) 5D (PUMP+)))/TI/AB/CLMS/TX	59
70	(((DIFFERENC+) 5D (RATE?)) AND ((FRACTUR+) 5D (PUMP+)))/TI/AB/CLMS/TX	214
71	70 AND (THRESHOLD+)	5
72	70 AND ((PUMP+) 5D (RATE?))	38
73	(EP3265218)/PN	1
74	..CITBF NOSOURCE SS 73 1 RANKED	29
75	((((FRAC+) 5D (PUMP+)) AND ((PUMP+) 3D (RATE?))) AND (THRESHOLD+))/TI/AB/CLMS/TX	926
76	75 AND ((CONTROL+) OR (+PROCESS+))	732
77	76 AND (((ADJUST+) OR (MODIFY+)) 8D ((FLOW+) 3D (RATE?)))	51

78	75 AND ((TARGET+) 5D (RATE?))	16
79	(WO2018125176)/PN	1
80	..CITBF NOSOURCE SS 79 1 RANKED	8
81	((((FRAC+) 5D (PUMP+)) AND ((PUMP+) 3D (RATE?))) AND (TARGET+))/TI/AB/CLMS/TX	1726
82	81 AND (((ADJUST+) OR (MODIFY+)) 8D ((FLOW+) 3D (RATE?)))	74
83	(166250010)/PCL	1301
84	(166250100)/PCL	320
85	(166305100)/PCL	1954
86	(166308100)/PCL	1258
87	(702011)/PCL	620
88	(073152180)/PCL	294
89	83 OR 84 OR 85 OR 86 OR 87 OR 88	5237
90	89 AND (((PUMP+) 3D (RATE?)) AND ((FRAC+) 3D (PUMP+)))	26
91	89 AND ((FRAC+) 3D (PUMP+))	248
92	91 AND ((ADJUST+) AND ((FLOW+) 3D (RATE?)))	7
93	91 AND ((ADJUST+) AND ((PUMP+) 3D (RATE?)))	5
94	89 AND ((WELLBORE?) OR ((WELL) 3D (BORE?)))	2578
95	94 AND ((ADJUST+) AND ((FLOW+) 3D (RATE?)))	65
96	89 AND (((ADJUST+) OR (MODIFY+)) 8D ((FLOW+) 3D (RATE?)))	39
97	89 AND ((MEASUR+) 8D ((PUMP+) 3D (RATE?)))	9
98	89 AND ((DESIR+) 8D ((PUMP+) 3D (RATE?)))	10
99	89 AND ((COMPAR+) 8D (((PUMP+) OR (FLOW+)) 3D (RATE?)))	17
100	89 AND ((PUMP+) 3D (RATE?))	110
101	89 AND ((INCREAS+) 5D ((PUMP+) 3D (RATE?)))	12
102	(US8417483 OR US8774972)/PN	2
103	89 AND ((INITIAL+) 5D ((PUMP+) 3D (RATE?)))	2
104	(US20120199356 OR US20140014338 OR US5536115 OR US20140251623 OR US20150192117)/PN	5
105	..CITBF NOSOURCE SS 104 2 RANKED	69
106	(US20140060831 OR US20050230117)/PN	2
107	(E21B-043/25)/IPC	4788
108	(E21B-043/26)/IPC	11280

109	(E21B-049/00)/IPC	13267
110	(E21B-047/00)/IPC	20462
111	(E21B-043/18)/IPC	1240
112	(E21B-049/00)/IPC	13267
113	(E21B-044/00)/IPC	6824
114	107 OR 108 OR 109 OR 110 OR 111 OR 112 OR 113	49621
115	114 AND ((WELLBORE?) OR ((WELL) 3D (BORE?)))	13439
116	115 AND ((FRAC+) 3D (PUMP+))	664
117	**116 AND ((PUMP+) 3D (RATE?))**	**70**
118	114 AND ((STEP) 3D (RATE?))	163
119	**118 AND (PUMP+)**	**52**
120	114 AND (((PUMP+) 3D (RATE?)) AND ((FRAC+) 3D (PUMP+)))	117
121	**120 AND ((ADJUST+) AND ((FLOW+) 3D (RATE?)))**	**10**
122	**(US20160258267)/PN**	**1**
123	**..CITBF NOSOURCE SS 122 1 RANKED**	**29**
124	**115 AND (((ADJUST+) OR (MODIFY+)) 8D ((FLOW+) 3D (RATE?)))**	**104**
125	**124 AND ((FRAC+) 3D (PUMP+))**	**5**
126	114 AND ((FRAC+) 3D (PUMP+))	1494
127	**126 AND ((TARGET+) 5D (RATE?))**	**4**
128	**(US2014027772 OR US20140027772 OR US8774972 OR US20170226842 OR US20150129210)/PN**	**4**
129	..CITBF NOSOURCE SS 128 4 RANKED	163
130	**129 AND ((FRAC+) 3D (PUMP+))**	**10**
131	114 AND (((STEP) 3D (RATE?)) OR ((RATE?) 3D (TEST+)))	456
132	**131 AND ((FRAC+) 3D (PUMP+))**	**15**
133	**(WO2018125176)/PN**	**1**
134	**..CITBF NOSOURCE SS 133 1 RANKED**	**8**
135	115 AND ((DAMAG+) 5D ((RATE?) OR (FLOW+) OR (INJECT+)))	113
136	**135 AND ((FRAC+) 3D (PUMP+))**	**9**
137	**(US4192182 OR US20130180722 OR US5597043)/PN**	**3**
138	**..CITBF NOSOURCE SS 137 3 RANKED**	**19**
139	**116 AND ((SENSOR?) 5D (TRANSMIT+))**	**5**

140	(US6814142)/PN	1
141	..CITBF NOSOURCE SS 140 1 RANKED	70
142	141 AND ((SENSOR?) 5D (TRANSMIT+))	7
143	118 AND ((LIMIT+) OR (THRESHOLD+))	67
144	(WO2018215763)/PN	1
145	..CITBF NOSOURCE SS 144 1 RANKED	4
146	(US9683432)/PN	1
147	..CITBF NOSOURCE SS 146 1 RANKED	60
148	114 AND ((DATA) 5D (TRANSMI+))	2293
149	148 AND ((PUMP+) 5D (SENSOR?))	84
150	(US20130118739)/PN	1
151	..CITBF NOSOURCE SS 150 1 RANKED	27
152	114 AND ((DAMAG+) 5D (PUMP?))	108
153	152 AND ((THRESHOLD+) OR (LIMIT+))	38
154	(E21B-043/25)/CPC	1217
155	(E21B-043/26)/CPC	6320
156	(E21B-043/267)/CPC	2621
157	(E21B-049/00)/CPC	5917
158	(E21B-049/008)/CPC	583
159	(E21B-047/00)/CPC	7277
160	(E21B-044/00)/CPC	2969
161	(E21B-043/16)/CPC	4723
162	154 OR 155 OR 156 OR 157 OR 158 OR 159 OR 160 OR 161	25780
163	162 AND ((WELLBORE?) OR ((WELL) 3D (BORE?)))	9191
164	163 AND ((DAMAG+) 5D (ACCUMULAT+))	5
165	(WO201762074)/PN	1
166	..CITBF NOSOURCE SS 165 1 RANKED	17
167	162 AND ((DAMAG+) 5D (ACCUMULAT+))	15
168	163 AND ((FRAC+) 3D (PUMP+))	561
169	168 AND ((PUMP+) 3D (RATE?))	72
170	163 AND ((STEP) 3D (RATE?))	56

171	(US8874383)/PN	1
172	..CITBF NOSOURCE SS 171 1 RANKED	35
173	162 AND ((FRAC+) 3D (PUMP+))	1106
174	173 AND ((STEP) 3D (RATE?))	9
175	173 AND ((PUMP+) 5D (SENSOR?))	29
176	173 AND ((DATA) 5D (TRANSMI+))	20
177	163 AND ((DAMAG+) 5D (PUMP?))	40
178	173 AND ((DAMAG+) 5D (PUMP?))	17
179	162 AND ((DAMAG+) 5D ((RATE?) OR (FLOW+) OR (INJECT+)))	188
180	179 AND ((WELLBORE?) OR ((WELL) 3D (BORE?)))	91
181	163 AND (((ADJUST+) OR (MODIFY+)) 8D ((FLOW+) 3D (RATE?)))	69
182	*MEM "home/QPTLD337/FRACP" /XPN /APID	202

Google Patents: https://patents.google.com

#	Search query	Results
1	(regulating pumping rate)(fracturing pump)(step rate limit)(pumping rate)(comparing the rates)(adjusting pumping rate)(damage accumulation)(threshold)	2,520
2	(step rate testing)(fracturing pump)(step rate limit)(pumping rate)(desired rate)(adjusting pumping rate)(well bore)(damage accumulation)	2,640
3	(wellbore)(pumps)(fracture)(receiving threshold pumping rate)(determine the desired rate)(measure the current rate)(compare the pumping rates)(adjusting pumping rate)	995
4	(wellbore)(step rate test)(step rate limit)(fracture pump)(damage accumulation rate)	2,620
5	(regulating pumping rate)(electrically powered)(fracturing pump)(desired pump rate)(target pump rate)(step rate limit)	10,900
6	(method)(regulating a pumping rate)(fracturing pump)(desired pump rate)(target pump rate)(damage accumulation rate)	5,317

Computer Accessed Text Databases Searched

The Patent Analyst searched the following computer accessed text databases:

Google: https://www.google.com/

#	Search query	Results
1	(US Well Services LLC)(fracturing pump)(pumping rate)(regulating)(step rate limit)(desired pumping rate)	580,000
2	(regulating pumping)(fracturing pump)(step rate)(determine desired pumping rate)(modifying the pumping rate)(adjustment)	3,400,000
3	(wellbore)(fracture pump)(sensor)(transmitting data)(pump rate)	366,000

4	(fracturing pump)(damage rate)(threshold)(pumping rate)(control)(step rate)	3,490,000
5	(pumping rate)(adjustment rate)(damage accumulation rate)(threshold)(fracture pump)(group of pumps)	552,000

Google Scholar: https://scholar.google.com/

#	Search query	Results
1	(fracturing pump)(regulating pump)(step rate limit for the pump)(determine pumping rate)(determine the current rate)(comparison)(adjusting the pumping rate)	17,900
2	(determine step rate)(frac pump)(desired pumping rate)(current pumping rate)(comparing the desired rate with the current pumping rate)(threshold)(adjusting pumping rate)(damage accumulation)	8,550
3	(frac pump)(step rate limit)(damage accumulation rate)(wellbore)(threshold)(transmitting a warning)	358
4	(fracture pump)(sensor)(measurement)(transmitting data)(control unit)	24,100
5	(fracture pump)(target pump rate)(damage accumulation rate)(warning)(sensor)(transmitting data)	7,790

YouTube: https://youtube.com

#	Search query	Results
1	(fracture pump)(pump rate)(step rate)(limit)(threshold)	N/A
2	(fracture pump)(regulating pump)(adjustment rate)(damage accumulation)	N/A
3	(fracture pump)(damage accumulation)(threshold)(wellbore)	N/A
4	(wellbore)(pumping rate)(fracture)(threshold)(target rate)(current rate)	N/A
5	(fracture pump)(step rate)(limit)(threshold)(multiple pumps)	N/A

Date search was completed: 11 May 2020

SR/DD

Electronic Acknowledgement Receipt

EFS ID:	39805605
Application Number:	16728359
International Application Number:	
Confirmation Number:	6981
Title of Invention:	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Taylor P. Evans/Tina Fluharty
Filer Authorized By:	Taylor P. Evans
Attorney Docket Number:	047158.100066
Receipt Date:	23-JUN-2020
Filing Date:	27-DEC-2019
Time Stamp:	17:28:14
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	047158-100066-IDS.pdf	1035195 2e073db797fccc0ae473c81a53884e7c52a8586a	no	5

Warnings:

Information:					
2	Non Patent Literature	047158-OA1.pdf	1272924 928a7e85dd2b734bd6e7e6f165fa2b1934ebc61c	no	13
Warnings:					
Information:					
3	Non Patent Literature	047158-OA2.pdf	1517850 311251f288e51ea2e54619d0aa9c614a8bb8ff93	no	15
Warnings:					
Information:					
4	Non Patent Literature	047158-OA3.pdf	1402077 200a2829d9c761f9ec16e70bdb14801 2c61545e1	no	13
Warnings:					
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5	Non Patent Literature	047158-ISR.pdf	819292 995b9739257b4c0cc50ec90ee2654ea72bfc1fd3	no	17
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6	Non Patent Literature	047158-Goodwin.pdf	2052394 445c5d2c928fd40eae7b25406d1755f2bfe8f599	no	10
Warnings:					
Information:					
7	Non Patent Literature	047158-Karim.pdf	5055149 f79d8552702a84ed0e231811674de304ae138298	no	23
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			Total Files Size (in bytes):	13154881	

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.